CLASS XII – PHYSICS (042)
PRACTICE PAPER – CHAPTER 12: ATOMS

Academic Session 2026–27

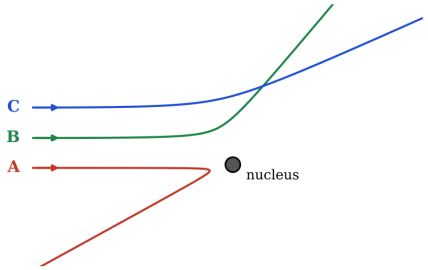
Maximum Marks : 35 **Time Allowed : 1 hour 15 minutes**

General Instructions

(1) There are 18 questions in all. All questions are compulsory.
(2) The question paper has five sections: Section A, B, C, D and E.
(3) Section A (Q.1–9) has seven MCQs and two Assertion–Reasoning questions of 1 mark each. Section B (Q.10–13) has four questions of 2 marks each. Section C (Q.14–16) has three questions of 3 marks each. Section D (Q.17) is one case study based question of 4 marks. Section E (Q.18) is one long answer question of 5 marks.
(4) There is no overall choice. An internal choice is provided in Q.12 (Section B), Q.15 (Section C), Q.17 part (iv) (Section D) and Q.18 (Section E). Attempt only one of the choices in such questions.
(5) Use of calculators is not allowed.
(6) You may use the following values wherever necessary: $h = 6.6 \times 10^{-34}$ J s, $c = 3 \times 10^{8}$ m s^{-1}, 1 eV = 1.6×10^{-19} J, hc = 1240 eV nm, $e^2/4\pi\varepsilon_0 = 1.44$ MeV fm, 1 fm = 10^{-15} m, 1 Å = 10^{-10} m, $\pi = 3.14$. For the hydrogen atom: $E_n = -13.6/n^2$ eV and the radius of the first Bohr orbit is 0.53 Å.

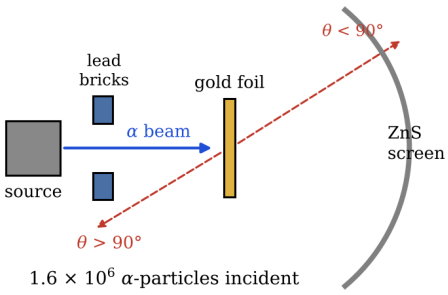
SECTION A (9 × 1 = 9)

1. Three α-particles A, B and C of the same kinetic energy approach a heavy nucleus, as shown. Which of the following statements is correct? **1**



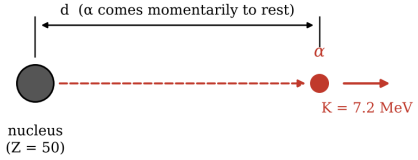
(a) A has the largest impact parameter and C the smallest.
(b) C has the largest scattering angle because its impact parameter is the largest.
(c) A has the smallest impact parameter and is scattered through the largest angle.
(d) All three are deflected equally, because they have the same kinetic energy.

2. In a Geiger–Marsden type experiment shown, 1.6×10^{6} α-particles are incident on a thin gold foil. If about 1 in 8000 particles is scattered through more than 90°, the number of α-particles scattered through more than 90° is about **1**



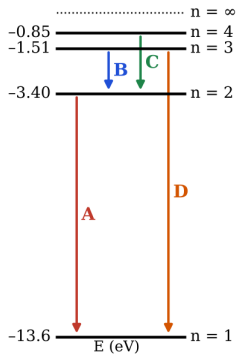
(a) 200
(b) 20
(c) 2000
(d) 8000

3. An α-particle of kinetic energy 7.2 MeV is fired directly at a nucleus of atomic number 50, as shown. The distance of closest approach d is **1**



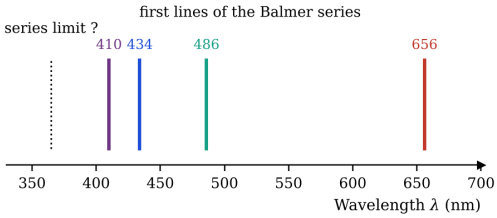
(a) 10 fm
(b) 40 fm
(c) 5 fm
(d) 20 fm

4. The figure shows four transitions A, B, C and D between energy levels of the hydrogen atom. The photon of the longest wavelength is emitted in the transition **1**



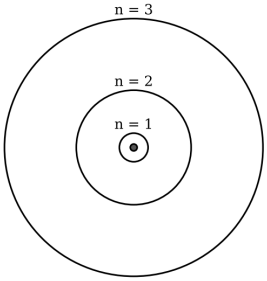
(a) A
(b) B
(c) C
(d) D

5. The figure shows some lines of the Balmer series of hydrogen. The shortest wavelength of this series, which corresponds to the transition from n = ∞ to n = 2, is about **1**



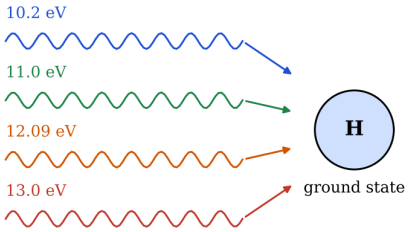
(a) 91 nm
(b) 122 nm
(c) 365 nm
(d) 656 nm

6. The figure shows the first three Bohr orbits of hydrogen. The ratio of the radius of the third orbit to the radius of the second orbit is **1**



(a) 9 : 4
(b) 3 : 2
(c) 27 : 8
(d) 81 : 16

7. A beam containing photons of energies 10.2 eV, 11.0 eV, 12.09 eV and 13.0 eV falls on hydrogen atoms in the ground state, as shown. The photons absorbed by the atoms are those of energy **1**



(a) all four energies
(b) 10.2 eV, 12.09 eV and 13.0 eV
(c) 10.2 eV and 11.0 eV
(d) 10.2 eV and 12.09 eV only

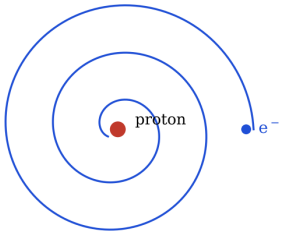
For Questions 8 and 9, a statement of Assertion (A) is followed by a statement of Reason (R). Select the correct answer from the options below.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

8. **Assertion (A):** According to classical physics, Rutherford's atom should be unstable. **1**
Reason (R): An electron revolving round the nucleus is accelerated, so it should radiate energy continuously and spiral into the nucleus.

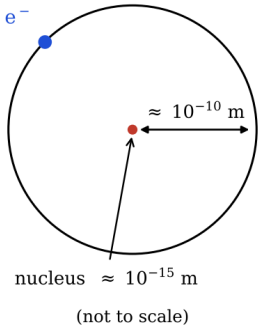
9. **Assertion (A):** A hydrogen atom emits light of only certain discrete wavelengths. **1**
Reason (R): The electron in a hydrogen atom can have any value of energy.

SECTION B (4 × 2 = 8)

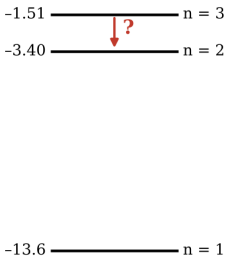
10. The figure shows the path of the electron in Rutherford's atom according to classical electromagnetic theory. (a) Why does the electron follow such a path? (b) Why would the atom emit a continuous spectrum instead of the observed line spectrum? **2**



11. In a hydrogen atom the radius of the nucleus is about 10^{-15} m and the radius of the electron's orbit is about 10^{-10} m, as shown. (a) Find the ratio of the size of the atom to the size of the nucleus. (b) If the nucleus were enlarged to the size of a marble of radius 2 cm, how large would the atom be? **2**



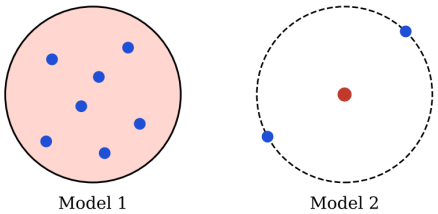
12. **(A)** The figure shows three of the energy levels of a hydrogen atom. Find the wavelength of the photon emitted in the transition from n = 3 to n = 2, and name the series to which the line belongs. **2**



OR

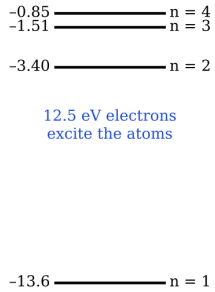
(B) State Bohr's second and third postulates for the hydrogen atom.

13. The figure shows two models of the atom. (a) Name Model 1 and Model 2. State one observation of the α-particle scattering experiment that supports Model 2 and rules out Model 1. (b) State one drawback of Model 2. **2**

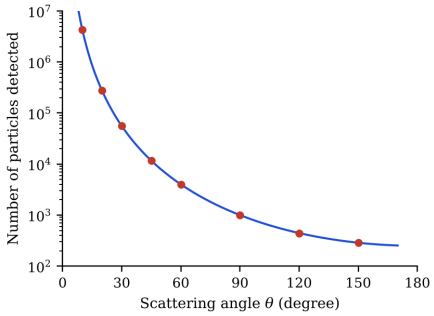


SECTION C (3 × 3 = 9)

14. A beam of electrons of energy 12.5 eV is used to bombard hydrogen atoms in the ground state. The first four energy levels of the atom are shown. (a) To which highest level can the atoms be excited? (b) How many spectral lines can be emitted? Name the series. (c) Find the longest wavelength emitted. **3**



15. **(A)** The graph shows the number of α-particles detected at different scattering angles in the Geiger–Marsden experiment. (a) Describe how the number detected varies with the angle of scattering. (b) What two conclusions about the structure of the atom follow from the experiment? **3**



OR

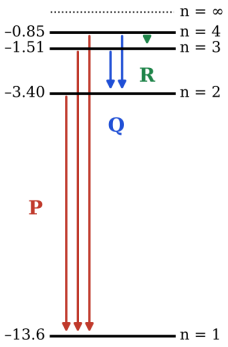
(B) An α-particle of kinetic energy K moves directly towards a nucleus of atomic number Z. Using energy conservation, obtain the expression for its distance of closest approach. By what factor does this distance change if K is doubled?

16. The table gives some quantities for the electron in the first three orbits of the hydrogen atom. Complete the missing entries for n = 2 and n = 3, using the n-dependence of the quantities in Bohr's model. **3**

n	r_n (Å)	v_n (× 10^6 m s^{-1})	E_n (eV)
1	0.53	2.2	–13.6
2	.....	.....	.....
3	.....	.....	.....

SECTION D (1 × 4 = 4)

17. **Case Study.** The light emitted by hydrogen gas in a discharge tube consists of a number of lines, which fall into groups called series. In the figure, the arrows P, Q and R show the groups of transitions that end on the levels n = 1, n = 2 and n = 3 respectively. Answer the following: **4**



(i) The group of transitions that gives lines in the visible region is

(a) P only (b) Q only (c) R only (d) P and Q

(ii) The longest wavelength emitted in group P is about

(a) 91 nm (b) 103 nm (c) 122 nm (d) 365 nm

(iii) The energy required to excite a hydrogen atom from the ground state to the level n = 3 is

(a) 10.2 eV (b) 12.09 eV (c) 12.75 eV (d) 13.6 eV

(iv) The shortest wavelength in group R (n = ∞ to n = 3) is about

(a) 365 nm (b) 656 nm (c) 820 nm (d) 1875 nm

OR

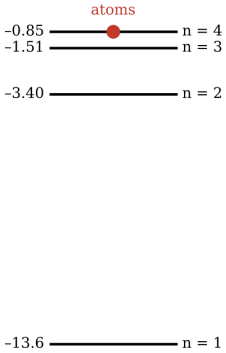
(iv) The wavelength of the photon emitted in the transition from n = 4 to n = 2 is about

(a) 410 nm (b) 434 nm (c) 486 nm (d) 656 nm

SECTION E (1 × 5 = 5)

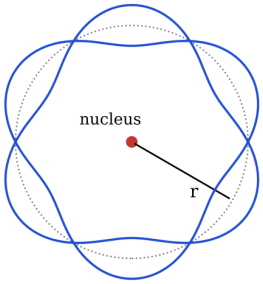
18. **(A)** (a) Using Bohr's postulates, obtain the expression for the radius of the n^{th} orbit and the total energy of the electron in the n^{th} orbit of the hydrogen atom. (3) **5**

(b) A sample of hydrogen atoms is excited to the level n = 4, as shown. Find the maximum number of different spectral lines that can be emitted, and the shortest wavelength among them. (2)



OR

(B) (a) With the help of the figure, which shows a standing wave of the electron on its orbit, explain how de Broglie's hypothesis leads to Bohr's condition for the quantisation of angular momentum. (3)



standing wave, n = 3

(b) The electron in the figure is in the n = 3 orbit of radius 4.77 Å. Find the de Broglie wavelength of the electron and its angular momentum. (2)

— End of Question Paper —