

Atoms — Assignment 1

Class 12 Physics · Topic-wise question bank covering every concept of the chapter · Narayan Gurukul Academy

Instructions: (1) Attempt all questions. This worksheet walks through every concept of the chapter, topic by topic.
(2) The interactive MCQ version of these questions (with instant answer reveal) is available on the notes page.
(3) Universal values: $g = 10 \text{ m/s}^2$ unless stated. Give answers with correct SI units.

Atomic Models (Thomson to Rutherford)

MCQ Questions (choose the correct option)

- Rutherford's alpha-particle scattering experiment established the existence of
 - the nucleus
 - the electron
 - the neutron
 - the photon
- In Rutherford's model the electrons revolve around the nucleus in
 - circular orbits
 - straight lines
 - random paths
 - a cloud
- The main defect of Rutherford's atomic model is that it
 - cannot explain the stability of the atom
 - has no nucleus
 - has no electrons
 - contradicts the photoelectric effect
- According to Thomson's model, the atom is
 - a sphere of positive charge with electrons embedded in it
 - mostly empty space
 - a nucleus with orbiting electrons
 - a plasma of ions

1 Mark Questions

- What did Rutherford's alpha-particle scattering experiment demonstrate?
- State the main drawback of Rutherford's model of the atom.
- According to Thomson's model, how are electrons arranged in an atom?

2 Mark Questions

- Describe Thomson's model of the atom and state its limitations.
- State two conclusions drawn from Rutherford's alpha-particle scattering experiment.

3 Mark Questions

- Describe Rutherford's alpha-particle scattering experiment and state the conclusions drawn from it.
- Explain Rutherford's atomic model and discuss its drawbacks.

Bohr's Model of the Hydrogen Atom

MCQ Questions (choose the correct option)

1. According to Bohr's postulate, the angular momentum of an electron in a stationary orbit is
 - (A) an integral multiple of $h/2\pi$
 - (B) an integral multiple of h
 - (C) zero
 - (D) continuous
2. The radius of the n th Bohr orbit of hydrogen is proportional to
 - (A) n^2
 - (B) n
 - (C) $1/n$
 - (D) $1/n^2$
3. The energy of the electron in the n th orbit of the hydrogen atom is proportional to
 - (A) $-1/n^2$
 - (B) $-n^2$
 - (C) $1/n$
 - (D) n
4. Bohr's model could successfully explain the spectrum of
 - (A) the hydrogen atom
 - (B) the helium atom
 - (C) multi-electron atoms
 - (D) the nucleus

1 Mark Questions

1. State Bohr's postulate about angular momentum.
2. Write the expression for the radius of the n th Bohr orbit.
3. Write the expression for the energy of the electron in the n th Bohr orbit.

2 Mark Questions

1. State the postulates of Bohr's model of the hydrogen atom.
2. The radius of the first Bohr orbit of hydrogen is $0.53 \text{ \AA}$. Find the radius of the third orbit. (Ans: $4.77 \text{ \AA}$)

3 Mark Questions

1. State the postulates of Bohr's model and derive the expression for the radius of the n th orbit of the hydrogen atom.
2. Derive the expression for the energy of the electron in the n th Bohr orbit of the hydrogen atom.

Hydrogen Line Spectra**MCQ Questions (choose the correct option)**

1. The series of the hydrogen spectrum lying in the visible region is the
 - (A) Balmer series
 - (B) Lyman series
 - (C) Paschen series
 - (D) Brackett series
2. The Lyman series of the hydrogen spectrum lies in the

- (A) ultraviolet region
 - (B) visible region
 - (C) infrared region
 - (D) microwave region
3. The wave number of a spectral line is given by
- (A) $R(1/n_1^2 - 1/n_2^2)$
 - (B) $R(n_1^2 - n_2^2)$
 - (C) $R(1/n_1 - 1/n_2)$
 - (D) $R n_1 n_2$
4. The Balmer series results from transitions to the energy level
- (A) $n = 2$
 - (B) $n = 1$
 - (C) $n = 3$
 - (D) $n = 4$

1 Mark Questions

1. Which series of the hydrogen spectrum lies in the visible region?
2. Write the Balmer formula for the wave number of a hydrogen spectral line.
3. In which region does the Lyman series lie?

2 Mark Questions

1. Name the different series of the hydrogen spectrum and state the region of the electromagnetic spectrum in which each lies.
2. Calculate the wavelength of the first line of the Balmer series of hydrogen. ($R = 1.097 \times 10^7 \text{ m}^{-1}$) (Ans: $\approx 656 \text{ nm}$)

3 Mark Questions

1. Draw a diagram of the energy levels of the hydrogen atom and explain the origin of the different spectral series.
2. Using Bohr's theory, derive the expression for the wave number of the lines in the hydrogen spectrum and identify the series.

Energy of the Electron and Ionisation

MCQ Questions (choose the correct option)

1. The ground-state energy of the hydrogen atom is
 - (A) -13.6 eV
 - (B) -3.4 eV
 - (C) -1.51 eV
 - (D) 0 eV
2. The ionisation energy of the hydrogen atom from the ground state is
 - (A) 13.6 eV
 - (B) 3.4 eV
 - (C) 1.51 eV
 - (D) 27.2 eV
3. The energy required to excite a hydrogen atom from $n = 1$ to $n = 2$ is
 - (A) 10.2 eV

- (B) 13.6 eV
 - (C) 3.4 eV
 - (D) 12.09 eV
4. The ionisation potential of hydrogen is
- (A) 13.6 V
 - (B) 3.4 V
 - (C) 1.51 V
 - (D) 27.2 V

1 Mark Questions

1. Write the value of the ground-state energy of the hydrogen atom.
2. What is the ionisation energy of the hydrogen atom?
3. What is the energy of the electron in the first excited state of hydrogen?

2 Mark Questions

1. Calculate the energy required to excite a hydrogen atom from the ground state to the first excited state. (Ans: 10.2 eV)
2. Find the energy of the electron in the second and third Bohr orbits of the hydrogen atom. (Ans: -3.4 eV, -1.51 eV)

3 Mark Questions

1. Calculate the energy required to remove an electron from the ground state of the hydrogen atom to infinity and hence find the ionisation potential.
2. Using the expression for the energy of the n th Bohr orbit, calculate the energies of the first three levels of hydrogen and the ionisation energy.

de Broglie Wavelength of the Electron

MCQ Questions (choose the correct option)

1. According to de Broglie, the circumference of a Bohr orbit is equal to
 - (A) an integral multiple of the wavelength
 - (B) half the wavelength
 - (C) the wavelength squared
 - (D) zero
2. The de Broglie wavelength of an electron in the n th Bohr orbit is proportional to
 - (A) n
 - (B) $1/n$
 - (C) n^2
 - (D) $1/n^2$
3. The de Broglie wavelength of an electron accelerated through potential V is proportional to
 - (A) $1/\sqrt{V}$
 - (B) $\sqrt{V}$
 - (C) V
 - (D) $1/V$
4. The de Broglie explanation of Bohr's postulate gives
 - (A) $2\pi r = n\lambda$
 - (B) $2\pi r = \lambda/n$

(C) $r = n\lambda$

(D) $2\pi r = n^2\lambda$

1 Mark Questions

1. State the de Broglie relation for a Bohr orbit.
2. Write the relation between the circumference of a Bohr orbit and the de Broglie wavelength.
3. Write the expression for the de Broglie wavelength of an accelerated electron.

2 Mark Questions

1. Show that the de Broglie wavelength of an electron in the n th Bohr orbit is proportional to n .
2. Calculate the de Broglie wavelength of an electron in the ground state of the hydrogen atom. (Ans: $\approx 3.32 \times 10^{-10}$ m)

3 Mark Questions

1. Using de Broglie's hypothesis, derive Bohr's quantisation condition for the angular momentum of an electron in a stationary orbit.
2. Explain how de Broglie's hypothesis provides an explanation for Bohr's postulate of quantised angular momentum.