ICSE CLASS 10 EXAMINATION

PRACTICE QUESTION PAPER

PHYSICS

Chapter 12 : RADIOACTIVITY

(Atomic Structure · Isotopes and Isobars · α, β and γ Radiations · Nuclear Changes · Uses and Hazards · Nuclear Fission and Fusion)

Maximum Marks: 40 **Time allowed: One hour**

1. Answers to this Paper must be written on the paper provided separately.

2. You will not be allowed to write during the first 5 minutes. This time is to be spent in reading the question paper.

3. The time given at the head of this Paper is the time allowed for writing the answers.

*4. **Section A** is compulsory. Attempt **all** questions from Section A and **any two** questions from Section B.*

5. The intended marks for questions or parts of questions are given in brackets [ ].

6. Take 1 a.m.u. = 931 MeV, speed of light $c = 3 \times 10^8$ m s^{-1} and 1 kWh = 3.6×10^6 J. Figures are for completion and labelling on the answer sheet.

SECTION A (20 Marks)

(Attempt all questions from this Section.)

Question 1

Choose the correct answers to the questions from the given options. *(Do not copy the question, write the correct answers only.)* **[8]**

(i) The number of neutrons in the nucleus of the sodium atom $^{23}_{11}Na$ is:

(a) 11 (b) 12

(c) 23 (d) 34

(ii) Which of the following radiations has the highest penetrating power?

(a) alpha particles (b) beta particles

(c) gamma radiations (d) ultraviolet rays

(iii) Isotopes of an element have the same:

(a) mass number (b) number of neutrons

(c) atomic number (d) number of nucleons

(iv) In β-emission from a radioactive substance, the electron comes from:

(a) the outermost orbit of the atom (b) the inner orbits of the atom

(c) the surface of the substance (d) the nucleus of the atom

(v) Assertion (A): In the same magnetic field, α-particles are deflected less than β-particles.

Reason (R): An α-particle has a much greater mass than a β-particle.

(a) (A) is true and (R) is false.

(b) (A) is false and (R) is true.

(c) Both (A) and (R) are true, and (R) is the correct explanation for (A).

(d) Both (A) and (R) are true, but (R) is not the correct explanation for (A).

(vi) When a nucleus emits an α-particle, its atomic number and mass number change by:

(a) −2 and −4 (b) +1 and 0

(c) −4 and −2 (d) 0 and 0

(vii) A loss of mass of 0.1 a.m.u. in a nuclear reaction releases energy equal to (1 a.m.u. = 931 MeV):

(a) 9.31 MeV (b) 93.1 MeV

(c) 931 MeV (d) 9310 MeV

(viii) A nuclear fusion reaction needs a temperature of nearly:

(a) 10^3 K (b) 10^5 K

(c) 10^7 K (d) 10^{10} K

Question 2

(a) Define (i) atomic number and (ii) mass number of an element. **[2]**

(b) Fig. 1 shows the model of a neutral atom. Its nucleus contains 6 protons and 8 neutrons, and the electrons are arranged in the K and L shells. **[3]**

(i) State the atomic number of the atom. **[1]**

(ii) Find its mass number and write the symbol of the atom in the form ${}^{A}_{Z}X$, taking X as C. **[1]**

(iii) Another atom of the same element has 6 neutrons in its nucleus. What is the relationship between the two atoms? **[1]**

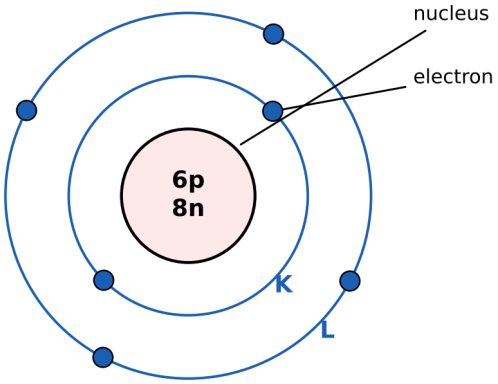


Fig. 1

(c) State one harmful effect of nuclear radiation on the human body. **[1]**

Question 3

(a) A radioactive nucleus ${}^{235}_{92}U$ finally changes into the stable nucleus ${}^{207}_{82}Pb$ by the emission of α-particles and β-particles only. Calculate (i) the number of α-particles emitted, (ii) the number of β-particles emitted, and (iii) the number of neutrons in the final nucleus. **[3]**

(b) Fig. 2 shows three radiations A, B and C from a radioactive source kept in a lead box, passing through a magnetic field directed into the plane of the paper. **[3]**

(i) Name the radiations A, B and C. **[1]**

(ii) Why is the radiation B deflected more than A? **[1]**

(iii) Name the rule used to find the direction of deflection. **[1]**

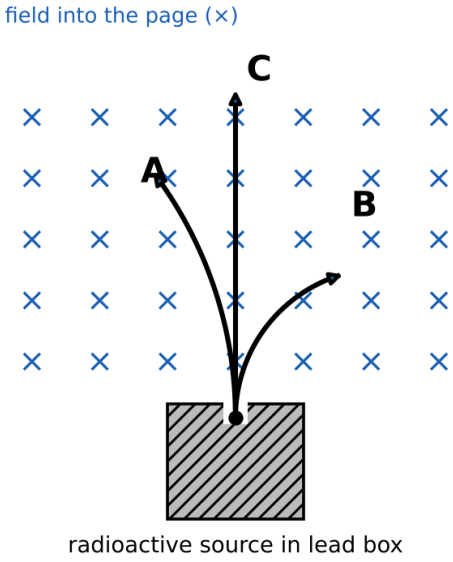


Fig. 2

SECTION B (20 Marks)

(Attempt any two questions from this Section.)

Question 4

(a) State three differences between α-particles and β-particles (nature, charge or mass, and ionising power). **[3]**

(b) Give a reason for each of the following: (i) A radioactive source is kept in a thick lead container with a narrow opening. (ii) α-particles are not used in radiotherapy. (iii) Radioisotopes emitting γ-rays are used as tracers in medicine. **[3]**

(c) Fig. 3 shows three radiations P, Q and R from a radioactive source being tested by placing a thin sheet of paper and a 5 mm thick aluminium sheet in their path. P is stopped by the paper, Q by the aluminium sheet and R reaches the detector. **[4]**

(i) Identify the radiations P, Q and R. **[1]**

(ii) Which of them has the maximum ionising power? **[1]**

(iii) Which one is an electromagnetic wave? State the order of its wavelength. **[1]**

(iv) Name the radiation used in the treatment of cancer. **[1]**

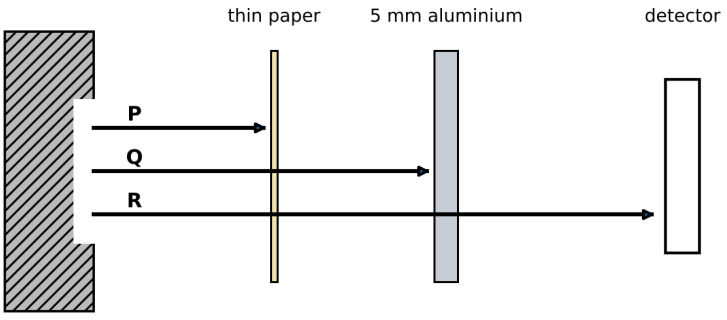


Fig. 3

Question 5

(a) State three safety precautions to be taken while handling radioactive materials. **[3]**

(b) Fig. 4 shows a radioactive series in which the nucleus $^{238}_{92}U$ changes to P, Q, R and S by successive emission of α, β, β and α respectively. **[3]**

(i) Find the atomic number and mass number of P. **[1]**

(ii) Write the atomic number and mass number of Q and R. How are R and U related? **[1]**

(iii) Find the atomic number and mass number of S. **[1]**

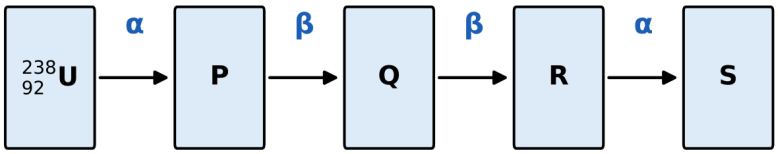


Fig. 4

(c) Fig. 5 shows the fission of a uranium nucleus $^{235}_{92}U$ on bombarding it with a neutron, giving barium-144 ($^{144}_{56}Ba$), a fragment X and three neutrons. **[4]**

(i) Find the atomic number and mass number of the fragment X and write its symbol. **[1]**

(ii) Which type of neutron (slow or fast) is used to cause the fission of $^{235}_{92}U$? **[1]**

(iii) If the loss of mass in the reaction is 0.2 a.m.u., calculate the energy released in MeV. **[1]**

(iv) How is the chain reaction controlled in a nuclear reactor? **[1]**

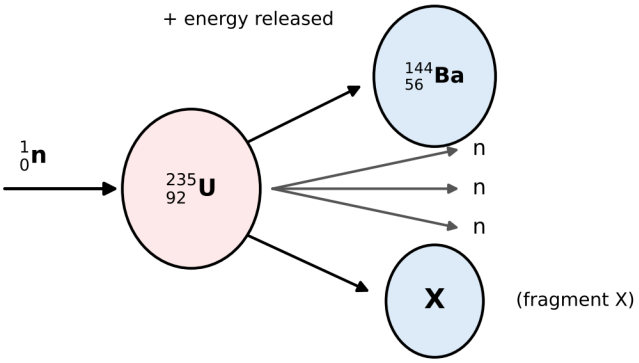


Fig. 5

Question 6

(a) (i) State Einstein's mass-energy relation, explaining each symbol. (ii) Calculate the energy released, in joule, when 2 g of mass is completely converted into energy. (iii) Express this energy in kWh. **[3]**

(b) State three differences between nuclear fission and nuclear fusion. **[3]**

(c) Fig. 6 shows two steps of a nuclear reaction taking place in the interior of the sun, in which X and Y are particles. **[4]**

(i) Name the process and state why a very high temperature (about 10^7 K) is needed for it. **[1]**

(ii) Identify the particles X and Y. **[1]**

(iii) Find the total energy released when three deuterium nuclei fuse to give a helium nucleus through these two steps. **[1]**

(iv) State one advantage of fusion over fission as a source of energy. **[1]**

Step 1: $^{2}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{3}_{2}\mathrm{He} + \mathrm{X} + 3.3\ \mathrm{MeV}$

Step 2: $^{3}_{2}\mathrm{He} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + \mathrm{Y} + 18.3\ \mathrm{MeV}$

Fig. 6

— End of Question Paper —