

Practice Questions: Atoms

Energy States, Transitions & Hydrogen Spectrum

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Instructions:

- This assignment contains **15 Multiple Choice Questions**.
- Each question carries 4 marks. There is **NO negative marking**.
- Choose the **single correct option** for each question.
- Use $R = 1.097 \times 10^7 \text{ m}^{-1}$, $hc = 12400 \text{ eV} \cdot \text{\AA}$, and Ground state energy of H-atom = -13.6 eV .

Q.1 The ionization energy of a hydrogen atom in its first excited state is:

- (a) 13.6 eV
- (b) 6.8 eV
- (c) 3.4 eV
- (d) 1.51 eV

Q.2 An electron in a hydrogen atom makes a transition from an excited state to the ground state. Which of the following transitions will result in the emission of a photon with the **shortest** wavelength?

- (a) $n = 2 \rightarrow n = 1$
- (b) $n = 3 \rightarrow n = 1$
- (c) $n = 4 \rightarrow n = 2$
- (d) $n = 5 \rightarrow n = 3$

Q.3 The ratio of the energy of an electron in the first excited state of a hydrogen atom to that in the second excited state is:

- (a) 4 : 9
- (b) 9 : 4
- (c) 2 : 3
- (d) 3 : 2

Q.4 If the wavelength of the first line of the Lyman series is λ , then the wavelength of the first line of the Balmer series is approximately:

- (a) $\frac{4}{3}\lambda$

- (b) $\frac{27}{5}\lambda$
- (c) $\frac{36}{5}\lambda$
- (d) $\frac{5}{36}\lambda$

Q.5 The total energy of an electron in a certain orbit of a hydrogen atom is -1.51 eV. The kinetic and potential energies of the electron in this orbit are respectively:

- (a) -1.51 eV, -3.02 eV
- (b) $+1.51$ eV, -3.02 eV
- (c) $+3.02$ eV, -1.51 eV
- (d) -3.02 eV, $+1.51$ eV

Q.6 In the spectrum of hydrogen, the series which lies entirely in the ultraviolet region is:

- (a) Balmer series
- (b) Paschen series
- (c) Brackett series
- (d) Lyman series

Q.7 The angular momentum of an electron in a hydrogen atom is $\frac{3h}{2\pi}$. The energy of the electron in this state is:

- (a) -13.6 eV
- (b) -3.4 eV
- (c) -1.51 eV
- (d) -0.85 eV

Q.8 A hydrogen atom in the ground state is excited by a monochromatic radiation of photon energy 12.1 eV. According to Bohr's theory, the number of spectral lines emitted by the hydrogen atom is:

- (a) 1
- (b) 2
- (c) 3
- (d) 4

Q.9 The wavelength of the last line of the Balmer series in the hydrogen spectrum is:

- (a) $\frac{1}{R}$
- (b) $\frac{2}{R}$
- (c) $\frac{4}{R}$
- (d) $\frac{R}{4}$

Q.10 An electron in a hydrogen atom jumps from an orbit with principal quantum number n_i to an orbit with principal quantum number n_f . If the time period of the electron in the initial state is 27 times that in the final state, the possible values of n_i and n_f are:

- (a) $n_i = 3, n_f = 1$

- (b) $n_i = 9, n_f = 3$
- (c) $n_i = 6, n_f = 2$
- (d) $n_i = 27, n_f = 1$

Q.11 The energy of an electron in the n^{th} orbit of a hydrogen-like atom is proportional to:

- (a) n
- (b) n^2
- (c) $\frac{1}{n^2}$
- (d) $\frac{1}{n}$

Q.12 The shortest wavelength in the Paschen series of the hydrogen spectrum is obtained when the electron transition takes place from:

- (a) $n = \infty \rightarrow n = 3$
- (b) $n = \infty \rightarrow n = 4$
- (c) $n = 5 \rightarrow n = 3$
- (d) $n = 6 \rightarrow n = 3$

Q.13 The radius of the first Bohr orbit of a hydrogen atom is a_0 . The radius of the third orbit is:

- (a) $3a_0$
- (b) $6a_0$
- (c) $9a_0$
- (d) $27a_0$

Q.14 The ratio of the longest wavelength corresponding to the Lyman series to the longest wavelength corresponding to the Balmer series in the hydrogen spectrum is:

- (a) $\frac{1}{4}$
- (b) $\frac{5}{27}$
- (c) $\frac{4}{1}$
- (d) $\frac{27}{5}$

Q.15 A hydrogen atom initially in the ground state absorbs a photon and gets excited to the $n = 4$ level. The wavelength of the absorbed photon is approximately:

- (a) 97.2 nm
- (b) 102.5 nm
- (c) 121.6 nm
- (d) 486.1 nm