

**Anjuman Islam Janjira Degree College of Science**  
**Murud-Janjira, Raigad-402401**  
**Affiliated to University of Mumbai**

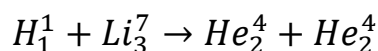
<b>Class: -F.Y.B.Sc.</b>	<b>Subject: - Physics - II</b>
<b>Semester:- I</b>	<b>Course code: -USPH102</b>
<b>Exam Event:- Additional Exam Summer 2024 (FH)</b>	<b>Marks: -75</b>
<b>Date:- 28/03/2024</b>	<b>Duration:- 2.30 Hours</b>

**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) State 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.



**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  $m = 6.62 \times 10^{-2}$  kg. and moving with velocity 2 m/s where h is  $6.62 \times 10^{-34}$  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  $12^\circ$ . with crystal and lattice constant  $2.8 \times 10^{-10}$ 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 ( $\lambda$ ) 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  $\text{Fe}^{56}$  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.