Anjuman Islam Janjira Degree College of Science Murud-Janjira, Raigad-402401 Affiliated to University of Mumbai	
Class: -F.Y.B.Sc.	**Subject: - Physics - II**
Semester:- I	**Course code: -USPH102**
Exam Event:- Additional Exam Summer 2024 (FH)	**Marks: -75**
Date:- 28/03/2024	**Duration:- 2.30 Hours**

Q1. Attempt any Four of the following. **(20)**

1) Describe the concept of nuclear density.

2) Write a note on Packing fraction.

3) What is Binding Energy and Binding Energy per nucleon? Explain it in detail.

4) Sate and explain laws of radioactive decay.

5) Write a short note on carbon dating?

6) Radioactive material reduces to its 20% of its initial quantity in 10 hrs. find decay constant and half-life.

Q 2. Attempt any Four of the following. **(20)**

1) Write principal, construction and working of gas filled detector.

2) Write difference between proportional counter and GM Counter.

3) An alpha particle loses all its energy in a gas and produces 10^5 ion-pairs if the energy requires to create one ion pair is 35 eV what is the energy of an alpha particle.

4) Describe the concept of Q value equation.

5) Write conservation laws of nuclear reaction.

6) Write Q value of following nuclear reaction.

$$H_1^1 + Li_3^7 \rightarrow He_2^4 + He_2^4$$

Q 3. Attempt any Four of the following. **(20)**

1) Explain the concept of wave particle duality.

2) Calculate the wavelength of matter wave associated with a mass of m = 6.62 x 10^{-2} kg. and moving with velocity 2 m/s where h is 6.62 x 10^{-34} J.s.

3) Draw a labeled diagram of Coolidge tube.

4) Calculate the wavelength of X-rays, if the glancing angle for first order is 12^o. with crystal and lattice constant 2.8 x 10^{-10}m.

5) Write any five properties of X-rays.

6) Write short note on pair production and pair annihilation.

Q4. A) Select correct answer. **(Solve any 8 out of 12)** **(08)**

1) Which of the following particles has the least mass?

a) Proton b) Neutron c) Electron d) Positron

2) The approximate nuclear radius is proportional to (A is the mass number and Z is the atomic number)

a) $\sqrt{A}$ b) $\sqrt{Z}$ c) $A^{1/3}$ d) $Z^{1/3}$

3) Which of the following is a natural radioactive series?

a) Thorium series b) Uranium series c) Radium series d) All of the above

4) Which type of radiation is the most penetrating?

a) Alpha radiation b) Beta radiation c) Gamma radiation d) Neutron radiation

5) What is the main advantage of a scintillation detector over a gas-filled detector?

a) Higher sensitivity b) Lower cost

c) Simplicity of construction d) Lower energy resolution

6) Which radiation detector is commonly used in medical imaging (X-ray machines)?

a) Ionization chamber b) Scintillation detector

c) Geiger-Muller counter d) Proportional counter

7) In a nuclear reaction, if the Q value is positive, what can be inferred about the reaction?

a) The reaction is endothermic b) The reaction is exothermic

c) The reaction is at equilibrium d) The reaction cannot occur

8) Which type of nuclear reaction involves the target nucleus absorbing an incident particle and then emitting a different particle?

a) Compound reaction b) Direct reaction

c) Fusion reaction d) Fission reaction

9) According to the de Broglie wavelength equation, the wavelength (λ) of a particle is inversely proportional to its:

a) Energy b) Momentum c) Mass d) Charge

10) Heisenberg's Uncertainty Principle states that it is impossible to simultaneously know both the exact position and the exact _____ of a particle.

a) Energy b) Momentum c) Velocity d) Angular momentum

11) X-rays are produced when high-speed electrons collide with:

a) Protons b) Neutrons c) Heavy nuclei d) Target atoms

12) X-ray diffraction is a powerful tool used to determine the:

a) Speed of X-rays b) Intensity of X-rays

c) Structure of crystalline substances d) Frequency of X-rays

Q4. B) Answer in one sentence (Solve any three out of five) (03)

1) Find the diameter of Fe^{56} nucleus.

2) What is artificial radioactivity?

3) What is the primary interaction mechanism between alpha particles and matter in a gas-filled radiation detector?

4) What did the Davisson-Germer experiment demonstrate regarding the wave nature of electrons?

5) According to Heisenberg's Uncertainty Principle, what two properties of a particle cannot be precisely known simultaneously?

Q4. C) Fill in the Blanks (Solve any four out of six) (04)

1) Nuclei have a high _____due to the concentration of mass in a small volume.

2) The _____ of a radioactive substance is the time required for half of the nuclei in a sample to decay.

3) The amount of ionization produced by radiation is directly proportional to the _____ and charge of the radiation particles.

4) Nuclear reactions involve changes in the _____ of atomic nuclei.

5) Phase velocity refers to the speed at which the _____ of a wave propagates through space.

6) X-rays have high _____ and can penetrate matter, making them useful for medical imaging and material analysis.