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XII-BIO-ZOOLOGY



BASED ON NEW SYLLABUS 2022-2023

TEXTBOOK QUESTIONS WITH ANSWERS
PREVIOUS YEAR QUESTIONS WITH ANSWERS
CREATIVE QUESTIONS WITH ANSWERS
PTA QUESTIONS WITH ANSWERS

NAME:
CLASS:
SEC:
SCHOOL:

Chapter: 1 Reproduction in organisms

Textbook questions and answers:

1. In which type of parthenogenesis are only male produced **Arrhenotoky**.

2. The mode of reproduction in bacteria by **Conjugation**.

3. In which mode of reproduction variation are seen **Sexual**.

4. Assertion and reasoning questions:

In each of the following questions there are two statements. One is assertion (A) and other is reasoning (R). Mark the correct answer as

A. If both A and R are true and R is correct explanation for A

B. If both A and R are true but R is not the correct explanation for A

C. If A is true but R is false

D. If both A and R are false

I) Assertion: In bee society, all the members are diploid except drones.

Reason: Drones are produced by parthenogenesis.

Answer: A) If both A and R are true and R is correct explanation for A.

II) Assertion: Offspring's produced by asexual reproduction are genetically identical to the parent.

Reason: Asexual reproduction involves only mitosis and no meiosis.

Answer: A) If both A and R are true and R is correct explanation for A.

5. Name an organism where cell division is itself a mode of reproduction.

Unicellular organisms like Amoeba, Bacteria, Paramecium and Vorticella.

6. Name the phenomenon where the female gamete directly develops into a new organism with an avian example.

Phenomenon is parthenogenesis Example: Turkey birds

7. What is parthenogenesis? Give two examples from animals (2021- 2022)

i) Development of an egg into a complete individual without fertilization.

ii) Example: Honeybees, Gall fly, annelid and sea urchin, sporocyst and Radia larvae of liver fluke

8. Which type of reproduction is effective Asexual or Sexual and why? (PTA-2019-2020)

Sexual reproduction is more effective than an asexual reproduction because sexual reproduction produces variations. Which are necessary for evolution and there are better chances for survival. Where as in asexual mode of reproduction no variation.

9. The unicellular organisms which reproduction by binary fission are considered immortal justify.

In binary fission the parent organism whole body divides into two halves and each half forms a daughter individual so there is no death for unicellular organism hence they are called immortal.

Example: Amoeba, paramecium, Euglena

10. Why is the offspring formed by asexual reproduction referred as a clone?

Asexual reproduction involves a single parent so offspring's produced morphologically and genetically similar hence they are called clones

11. Give reasons for the following:

a) Some organisms like honey bees are called parthenogenetic animals.

Drones (Male honey bees) are developed from unfertilized egg they are called parthenogenetic animals.

b) A male honey bee has 16 chromosomes where as its female has 32 chromosomes.

Male honey bee- Develop from unfertilized eggs(n).Female honey bee – Develops from fertilized eggs (2n)

12. Differentiate between the following**a. Binary fission in amoeba and multiple fission in plasmodium**

Binary fission amoeba	Multiple fission plasmodium
It occurs in favourable conditions	It occurs in both favourable and unfavourable conditions
Nucleus and cytoplasm divide once	Nucleus and cytoplasm divide multiple time
Produce two daughters	Produce many daughter

B) Budding in yeast and budding in hydra

Budding in yeast	Budding in hydra
In yeast a small bud rises as an outgrowth of the parent body. Later the nucleus of the parental yeast is divided into two parts and one of the nucleic moves into the bud. The newly made bud splits and grows into a new cell.	In hydra a bud grows as an outer growth due to constant cell division at one site. These buds grow into tiny characters and when fully developed they separate from the parents body become new free individuals.

C) Regeneration in lizard and Regeneration in planaria.

Regeneration in lizard	Regeneration in planaria
Lizard show the epimorphosis types of regeneration.	Planaria show the morphallaxis type of regeneration.
In this type replacement of lost body parts.	In this type whole body grows from a small fragment.

13. How is juvenile phase different from reproductive phase?

Juvenile phase	Reproductive phase
This vegetative phase is the period of growth between the birth of the individual up to reproductive maturity.	The organisms reproduce and their offspring's reach maturity period. On the basis of time, breeders animals are of two types. i) Seasonal breeders (Frogs, Lizards, Most birds) ii) Continuous breeders (Honey bees, poultry, rabbit)

14. Explain the different kinds of syngamy in living organisms.

Autogamy- The male and female gametes are produced by the same cell or same organism and both the gametes fuse together to form a zygote. e.g. **Actinosphaerium and Paramecium.**

Exogamy- The male and female gametes are produced by different parents and they fuse to form a zygote. So it is biparental. e.g. **Human – dioecious or unisexual animal.**

Hologamy- Lower organisms, sometimes the entire mature organisms do not form gametes but they themselves behave as gametes and the fusion of such mature individuals is known as hologamy

e.g. **Trichonympha**

Paedogamy- It is the sexual union of young individuals produced immediately after the division of the adult parent cell by mitosis.

Merogamy- The fusion of small sized and morphologically different gametes (merogametes) takes place.

Isogamy- The fusion of morphological and physiological identical gametes (isogametes) is called isogamy. e.g. **Monocystis.**

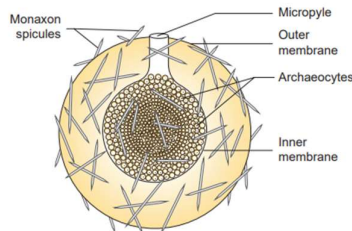
Anisogamy- The fusion of dissimilar gametes is called anisogamy (Gr. An-without; iso-equal; gam-marriage). Anisogamy occurs in higher animals but it is customary to use the term fertilization instead of anisogamy or syngamy. e.g. **higher invertebrates and all vertebrates.**

Other important 2 and 3 marks questions and answers.

1. Differentiate merozoites from sporozoites. (PTA-2019-2020)

merozoites	sporozoites
When multiple fission occurs in the schizont, the process is called schizogony and the daughter individuals are called merozoites.	When multiple fission occurs in the oocyte, it is called sporogony and the daughter individuals are called sporozoites

2. Draw the diagram of gemmule and label the parts. (PTA-2019-2020)



3. Zygote is not formed during the conjugation of paramecia, but we call it as sexual reproduction why? (PTA-2019-2020)

Conjugation is a form of sexual reproduction. It is a temporary union of two individuals of same species for mutual exchange of genetic materials.

4. Meiosis cell division does not take place during the gametes formation of drone bees. Give reason. (PTA-2019-2020)

1. Meiosis occurs during its post zygotic stage. As the organism is haploid meiosis cannot occur during gametogenesis.
2. In haploid organism's meiosis occurs during the gametogenesis. In haploid organisms meiosis occurs during the germination of zygote because the zygote is the only diploid cell in the life cycle of such organisms.

5. Write the differences between multiple fission and sporulation in amoeba. (PTA- 2019-2020)

Multiple fission amoeba	Sporulation amoeba
<ol style="list-style-type: none"> 1. Unfavourable conditions amoeba withdraws its pseudopodia and secretes a three layered protective chitinous cyst wall around it and becomes inactive. 2. When conditions become favourable the encysted amoeba divides by multiple fission and produces many minute amoebae called pseudopodiospore or amoebulae. 3. The cyst wall absorbs water and breaks off liberating the young pseudopodiospores. 	<ol style="list-style-type: none"> 1. Unfavourable conditions amoeba multiplies by sporulation without encystment. 2. Nucleus breaks into several small fragments. Each fragment develops a nuclear membrane becomes surrounded by cytoplasm and develops a spore case around it. 3. When conditions become favourable the parent body disintegrates and the spores are liberated each hatching into a young amoeba

6. What is senescent phase of life? (2021-2022)

Senescent phase begins at the end of reproductive phase when degeneration sets in the structure and functioning of the body.

7. Mention the phases in the life cycle of an organisms.

1. Juvenile phase/Vegetative phase
2. Reproductive phase/ maturity phase
3. Senescent phase.

8. What is conjugation?

1. It is the temporary union of the two individuals of the same species.

2. During their union both individuals, exchange certain amount of nuclear material (DNA) and then get separated.

Example: Paramecium, Vorticella and Bacteria (Prokaryotes)

9. What are the two types of breeding animals?

1. Seasonal breeders:

It reproduces at particular period of the year.

Example: Frog, Lizards, Most birds, Deer's.

2. Continuous breeders:

It continues to breed throughout their sexual maturity.

Example: Honey bees, Poultry, Rabbit.

10. Differentiate natural parthenogenesis and artificial parthenogenesis.

Natural parthenogenesis	Artificial parthenogenesis
It occurs regularly constantly and naturally in their life cycle.	The unfertilized egg (Ovum) is induced to develop into a complete individual by physical or chemical stimuli.

11. What is paedogenetic parthenogenesis or paedogenesis?

The larvae produce a new generation of larvae by parthenogenesis. Sporocyst and Redia larvae of liver fluke and larvae of insects.

Example: Gall fly.

12. Differentiate complete parthenogenesis and incomplete parthenogenesis.

Complete parthenogenesis	Incomplete parthenogenesis
It is the only form of reproduction in certain animals and there is no biparental sexual reproduction. There are no male organisms and so such individuals are represented by females only	It is found in animals in which both sexual reproduction and parthenogenesis occurs. Example: In honeybees fertilized eggs (zygotes) develop into queen and workers. Unfertilized eggs develop into drones (male)

13. What are the disadvantages of external fertilization?

1. Eggs have less chances of fertilization. This can lead to wastage of large number of eggs.

2. There is an absence of proper parental care of the offspring's. It results in low rate of survival of the progenies.

14. Name the three types of natural parthenogenesis.

i) Arrhenotoky- Honey bees.

ii) Thelytoky- Solenobia.

iii) Amphitoky- Aphis

Five marks:

1. Explain parthenogenesis

1. The development of an egg into a complete individual without fertilization is known as parthenogenesis

2. It was first discovered by Charles Bonnet in 1745.

3. Parthenogenesis is of two main types namely

i) Natural parthenogenesis

ii) Artificial parthenogenesis

i) Natural parthenogenesis:

In certain animals, parthenogenesis occurs regularly, constantly and naturally in their life cycle and is known as natural parthenogenesis.

Natural parthenogenesis are of different types:

i) **Arrhenotoky:** In this type only males are produced by parthenogenesis.

Example: Honey bees

ii) **Thelytoky:** In this type only female are produced by parthenogenesis.

Example: Solenobia

iii) **Amphitoky:** In this type parthenogenetic egg may develop into individuals of any sex.

Example: Aphis

Natural parthenogenesis may be of two types complete and incomplete.

Complete parthenogenesis:

1. The complete parthenogenesis is only form of reproduction in certain animals and there is no biparental sexual reproduction.

2. There are no male organisms and so such individuals are represented by females only.

Incomplete parthenogenesis:

Incomplete parthenogenesis is found in some animals in which both sexual reproduction and parthenogenesis occurs.

Example: Honey bees fertilized eggs (zygotes) develop into queen and workers, whereas unfertilized eggs develop into drones (male)

Paedogenetic parthenogenesis (paedogenesis):

The larvae produce a new generation of larvae by parthenogenesis. It is also seen in the larvae of some insects.

Example: Gall fly.

Artificial parthenogenesis:

The unfertilized egg is induced to develop into a complete individual by physical or chemical stimuli.

Example: Annelid and sea urchin eggs.

2. Enumerate the process and types of syngamy.

Different kinds of syngamy (fertilization) are prevalent among living organisms.

Autogamy:

The and female gametes are produced by the same cell or same organism and both the gametes fuse together to form a zygote

Example: Actinosphaerium and paramecium.

Exogamy:

The male and female gametes are produced by different parents and they fuse to form a zygote. So it is biparental.

Example: Human-dioecious or unisexual animals.

Hologamy:

In lower organisms, sometimes the entire mature organisms do not form gametes but they themselves behave as gametes and the fusion of such mature individuals is known as hologamy.

Example: Trichonympha.

Paedogamy: The sexual union of young individuals produced immediately after the division of adult parent cell by mitosis.

Merogamy:

The fusion of small sized and morphologically different gametes (merogametes) takes place.

Isogamy:

The fusion of morphological and physiological identical gametes (Isogametes).

Example: Monocystis.

Anisogamy: (An-without, Iso-Equal, Gam-Marriage)

The fusion of dissimilar gametes.

Anisogamy occurs in higher animals but it is customary to use the term fertilization instead of anisogamy or syngamy.

Example: Higher invertebrates and all vertebrates

Chapter: 2 Human Reproduction

Textbook question and answers:

- The mature sperms are stored in the **Epididymis**.
- The male sex hormone testosterone is secreted from **Leydig cell**.
- The glandular accessory organ which produces the largest proportion of semen is **Seminal vesicle**.
- The male homologue of the female clitoris is **Penis**.
- The site of embryo implantation is the **Uterus**.
- The foetal membrane that forms the basis of the umbilical cord is **Allantois**.
- The most important hormone in initiating and maintaining lactation after birth is **Prolactin**.
- Mammalian egg is **Alecithal** and **non cleidoic**.
- The process which the sperm undergoes before penetrating the ovum is **Capacitation**.
- The milk secreted by the mammary gland soon after child birth is called **colostrum**.
- Colostrum is rich in **IgA**
- The Androgen binding protein (ABP) is produced by **Sertoli cells**.
- Find the wrongly matched pair.
 - Bleeding phase- fall in oestrogen and progesterone
 - Follicular phase- rise in oestrogen
 - Luteal phase- rise in FSH level**
 - Ovulatory phase- LH surge
- A-** In human male, testes are extra abdominal and lie in scrotal sacs.
R- Scrotum acts as thermoregulator and keeps temperature Lower by 2°C normal sperm production.
Answer: A and R are true, R is the correct explanation of A.
- A-** Ovulation is the release of ovum from the Graafian follicle.
R- It occurs during the follicular phase of the menstrual cycle.
Answer: A is true, R is false.
- A-** Head of the sperm consists acrosome and mitochondria.
R- Acrosome contains spiral rows mitochondria.
Answer: d) Both A and R are false.

17. Mention the differences between spermiogenesis and spermatogenesis.

Spermiogenesis	Spermatogenesis
The secondary spermatocytes undergo second meiotic division to produce four haploid spermatids. The spermatids are transformed into mature spermatozoa by the process called spermiogenesis.	Spermatogenesis is the sequence of events in the seminiferous tubules of the testes that produce the male gametes the sperm. Spermatogonia diploid cell undergo mitotic and meiotic division and produce haploid mature sperm process is call spermatogenesis

18. At what stage of development are the gametes formed in new born male and female?

- i) Sperm mother cell- spermatogonia in males.
- ii) Oogonia in female.

19. Expand the acronyms.

- a) **FSH**- Follicle Stimulating Hormone.
- b) **LH**- Leutinisising Hormone.
- c) **hCG**- human Chorionic Gonadotropin.
- d) **hPL**- human Placenta Lactogen.

20. How is polyspermy avoided in humans?

One fertilization is accomplished cortical granules from the cytoplasm of the ovum form a barrier called the fertilization membrane around the ovum preventing further penetration of other sperms.

21. What is colostrum's? Write its significance. (2019-2020)

1. The mammary glands secrete a yellowish fluid called colostrum's during the initial few days after parturition.
2. Colostrum has less lactose than milk and almost no fat.
3. Colostrum contains more proteins, vitamin-A and minerals.
4. Colostrum is also rich in IgA antibodies.
5. It is fully sufficient till about 6 months of age and all infants must be breast fed by the mother to ensure the growth of a healthy baby.

22. Placenta is an endocrine tissue. Justify. (2019-2020)

- 1) Placenta is connected to the embryo through an umbilical cord which helps in the transport of substance (Nutrients, Oxygen) and removing metabolites from the foetus.
- 2) Placenta acts as an endocrine tissue. and produces several hormones like human Chorionic Gonadotropin (hCG) human Placental Lactogen (hPL) human Chorionic Somatomammotropin (hCS) Oestrogens and Progesterone.

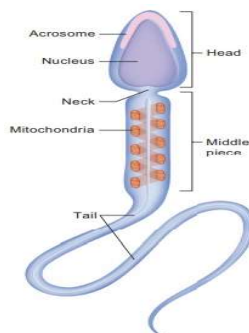
23. Draw a labeled sketch of a spermatozoan.

Fig. 2.7 Structure of human sperm

24. What is inhibin? State its functions.

1. It is a hormone secreted by Sertoli cells in the testis.
2. It is involved in the negative feedback control of sperm production.

25. Mention the importance of the position of the testes in humans.

1. Testes are paired male sex organs lying in the scrotum, which hangs outside the abdominal cavity, because viable sperms cannot be produced at normal body temperature.
2. The scrotum is placed outside the abdominal cavity to create a temperature 2-3°C lower than the normal internal body temperature.
3. Thus the testes are placed in the scrotum, which acts as a thermo regulator for better

Spermatogenesis.

26. What is the composition of semen? (2021-2022)

Sperms, seminal plasma, fructose, ascorbic acid, prostaglandins and coagulating enzyme called vesiculase.

27. Explain the process of fertilization and implantation of the fertilized ovum.

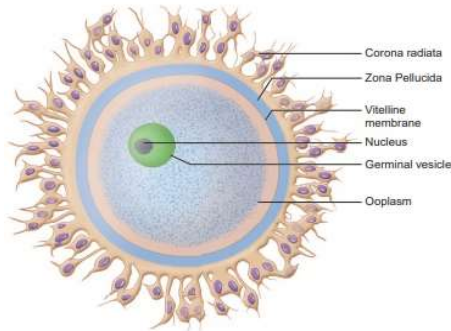
Fertilization: Haploid sperm fuses with a haploid ovum to form a fertilized egg or diploid zygote.

Implantation: Blastocyst develops into the embryo and becomes embedded in the endometrium of the uterus. This process is called implantation and it results in pregnancy.

28. Define gametogenesis.

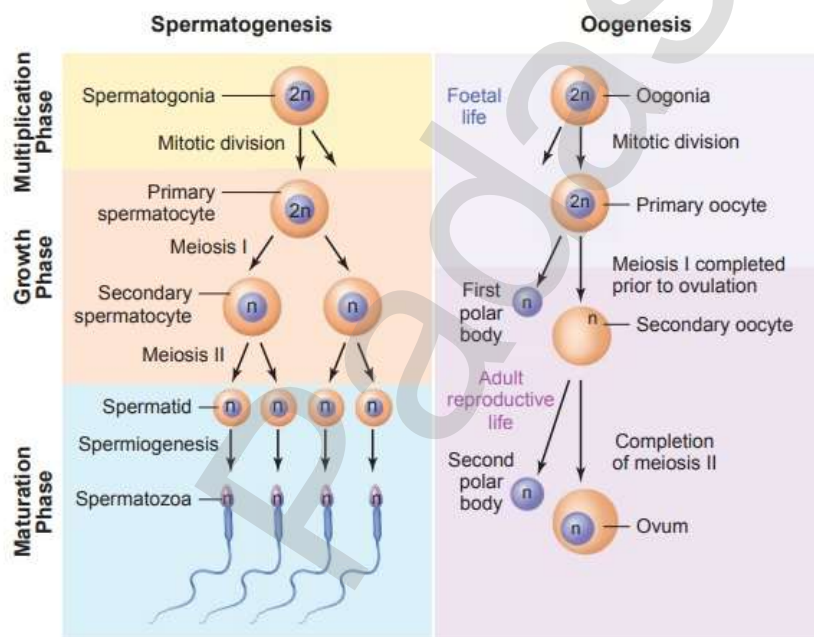
Gametogenesis is the process of formation of gametes. Testes and ovary from the primary sex organs in all sexually reproducing organisms. Meiosis play the most significant role in the process of gametogenesis.

29. Describe the structure of the human ovum with a neat labelled diagram. (2021-2022)

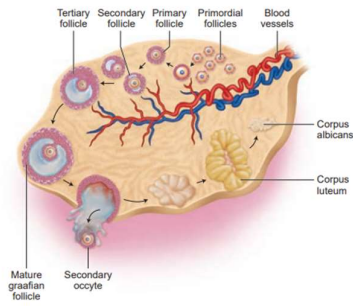


1. Human ovum is non-cleidoic, alecithal and microscopic in nature.
2. Its cytoplasm called ooplasm contains a large nucleus called the germinal vesicle.
3. The ovum is surrounded by three coverings namely an inner thin transparent vitelline membrane, middle thick zona pellucida and outer thick coat of follicular cells called corona radiata.
4. The vitelline membrane and zona pellucida is a narrow perivitelline space.

30. Give a schematic representation of Spermatogenesis and Oogenesis in humans.



31. Explain the various phases of the menstrual cycle. Menstrual cycle



The menstrual or ovarian cycle occurs approximately one in every 28/29 days during the reproductive life of the female from menarche to menopause except during pregnancy.

Menstrual cycle comprises of the following phases:

1. Menstrual phase
2. Follicular or proliferative phase
3. Ovulatory phase
4. Luteal or secretory phase.

1. Menstrual phase:

- Menstrual flow occurs and lasts for 3-5 days.
- Breakdown of endometrial lining of the uterus.
- Decline in the level of progesterone and oestrogen.

2. Follicular or proliferative phase:

- 5th day to the cycle until the time of ovulation.
- Endometrium regenerates through proliferation.
- FSH and LH increase and stimulates follicular development and secretion of oestrogen by the follicle cell.

3. Ovulation:

- 14th day cycle. LH and FSH attain peak level.
- The Graafian follicle ruptures and releases the ovum.
- Increase in endometrial thickness.

4. Luteal or secretory phase:

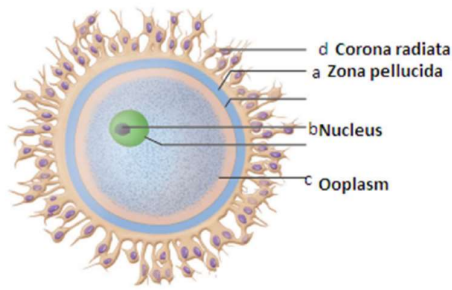
- 15th to 28th day cycle. The remaining part of the Graafian follicle is transformed into corpus luteum.
- Endometrium is prepared for implantation if fertilization of egg takes place if fertilization does not occur corpus luteum degenerates, uterine wall rupture bleeding starts and unfertilized egg is expelled.
- LH and FSH decrease, Corpus luteum produces progesterone and its level increase followed by a decline if menstrual bleeding occurs.

32. Explain the role of oxytocin and relaxin in parturition and lactation. (2019-2020)

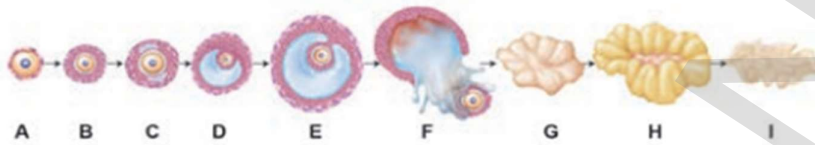
Role of Oxytocin:

1. Oxytocin brings about the powerful contraction of the uterine muscles and leads the to expulsion of the baby through the birth canal.
2. Oxytocin causes the Let-Down reflex the actual ejection of milk from the alveoli of the mammary glands.
3. During lactation, oxytocin stimulates the recently emptied uterus to contract, helping it to return to pre- pregnancy size.

33. Identify the given image and label its parts marked as a, b, c and d.



34. The following is the illustration of the sequence of ovarian events (a-i) in a human female.



a) Identify the figure that illustrates ovulation and mention the stage of oogenesis it represents.

A-D- The stages of follicular development

E- Single mature follicle

F- Ovulation

G and H- Corpus luteum

I- Corpus albicans.

It represents the maturation state of oogenesis.

b) Name the ovarian hormone and the pituitary hormone that have caused the above mentioned events.

Ovarian hormones: Oestrogen and Progesterone.

Pituitary hormone: Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH)

c) Explain the change that occurs in the uterus simultaneously in anticipation.

The uterus wall become thick and spongy so as to receive the eggs and nourish it. The wall surrounds with extensive network of blood.

d) write the difference between C and H

C-Developing stage of follicle H- Developed corpus luteum

C-Developing stage of follicle	H- Developed corpus luteum
Primary follicle in the ovary grow to become a mature follicle (Graafian follicle)	A corpus luteum is a mass of cells that forms in an ovary and is responsible for the production of the hormone progesterone during early pregnancy.
It extends for about 10-12 days in a 28 day cycle.	Corpus luteum is temporary endocrine gland secretes large quantities of progesterone and small quantities of oestrogens.
Changes in follicular phase are due to high level of FSH, LH and Oestrogen.	Maintenance of pregnancy

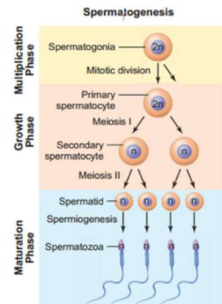
Other important 2 and 3 mark question and answers:

1. Scrotum acts as a thermo regulator for spermatogenesis why? (PTA-2019-2020)

The viable sperms cannot be produced at normal body temperature, the scrotum is placed outside the abdominal cavity to provide a temperature 2-3°C lower than the normal internal

body temperature. Thus the scrotum acts as a thermoregulator for spermatogenesis.

2. Draw the diagrammatic representation of spermatogenesis. (PTA-2019-2020)



3. Explain the penetration mechanism of a sperm into an egg. (PTA-2019-2020)

1. A sperm can enter the egg it must penetrate the multiple layers of granulosa cells which are around the ovum forming the corona radiata.
2. The follicular cells are held together by an adhesive cementing substance called hyaluronic acid.
3. The acrosomal membrane disintegrates releasing the proteolytic enzyme hyaluronidase during sperm entry through the corona radiata and zona pellucida. This is called acrosomal reaction.
4. Once fertilization is accomplished, cortical granules from the cytoplasm of the ovum form a barrier called the fertilisation membrane around the ovum preventing further penetration of other sperms. Thus polyspermy is prevented.

4. What are sertoli cells? Explain its function.

1. Sertoli cells are one of the two types of cells of the seminiferous tubule.
2. It provides nourishment to the sperm till maturation.
3. It also secretes a hormone namely inhibin, which is involved in the negative feedback control of sperm production.

5. What is epididymis?

1. Epididymis is single highly coiled tube.
2. It is temporarily stores the spermatozoa where they undergo physiological maturation.
3. Acquire increased motility and fertilizing capacity.

6. Leydig cells are endocrine in nature. Justify.

Leydig cells are endocrine in nature, because they secrete hormone, androgens namely the testosterone, which initiates the process of spermatogenesis.

7. What is rete testis?

It is a tubular network on the posterior side of the testis.

8. Name the accessory ducts associated with the male reproductive system.

- i) Rete testis.
- ii) Vasa efferentia.
- iii) Epididymis.
- iv) Vas deferens.

9. Differentiate between vasa efferentia and vasa deferentia?

Vasa efferentia	Vasa deferentia
They arise from the rete testes.	They arise from the epididymis.
Fine and convoluted ductless.	Thick and coiled ductless.
Carry spermatozoa from rete testes to epididymis.	Carry spermatozoa from epididymis to ejaculatory ducts.

10. Explain the function of seminal vesicle.

1. Seminal vesicle secretes an alkaline fluid, containing fructose sugar, ascorbic acid, prostoglandins.
2. It also secretes a coagulating enzyme called vesiculase, which helps in sperm motility.

11. Mention the female accessory reproductive organs.

- i) Fallopian tube.
- ii) Uterus.
- iii) Vagina

12. What is the function of the sperm tail?

It helps in the movement of sperm in the female genital tract for fertilization.

13. What are the functions of centrioles in the sperm?

1. The proximal centriole lies towards the nucleus and plays a role in the first division of the zygote.
2. Distal centriole gives rise to axial filament of the sperm.

14. What is the function of middle piece of sperm?

It contains mitochondria and produces energy in the form of ATP molecules for the movement of sperm.

15. What is acrosome? Mention its role during fertilization.

1. It is a small cap like pointed structure present at the tip of the nucleus in the sperm.
2. It is formed from the Golgi body of the spermatid.
3. It contains hyaluronidase or sperm lysine a proteolytic enzyme which helps to penetrate the ovum during fertilization.

16. What are the three layers of uterus wall?

The wall of the uterus has three layers of tissue namely

1. Perimetrium
2. Myometrium
3. Endometrium

17. What is spermiation?

The process that the sperms are released into the cavity of seminiferous tubules.

18. What is azospermia?

Azospermia refers to the failure spermatogenesis. It is seen in males.

19. What is orchidectomy?

Castration or surgical removal of testis is known as orchidectomy.

20. Explain the functions of skene's gland.

The skene's glands are present on the anterior wall of the vagina, surrounding the lower end of the urethra. These glands secrete a lubricating fluid.

21. What is the function of seminal fluid?

The seminal fluid acts as a transport medium, provides nutrients, contains chemicals that protect and activate the sperms and also facilitate their movement.

22. Mention the pathway of the sperms in the male reproductive system?

Seminiferous tubule → Rete testis → Vas deferens → Epididymis → Vasa Efferentia → Ejaculatory duct → Urethra → Urethral meatus.

23. What is Nebenkern?

1. The middle piece of sperm possesses mitochondria spirally twisted around the axial filament called mitochondrial spiral or nebenkern.
2. It produces ATP molecules for the movement of sperms.

24. What is the function of amnion?

1. The amnion is a double layered translucent membrane filled with the amniotic fluid.
2. It provides a buoyant environment to protect the developing embryo from injury.

3. Regulates the temperature of the foetus and provides a medium in which the foetus can move.

25. What is the significance of allantois?

1. The allantois is an extra embryonic membrane which forms a small out pocketing of embryonic tissue at the caudal end of the yolk sac.
2. It is the structural base for the umbilical cord that links the embryo to the placenta and ultimately it becomes part of the urinary bladder.

26. What is Gastrulation?

The transformation of the blastocyst into a gastrula with the primary germ layers by the movement of the blastomeres.

27. What is Ectopic pregnancy?

1. If the fertilized ovum is implanted outside the uterus it is called ectopic pregnancy.
2. It occurs in the fallopian tube.
3. The growth of the embryo causes internal bleeding, infection and even death due to rupture of the fallopian tube.

28. What is Blastocyst?

After implanted in the uterine wall the embryo consists of a fluid filled hollow ball of about 100 cells.

29. What is Implantation?

Implantation is the process of the inner cell mass of the blastocyst develops into the embryo and becomes embedded in the endometrium of the uterus. It results in pregnancy.

30. How is placenta formed? Mention its function?

1. The trophoblast cells in the blastocyst send out several finger like projections called chorionic villi .
2. The chorionic villi carrying foetal blood and are surrounded by sinuses that contain maternal blood (mother blood).
3. The chorionic villi and the uterine tissues form the disc-shaped placenta.

Functions:

1. It connects the foetus to the uterine wall through the umbilical cord.
2. It is the organ of nutritive, respiratory and excretory functions.
3. The blood circulates through the umbilical cord and placenta.

31. Mention the organs developed from the germ layers?

1. The Ectoderm:

The central nervous system (brain and spinal cord), Peripheral nervous system, epidermis and it's derivatives and mammary glands.

2. The mesoderm:

The connective tissue, cartilage and bone, muscle, organs of urinogenital system (kidney, ureter and gonads) arise from the mesoderm.

3. The endoderm:

Epithelium of gastrointestinal and respiratory tract, liver, pancreas, thyroid and parathyroid's.

32. What are twins? Mention their types.

Twins are two off springs produced in the same pregnancy.

1. Monozygotic twins:

The monozygotic (Identical) twins are produced when single fertilized egg splits into two during the first cleavage. They are of the same sex, look alike and share the same genes.

2. Dizygotic twins:

The dizygotic (fraternal) twins are produced when two separate eggs are fertilized by

two separate sperms. The twins may be of the same sex or different sex and are nonidentical.

3. Siamese:

The Siamese (united) twins are the conjoined twins who are joined during birth.

33. Name the hormones produced from the placenta during pregnancy.

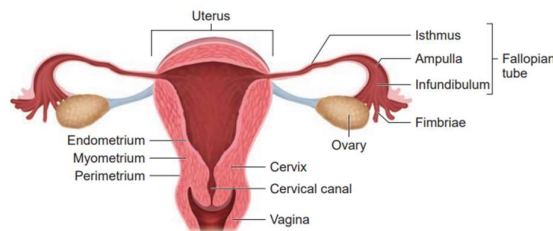
1. human Chorionic Gonadotropin (hCG)
2. human Chorionic Somatomammotropin (hCS)
3. human placental Lactogen (hPL)
4. Oestrogens
5. Progesterone

6. Relaxin:

- i) Relaxin secreted during the later phase of pregnancy
- ii) It help in relaxation of the pelvic ligaments at the time of parturition.

Five mark questions:

1. Describe the structure of the human uterus with a neat labelled diagram. (2021-2022)



1. The uterus or womb is a hollow, thick walled muscular, highly vascular and inverted pear shaped structure laying in the pelvic cavity between the urinary bladder and rectum.
2. The major portion of the uterus is the body and the rounded region superior to it is the fundus.
4. The wall of the uterus has three layers of tissues.
5. The outermost thin membranous serous layer called the perimetrium. The middle thick muscular layer called myometrium. The inner glandular layer called endometrium.
6. The endometrium undergoes cyclic changes during the menstrual cycle while myometrium exhibits strong contractions during parturition.
7. The uterus opens into the vagina through a narrow cervix. The cavity of the cervix called the cervical canal communicates with the vagina.
8. The cervical canal along with vagina forms the birth canal.

2. Describe the structure of a sperm.

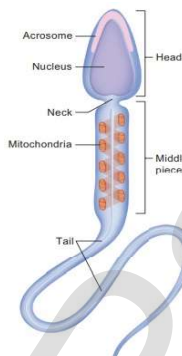


Fig. 2.7 Structure of human sperm

1. The human sperm is a microscopic, flagellated and motile gamete.
2. The whole body of the sperm is enveloped by plasma membrane and is composed of head, neck, and a tail.

3. The head comprises of two parts namely acrosome and nucleus.
4. Acrosome is a small cap like pointed structure present at the tip of the nucleus and is formed mainly from the Golgi body of the spermatid.
5. It contains hyaluronidase, a proteolytic enzyme, popularly known as sperm lysine which helps to penetrate the ovum during fertilization.
6. The nucleus is flat and oval.
7. The neck is very short and is present between the head and the middle piece.
8. The middle piece possesses mitochondria spirally twisted around the axial filament called mitochondrial spiral or nebenkern.
9. It produces energy in the form of ATP molecules for the movement of sperms.
10. The lashing movements of the tail push the sperm forward.

3. Write about the accessory glands of male reproductive system.

The accessory glands associated with male reproductive system include the following:

- i) A paired seminal vesicles.
- ii) Bulbourethral glands or cowper's glands.
- iii) A single prostate gland

Seminal vesicles:

Seminal vesicles are located on either side of the prostate gland and secrete an alkaline fluid called seminal plasma, which contains fructose sugar ascorbic acid, prostaglandins and a coagulating enzyme called vesiculases, which helps sperm motility.

The Bulbourethral glands:

These glands are located inferior to the prostate gland and they secrete a lubricating fluid, which helps to lubricate the penis.

The prostate glands:

The single prostate gland is placed just below the urinary bladder, encircling the urethra. It secretes slightly acidic fluid, which contains citrate several enzymes and prostate specific antigens.

The secretions of the three glands along with sperm is called semen or seminal fluid.

4. Explain the sequence of events in the fertilization process in human.

1. The sperm migrates through the coat of follicle cells and binds to receptor molecules in the zona pellucida of the egg.
2. This binding induces the acrosome reaction in which the sperm releases hyaluronidase into the zona pellucida.
3. Breakdown of the zona pellucida by these enzymes allows the sperm to reach the plasma membrane of the egg.
4. The nucleus and other components of the sperm enter the egg.
5. Cortical granules form a barrier called fertilization membrane which now functions as a block to polyspermy

5. Write a note on extra embryonic membranes.

The extra embryonic membranes namely the amnion, yolk sac, allantois and chorion protect the embryo from desiccation, mechanical shock and help in the absorption of nutrients and exchange of gases.

Amnion:

1. The amnion is a double layered translucent membrane filled with the amniotic fluid.
2. It provides a buoyant environment to protect the developing embryo from injury, regulates the temperature of the foetus and provides a medium in which the foetus can move.

Yolk sac:

1. The yolk sac forms a part of the gut and is the source of the earliest blood cells and

blood vessels.

Allantois:

1. The allantois is an extra embryonic membrane which forms a small out pocketing of embryonic tissue at the caudal end of the yolk sac.
2. It is the structural base for the umbilical cord that links the embryo to the placenta and ultimately it becomes part of the urinary bladder.

Chorion:

The chorion is the outermost membrane which encloses the embryo and all other membranes and also helps in the formation of the placenta.

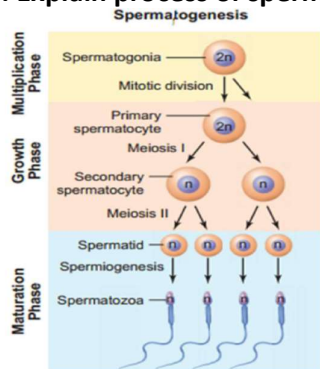
Chorionic villi:

1. The trophoblast cells in the blastocyst send out several finger like projections called chorionic villi.
2. The chorionic villi carrying foetal blood and are surrounded by sinuses that contain maternal blood.
3. The chorionic villi and the uterine tissues form the disc shaped placenta.

Placenta:

1. Placenta is a temporary endocrine organ formed during pregnancy and it connects the foetus to the uterine wall through the umbilical cord.
2. It is the organ by which the nutritive, respiratory and excretory functions are fulfilled.

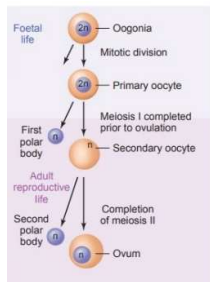
6. Explain process of spermatogenesis.



1. Spermatogenesis is the sequence of events in the seminiferous tubules of the testes that produce the male gametes, the sperms.
2. The first stage of spermatogenesis, the spermatogonia migrate among sertoli cells towards the central lumen of the seminiferous tubule and become modified and enlarged to form primary spermatocytes which are diploid with 23 pairs, 46 chromosomes.
3. The primary spermatocytes undergo first meiotic division to form two secondary spermatocytes which are haploid with 23 chromosomes each.
4. The secondary spermatocytes undergo second meiotic division to produce four haploid spermatids.
5. The spermatids are transformed into mature spermatozoa (sperms) by the process called spermiogenesis.
6. Sperms are finally released into the cavity of seminiferous tubules by a process called spermiation.
7. The whole process of spermatogenesis about about 64 days.
8. Spermatogenesis starts at the age of puberty and is initiated due to the increase in the release of Gonadotropin Releasing Hormone by the hypothalamus.
9. FSH stimulates testicular growth and enhances the production of Androgen Binding Protein by the sertoli cells and helps in the process of spermiogenesis.

10. LH acts on the Leyding cells and stimulates the synthesis of testosterone which in turn stimulates the process of spermatogenesis.

7. Explain process of Oogenesis.



- Oogenesis is the process of development of the female gamete or ovum or egg in the ovaries.
- The germinal epithelium of the foetal ovary divide by mitosis and produce millions of egg mother cells or oogonia.
- The oogonial cells start dividing and enter into prophase I of meiotic division I to form the primary oocytes which are temporarily arrested at this stage.
- The primary oocytes then get surrounded by single layer of granulose cells to form the primordial or primary follicles.
- A large number of follicles degenerate during the period from birth to puberty.
- The primary follicle gets surrounded by many layers of granulose cells and a new theca layer to form to secondary follicle.
- A fluid filled space, the antrum develops in the follicle and gets transformed into a tertiary follicle.
- The theca layer gets organized into an inner theca interna and an outer theca externa.
- The primary oocyte within the tertiary follicle grows in size and completes its first meiotic division and forms the secondary oocyte.
- It is an unequal division resulting in the formation of a large haploid secondary oocyte and a first polar body. The first polar body disintegrates.
- During fertilization, the secondary oocyte undergoes second meiotic division and produces a large cell, the ovum and a second polar body. The second polar body also degenerates.
- The tertiary follicle eventually becomes a mature follicle or Graafian follicle.
- The end of gametogenesis in females, each primary oocyte gives rise to only one haploid ovum.

8. Explain the role of hormones in the maintenance of human male fertility (PTA-2019 to-2020)

- Spermatogenesis starts at the age of puberty and is initiated due to the increase in the release of Gonadotropin Releasing Hormone (GnRH) by the hypothalamus.
- GnRH acts on the anterior pituitary gland and stimulates the secretion of two gonadotropins namely Follicle Stimulating Hormone (FSH) and Lutenizing Hormone (LH).
- FSH stimulates testicular growth and enhances the production of Androgen Binding Protein (ABP) by the Sertoli cells and helps in the process of spermiogenesis.
- LH acts on the Leyding cells and stimulates the synthesis of testosterone which in turn stimulates the process of spermatogenesis.

9. Explain the role of placenta during pregnancy.(PTA-2019-2020)

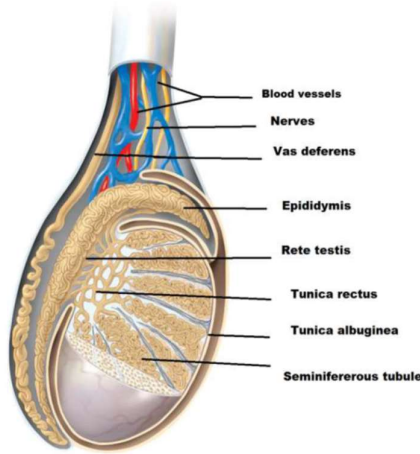
- Placenta is a temporary endocrine organ.
- Its formed during pregnancy and it connects the foetus to the uterine wall through the

umbilical cord.

3. It is the organ by which the nutritive, respiratory and excretory functions are fulfilled.

4. The embryo's heart develops during the fourth week of pregnancy and circulates blood through the umbilical cord and placenta as well as through its own tissues.

10. Explain the anatomy of testis with the help of a diagram. (PTA-2019-2020)



1. The male reproductive system includes rete testis, vasa efferentia, epididymis and vas deferens.

2. The seminiferous tubules of each lobule converge to form a tubulus rectus that conveys the sperms into the rete testis.

3. The rete testis is a tubular network on the posterior side of the testis.

4. The sperms leave the rete testis and enter the epididymis through the vasa efferentia.

5. The epididymis is a single highly coiled structure that temporarily stores the spermatozoa and they undergo physiological maturation and acquire increased motility and fertilizing capacity.

6. The epididymis leads to the vas deferens and joins the duct of the seminal vesicle to form the ejaculatory duct which passes through the prostate and opens into the urethra.

7. The urethra is the terminal portion of the male reproductive system and is used to convey both urine and semen at different times.

8. It originates from the urinary bladder and extends through the penis by an external opening called urethral meatus.

11. Briefly explain the mechanism of fertilization and implantation in human beings. (PTA-2019-2020)

Fertilisation:

Fertilisation occurs when a haploid sperm fuses with a haploid ovum to form a fertilized egg or diploid zygote.

Implantation:

1. The first cleavage produces two identical cells called blastomeres. These produce 4 cells then 8 cells.

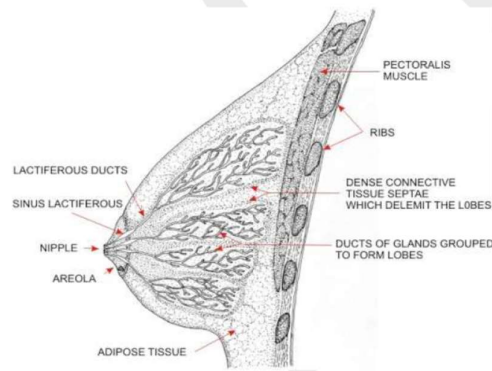
2. After 72 hours of fertilization, a loose collection of cells forms a berry shaped cluster of 16 or more cells called the morula.

3. Under the influence of progesterone, smooth muscles of the fallopian tube relax and the dividing embryo takes 4-5 days to move through the fallopian tube into the uterine cavity and finally gets implanted in the uterine wall.

4. At this point the embryo consists of a fluid filled hollow ball of about 100 cells called the blastocyst.

5. The blastocyst is composed of a single layer of large flattened cells called trophoblast and a small cluster of 20-30 rounded cells called the inner cell mass.
6. The inner cell mass of the blastocyst develops into the embryo and becomes embedded in the endometrium of the uterus this process is called implantation and it results in pregnancy.

12. Give an account of mammary glands.



1. Mammary glands are modified sweat glands present in both sexes.
2. It is functional in females and rudimentary in males.
3. In human a pair of mammary glands is placed in the thoracic region.
4. The glandular tissues and variable quantities of fat are present in mammary gland along with a median nipple.
5. The nipple is surrounded by a pigmented area called areola.
6. The areolar glands modified sebaceous glands are present on the surface.
7. They help in reducing the cracking of the skin of the nipple.
8. Each mammary gland consists of 2-25 lobes. They are separated by fat and connective tissues.
9. They are separated by fat and connective tissues. Each lobe contains many lobules, which contain acini or alveoli lined by epithelial cells.
10. Milk is secreted by the cells of alveoli which opens into mammary tubules.
11. Mammary ampulla is formed by joining several mammary ducts.
12. The mammary duct is connected to lactiferous duct in the nipple. The lactiferous sinus is the expansion of lactiferous duct under the nipple and was a reservoir of milk.

13. On the surface of the nipple, each lactiferous duct opens by a minute pore.

	Spermatogenesis	Oogenesis
Location	Testis	Ovary
Number of gametes produced	Life long production (Millions)	Fixed amount (only-mature)
Gametes per germ cell	Four	One
Beginning of process	Begins at puberty	Begins during fetal
Timing of gamete formation	Continuous (any time)	Once a month (menstrual cycle)
End of process	Fertility is life long but reduces	Fertility stops at menopause

Timing of gamete	release Any time	Monthly cycle
Meiotic divisions	Uninterrupted	Arrested

Chapter: 3 Reproductive Health

Textbook questions and answers:

- Which of the following is correct regarding HIV hepatitis B gonorrhoea and trichomoniasis?
C. HIV is a pathogen whereas others are diseases.
- Which one of the following groups includes sexually transmitted diseases caused by bacteria only?
b) Syphilis, chlamydia and gonorrhoea.
- Identify the correct statements from the following.
d) Both syphilis and gonorrhoea are easily cured with antibiotics.

4. A contraceptive pill prevents ovulation by

- Blocking fallopian tube
- Inhibiting release of FSH and LH**
- Stimulating release of FSH and LH
- Causing immediate degeneration of released ovum

5. The approach which does not give the defined action of contraceptive is

b) Vasectomy prevents spermatogenesis.

6. Read the given statements and select the correct option.

Statement 1: Diaphragms, cervical caps and vaults are made of rubber and are inserted into the female reproductive tract to cover the cervix before coitus.

Statement 2: They are chemical barriers of conception and are reusable.

Answer: Statement 1 is correct but statement 2 is incorrect.

7. Match column I with column II and select the correct option from the codes given below. Answer:

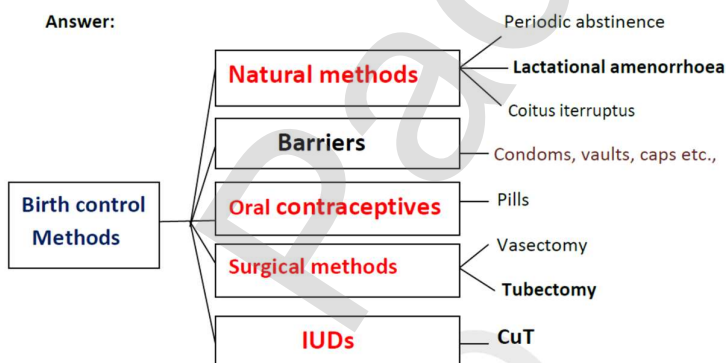
Column I	Column II
A. Copper releasing IUD	Multiload-3759 (iv)
B. Hormone releasing	LNG-20 (i)
C. Non medicated IUD	Lippes loop IUD (ii)
D. Mini pills	Saheli (iii)

d)A-(iv), B(i), C-(ii), D-(iii)

8. Select the incorrect action of hormonal contraceptive pills from the following

- Inhibition of spermatogenesis.**
- Inhibition of ovulation
- Changes in cervical mucus impairing its ability to allow passage and transport of sperms.
- Alteration in uterine endometrium to make it unsuitable for implantation.

9. Select the correct term from the bracket and complete the given branching tree



10. Correct the following statements:**Answer:**

- a) Transfer of an ovum collected from donor into the fallopian tube is called **GIFT**.
 b) Transferring of an embryo with more than 8 blastomeres into uterus is called **IUT**.
 c) Multiload 375 is a **copper** releasing IUD.

11. Which method do you suggest the couple to have a baby, if the male partner fails to inseminate the female or due to very low sperm count in the ejaculate?

1. Intra uterine insemination (IUI)
2. In vitro fertilization (IVF) or Test tube bay
3. Zygote intra fallopian transfer (ZIFT)
4. Intra uterine transfer (IUT)
5. Gamete intra fallopian transfer (GIFT)
6. Intra cytoplasmic sperm injection (ICSI)
7. Micro testicular sperm extraction (TESE)

12. Expand the following:

- a) **ZIFT**- Zygote Intra- Fallopian Transfer.
 b) **ICSI**- Intra - Cytoplasmic Sperm Injection.

13. What are the strategies to be implemented in India to attain total reproductive health?

1. health care programmes such as massive child immunization and supply of nutritional food to the pregnant women.
2. Janani Suraksha Yojana, Janani Shishu Suraksha Karyakaram, RMNCH+A an integrated approach for reproductive maternal, new born, child and adolescent health.
3. Pradhan Mantri Surakshit Matritva Abhiyan are taken up at the national level by the government of India.
4. Introducing sex education in schools to provide information about adolescence and adolescence related changes.
5. Creating awareness about care for pregnant women, post-natal care of mother and child and the importance of breast feeding.

14. Differentiate foeticide and infanticide. (2021-2022)

Foeticide: aborting the foetus in the mother's womb.

Infanticide: Killing the female child after her birth.

15. Describe the major STDS and their symptoms

Gonorrhoea	<ol style="list-style-type: none"> 1. Affects the urethra, rectum and throat and in females the cervix also get affected. 2. Pain and pus discharge in the genital tract and burning sensation during urination.
Syphilis	<ol style="list-style-type: none"> 1. Primary stage: Formation of painless ulcer on the external genitalia. 2. Secondary stage: Skin lesions, rashes, swollen joints and fever and hair loss. 3. Tertiary stage: Appearance of chronic ulcer on nose, lower legs and palate. Loss of movement, mental disorder, visual impairment, heart problems, gummas.
Hepatitis-B	Fatigue, jaundice, fever, rashes, and stomach pain. Liver cirrhosis and liver failure occur in the later stage.

AIDS	Enlarged lymph nodes, prolonged fever, prolonged diarrhoea, weight reduction, night sweating.
Candidiasis	Attacks mouth, throat, intestinal tract and vagina. Vaginal itching or soreness, abnormal vaginal discharge and pain during urination.
Trichomoniasis	Vaginitis, greenish yellow vaginal discharge, itching and burning sensation, urethritis, epididymitis and prostatitis.

16. How are STDs transmitted?

STDs transmitted from person to person during intimate sexual contact with an infected partner.

Infection like Hepatitis-B and HIV are transmitted sexually as well as by Sharing of infusion needles, surgical instrument with infected people, blood transfusion or from infected mother to baby.

17. Write the preventive measures of STDs.

1. Avoid sex with unknown partner/ multiple partners.
2. Use condoms.
3. In case of doubt, consult a doctor for diagnosis and get complete treatment.

18. The procedure of GIFT involves the transfer of female gametes into the fallopian tube, can gametes be transferred to the uterus to achieve the same result?

1. Gametes cannot be transferred to the uterus because the uterine environment is not congenial for the survival of the gamete.
2. If directly transferred to the uterus they will undergo degeneration or could be phagocytosis and hence viable zygote would not be formed.

19. Amniocentesis, the foetal sex determination test, is banned in our country, is it necessary?

Comment.

1. Amniocentesis is misused to determine the sex of the foetus.
2. When the sex of the foetus is known, there may be chance of female foeticide due to family norms and skewed choice for a male child.
3. Hence, a statutory ban on amniocentesis is necessary in our country.

20. Explain the various barrier methods to control human population.

Barrier methods: In these methods, the ovum and sperm are prevented from meeting so that fertilization does not occur.

Chemical barrier: Foaming tablets, melting suppositories, jellies and creams are used as chemical agents that inactivate the sperms in the vagina.

Mechanical barrier: Condoms are a thin sheath used to cover the penis in male whereas in female it is used to cover vagina and cervix just before coitus so as to prevent the entry of ejaculated semen into the female reproductive tract. This can prevent conception. Condoms should be discarded after a single use. Condom also safeguards the user from AIDS and STDs. Condoms are made of polyurethane, latex and lambskin.

Hormonal barrier: It prevents the ovaries from releasing the ova and thickens the cervical fluid which keeps the sperm away from ovum.

Intrauterine Devices (IUDs): Intrauterine devices are inserted by medical experts in the uterus through the vagina. These devices are available as copper releasing IUDs, hormone releasing IUDs and non-medicated IUDs.

21. Open book assessment:

“Healthy reproduction, legally checked birth control measures and proper family planning programmes are essential for the survival of mankind” justify.

- Healthy reproduction involves safe and protected reproduction, through which STDs may

not be transmitted from one person to another.

- A healthy society without such diseases can be developed. This in turn will develop a healthy nation.
- The population explosion is the main cause of under development of a society and or a nation.
- To overcome the problem of population explosion, birth control is the only available solution.
- The voluntary use of contraceptive procedures to prevent fertilization or prevent implantation of a fertilized egg in the uterus is called as birth control.
- The proper family planning programme includes:
 - Planning for one or two children.
 - Preventing child birth through the use of contraceptive devices.
 - Creating awareness among people about the importance of family planning.
 - Implementing Government policies on family planning programme.

Other important questions and answer:

1. Write a note on "Amniocentesis". (2019-2020) (Or) How do Amniocentesis? (PTA-2019-2020)

1. Amniocentesis involves taking a small sample of the amniotic fluid that surrounds the foetus to diagnose for chromosomal abnormalities.
2. Amniocentesis is generally performed in a pregnant woman between the 15th and 20th weeks of pregnancy by inserting a long thin needle through the abdomen into the amniotic sac to with draw a small sample of amniotic fluid.
3. The amniotic fluid contains cells shed from the foetus.

2. Differentiate ZIFT and GIFT. (PTA-2019-2020)

ZIFT	GIFT
<ol style="list-style-type: none"> 1. As in IVF, the zygote up to 8 blastomere stage is transferred to the fallopian tube by laparoscopy. 2. The zygote continues its natural divisions and migrates towards the uterus where it gets implanted. 	<ol style="list-style-type: none"> 1. Transfer of an ovum collected from a donor into the fallopian tube. In this the eggs are collected from the ovaries and placed with the sperms in one of the fallopian tubes. 2. The zygote travels toward the uterus and gets implanted in the inner lining of the uterus.

3. State importance of POCSO Act. (2021-2022)

1. Prevention of children from sexual offences.
2. Sexual harassment at work place prevention prohibition and redressal.
3. Creating a safe and secure environment for both females and males.

4. What are the strategies to be implemented in India to attain total reproductive health? (2021-2022)

1. Creating awareness and providing medical assistance to build a healthy society.
2. Introducing sex education in school to provide information about adolescence and adolescence related changes.
3. Education couples and those in the marriageable age groups about the available birth control methods and family planning norms.
4. Creating awareness about care for pregnant women, post-natal care of mother and child and the importance of breast feeding.

5. Encouraging and supporting governmental and non-governmental agencies to identify new methods and to improve upon the existing methods of birth control

5. Surrogacy: (2021-2022)

Surrogacy is a method of reproduction or an agreement whereby a woman agrees to carry a pregnancy for another person who will become the new born child's parent after birth.

6. Define birth control.

Birth control is the voluntary use of contraceptive methods to prevent child birth, by prevent child birth, by preventing fertilization of egg or by preventing the implantation of egg or by preventing the implantation of embryo in the uterus.

7. Distinguish tubectomy and vasectomy.

Tubectomy	Vasectomy
1. It is the surgical sterilization in Women.	1. It is the surgical procedure for male Sterilization.
2. A small portion of both fallopian tubes are cut and tied up through a small incision in the abdomen or through vagina.	2. Both vas deferens are cut and tied through a small incision on the scrotum to prevent the entry of sperm into the urethra.
3. This prevents fertilization as well as the entry of the egg into the uterus.	3. It prevents sperm from heading off to penis as the discharge has no sperms in it.

8. Define Azoospermia.

Azoospermia is defined as the absence of spermatozoa in the ejaculate semen on at least two occasions.

9. What is Foetoscope?

Foetoscope is an instrument used to monitor the heart rate of foetus and other functions during late pregnancy and labour.

10. How are IUDs the ideal contraceptives for females who want to delay pregnancy?

1. IUDs are inserted by medical experts in the uterus through the vagina.
2. They are available as copper releasing IUDs, hormone releasing IUDs and non-medicated IUDs.
3. IUDs increase phagocytosis of sperm within the uterus.
4. IUDs are the popular method of contraception in India and have a success rate of 95 to 99%.

11. Copper releasing IUDs are more efficient contraceptives in human females. How?

1. Copper releasing IUDs differ from each other by the amount of copper.
2. Copper IUDs such as CuT-380A, Nova T, Cu7, CuT380 Ag, Multiload 375, ect. Release free copper and copper salts into the uterus and suppress sperm motility.
3. They can remain in the uterus for five to ten years.

12. Write briefly about oral contraceptives.

1. Oral contraceptives are taken orally in the form of pills, used to prevent ovulation in females.
2. They inhibit the secretion of FSH and LH hormones. Most commonly used birth control pills are combined pills, which contain synthetic progesterone and oestrogen hormones.
3. Central Drug Research Institute (CDRI) in Lucknow, India developed a non-steroidal contraceptive pill, called sahari.

13. Early medical termination is safe. But abortions during the second trimester are more risky. Give reason.

1. Early medical termination is extremely safe up to 12 weeks (the first trimester) of pregnancy and has no impact on a women's fertility.
2. Abortion during the second trimester is more risky as the foetus becomes intimately associated with the maternal tissue.

14. Mention the types of IUDs.**1. Copper IUDs:**

Copper IUDs release free copper and copper salts the uterus and suppress sperm motility can remain in the uterus for five to ten years.

Example: Cu T-380 A, Nova T, Cu 7, CuT380Ag, Multiload 375,ect.

2. Hormone-releasing IUDs:

The Hormone releasing IUDs increase the viscosity of the cervical mucus and prevent sperms from entering the cervix.

Example: Progestasert and LNG-20

3. Non-medicated IUDs:

Non-medicated IUDs are made of plastic or stainless steel. Lippes loop is a double S-shaped plastic device.

15. What is Assisted Reproductive Technology?

1. Assisted Reproductive Technology collection of procedure, which includes the handling of gametes and or embryo outside the body to achieve a pregnancy.
2. It increases the chance of pregnancy in infertile couples.

16. What is sahari?

1. Sahari is a contraceptive pill devised by Central Drug Research Institute (CDRI) in Lucknow, India.
2. It contains a non-steroidal preparation called centchroman.

17. What is cryopreservation?

1. Cryopreservation (freezing) of embryos is often used when there are more embryos than needed for a single IVF transfer.
2. Embryo cryopreservation can provide an additional opportunity for pregnancy through a Frozen embryo transfer (FET) without undergoing another ovarian stimulation and retrieval.

18. What is IUT?

IUT- Intra Uterine Transfer

1. Embryo with more than 8 blastomeres is inserted into uterus to complete its further development.
2. It is a method to achieve pregnancy by Assisted Reproductive Technology.

19. What is micro- testicular sperm extraction (TESE)?

Microsurgical sperm retrieval retrieval from the testicle involves a dilation of the microscope, the seminiferous tubules under the microscope and small amount of testicular tissue in areas of active sperm production are removed. This is improved for sperm yield compare to traditional biopsy techniques.

20. Name any three procedures followed under assisted reproductive technology.

1. Intra Uterine Insemination (IUI)
2. In Vitro Fertilization (IVF)
3. Embryo Transfer (ET)

Five mark questions and answers:**1. Describe the different natural methods of birth control.****Natural method:**

Natural method is used to prevent meeting of sperm with ovum. Rhythm method, coitus interruptus, continuous abstinence and lactational amenorrhoea.

i) Periodic abstinence/ rhythm method:

1. Ovulation occurs at about the 14th day of the menstrual cycle.
2. Ovum survives for about two days and sperm remains alive for about 72 hours in the female reproductive tract.
3. Coitus is to be avoided during this time.

ii) Continuous abstinence:

It is the simplest and most reliable way to avoid pregnancy is not to have coitus for a defined period that facilitates conception.

iii) Coitus interruptus:

It is the oldest family planning method. The male partner withdraws his penis before ejaculation, thereby preventing deposition of semen into the vagina.

iv) Lactational amenorrhoea:

1. It is menstrual cycles resume as early as 6 to 8 weeks from parturition.
2. However the reappearance of normal ovarian cycle may be delayed for six months during breast feeding.
3. This delay in ovarian cycles is called lactational amenorrhoea.
4. It serves as a natural but an unreliable form of birth control.

2. Describe the different barrier methods of birth control.

In these methods the ovum and sperm are prevented from meeting so that fertilization does not occur.

i) Chemical barrier:

1. Foaming tablets.
2. Melting suppositories.
3. Jellies.
4. Creams.

They are used as chemical agents that inactivate the sperms in the vagina.

ii) Mechanical barrier:

1. Condoms are a thin sheath used to cover the penis in male whereas in female it is used to cover vagina and cervix just before coitus so as to prevent the entry of ejaculated semen into the female reproductive tract.
2. This can prevent conception.
3. Condoms should be discarded after a single uses.
4. Condoms are made of polyurethane, latex and lambskin.
5. Diaphragms, cervical caps and vaults are made of rubber and are inserted into the female reproductive tract to cover the cervix before coitus in order to prevent the sperms from entering the uterus.

iii) Hormonal barrier:

1. It prevents the ovaries from releasing the ova and thickens the cervical fluid which keeps the sperm away from ovum.
2. Oral contraceptive pills are used to prevent ovulation by inhibiting the secretion of FSH and LH hormones.
3. A combined pill is the most commonly used birth control pill. It contains synthetic progesterone and estrogen hormones.
4. Saheli, contraceptive pill by Central Drug Research Institute in Lucknow, India contains a non-steroidal preparation called centchroman.

iv) Intrauterine Devices (IUDs):

1. Intrauterine devices are inserted by medical experts in the uterus through the vagina.
2. These devices are available as copper releasing IUDs, hormone releasing IUDs and nonmedicated IUDs.
3. IUDs increase phagocytosis of sperm within the uterus.
4. IUDs are the ideal contraceptives for females who want to delay pregnancy.
5. It is one of the popular methods of contraception in India and has a success rate of 95 To 99%.

3. Explain intrauterine devices (IUDs).

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2. These devices are available as copper releasing IUDs, hormone releasing IUDs and non medicated IUDs.

- IUDs increase phagocytosis of sperm within the uterus.
- IUDs are the ideal contraceptives for females who want to delay pregnancy.
- It is one of the popular methods of contraception in India and has a success rate of 95 to 99%

Copper releasing IUDs:

- It differs from each other by the amount of copper.
- Copper IUDs such as Cu T-380 A, Nova T, Cu 7, Cu T 380 Ag, Multiload 375, etc.
- Release free copper and copper salts in the uterus and suppress sperm motility.
- They can remain in the uterus for five to ten years.

Hormone-releasing IUDs:

- It such as progestasert and LNG-20 are often called as intrauterine systems (IUS).
- They increase the viscosity of the cervical mucus and thereby prevent sperms from entering the cervix.

Non-medicated IUDs:

- They are made of plastic or stainless steel, Lippes loop is a double S-shaped plastic device.

4. Describe the method of surgical sterilization.

- The surgical sterilization methods are the permanent contraception methods advised for male and female partners to prevent any more pregnancies.
- It blocks the transport of the gametes and prevents conception.

Tubectomy:

- Tubectomy is the surgical sterilization in women.
- In this procedure a small portion of both fallopian tubes are cut and tied up through a small incision in the abdomen or through vagina.
- This prevents fertilization as well as the entry of the egg into the uterus.

Vasectomy:

- Vasectomy is the surgical procedure for male sterilization.
- In this procedure both vas deferens are cut and tied through a small incision on the scrotum to prevent the entry of sperm into the urethra.
- Vasectomy prevents sperm from heading off to penis as the discharge has no sperms in it.

5. Describe the method of In Vitro Fertilization (IVF). Or Test tube baby.

- In this technique, sperm and eggs are allowed to unite outside the body in a laboratory.
- One or more fertilized eggs may be transferred into the woman's uterus, where they may implant in the uterine lining and develop.
- Excess embryos may be cryopreserved for future use.
- Initially IVF was used to treat women with blocked, damaged, or absent fallopian tubes. Today IVF is used to treat many causes of infertility.
- The basic steps in an IVF treatment cycle are ovarian stimulation, egg retrieval, fertilization, embryo culture and embryo transfer.
- Egg retrieval is done by minor surgery under general anesthesia, using ultrasound guide after 34 to 37 hours of hCG (human Chorionic Gonadotropin) injection.
- The eggs are prepared and stripped from the surrounding cells.
- At the same time, sperm preparation is done using a special media.
- After preparing the sperms the eggs are brought together. 10,000-1,00,000 motile sperms are needed for each egg.
- Then the zygote is allowed to divide to form 8 celled blastomere and then transferred into the uterus for a successful pregnancy.
- The transfer of an embryo of an embryo with more than 8 blastomere stage into uterus is called Embryo transfer technique.

Unit-II

Chapter: 4 Principles of Inheritance and Variation

Textbook questions and answers:

1. Hemophilia is more common in males because it is a **Recessive trait carried by x-chromosome**.
2. ABO blood group in man is controlled by **Multiple alleles**.
3. Three children of a family have blood groups A, AB and B. What could be the genotypes of their parents?
I^AI^o and I^BI^o

4. Which of the following is not correct?

- a) Three or more alleles of a trait in the population are called multiple alleles.
- b) A normal gene undergoes mutations to form many alleles.
- c) Multiple alleles map at different loci of a chromosome.**
- d) A diploid organism has only two alleles out of many in the population.

5. Which of the following phenotypes in the progeny are possible from the parental combination A x B?, **A, B, AB, and O**

6. Which of the following phenotypes is not possible in the progeny of the parental genotypic combination I^AI^o x I^AI^B? **“O” phenotypes is not possible**

7. Which of the following is true about Rh factor in the offspring of a parental combination D⁺x D⁺ (both Rh positive)?

Answer: About one fourth will be Rh negative.

8. What can be the blood group of offspring when both parents have AB blood group? **A, B and AB**

9. If the child's blood group is 'O' and father's blood group is 'A' and mother's blood group is 'B' the genotype of the parents will be **I^AI^o and I^BI^o**

10. XO type of sex determination and XY type of sex determination are examples of **Male heterogamety**

11. In an accident there is great loss of blood and there is no time to analyse the blood group which blood can be safely transferred? **O and Rh negative**

12. Father of a child is colorblind and mother is carrier for colorblindness, the probability of the child being colorblind is **50%**

13. A marriage between a colorblind man and a normal woman produces **All carrier daughters and normal sons.**

14. Mongolism is a genetic disorder caused by the presence of an extra chromosome number **21.**

15. Klinefelter's syndrome is characterized by a karyotype of **XXY**

16. Female with Turner's syndrome have **Small uterus, Rudimentary ovaries, Underdeveloped breasts.**

17. Patau's syndrome is also referred to as **13- Trisomy.**

18. "Universal Donor" and "Universal Recipients" blood group are **O** and **AB** respectively.

19. ZW-ZZ system of sex determination occurs in Gypsy moth, fishes, reptiles and birds.

Answer: (All of these)

20. Co-dominant blood group is **AB.**

21. Which of the following is incorrect regarding ZW-ZZ type of sex determination?

Females are homogametic and males are heterogametic.

22. What is haplodiploidy?

1. The males have half the number of chromosomes (haploid)
2. The females have double the number (diploid)
3. The name haplodiploidy for this system of sex determination

Example: Honeybees, ants and wasps a mechanism of sex determination called haplodiploidy mechanism of sex determination is common.

23. Distinguish between heterogametic and homogametic sex determination systems.

Heterogametic	Homogametic
1. Heterogametic individuals (dissimilar sex chromosomes) 2. Produce two types of gametes, so they are called heterogamete. Example: In human males produce two kinds of sperms. Some with X chromosome and some with Y chromosome.	1. Homogametic individuals (similar chromosomes) 2. Produce only one type of gamete so they are called homogametic. Example: In human the female are homogametic. They are produce only one kind of egg with X chromosome.

24. What is Lyonisation?

1. Lyonisation is commonly known as X-inactivation in mammals.
2. Male receives one copy (X) of the X chromosome.
3. Female receives two copies (XX) of the X chromosome.
4. One of the two X chromosomes in every cell in a female is randomly inactivated early in embryonic development named after geneticist Mary Lyon.

25. What is criss-cross inheritance.

1. Criss-cross inheritance is the transmission of a gene from mother to son or father to daughter.
2. Those patterns of inheritance are called criss-cross inheritance or skip generation inheritance.
3. In which a character is inherited to the second generation through the carrier of first generation.

Example: X-chromosome linkage haemophilia.

26. Why are sex linked recessive characters more common in the male human beings?

1. A male with a mutation in a gene on the X chromosome is typically affected with the condition. Because females have (XX) two copies of the X chromosome and males have (XY) only one X chromosome.
2. So X linked recessive diseases are more common among males than females.

Example: Haemophilia.

27. What are holandric genes?

1. Holandric gene is Y linked genes that are found on the Y chromosome.
2. Therefore this gene is only found in males. An example of a trait for this gene is facial hair growth.
3. "Holandric" means basically a gene on the Y chromosome (in mammal) that does not have a homolog on the X chromosome.

Example: A father may carry the gene for hairy ears on his Y chromosome his daughter will not inherit this gene but his son would.

28. Mention the symptoms of phenylketonuria.

Sever mental retardation, light pigmentation of skin and hair, phenylpyruvic acid is excreted in the urine.

29. Mention symptoms of downs syndrome.

Severe mental retardation, defective development of the central nervous system, increased separation between the eye, flattened nose, ears are malformed mouth is constantly open and the tongue protrudes.

30. Explain the genetic basis of ABO blood grouping in man.

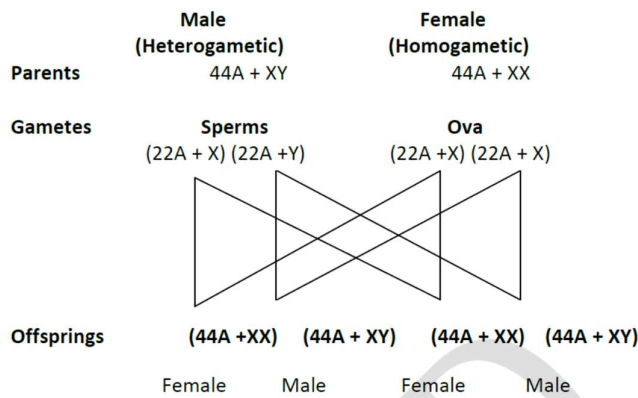
Genotype	ABO blood group phenotype	Antigens present on red blood cell	Antibodies present in blood plasma
I^AI^A	Type A	A	Anti-B
I^AI^O	Type A	A	Anti-B
I^BI^B	Type B	B	Anti-A
I^BI^O	Type B	B	Anti-A
I^AI^B	Type AB	AB	Neither Anti-A nor Anti-B
I^OI^O	Type O	Neither A nor B	Anti-A and Anti-B

1. Karl Landsteiner discovered two kinds of antigens called antigen A and antigen B on the surface of RBCs of human blood.
2. Based on the presence or absence of these antigens three kinds of blood group type "A", type "B" and type "O" (universal donor).
3. The fourth and the rarest blood group "AB" (Universal recipient) was discovered in 1902 by two of Landsteiner's students Von De Castelle and Struli.
4. Bernstein in 1925 discovered that the inheritance of different blood groups in human beings is determined by a number of multiple allelic series.
5. The three autosomal alleles located on chromosome 9 are concerned with the determination of blood group in any person.
6. The gene controlling blood type has been labeled as "I" (Iso agglutination).
7. The I gene exists in three allelic forms I_A, I_B and I_O.
8. I_A specifies A antigen, I_B allele determines B antigen and I_O allele specifies no antigen.
9. Each allele (I_A and I_B) produce transferase enzyme.
10. I_A allele produces N- acetyl galactose transferase and can add N-acetyl galactosamine (NAG).
11. I_B allele encodes for the enzyme galactose transferase that adds galactose to the precursor.
12. I_O/I_O allele no terminal transferase enzyme is produced and therefore called null allele and hence cannot add NAG or galactose to the precursor.

31. How is sex determined in human beings?

1. Genes determining sex in human beings are located on two sex chromosomes, called allosomes.
2. Mamma's sex determination is associated with chromosomal differences between the two sexes typically XX females and XY males.
3. 23 pairs of human chromosomes include 22 pairs of autosomes (44A) and one pair of sex chromosome (XX or XY).
4. Females are homogametic producing only one type of gamete (egg) each containing one X chromosome.

5. The males are heterogametic producing two types of sperms with X and Y chromosomes.



32. What is male heterogamety?

1. In this method of sex determination the males are heterogametic producing dissimilar gametes while females are homogametic producing similar gametes.
2. It is of two kinds XX-Xo type

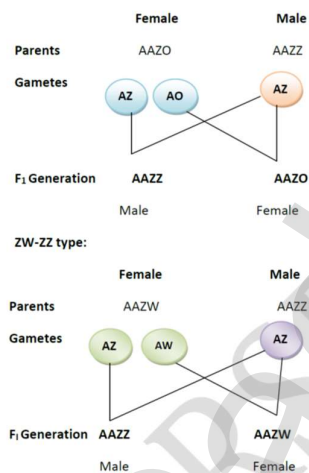
Example: Bugs, cockroaches and grasshoppers. And XX-Xy type (Human beings and Drosophila)

33. Brief about female heterogamety.

1. In this method of sex determination the females are heterogametic producing dissimilar gametes while males are homogametic producing similar gametes.
2. Sex determination the alphabets Z and W are used here instead of X and Y respectively.

ZO-ZZ Type:

1. This method of sex determination is seen in certain moths, butterflies and domestic chickens.
2. In this type the female possesses single Z chromosome in its body cells and is heterogametic (ZO) producing two kinds of eggs some with Z chromosome and some without Z chromosome.
2. The male possesses two Z chromosomes and is homogametic.



1. This method of sex determination occurs in certain insects (gypsy moth) and in vertebrates such as fishes, reptiles and birds.
2. In this method the female has one Z and one W chromosome (ZW) producing two types of egg
3. The male sex has two Z chromosomes and is homogametic (ZZ) producing a single type of sperm.

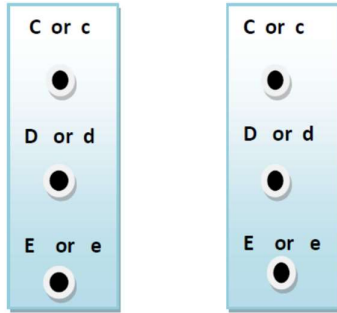
34. Give an account of genetic control Rh factor.

Fisher and Race hypothesis:

1. Rh factor involves three different pairs of alleles located on three different closely linked loci

on the chromosome pair.

2. Three pairs of Rh alleles (Cc, Dd and Ee) occur at 3 different loci on homologous chromosome pair.



3. The possible genotypes will be one C or c, one D or d, one E or e from each chromosome.

4. All genotypes carrying a dominant 'D' allele will produce Rh positive phenotype and double recessive genotype 'dd' will give rise to Rh negative phenotype.

Wiener hypothesis:

1. Wiener proposed the existence of eight alleles ($R_1, R_2, R_0, R_z, r, r_1, r_{11}, r_Y$) at a single Rh locus.

2. All genotypes carrying a dominant R allele (R_1, R_2, R_0, R_z) will produce Rh positive phenotype and

3. Double recessive genotypes ($rr, r_1r_1, r_{11}r_{11}, r_Yr_Y$) will give rise to Rh negative phenotype.

35. Explain the mode of sex determination honeybees.

1. The sex of offspring is determined by the number of sets of chromosomes it receives.

2. Fertilized eggs develop into females (Queen or Worker) and unfertilized eggs develop into males (drones) by parthenogenesis.

3. The male have half the number of chromosomes (haploid) and the females have double the number (diploid)

4. Sex determination facilitates the evolution of sociality in which only one diploid female becomes a queen and lays the eggs for the colony.

5. All other females which are diploid having developed from fertilized eggs help to raise the queen's eggs and so contribute to the queen's reproductive success and indirectly to their own, a phenomenon known as kin selection.

6. The queen constructs their social environment by releasing a hormone that suppresses fertility of the workers.

36. What are the applications of Karyotyping?

1. It helps in gender identification.

2. It is used to detect the chromosomal aberrations like deletion, duplication, translocation, nondisjunction of chromosomes.

3. It helps to identify the abnormalities of chromosomes like aneuploidy.

4. It is also used in predicting the evolutionary relationships between species.

5. Genetic diseases in human beings can be detected by this technique.

37. Explain the inheritance of sex linked characters in human being.

Red-green color blindness or daltonism, haemophilia are example of X-linked gene inheritance in human.

1. Haemophilia:

1. Haemophilia is commonly known as bleeders disease, which is more common men than women.

2. This hereditary disease was first reported by John Cotto in 1803.

3. Haemophilia is caused by a recessive X-linked gene.

3. A person with recessive gene haemophilia lacks a normal clotting substance (thromboplastin) in blood, hence minor injuries cause continuous bleeding, leading to

death.

4. The female are carriers of the disease and would transmit the disease to 50% of their sons even if the he male parent is normal Haemophilia follows the characteristic criss- cross pattern of inheritances.

2. Colour blindness:

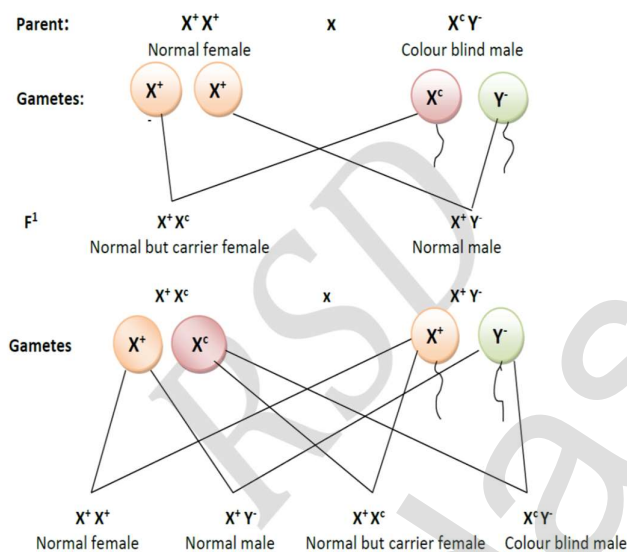
1. In human beings a dominant X-linked gene is necessary for the formation of colour sensitive cells, the cone.
2. The recessive form of this gene is incapable of producing colour sensitive cone cells.
3. Homozygous recessive females (X^cX^c) and hemizygous recessive males (X^cY) are unable to distinguish red and green colour.

Other importance questions:

1. Sex linked inheritable diseases mostly affects men. Explain it with an example. (PTA-2019-2020)

1. All males possessing an x linked recessive mutation will be affected since males have only a single X chromosome and therefore have only one copy of X linked gene.
2. All offspring of a carrier female have a 50% chance of inheriting the mutation if the father does not carry the recessive allele.

2. A character present in grandfather goes to grandson through. Draw flow chart for this pattern of inheritance. (2019-2020)



3. Y- linked genes are non homologous why? (PTA-2019-2020)

1. Over time, the Y chromosome changed in such a way as to inhibit the areas around the sex determining genes from recombining at all with the X chromosome.
2. As a result of this process, 95% of the human Y chromosome is unable to recombine. Only the tips of the Y and X chromosomes recombine.

4. A thalassemia baby is born to a normal non thalassemia parents. Explain the possible for the occurrence of thalassemia. (PTA 2019-2020)

1. Thalassemia is an autosomal recessive disorder.
2. It is caused by gene mutation resulting in excessive destruction of RBC's due to the formation of abnormal haemoglobin molecules.
3. Normally haemoglobin is composed of four polypeptide chains two alpha and two beta globin chains.

4. Thalassaemia patients have defects in either the alpha or beta globin chain causing the production of abnormal haemoglobin molecules resulting in anaemia.

5. Write the Wiener hypothesis for Rh+ phenotype. (2019-2020)

1. Wiener proposed the existence of eight alleles ($R_1, R_2, R_0, R_z, r, r_1, r_{11}, r'$) at a single Rh locus.
2. All genotypes carrying a dominant R allele (R_1, R_2, R_0, R_z) will produce Rh positive phenotype.
3. Double recessive genotypes ($rr, r_1r_1, r_{11}r_{11}, r'r'$) will give rise to Rh negative phenotype.

6. Write the cause of Down's syndrome. (2019-2020)

1. Trisomic conditions of chromosome-21 results in down's syndrome.
2. It is characterized by severe mental retardation, defective development of the central nervous system.

7. How can Erythroblastosis foetalis be prevented? (2021-2022)

1. If the mother is Rh negative and foetus is Rh positive, anti D antibodies should be administered to the mother at 28th and 34th week of gestations as a prophylactic measure.
2. If the Rh negative mother delivers Rh positive child then anti D antibodies should be administered to the mother soon after delivery.

8. In the XY chromosomal system of sex determination, males have only one X chromosome, whereas females have two: (2021-2022)

1. In mammals the necessary dosage compensation is accomplished by the inactivation of one of the x chromosomes in females.
2. So that both males and females have only one functional X chromosome per cell.
3. Mary Lyon suggested that bar bodies represented an inactive chromosome or Lyon's hypothesis.

9. What are multiple alleles?

When three or more alleles of a gene that control a particular trait occupy the same locus on the homologous chromosome of an organism, they are called multiple alleles and their inheritance.

10. What is Erythroblastosis foetalis?

1. Rh+ ve children carried by the Rh- ve mother, is exposed to antibodies produced by the mother.
2. Rh antibodies are carried across the placenta into the foetal blood circulation.
3. This causes haemolysis of foetal RBCs resulting in haemolytic jaundice and anaemia.
4. This condition is known as Erythroblastosis foetalis or Haemolytic disease of the new born (HDN).

11. What is Barr body? How many Barr bodies are seen in male and female?

1. In 1949, Barr and Bertram first observed a condensed body in the nerve cells of female cat which was absent in the male.
2. This condensed body was called sex chromatin by them and was later referred as Barr body.
3. Barr bodies are inactive X chromosome, in females, in the form of condensed tightly coiled and visible chromatin.
4. The number of Barr bodies observed in cell is one less than the number of X chromosome. XX female has one Barr body. XO females have no Barr body. XXY males have one Barr body.
5. In mammals the necessary dosage compensation is accomplished by the inactivation of one of the X chromosome in females so that both males and females have only one functional X chromosome per cell.

12. In the XX-XY type, males have one X chromosome and female has two. How does the organism compensate for this dosage differences between the sexes?

In mammals the dosage compensation is accomplished by the inactivation of one of the X chromosome in females so that both males and females have only one functional X chromosome per cell.

13. What is kin selection?

1. In honey bees only one diploid female becomes a queen and lays the eggs for the colony.
2. All other diploid female developed from fertilized eggs help to raise the queen's eggs and so contribute to the queen's reproductive success and indirectly to their own, This is known as kin selection.

14. What are called X- linked genes? Give example.

The genes present in the "X" chromosome are called X linked genes. They have no alleles in the Y chromosome.

Example: Haemophilia, colour blindness, Duchenne's muscular dystrophy.

15. Write short notes on Haemophilia.

1. Haemophilia is commonly known as bleeder's disease, which is more common in men than women.
2. This hereditary disease was first reported by John Cotto in 1803.
3. Haemophilia is caused by a recessive X- linked gene.
4. A person with a recessive gene for haemophilia lacks a normal clotting substance (thromboplastin) in blood, hence minor injuries cause continuous bleeding, leading to death.
5. The female are carriers of the disease and would transmit the disease to 50% of their sons even if the male parent is normal.
6. Haemophilia follows the characteristic criss- cross pattern of inheritance.

16. Write the genetic reason colour blindness.

1. In human beings a dominant X- linked gene is necessary for the formation of colour sensitive cells, the cones.
2. The recessive females, ($XcXc$) and hemizygous recessive males (XcY) are unable to distinguish red and green colour.

17. Write about the inheritance of Y- linked genes with example.

1. Genes in the Y- chromosome are inherited directly from male to male.

Example: Hypertrichosis (excessive development of hairs on pinna of the ear) are transmitted directly from father to son, because males inherit the Y chromosome from the father.

2. Female inherits only X chromosome from the father and are not affected.

18. Define the terms karyotyping and ideogram.**1. Karyotyping:**

It is a technique through which a complete set of chromosomes is separated from a cell and the chromosomes are arranged in pairs.

2. Idiogram:

It refers to a diagrammatic representation of chromosomes.

19. What is pedigree?

It is a "family tree" drawn with standard genetic symbols, showing the inheritance pathway for specific phenotypic characters.

20. How is karyotype prepared?

1. Tjio and Levan (1960) described a simple method of culturing lymphocytes from the human blood.
2. Mitosis is induced, followed by addition of colchicine to arrest cell division at metaphase stage and the suitable spread of chromosomes is photographed.
3. The individual chromosomes are cut from the photograph and are arranged in an orderly fashion in homologous pairs. This arrangement is called karyotype.

21. What is pedigree analysis?

Pedigree analysis is the study of traits as they have appeared in a given family line for several past generations.

22. What is Lyon's hypothesis?

1. Mary Lyon suggested that Barr bodies represented an inactive chromosome, which in females become tightly coiled into a heterochromatin, a condensed and visible form of chromatin.
2. The number of Barr bodies observed in cell was one less than the number of X Chromosome.
3. XO females have no Barr body, whereas XXY males have one Barr body.

Chapter-5 Molecular Genetics**Textual questions and answers:**

1. Hershey and chase experiment with bacteriophage showed that
b) DNA is the genetic material
2. DNA and RNA are similar with respect to
c) Nucleotide containing sugars, nitrogen bases and phosphates.
3. A mRNA molecule is produced by **Transcription.**
4. The total number of nitrogenous bases in human genome is estimated to be about **3.1 billion.**
5. E. coli cell grown on ^{15}N medium are transferred to ^{14}N medium and allowed to grow for two generations. DNA extracted from these cells is ultracentrifuged in a cesium chloride density gradient. What density distribution of DNA would you expect in this experiment?
d) One low and one intermediate density band.
6. What is the basis for the difference in the synthesis of the leading and lagging strand of DNA molecules?
c) DNA polymerase can join new nucleotides only to the 3' end of the growing strand.
7. Which of the following is the correct sequence of event with reference to the central dogma?
d) Replication, Transcription, Translation.
8. Which of the following statements about DNA replication is not correct?
b) Replication occurs as each base is paired with another exactly like it.
9. Which of the following statements is not true about DNA replication in eukaryotes?
d) There are numerous different bacterial chromosomes, with replication occurring in each at the same time.
10. The first codon to be deciphered was **UUU** which codes for **Phenylalanine.**
11. Meselson and Stahl's experiment proved
d) semi-conservative nature of DNA replication.
12. Ribosomes are composed of two subunits the smaller subunit of a ribosome has a binding site for **mRNA** and the larger subunit has two binding sites for two **tRNA.**
13. An operon is a **Cluster of structural genes with related function.**
14. When lactose is present in the culture medium:
a) Transcription of lac y, lac z, lac a genes occurs.
b) Repressor is unable to bind to the operator.
c) Repressor is able to bind to the operator.
d) Both (a) and (b) are correct.
15. **Give reasons: Genetic code is 'universal'.**
The genetic code is universal. It means that all known living systems use nucleic acids and the same three base codons (triplet codon) direct the synthesis of protein from amino acids. Example: The mRNA (UUU) codon codes for phenylalanine in all cells of all organisms. Some exceptions are reported in prokaryotic, mitochondrial and chloroplast genome. However similarities are more common than differences.
16. **Name the parts marked 'A' and 'B' in the given transcription unit.**
A=Promoter, B=Template strand

17. Differentiate leading strand and lagging strand

Leading strand	Lagging strand
1. It is a replicated strand of DNA which grows continuously without any gap. 2. It does not require DNA ligase for its growth. 3. The polarity of this strand is 3'-----5'	1. Lagging strand is a replicated strand of DNA which is formed in short segments called okazaki fragment. Its growth is discontinuous. 2. DNA- ligase is required for joining okazaki fragments. 3. The polarity of this strand is 5'-----3'

18. Differentiate template strand and coding strand (2021-2022)

Template strand	Coding strand
Leading strand.	Lagging strand.
DNA strand with 3'-----5' polarity.	DNA strand with 5'-----3' polarity.
Replication is continuous.	Replication is discontinuous.

19. Mention any two ways in which single nucleotide polymorphism (SNPs) identified in human genome can bring revolutionary change in biological and medical science.

1. Scientists have identified about 1.4 million locations where single base DNA differences (BSNPs- Single nucleotide polymorphism-pronounce as 'snips') occur in humans.
2. Identifications of 'SNIPS' is helpful in finding chromosomal locations for disease associated sequences and tracing human history.

20. State any three goals of the human genome project.

The main goals of Human Genome Project are as follows:

1. Identify all the genes (approximately 30000) in human DNA.
2. Determine the sequence of the three billion chemical base pairs that make up the human DNA.
3. To store this information in databases.
4. Improve tools for data analysis.
5. Transfer related technologies to other sectors, such as industries.
6. Address the ethical, legal and social issues (ELSI) that may arise from the project.

21. In E.coli, three enzymes β - galactosidase, permease and transacetylase are produced in the presence of lactose. Explain why the enzymes are not synthesized in the absence of lactose.

1. In the absence of lactose the 'I' gene transcribes a repressor mRNA and after translation a repressor protein is produced.
2. The repressor protein binds to the operator of the operon and prevents RNA polymerase from transcribing the operon.
3. It prevents translation as a result β - galactosidase is not produced.
4. In the presence of lactose, the repressor is inactivated by interaction with the inducer.
5. This allows RNA polymerase to bind to the promoter site and transcribe the operon to produce lac mRNA.
6. It enables the formation of all the required enzymes needed for lactose metabolism.

22. Distinguish between structural gene, regulatory gene and operator gene.

Structural Gene	Regulatory gene
1. Structural gene represents an enormous variety of protein structures and functions, including structural proteins, enzymes and regulatory proteins.	1. The interaction can regulate a target gene in a manner either positive (the interaction turns the gene on) or negative (the interaction turns the gene off).

23. A low level of expression of lac operon occurs at all the time. Justify the statement.

1. A low level of lac operon occurs due to the absence of formation of permeases.
2. Due to the failure of transport of lactose into the cell, it will not act as inducer.

24. HGP is the windows for treatment of various genetic disorders. Justify the statement.

1. The Human Genome Project has made it easier to genetically map and clone mutant genes which predispose to a great many human diseases.
2. Once a gene or genes associated with disease has been cloned, it is possible to design DNA- based diagnostics to detect altered forms of the gene which predispose to disease.

25. Why the human genome project is called a mega project?

The human genome project (HGP) is called as a mega project because of the following reasons:

1. It took 13 years to complete.
2. It is the first vertebrate genome to be completed.
3. Human genome is about 25 times larger than the genome of any other organism sequenced so far.
4. Human genome is said to have approximately 3×10^9 bp.

26. From their examination of the structure of DNA, What did Watson and Crick infer about the probable mechanism of DNA replication, coding capability and mutation.

1. They suggested that polynucleotide strands of DNA molecules unwind and start separating at one end.
2. During this process covalent hydrogen bonds are broken.
3. The separated single strand then acts as template for the synthesis of a new strand.
4. Each daughter double helix carries one polynucleotide strand from the parent molecule that acts as a template and the other strand is newly synthesised and complementary to the parent strand.
5. Watson and Crick inferred that the DNA strands have the capacity to pass on genetic information to the RNA.
6. DNA replication \rightarrow RNA \rightarrow Protein
7. They also inferred that nucleic acids are able to undergo sudden changes in structure which is termed as mutation.

27. Why tRNA is called an adapter molecule? (PTA- 2019-2020)

The transfer RNA molecule of a cell acts as a vehicle that picks up the amino acids scattered through the cytoplasm and also reads specific codes of mRNA molecules hence it is called an adapter molecule.

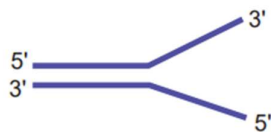
28. What are the three structural differences between RNA and DNA?

DNA	RNA
1. Double stranded with exception of some viruses.	1. Single stranded.
2. The sugar molecule is deoxy ribose.	2. The sugar molecule is ribose.
3. Presence of thymine instead of uracil.	3. Presence of uracil instead of thymine.
4. DNA structure is more stable.	4. RNA is unstable when compared to DNA

29. Name the anticodon required to recognize the following codons: AAU, CGA, UAU, and GCA.

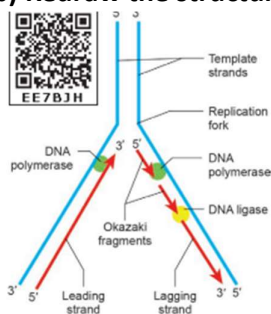
Codon	Anticodon
1. AAU	1. UUA
2. CGA	2. GCU
3. UAU	3. AUA
4. GCA	4. CGU

30.a) Identify the figure given below:



Mechanism of DNA replication showing a replication fork.

b) Redraw the structure as a replicating fork and label the parts.



c) Write the source of energy for this replication and name the enzyme involved in this process.

Source of energy: Deoxy nucleotide triphosphate acts as a substrate and provides energy.

Enzymes involved: DNA polymerase I, II, and III, DNA helicase for unwinding of DNA, DNA ligase to join the broken DNA fragments.

d) Mention the difference in the synthesis of protein based on the polarity of the two template strands.

The mRNA base sequence is complementary to the template strand only. mRNA brings the information for the formation of protein. Thus the synthesis of protein is based on the sequence of the template, strand of DNA with polarity 3'-----5'

31. If the coding sequence in a transcription unit is written as follows:

5' TGCATGCATGCATGCATGCATGC 3' Write down the sequence of mRNA.

3' ACGUACGUACGUACGUACGUACG 5'

32. How is the two stage process of protein synthesis advantageous?

1. The process of copying genetic information from one strand of DNA into RNA is transcription.
2. Translation in the process of polymerization of amino acids to form polypeptide chain.
3. Protein synthesis occurs when the mRNA is translated by the ribosomes.
4. Each mRNA may encode the information for more than one protein.
5. It is done by many ribosomes binding to a single mRNA to form polysomes. Thus it can rapidly synthesize many copies of the peptide.

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33. Why did Hershey and chase radioactively labelled phosphorous and sulphur only? Would they have got the same result if they use radiolabelled carbon and nitrogen?

1. Hershey and Chase Wanted to observe whether it was DNA or protein that entered the bacteria through phage T₂.
2. They designed their experiments with radioactive isotopes of sulphur (³⁵S) and phosphorous (³²P), in order to keep track of viral proteins and nucleus acids during infection process.

3. The culture medium with isotope ^{35}S or ^{32}P was used to culture virus and bacteria to infect.
4. When the bacteriophages were grown in the presence of isotopes (^{35}S) in the culture medium, the proteins will be labeled with ^{35}S .
5. The bacteriophage grown in presence ^{32}P had labeled DNA.
6. This differential labeling thus enabled them to identify DNA and proteins of the phage.
7. Hershey and Chase proved that it was DNA not the protein which carries the genetic information from virus to bacteria.
8. If they use radioactive isotopes of ^{14}C and ^{15}N .
9. They may not be incorporated separately in proteins and DNA of the bacteriophage and hence the purpose of their experiments may not be solved, if they would have used radioactive carbon and nitrogen instead isotopes of phosphorous and sulphur.

34. Explain the formation of a nucleosome.

1. Nucleosome is a structural unit of a eukaryotic chromosome, consisting of a length of DNA coiled around a core of histones.
2. In eukaryotes, the formation of nucleosome is much more complex.
3. Chromatin is formed by a series of repeating units of nucleosomes.
4. Kornberg proposed a model for the nucleosome.
5. Histone octamere is an unit of two molecules of the four histone proteins, H2A, H2B, H3 and H4.
6. The negatively charged DNA is wrapped around positively charged histone octamere to form a structure known as nucleosome.

35. It is established that RNA is the first genetic material. Justify giving reasons. (PTA2019-2020)

The reasons to establish that RNA is the first genetic material, are as follows:

1. A typical cell contains about ten times as much RNA as DNA.
2. The high RNA content is mainly due to the variety of roles played by RNA in the cell.
3. Fraemkel-Conrat and Singer (1957) first demonstrated to RNA is the genetic material in RNA containing viruses like TMV (Tobacco Mosaic Virus) and they separated RNA from the protein of TMV viruses.
4. Three molecular biologists in the early 1980's (Leslie Orgel, Francis Brick and Carl Woese) independently proposed the 'RNA World' as the first stage in the evolution of life, a stage when RNS catalysed all molecules necessary for survival and replication.
5. The term 'RNA World' first used by Walter Gilbert in 1986, hypothesizes RNA as the first genetic material on earth.
6. There is now enough evidence to suggest that essential life processes (Such as metabolism, Translation, splicing ect.) evolved around RNA.
7. RNA has the ability to act as both genetic material and catalyst.

Other important questions and answers:

1. Write the main goals of Human Genome Project. (2019-2020)

1. Identify all the genes (approximately 30000) in human DNA.
2. Determine the sequence of the three billion chemical base pairs that makeup the human DNA.
3. To store this information in databases.
4. Improve tools for data analysis.
5. Transfer related technologies to other sectors, such as industries.
6. Address the ethical, legal and social issues (ELSI) that may arise from the project.

2. List out the salient features of genetic code.(2019-2020)

1. The genetic codon is a triplet code and 61 codons code for amino acids and 3 codons do not code for any amino acid and function as stop codon (Termination).
2. The genetic code is universal. It means that all known living systems use nucleic acids and the same three base codons (triplet codon) direct the synthesis of protein from amino acids.
3. For example, the mRNA (UUU) codon codes for phenylalanine in all cells of all organisms. Some exceptions are reported in prokaryotic, mitochondrial and chloroplast genomes.
4. However similarities are more common than differences.
5. A non-overlapping codon means that the same letter is not used for two different codons. For instance, the nucleotide sequence GUU GUC represents only two codons.
6. It is comma less, which means that the message would be read directly from one end to the other i.e., no punctuation are needed between two codes.
7. A degenerate code means that more than one triplet codon could code for a specific amino acid. For example: codons GUU, GUC, GUA and GUG code for valine.
8. Non-ambiguous code means that one codon will code for one amino acid.
9. The code is always read in a fixed direction from 5' · 3' direction called polarity.
10. AUG has dual functions. It acts as a initiator codon and also codes for the amino acid methionine.
11. UAA, UAG (tyrosine) and UGA (tryptophan) codons are designated as termination (stop) codons and also are known as "non_sense" codons.

3. Explain the process of transcription in eukaryotes. (2019-2020)

1. In Eukaryotes, there are at least three RNA polymerases in the nucleus (in addition to RNA polymerase found in the organelles).
2. There is a clear division of labour . The RNA polymerase I transcribes rRNAs (28s, 18s and 5.8s), whereas the RNA polymerase III is responsible for transcription of tRNA, 5s rRNA and snRNA.
3. The RNA polymerase II transcribes precursor of mRNA, the hnRNA (heterogenous nuclear RNA).
4. In eukaryotes, the monocistronic structural genes have interrupted coding sequences known as exons (expressed sequences) and non- coding sequences called introns (intervening sequences). The introns are removed by a process called splicing.
5. hnRNA undergoes additional processing called as capping and tailing. In capping an unusual nucleotide, methyl guanosine triphosphate is added at the 5' end, whereas adenylate residues (200-300) (poly A) are added at the 3' end in tailing.
6. Thereafter, this processed hnRNA, now called mRNA is transported out of the nucleus for translation.

4. What are Operons? How many operon groups are present in E.coli? (2019-2020)

1. The cluster of gene with related functions are called operons.
2. 75 different operons.

5. Write about the methodologies of HGP. (2019-2020)**Identifying all the genes that are:**

1. Expressed as RNA or expressed sequence tags EST
2. Sequence annotation.
3. Sequence coding and non- coding sequence.
4. Sequence with functions.
5. DNA- small fragments.
6. Amplification of DNA by vector.
7. BAC (Bacterial Artificial Chromosomes), YAC (Yeast Artificial Chromosome)
8. Fragments Sequence- automated DNA sequences.

9. Genetic and physical maps on genome restriction endonucleus microsatellites.

10. Sequencing longer fragments by shotgun sequencing.

6. Explain the transformation experiment of Avery et.al., (PTA-2019-2020)

1. Later, Oswald Avery, Colin Macleod and Maclyn McCarty in 1944 repeated Griffith's experiments in an 'in vitro' system in order to identify the nature of the transforming substance responsible for converting a non-virulent strain into virulent strain.

2. They observed that the DNA, RNA and proteins isolated from the heat-killed S-strain when added to R-strain changed their surface character from rough to smooth and also made them pathogenic.

3. But when the extract was treated with DNase (an enzyme which destroys DNA) the transforming ability was lost.

4. RNase (an enzyme which destroys RNA) and Proteases (an enzyme which destroys protein) did not affect the transformation.

5. Digestion with DNase inhibited transformation suggesting that the DNA caused the transformation.

6. These experiments suggested that DNA and not proteins is the genetic material.

7. The phenomenon, by which DNA isolated from one type of cell (R-strain), when introduced into another type (S-strain), is able to retain some of the properties of the Restrain is referred to as transformation.

7. Statellite DNA forms the basis of DNA finger printing. Explain? (PTA-2019-2020)

1. DNA finger printing involves identifying differences in some specific regions in DNA sequence called repetitive DNA, because in these sequences, a small stretch of DNA is repeated many times.

2. These repetitive DNA as different peaks during density gradient centrifugation.

3. The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA.

4. Depending on base composition (A:T rich or G:C rich), length of segment and number of repetitive units, the satellite DNA is classified into many sub categories such categories such as micro- satellites, mini-satellites, etc.,

5. These sequences do not code for any proteins, but they form a large portion of human genome.

6. These sequence show high degree of polymorphism and form the basis of DNA Fingerprinting.

7. DNA isolated from blood, hair, skin cell, or other genetic evidences left at the scene of a crime can be compared through VNTR patterns, with the DNA of a criminal suspect to determine guilt or innocence.

8. VNTR patterns are also useful in establishing the identify of a homicide victim, either from DNA founds as evidence or from the body itself.

8. What is known as ribozyme? What is its significance. (PTA-2019-2020)

1. There are several biochemical reactions in living systems that are catalysed by RNA. This catalytic RNA is known as ribozyme.

2. The ribozyme catalyses specific reactions in a similar way to that of protein enzymes.

3. Also called catalytic RNA, ribozymes are found in the ribosome where they join amino acids together to form protein chains.

9. What is known as RNA world? (PTA-2019-2020)

The term RNA World first used by Walter Gilbert in 1986 hypothesizes RNA as the first genetic material on earth. There is now enough evidence to suggest that essential life processes such as metabolism, translation, splicing etc...

10. HGP is useful in tracing human history. How? (PTA2019-2020)

1. The mapping of human chromosomes is possible to examine a person's DNA and to identify genetic abnormalities.

2. This is extremely useful in diagnosing diseases and to provide genetic counselling to those planning to have children.
3. This kind of information would also create possibilities for new gene therapies.
4. Besides providing clues to understand human biology, learning about non-human organisms, DNA sequences can lead to an understanding of their natural capabilities that can be applied towards solving challenges in healthcare, agriculture, energy production and environmental remediation.
5. A new era of molecular medicine, characterized by looking into the most fundamental causes of disease than treating the symptoms will be an important advantage.

11. Explain gene switch on and off mechanism in E.coli. (PTA-2019-2020)

1. Jacob and monod proposed the classical model of lac operon to explain gene expression and regulation in E.coli.
2. In lac operon, a polycistronic structural gene is regulated by a common promoter and regulatory gene.
3. When the cell is using its normal energy source as glucose, the 'i' gene transcribes a repressor mRNA and after its translation, a repressor protein is produced.
4. It binds to the operator region of the operon and prevents translation, as a result β -galactosidase is not produced.
5. In the absence of preferred carbon source such as glucose, if lactose is available as an energy source for the bacteria then lactose enters the cell as a result of permease enzyme.
6. Lactose acts as an inducer and interacts with the repressor to inactivate it.
7. The repressor protein binds to the operator of the operon and prevents RNA polymerase from transcribing the operon.
8. In the presence of inducer, such as lactose or allolactose, the repressor is inactivated by interaction with the inducer.
9. This allows RNA polymerase to bind to the promoter site and transcribe the operon to produce lac mRNA which enables formation of all the require enzymes needed for lactose metabolism.
10. This regulation of lac operon by the repressor is an example of negative control of transcription initiation.
11. Lac operon is also under the control of positive regulation as well.

12. There are no tRNAs for stop codons why? (PTA-2019-2020)

1. During initiation, the small ribosomal subunit binds to the start of the mRNA sequence.
2. Lastly, termination occurs when the ribosome reaches a stop codon (UAA, UAG, and UGA).
3. Since there are no tRNA molecules that can recognize these codons, the ribosome recognize that translation is complete.

13. 5'-----3' direction of a nucleic acid. Write the meaning of 5' and 3' in the above statement. (PTA-2019-2020)

1. The symbol 5' refers to carbon in the sugar to which a phosphate (PO_4) functional group is attached.
2. The symbol 3' refers to carbon in the sugar to which hydroxyl (OH) functional group is attached.
3. Understanding the 5'-----3' direction of a nucleic acid is critical for understanding the aspects of replication and transcription.

14. What is known as RNA world? (PTA-2019-2020)

1. The term 'RNA World' first used by Walter Gilbert in 1986, hypothesize RNA as the first genetic material on earth.
2. There is now enough evidence to suggest that essential life processes (such as metabolism, translation, splicing etc.,) evolved around RNA.
3. RNA has the ability to act as both genetic material and catalyist.

15. Write about the applications and future challenges of HGP. (PTA-2019-2020)

1. The mapping of human chromosomes is possible to examine a person's DNA and to identify genetic abnormalities.
2. This is extremely useful in diagnosing diseases and to provide genetic counseling to those planning to have children.
3. This kind of information would also create possibilities for new gene therapies.
4. Besides providing clues to understand human biology, learning about non-human organisms, DNA sequences can lead to an understanding of their natural capabilities that can be applied towards solving challenges in healthcare, agriculture, energy production and environmental remediation.
5. A new era of molecular medicine, characterized by looking into the most fundamental causes of disease than treating the symptoms will be an important advantage

16. Discuss the properties of genetic material (PTA- 2019-2020)

Self Replication: 1. It should be able to replicate. 2. According to the rule of base pairing and complementarily, both nucleic acids (DNA and RNA) have the ability to direct duplications. 3. Proteins fail to fulfill this criteria.

Stability: 1. It should be stable structurally and chemically.

2. The genetic material should be stable enough not to change with different stages of life cycle, age or with change in physiology of the organisms.
3. Stability as one of property of genetic material was clearly evident in Griffith transforming principle.
4. Heat which killed the bacteria did not destroy some of the properties of genetic material.
5. In DNA the two strands being complementary, if separated (denatured) by heating can come together (renaturation) when appropriate condition is provided.
6. Further 2' OH group present at every nucleotide in RNA is a reactive group that makes RNA liable and easily degradable.
7. RNA is also known to be catalytic and reactive.
8. Hence, DNA is chemically more stable and chemically less reactive when compared to RNA.
9. Presence of thymine instead of uracil in DNA confers additional stability to DNA.

Information storage: 1. It should be able to express itself in the form of 'Mendelian characters

2. RNA can directly code for protein synthesis and can easily express the characters.
3. DNA, however depends on RNA for synthesis of proteins.
4. Both DNA and RNA can act as a genetic material, but DNA being more stable store the genetic information and RNA transfers the genetic information.

Variation through mutation: 1. It should be able to mutate

2. Both DNA and RNA are able to mutate. 3. RNA being unstable mutates at a faster rate.
3. Thus viruses having RNA genome with shorter life span can mutate and evolve faster.
4. The above discussion indicates that both RNA and DNA can function as a genetic material
5. DNA is more stable, and is preferred for storage of genetic information.

17. State one gene one enzyme hypothesis (PTA 2019-2020)

1. The experiments of George Beadle and Edward Tatum in the early 1940's on *Neurospora crassa* (the red bread mould) led them to propose one gene one enzyme hypothesis, which states that one gene controls the production of one enzyme.

18. Write about the third phase of translation in protein synthesis. (PTA-2019-2020)

1. Translation is a process by which the genetic code contained within a messenger RNA (mRNA) molecule is decoded to produce a specific sequence of amino acids in a polypeptide chain.
2. It occurs in the cytoplasm following transcription and, like transcription, has three stages:

Initiation, elongation and termination.

19. Fingerprinting technique is inevitable in the detection of criminal in human beings. (PTA- 2019-2020)

1. DNA finger printing involves identifying differences in some specific regions in DNA sequence called repetitive DNA, because in these sequences, a small stretch of DNA is repeated many times.
2. These repetitive DNA as different peaks during density gradient centrifugation.
3. The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA.
4. Depending on base composition (A:T rich or G:C rich), length of segment and number of repetitive units, the satellite DNA is classified into many sub categories such categories such as micro- satellites, mini-satellites, etc.,
5. These sequences do not code for any proteins, but they form a large portion of human genome.
6. These sequence show high degree of polymorphism and form the basis of DNA Fingerprinting.
7. DNA isolated from blood, hair, skin cell, or other genetic evidences left at the scene of a crime can be compared through VNTR patterns, with the DNA of a criminal suspect to determine guilt or innocence.
8. VNTR patterns are also useful in establishing the identify of a homicide victim, either from DNA founds as evidence or from the body itself.

17. What is transcription? (2021-2022)

Process of copying genetic information from one strand of DNA into RNA.

18. Corona Virus is a RNA virus. Basically, PCR technique is used for detecting DNA. If so how PCR technique is used for diagnosing Corona Virus? (2021-2022)

Corona virus can be detected by Reverse transcription PCR (RT-PCR).

19. Explain the role of translation components in protein synthesis? (2021-2022)

Translation components:

Ribosome, Initiator tRNA, Initiation factors, Elongation factors, Many triplet codons.

Initiation:

1. mRNA binds to small subunit along with initiation factors (IF1,IF2,IF3)
2. Initiator tRNA^{fMet} binds to mRNA codon in P site IF3 released.
3. Large subunit binds to complex IF1 and IF2 released EF-Tu binds to tRNA, facilitating entry into A site.

Elongation:

1. Second charge tRNA has entered A site facilitated by EF-Tu first elongation step commences.
2. Dipeptide bond forms uncharged tRNA moves to E-site and then out of ribosome.
3. Third charge tRNA has entered A site facilitated by EF-Tu second elongation step begins.
4. mRNA has shifted by 3bases EF-G facilitates the translocation step first elongation step completed.
5. Tripeptide formed second elongation step completed uncharged tRNA moves to E site.
6. Polypeptide chain synthesized and exiting ribosome.

Termination:

1. tRNA and polypeptide chain released.
- GTP dependent termination factors activated components separate polypeptide folds into protein.

20. List the salient features of genetic code. (2021-2022)

1. The genetic codon is a triplet code and 61 codons code for amino acids and 3 codons do not code for any amino acid and function as stop codon (Termination).
2. The genetic code is universal. It means that all known living systems use nucleic acids and the same three base codons (triplet codon) direct the synthesis of protein from amino acids. Some exceptions are reported in prokaryotic, mitochondrial and chloroplast genomes. However, similarities are more common than differences.

3. A non- overlapping codon means that the same letter is not used for two different codons. For instance, the nucleotide sequence GUU GUC represents only two codons.
4. It is comma less, which means that the message would be read directly from one end to the other i.e., no punctuation are needed between two codes.
5. A degenerate code means that more than one triplet codon could code for a specific amino acid. For example: codons GUU, GUC, GUA and GUG code for valine.
6. Non- ambiguous code means that one codon will code for one amino acid.
7. The code is always read in a fixed direction i.e. from 5' → 3' direction called polarity.
8. AUG has dual function. It acts as initiator codon and also codes for the amino acid methionine.

Creative questions and answers:

1. Define 'Non-sense' codon.

'Non-sense' codons are defined as the codons designated as termination (stop) codons.

2. Define translation.

Translation is a process in which polymerisation of amino acids to form polypeptide chain takes place.

3. What is reverse transcription?

1. In some retroviruses that contain RNA as the genetic material (e.g. HIV), the flow of information is reversed.
2. RNA synthesizes DNA by reverse transcription, then transcribed into mRNA by transcription and then into proteins by translation. This is called reverse transcription.

4. What is open reading frame?

1. One of the alternative ways of dividing up a sequence of bases in DNA or RNA into codon is called reading frame.
2. Any sequence of DNA or RNA, beginning with a start codon and which can be translated into a protein is known as an open reading frame (ORF).

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6. What is operon reading frame?

1. One of the alternative ways of dividing up a sequence of bases in DNA or RNA into codon is called reading frame.
2. Any sequence of DNA or RNA, beginning with a start codon and which can be translated into a protein is known as an open reading frame (ORF).

7. What are genes present in lac operon? Mention their function.

The genes present in lac operon and their function include the following:

1. One inhibitor gene (i) present it between promoter site (p) and operator site (o).
2. Three structural genes namely lac z, y and lac a gene are present.
3. Lac z gene codes for B galactosidase enzyme.
4. Lac y gene codes for permease enzyme.
5. Lac a gene codes for transactylase enzyme.

8. Explain negative control of transcription initiation.

1. The repressor protein binds to the operator of the operon, preventing RNA polymerase from transcribing the operon.
2. When an inducer such as lactose is present, the repressor protein is inactivated by the interaction with inducer.
3. This allows RNA polymerase to bind to the promoter site and transcribe the operon to

produce lac mRNA.

4. This enables the formation of all required enzymes for lactate metabolism.

9. What are called TATA box and pribnow box?

In eukaryotes the promoter has AT rich regions called TATA box (Goldberg Hogness box) and in prokaryotes this region is called pribnow box.

10. List out the three regions of a transcriptional unit. Write the role of them.

Promoter: It is located towards the 5' end. It is a DNA sequence that provides binding site for RNA polymerase.

Structural gene: It defines the template and coding strands.

The terminator region: Located towards the 3' causes the RNA polymerase to stop transcribing.

11. Which is called the start codon? Write its role in initiation.

1. AUG is the start codon.

2. It begins the coding sequence and is read by a special tRNA that carries methionine (met).

3. The initiator tRNA charged with methionine binds to the AUG start codon.

4. In prokaryotes, N-formyl methionine (f_{met}) is attached to the initiator tRNA.

12. Define operon.

It is a unit of gene expression and regulation it consists of one or more structural genes and an adjacent operator gene that control transcriptional activity of the structural gene.

13. Mention the functions of the three enzymes involved in Metabolism of lactose in E.coli.

1. The enzyme permease is needed for entry of lactose into the cell.

2. β -galactosidase brings about hydrolysis of lactose to glucose and galactose.

3. Transacetylase transfers acetyl group from acetyl CoA to β -galactosidase.

14. What are the component of the lac operon?

1. It consists of one regulator gene ('i' gene refers to inhibitor) promoter sites (p), operator site (o) and three structural genes namely lac z, y and lac a.

2. The lac 'z' gene codes for β -galactosidase, lac 'y' gene codes for permease and 'a' gene codes for transacetylase.

Five marks:

1. Write the applications of DNA finger printing.

i. Forensic analysis:

It can be used in the identification of a person involved in criminal activities, for settling paternity or maternity disputes, and in determining relationships for immigration purposes.

ii. Pedigree analysis:

Inheritance pattern of genes through generations and for detecting inherited diseases.

iii. Conservation of wild life:

Protection of endangered species. By maintaining DNA records for identification of tissues of the dead endangered organisms.

iv. Anthropological studies:

It is useful in determining the origin and migration of human populations and genetic diversities.

2. Describe the steps involved in DNA finger printing.

i. Extraction of DNA:

The process of DNA fingerprinting starts with obtaining a sample of DNA from blood, semen, vaginal fluids, hair roots, teeth, bones, etc.,

ii. Polymerase chain reaction (PCR):

In many situations, there is only a small amount of DNA available for DNA fingerprinting.

If needed many copies of the DNA can be produced by PCR (DNA amplification).

iii. Fragmenting DNA:

DNA is treated with restriction enzymes which cut the DNA into smaller fragments at specific sites.

iv. Separation of DNA by electrophoresis:

During electrophoresis in an agarose gel, the DNA fragments are separated into bands of different sizes. The bands of separated DNA are sieved out of the gel using a nylon membrane (treated with chemicals that allow for it to break the hydrogen bonds of DNA so there are single strands).

v. Denaturing DNA:

The DNA on gels is denatured by using alkaline chemicals or by heating.

vi. Blotting:

The DNA band pattern in the gel is transferred to a thin nylon membrane placed over the 'size fractionated DNA strand' by southern blotting.

vii. Using probes to identify specific DNA:

A radioactive probe (DNA labelled with a radioactive substance) is added to the DNA bands. The probe attaches by base pairing to those restriction fragments that are complementary to its sequence. The probes can also be prepared by using either 'fluorescent substance' or 'radioactive isotopes'.

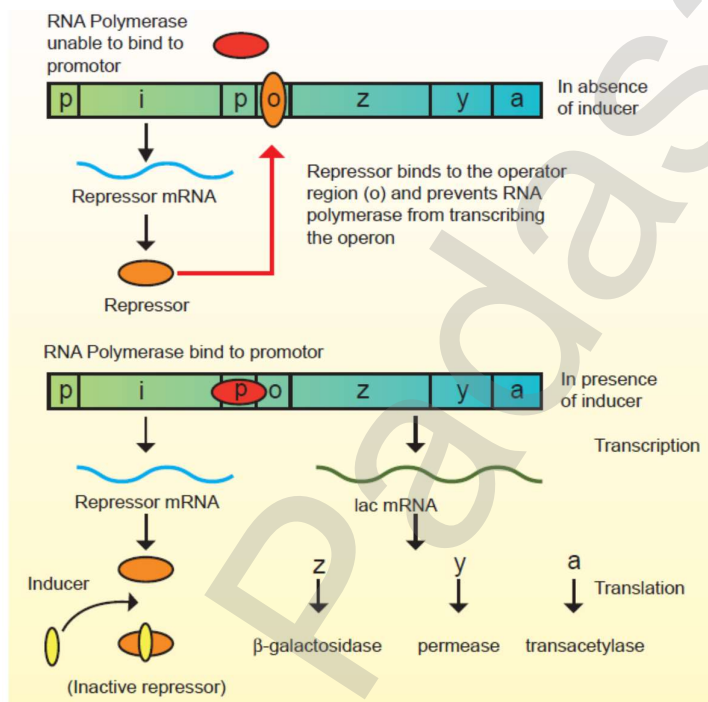
viii. Hybridization with probe:

After the probe hybridizes and the excess probe washed off, a photographic film is placed on the membrane containing 'DNA hybrids'.

ix. Exposure on film to make a generic/ DNA Fingerprint:

The radioactive label exposes the film to form an image (image of bands) corresponding to specific DNA bands. The thick and thin dark bands from a pattern of bars which constitutes a genetic fingerprint.

3. Explain the structure of Lac operon.



1. Jacob and Monod proposed the classical model of lac operon to explain gene expression

and regulation in E.coli.

2. The metabolism of lactose in E.coli requires three enzymes permease, β -galactosidase (β -gal) and transacetylase.
3. The enzyme permease is needed for entry of lactose into the cell, β -galactosidase brings about hydrolysis of lactose to glucose and galactose, while transacetylase transfers acetyl group from acetyl CoA to β -galactosidase.
4. The lac operon consists of one regulator gene ('i' gene refers to inhibitor) promoter sites (P), and operator site (o).
5. Besides these, it has three structural genes namely lac z,y and lac a. the lac 'z' gene codes for β -galactosidase, lac 'y' gene codes for permease and 'a' gene codes for transacetylase.

4. Mention any five salient features of human genome project. (2021-2022)

1. The human genome contains 3 billion nucleotide bases.
2. An average gene consists of 3000 bases, the largest known human gene being dystrophin with 2.4 million bases.
3. Genes are distributed over 24 chromosomes. Chromosome 13 and Y chromosome have lowest gene densities.
4. The chromosomal organization of human genes shows diversity.
5. There may be 35000-40000 genes in the genome and almost 99.9 nucleotide bases are exactly the same in all people.
6. Functions for over 50 percent of the discovered genes are unknown.
7. Less than 2 percent of the genome codes for proteins.
8. Repeated sequences make up very large portion of the human genome. Repetitive sequences have no direct coding functions but they shed light on chromosome structure, dynamics and evolution (genetic diversity).
9. Chromosome 1 has 2968 genes whereas chromosome 'Y' has 231 genes.
10. Scientists have identified about 1.4 million locations where single base DNA differences (SNPs- Single nucleotide polymorphism- pronounce as 'snips') occur in humans. Identification of 'SNIPS' is helpful in finding chromosomal locations for disease associated sequences and tracing human history

Chapter: 6 Evolution

Textbook questions and answers:

1. The first life on earth originated **in water**.
2. Who published the book "Origin of species by Natural Selection" in 1859? **Charles Darwin**.
3. Which of the following was the contribution of Hugo de vries? **Theory of mutation**.
4. The wing of birds and butterflies example of **Convergent evolution**.
5. The phenomenon of " Industrial Melanism" demonstrates **Natural selection**.
6. Darwin's finches are an excellent example of **adaptive radiation**.
7. Who proposed the Germplasm theory? **August Weismann**
8. The age of fossils can be determined by **Carbon dating**.
9. Fossils are generally found in **Sedimentary rocks**.
10. Evolutionary history of an organism is called **phylogeny**.
11. The golden age of reptiles was **Mesozoic era**.
12. Which period was called 'Age of fishes"? **Devonian**.
13. Modern man belongs to which period? **Quaternary**
14. The Neanderthal man had the brain capacity of **1400cc**.
15. According to Darwin, the organic evolution is due to **interspecific competition**.
16. A population will not exist in Hardy Weinberg equilibrium if **individuals mate selectively**.

17. List out the major gases seems to be found in the primitive earth. (2021-2022)

Ammonia, methane, hydrogen and water vapour.

18. Explain the three major categories in which fossilization occur?

Actual remains:

1. The original hard parts such as bone, teeth or shells are preserved as such in the earth's atmosphere.
2. Marine animals die their hard parts such as bones shells are covered with sediments and are protected from further deterioration.
3. The sediments become hardened to form definite layers or strata for example: Woolly mammoth

Petrifaction:

1. Animals die the original portion of their body may be replaced molecule for molecule by minerals and the original substance being lost through disintegration.
2. Minerals involved in this type fossilization are iron, pyrites, silica, calcium carbonate and bicarbonates of calcium and magnesium.

Natural moulds and casts:

1. The body of an animal might leave indelible impression on the soft mud which later becomes hardened into stones.
2. The cavities of the moulds may get filled up by hard minerals and get fossilized which are called casts.

19. Differentiate between divergent evolution and convergent evolution with one example for each.

Divergent evolution	Convergent evolution
Structure which are similar in origin but perform different functions are called homologous structure. Example: Forelimbs of terrestrial vertebrates bird, bat, whale, horse and human	Organism having different structural patterns but similar function is termed as analogous structure. Example: Wings of bird and insect (Butterfly, drognfly)

20. How does Hardy- Weinberg's expression ($p^2+2pq+q^2$) explain that genetic equilibrium is maintained in a population? List any four factors that can disturb the genetic equilibrium. (

- 1) A population is in a state of Hardy Weinberg equilibrium, the frequencies of alleles and genotypes or sets of alleles in that population will remain same over generation.
- 2) Population of beetles, (infinitely large) and appear in two colours dark grey (black) and light grey, and their colour is determined by 'A' gene.
- 3) 'AA' and 'Aa' beetles are dark grey and 'aa' beetles are light grey.
- 4) In a population let's say that 'A' allele has frequency (p) of 0.3 and 'a' allele has a frequency (q) of 0.7. Then $p+q=1$.

$$(p+q)^2=p^2+2pq+q^2$$

P_2 = frequency of AA

$2pq$ = frequency of Aa

q^2 = frequency of aa

$p = 0.3, q = 0.7$ then,

$$p^2 = (0.3)^2 = 0.09 = 9\% \text{ AA}$$

$$2pq = 2(0.3)(0.7) = 0.42 = 42\% \text{ Aa}$$

$$q^2 = (0.7)^2 = 0.49 = 49\% \text{ aa.}$$

The genotype frequencies of the parent appear in the next generation.

(9%AA, 42%Aa and 49%aa)

The major factors which disturb Hardy- Weinberg equilibrium are Gene flow, Mutation, Genetic drift, recombination, natural selection.

21. Explain how mutations, natural selection and genetic drift affect Hardy Weinberg equilibrium.

1. The allele frequencies in a population are stable and are constant from generation to generation in the absence of gene flow, genetic drift, mutation, recombination, and natural selection. The population is in a state of Hardy Weinberg equilibrium.
2. If there is a change in these factors there will be a shift in the frequency of a gene the population will not be in Hardy Weinberg equilibrium evolution will take place

22. How did Darwin explain fitness of organisms?

He proved that fittest organisms can survive and leave more progenies than the unfit ones through natural selection.

Over production, Struggle for existence, Universal occurrence of variations, origin of species by natural selection.

23. Mention the main objections to Darwinism.

1. Darwin failed to explain the mechanism of variation.
2. Darwinism explains the survival of the fittest but not the arrival of the fittest.
3. He focused on small fluctuating variations that are mostly non- heritable.
4. He did not distinguish between somatic and germinal variations.
5. He could not explain the occurrence of vestigial organs, over specialization of some organs like large tusks in extinct mammoths, oversized antlers in the extinct Irish deer, etc.,

24. Taking the example of peppered moth, explain the action of natural selection. What do you call the above phenomenon? (PTA-2019-2020)

1. Natural selection can be explained clearly through industrial melanism is a classical case of Natural selection exhibited by the peppered moth, Biston betularia.
2. These were available in two colours, white and black. Before industrialization peppered moth both white and black coloured were common in England.
3. Pre-industrialization witnessed white coloured background of the wall of the buildings hence the white coloured moths escaped from their predators.
4. Post industrialization, the tree trunks became dark due to smoke and soot let out from the industries.
5. The black moths camouflaged on the dark bark of the trees and the white moths were easily identified by their predators.
6. Hence the dark coloured moth population was selected and their number increase when compared to the white moths.
7. Nature offered positive selection pressure to the black coloured moths.
8. The above proof shows that in a population, organisms that can adapt will survive and produce more progenies resulting in increase in population through natural selection.

25. Darwin's finches and Australian marsupials are suitable example of adaptive radiation justify the statement.

Darwin's finches and Australian marsupials are best examples for adaptive radiation. When more than one adaptive radiation occurs in an isolated geographical area, having the same structural and functional similarity is referred to as convergent evolution.

1. Their common ancestor arrived on the Galapagos about 2 million years ago. During that time, Darwin's finches have evolved into 14 recognized species differing in body size, beak shape and feeding behavior.
2. Changes in the size and form of the beak have enabled different species to utilize different food resources such as insects, seeds, nectar from cactus flowers and blood from iguanas, all driven by Natural selection represents some of the finches observed by Darwin.

- Genetic variation in the ALX1 gene in the DNA of Darwin finches is associated with variation in the beak shape.
- Mild mutation in the ALX1 gene leads to phenotypic change in the shape of the beak of the Darwin finches.

26. Who disproved Lamarck's Theory of acquired characters? How?

The theory of inheritance of acquired character:

- Characters that are developed during the life time of an organism are called acquired characters and these are than inherited.
- Lamarck's "Theory of Acquired characters" was disproved by August Weismann who conducted experiments on mice for twenty generations by cutting their tails and breeding them.
- All mice born were with tail. Weismann proved his germplasm theory that change in the somatoplasm will not be transferred to the next generation but changes in the germplasm will be inherited.

27. How does mutation theory of De Vries differ from Lamarck and Darwin's view in the origin of new species?

- According to de Vries, sudden and large variations were responsible for the origin of new species whereas Lamarck and Darwin believed in gradual accumulation of all variations as the causative factors in the origin of new species.
- Hugo de Vries believed that Mutations are random and directionless, but Darwinian variations are small and directional.

28. Explain stabilizing, directional and disruptive selection with examples.

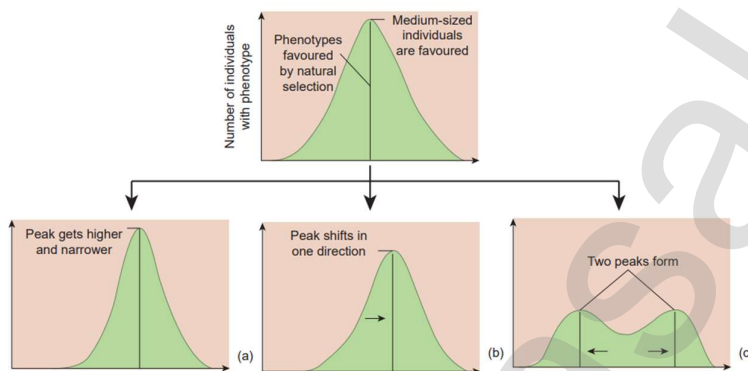


Fig 6.7 Operation of natural selection on different traits (a) Stabilising (b) Directional and (c) Disruptive

Stabilising selection (Centripetal selection):

Stable environment. The organisms with average phenotypes survive whereas the extreme individuals from both the ends are eliminated.

Directional selection:

Environment Undergoes gradual change is subjected to directional selection. This type of selection removes the individuals from one end towards the other end of phenotypic distribution.

Disruptive selection (Centrifugal selection):

Homogenous environment changes into heterogenous environment this type of selection is operational. The organisms of both the extreme phenotypes are selected whereas individuals average phenotype are eliminated

29. Rearrange the descent in human evolution.

Ramapithecus → *Australopithecus* → *Homo habilis* → *Homo erectus* → *Homo sapiens*.

30. How does Neanderthal man differ from the modern man in appearance?

Neanderthal man differ from the modern human in having semierect posture, flat cranium, sloping forehead, thin large orbits, heavy brow ridges, protruding jaw and no chin.

They used animal hides to protect their bodies, use of fire and buried their dead. They did not practice agriculture and animal domestication.

Other importance question and answer:

1. Darwin's finches and Australian marsupials are suitable examples of adaptive radiation- Justify this statement. (2019-2020)

The evolutionary process which produces new species diverged from a single ancestral form becomes adapted to newly invaded habitats is called adaptive radiation. Adaptive radiations are best exemplified in closely related groups that have evolved in relatively short time. Darwin's finches and Australian marsupials are best examples for adaptive radiation.

Darwin's finches:

- 1) Their common ancestor arrived on the Galapagos about 2 million years ago. During that time, Darwin's finches have evolved into 14 recognized species differing in body size, beak shape and feeding behaviour.
- 2) Changes in the size and form of the beak have enabled different species to utilize different food resources such as insects, seeds, nectar from cactus flowers and blood from iguanas, all driven by Natural selection represents some of the finches observed by Darwin.
- 3) Genetic variation in the ALX1 gene in the DNA of Darwin finches is associated with variation in the beak shape.
- 4) Mild mutation in the ALX1 gene leads to phenotypic change in the shape of the beak of the Darwin finches
- 5) Australian Marsupials:
- 6) Marsupials in Australia and placental mammals in North America are two subclasses of mammals they have adapted in similar way to a particular food resource, locomotory skill or climate.
- 7) They were separated from the common ancestor more than 100 millions year ago and each lineage continued to evolve independently.
- 8) Despite temporal and geographical separation, marsupials in Australia and placental mammals in North America have produced varieties of species living in similar habitats with similar ways of life.
- 9) Their overall resemblance in shape, locomotory mode, feeding and foraging are superimposed upon different modes of reproduction.
- 10) This feature reflects their distinctive evolutionary relationships.
- 11) The marsupials have undergone adaptive radiation to occupy the diverse habitats in Australia, just as the placental mammals have radiated across North America.

2. Explain the evolutionary path of man (2019-2020)

1. 210 million years ago mammals evolved.
2. Hominids evolution occurred in Asia and Africa.
3. 14 mya ago Dryopithecus 1) Ramapithecus 2) Sivapithecus.
5. 5mya ago- Australopithecus- Australian ape man.
6. 1.7 mya ago human in likes Homo erectus.
7. Homo ergaster and Homo erectus first leave to Africa.
8. 34,000-1,00,000 years ago Neanderthal human.
9. Cro-magnon ancestor of modern Europeans adapted various environmental condition cave paintings.
10. 25000 years ago Homo sapiens cultivating crops and domesticating animals

3. State the theory of chemical evolution. (PTA-2019-2020)

A third theory of life's origin is known as chemical evolution. In this idea, pre

biological changes slowly transform simple atoms and molecules into the more complex chemicals needed to produce life. This modern theory then suggests that life originated on Earth by means of a rather slow evolution of non-living matter.

4. What is the evolutionary significance of Archaeopteryx? (PTA 2019-2020)

Archaeopteryx is considered as the common ancestors of all birds. This organism existed about 150 million years ago and its fossils are the proof that Aves have originated from reptiles.

5. Differentiate relative dating from absolute dating. (PTA-2019-2020)

Relative dating	Absolute dating
Relative dating is used to determine a fossil by comparing it to similar rocks and fossils of known age.	Absolute dating is used to determine the precise age of a fossil by using radiometric dating to measure the decay of isotopes.

6. What is the role of connecting links in evolution? (PTA 2019-2020)

Connecting link provide the evidence for the path of evolution and lie midway between the two groups that is they have features of both the groups of organisms. These confirm evolution of amphibians from fishes, mammals from reptiles, arthropods and molluscs from the annelids.

7. Gene flow can be a strong agent of evolution Explain how? (PTA-2019-2020)

1) Movement of genes through gametes or movement of individuals in (immigration) and out (emigration) of a population is referred to as gene flow.

2) Organisms and gametes that enter the population may have new alleles or may bring in existing alleles but in different proportions than those already in the population. Gene flow can be a strong agent of evolution.

8. Explain the modern synthetic theory of natural selection. (PTA-2019-2020)

Sewell Wright, Fisher, Mayer, Huxley, Dobzhansky, Simpson and Haeckel explained Natural Selection in the light of Post- Darwinian discoveries.

According to this theory gene mutations, chromosomal mutations, genetic recombination's, natural selection and reproductive isolation are the five basic factors involved in the process of organic evolution.

Gene mutations:

Gene mutation refers to the changes in the structure of the gene. It is also called gene/ point mutation. It alters the phenotype of an organism and produces variations in their offspring.

Chromosomal mutation:

Chromosomal mutation refers to the changes in the structure of chromosomes due to deletion, addition, duplication, inversion or translocation. This too alters the phenotype of an organism and produces variations in their offspring.

Genetic recombination:

Genetic recombination is due to crossing over of genes during meiosis.

This brings about genetic variations in the individuals of the same species and leads to heritable variations.

Natural selection:

Natural selection does not produce any genetic variations but once such variations occur it favours some genetic changes while rejecting others (driving force of evolution).

Reproductive isolation:

Reproductive isolation helps in preventing interbreeding between related organisms.

9. Disproved Lamarcks theory of Acquired characters: (2021-2022)

a) August Weismann

b) August Weismann conducted experiments on mice for twenty generations by cutting their tails and breeding them. All mice born were with tail.

The somatoplasm will not be transferred to the next generation.

Creative questions and answers (2 and 3 marks):**1. When was earth formed? What was it's conditions at that time?**

1) An estimated age for earth was around 4.4-4.6 billion years.

2) The new born earth was inhospitable at first it was too hot. This is because the collisions of the planetesimals released much heat to melt the entire planet.

3) The outer surface of the earth cooled and solidified to form a crust. Water vapor released from the planet's interior cooled and condensed to form oceans.

4) Hence origin of life can be reconstructed, using indirect evidences.

2. Explain briefly about the theory of special creation.

The theory of special creation is the process of origin of life in which all the component of universe namely plants and animals are created by a supernatural power, referred as God.

3. What is Big bang theory?

It explains the origin of universe as a singular huge explosion in physical terms.

4. Define biogenesis.

Biogenesis is defined as a process, through which life arose from pre- existing life. Hendry Bastaian coined this word "biogenesis".

5. Explain the view of oparin- Haldane on the origin of life.

Oparin and Haldane independently proposed prebiotic soup with wide range of organic compounds formed with energy as lightening or UV light, leading to origin of life.

6. Define mutation theory of evolution.

Mutation theory is defined as process sudden and large variations due to mutation which is responsible for the origin of new species. This is proposed by Hugo De Vries.

7. State Hardy-Weinberg law.

The law states that if the population is in equilibrium state, the frequencies of alleles and genotypes or sets of alleles in a population will remain same over generations.

8. State Hardy- Weinberg principle.

The allele frequencies in a population are stable and are constant from generation to generation in the absence of gene flow, genetic drift, mutation, recombination and natural selection.

9. Mention the salient features of mutation theory.

1. Mutations or discontinuous variation are transmitted to other generation are transmitted to other generations.

2. In naturally breeding populations, mutations occur from time to time.

3. There are no intermediate forms, as they are fully fledged.

4. They are strictly subjected to natural selection.

10. State the theory of Germplasm.

Change in the somatoplasm will not be transferred to the next generation but changes in the germplasm will be inherited.

11. What is molecular evolution?

It is the process of change in the sequence and composition of molecules such as DNA, RNA and proteins across generations.

12. What are called protobionts?

1) Abiotically produced molecules can spontaneously self assemble into droplets.

2) These enclose a watery solution and maintain a chemical environment different from

their surroundings. These spheres are called as 'protobionts'.

13. Which is called golden age of reptiles? What are the three periods of it?

Mesozoic era is called the Golden age of reptiles, It is divided into three periods namely.

- i) Triassic-Origin of eggs laying mammals.
- ii) Jurassic- Dinosaurs, fossil bird Archaeopteryx.
- iii) Cretaceous-Extinction of toothed birds and dinosaurs, emergence of modern birds.

14. Explain briefly about Mesozoic era.

Mesozoic era is otherwise known as golden age of reptiles. This era is divided into three periods as follows:

- i) **Triassic:** Origin of egg laying mammals.
- ii) **Jurassic:** Dinosaurs were dominant and the fossil bird- Archaeopteryx was present on earth.
- iii) **Cretaceous:** Extinction of toothed birds and dinosaurs, emergence of modern birds occur.

15. Explain the principles of Lamarck's theory.

Lamarck's proposed two principles in his theory and they are:

i. The theory of use and disuse:

The organs increase in size, when they are used often and the organs, that are not used will degenerate.

Example:

Neck in giraffe is an example of constant use and the absence of limbs in snakes is the example of disuse theory.

ii. The theory of inheritance of acquired characters:

The characters developed by an organism during its life time are the acquired characters. Lamarck postulated that these acquired characters are then inherited to next generation.

16. List the three ways of struggle for existence denoted by Darwin.

1. Intraspecific struggle between individuals of the same species for food, space and mate.
2. Interspecific struggle between different species for food and space.
3. Struggle with the environment to cope with climatic variations like flood, earth quakes, Drought.

17. What is founder's effect?

Genetic drift can have major effects, when the population is reduced in size. When a small group of population splits from the main population to form a new colony. It is called founder's effect.

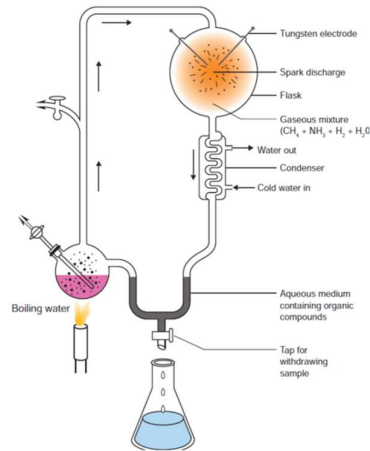
Five mark question and answer:

1. Give an account of theory of chemical evolution.

1. According to the theory of chemical evolution primitive organisms in the primordial environment of the earth evolved spontaneously from inorganic substances and physical forces such, as lightning, UV radiations, volcanic activities, etc.,
2. Oparin (1924) suggested the organic compounds could have undergone a series of reactions leading to more complex molecules.
3. He proposed that the molecules formed colloidal aggregates or 'coacervates' in an aqueous environment.
4. The coacervates were able to absorb and assimilate organic compounds from the environment.
5. Haldane (1929) proposed that the primordial sea served as a vast chemical laboratory powered by solar energy.
6. The atmosphere was oxygen free and the combination of CO_2 , NH_3 and UV radiations gave rise to organic compounds.

7. The sea then becomes a 'hot' dilute soup containing large populations of organic monomers and polymers.
8. They envisaged that groups of monomers and polymers acquired lipid membranes and further developed into the first living cell.
9. Haldane coined the term prebiotic soup and this became the powerful symbol of the Oparin- Haldane view of the origin of life (1924-1929).
10. Oparin and Haldane independently suggested that if the primitive atmosphere was reducing and if there was appropriate supply of energy such as lightning or UV light then a wide range of organic compounds can be synthesized.

2. Urey and Miller experiment.



1. Urey and Miller (1953), paved way for understanding the possible synthesis of organic compounds that led to the appearance of living organisms.
2. In their experiment, a mixture of gases was allowed to circulate over electric discharge from an tungsten electrode.
3. A small flask was kept boiling and the steam emanating from it was made to mix with the mixture of gases (ammonia, methane and hydrogen) in the large chamber that was connected to the boiling water.
4. The steam condensed to form water which ran down the 'U' tube. Experiment was conducted continuously for a week and the liquid was analyzed. Glycine, alanine, beta alanine and aspartic acid were identified.
5. Thus Miller's experiments had an insight as to the possibility of abiogenetic synthesis of large amount of variety of organic compounds in nature from a mixture of sample gases in which the only source of carbon was methane.
6. Later in similar experiments, formation of all types of amino acids and nitrogen bases were noticed.

Chapter: 7 Human Health and Diseases

Textbook question and answer:

1. A 30 year old woman has bloody diarrhoea for the past 14 hours, which one of the following organisms is likely to cause this illness? **Shigella dysenteriae**.
2. Exo- erythrocytic schizogony of plasmodium takes place in **Liver**.
3. The sporozoites of plasmodium vivax are formed from **Oocysts**.
4. Amphetamines are stimulants of the CNS, whereas barbiturates are **CNS depressants**.
5. Choose the correctly match pair.
 - a) **Amphetamines- Stimulant**
 - b) LSD- narcotic
 - c) Heroin- Psychotropic

- d) Benzodiazepine- Pain killer
6. The Athlete's foot disease in human is caused by **Fungi**.
7. Cirrhosis of liver is caused by chronic intake of **Alcohol**.
8. The sporozoite of the malarial parasite is present in **Saliva of infected female anopheles mosquito**.
9. Match the pathogens with respective diseases caused by them and select the correct match using the codes given below.

A. Leishmania donovani- Kala- azar

b. Wuchereria bancrofti- Filariasis

c. Trypanosoma gambiense- Sleeping sickness

d. Entamoeba histolytica- Amoebiasis

10. Paratope is an Antigen binding site in variable regions.

11. Allergy involves IgE.

12. Spread of cancerous cells to distant sites is termed as Metastasis.

13. AIDS virus has Single stranded RNA.

14. B cells that produce and release large amount of antibody are called Plasma cells.

15. Give below are some human organs. Identify one primary and one secondary lymphoid organ. Explain its role. Liver, thymus, stomach, thyroid, tonsils.

i) Primary lymphatic organ:

Thymus is a primary lymphoid organ.

Function:

i) One of its main secretions is the hormone thymosin.

ii) It stimulates the T cell to become mature and immunocompetent. By the early teens, the thymus begins to atrophy and is replaced by adipose tissue.

ii) Secondary lymphatic organ:

Tonsils is a secondary lymphoid organ.

Function:

i) The tonsils are part of the lymphatic system, which help to fight infections.

ii) They stop invading germs including bacteria and viruses.

16. Name and explain the type of barriers which involve macrophages.

i) The type of barriers that involve the macrophages is phagocytic barriers.

ii) They are specialized cells like monocytes, neutrophils and tissue macrophages.

iii) These cells phagocytose and digest whole microorganisms.

17. What are interferons? Mentions their role.

i) Interferons are proteins produced by animal's body in response to viral infection.

ii) They are named as such because they interfere with the proliferation of viruses.

iii) They play an important role in protecting the organism from viral infection and also bacterial and parasitic pathogens.

18. List out chemical alarm signals produced during inflammation.

i) Inflammatory barriers is a type of innate immunity.

ii) Tissues damage and infection induce leakage of vascular fluid, containing chemotactic signals like serotonin, histamine and prostaglandins.

iii) They influx the phagocytic cells into the affected area. This phenomenon is called diapedesis.

19. Explain the process of replication of retrovirus after it gains entry into the human body.

1. After getting into the body of the person, the virus enter into macrophages where RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase.

2. This viral DNA gets incorporated into the DNA of host cells and directs the infected cells

to produce viral particles.

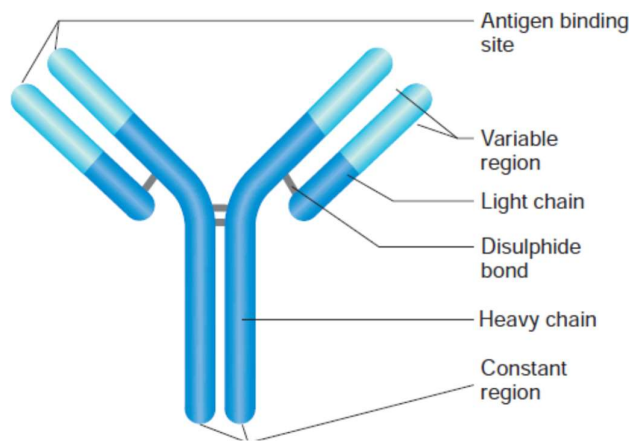
3. The macrophages continue to produce virus and in this way act like a HIV factory.

4. Simultaneously HIV enters into helper T-lymphocytes, replicates and produces progeny viruses. The progeny viruses released in the blood attack other helper T-lymphocytes.

5. This is repeated, leading to a progressive decrease in the number of helper T lymphocytes in the body of the infected person.

6. During this period, the person suffers from bouts of fever, diarrhea and weight loss. Due to decrease in the number of helper T lymphocytes, the person starts suffering from infections and becomes immune deficient and unable to protect against any infection.

20. Explain the structure of immunoglobulin with suitable diagram. (2021-2022)



1. In the 1950, experiments by **Porter and Edelman** revealed the basic structure of the immunoglobulin.
2. An antibody molecule is **Y** shaped structure that comprises of four polypeptide chains, two identical light chain (**L**) of molecular weight 25,000 Da (approximately 214 amino acids) and two identical heavy chains (**H**) of molecular weight 50,000 Da (approximately 450 amino acids).
3. The polypeptide chains are linked together by di-sulphide (s-s) bonds.
4. One light chain is attached to each heavy chain and two heavy chains are attached to each other to form a Y shaped structure.
5. The heavy chains have a flexible hinge region at their approximate middles.
6. Each chain (L and H) has two terminals. They are C- terminal and N- terminal.
7. Each chain has two regions they have variable (v) region at one end and a much larger constant (c) region at the other end.
8. Antibodies responding to different antigens have very different (V) regions but their (C) regions are the same in all antibodies.
9. In each arm of the monomer antibody the (V) regions of the heavy and light chains combine to form an antigen binding site shaped to fit a specific antigenic determinant.
10. Consequently, each antibody monomer has two such antigen- binding regions.
11. The (C) regions that form the stem of the antibody monomer determine the antibody class and serve common functions in all antibodies.

21. What are the cells involved in innate immune system?

Natural killer cells, mast cells, Eosinophils, basophils and the phagocytic cells include macrophages, neutrophils, dendritic cells and function within the immune system by identifying and eliminating pathogens that might cause infection.

22. What is vaccine? What are its types?

A Vaccine is a biological preparation that provides active acquired immunity to a particular disease and resembles a disease- causing microorganism and is often made from weakened or attenuated or killed forms of the microbes, their toxins, or one of its

surface proteins.

Vaccines teach our body how to defend itself when viruses or bacteria, invade it.

Vaccines deliver only very little amounts of inactivated or weakened viruses or bacteria or parts of them. This allows the immune system to recognize the organism without actually experiencing the disease

First generation vaccine:

First generation vaccine is further subdivided into live attenuated vaccine, killed vaccine and toxoids.

Example: MMR vaccine, Salk's polio vaccine, DPT vaccine.

Second generation vaccine:

Second generation vaccine contains the pure surface antigen of the pathogen.

Example: Hepatitis-B

Third generation vaccine:

Third generation vaccine contains the purest and the highest potency vaccines which are synthetic generation.

Example: DNA vaccine or recombinant vaccine.

25. List the causative agent, mode of transmission and symptoms for Diphtheria and Typhoid.

Diseases	Causative agent	Transmission	Symptoms
Diphtheria	<i>Corynebacterium diphtheria</i>	Droplet infection	Fever, sore throat, hoarseness and difficulty in breathing.
Typhoid (Enteric fever)	<i>Salmonella typhi</i>	Through contaminated food and water	Headache, abdominal discomfort, fever and diarrhea.

26. A patient was hospitalized with fever and chills. Merozoites were observed in her blood. What is your diagnosis?

Occurrence of Merozoites in the blood indicates that the person is suffering from malaria, shivering, chills are the other symptoms of the disease.

27. i) Write the scientific name of the filarial worm that causes filariasis.

Scientific name of Filarial Worm that causes filariasis is "Wuchereria bancrofti"

ii) Write the symptoms of fillariasis.

The accumulation of the worms in lymph glands block the lymphatic system resulting in inflammation of the lymph nodes. In some cases, the obstruction of lymph vessels causes elephantiasis or filariasis of the limbs, scrotum and mammary glands.

iii) How is this disease transmitted?

The disease is transmitted by female culex mosquito, when the mosquito bites an infected person and then bites a healthy person

28. List the common withdrawal symptoms of drugs and alcohol abuse.

Mild tremors to convulsions, severe agitation and fits, depressed mood, anxiety, nervousness, restlessness, irritability, insomnia, dryness of throat etc. depending on the type of drug abuse.

29. Why do you think it is not possible to produce vaccine against common cold?

It is difficult to make, a vaccine to prevent the common cold primarily because there are more than 200 different varieties of viruses that can cause colds.

Other important question and answers:**1. Explain the role of immunity in prevention of cancer. (PTA 2019- 2020)**

Immunotherapy appears to be important in getting rid of the residual malignant cells after the gross tumour has been removed.

The best result in the treatment of cancer is to follow an integrated approach to therapy combining, surgery, radiotherapy, chemotherapy and immunotherapy.

2. Suggest methods of maintenance of personal and public hygiene. (PTA-2019-2020)

1. Hygiene is a set of practices performed to conserve good health. According to the World Health Organization (WHO), hygiene refers to conditions and practices that help to maintain health and prevent the spread of diseases.

2. Personal hygiene refers to maintaining one's body clean by bathing, washing hands, trimming fingernails, wearing clean clothes and also includes attention to keeping surfaces in the home and workplace, including toilets, bathroom facilities, clean and pathogen-free.

3. AIDS is not a disease but it facilitates the attack by other organisms. Explain why? (PTA 2019- 2020)

AIDS is caused by Human Immuno Deficiency Virus (HIV) it selectively infects helper T cells. The infected helper T cells will not stimulate antibody production by B cell resulting in loss of natural defence against viral infection.

4. A 10 year old child is suffering from chicken pox. Is this infection good or bad? Give reason for your answer. (PTA-2019-2020)

Most commonly, children get chickenpox before the age of 10 years. The immune system makes proteins called antibodies during the infection. These fight the virus and then provide lifelong protection against it (immunity). Therefore, it is uncommon to have more than one bout of chickenpox in your lifetime.

5. Why is typhoid called as enteric fever? (PTA-2019-2020)

Typhoid is an infection caused by a bacteria called as salmonella typhi. It leads to fever and is also known as Enteric fever. Typhoid spreads through contamination of food and water and ingesting these contaminated foods.

6. Define metastasis. (PTA- 2019-2020)

A tumour or neoplasm is a group of cells whose growth has gone unchecked. When a tumour continues to grow and invades healthy tissue it is called cancer. They spread to other parts of the body from the tumour and give rise to secondary tumour. This is known as metastasis.

7. Mention the four types malaria and their causative agents (PTA- 2019- 2020)

Sl. No	Types of Malaria	Causative agent	Duration of Erythrocytic cycle
1	Tertian, benign tertian or vivax malaria	<i>P. vivax</i>	48 hours
2	Quartan malaria	<i>P. malariae</i>	72 hours
3	Mild tertian malaria	<i>P. ovale</i>	48 hours
4	Malignant tertian or quotidian malaria	<i>P. falciparum</i>	36 – 48 hours

8. How does a chemical mediator act as physiological barriers? (2019-2020)

1. Lysozyme acts as antibacterial agent and cleaves the bacterial cell wall. Interferons induce antiviral state in the uninfected cells.

2. Complementary substances produced from leucocytes lyse the pathogenic microbes or facilitate phagocytosis.

9. Imagine, if atrophy of thymus occurs in a child, what would be the serious consequences the child would face? Explain briefly. (2019-2020)

1. The hormone thymosin is not secreted.
2. T cells do not become mature and immunocompetent.

10. What are the two most prevalent helminthic diseases in human beings? Explain them. (2019-2020)

Helminthes are mostly endoparasitic in the gut and blood of human beings and cause diseases called helminthiasis. The two most prevalent helminthic diseases are Ascariasis and Filariasis.

Ascariasis:

1. Ascaris is a monogenic parasite and exhibits sexual dimorphism.
2. Ascariasis is a disease caused by the intestinal endoparasite *Ascaris lumbricoides* commonly called the round worms.
3. It is transmitted through ingestion of embryonated eggs through contaminated food and water.
4. Children playing in contaminated soils are also prone to have a chance of transfer of eggs from hand to mouth.

Symptoms:

Abdominal pain, vomiting, headache, anaemia, irritability and diarrhoea. A heavy infection can cause nutritional deficiency and severe abdominal pain and causes stunted growth in children. It may also cause enteritis, hepatitis and bronchitis.

Filariasis:

1. Filariasis is caused by *Wuchereria bancrofti*, commonly called filarial worm.
2. It is found in the lymph vessels and lymph nodes of man.
3. *Wuchereria bancrofti* is sexually dimorphic, viviparous and digenic.
4. The life cycle is completed in two hosts, man and the female culex mosquito the female filarial worm gives rise to juveniles called microfilariae larva. In the lymph glands the juveniles develop into adults.

Symptoms:

The worms block the lymphatic system resulting in inflammation of the lymph nodes. In some cases, the obstruction of lymph vessels causes elephantiasis or filariasis of the limbs, scrotum and mammary glands.

11. Name the hormone secreted by thymus gland and mention two functions of that hormone.

Hormone: Thymosin.

Function:

- i) Stimulates the T cell to become mature.
- ii) Mature and immune component.
- iii) Most active during the neonatal and pre-adolescent periods.

12. Write any two differences between active and passive immunity. (2019-2020)

Sl.No	Active Immunity	Passive Immunity
1	Active immunity is produced actively by host's immune system.	Passive immunity is received passively and there is no active host participation.
2	It is produced due to contact with pathogen or by its antigen.	It is produced due to antibodies obtained from outside.
3	It is durable and effective in protection.	It is transient and less effective.
4	Immunological memory is present.	No memory.
5	Booster effect on subsequent dose is possible.	Subsequent dose is less effective.
6	Immunity is effective only after a short period.	Immunity develops immediately.

13. Compare and contrast bacillary dysentery and amoebic dysentery. (2019-2020)

S.No		Bacillary Dysentery	Amoebic Dysentery
1	Causative agent	<i>Shigella species</i> (Bacteria)	<i>Entamoeba histolytica</i> (Protozoan)
2	Site of infection	Intestine	Intestine (colon) and secretes histolytic enzymes causing ulceration.
3	Mode of transmission	Food and water contaminated by faeces/ faecal oral route	Faecal oral route (food and water contaminated with faeces).
4	Symptoms	Abdominal pain, dehydration, blood and mucus in the stools. Frequency of stools is less and not frequent as in amoebiasis.	Bleeding abdominal pain and stools with excess mucus. Foul smelling stools symptoms can range from diarrhea to dysentery.

14. Discuss the various types of innate immunity and their functioning mechanisms. (PTA-2019-2020) and 2021-2022

Type of innate immunity	Mechanism
1. Anatomical barriers	
Skin	Prevents the entry of microbes. Its acidic environment (pH 3-5) retards the growth of microbes.
Mucus membrane	Mucus entraps foreign microorganisms and competes with microbes for attachment.
2. Physiological barriers	
Temperature	Normal body temperature inhibits the growth of pathogens. Fever also inhibits the growth of pathogens.
Low pH	Acidity of gastric secretions (HCl) kills most ingested microbes.
Chemical mediators	Lysozyme acts as antibacterial agent and cleaves the bacterial cell wall. Interferons induce antiviral state in the uninfected cells. Complementary substances produced from leucocytes lyse the pathogenic microbes or facilitate phagocytosis.
3. Phagocytic barriers	Specialized cells (Monocytes, neutrophils, tissue macrophages) phagocytose, and digest whole microorganisms.
4. Inflammatory barriers	Tissue damage and infection induce leakage of vascular fluid, containing chemotactic signals like serotonin, histamine and prostaglandins. They influx the phagocytic cells into the affected area. This phenomenon is called diapedesis.

15. How does the trophozoite of Amoebiasis reach the final destination in our body? (2021-2022)

Trophozoite penetrates the walls of the host intestine (Colon) and secretes histolytic enzyme causing ulceration, bleeding, abdominal pain and stools with excess mucus.

16. Is vaccine available against malaria? Give reason for your answer. (2021-2022)

Yes. Malaria vaccine is used to prevent malaria.

The only approved vaccine as of 2015 is RTS,S

17. Symptoms of Filariasis. (2021-2022)

1. Inflammation of the lymph nodes.
2. The obstruction of lymph vessels.
3. Inflammation in limbs, scrotum and mammary glands.

18. Antibiotic Resistance Develop: 2021-2022

1. Misuse of antibiotics.
2. Over use of antibiotics.
3. Poor infection prevention control.

19. Explain any five bacterial disease. (2021-2022)

S.No	Diseases	Causative agent	Site of infection	Mode of transmission	Symptoms
1	Shigellosis (Bacillary dysentery)	<i>Shigella sp.</i>	Intestine	Food and water contaminated by faeces/ faecal oral route	Abdominal pain, dehydration, blood and mucus in the stools.
2	Bubonic plague (Black death)	<i>Yersinia pestis</i>	Lymph nodes	Rat flea vector <i>Xenopsylla cheopis</i>	Fever, headache, and swollen lymph nodes.
3	Diphtheria	<i>Corynebacterium</i>	Larynx, skin, nasal and genital passage	Droplet infection	Fever, sore throat, hoarseness and difficulty in breathing
4	Cholera	<i>Vibrio cholera</i>	Intestine	contaminated food and water/ faecal oral route	Severe diarrhea and dehydration
5	Tetanus (Lock jaw)	<i>Clostridium tetani</i>	Spasm of muscles	Through wound infection	Rigidity of jaw muscle, increase heart beat rate and spasm of the muscles of the jaw and face
6	Typhoid (Enteric fever)	<i>Salmonella typhi</i>	Intestine	Through contaminated food and water	Headache abdominal discomfort, fever and diarrhea.
7	Pneumonia	<i>Streptococcus pneumonia</i>	Lungs	Droplet infection	Fever, cough, painful breathing and brown sputum
8	Tuberculosis	<i>Tuberculosis</i>	lungs	Droplet infection	Thick mucopurulent nasal discharge

2 and 3 marks creative questions and answers:

1. What is the primary function of the thymus?

The thymus produces progenitor cells, which mature into T-cells (Thymus- derived cells). The body uses T-cells help destroy infected or cancerous cells. T-cells created by the thymus also help other organs in the immune system grow properly.

2. What is anaphylaxis?

Anaphylaxis is the classical immediate hypersensitivity reaction. It is a sudden, systematic, severe and immediate hypersensitivity reaction occurring as a result of rapid generalized mast-cell degranulation.

3. What does the term antibiotic refer to?

Antibiotics are medicines that treat infections by killing bacteria. They don't work on viruses, like the flu. B-lymphocytes produce an army of proteins called antibodies to fight with them. Thus, they are secreted in response to an antigen (Ag) by the effects of B cells called plasma cells.

4. Write any three unique features of specific immunity.

The unique features of specific immunity are antigenic specificity, diversity, recognition of self and non-self and immunological memory.

5. What are the main functions of free antibodies?

- i) Agglutination.
- ii) Precipitation.
- iii) Opsonisation.
- iv) Neutralization

6. Name the secondary lymphoid organs.

1. Lymph nodes.
2. Appendix.
3. Peyer's patches of gastrointestinal tract.
4. Tonsils.
5. Adenoids.
6. Spleen.
7. Mucosa Associated Lymphoid Tissue-MALT
8. Gut Associated Lymphoid Tissue-GALT
9. Bronchial Tracheal Associated Lymphoid Tissue-BALT

7. Distinguish between paratope and epitope

Paratope	Epitope
A paratope is the antigen binding site and is a part of an antibody which recognizes and binds to an antigen	Epitope is an antigenic determinate and is the active part of an antigen.

8. What are haptens?

Haptens are substances that are non-immunogenic but can react with the products of a specific immune response.

9. What is phagocytosis?

Phagocytosis is the process by which a cell uses its plasma membrane to engulf a large particle, giving rise to an internal compartment called the phagosome. It is one type of endocytosis. In a multicellular organism immune system, phagocytosis is major mechanism used to remove pathogen and cell debris.

10. What is signet ring stage?

1. Inside the RBC the merozoite of plasmodium develops in to unicellular trophozoites.
2. It grows in size and a central vacuole develops pushing nucleus to one side of cytoplasm. It is called signet ring stage.

11. What is immunity?

The overall ability of body to fight against the disease causing pathogen.

12. What is immunology?

It is the study of immune system. It refers to all the mechanism used by the body for protection from environmental agents that are foreign to the body.

13. What is called antigen?

Any substance capable of eliciting immune response is called antigen. (ANTIBody GENERator)

14. Distinguish infectious and non-infectious diseases.

S.No	Infection	Non infections
1	They are transmitted from one person to another.	They are not transmitted from an infected person to a healthy person.
2	They are transmitted through air, water, food, physical contact and vectors by virus, bacteria, fungi, protozoan parasites, helminthic parasites.	In origin they may be genetic, nutritional and degenerative.
3	Most of the bacterial diseases are curable but all viral diseases are not Example: AIDS may be fatal.	They are not curable. Example: Cancer.

15. Bacteria have developed resistance to antibiotics justify. How can it be avoided?**Bacterial resistance:**

If an antibiotic is used too often to light a specific bacterial infection, the bacteria may become resistant to the specific antibiotic. The specific antibiotic can no longer be used. Therefore, infections are difficult to be cured.

Prevention:

1. Avoid using antibiotics to treat minor infections that can be taken care by our immune system.
2. Do not use an antibiotic to treat viral infections such as common cold or flu.
3. Always follow the prescription. Skipping doses or failing to complete the prescription may allow antibiotic resistance to develop.

16. Mention the symptoms of malaria.

Early symptoms: Headache, nausea and muscular pain.

Classic symptoms:

1. By release of haemozoin toxin and erythrocyte debris resulting in –Shivering chills, high fever sweating.
2. Fever and chills are caused by malarial toxins that induce macrophages to release tumour necrosis factor (TNF- α) and interleukin.

17. Write the preventive methods of malaria.

1. Oil can be sprayed over the water surface, to prevent mosquito larvae and pupae to breathe.
2. Ponds, drainage and ditches can be stocked with fishes such as Gambusia.
3. Bacillus thuringiensis can be sprayed to kill the mosquito larvae can be sprayed to kill the mosquito larvae.
4. People are advised to use mosquito nets, wire gauging of windows and doors.

18. List the fungi causing dermatomycosis?

1. Trichophyton
2. Microsporum
3. Epidermophyton

19. Write short notes on ring worm.

It is a fungal disease in humans.

Symptoms:

1. Appearance of dry, scaly lesions on the skin nails and scalp.
2. Heat and moisture help these fungi to grow in the groin or between the toes.

Athlete's foot:

1. Ringworm of the feet is caused by *Tinea pedis*.
2. They are acquired from soil or by using clothes, towels and comb used by infected persons.

20. What is Diapedesis?

1. Tissue damage and infection induce leakage of vascular fluid, containing chemo tactic signals like serotonin, histamine and prostaglandins.
2. They influx the phagocytic cells into the affected are. This phenomenon is called diapedesis.

21. What are the unique features of acquired immunity?

Antigenic specificity, diversity, recognition of self and non-self and immunological memory.

22. Mention the two components of acquired immunity.

1. Cell mediated immunity (CMI).
2. Antibody Mediated Immunity or Humoral immunity.

23. What is active immunity?

1. The immunological resistance developed by the organisms through the production of antibodies in their body is called active immunity.
2. Active immunity is acquire through the use of a person's immune responses, which lead to the development of memory cells Active immunity results from an infection or an immunization.

24. What is passive immunity?

1. Passive immunity does not require the body to produce antibodies to antigens.
2. The antibodies are introduced from outside into the organism.
3. Thus passive immunity is acquired without the activation of a person's immune response, and therefore there is no memory.

25. What are two types of acquired immunity?

1. Active immunity
2. Passive immunity

26. Primary immune response is the first step of immunity against pathogens-justify.

1. The primary immune response occurs when a pathogen comes in contact with the immune system for the first time.
2. During this the immune system has to learn to recognize the antigen, produce antibody against it and eventually produce memory lymphocytes.
3. The primary immune response slow and short lived.

27. Why secondary immune response is called booster response?

1. The secondary immune response occurs when a person is exposed to the same antigen again.
2. During this time, immunological memory has been established and the immune system can start producing antibodies immediately.
3. Within hours after recognition of the antigen, a new army of plasma cells are generated.
4. Within 2 to 3 days the antibody concentration in the blood rises steeply to reach much higher level than primary response. This is also called as booster response.

28. How do you maintain personal hygiene?

Maintaining one's body clean by bathing, washing hands, trimming fingernails, wearing clean clothes and also includes attention to keeping surfaces in the home and workplace, toilets, bathroom facilities, clean and pathogen-free.

29. What are lymphoid organs? Classify them with examples.

The organs involved in the origin, maturation and proliferation of lymphocytes are called

lymphoid organs. Based on their functions they are classified into primary or central lymphoid organs and secondary or peripheral lymphoid organs.

Primary lymphoid organs:

Primary lymphoid organs provide appropriate environment for lymphocytic maturation.

Secondary lymphoid organs:

The secondary lymphoid organs trap antigens and make it available for mature lymphocytes, which can effectively fight against these antigens.

30. What is the reason for the visible swelling of lymph nodes?

1. Sometimes visible swelling of lymph nodes occurs due to active immune response and increase concentration of lymphocytes.
2. It indicates the signal of an infection.
3. The most frequently enlarged lymph nodes are found in the neck, under the chin, in the armpits and in the groin.

31. What is MALT?

1. The Mucosa Associated Lymphoid Tissue (MALT) is a diffuse system of small concentrations of lymphoid tissue in the alimentary, respiratory and urogenital tracts.
2. MALT is populated by lymphocytes such as T and B cells, as well as plasma cells and macrophages, each of which is well situated to encounter antigens passing through the mucosal epithelium.
3. It also possesses IgA antibodies.

32. What is GALT?

Gut Associated Lymphoid Tissue (GALT) is a component of the mucosa associated lymphoid tissue (MALT) which works in the immune system to protect the body from invasion in the gut.

33. What is BALT?

Bronchus Associated Lymphoid Tissues (BALT) also a component of MALT is made of lymphoid tissue (tonsils, lymph nodes, lymph follicles) is found in the respiratory mucosae from the nasal cavities to the lungs.

34. Why are dendritic cells called so? List their types.

1. Dendritic cells are called so because its covered with long thin membrane extensions that resemble dendrites of nerve cells.
2. These cells present the antigen to T-helper cells.
3. Four types of dendritic cells are known. They are langerhans , interstitial cells, myeloid and lymphoid cells.

35. Differentiate antigens on the basis of origin.

Exogenous antigens:

The antigens which enter the host from the outside.

Example: Microorganisms, pollens.

Endogenous antigens:

The antigens which are formed with in the individual.

Example: Blood group antigens.

36. What are the functional differences between B and T cells?

S.No	B-lymphocytes	T-lymphocytes
1	They form humoral or antibody mediated immune system (AMIS)	They form cell mediated immune system (CMIS).
2	They defend against viruses and bacteria that enter the blood and lymph.	They defend against pathogens including protists and fungi that enter the cells.
3	They form plasma cells and memory cells by the division.	They form killer, helper and suppressor cells by the division of lymphoblasts.

37. Discuss the three stages of the reaction between antigen and antibody.**First stage:**

The reaction involves the formation of antigen antibody complex.

Section stage:

It leads to visible events like precipitation, agglutination ect.,

Final stage:

The final stage includes destruction of antigen or its neutralization.

38. Define the terms allergy and allergens.**Allergy:**

1. Some of the individuals are very sensitive to some particles present in the environment.
2. The exaggerated response of the immune system to certain antigens present in the environment is called allergy. (allo-altered, erg-reaction)

Allergens:

1. The substances to which such an immune response is produced are called allergens. An allergen is an antigen that causes an allergic reaction.
2. Allergic reactions begin within few seconds after the contact with the allergen and last about half an hour.

39. What is precipitin reaction?

1. The reaction between soluble antigen and antibody leads to visible precipitate formation, which is called precipitin reaction.
2. Antibodies that bring about precipitate formation on reacting with antigens are called as precipitins.

40. What is agglutination reaction?

1. A particulate antigen interacts with its antibody it would result in clumping or agglutination of the particulate antigen, which is called agglutination reaction.
2. The antibody involved in bringing about agglutination reaction is called agglutinin.

41. What is opsonisation or enhanced attachment?

1. Opsonisation or enhanced attachment is the process by which a pathogen is marked of ingestion and destruction by a phagocyte.
2. Opsonisation involves the binding of an opsonin antibody to a receptor on the pathogen's cell membrane.
3. After opsonin binds to the membrane, phagocytes are attracted to the pathogen. So, opsonisation is a process in which pathogens are coated with a substance called an opsonin marking the pathogen out for destruction by the immune system. This result in a much more efficient phagocytosis.

42. What is neutralization?

1. The neutralization reactions are the reactions of antigen-antibody that involve the elimination of harmful effects of bacterial exotoxins or a virus by specific antibodies.
2. These neutralizing substances antibodies are known as antitoxins.
3. This specific antibody is produced by a host cell in response to a bacterial exotoxin or corresponding toxoid (inactivated toxin).

43. What is vaccination?

Vaccination is the process of administering a vaccine into the body or the act of introducing a vaccine into the body to produce immunity to a specific disease.

44. What is Immunization?

1. Immunization is the process of the body building up immunity to a particular disease.
2. Immunization describes the actual changes in the body after receiving a vaccine.
3. Vaccines work by fighting the pathogen and then recoding it in their memory system to ensure that the next time this pathogen enters the body, it is eliminated far quickly.
4. Once the body is able to fight against the disease, it is believed to have built the immunity for it also known as the body being immunized against the disease.

45. Write the symptoms of hypersensitivity?

1. Allergic reactions include sneezing, watery eyes, running nose and difficulty in breathing.
2. Allergy is a form of over active immune response mediated by IgE and mast cells.
3. It can also be due to the release of chemical like histamine and serotonin from the mast cells.

46. What is called drug abuse?

The intake of certain drugs for a purpose other than their normal clinical use in an amount and frequency that impair one's physical, physiological and psychological functions is called drug abuse.

47. Name the drugs obtained from hemp plant *cannabis sativa*. Mention their effects on human body.

1. Natural cannabinoids are the main source of marijuana, ganja, hashish and charas.
2. It interferes in the transport of the neurotransmitter, dopamine and has a potent stimulating action on the CNS, producing increased energy and a sense of euphoria.

48. Name some drugs which are commonly abused.

1. Opioids.
2. Cannabinoids.
3. Coca-alkaloids.
4. Barbiturates.
5. Amphetamines.
6. LSD

49. Mention the effects of morphine and Heroin on the human body.

1. Heroin is obtained by acetylation of morphine, which is extracted from flowers of the poppy plant.
2. Morphine is one of the strongest pain killers and is used during surgery. It is the most widely abused narcotic drug which acts as a depressant and slows down body function.

50. Name the drug obtained from the leaves of coca plant. Mention their effects on human body.

1. Cocaine is a white powder that is obtained from the leaves of the coca plant, *Erythroxylum coca*.
2. Cocaine causes serious physical and psychological problems including hallucinations and paranoia.

51. Mention the drugs that are medically useful, but are often abused.

Drugs like methamphetamine, amphetamines, barbiturates, tranquilizers, Lysergic acid diethylamide (LSD) are normally used as medicine to treat patients with mental illness like depression and insomnia and are often abused.

52. Explain why using tobacco in any form is injurious to health.

1. Tobacco is smoked, chewed and used as snuff. It increases the carbon monoxide content of blood and reduces the concentration of hemoglobin bound oxygen, thus causing oxygen deficiency in the body.
2. Tobacco contains nicotine, Carbon monoxide and tars, which cause problems in the

heart, lung and nervous system.

3. Adrenal glands are stimulated by nicotine to release adrenaline and nor adrenaline which increases blood pressure and heart beat.

53. How do repeated uses of drugs affect the addicted person?

1. Repeated use of drugs and alcohol may affect the tolerance level of the receptors present in the body.
2. These receptors then respond only to highest doses of drugs and alcohol leading to greater intake and addiction.
3. Excessive use of drug and alcohol leads to physical and psychological dependence. When psychological dependence develops the drug user gets mentally hooked on to the drug.
4. The drug user constantly thinks only about the drug and has continuous uncontrollable craving for it. This state called "euphoria" is characterized by mental and emotional preoccupation with the drug.

54. State some short term-effects of drugs and alcohol.

Euphoria, pain, dullness of sense, alteration in behavior, blood pressure, narcosis(deep sleep), nausea and vomiting.

55. Mention the long-term of alcohol.

1. Alcohol interferes with the ability of the liver to break down fat. Over time fat accumulation and high levels of alcohol destroy the liver cells and a scar tissue grows in the place of dead cells. This scarring of the liver is called "Liver cirrhosis".
2. Alcohol irritates the stomach lining due to the production of excess acid leading to ulcers.
3. Excessive alcohol use weakens the heart muscle, causing scar tissue to build up in the cardiac muscle fibers. As a result heavy drinkers have an increased risk of high blood pressure, stroke, coronary artery disease and heart attack.
4. Korsakoff syndrome a chronic memory disorder is most commonly caused by alcohol misuses.

56. Mention the symptoms of mental depression.

1. Loss of self confidence and self esteem.
2. Anxiety
3. Not being able to enjoy things that are usually pleasurable or interesting.

57. Write the ways that can help to be relieved from depression.

1. Lifestyle changes like exercise, meditation, yoga and healthy food habits can help to be relieved from depression.
2. Exercise stimulates the body to produce serotonin and endorphins, which are neurotransmitters that suppress depression. Practicing exercise in daily life creates a positive attitude.
3. Participating in an exercise programme can:
 - Increase self-esteem.
 - Boost self-confidence.
 - Create a sense of empowerment.
 - Enhance social connections and relationships

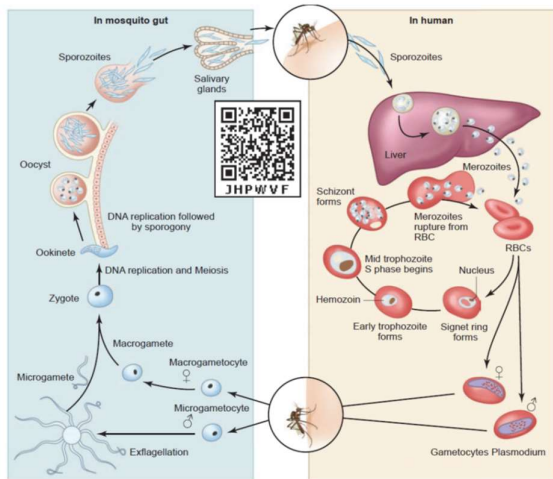
58. Where do the following events in the life cycle of plasmodium takes place?

- a) Fertilization- **Gut of mosquito**
- b) Development of gametocytes- **Human RBC's**
- c) Release of sporozoites- **From Mosquito to the human blood**
- d) Schizogony- **Human liver cells**

5 marks creative questions and answers:

1. Explain the events in life cycle of plasmodium in the secondary host/Man.

1. *Plasmodium vivax* is a digenic parasite, involving two hosts, man as the secondary host and female *anopheles* mosquito as the primary host.



2. The life cycle of plasmodium involves three phases namely schizogony, gamogony and sporogony.

3. The parasite first enters the human blood stream through the bite of an infected female anopheles mosquito. As it feeds, the mosquito injects the saliva containing the sporozoites.

4. The sporozoite within the blood stream immediately enters the hepatic cells of the liver. Further in the liver they undergo multiple asexual fission (schizogony) and produce merozoites.

5. After being released from liver cells, the merozoites penetrate the RBC's. Inside the RBC, the merozoite begins to develop as unicellular trophozoites.

6. The trophozoite grows in size and a central vacuole develops pushing them to one side of cytoplasm and becomes the signet ring stage.

7. The trophozoite nucleus then divides asexually to produce the schizont. The large schizont shows yellowish-brown pigmented granules called schuffner's granules.

8. The schizont divides and produces mononucleated merozoites. Eventually the erythrocyte lyses, releasing the merozoites and haemozoin toxin into the blood stream to infect other erythrocytes. Lysis of red blood cells results in cycles of fever and other symptoms.

9. This erythrocytic stage is cyclic and repeats itself approximately every 48 to 72 hours or longer depending on the species of plasmodium involved.

10. The sudden release of merozoites triggers an attack on the RBCs. Occasionally, merozoites differentiate into macrogametocytes and microgametocytes.

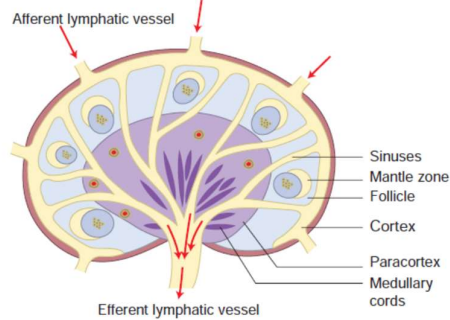
11. When these are ingested by a mosquito, they develop into male and female gametes respectively.

12. In the mosquito's gut, the infected erythrocytes lyse and male and female gametes fertilize to form a diploid zygote called ookinete.

13. The ookinete migrates to the mosquito's gut wall and develops into an oocyte. The oocyte undergoes meiosis by a process called sporogony to form sporozoites. These sporozoites migrate to the salivary glands of the mosquito.

14. The cycle is now completed and when the mosquito bites another human host, the sporozoites are injected and the cycle begins anew.

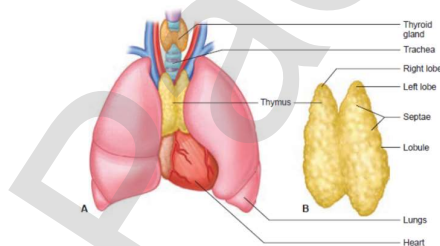
2. Explain the structure of peripheral lymphoid organ lymph node with suitable diagram.



1. Lymph node is a small bean shaped structure and is part of the body's immune system. It is the first one to encounter the antigen that enters the tissue spaces.
2. Lymph nodes filter and trap substances that travel through the lymphatic fluid. They are packed tightly with white blood cells, namely lymphocytes and macrophages.
3. There are hundreds of lymph nodes found throughout the body. They are connected to one another by lymph vessels.
4. Lymph is a clear, transparent, colorless, mobile and extracellular fluid connective tissue. As the lymph percolates through the lymph node, the particulate antigen brought in by the lymph will be trapped by the phagocytic cells, follicular and interdigitating dendritic cells.
5. Lymph node has three zones they are the cortex, paracortex and medulla. The outer most layer of the lymph node is called cortex, which consists of B-lymphocytes, macrophages. And follicular dendritic cells.
6. The paracortex zone is beneath the cortex, which is richly populated by T lymphocytes and interdigitating dendritic cell.
7. The inner most zone is called the medulla which is sparsely populated by lymphocytes, but many of them are plasma cells, which actively secrete antibody molecules.
8. As the lymph enters, it slowly percolates through the cortex, paracortex and medulla, giving sufficient chance for the phagocytic cells and dendritic cells to trap the antigen brought y the lymph.
9. The lymph leaving a node carries enriched antibodies secreted by the medullary plasma cells against the antigens that enter the lymph node.
10. Sometimes visible swelling of lymph nodes occurs due to active immune response and increase concentration of lymphocytes.
11. Thus swollen lymph nodes may signal an infection. There are several groups of lymph nodes. The most frequently enlarged lymph nodes are found in the neck, under the chin, in the armpits and in the groin.

3. Explain the structure of primary lymphoid organ thymus and Bone marrow with suitable diagram.

Thymus:



1. The thymus is a flat and bilobed organ located behind the sternum, above the heart.
2. Each lobe of the thymus contains numerous lobules, separated from each other by connective tissue called septa.
3. Each lobule is differentiated into two compartments, the outer compartment or outer

cortex, is densely packed with immature T cells called thymocytes, whereas the inner compartment or medulla is sparsely populated with mature thymocytes.

4. One of its main secretions is the hormone thymosin. It stimulates the T cell to become mature and immune competent.

5. By the early teens, the thymus begins to atrophy and is replaced by adipose tissue thus, thymus is most active during the neonatal and pre-adolescent periods.

Bone marrow:

1. Bone marrow is a lymphoid tissue found within the spongy portion of the bone.

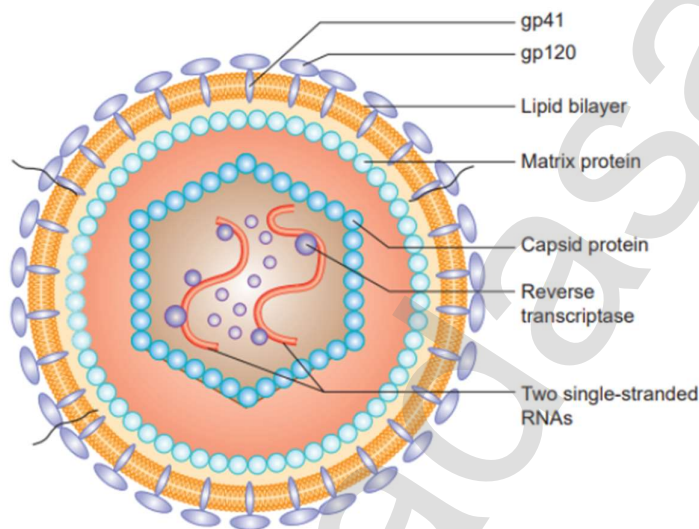
2. Bone marrow contains stem cells known as hematopoietic cells.

3. These cells have the potential to multiply through cell division and either remain as stem cells or differentiate and mature into different kinds of blood cells.

4. List out the classification of drugs.

Group	Drugs	Effects
Stimulants	Amphetamines, cocaine, nicotine and tobacco	Accelerates the activity of the brain
Depressants	Alcohol, barbiturates, tranquilizers	Slow down the activity of the brain
Narcotic/ Analgesics	Opium, morphine	Act as depressants on the Central Nervous System.
Hallucinogens	Lysergic acid diethylamide (LSD), phenylclidine	Distorts the way one sees, hears and feels
Stimulants, Depressants, Hallucinogens	Bhang (Marijuana), Ganja, Charas	Stimulating action on the CNS and affects the cardiovascular system

5. Describe the structure of HIV.



The human immunodeficiency virus belongs to the genus Lentivirus. When observed under the electron microscope, HIV is seen as a spherical virus, 100-120 nm in diameter, containing a dense core surrounded by a lipoprotein envelope. The envelope has glycoprotein (gp) spikes termed gp 41 and gp 120. At the core, there are two large single stranded RNA. Attached to the RNA are molecules of reverse transcriptase. It also contains enzymes like protease and ribonuclease. The core is covered by a capsid made of proteins. This is followed by another layer of matrix protein

6. List any five viral diseases, their causative agents ,site of infection, mode of transmission and symptoms

S.No	Diseases	Causative agent	Site of infection	Mode of transmission	Symptoms
1	Common cold	<i>Rhino viruses</i>	Respiratory tract	Droplet infection	Nasal congestion and discharge, sore throat, cough and headache
2	Mumps	<i>Mumps virus (RNA virus), Paramyxo virus</i>	Salivary glands	Saliva and droplet infection	Enlargement of the parotids glands
3	Measles	<i>Rubella virus (RNA virus), paramyxo virus</i>	Skin and respiratory tract	Droplet infection	Sore throat, running nose, cough and fever, reddish rashes on the skin, neck and ears.
4	Viral hepatitis	<i>Hepatitis-B virus</i>	Liver	Parenteral route, blood transfusion	Liver damage, jaundice, nausea, yellowish eyes, fever and pain in the abdomen
5	Chicken pox	<i>Varicella zoster virus (DNA virus)</i>	Respiratory track, skin and nervous system	Droplet infection and direct contact	Mild fever with itchy skin, rash and blisters
6	Poliomyelitis	<i>Polio virus (RNA virus)</i>	Intestine, brain, spinal cord	Droplet infection through faecal oral route	Fever, muscular stiffness and weakness, paralysis and respiratory failure
7	Dengue fever (Break bone fever)	<i>Dengue virus or flavi virus (DENV1-4 virus)</i>	Skin and blood	Mosquito vector <i>Aedes aegypti</i>	Severe flu like illness with a sudden onset of fever and painful headache, muscle and joint pain

Chapter: 8 Microbes in Human Welfare

Textbook questions and answers:

- Which of the following microorganism is used for production of citric acid industries
Aspergillus niger.
- Which of the following pair is correctly matched for the product produced by them?
a) Asetobacter aceti- Antibiotics
b) Methanobacterium-Lactic acid
c) Penicilium notatum- Acetic acid
d) **Saccharomyces cerevisiae- Ethanol**

3. The most common substrate used in distilleries for the production of ethanol is **Molasses**.
4. Cyclosporin- A is an immunosuppressive drug produced from **Trichoderma polysporum**.
5. CO₂ is not released during **Lactate fermentation**.
6. The purpose of biological treatment of waste water is to **Reduce BOD**.
7. The gases produced in anaerobic sludge digesters are **Methane, hydrogen sulphide and CO₂**.

8. How is milk converted into curd? Explain the process of curd formation.

A small amount of curd added to fresh milk as a starter or inoculum contains millions of lactobacilli, which under suitable temperature $\leq 40^{\circ}\text{C}$ multiply and convert milk into curd.

9. Give any two bioactive molecules produced by microbes and state their uses.

1. **Lipases** are used in detergent formulations and are used for removing oily stains from the laundry.
2. **Rennet** can also be used to separate milk into solid curds for cheese making.
3. Bottled juices are clarified by the use of **pectinase, protease and cellulose**.
4. **Streptococcus** and genetically engineered **streptococci** are used as “**Clot buster**” for removing clots from the blood vessels of patients who have undergone myocardial infarction.
5. **Cyclosporin A** an immunosuppressant used in organ transplantation is produced from the fungus.
6. **Statins** produced by the yeast *monascus purpureus* have been used to lower blood cholesterol levels. It acts by competitively inhibiting the enzyme responsible for the synthesis of cholesterol.

10. Define the following terms.

a) Antibiotics:

1. Selman Waksman discovered streptomycin and was the first to use the term “Antibiotic” in 1943.
2. Antibiotics are chemical substances produced by microorganism which can kill or retard the growth of other disease causing microbes even in low concentration. Antibiotic means “against life”.
3. Antibiotics are used to treat diseases such as plague, meningitis, syphilis, leprosy, tuberculosis etc.,

b) Zymology:

The zymology is an applied science which deals with the biochemical process of fermentation and its practical uses.

c) Superbug:

“Superbug” is a term used to describe strains of bacteria that are resistant to the majority of antibiotics commonly used today.

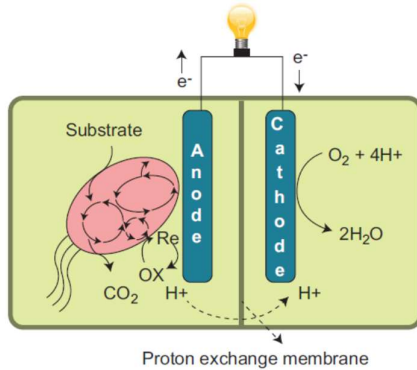
11. Write short notes on the following.

a) Brewer’s yeast:

1. *Saccharomyces cerevisiae* commonly called brewer’s yeast is used for fermenting malted cereals and fruit juices to produce various alcoholic beverages.
2. Wine and beer are produced without distillation, whereas whisky, brandy and rum are obtained by fermentation and distillation.

b) *Ideonella sakaiensis*:

1. *Ideonella sakaiensis* is currently tried for recycling of PET plastics.
2. These bacteria use PTEase and MHETase enzymes to breakdown PET plastic into terephthalic acid and ethylene glycol.

c) Microbial fuel cells: (2021-2022)

1. A microbial fuel cell is a bio-electrochemical system that drives an electric current by using bacteria and mimicking bacterial interaction found in nature.
2. Microbial fuel cells work by allowing bacteria to oxidize and reduce organic molecules.
3. Bacterial respiration is basically one big redox reaction in which electrons are being moved around.
4. A MFC consists of an anode and a cathode separated by a proton exchange membrane.
5. Microbes at the anode oxidize the organic fuel generating protons which pass through the membrane to the cathode and the electrons pass through the anode to the cathode and the electrons pass through the anode to the external circuit to generate current.

12. List the advantages of biogas plants in rural areas.

1. The slurry is drained through another outlet and is used as fertilizer. Biogas is used for cooking and lighting.

The technology of biogas production was developed in India mainly due to the efforts of Indian Agricultural Research Institute (IARI) and khadi and village industries commission. (KVIC).

13. When does antibiotic resistance develop?

1. Antibiotic resistance occurs when bacteria develop the ability to defeat the drug designed to kill or inhibit their growth. It is one of the most acute threats to public health.
2. Antibiotic resistance is accelerated by the misuse and over use of antibiotics, as well as poor infection prevention control.
3. Antibiotics should be used only when prescribed by a certified health professional.
4. When the bacteria become resistant, antibiotics cannot fight against them and the bacteria multiply.
5. Narrow spectrum antibiotics are preferred over broad spectrum antibiotics. They effectively and accurately target specific pathogenic organisms and are less likely to cause resistance.
6. "Superbug" is a term used to describe strains of bacteria that are resistant to the majority of antibiotics commonly used today.

14. What is referred to as industrial alcohol? Briefly describe its preparation.

1. Saccharomyces cerevisiae is the major producer of ethanol (C₂H₅OH). It is used for industrial, laboratory and fuel purposes. So ethanol is referred to as industrial alcohol.
2. Bacteria such as Zymomonas mobilis and Sarcina ventriculi are also involved in ethanol production.

3. The principal substrates for the commercial production of industrial alcohol include molasses or corn, potatoes and wood wastes.
4. The process of ethanol production starts by milling a feed stock followed by the addition of dilute or fungal amylase (enzyme) from *Aspergillus* to break down the starch into fermentable sugars.
5. Yeast is then added to convert the sugars to ethanol which is then distilled off to obtain ethanol which is upto 96% in concentration.
6. The two most common type of biofuels in use today are ethanol and biodiesel, both of them represent the first generation of biofuel technology.
7. Ethanol is often used as a fuel, mainly as a biofuel additive for gasoline.

15. What is bioremediation?

1. The use of naturally occurring or genetically engineered microorganisms to reduce or degrade pollutants is called bioremediation.
2. Bioremediation is less expensive and more sustainable than other remediation's available.
3. It is grouped into in situ bioremediation (treatment of contaminated soil or water in the site) and ex situ bioremediation (treatment of contaminated soil or water that is removed from the site and treated).

Other important questions and answers:

16. Which is referred to as industrial alcohol? Why? (2019-2020)

1. Ethanol is referred to as industrial alcohol.
2. It is used for industrial, laboratory and fuel purposes.

18. Why do we call some strains of bacteria super bug? (PTA-2019-2020)

They effectively and accurately target specific pathogenic organisms and are less likely to cause resistance. "Superbug" is a term used to describe strains of bacteria that are resistant to the majority of antibiotics commonly used today.

19. PET plastics are no more environmental hazarder's substances. Why? (PTA 2019-2020)

Because *Ideonella sakaiensis* is currently tried for recycling of PET plastics. These bacteria use PETase and MHETase enzymes to breakdown PET plastic into terephthalic acid and ethylene glycol.

20. What is Zymology? 2021-2022

Zymology is an applied science which deals with the biochemical process of fermentation and its practical uses.

2 and 3 marks Creative questions and answers:

21. What is penicillin?

1. Penicillin is produced by the fungi *penicillium notatum* and *penicillium chrysogenum*.
2. It is bactericidal (antibiotics that kill bacteria) in action and inhibits the synthesis of the bacterial cell wall.
3. Penicillin is also referred as the "Queen of drugs".

22. What is antibiosis?

The antibiosis is the property of antibiotics to kill microorganisms.

23. Define tetracycline.

Tetracycline is a broad spectrum bacteriostatic antibiotic (antibiotics that limit the growth of bacteria) that inhibits microbial protein synthesis.

24. Define streptomycin.

1. Streptomycin is a broad spectrum antibiotic isolated from the actinomycetes, *streptomyces griseus*.
2. It is bactericidal against both gram positive and gram negative bacteria, especially against *mycobacterium tuberculosis*.

25. Name some antibiotics isolated as microbial products.

1. Erythromycin.
2. Chloromycetin.
3. Griseofulvin.
4. Neomycin.
5. Kenamycin.
6. Bacitracin.

26. Why were Chain and Florey awarded Nobel Prize?

1. The first antibiotic (penicillin) discovered by Alexander Fleming in 1926.
2. Penicillin is also referred as the "queen of drugs" and its full potential as an effective antibiotic was established much later by Earnest Chain and Howard Florey when they treated the wounded soldiers in World War II with penicillin.
3. Fleming, chain and Florey were awarded the nobel prize in 1945 for the discovery of penicillin.

27. Give example of two antibiotics and their mode of action.

1. Penicillin is a bactericidal (antibiotics that kill bacteria) in action and inhibits the synthesis of the bacterial cell wall.
2. Tetracycline is a broad spectrum bacteriostatic antibiotic (antibiotics that limit the growth of bacteria) that inhibits microbial protein synthesis.

28. What is Oenology?

Oenology is the science and study of wine and wine making. Wine is made from the fermentation of grape juice.

29. Name the substrates used for production of industrial alcohol.

The principal substrates for the commercial production of industrial alcohol include molasses or corn, potatoes and wood wastes.

30. How is wine made? What are the two types of wine?

1. Wine is made from the fermentation of grape juice. Grape juice is fermented by various strains of *saccharomyces cerevisiae* into alcohol.
2. Grape wine is of two types, red wine and white wine.

Red wine:

Black grapes are used including skins and sometimes the stems also are used.

White wine:

White wine is produced only from the juice of either white or red grapes without their skin and stems.

31. What is toddy? How is vinegar produced?

1. When pathaneer is left undisturbed for few hours it gets fermented to form toddy with the help of naturally occurring yeast, to form a beverage that contains 4% alcohol.
2. After 24 hours toddy becomes unpalatable and is used for the production of vinegar.

32. How are palm trees used for obtaining alcoholic beverages?

Pathaneer a traditional drink is got from fermenting sap of palm and coconut trees. When pathaneer is left undisturbed for few hours it gets fermented to form toddy with the help of naturally occurring yeast, to form a beverage that contains 4% alcohol

33. Write the scientific name of the microbes used for fermenting the following and mention their products.

S.No	Microbes	Plant	Product
1	<i>Saccharomyces carlsbergensis</i> or <i>Saccharomyces cerevisiae</i> .	Barley Malt grain	Beer
2	<i>Saccharomyces cerevisiae</i>	Fermented sugarcane or molasses or directly from sugarcane juice.	Rum
3	<i>Saccharomyces cerevisiae</i>	Fermented grain mash	Whisky

33. Write the equation for

fermentation of glucose.



34. Give four examples of acids produced from microbes.

1. *Aspergillus niger* for citric acid.
2. *Acetobacter aceti* for acetic acid.
3. *Rhizopus oryzae* for fumaric acid.
4. *Clostridium butyricum* for butyric acid.
5. *Lactobacillus* for lactic acid.

35. What is GEM? Give an example.

1. *Pseudomonas putida* is a genetically engineered microorganism (GEM). Ananda Mohan Chakrabarty obtained patent for this recombinant bacterial strain.
2. It is multi plasmid hydrocarbon degrading bacterium which can digest the hydrocarbons in the oil spills.

36. Mention the commercial enzymes and their importance.

1. Lipases are used in detergent formulations and are used for removing oily stains from the laundry.
2. Bottled juices are clarified by the use of pectinase, protease and cellulose.
3. Rennet can also be used to separate milk into solid curds for cheese making.

37. Name the enzyme produced by streptococcus bacterium. Explain its importance in medical sciences.

Streptokinase produced by the bacterium streptococcus and genetically engineered streptococci are used as clot buster for removing clots from the blood vessels of patients who have undergone myocardial infarction.

38. Explain Bio remediation by aerobic microbes with examples.

1. Aerobic microbes degrade the pollutants in the presence of oxygen. They mainly degrade pesticides and hydrocarbons.
2. *Pseudomonas putida* is a genetically engineered microorganism (GEM). Ananda Mohan Chakrabarty obtained patent for this recombinant bacterial strain.
3. It is multi plasmid hydrocarbon degrading bacterium which can digest the hydrocarbons in the oil spills.
4. *Nitrosomonas europaea* is also capable of degrading benzene and a variety of halogenated organic compounds including trichloroethylene and vinyl chloride.

5. Ideonella sakaiensis is currently tried for recycling of PET plastics. These bacteria use PETase and MHETase enzymes to breakdown PET plastic into terephthalic acid and ethylene glycol.

39. Explain Bio remediation by anaerobic microbes with examples.

1. Anaerobic microbes degrade the pollutants in the absence of oxygen.

Dechloromonas aromatica has the ability to degrade benzene anaerobically and to oxidize toluene and xylene.

2. Phanerochaete chrysosporium an anaerobic fungus exhibits strong potential for bioremediation of pesticides, polyaromatic hydrocarbons, dyes, trinitrotoluene, cyanides, carbon tetrachloride etc.,

3. Dehalococcoides species of are responsible for anaerobic bioremediation of toxic trichloroethene to non-toxic ethane.

4. Pestalotiopsis microspora is a species of endophytic fungus capable of breaking down and digesting polyurethane. This makes the fungus a potential candidate for bioremediation projects involving large quantities of plastics.

40. Explain how microorganisms involved in bioremediation?

Aerobic microbes:

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4. Pestalotiopsis microspora is a species of endophytic fungus capable of breaking down and digesting polyurethane. This makes the fungus a potential candidate for bioremediation projects involving large quantities of plastics.

41. Define fermentation. Explain any

three fermented beverages.

Saccharomyces cerevisiae commonly called brewer's yeast is used for fermenting malted cereal and fruit juices to produce various alcoholic beverages. Wine and beer are produced without distillation, whereas whisky, brandy and rum are obtained by fermentation and distillation.

Beer:

Beer is produced from germinated barley malt grain by saccharomyces carlsbergensis or saccharomyces cerevisiae.

Rum:

Rum is made from fermented sugarcane or molasses or directly from sugarcane juice by *saccharomyces cerevisiae*.

Whisky:

Whisky is a type of distilled alcoholic beverage made from fermented grain mash by *saccharomyces cerevisiae*.

Wine:

Grape juice is fermented by various strains of *saccharomyces cerevisiae* into alcohol. Grape wine is of two types, red wine and white wine.

Red wine:

Black grapes are used including skins and sometimes the stems also are used.

White wine:

White wine is produced only from the juice of either white or red grapes without their skin and stems.

Chapter: 9 Applications of Biotechnology

Textbook questions and answers:

1. The first clinical gene therapy was done for the treatment of **SCID**.
2. Dolly the sheep was obtained by a technique known as **Cloning by nuclear transfer**.
3. The genetic defect adenosine deaminase deficiency may be cured permanently by **Introducing bone marrow cells producing ADA into embryo at an early stage of development**.
4. Chain A has 21 and chain B has 30 amino acids are arranged in the two chains of insulin.
5. PCR proceeds in three distinct steps governed by temperature, they are in order of Denaturation, Annealing and Synthesis.
6. Which one of the following statements is true regarding DNA polymerase used in PCR?
 - a) It is used to ligate introduced DNA in recipient cells.
 - b) It serves as a selectable marker.
 - c) It is isolated from a virus.
 - d) It remains active at a high temperature.**
7. ELISA is mainly used for **Detection of pathogens**.
8. Transgenic animals are those which have **Foreign DNA in all their cells**.
9. Vaccines that use components of a pathogenic organism rather than the whole organism are called **subunit recombinant vaccines**.
- 10. Mention the number of primers required in each cycle of PCR. Write the role of primers and DNA polymerase in PCR. Name the source organism of the DNA polymerase used in PCR.**
Two sets of primers and the enzyme DNA polymerase are required in each cycle of polymerase chain reaction.
Role of primers and DNS polymerase:
 1. Primers are necessary to start the functioning of DNA polymerase.
 2. DNA polymerase extends the primers using the nucleotides provided in the reaction and the genomic DNA as the template.
 3. The segment of DNA can be amplified to approximately billion times.**Source organism of the DNA polymerase used in PCR:**
DNA polymerase used in PCR reaction is known as Taq polymerase, which is obtained from a bacterium *Thermus aquaticus*. It remains active during the high-temperature induced denaturation of double stranded DNA.

11. How is the amplification of a gene sample of interest carried out using PCR? (2019-2020)

1. The polymerase chain reaction (PCR) is an invitro amplification technique used for synthesising multiple identical copies (billions) of DNA of interest. The technique was developed by Kary Mullis (Nobel laureate, 1993) in the year 1983.
2. Denaturation, maturation or primer annealing and synthesis or primer extension, are the three steps involved in PCR.
3. The double stranded DNA of interests denatured to separate into two individual strands by high temperature. This is called denaturation.
4. Each strand is allowed to hybridize with a primer (renaturation or primer annealing). The primer template is used to synthesize DNA by using Taq-DNA polymerase.
5. During denaturation the reaction mixture is heated to 95°C for a short time to denature the target DNA into single strands that will act as a template for DNA synthesis.
6. Annealing is done by rapid cooling of the mixture, allowing the primers to bind to the sequences on each of the two strands flanking the target DNA.
7. During primer extension or synthesis the temperature of the mixture is increased to 75°C for a sufficient period of time to allow taq DNA polymerase to extend each primer by copying the single stranded template.
8. At the end of incubation both single template strands will be made partially double stranded.
9. The new strand of each double stranded DNA extends to a variable distance downstream. These steps are repeated again and again to generate multiple forms of the desired DNA. This process is also called DNA amplification.
10. The PCR technique can also be used for amplifications of RNA in which case it is referred to as reverse transcription PCR.
11. In this process the RNA molecules (mRNA) must be converted to complementary DNA by the enzyme reverse transcriptase. The cDNA then serves as the template for PCR.

12. What is genetically engineered Insulin?

1. Production of insulin by recombinant DNA technology started in the late 1970s.
2. This technique involved the insertion of human insulin gene on the plasmids of E.coli.
3. Insulin produced by recombination DNA technology to treat diabetic patients is called genetic engineered insulin. It is otherwise known as humulin.

13. Explain how “Rosie” is different from a normal cow?

1. Rosie is the first transgenic cow produced human protein enriched milk.
2. Which contained the human alpha lactalbumin.
3. The protein rich milk (2.4 gm/litre) was a nutritionally balanced food for new born babies than the normal milk produced by the cows.

14. How was Insulin obtained before the advent of rDNA technology? What were the problems encountered?

1. In the early years insulin isolated and purified from the pancreas of pigs and cows was used to treat diabetic patients.
2. Due to minor differences in the structure of the animal insulin as compare to human insulin it resulted in the occurrence of allergic reactions in some diabetic patients.

15. ELISA is a technique based on the principles of antigen antibody reactions. Can this technique be used in the molecular diagnosis of a genetic disorder such as Phenylketonuria?

1. Yes one can use antibody against the enzyme (that is responsible for the metabolism of phenylalanine) to develop ELISA based diagnostic technique.

2. The patient in which the enzyme protein is absent would give negative result in ELISA when compared to the normal individual.

16. Gene therapy is an attempt to correct a genetic defect by providing a normal gene into the individual. By this the function can be restored. An alternate method would be to provide gene product known as enzyme replacement therapy, which would also restore the function. Which in your opinion is a better option? Give reasons for your answer.

1. Gene therapy is the best option to correct a genetic defect. Because the disease could be cured permanently if the gene for that defect is introduced to the affected person.

2. In case of enzyme replacement therapy it will only be a temporary solution and involves injection of the enzyme to the patient which has to be done periodically.

17. What is transgenic animals? Give reasons for your answer.

1. Transgenesis is the process of introduction of extra DNA into the genome of the animals to create and maintain stable heritable characters.

2. The foreign DNA that is introduced is called the transgene and the animals that are produced by DNA manipulations are called transgenic animals or the genetically engineered or genetically modified organisms.

18. If a person thinks he is infected with HIV due to unprotected sex and goes for a blood test. Do you think a test such as ELISA will help? If so why? If not, why?

1. ELISA is a biochemical procedure to detect the presence of specific antibodies or antigens in a sample of serum, urine, etc.,

2. It is a very important diagnostic tool to determine if a person is HIV positive or negative.

3. ELISA is a tool for determining serum antibody concentrations (such as the antibodies produced in a person infected by pathogens such as HIV).

4. ELISA is highly sensitive and can detect antigens in the range of a nanogram.

5. ELISA will help to detect the presence of HIV antigens in the blood to show if the person is infected with HIV or not since it is only based on determination of antigens or antibodies in the sample being tested serum, urine etc.,

19. Explain how ADA deficiency can be corrected?

1. ADA deficiency could be cured by bone marrow transplantation, where defective immune cells could be replaced with healthy immune cells from a donor.

2. In some patients it can be treated by enzyme replacement therapy, in which functional ADA is injected into the patient.

3. During gene therapy the lymphocyte from the blood of the patient are removed and grown in a nutrient culture medium.

4. A healthy and functional human gene, ADA cDNA encoding this enzyme is introduced into the lymphocytes using a retrovirus.

5. The genetically engineered lymphocytes are subsequently returned to the patient. Since these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes.

6. The disease could be cured permanently if the gene for ADA isolated from bone marrow cells are introduced into the cells of the early embryonic stages.

20. What are DNA vaccines?

1. A DNA vaccine consists of a gene encoding an antigenic protein, inserted onto a plasmid, and then incorporated into the cells in target animal.

2. DNA instructs the cells to make antigenic molecules which are displayed on its surfaces.

3. The DNA vaccine cannot cause the disease as it contains only copies of a few of its genes. DNA vaccines are relatively easy and inexpensive to design and produce.

21. Differentiate between somatic cell gene therapy and germline gene therapy.

S.No	Somatic cell gene therapy	Germ line gene therapy
1	Therapeutic genes transferred into the somatic cells.	Therapeutic genes transferred into the germ cells.
2	Introduction of genes into bone marrow cells, blood cells, skin cells etc.,	Genes introduced into eggs and sperms.
3	Will not be inherited in later generations.	Heritable and passed on to later generation.

22. What are stem cells? Explain its role in the field of medicine.

1. Stem cells are undifferentiated cells found in most of the multi cellular animals. These cells maintain their undifferentiated state even after undergoing numerous mitotic divisions.
2. Most of the adult stem cells are multipotent and can act as a repair system of the body, replenishing adult tissues.
3. The red bone marrow is a rich source of adult stem cells.
4. The most important and potential application of human stem cells is the generation of cells and tissues that could be used for cell based therapies. Human stem cells could be used to test new drug.

23. One of the applications of biotechnology is “gene therapy” to treat a person born with a hereditary disease.

i) What does “gene therapy” mean?

1. The transfer of a normal gene into a person’s cells that carries one or more mutant alleles.
2. Expression of normal gene in the person results in a functional gene product whose action produces a normal phenotype.

ii) Name the hereditary disease for which the first clinical gene therapy was used.

The first clinical gene therapy was given in 1990 by French Anderson to a four year old girl with adenosine deaminase (ADA) deficiency.

iii) Mention the steps involved in gene therapy to treat this disease.

1. Gene therapy the lymphocytes from the blood of the patient are removed and grown in a nutrient culture medium.
2. A healthy and functional human gene, ADA cDNA encoding this enzyme is introduced into the lymphocytes using a retrovirus.
3. The genetically engineered lymphocytes are subsequently returned to the patient. Since these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes.
4. The disease could be cured permanently if the gene for ADA isolated from bone marrow cells are introduced into the cells of the early embryonic stages.

24. PCR is a useful tool for early diagnosis of an infectious disease. Elaborate. (PTA-2019-2020)

1. The specificity and sensitivity of PCR is useful for the diagnosis of inherited disorders (genetic diseases), viral diseases, bacterial diseases, etc.,
2. The diagnosis and treatment of a particular disease often requires identifying a particular pathogen.
3. DNA has unique sequences that can be detected by PCR, often using the clinical

specimen (for example, blood, stool, spinal fluid, or sputum) in the PCR mixture.

4. PCR is also employed in the prenatal diagnosis of inherited diseases by using chorionic villi samples or cells from amniocentesis.

5. cDNA from PCR is a valuable tools for diagnosis and monitoring retroviral infections.

Examples: Tuberculosis by Mycobacterium tuberculosis.

6. Sex of human beings and live stocks, embryos fertilized invitro can be determined by PCR by using primers and DNA probes specific for sex chromosomes.

7. PCR technique is also used to detect sex-linked disorders in fertilized embryos.

25. What are recombinant vaccines? Explain the types.

1. The recombinant vaccines are generally of uniform quality and produce less side effects as compared to the vaccines produced by conventional methods.

2. Different types of recombinant vaccines include subunit recombinant vaccines, attenuated recombinant vaccines and DNA vaccines.

Subunit recombinant vaccines:

1. Vaccines that use components of a pathogenic organism rather than the whole organism are called Subunit vaccines.

2. It includes components like proteins, peptides and DNAs of pathogenic organisms.

Attenuated recombinant vaccines:

1. This includes genetically modified pathogenic organisms (bacteria or viruses) that are made non-pathogenic and are used as vaccines.

2. It is now possible to genetically engineer the organisms (bacteria or viruses) and use them as live vaccines and such vaccines are referred to as attenuated recombinant vaccines.

DNA vaccines:

1. A DNA vaccine consists of a gene encoding an antigenic protein, inserted into a plasmid, and then incorporated into the cells in a target animal.

2. DNA instructs the cells to make antigenic molecules which are displayed on its surfaces.

3. The DNA vaccine cannot cause the disease as it contains only copies of a few of its gene. DNA vaccines are relatively easy and inexpensive to design and produce.

26. Explain why cloning of Dolly the sheep was such a major scientific breakthrough?

Dolly was the first animal to be clone from a differentiated somatic cell taken from an adult animal without the process of fertilization. This study offers a benefit of clinical trials and medical researchers. It is a breakthrough in receiving endangered species through this technique.

27. Mention how recombinant insulin can be produced.

- Offers benefits for clinical trials and medical research. It can help in the production of proteins and drugs in the field of medicine.

- Aids stem cell research.

- Animal cloning could help to save endangered species.

- Animal and human activists see it as a threat to biodiversity saying that this alters evolution which will have an impact on populations and the ecosystem.

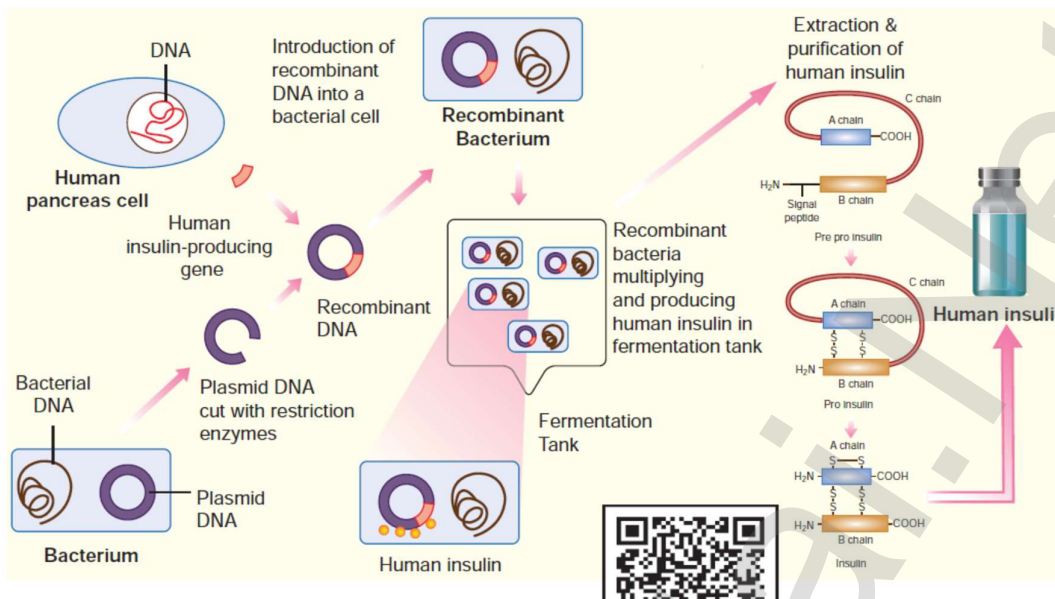
- The process is tedious and very expensive.

- It can cause animals to suffer.

- Reports show that animal surrogates were manifesting adverse outcomes and cloned animals were affected with disease and have high mortality rate.

- It might compromise human health through consumption of cloned animal meat.
- Cloned animals age faster than normal animals and are less healthy than the parent organism as discovered in Dolly.
- Cloning can lead to occurrence of genetic disorders in animals.
- More than 90% of cloning attempts fail to produce a viable offspring.

28. Explain how recombinant Insulin can be produced.



1. The production of insulin by recombinant DNA technology started in the late 1970s.
2. This technique involved the insertion of human insulin gene on the plasmids of E.coli.
3. The polypeptide chains are synthesized as a precursor called pre-pro insulin, which contains A and B segments linked by a third chain (C) and preceded by a leader sequence.
4. The leader sequence is removed after translation and the C chain is excised, leaving the A and B polypeptide chains.
5. The approval to use recombinant insulin for diabetes mellitus was given in 1982. In 1986 human insulin was marketed under the trade name Humulin.

Other important questions and answers:

1. What is the most important application of human stem cells? (2019-2020)

1. Generation of cells and tissues used for cell based therapies.
2. Could be used to test new drugs.

2. Stem cell therapy will increase the longevity of human life. Explain it logically. (PTA-2019-2020)

Stem cells regenerate many adult tissues and contribute to the development of cancer by accumulating mutations age-related changes in stem cells likely contribute to age-related morbidity. However, mechanisms that influence longevity also modulate age related morbidity, partly through effects on stem cells.

3. A diabetic patient wants to have a single time treatment and permanent care for diabetes possible? If so explain. (PTA-2019-2020)

1. Production of insulin by recombinant DNA technology started in the late 1970s. This technique involved the insertion of human insulin gene on the plasmids of E.coli.
2. Insulin was the first ever pharmaceutical product of recombinant DNA technology administered to humans.

3. The approval to use recombinant insulin for diabetes mellitus was given in 1982. In 1986 human insulin was marketed under the trade name Humulin.

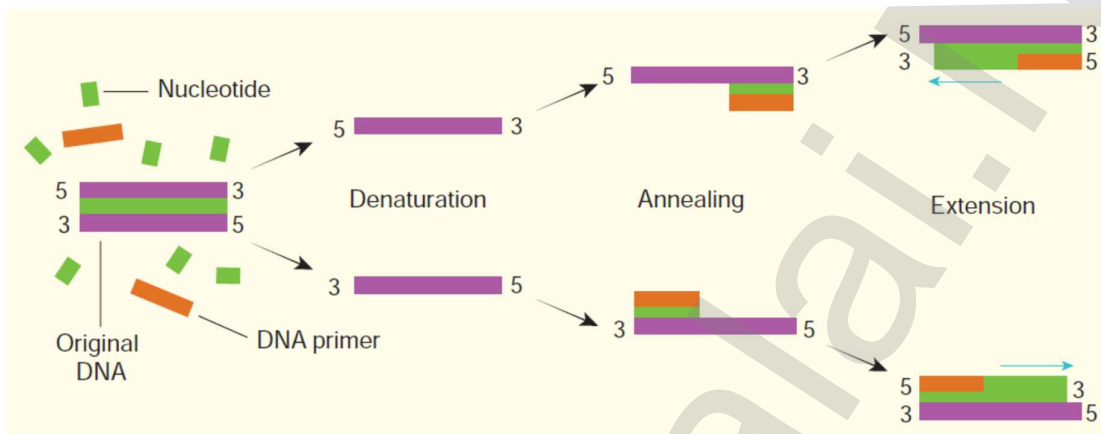
4. Differentiate oligopotency from unipotency? (PTA-2019-2020)

Oligopotency	Unipotency
Oligopotency refers to stem cells that can differentiate into few cell types. Example: Lymphoid or myeloid stem cells can differentiate into B and T cells but not RBC.	Unipotency refers to the ability of the stem cells to differentiate into only one cell type.

5. How can we utilize PCR technique in the field of forensic medicine?(PTA-2019-2020)

PCR can be used as a tool in genetic fingerprinting. This technology can identify any one person from millions of others.

6. Explain the process of PCR technique. 2021-2022



1. Denaturing:

When the double stranded template DNA is heated to separate it into two single strands.

2. Annealing:

When the temperature is lowered to enable the DNA primers to attach to the template DNA.

3. Extension:

Polymerisation of nucleotide chain by the enzyme. Taq polymerase using the nucleotides provided in the medium

7. Write the differences between multipotency and oligopotency. (2021-2022)

Multipotency	oligopotency
It refers to the stem cells that can differentiate into various types of cells that are related.	It refers to stem cells that can differentiate into few cell types.
Example: Blood stem cells can differentiate into lymphocytes, monocytes, neutrophils etc.	Example: Lymphoid or myeloid stem cells can differentiate into B and T cells but not RBC

8. Gene therapy: (2021-2022)

The process involves the transfer of a normal gene into a persons cells that carries one or more mutant alleles. Or Genetic defect could be corrected by a process call gene therapy.

2 and 3 marks creative questions:

6. What us genetic engineering?

1. Genetic engineering involves the manipulation of DNA and naturally occurring

processes such as protein synthesis for a wide range of applications including the production of therapeutically important proteins. This also involves extracting a gene from one organism and transferring it to the DNA of another organism of the same or another species.

7. Define Biotechnology?

Biotechnology which can be defined as the applications of scientific and engineering principles to the processing of material by biological agents to provide goods and services.

8. Mention the functions of Insulin?

1. Insulin controls the levels of glucose in blood.
2. It facilitates the cellular uptake and utilization of glucose for the release of energy.

9. What is prepro insulin?

The polypeptide chains are synthesized as a precursor called pre-pro insulin, which contains A and B segments linked by a third chain (C) and preceded by a leader sequence.

10. Write the structure of human insulin?

1. Human insulin is formed of 51 amino acids which are arranged in two polypeptide chains A and B.
2. The polypeptide chain A has 21 amino acids while the polypeptide chain B has 30 amino acids.
3. Both A and B chains are attached together by disulphide bonds.

11. What are interferons? Write their function.

1. Interferons were discovered by Alick Isaacs and Jean Lindemann in 1957.
2. Interferons are proteinaceous, antiviral, species specific substances produced by mammalian cells when infected with viruses.

12. State the uses of Interferons.

1. Interferons are used for the treatment of various diseases like cancer, AIDS, multiple sclerosis, hepatitis C and herpes zoster.
2. In spite of the therapeutic applications interferons are not within the reach of the common man due to high cost for its production.

13. Which is suitable for the production of recombinant interferons than E.Coli? why?

The yeast *Saccharomyces cerevisiae* is more suitable for production of recombinant interferons than *E.coli*, since *E.coli* does not possess the machinery for glycosylation of proteins.

14. Name the diseases cured by interferons.

1. Cancer.
2. AIDS.
3. Multiple sclerosis.
4. Hepatitis C.
5. Herpes zoster.

15. Write short notes on edible vaccines?

1. Edible vaccines are prepared by molecular pharming using the science of genetic engineering.
2. Selected genes are introduced into plants and the transgenic plants are induced to manufacture the encoded protein.
3. Edible vaccines are mucosal targeted vaccines which cause stimulation of both systemic and mucosal immune response.
4. At present edible vaccines are produced for human and animal diseases like measles, cholera, foot and mouth disease and hepatitis.

16. Difference between subunit recombinant vaccines and Attenuated recombinant vaccines.

S.No	Subunit recombinant vaccines	Attenuated recombinant vaccines
1	Vaccines that use components of a pathogenic organism rather than the whole organism are called subunit vaccines. Recombinant DNA technology is very suited for developing new subunit vaccines.	This includes genetically modified pathogenic organism (bacteria or viruses) that are made nonpathogenic and are used as vaccines.
2	It includes components like proteins, peptides and DNAs of pathogenic organisms. The advantages of these vaccines include their purity in preparation, stability and safe use.	It is now possible to genetically engineer the organisms (Bacteria or viruses) and use them as live vaccines and such vaccines are referred to as attenuated recombinant vaccines.

17. What are the two types of stem cells? Write the characteristic features of these cells.

In mammals there are two main types of stem cells.

i) Embryonic stem cells (ES cells):

1. ES cells are pluripotent and can produce the three primary germ layers ectoderm, mesoderm and endoderm.
2. Embryonic stem cells are multipotent stem cells that can differentiate into a number of types of cells.
3. ES cells are isolated from the epiblast tissue of the inner cell mass of a blastocyst.
4. When stimulated ES can develop into more than 200 cells types of the adult body.
4. ES cells are immortal they can proliferate in a sterile culture medium and maintain their undifferentiated state.

ii) Adult stem cells:

1. Adult stem cells are found in various tissues of children as well as adults.
2. An adult stem cell or somatic stem cell can divide and created another cell similar to it.
3. Most of the adult stem cells are multipotent and can act as a repair system of the body, replenishing adult tissues.
4. The red bone marrow is a rich source of adult stem cells.

18. What is stem cell banking? Mention the sources of stem cells.

Stem cell banking:

Stem cell banking is the extraction, processing and storage of stem cells, so that they may be used for treatment in the future, when required.

Sources of stem cells:

The umbilical cord and cord blood are the most popular sources of stem cells, the placenta, amniotic sac and amniotic fluid are also rich sources in terms of both quantity and quality.

19. Write the techniques involved in ELISA test.

1. Diagnosis the sample suspected to contain the antigen is immobilized on the surface of an ELISA plate.
2. The antibody specific to this antigen is added and allowed to react with the Immobilized antigen.
3. The anti-antibody is linked to an appropriate enzyme like peroxidase.
4. The unreacted anti-antibody is washed away and the substrate of the enzyme

(hydrogen peroxidase) is added with certain reagents such as 4-chloronaphthol.

5. The activity of the enzyme yields a coloured product indicating the presence of the antigen.

6. The intensity of the colour is directly proportional to the amount of the antigen.

ELUISA is highly sensitive and can detect antigens in the range of a nanogram.

20. What are the four types of ELISA? Write the advantages of ELISA.

1. Direct ELISA.
2. Indirect ELISA.
3. Sandwich ELISA.
4. Competitive ELISA.

Advantages:

1. It is a highly sensitive and specific method used for diagnosis.
2. ELISA possesses the added advantages of not requiring radioisotopes or a radiation counting apparatus.

21. How is PCR used in the forensic medicine?

1. PCR technique can also be used in the field of forensic medicine. A single molecule of DNA from blood stains, hair, semen of an individual is adequate for amplification by PCR.
2. The amplified DNA is used to develop DNA fingerprint which is used as an important tool in forensic science.
3. Thus, PCR is very useful for identification of criminals.
4. PCR is also used in amplification of specific DNA segment to be used in gene therapy.

22. Difference between Totipotency and Pluripotency?

Totipotency	Pluripotency
Totipotency is the ability of a single cell to divide and produce all of the differentiated cells in an organism.	Pluripotency refers to a stem cell that has the potential to differentiate into any of the three germ layers ectoderm, endoderm, and mesoderm.

23. Define Unipotency?

Unipotency refers to the ability of the stem cells to differentiate into only one cell type.

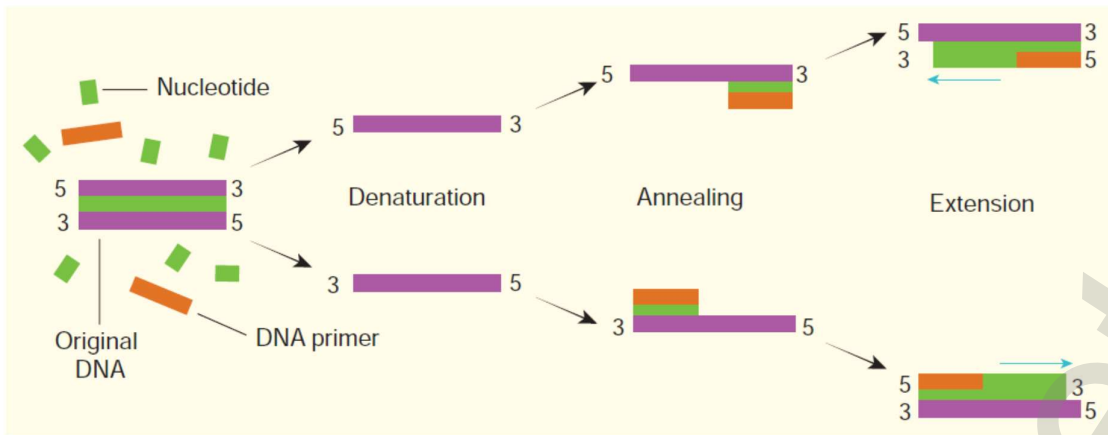
5 Mark creative questions and answers:

24. Write the applications of PCR.

1. The differences in the genomes of two different organisms can be studied by PCR.
2. PCR is very important in the study of evolutions, more specifically phylogenetics.
3. As a technique which can amplify even minute quantities of DNA from any source, like hair, mummified tissues, bones or any fossilized materials.
4. PCR technique can also be used in the field of forensic medicine.
5. A single molecule of DNA from blood stains, hair, semen of an individual is adequate for amplification by PCR.
6. The amplified DNA is used to develop DNA fingerprint which is used as an important tool in forensic science.
7. Thus, PCR is very useful for identifications of criminals.
8. PCR is also used in amplification of specific DNA segment to be used in gene therapy.

24. What are steps involved in polymerase chain reactions?

The polymerase chain reaction is used to reproduce selected sections of DNS or RNA for analysis. Previously, amplification of DNA involved cloning the segments of interest into vectors for expression in bacteria.



The three steps are used for amplification:

1. Denaturing:

When the double stranded template DNA is heated to separate it into two single strands.

2. Annealing:

When the temperature is lowered to enable the DNA primers to attach to the template DNA.

3. Extension:

Polymerisation of nucleotide chain by the enzyme. Taq polymerase using the nucleotides provided in the medium

Chapter: 10 Organisms and populations

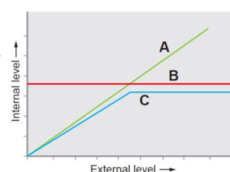
Textbook questions and answers:

- All populations in a given physical area defined as **Biome**
- Organisms which can survive a wide range of temperature are called **Eurytherms**.
- The interaction in nature, where one gets benefit on the expense of other is **Commensalism**.
- Predation and parasitism are **(+,-)** type of interactions.
- Competition between species leads to **Extinction**.
- Which of the following is an r species
a) Human **b) Insects** c) Rhinoceros d) Whale
- Match the following and choose the correct combination from the options given below.

S.No	Column I	S.No	Column II
A	Mutualism	1	Lion and deer
B	Commensalism	2	Round worm and man
C	Parasitism	3	Birds compete with squirrels for nuts
D	Competition	4	Sea anemone on hermit crab
E	Predation	5	Barnacles attached to whales.

Answer: a) A-4, B-5, C-2, D-3, E-1.

- The figure given below is a diagrammatic representation of response of organisms to abiotic factors. What do A, B and C represent respectively.



S.No	A	B	C
A	Conformer	Regulator	Partial Regulator
B	Regulator	Partial Regulator	Conformer
c	Partial Regulator	Regulator	Conformer
D	Regulator	Conformer	Partial Regulator

9. The relationship between sucker fish and shark is **commensalism**.

10. Which of the following is correct for r-selected species.

a) **Large number of progeny with small size**

11. Animals that can move from fresh water to sea called as **Catadromous**.

12. Some organisms by physical means **Regulate**.

13. **What is a Habitat?**

Habitat refers to the place where an organism or a community of organisms live including all biotic and abiotic factors or conditions of the surrounding environment.

14. **Define ecological niche.**

Every organism has its unique habitat so also it has an ecological niche which includes the physical space occupied by an organism and its functional role in the community.

The ecological niche of an organism not only depends on where it lives but also includes the sum total of its environmental requirements.

15. **What is Acclimatisation?**

Animals are known to modify their response to environmental changes (Stress) in reasonably short time spans. This is known as Acclimatization.

Example:

People who have moved from the plains to higher altitudes show enhanced RBC count within a few days of settling in their new habitat. This helps them cope with lower atmospheric oxygen and higher oxygen demand.

16. **What is pedogenesis?**

Soil is formed from rocks which are the parent materials of soil, by weathering and is called embryonic soil (pedogenesis).

17. **What is soil permeability?**

1. The characteristic of soil that determines the movement of water through pore spaces is known as soil permeability.

2. Soil permeability is directly dependent on the pore size.

3. Water holding capacity of the soil is inversely dependent on soil porosity.

18. **Differentiate between Eurytherms and Stenotherms . (2021-2022)**

Eurytherms	Stenotherms
Organisms which can survive a wide range of temperature are referred to as Eurytherms.	Those organisms which can tolerate only a narrow range of temperature are stenotherms.
Examples: Cat, dog, tiger, human.	Examples: Fish, Frogs, Lizards and Snakes.

19. **Explain hibernation and aestivation with example.**

Hibernation	Aestivation
Hibernation is a state of reduced activity in some organism to escape cold winter conditions.	Aestivation is a state of reduced activity in some organisms to escape desiccation due to heat in summers.
Bear and squirrels inhabiting cold regions are examples of animals that hibernate during winters.	Fishes and snails are examples of organisms aestivating during summers.

20. Give the characters of a biome?

- Location, Geographical position (Latitude, Longitude)
- Climate and physiochemical environment
- Predominant plant and animal life
- Boundaries between biomes are not always sharply defined. Transition or transient zones are seen as in case of grassland and forest biomes.

21. Classify the aquatic biomes of Earth.

1. Freshwater (Lakes, ponds, rivers)
2. Brackish water (Estuaries/ Wetlands)
3. Marine (Coral reefs, pelagic zones and abyssal zones)

22. What are the ways by which organisms respond to abiotic factors?(PTA 2019-2020) and (2019-2020)**Regulate:**

Some organisms are able to maintain homeostasis by physiological means which ensures constant body temperature, ionic / osmotic balance. Birds, mammals and a few lower vertebrate and invertebrate species are capable of such regulation.

- **Conform:**

Most animals cannot maintain a constant internal environment. Their body temperature changes with the ambient temperature. In aquatic animals like fishes, the osmotic concentration of the body fluids changes with that of the ambient water osmotic concentration. Such animals are called Conformers. In case of extreme condition, the inhabitants relocate themselves as in migration.

- **Migrate:**

Organisms tend to move away temporarily from a stressful habitat to a new, hospitable area and return when the stressful period is over. Birds migrate from Siberia to Vedanthangal in Tamilnadu to escape from the severe winter periods.

- **Suspend:**

In certain conditions, if the organisms is unable to migrate, it may avoid the stress by becoming inactive. This is seen commonly in bears going into hibernation during winter. Some snails and fish go into aestivation to avoid summer related problems like heat and desiccation. Some lower animals suspend a certain phase of their life cycle, which is referred to as diapause.

23. Classify the adaptive traits found in organisms.**Structural adaptations:**

The external and internal structures of animals can help them to adapt better to their environment. Some of the most common examples are mammals growing thicker fur to survive freezing climates.

Example: Likewise, horse legs are suitable for fast running and adapted for grasslands and similar terrestrial environments.

Behavioural adaptations:

Action and behaviour of animals are instinctive or learned. Animals develop certain behavioural traits or adaptations for survival. Fleeing from a predator, hiding during sleep, seeking refuge from climate change or moving to find different food sources are all behavioral adaptations.

Example: Courtship is a set of behavioral patterns to find a mate to reproduce. Most nocturnal animals remain underground or inactive during daytime.

Physiological adaptations:

These are adaptations of organisms that help them to live and survive in their environment with unique niches. **Example:** Lions have sharp canines to hunt and tear meat and a digestive system suitable for digesting raw meat.

24. Differentiate Natality and Mortality. (2019-2020) and 2021-2022**b) Natality (Population increase):**

- i) Populations increase because of natality
- ii) Birth rate (Y) = $\frac{\text{number of birth per unit time}}{\text{Average population}}$

Mortality (Population decrease):

- i) Mortality is the population decline factor.
- ii) Death rate (d) = $\frac{\text{number of deaths per unit time}}{\text{Average population}}$

25. Differentiate j and s shaped curve.

J-shaped growth curve	S shaped growth curve
<p>population increases rapidly in an exponential fashion and then stops abruptly due to environmental resistance or due to sudden appearance of a limiting factor, they are said to exhibit J-shaped growth form.</p> <p>Many insects show explosive increase in number during the rainy season followed by their disappearance at the end of the season</p>	<p>population of small mammals, increase slowly at first then more rapidly and gradually slow down as environmental resistance increases where by equilibrium is reached and maintained. Their growth is represented by S shaped growth curve.</p>

26. Give an account of population regulation.

1. The inherent tendency of all animal populations is to increase in number. But it does not increase indefinitely.
 2. Once the carrying capacity of the environment is reached, population numbers remain static or fluctuate depending on environmental conditions.
- This is regulated by many factors which are 1. Density independent – Extrinsic factors 2. Density dependent - Intrinsic factors
- Extrinsic factors include availability of space, shelter, weather, food, etc. Intrinsic factors include competition, predation, emigration, immigration and diseases.

27. Give an account of the properties of soil. (PTA 2019-2020)**1. Texture of soil:**

1. The texture of soil is determined by the size of the soil particles.
- The types of soil include sand, silt and clay on the basis of their size differences.

2. Porosity:

1. The space present between soil particles in a given volume of soil are called pore spaces.
2. The percentage of soil volume occupied by pore space or by the interstitial spaces is called porosity of the soil.

3. Permeability of soil:

1. The characteristic of soil that determines the movement of water through pore spaces is known as soil permeability.
2. Soil permeability is directly dependent on the pore size.
3. Water holding capacity of the soil is inversely dependent on soil porosity.

4. Soil temperature:

1. Soil gets its heat energy from solar radiation, decomposing organic matter, and heat from the interior of earth.
2. Soil temperature effects the germination of seeds, growth of roots and biological activity of soil- inhabiting micro and macro organisms.

5. Soil water:

In soil, water is not only important as a solvent and transporting agent, but also maintains soil texture, arrangement and compactness of soil particles, making soil habitable for plants and animals.

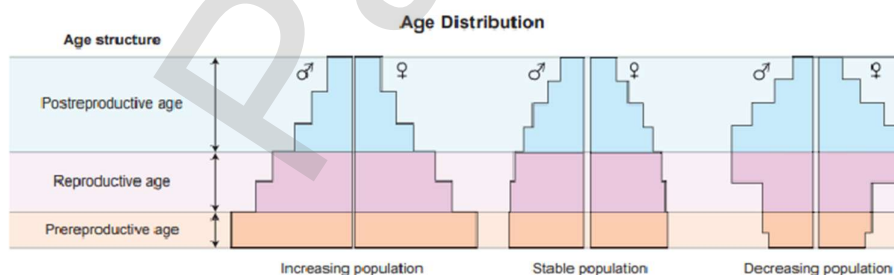
28. Differentiate between Tundra and Taiga Biomes.

S.No	Tundra Biome	Taiga Biome
1	This is the almost treeless plain in the northern parts of Asia, Europe and North America.	The Taiga is 1300-1450 km wide zone south of the Tundra.
2	Winters are long with little daylight, Summers are short, with long daylight hours.	This area has long and cold winters. Summer temperature ranges from 10°C to 21°C.
3	Precipitation is less than 250 mm per year. It is a zone of permafrost.	Precipitation ranges about 380-1000 mm annually.
4	Dwarf willows, birches, mosses, grasses, sedges are the flora here.	The taiga is a forest of coniferous trees such as spruce, fir and pine. This is a major source for the logging industry.
5	Reindeer, arctic hare, musk ox, lemmings are important Tundra herbivores. Some important carnivores are the arctic fox, arctic wolf, bobcat and snowy owl. Polar bears live along coastal areas.	Important migratory herbivores include moose, elk, deer and reindeer. Moose and reindeer migrate to the Taiga for winter and to the Tundra for summers. The common smaller mammals are herbivorous squirrels, snowshoe here and predatory pine martens. Important predators include the timber wolf, grizzly bear, black bear, bobcat and wolverines.

29. List the adaptations seen in terrestrial animals.

1. Earthworms, land Planarians secrete a mucus coating to maintain a moist situation for burrowing, coiling, respiration, etc.,
2. Arthropods have an external covering over the respiratory surfaces and well developed tracheal systems.
3. In vertebrate skin, there are many cellular layers besides the well protected respiratory surfaces that help in preventing loss of water.
4. Some animals obtain their water requirement from food as partial replacement of water lost through excretion.
5. Birds make nests and breed before the rainy season as there is availability of abundant food. But during drought birds rarely reproduce.
6. Camels are able to regulate water effectively for evaporative cooling through the skin and respiratory system and excrete highly concentrated urine, and can also withstand dehydration up to 25% of their body weight.

30. Describe population Age Distribution.



The proportion of the age groups (pre-reproductive, reproductive and post reproductive) in a population is its age distribution attribute. This determines the reproductive status of the population at the given time and is an indicator of the future population size. Usually a rapidly growing population will have larger proportion of young individuals. A stable population will have an even distribution of various age classes. A declining population tends to have a larger proportion of older individuals

31. Describe Growth Models/ Curves

Populations show characteristic growth patterns or forms. These patterns can be plotted and termed as J-shaped growth form and S-shaped growth form (Sigmoid form).

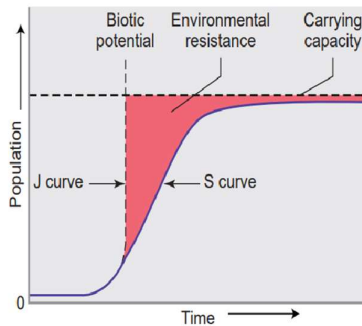


Fig. 10.11 J - shaped and S - shaped growth curves

J shaped growth form: population increases rapidly in an exponential fashion and then stops abruptly due to environmental resistance or due to sudden appearance of a limiting factor, they are said to exhibit J-shaped growth form. Many insects show explosive increase in number during the rainy season followed by their disappearance at the end of the season.

S-Shaped growth form (sigmoid growth): populations, as in a population of small mammals, increase slowly at first then more rapidly and gradually slow down as environmental resistance increases whereby equilibrium is reached and maintained. Their growth is represented by S shaped growth curve.

32. Tabulate and analysis of two species population interaction. (PTA 2019-2020)

S.No	Types of interaction	Species 1	Species 2	General nature of interaction	Examples
1	Amensalism	-	0	The most powerful animal or large organisms inhibits the growth of other lower organisms.	Cat and Rat
2	Mutualism	+	+	Interaction favorable to both and obligatory.	Between crocodile and bird.
3	Commensalism	+	0	Population 1, the commensal benefits, while 2 the host is not affected.	Sucker fish on shark.
4	Competition	-	-	Direct inhibition of each species by the other.	Birds compete with squirrels for nuts and seeds.
5	Parasitism	+	-	Population 1, the parasite, generally smaller than 2, the host.	<i>Ascaris</i> and tapeworm in human digestive tract.
6	Predation	+	-	Population 1, the predator, generally larger than 2, the prey.	Lion predatory on deer.

33. Write short notes on: (2019-2020)**a) Population Density**

The density of a population refers to its size in relation to unit of space and time or population density is the total number of that species within a natural habitat.

b) Natality (Population increase): (2021-2022)

i) Populations increase because of natality

ii) Birth rate (Y) = $\frac{\text{number of birth per unit time}}{\text{Average population}}$

Mortality (Population decrease):

ii) Mortality is the population decline factor.

ii) Death rate (d) = $\frac{\text{number of deaths per unit time}}{\text{Average population}}$

34. What is commensalism? Explain with an example. (2019-2020)

1. This defines the interaction in which two or more species are mutually associated in activities centering on food and one species at least, derives benefit from the association while the other associated are neither benefited no harmed.

2. The concept of commensalism has been broadened in recent years to apply to coactions other than those centering on food such as cover, support production and locomotion.

3. **Examples:** Barnacle attached to whales travel thousands of miles collecting and filtering food from the moving water. The whales are not affected by the barnacles.

35. What is called positive phototaxis? (PTA 2019-2020)

The movement of organism in response to light, either towards the source of light as in Moths (positive phototaxis).

36. How are the different fish communities living in a pond ecosystem? (PTA-2019-2020)

1. In a pond ecosystem, where Catla, Rohu and Mrigal are present, the ecological niche of the Catla is a surface feeder, Rohu is a column feeder and Mrigal is a bottom feeder.

2. Their mouths are designed to suit their niche and hence have different positions and functions in their habitat.

37. What is known as photokinesis? (PTA-2019-2020)

A change in the speed of locomotion in a motile organism or cell which is made in response to a change in light intensity is called photokinesis. It involves undirected random movement in response to light.

38. Differentiate mutualism from commensalism. (PTA 2019-2020)

S.No	Mutualism	Commensalism
1	Mutualism is a type of symbiotic relationship among two or more different species where both species benefit.	Commensalism is a type of symbiotic relationship where only one species benefits and the other are unaffected.
2	Both species receive benefits.	Only one species receive benefits
3	Example: Crocodile and bird	Example: Sucker fish on shark

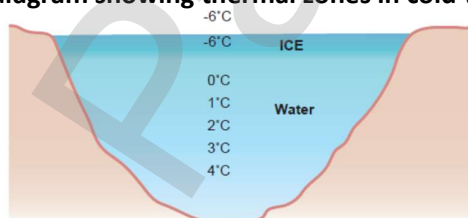
39. Draw the diagram showing thermal zones in cold water bodies. (PTA-2019-2020)

Fig. 10.3 Thermal zones in cold water bodies

40. Write about the essential properties of water. (2021-2022)

1. Water is one of the main agent in pedogenesis (soil formation)
2. It is the medium for several different ecosystems.
3. It is present as moisture in the atmosphere and the outer layers of the lithosphere and is uneven in distribution on the earth.
4. Water is heavier than air and imparts greater buoyancy to the aquatic medium. This enables organism to float at variable levels.
5. Water has high heat capacity and latent heat, due to which it can withhold large amounts of heat. Thus, oceans and lakes tend to maintain a relatively constant temperature, and the biosphere is relatively thermostable.
6. Water is physically unique because it is less dense as a solid than as a liquid.
7. When water freezes (0°C), it contracts. The maximum density of liquid water occurs at 4°C. below that, it expands markedly. This enables ice to float on the top of water bodies. Hence, only the surface of water bodies will freeze, while below the surface, water will be in liquid form, sustaining life.
8. Water is considered as the Universal solvent. It is the main medium by which chemical constituents are transported from abiotic components to the living components of an ecosystem.
9. Water has high surface tension. This allows pollen, dust and even water striders to remain at the surface of a water body even though they are denser than the water.

2 and 3 Marks creative questions and answers**41. State Bergmann's rule.**

1. In certain environments the size and colouration of animals are influenced by temperature.
2. Birds and mammals attain greater body size in colder regions than warmer region.

42. State Allen's rule.

Warm blooded animals living in colder climates, tend to have shorter limbs, ears and other appendages when compared to the members of the same species in warmer climates.

43. State Jordan's rule.

In some aquatic environments an inverse relationship between water temperature and fish meristic characters is observed lower the temperature, more the vertebrae.

44. State. Van't Hoff's rule. Mention the value of living system.

1. Van't Hoff proposed that, with the increase of every 10°C, the rate of metabolic activity doubles or the reaction rate is halved with the decrease of 10°C. This rule is referred as the van't Hoff's rule.
2. The effect of temperature on the rate of reaction is expressed in terms of temperature coefficient or Q_{10} value.
3. The Q_{10} values are estimated taking the ratio between the rate of reaction at $X^{\circ}\text{C}$ and rate of reaction at $(X-10^{\circ}\text{C})$.
4. In the living system the Q_{10} value is about 2.0 it means 10°C increase and the rate of metabolism doubles.

45. Differentiate absolute humidity and relative humidity.

S.No	Absolute Humidity	Relative Humidity
1	Absolute humidity is the total mass of water vapor present in a given volume or mass of air	Relative humidity is the amount of water vapor present in air and is expressed as a percentage of the amount needed for saturation at the same temperature relative humidity is expressed as a percentage.
2	It does not take temperature into consideration	A high percentage means that the air-water mixture is more humid at a given temperature.

46. Light is an important and essential abiotic factor- Justify your Answer

1. Light influences growth, pigmentation, migration and reproduction.
2. The intensity and frequency of light influences metabolic activity, induce gene mutations (UV, X-rays).
3. Light is essential for vision. It influences Diapause.
4. Gonads of birds become more active with increasing light in summer. It influences the locomotion and movement of lower animals.

47. Where does soil get heat energy? Mention the effects of soil temperature.

1. Soil gets its heat energy from solar radiation, decomposing organic matter, and heat from the interior of earth.
2. Soil temperature effects the germination of seeds, growth of roots and biological activity of soil-inhabiting micro and macro-organisms.

48. What is the use of wind in the environment?

Wind helps to transport pollen grains, seeds, and even flight of birds. While it is the source of wind energy, it also causes erosion.

49. Write about the essential properties of water.

1. Water is one of the main agent in pedogenesis (soil formation)
2. It is the medium for several different ecosystems.
3. It is present as moisture in the atmosphere and the outer layers of the lithosphere and is uneven in distribution on the earth.
4. Water is heavier than air and imparts greater buoyancy to the aquatic medium. This enables organism to float at variable levels.
5. Water has high heat capacity and latent heat, due to which it can withhold large amounts of heat. Thus, oceans and lakes tend to maintain a relatively constant temperature, and the biosphere is relatively thermostable.
6. Water is physically unique because it is less dense as a solid than as a liquid.
7. When water freezes (0°C), it contracts. The maximum density of liquid water occurs at 4°C. below that, it expands markedly. This enables ice to float on the top of water bodies. Hence, only the surface of water bodies will freeze, while below the surface, water will be in liquid form, sustaining life.
8. Water is considered as the Universal solvent. It is the main medium by which chemical constituents are transported from abiotic components to the living components of an ecosystem.
9. Water has high surface tension. This allows pollen, dust and even water striders to remain at the surface of a water body even though they are denser than the water.

Chapter: 11 Biodiversity and its Conservation**Textbook questions and answers:**

1. **Tropical forest** region has maximum biodiversity.
2. Conservation of biodiversity within their natural habitat is **In situ conservation**.
3. **Zoological Park** is not coming under insitu conservation.
4. Western ghats and Eastern Himalayas is considered a hotspot of biodiversity in India.

Answer: d) A and C

5. The organization published the **IUCN** red list of species.
6. **Water Rosen** introduced the term biodiversity.
7. **Amazon rain forest** is known as the lungs of the planet earth.
8. **Amphibians** are at high risk extinction due to habitat destruction.
9. Assertion: The environmental conditions of the tropics are favorable for speciation and diversity of organisms.

Reason: The climate seasons, temperature, humidity and photoperiod are more or less

stable and congenial.

a) **Both Assertion and Reason are true and Reason explains Assertion correctly.**

10. Define endemism.

The phenomenon in which the organisms are exclusively restricted to a given area.

11. How many hotspots are there in India? Name them.

India is home to four biodiversity hotspots. They are

i) **Himalaya** (the entire Indian Himalayan region)

ii) **Western Ghats.**

iii) **Indo-Burma:** includes entire North- eastern India, except Assam and Andaman group of Islands (and Myanmar, Thailand, Vietnam, Laos, Cambodia and Southern China)

iv) **Sundalands:** includes Nicobar group of Islands (and Indonesia, Malaysia, Singapore, Brunei, Philippines)

12. What are the three levels of biodiversity?

There are three levels of biodiversity Genetic diversity, Species diversity and Community/ Ecosystem diversity.

Genetic diversity:

1. Genetic diversity refers to the differences in genetic makeup (number and types of genes) between distinct species and to the genetic variation within a single species also covers genetic variation between distinct populations of the same species.
2. Genetic diversity can be measured using a variety of molecular techniques.
3. India has more than 50,000 genetic variants of paddy and 1000 variants of mango.
4. Variation of genes of a species increases with diversity in size and habitat. It result in the formation of different races, varieties and subspecies.
5. *Rouwolfia vomitaria* a medicinal plant growing in different ranges of the Himalayas shows differences in the potency and concentration of the active ingredient reserpine due to genetic diversity.
6. Genetic diversity helps in developing adaptations to changing environmental conditions.

Species diversity: (2021-2022)

1. Species diversity refers to the variety in number and richness of the species in any habitat.
2. The number of species per unity area at a specific time is called species richness, which denotes the measure of species diversity.
3. The Western Ghats have greater amphibian species diversity than the Eastern Ghats. The more the number of species in an area the more is the species richness.
4. The three indices of diversity are Alpha, Beta and Gamma diversity.

a) Alpha diversity:

It is measured by counting the number of taxa (usually species) within a particular area, community or ecosystem.

b) Beta diversity:

It is species diversity between two adjacent ecosystem and is obtaining by comparing the number of species unique to each of the ecosystem

c) Gamma diversity:

Gamma diversity refers to the diversity of the habitats over the total landscape or geographical are.

Community/Ecosystem diversity:

1. Community /Ecosystem diversity is the variety of habitats, biotic communities, and ecological processes in the biosphere.
2. It is the diversity at ecosystem level due to diversity of niches, tropic levels and

ecological processes like nutrient cycles, food webs, energy flow and several biotic interactions.

3. India with its alpine meadows, rain forests, mangroves, coral reefs, grass lands and deserts has one of the greatest ecosystem diversity on earth.

13. Name the active chemical found in the medicinal plant *Rauwolfia vomitoria*. What type of divert it belongs to?

1. Genetic diversity is the diversity at the genetic level. It enables a population to adapt to its environment.

2. Genetic variation in the medicinal plant *Rauwolfia vomitoria* growing in different Himalayan ranges might be in terms of the potency and concentration of the active chemical (reserpine) that the plant produces

14. "Amazon forest is considered to be the lungs of the planet"-Justify this statement.

The Amazon rainforest, a vast area, harbouring millions of species also called Lungs of the planet is destroyed and being replaced for agriculture and human settlements.

15. Red data book what do you know about it?

Red Data book or Red list is a catalogue of taxa facing risk of extinction. IUCN – International Union of Conservation of Nature and Natural Resources, which is renamed as WCU – World Conservation Union (Morges Switzerland) maintains the Red Data book. The concept of Red list was mooted in 1963.

The purpose of preparation of Red List are:

- To create awareness on the degree of threat to biodiversity.
- Identification and documentation of species at high risk of extinction.
- Provide global index on declining biodiversity.
- Preparing conservation priorities and help in conservation of action.
- Information on international agreements on conservation of biological diversity Red list has eight categories of species i) Extinct ii) Extinct in wild iii) Critically Endangered iv) Endangered v) Vulnerable vi) Lower risk vii) Data deficiency viii) Not evaluated.

16. Compare and Contrast the insitu and exsitu conservation.

S.No	Insitu Conservation	Exsitu Conservation
1	It is the on-site conservation or the conservation of genetic resources in natural populations of plant or animal species.	This is a conservation strategy which involves placing of threatened animals and plants in special care locations for their protection.
2	It is the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or restoring the habitat itself or by defending the species from predators.	It helps in recovering populations or preventing their extinction under simulated conditions that closely resemble their natural habitats.
3	National Parks, Biosphere Reserve, Wild Life Sanctuaries form insitu conservation strategies.	Zoological parks and Botanical gardens are common exsitu conservation programs

17. What are called endangered species? Explain with examples.

1. A species that has been categorized as very likely to become extinct is an endangered species.

2. Endangered (EN) as categorized by the International Union for Conservation of Nature (IUCN) Red List is the second most severe conservation status for wild

populations in the IUCN's scheme after Critically Endangered (CR).

Example: George the tree snail (*Achatinella apexfulva*)

18. Why do we find a decrease in biodiversity distribution, if we move from the tropics towards the poles?

1. Temperature, precipitation, distance from the equator (latitudinal gradient), altitude from sea level (altitudinal gradient) are some of the factors that determine biodiversity distribution patterns.

2. The most important pattern of biodiversity is latitudinal gradient in diversity. This means that there is an increasing diversity from the poles to equator.

19. What are the factors that drive habitat loss?

1. Development of human society is inevitable. Natural habitats are destroyed for the purpose of settlement, agriculture, mining, industries and construction of highways.

2. As a result species are forced to adapt to the changes in the environment or move to other places.

3. If not they become victim to predation, starvation, disease and eventually die or results in human animal conflict.

20. Alien species invasion is a threat to endemic species- substantiate this statement.

1. Exotic species (Non-native; alien) are organisms often introduced unintentionally or deliberately for commercial purpose, as biological control agents and other uses.

2. They often become invasive and drive away the local species and is considered as the second major cause for extinction of species.

3. Exotic species have proved harmful to both aquatic and terrestrial ecosystems.

4. Tilapia fish (Jilabi kendai) (*Oreochromis mosambicus*) introduced from east coast of South Africa in 1952 for its high productivity into Kerala's inland waters, became invasive, due to which the native species such as *puntius dubius* and *labeo kontius* face local extinction.

5. The introduction of the Nile Perch, a predatory fish into Lake Victoria in East Africa led to the extinction of an ecologically unique assemblage of more than 200 nature species of cichlid fish in the lake.

6. Papaya Mealy Bug (*Paracoccus marginatus*) is native of Mexico and Central America, is believed to have destroyed huge crops of papaya in Assam, West Bengal and Tamil Nadu.

21. Mention the major threats to biodiversity caused by human activities. Explain.

1. Human activities greatly contribute to the loss of biodiversity. Natural resources such as land, water and organisms are indiscriminately exploited by human beings.

2. According to the convention of Biological Diversity, direct and indirect human activities have a detrimental effect on biodiversity.

3. Direct human activities like change in local land use, species introduction or removal, harvesting, pollution and climate change contribute a greater pressure on loss of biodiversity.

4. Indirect human drivers include demographic, economic, technological, cultural and religious factors.

5. Monsoon failure, global warming, depletion in ozone layer, landslides in hilly states, pollution are a few indirect effects of human activities which results in the loss of biodiversity.

6. This loss of biodiversity has a immense impact on plant animal and human life. The negative effects include dramatic influence on the food web.

7. Even reduction in one species can adversely affect the entire food chain which

further leads to an overall reduction in biodiversity. Reduced biodiversity leads to immediate danger for food security by reducing ecosystem services.

22. What is mass extinction? Will you encounter one such extinction in the near future?

Enumerate the steps to be taken to prevent it.

Mass extinction: (2021-2022)

1. The earth has experienced quite a few mass extinctions due to environmental catastrophes.
2. A mass extinction occurred about 225 million years ago during the Permian, where 90% of shallow water marine invertebrates disappeared.

The steps to be taken to prevent:

1. Identify and protect all threatened species.
2. Identify and conserve in protected areas the wild relatives of all the economically important organisms.
3. Identify and protect critical habitats for feeding, breeding, nursing, resting of each species.
4. Resting, feeding and breeding places of the organisms should be identified and protected.
5. Air, water and soil should be conserved on priority basis.
6. Wildlife protection Act should be implemented.

23. In north eastern states, the jhum cultivation is a major threat to biodiversity substantiates the statement.

1. In shifting cultivation, plots of natural tree vegetation are burnt away and the cleared patches are farmed for 2-3 seasons, after which their fertility reduces to a point where crop production is no longer profitable.
2. The farmer then abandons this patch and cuts down a new patch of forest trees elsewhere for crop production.
3. This system is practiced in north-eastern regions of India. When vast areas are cleared and burnt, it results in loss of forest cover, pollution and discharge of CO₂ which in turn attributes to loss of habitat and climate change which has an impact on the faunal diversity of that region.

24. List out the various causes for biodiversity losses.

1. Habitat loss, fragmentation and destruction (affects about 73% of all species)
2. Pollution and pollutants (Smog, pesticides, herbicides, oil slicks, GHGs)
3. Climate change.
4. Introduction of alien/ exotic species.
5. Over exploitation of resources (poaching, indiscriminate cutting of trees, over fishing, hunting, mining)
6. Intensive agriculture and aquaculture practices.
7. Hybridization between native and non-native species and loss of native species.
8. Natural disasters (Tsunami, forest fire, earth quake, volcanoes)
9. Industrialization, Urbanization infrastructure development, Transport Road and shipping activity, communication towers, dam construction, unregulated tourism and monoculture are common area of specific threats.
10. Co-extinction.

25. How can we contribute to promote biodiversity conservation?

1. Conservation of biodiversity is protection and scientific management of biodiversity so as to maintain it at its optimum level and derive sustainable benefits for the present as well as future generations.
2. It aims to protect species from extinction and their habitats and ecosystems form

degradation.

General strategies in conservation:

1. Identify and protect all threatened species.
2. Identify and conserve in protected areas the wild relatives of all the economically important organisms.
3. Identify and protect critical habitats for feeding, breeding, nursing, resting of each species.
4. Resting, feeding and breeding places of the organisms should be identified and protected.
5. Air, water and soil should be conserved on priority basis.
6. Wildlife protection Act should be implemented

26. Write a note on i) Protected areas, ii) Wild life sanctuaries, iii) WWF

i) Protected areas:

1. These are biogeographical areas where biological diversity along with natural and cultural resources is protected, maintained and managed through legal measures.
2. Protected areas include national parks, wild life sanctuaries community reserves and biosphere reserves.
3. World Conservation monitoring center has recognized 37,000 protected areas world- wide.
4. India has about 771 protected areas covering 162099 km² comprising of National Parks (104), Wild Life Sanctuaries (544). Biosphere reserves (18) and several sacred groves.

ii) Wild life sanctuaries:

1. Any area other than the area comprised with any reserve forest or the territorial waters can be notified by the State Government to constitute as a sanctuary if such are is of adequate ecological, faunal, and floral. geomorphological, natural or zoological significance.
2. This is for the purpose of protecting, endangered factual species.
3. Some restricted human activities are allowed inside the Sanctuary area.
4. Ecotourism is permitted as long as animal life is undisturbed.

Other important questions and answers:

27. What are the eight categories of species in Red List? (2019-2020)

Red list has eight categories of species:

- i) Extinct ii) Extinct in wild iii) Critically Endangered iv) Endangered v) Vulnerable vi) Lower risk vii) Data deficiency viii) Not evaluated.

28. Explain the exotic species invasion. (2019-2020)

1. Exotic species (Non-native; alien) are organisms often introduced unintentionally or deliberately for commercial purpose, as biological control agents and other uses.
2. They often become invasive and drive away the local species and is considered as the second major cause for extinction of species.
3. Exotic species have proved harmful to both aquatic and terrestrial ecosystems.
4. Tilapia fish (Jilabi kendai) (*Oreochromis mosambicus*) introduced from east coast of South Africa in 1952 for its high productivity into kerala's inland waters, became invasive, sue to which the native species such as *puntius dubius* and *labeo kontius* face local extinction.
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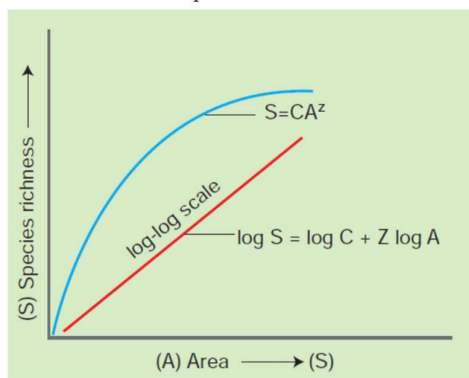
29. Intensive agriculture results in reduction of genetic diversity. How? (PTA-2019-2020)

1. Spread of agriculture is sometimes at the cost of wetlands, grasslands and forests. Intensive agriculture is based on a few high yielding varieties.
2. As a result there is reduction in the genetic diversity. It also increases vulnerability of the crop plants to sudden attack by pathogens and pests.
3. There are only few varieties of traditional paddy strains today due to use to hybrid varieties in Tamil Nadu.

30. List out the fauna of Trans Himalayan region. (PTA 2019-2020)

Richest wild sheep and goat community in the world (renowned for its quality wool), Chiru, black rocked crane etc.,

31. Describe species- are relationship on log scale. (PTA-2019-2020)



1. German Naturalist and Geographer Alexander von Humboldt explored the wilderness of South American jungles and found that within a region the species richness increased with increasing area but up to a certain limit.
2. The relationship between species richness and area for a wide variety of taxa (angiosperm plants, birds, bats, freshwater fishes) turned out to be the rectangular hyperbola)
3. On a logarithmic scale, the relationship is a straight line described by the equation. $\log S = \log C + Z \log A$
Where
S= Species richness
A= Area
Z= Slope of the line (regression coefficient)
C= Y- intercept
4. Regression coefficient Z generally has a value of 0.1-0.2 regardless of taxonomic group or region.
5. However, in case of the species area relationship in very large areas like entire continents the slope of the line appears to be much steeper (Z-value in the range of 0.6-1.2)
6. For example, in case of the fruit eating birds and mammals in the tropical forests of different continents, the slope is found to be a steeper line of 1.15

32. What is coextinction? Give an example. (PTA-2019-2020)

Co extinction of a species is the loss of a species as a consequence of the extinction of another.

Example: (Orchid bees and forest trees by cross pollination). Extinction of one will automatically cause extinction of the other.

Another example:

The Calvaria tree is dependent on the Dodo bird for completion of its life cycle. The mutualistic association is that the tough horny endocarp of the seeds of Calvaria tree are made permeable by the actions of the large stones in birds gizzard and digestive juices thereby facilitating easier germination. The extinction of the Dodo bird led to the imminent danger of the Calvaria tree coextinction.

33. Write about the three indices of species diversity. (PTA-2019-2020)**i) Alpha diversity:**

It is measured by counting the number of taxa (usually species) within a particular area, community or ecosystem.

ii) Beta diversity:

It is species diversity between two adjacent ecosystem and is obtained by comparing the number of species unique to each of the ecosystem

iii) Gamma diversity:

Gamma diversity refers to the diversity of the habitats over the total landscape or geographical area.

34. What is mass extinction? (2021-2022)

A mass extinction occurred about 225 millions years ago during the permian as where 90% of shallow water marine invertebrates disappeared.

Creative questions and answers:**35. Name any two alien species introduced in india.**

1. Tilapia fish (jilabi kendain) (*Oreochromis mosambicus*)
2. Nile perch.
3. Papaya Mealy Bug (*Paracoccus marginatus*)

36. How do habitat fragmentations affect biodiversity?

1. It results in the destruction of complex interactions amongst species, (food chain and webs).
2. Destruction of species in the cleared regions.
3. Annihilation of species restricted to these habitats (endemic).
4. Decreased biodiversity in the habitat fragments.
5. Animals requiring large territories such as mammals and birds are severely affected.
6. The elephant corridors and migratory routes are highly vulnerable.
7. The dwindling of many well- known birds (sparrows) and animals.

37. Write short notes on Biosphere Reserve.

1. Biosphere Reserve (BR) is an international designation by UNESCO for representative parts of natural and cultural landscapes extending over large area of terrestrial or coastal/ marine ecosystems or a combination thereof.
2. BRs are designated to deal with the conservation of biodiversity, economic and social development and maintenance of associated cultural values.
3. Biosphere Reserves are thus special environment for both people and nature and are living examples of how human beings and nature can co-exist while respecting each other's needs.
4. The Biosphere Reserve Programme is guided by UNESCO's Man and Biosphere (MAB)

programme, as India is a signatory to the landscape approach supported by MAB.

5. The scheme called Biosphere Reserve was implemented by the Government of India in 1986. There are 18 Biosphere Reserves in the country.

Agasthyamalai (Karnataka- Tamil Nadu- Kerala)

Nilgiri (Tamil Nadu- Kerala)

Gulf of Mannar (Tamil Nadu) are the BRs notified in Tamil Nadu.

38. List out and explain the types of extinction.

The extinction of species is mainly due to drastic environmental changes and population characteristics. There are three types of Extinctions.

i) Natural extinction:

1. The Natural extinction is a slow process of replacement of existing species with better adapted species due to changes in environmental conditions, evolutionary changes, predators and diseases.

2. A small population can get extinct sooner than the large population due to inbreeding depression (less adaptivity and variation)

ii) Mass extinction:(2021-2022)

1. The earth has experienced quite a few mass extinctions due to environmental catastrophes.

2. A mass extinction occurred about 225 million years ago during the Permian, where 90% of shallow water marine invertebrates disappeared.

iii) Anthropogenic extinctions:

1. These are abetted by human activities like hunting, habitat destruction, over exploitation, urbanization and industrialization.

2. Some examples of extinctions are Dodo of Mauritius and steller's sea cow of Russia. Amphibians seem to be at higher risk of extinction because of habitat destruction.

39. List out the reasons for the richness of biodiversity in the tropics.

1. Warm tropical regions between the tropic of cancer and Capricorn on either side of equator possess congenial habitats for living organisms.

2. Environmental conditions of the tropics are favourable not only for speciation but also for supporting both variety and number of organisms.

3. The temperatures vary between 25°C to 35°C a range in which most metabolic activities of living organisms occur with ease and efficiency.

4. The average rainfall is often more than 200 mm per year.

5. Climate, seasons, temperature, humidity, photoperiods are more or less stable and encourage both variety and numbers.

6. Rich resource and nutrient availability.

Chapter: 12 Environmental Issues

Textbook questions and answers:

1. Right to clean Water is fundamental right, under the Indian Constitution. **b) Article 21**

2. The thickness of Stratospheric Ozone layer is measured in/on **b) Dobson units.**

3. As per 2017 statistics, the highest per capita emitter of Carbon dioxide in the world is..... **b) China.**

4. The use of microorganism metabolism to remove pollutants such as oil spills in the water bodies is known as **b) Bioremediation.**

5. Which among the following always decreases in a food chain across trophic levels? **c) Energy.**

6. In the E-waste generated by the mobile phones which among the following metal is most abundant? **a) Copper**

7. **U-V rays** is an ideal disinfectant for waste water.

8. SMOG is derived from **Smoke and fog**

9. Excess of fluoride in drinking water causes: **Fluorosis**

10. Expand (i) CFC (ii) AQI (iii) PAN

i) Chloro Fluoro Carbons ii) Air Quality Index iii) Peroxy Acetyl Nitrate

11. What is SMOG and how it is harmful for us?

Smog is a type of air pollution caused by tiny particles in the air. The word comes from a mixture of the words smoke and fog .

Smog generally refers to photochemical smog, which is created when sunlight reacts with nitrogen oxides and volatile organic compounds found in fossil fuel emissions from automobiles, factories, and power plants. These reactions create ground-level ozone and particulate matter, reducing visibility. Smog can make breathing more difficult, especially for people with asthma.

12. List all the wastes that you generate, at home, school or during your trips to other places. Could you very easily reduce the generation of these wastes? Which would be difficult or rather impossible to reduce?

S.No	Place	Waste generated	Mode of reduction
1	Home	1. Vegetable, Fruit, Food waste. 2. E-waste	1. They can be composted to form manure. 2. Reduce usage
2	School	Stationary waste/ paper waste	Segregate and sent to recycling unit.
3	Trips	Plastic cups/ Water bottles/ Plates	1. Avoid plastic usage. Use ecofriendly plates/ cups. Throw waste in garbage dry meant for the same in hotels/ trains/ public places.

13. Write notes on the following:**a) Eutrophication:**

run-off from land containing nutrients reaches water bodies like lakes, it results in dense growth of plant life. This phenomenon is called Eutrophication.

b) Algal Bloom:

Algal Bloom is a rapid growth microscopic algae or cyanobacteria in water, due to nutrient enrichment, often enrichment, often resulting in a coloured scum on the surface.

14. What effect can fertilizer runoff have on an aquatic ecosystem?

Agrochemicals have been observed to generate residues that cause nutrients imbalance.

15. How can we control eutrophication? PTA (2019-2020) and (2021- 2022)

Run off from land containing nutrients reaches water bodies like lakes should be avoided.

16. Discuss the role of an individual to reduce environmental pollution.

1. Using public transports, Turnoff the lights when not in use.
2. Recycle and reuse, no to plastic bags, Reduction of forest fires and smoking.
3. Use of fans instead of Air conditioner, Use filters for chimneys, Avoid usage of crackers.

17. How does recycling help reduce pollution?

1. Recycling prevents the emission of many greenhouse gases and water pollutants and saves energy. Using recovered material generates less solid waste.
2. Recycling helps to reduce the pollution caused by the extraction and processing of virgin materials.

18. Discuss briefly the following:**a) Catalytic converter**

Catalytic converter is an exhaust emission control device that reduces toxic gases and pollutants in exhaust gas from an internal combustion engine into less toxic pollutant

by catalyzing a redox reaction.

b) Ecosan toilets.

1. 150 liters of waste water at an average is generated by an Indian individual daily, and a large amount of its is generated from toilets.
2. Ecological sanitation is a sustainable system for handling human excreta by using dry composting toilets.
3. Ecosan toilets not only reduce waste water generation but also generated the natural fertilizer from recycled human excreta, which forms an excellent substitute for chemical fertilizers.
4. This method is based on the principles of recovery and recycling of nutrients from excreta to create a valuable supply for agriculture. 'Ecosan' toilets are being used in several parts of India and Sri Lanka.

19. What are some solutions to toxic dumping in our oceans?

Toxic dumping involves depositing all the waste materials from factories and industries, tankers and ships and disposing sewage waste materials and ships and disposing sewage waste materials into the oceans and seas. Some of them may be toxic.

Ways to prevent ocean pollution are:

1. Avoid plastic usage. It is the single largest threat to oceans.
2. Avoid products containing microbeads.
3. Fat sustainable Reduce energy usage.
4. Practice proper disposal of hazardous materials.
5. Practice organic methods agriculture and less usage of chemical fertilizer/ pesticides etc.
6. Beach cleanup campaigns to be organized and make every individual to practice hygienic methods of waste disposal in beaches.

20. Define BOD.

BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one litre of water were oxidized by bacteria.

21. What is referred to as biomagnification?

non-degradable substances enter the food chain, they do not get metabolized or broken down or expelled and instead get transferred up the tropic levels of the food chain. During this process, they show an increase in concentration which is referred to as biomagnification.

22. What are the effects of noise pollution?

Heart disease, high blood pressure, stress related illness, sleep disruption, hearing loss (deafness), and productivity loss are the problems related to noise pollution.

- Increased stress and tension, nervousness, irritability, anxiety, depression and panic attacks.
- Peptic ulcer, severe head ache, memory loss.
- Marine animals are affected by noise pollution from offshore activities and port activities.
- Fire crackers frighten animals. Birds are often affected by increased air traffic.

Other important questions and answers:

21. Which is referred to as biomagnifications? PTA (2019-2020)

1. Non- degradable substances enter the food chain, they do not get metabolized or broken down or expelled and instead get transferred up the tropic levels of the food chain.
2. During this process they show an increase in concentration which is referred to as biomagnifications.

22. Ecosan toilets are an excellent substitute for chemical fertilizer. How? PTA (2019-2020)

1. The toilet is based on the principle of recovery and recycling of nutrients from excreta to create a valuable resource for agriculture.

2. When the pit of an Ecosan toilet fills up it is closed and sealed.
3. After about eight to nine months the faeces are completely composted to organic manure and can be used on farms.

23. How can we manage medical wastes and e-Waste? (2021-2022)

Management of medical wastes:

The safe and sustainable management of biomedical waste is the social and legal responsibilities of people working in healthcare centers.

Waste disposal: Involved by incineration, chemical disinfection, autoclaving, encapsulation, microwave irradiation are methods of waste disposals. Final disposal includes landfill and burying as per norms inside premises.

Management of e- Waste:

Recycling and disposal of e-waste may involve significant risk to the health of workers and communities in developed countries and great care must be taken to avoid unsafe exposure in recycling operations and leaking of materials such as heavy metals from landfills and incinerator ashes.

24. Radioactive waste management:

Explanation: Radioactive waste management involves the treatment storage and disposal of liquid, airborne, and solid effluents from the nuclear industry.

Methods of disposal of radioactive wastes:

1. **Limit generation:** Limiting the generation of waste.
2. **Dilute and disperse:** Low radioactivity dilution and dispersion are adopted.
3. **Delay and decay:** Nuclear reactors and accelerators is very short lived.
4. **Concentrated and confine Process:** The objective of treatment activities for longer lived radioactivity.

Control and management:

1. **Spent fuel pools:** The spent fuel discharged from the reactors is temporarily stored in the reactor pool.
2. **Vitrification method:** Nuclear waste are encased in dry cement caskets.
3. **Geological repositories:** Nuclear waste repository excavated deep within a stable geologic environment.

23. List the methods of Medical waste disposal.

1. Incineration
2. Chemical disinfection
3. Autoclaving
4. Encapsulation
5. Landfill
6. Burying
7. Microwave irradiation

24. Recycling and disposal of e-waste involve significant risk-justify.

The recycling and disposal of e-waste may involve risk to the health of workers and communities in developed countries.

1. Great care must be taken to avoid unsafe exposure in recycling operation.
2. The leaking of materials like heavy metals from landfills and incinerator ashes may cause health problem to human and animals.

25. Define pollution.

Pollution is any undesirable change in the physical, chemical and biological characteristics of the environment due to natural causes and human activities the agents which cause pollution are called pollutants.

26. Define Global warming.

Increase in the concentrations of greenhouse gases such as CO₂, methane, nitrous oxide, CFCs, and ozone cause green house effect, warming of the earth, resulting in sea level rise, submerging of islands and sea shores of various parts of the world.

27. Define ozone depletion.

Thinning of the stratospheric ozone layer is known as ozone depletion. Depletion causes the ozone hole resulting in poor screening of the harmful UV rays and increase in incidences of skin cancer. Some of the common agents that deplete ozone are CFCs.

28. Define acid rain.

Acid rain is a form of precipitation that contains acidic components such as sulphuric acid or nitric acid. It damages trees, crops and harms marine animals and induces corrosion.

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