Class 12 Physics · Chapter 12: Atoms

Worksheet · 20 marks · about 40 minutes · based on NCERT

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1. Bohr's first postulate states that an electron in an atom [1]

(a) can revolve in certain stable orbits without emitting radiant energy

(b) radiates energy at the frequency of its revolution

(c) has an angular momentum that can take any value

(d) emits a photon whenever it is in an excited orbit

2. Bohr's model can be applied directly to which one of the following? [1]

(a) A neutral helium atom

(b) A singly ionised lithium ion, Li^{+}

(c) A doubly ionised lithium ion, Li^{2+}

(d) A neutral lithium atom

3. An α-particle aimed head-on at a nucleus comes momentarily to rest at a distance d from its centre. If the kinetic energy of the α-particle is doubled, the distance of closest approach becomes how many times d? [1]

(a) 2

(b) 0.5

(c) 0.25

(d) 1.41

4. α-particles of the same kinetic energy are aimed head-on, in turn, at a gold nucleus (Z = 79) and a silver nucleus (Z = 47). The ratio of the distance of closest approach for gold to that for silver is about [1]

(a) 0.59

(b) 1.30

(c) 2.83

(d) 1.68

5. According to classical electromagnetic theory, an electron revolving round the nucleus in Rutherford's model [1]

(a) moves in a fixed orbit for ever, since the Coulomb force supplies the centripetal force

(b) radiates energy continuously and spirals into the nucleus

(c) radiates energy only when it jumps between orbits

(d) radiates no energy, since its speed is constant

6. A line of wavelength 434 nm is observed in the emission spectrum of hydrogen. Taking $E_n = -13.6/n^2$ eV and hc = 1240 eV nm, find the energy of the photon and identify the transition that produces this line. To which series does it belong? [2]

7. Give one observation of the α-particle scattering experiment that Thomson's model of the atom cannot explain, and the reason Rutherford's model of the atom is unstable. [2]

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8. Distinguish between the emission line spectrum and the absorption spectrum of a gas. Why can the line spectrum of a gas serve to identify it? [2]

9. A sample of hydrogen gas has its atoms excited to the level n = 4. (a) How many different lines can the sample emit, and how many of them belong to each of the Lyman, Balmer and Paschen series? (b) Taking $E_n = -13.6/n^2$ eV and hc = 1240 eV nm, find the longest wavelength among these lines. [3]

10. (a) Why, according to de Broglie, can an electron wave persist in a Bohr orbit only if the circumference holds a whole number of wavelengths? (b) The circumference of a Bohr orbit of hydrogen holds exactly three de Broglie wavelengths of the electron. Taking $a_0 = 0.53$ Å, find the radius of the orbit and the de Broglie wavelength of the electron. [3]

11. Using Bohr's second postulate and the condition for a stable circular orbit, show that the radius of the nth orbit of the electron in a hydrogen atom is proportional to n^2. In which orbit is the radius 9 times the radius of the second orbit? [3]

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