PETIT SEMINAIRE HIGHER SECONDARY SCHOOL – PUDUCHERRY

UNIT – 6 NUCLEAR PHYSICS

STD: X SELF – EVALUATION

I. Choose the best answer:

1. **(D)** a & c
2. **(D)** all the above
3. **(B)** Irene Curie
4. **(B)** (ii) and (iii) are correct
5. **(B)** Radio Cobalt
6. **(C)** it produces genetic disorder
7. **(C)** Lead
8. **(D)** (iii) & (iv) are correct
9. **(C)** Nuclear fusion
10. **(B)** 8,4
11. **(A)** Kalpakkam
12. **(B)** (i) & (ii) are correct

II. Fill in the blanks:

1. Wrong question
2. Antiparticles of electron (or) elementary particle
3. Radio iron (Fe^{59})
4. International Commission on Radiological Protection
5. Dosimeter
6. Gamma rays
7. Beta particle
8. Gamma
9. 3.84×10^{-12} J
10. 10^7 to 10^9 K
11. Phosphorus
12. Leukemia (or) cancer

III. State whether the following statements are true or false:

1. True
2. False

   Correct statement: Elements having atomic number greater than 83 can undergo natural radioactivity.

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3. True
4. False

   Correct statement: Natural Uranium U – 235 is the core fuel used in a nuclear reactor.
5. False

   Correct statement: If a control rod is not present, then a nuclear reactor will behave as an atom bomb.
6. True
7. True

IV. Match the following:

Match I

S.No	Column 1	Column 2
a	BARC	Mumbai
b	India's first atomic power station	Tarapur
c	IGCAR	Kalpakkam
d	First nuclear reactor in India	Apsara

Match II

S.No	Column 1	Column 2
a	Fuel	Uranium
b	Moderator	Heavy water
c	Coolant	Cadmium rods
d	Shield	Lead

Match III

S.No	Column 1	Column 2
a	Soddy fajan	Displacement law
b	Irene Curie	Artificial radioactivity
c	Henry Bequerel	Natural radioactivity
d	Albert Einstein	Mass energy equivalence

Match IV

S.No	Column 1	Column 2
a	Uncontrolled fission reaction	Atom bomb
b	Fertile material	Breeder reactor
c	Controlled fission reaction	Nuclear reactor

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d	Fusion reaction	Hydrogen bomb

Match V

S.No	Column 1	Column 2
a	Co – 60	Leukemia
b	I – 131	Thyroid disease
c	Na – 24	Function of heart
d	C - 14	Age of fossil

V. Arrange the following in the correct sequence:

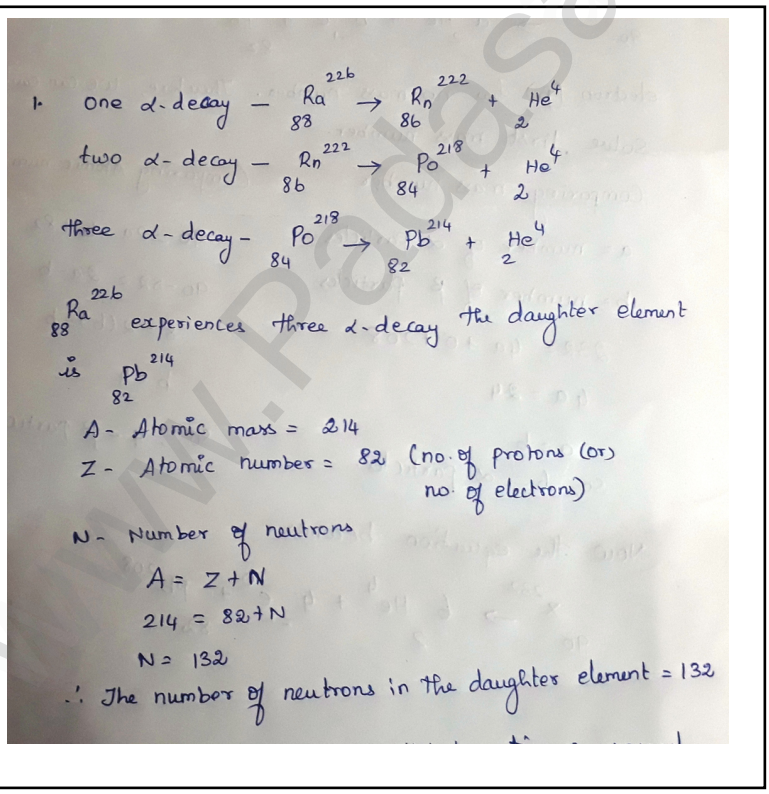
1. Gamma rays > Beta rays > Alpha rays > Cosmic rays.
2. Radioactivity > Discovery of radium > Artificial radioactivity > Nuclear reactor.

VI. Use the analogy to fill in the blank:

1. Artificial radioactivity.
2. Room temperature
3. Radio sodium
4. γ – Ray (Gamma).

VII. Numerical problems:

1. Ans:



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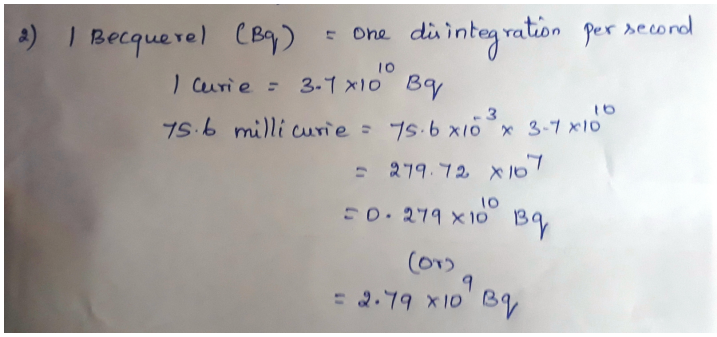
2. Ans:



VIII. Assertion & Reasoning:

1. (a) If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
2. (a) If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
3. (c) Assertion is true, but the reason is false.
4. (a) If both the assertion and the reason are true and the reason is the correct explanation of the assertion.

IX. Answer in one or two word:

1. Henri Becquerel
2. Uranium
3. Boron, Aluminium.
4. Alpha, Beta and Gamma
5. Atomic number = 106, Mass number = 263
6. 200 Mev (or) 3.2 x 10 -11 J
7. Gamma radiation
8. 600 R
9. 1942 at Chicago, U.S.A
10. Becquerel (Bq)
11. Lead

X. Answer the following questions in few sentences:

1. Ans:

S.No.	Natural radioactivity	Artificial radioactivity
1	Emission of radiation due to self-disintegration of a nucleus.	Emission of radiation due to disintegration of a nucleus through induced process.
2	Alpha, beta and gamma radiations are emitted.	Mostly elementary particles such as neutron, positron, etc. are emitted.
3	It is a spontaneous process.	It is an induced process.
4	Exhibited by elements with atomic number more than 83.	Exhibited by elements with atomic number less than 83.
5	This cannot be controlled.	This can be controlled.

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2. To sustain the chain reaction, the rate of production of neutrons due to nuclear fission must be more than the rate of its loss. This can be achieved only when the size (i.e mass) of the fissionable material is equal to a certain optimum value is known as “critical mass”. (or) The minimum mass of a fissile material necessary to sustain the chain reaction is called critical mass. It depends on the nature, density and the size of the fissile material.
3. One roentgen is defined as the quantity of radioactive substance which produces a charge of 2.58×10^{-4} coulomb in 1 kg of air under standard conditions of pressure, temperature and humidity.
4. Ans:

(i) When a radioactive element emits an alpha particle, a daughter nucleus is formed whose mass number is less by 4 units and the atomic number is less by 2 units, than the mass number and atomic number of the parent nucleus.	(ii) When a radioactive element emits a beta particle, a daughter nucleus is formed whose mass number is the same and the atomic number is more by 1 unit, than the atomic number of the parent nucleus.

5. Control rods are used to control the number of neutrons in order to have sustained chain reaction. Mostly boron or cadmium rods are used as control rods. They absorb the neutrons.
6. Ans:
   - In Japan a birth defect, also known as a congenital disorder is a condition prevent at birth regardless of its cause.
   - Birth defects may result in disabilities that may be physical, intellectual, or developmental. The disabilities can range from mild to serve.
   - Some birth defects include both structural and functional disorders.

   Reason:

   The detonation of atomic bomb over Hiroshima and Nagasaki in August 1945 resulted in the long term effects of radiation exposure also increased cancer rates in the survivors.

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7. Ans:

- Radioactive materials should be kept in a thick walled lead container.
- Lead coated aprons and lead gloves should be used while working with hazardous radioactive materials.
- You should avoid eating while handling radioactive materials.
- The radioactive materials should be handled only by tongs or by a remote control device.
- Dosimeters should be worn by the users to check the level of radiation.

8. Fusion reactions that take place in the cores of the sun and other stars results in an enormous amount of energy, which is called as stellar energy.

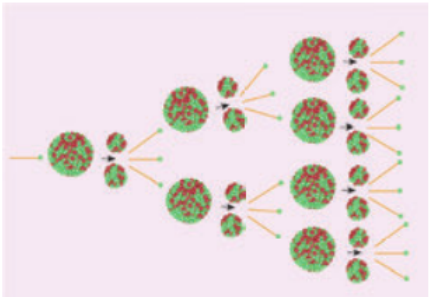
9. Ans:

The radio isotope of phosphorous (P-32) helps to increase the productivity of crops. The radiations from the radio isotopes can be used to kill the insects and parasites and	prevent the wastage of agricultural products. Certain perishable cereals exposed to radiations remain fresh beyond their normal life, enhancing the storage time. Very small doses of radiation prevent sprouting and spoilage of onions, potatoes and gram.

XI. Answer the following questions in detail:

1. Controlled chain reaction:
   - In the controlled chain reaction, the number of neutrons released is maintained to be one.
   - This is achieved by absorbing the extra neutrons with a neutron absorber leaving only one neutron to produce further fission.
   - Thus, the reaction is sustained in a controlled manner. The energy released due to a controlled chain reaction can be utilized for constructive purposes.
   - Controlled chain reaction is used in a nuclear reaction to produce energy in a sustained and controlled manner.

   Uncontrolled chain reaction:



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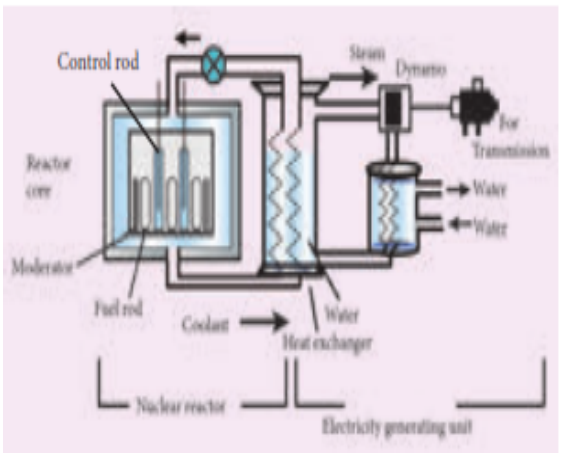
- In the uncontrolled chain reaction the number of neutrons multiples indefinitely and causes fission in a large amount of the fissile material.
- This results in the release of a huge amount of energy within a fraction of a second.
- This kind of chain reaction is used in the atom bomb to produce an explosion.

2. Ans:

Properties	α rays	β rays	γ rays
What are they?	Helium nucleus ($_2He^4$) consisting of two protons and two neutrons.	They are electrons ($_{-1}e^0$), basic elementary particle in all atoms.	They are electromagnetic waves consisting of photons.
Charge	Positively charged particles. Charge of each alpha particle = +2e	Negatively charged particles. Charge of each beta particle = –e	Neutral particles. Charge of each gamma particle = zero
Ionising power	100 time greater than β rays and 10,000 times greater than γ rays	Comparatively low	Very less ionization power
Penetrating power	Low penetrating power (even stopped by a thick paper)	Penetrating power is greater than that of α rays. They can penetrate through a thin metal foil.	They have a very high penetrating power greater than that of β rays. They can penetrate through thick metal blocks.
Effect of electric and magnetic field	Deflected by both the fields. (in accordance with Fleming's left hand rule)	Deflected by both the fields; but the direction of deflection is opposite to that for alpha rays. (in accordance with Fleming's left hand rule)	They are not deflected by both the fields.
Speed	Their speed ranges from 1/10 to 1/20 times the speed of light.	Their speed can go up to 9/10 times the speed of light.	They travel with the speed of light.

3. A nuclear reactor is a device in which the nuclear fission reaction takes place in a self sustained and controlled manner to produce electricity.
The essential components of a nuclear reactor are (i) fuel (ii) moderator (iii) control rod (iv) coolant (v) protection wall.

i. **Fuel:** A fissile material is used as the fuel. The commonly used fuel material is uranium.
ii. **Moderator:** A moderator is used to slow down the high energy neutrons to provide slow neutrons. Graphite and heavy water are the commonly used moderators.
iii. **Control rod:** Control rods are used to control the number of neutrons in order to have sustained chain reaction. Mostly boron or cadmium rods are used as control rods. They absorb the neutrons.
iv. **Coolant:** A coolant is used to remove the heat produced in the reactor core, to produce steam. This steam is used to run a turbine in order to produce electricity. Water, air and helium are some of the coolants.
v. **Protection wall:** A thick concrete lead wall is built around the nuclear reactor in order to prevent the harmful radiations from escaping into the environment.



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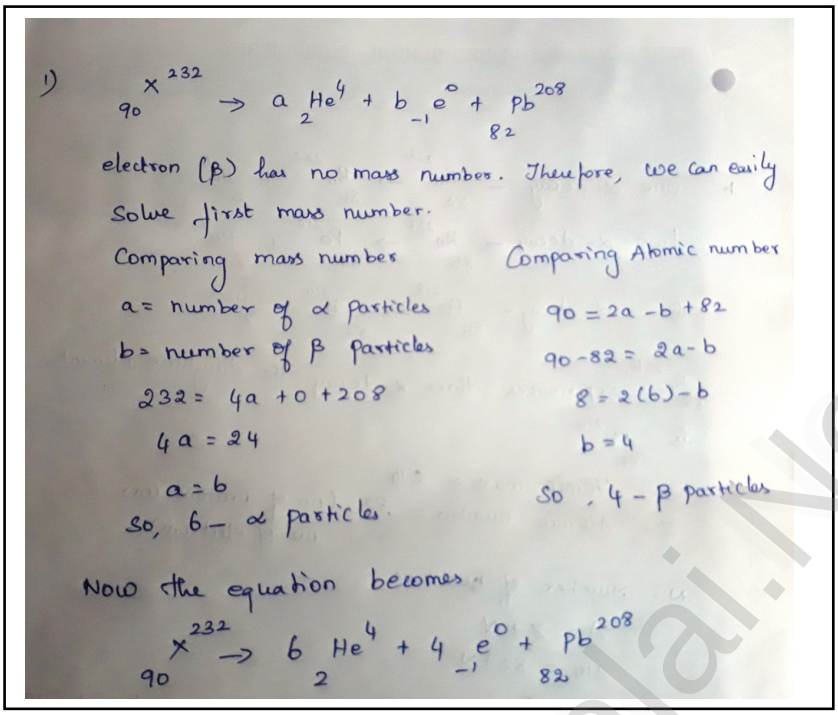
XII. HOT question:

1. Ans:



2. Ans:

- X – rays should not be taken often. The reason is X – rays are not safe that radiation exposure can cause cell mutations that may lead to cancer.
- But the amount of radiation you're exposed to during an X – ray depends on the tissue or organ being examined.
- Sensitivity to the radiation depends on your age, with children being more sensitive than adults.
- It is better to wear lead aprons while taking X – ray films.

3. Ans:

- Living near cell phone tower is not healthy.
- Cell phone towers emit high frequency radio waves or microwaves, which are dangerous to humans.
- Cell phone towers communicate by use of pulsed microwave signals with each other.
- There are multiple health risks like Cancer, Birth defects, memory loss etc., associated with living near cell phone tower.
- So it is better to place cell phone towers far away from residential areas.

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