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XII COMMON PUBLIC EXAMINATION, MARCH -2022 (17-05-2022)

TENTATIVE ANSWER KEY

Question type A

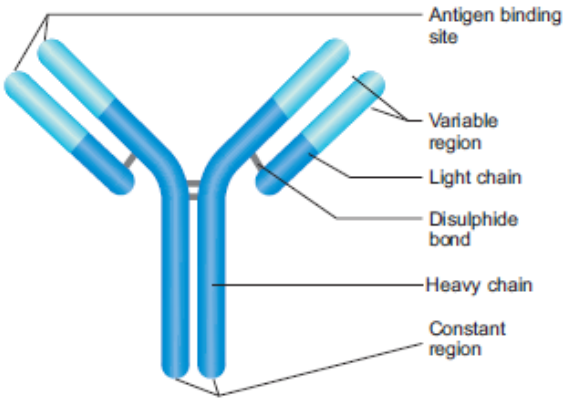
SUB: ZOOLOGY MARKS: 70

Q.NO	CONTENT	MARKS	MODE OF QUESTION
I.	**PART -I** CHOOSE THE CORRECT ANSWER	15 X 1 =15	BOOK BACK / BOOK INSIDE/ CREATIVE
1	d. a deep geological repository	1	BOOK INSIDE
2	c. sexual	1	BOOK BACK
3	a. amphibians	1	BOOK BACK
4	c. intersex	1	BOOK INSIDE
5	c. 3.1 billion	1	BOOK INSIDE
6	D. inhibiting release of FSH & LH	1	BOOK BACK
7	d. Eurytherms	1	BOOK BACK
8	c. Antigen	1	BOOK BACK
9	a. molasses	1	BOOK BACK
10	b. LH→Leydig	1	BOOK

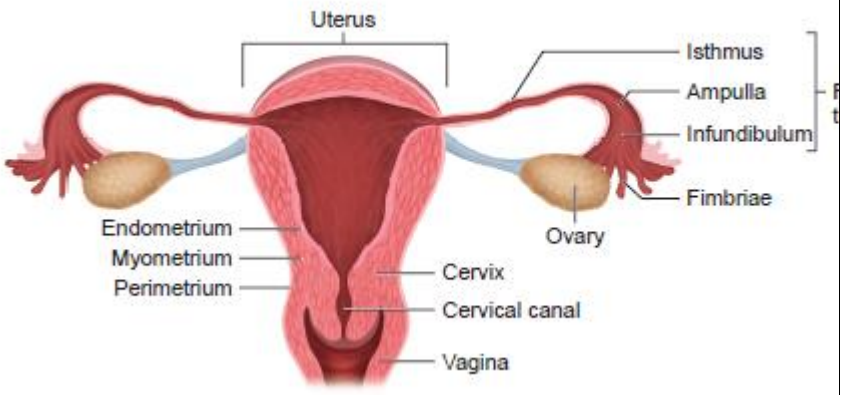
	cells→Testosterone→Spermatogenesis		INSIDE
11	b. Individuals mate selectively	1	BOOK BACK
12	b. Multiple alleles	1	BOOK BACK
13	a. A toxin from plasmodium species	1	BOOK BACK
14	c. Migration	1	BOOK BACK
15	b. Reduce BOD	1	BOOK INSIDE
Q.NO	**CONTENT**	**MARKS**	**MODE OF QUESTION**
II.	**PART -II** ANSWER ANY SIX OF THE FOLLOWING QUESTION NUMBER 24 IS COMPULSORY	6 X 2 = 12	BOOK BACK / BOOK INSIDE/ CREATIVE
16	**Senescent phase** begins at the end of reproductive phase when degeneration sets in the structure and functioning of the body.	2	BOOK BACK
17	**Semen** or seminal fluid is a milky white fluid which contains sperms and the seminal plasma (secreted from the seminal vesicles, prostate gland and the bulbourethal glands). The seminal vesicles secrete an alkaline fluid called seminal plasma containing fructose sugar, ascorbic acid, prostaglandins and a coagulating enzyme called **vesiculase** which enhances sperm motility.	2	BOOK BACK
18	**POCSO Act** (Prevention of children from sexual offences), **Sexual harassment at workplace** (Prevention, prohibition and redressal) Act and the changes in the Criminal law based on the recommendations of **Justice Verma Committee**, 2013 aims at creating a safe and secure environment for both females and males.	1 1	BOOK INSIDE

19	The process of copying genetic information from one strand of DNA into RNA is termed **transcription**. This process takes place in presence of DNA dependent RNA polymerase.	2	BOOK INSIDE
20	The primitive earth had no proper atmosphere, but consisted of ammonia, methane, hydrogen and water vapour. The climate of the earth was extremely high.	2	BOOK INSIDE
21	Infective stage of this parasite is the **trophozoite**, which penetrates the walls of the host intestine (colon) and secretes histolytic enzymes causing ulceration, bleeding, abdominal pain and stools with excess mucus.	2	BOOK INSIDE
22	**Zymology** is an applied science which deals with the biochemical process of fermentation and its practical uses.	2	BOOK BACK
23	**Mass extinction:** The earth has experienced quite a few mass extinctions due to environmental catastrophes. A mass extinction occurred about 225 million years ago during the Permian, where 90% of shallow water marine invertebrates disappeared.	2	BOOK BACK
24	The PCR technique can also be used for amplifications of RNA in which case it is referred to as reverse transcription PCR (RT-PCR). 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. So the above method in PCR help to diagnosing Corona Virus	1 1	BOOK INSIDE

Q.NO	CONTENT	MARKS	MODE OF QUESTION
III.	**PART -III** ANSWER ANY SIX OF THE FOLLOWING QUESTION NUMBER 33 IS COMPULSORY	6 X 3 = 18	BOOK BACK / BOOK INSIDE/ CREATIVE
25	**Female foeticide** refers to 'aborting the female in the mother's womb'; whereas female **infanticide** is 'killing the female child after her birth'	1.5 1.5	BOOK BACK
26	**Prevention of Eryhroblastosis foetalis** 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 gestation as a prophylactic measure. If the Rh negative mother delivers Rh positive child then anti D antibodies should be administered to the mother soon after delivery. This develops passive immunity and prevents the formation of anti D antibodies in the mothers blood by destroying the Rh foetal RBC before the mother's immune system is sensitized. This has to be done whenever the woman attains pregnancy.	1 1 1	BOOK INSIDE
27	**Malaria vaccine** is used to prevent malaria. The only approved vaccine as of 2015 is RTS,S(Mosquirix). It requires four injections and has relatively low efficacy (26–50%). Due to this low efficacy, WHO does not recommend the use of RTS,S vaccine in babies between 6 and 12 weeks of age.	1 1 1	BOOK INSIDE

28	 Fig. 7.15 Structure of immunoglobulin	3	BOOK BACK
29	A microbial fuel cell is a bio-electrochemical system that drives an electric current by using bacteria and mimicking bacterial interaction found in nature **(F**. Microbial fuel cells work by allowing bacteria to oxidize and reduce organic molecules. Bacterial respiration is basically one big redox reaction in which electrons are being moved around. A MFC consists of an anode and a cathode separated by a proton exchange membrane. 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 external circuit to generate current.	1 1 1	BOOK BACK
30	Organisms which can survive a wide range of temperature are referred to as **Eurytherms** (cat, dog, tiger, human). Those organisms which can tolerate only a narrow range of temperature are **Stenotherms** (Fish, Frogs, Lizards and Snakes).	1.5 1.5	BOOK BACK

31	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 ecosystems and is obtaining by comparing the number of species unique to each of the ecosystem. iii. Gamma diversity refers to the diversity of the habitats over the total landscape or geographical area.	1 1 1	BOOK INSIDE
32	(i) It is a method of farming system which primarily aims at cultivating the land and raising crops in such a way: so as tokeep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an ecofriendly pollution free environment. (ii) Use of fertilizer pesticides will always lead to surface runoff. One only way to prevent surface runoff will be to reason to organic farming.	2 1	BOOK BACK
33	**Multipotency (multi-Many)** refers to the stem cells that can differentiate into various types of cells that are related. For example blood stem cells can differentiate into lymphocytes, monocytes , neutrophils etc., **Oligopotency (Oligo-Few)** refers to stem cells that can differentiate into few cell types. For example lymphoid or myeloid stem cells can differentiate into B and T cells but not RBC.	1.5 1.5	BOOK BACK

Q.NO	CONTENT	MARKS	MODE OF QUESTION
	PART –IV		
IV.	ANSWER ALL THE QUESTION	5 X 5 = 25	BOOK BACK / BOOK INSIDE/ CREATIVE
34 (a)	The uterus or womb is a hollow, thick-walled, muscular, highly vascular and inverted pear shaped structure lying in the pelvic cavity between the urinary bladder and rectum. The major portion of the uterus is the body and the rounded region superior to it, is the **fundus**. The uterus opens into the vagina through a narrow **cervix**. The cavity of the cervix called the cervical canal communicates with the vagina through the external orifice and with the uterus through the internal orifice. The cervical canal along with vagina forms the birth canal. The wall of the uterus has three layers of tissues. The outermost thin membranous serous layer called the **perimetrium**, the middle thick muscular layer called **myometrium** and the inner glandular layer called **endometrium**. The endometrium undergoes cyclic changes during the menstrual cycle while myometrium exhibits strong contractions during parturition.  	2 2 1	BOOK INSIDE
34 (b)	Major tasks carried out under these programmes are: *Creating awareness and providing medical assistance to build a healthy society. *Introducing sex education in schools to provide information about adolescence and adolescence related changes.	1 1	BOOK INSIDE

	*Educating couples and those in the marriageable age groups about the available birth control methods and family planning norms. *Creating awareness about care for pregnant women, post-natal care of mother and child and the importance of breast feeding. *Encouraging and supporting governmental and non-governmental agencies to identify new methods and/or to improve upon the existing methods of birth control.	1 1 1	
35 (a)	The cellular factory responsible for synthesizing protein is the ribosome. The ribosome consists of structural RNAs and about 80 different proteins. In inactive state, it exists as two subunits; large subunit and small subunit. When the subunit encounters an mRNA, the process of translation of the mRNA to protein begins. The prokaryotic ribosome (70 S) consists of two subunits, the larger subunit (50 S) and smaller subunit(30 S). The ribosomes of eukaryotes (80 S) are larger, consisting of 60 S and 40 S sub units. 'S' denotes the sedimentation efficient which is expressed as Svedberg unit (S). The 30 S subunit of bacterial ribosome contains 16Sr RNA and 50 S subunit contains 5Sr RNA molecules and 23 S RNA and 31 ribosomal proteins. The larger subunit in eukaryotes consist of a 23 S RNA and 5Sr RNA molecule and 31 ribosomal proteins. The smaller eukaryotic subunit consist of 18Sr RNA component and about 33 proteins. One of the alternative ways of dividing up a sequence of bases in DNA or RNA into codons is called **reading frame**. 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)**. A translational unit in mRNA is the sequence of RNA that is flanked by the start codon (AUG) and the stop codon and codes for polypeptides. mRNA also have some additional sequences that are not translated and are referred to as **Untranslated Regions (UTR).** UTRs are present at both 5' end (before start codon) and at 3' end (after stop codon). The start codon **(AUG)** begins the coding sequence and is read by a special tRNA that carries methionine (met). The initiator tRNA charged with methionine binds to the AUG start codon. In prokaryotes, N - formyl methionine (f_{met}) is attached to the initiator tRNA whereas in eukaryotes unmodified methionine is used. The 5' end of the mRNA of prokaryotes has a special sequence which precedes the initial AUG start codon of mRNA. This ribosome binding site is called the **Shine – Dalgarno sequence** or **S-D sequence**. This sequences base-pairs with a region of the 16Sr RNA of the small ribosomal subunit facilitating initiation. The subunits of the ribosomes (30 S and 50 S) are usually dissociated from each other when not involved in translation**.** **Initiation** of translation in *E. coli* begins with the formation of an initiation complex, consisting of the 30S subunits of the	5	BOOK INSIDE

ribosome, a messenger RNA and the charged N-formyl methionine tRNA (f_{met} – t

RNA f_{met}), three proteinaceous initiation factors (IF1, IF2, IF3), GTP(Guanine Tri Phosphate) and Mg^{2+}.

The components that form the initiation complex interact in a series of steps. IF3 binds to the 30S and allows the 30S subunit to bind to mRNA. Another initiation protein (IF2) then enhances the binding of charged formyl methionine tRNA to the small subunit in response to the AUG triplet. This step 'sets' the reading frame so that all subsequent groups of three ribonucleotides are translated accurately.

The assembly of ribosomal subunits, mRNA and tRNA represent the initiation complex. Once **initiation complex** has been assembled, IF3 is released and allows the initiation complex to combine with the 50S ribosomal subunit to form the complete ribosome (70S). In this process a molecule of GTP is hydrolyzed providing the required energy and the initiation factors (IF2 and IF2 and GDP) are released.

Elongation is the second phase of translation. Once both subunits of the ribosomes are assembled with the mRNA, binding sites for two charged tRNA molecules are formed. The sites in the ribosome are referred to as the aminoacyl site (A site), the peptidyl site (P site) and the exit site (E site). The charged initiator tRNA binds to the P site. The next step in prokaryotic translation is to position the second tRNA at the 'A' site

of the ribosome to form hydrogen bonds between its anticodon and the second codon on the mRNA (step1). This step requires the correct transfer RNA, another GTP and two proteins called elongation factors (EF-Ts and EF-Tu).

Once the charged tRNA molecule is positioned at the A site, the enzyme peptidyl transferase catalyses the formation of peptide bonds that link the two amino acids together (step 2). At the

same time, the covalent bond between the amino acid and tRNA occupying the P site is hydrolyzed (broken). The product of this reaction is a dipeptide which is attached to the 3' end of tRNA still residing in the A site. For elongation to be repeated, the tRNA attached to the P site, which is now uncharged is released from the large subunit. The uncharged tRNA moves through the **'E' site** on the ribosome.

The entire mRNA-tRNA-aa1-aa2 complex shifts in the direction of the **'P' site** by a distance of three nucleotides (step 3). This step requires several elongation factors (EFs) and the energy derived from hydrolysis of GTP. This results in the third triplet of mRNA to accept another charged tRNA into the A site (step 4). The sequence of elongation is repeated over and over (step 5 and step 6). An additional amino acid is added to the growing polypeptide, each time mRNA advances through the ribosome. Once a polypeptide chain is assembled, it emerges out from the

base of the large subunit (**Fig. 5.13 c**).

Termination is the third phase of translation. Termination of protein synthesis occurs when one of the three stop codons appears in the 'A' site of the ribosome. The terminal codon signals the action of **GTP – dependent release factor,** which cleaves the polypeptide chain from the terminal tRNA releasing it from the translational complex (step 1). The tRNA is then released from the ribosome, which then dissociates into its

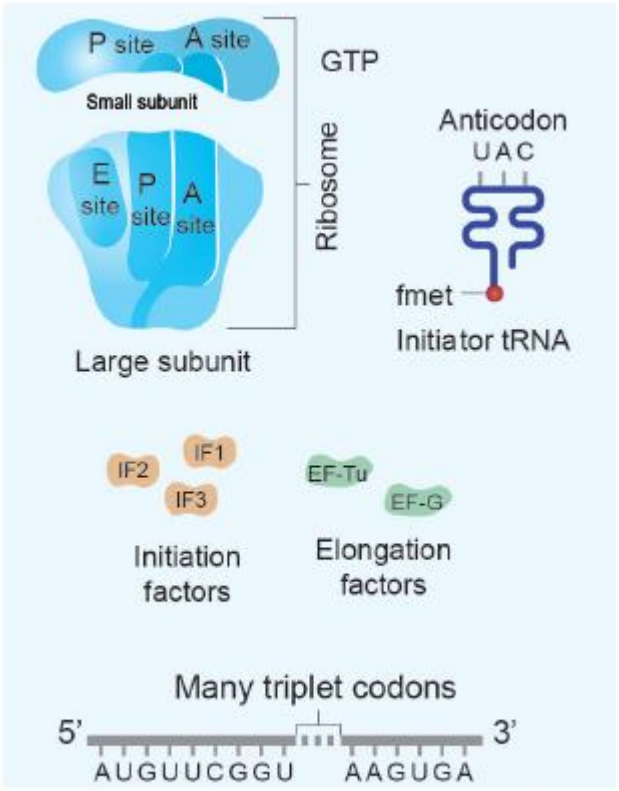


Fig. 5.13 a-Translation components

subunits

35 (b)	The salient features of genetic code are as follows: 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**)**. . 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. 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. However similarities are more common than differences. • 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. • It is comma less, which means that the message would be read	5	BOOK INSIDE

	directly from one end to the other i.e., no punctuation are needed between two codes. • 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. • Non-ambiguous code means that one codon will code for one amino acid. • The code is always read in a fixed direction i.e. from 5'→3' direction called polarity. • AUG has dual functions. It acts as a initiator codon and also codes for the amino acid methionine. UAA, UAG (tyrosine) and UGA (tryptophan) codons are designated as termination (stop) codons and also are known as "non-sense" codons. (ANY FIVE)		
36 (a)	Suppose we have a large population of beetles, (infinitely large) and appear in two colours dark grey (black) and light grey, and their colour is determined by 'A' gene. 'AA' and 'Aa' beetles are dark grey and 'aa' beetles are light grey. 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. If a population is in Hardy Weinberg equilibrium, the genotype frequency can be estimated by Hardy Weinberg equation. $(p + q)^2 = p^2 + 2pq + q^2$ p^2 = frequency of AA 2pq= frequency of Aa q^2= frequency of aa p = 0.3, q = 0.7 then, $p^2 = (0.3)^2 = 0.09 = 9$ % AA 2pq = 2(0.3) (0.7) = 0.42 = 42 % Aa $q^2 = (0.7)^2$ 0.49 = 49 % aa Hence the beetle population appears to be in Hardy- Weinberg equilibrium. When the beetles in Hardy- Weinberg equilibrium reproduce, the allele and genotype frequency in the next generation would be: Let's assume that the frequency of 'A' and 'a' allele in the pool of gametes that make the next generation would be the same, then there would be no variation in the progeny. The genotype frequencies of the parent appears in the next generation. (i.e. 9% AA, 42% Aa and 49% aa). If we assume that the beetles mate randomly (selection of male gamete and female gamete in the pool of gametes), the probability of getting the offspring genotype depends on the genotype of the combining parental gametes.	1 1 1 1 1	BOOK BACK

36 (b)

Table 7.1. Bacterial diseases in human beings

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

ANY FIVE

5

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37 (a)

Innate immunity is the natural phenomenon of resistance to infection which an individual possesses right from the birth. The innate defense mechanisms are non-specific in the sense that they are effective against a wide range of potentially infectious agents. It is otherwise known as **non-specific immunity** or **natural immunity.**

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Table 7.4 Innate immunity- types and mechanisms

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.

37 (b) 5 BOOK INSIDE

PCR (Polymerase Chain Reaction)

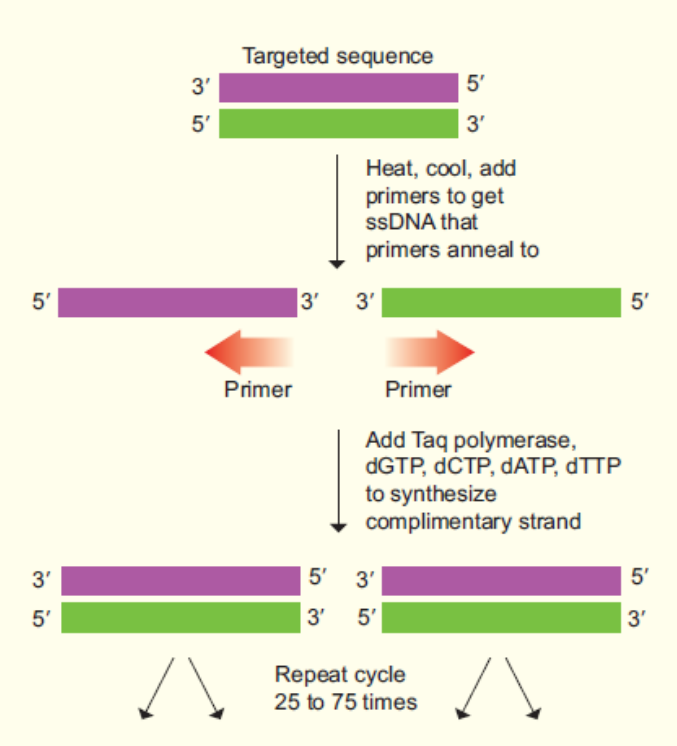
The polymerase chain reaction (PCR) is an *invitro* amplification technique used for synthesising multiple identical copies (billions) of DNA of interest. The technique was developed by **Kary Mullis** (Nobel laureate, 1993) in the year 1983.

Denaturation, renaturation or primer annealing and synthesis or primer extension, are the three steps involved in PCR **(Fig. 9.7).** The double stranded DNA of interest is denatured to separate into two individual strands by high temperature . This is called **denaturation**. 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.

During denaturation the reaction mixture is heated to 95^0 C for a short time to denature the target DNA into single strands that will act as a template for DNA synthesis. 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. During primer extension or synthesis the temperature of the mixture is increased to 75^0C for a sufficient period of time to allow Taq DNA polymerase to extend each primer by copying the single stranded template. At the

end of incubation both single template strands will be made partially double stranded. 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

The PCR technique can also be used for amplifications of RNA in

	which case it is referred to as reverse transcription PCR (RT-PCR). 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.  **Fig. 9.8 Polymerase chain reaction**		
38 (a)	Water is one of the main agents in Pedogenesis (soil formation). It is the medium for several different ecosystems. It is present as moisture in the atmosphere and the outer layers of the lithosphere and is uneven in distribution on the earth. Water is heavier than air and imparts greater buoyancy to the aquatic medium. This enables organism to float at variable levels. 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. Water is physically unique because it is less dense as a solid (ice) than as a liquid. When water freezes (0ºC), it contracts. The maximum density of liquid water occurs at 4ºC. 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	5	BOOK BACK

	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. 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. (ANY FIVE)		
38 (b)	Any kind of waste that contains infectious material generated by hospitals, laboratories, medical research centers, Pharmaceutical companies and Veterinary clinics are called medical wastes. Medical wastes contain body fluids like blood, urine, body parts and other contaminants, culture dishes, glasswares, bandages, gloves, discarded needles, scalpels, swabs and tissues. **Management:** 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. **E-Waste** Electronic waste or e-waste describes discarded electrical electronic devices as well as any refuse created by discarded electronic devices and components and substances involved in their manufacture or use. Their disposal is a growing problem because electronic equipment frequently contains hazardous substances. In a personal computer, for example, there may be lead (Pb) in the cathode ray tube (CRT) and soldering compound, mercury (Hg) in switches and housing, and cobalt (Co) in steel components, among other equally toxic substances. E-wastes are basically PCB (Polychlorinated biphenyl) based, which are non-degradable Used electronics which are destined for reuse, resale, salvage, recycling, or disposal are also considered e-waste. Unauthorised processing of e-waste in developing countries can lead to adverse human health effects and environmental pollution. 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.	2.5 2.5	BOOK BACK

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