



DPP – 5 [Bohr's Model]

Chapter: Structure of Atom

“Fear of starting hi sabse bada enemy hai. Ek baar pen uth gaya... Toh aadhi battle wahi jeet jaate ho.”

TYPE 1 : Bohr's Model — Radius

Q.1 The radius for the Bohr orbit is given by

- (1) $r = 0.529 \times \frac{Z^2}{n} \text{ \AA}$ (3) $r = 0.529 \times \frac{Z}{n^2} \text{ \AA}$
 (2) $r = 0.529 \times \frac{n^2}{Z^2} \text{ \AA}$ (4) $r = 0.529 \times \frac{n^2}{Z} \text{ \AA}$

Q.2 Bohr's radius for first orbit of hydrogen atom is

- (1) 0.529 Å (2) 5.29 Å (3) 52.9 Å (4) 529 Å

Q.3 Calculate the radius of 1st, 2nd, 3rd, 4th Bohr's orbit of hydrogen. Which of the following gives all four values correctly?

(Use $r = 0.529 \times \frac{n^2}{Z} \text{ \AA}$)

- (1) 0.529 Å; 2.116 Å; 4.761 Å; 8.464 Å (3) 0.265 Å; 1.058 Å; 2.381 Å; 4.232 Å
 (2) 0.529 Å; 1.058 Å; 1.587 Å; 2.116 Å (4) 1.058 Å; 2.116 Å; 4.761 Å; 9.522 Å

Q.4 Calculate the radii of the 2nd Bohr orbit of Li²⁺.

(Use $r_n = \frac{52.9(n^2)}{Z} \text{ pm}$)

- (1) 70.53 pm (2) 105.8 pm (3) 35.27 pm (4) 141.1 pm

Q.5 The radius of the second Bohr orbit for hydrogen atom is

(Planck's const. $h = 6.6262 \times 10^{-34} \text{ Js}$, mass of electron = $9.1091 \times 10^{-31} \text{ kg}$, charge of electron $e = 1.60210 \times 10^{-19} \text{ C}$, permittivity of vacuum $\epsilon_0 = 8.854185 \times 10^{-12} \text{ kg}^{-1}\text{m}^{-3}\text{A}^2$) [JEE Main 2017]

- (1) 1.65 Å (2) 4.76 Å (3) 0.529 Å (4) 2.12 Å

Q.6 In Bohr's model of hydrogen atom, if atomic radius of the first orbit is x , then the radius of the 3rd orbit will be [NCERT Pg. 46]

- (1) $\frac{x}{3}$ (2) $3x$ (3) $9x$ (4) $6x$

Q.7 In Bohr's atomic model radius of 1st orbit of hydrogen is 0.053 nm, then radius of 3rd orbit of Li^{2+} is

- (1) 0.159 nm (3) 0.023 nm
(2) 0.053 nm (4) 0.026 nm

Q.8 The radius of hydrogen atom in the ground state is 0.53 Å. The radius of Li^{2+} ion (atomic number = 3) in a similar state is

- (1) 0.53 Å (3) 0.17 Å
(2) 1.06 Å (4) 0.265 Å

Q.9 The radius of which of the following orbit is same as that of second Bohr's orbit of hydrogen atom?

- (1) He^+ ($n = 4$) (3) Li^{2+} ($n = 3$)
(2) Be^{3+} ($n = 4$) (4) He^+ ($n = 2$)

Q.10 In which of the following is the radius of the first orbit minimum?

- (1) A Hydrogen atom (3) Triply ionized beryllium
(2) A tritium atom (4) Double ionized helium

Q.11 The radius of a shell for H-atom is 4.761 Å. The value of n is

- (1) 3 (2) 9 (3) 5 (4) 4

Q.12 If r_1 is the radius of the first orbit of hydrogen atom, then the radii of second, third and fourth orbits in term of r_1 are

- (1) r_1^2, r_1^3, r_1^4 (3) $8r_1, 27r_1, 64r_1$
(2) $4r_1, 9r_1, 16r_1$ (4) $2r_1, 6r_1, 8r_1$

TYPE 2 : Bohr's Model — Radius Ratio

Q.13 For Li^{2+} ion, $r_2 : r_5$ will be

- (1) 9 : 25 (2) 4 : 25 (3) 25 : 4 (4) 25 : 9

Q.14 Calculate the radius ratio of 3rd & 5th orbit of He^+ . The ratio $r_3 : r_5$ is

- (1) 9 : 25 (2) 25 : 9 (3) 3 : 5 (4) 5 : 3

Q.15 Calculate the radius ratio of 2nd orbit of hydrogen and 3rd orbit of Li²⁺. The ratio $(r_2)_H : (r_3)_{Li^{2+}}$ is

- (1) 4 : 3 (2) 3 : 4 (3) 2 : 3 (4) 3 : 2

Q.16 The ratio of radius of first orbit in hydrogen to the radius of first orbit in deuterium will be

- (1) 1 : 1 (2) 1 : 2 (3) 2 : 1 (4) 4 : 1

Q.17 The first three radius ratio of Bohr orbits is

- (1) 1 : 0.5 : 0.5 (2) 1 : 2 : 3 (3) 1 : 4 : 9 (4) 1 : 8 : 27

Q.18 The ratio of the radii of two Bohr orbits of H-atom is 4 : 1, what would be their nomenclature?

- (1) K & L (2) L & K (3) N & L (4) 2 & 3 both

TYPE 3 : Bohr's Model — Velocity

Q.19 According to Bohr theory, the radius (r) and velocity (v) of an electron vary with the increasing principal quantum number ' n ' as

- (1) r increases, v decreases (3) r & v both decreases
(2) r and v both increases (4) r decreases, v increases

Q.20 What will be velocity of an electron revolving in second orbit of H-atom?

- (1) 5.45×10^5 m/sec (3) 10.9×10^5 m/sec
(2) 21.8×10^5 m/sec (4) 43.6×10^5 m/sec

Q.21 For any H-like system, the ratio of velocities of I, II & III orbit i.e., $V_1 : V_2 : V_3$ will be

- (1) 1 : 2 : 3 (3) 3 : 2 : 1
(2) $1 : \frac{1}{2} : \frac{1}{3}$ (4) 1 : 1 : 1

Q.22 An electron is moving in 2nd orbit of He⁺, then what will be velocity of electron?

- (1) $\frac{2\pi Ke^2}{h}$ (3) $\frac{8\pi Ke^2}{h}$
(2) $\frac{16\pi Ke^2}{h}$ (4) $\frac{\pi Ke^2}{4h}$

Q.23 Calculate the velocity of an electron placed in the third orbit of hydrogen atom. Also calculate the number of revolutions per second that this electron makes around the nucleus. Which option is correct?

- (1) $V_3 = 7.27 \times 10^5 \text{ ms}^{-1}$; $\nu = 2.43 \times 10^{14} \text{ r.p.s.}$ (3) $V_3 = 1.09 \times 10^6 \text{ ms}^{-1}$; $\nu = 8.12 \times 10^{14} \text{ r.p.s.}$
 (2) $V_3 = 2.18 \times 10^6 \text{ ms}^{-1}$; $\nu = 6.57 \times 10^{15} \text{ r.p.s.}$ (4) $V_3 = 3.64 \times 10^5 \text{ ms}^{-1}$; $\nu = 1.21 \times 10^{14} \text{ r.p.s.}$

TYPE 4 : Bohr's Model — Time period

Q.24 How much time will an electron take for one complete revolution in the 2nd orbit of He⁺?

- (1) $3.05 \times 10^{-16} \text{ s}$ (3) $1.52 \times 10^{-16} \text{ s}$
 (2) $6.10 \times 10^{-16} \text{ s}$ (4) $9.15 \times 10^{-16} \text{ s}$

Q.25 The time taken by the electron in one complete revolution in the n^{th} Bohr's orbit of the hydrogen atom is

- (1) Inversely proportional to n^2 (3) Directly proportional to $\frac{h}{2\pi n}$
 (2) Directly proportional to n^3 (4) Inversely proportional to $\frac{n}{h}$

TYPE 5 : Bohr's Model — Angular momentum

Q.26 In Bohr's orbit $\frac{nh}{2\pi}$ indicates

- (1) Momentum (3) Potential energy
 (2) Kinetic energy (4) Angular momentum

Q.27 According to Bohr's theory angular momentum of electron in 5th shell is [AIEEE-2006]

- (1) $1.0 h/\pi$ (2) $10 h/\pi$ (3) $2.5 h/\pi$ (4) $25 h/\pi$

Q.28 Angular momentum for P-shell electron is

- (1) $\frac{3h}{\pi}$ (2) Zero (3) $\frac{\sqrt{2}h}{2\pi}$ (4) None

Q.29 $\frac{h}{2\pi}$ is angular momentum inorbit of He⁺.

- (1) First (2) Second (3) Third (4) Infinite

Q.30 Multiplication of electron velocity and radius for an orbit in an atom is

- (1) Proportional to mass of electron
 (2) Proportional to square of mass of electron
 (3) Inversely proportional to mass of electron
 (4) Does not depend upon mass of electron

Q.31 For which of the following orbital, ratio of orbit angular momentum to orbital angular momentum is $\sqrt{2} : 1$?

- (1) $2s$ (2) $2p$ (3) $3p$ (4) $4s$

TYPE 6 : Bohr's Model — Excited state [Radius and velocity]

Q.32 Calculate the radius ratio of 2nd excited state of H & 1st excited state of Li^{2+} . The ratio is

- (1) 27 : 4 (2) 4 : 27 (3) 9 : 4 (4) 4 : 9

Q.33 What would be the radius of 2nd excited state in Li^{2+} ion?

- (1) 0.529 \AA (2) 1.51 \AA (3) 0.2645 \AA (4) 0.5299 \AA

Q.34 The Bohr orbit radius for the hydrogen atom ($n = 1$) is approximately 0.530 \AA . The radius for the first excited state ($n = 2$) will be

- (1) 0.13 \AA (2) 1.0 \AA (3) 4.77 \AA (4) 2.12 \AA

Q.35 The Bohr orbit radius for the hydrogen atom ($n = 1$) is approximately 0.530 \AA . The radius for the first excited state ($n = 2$) orbit is (in \AA)

- (1) 4.77 (2) 1.06 (3) 0.13 (4) 2.12

Q.36 The velocity of electron in third excited state of Be^{3+} ion will be

- (1) $\frac{3}{4}(2.188 \times 10^8) \text{ ms}^{-1}$ (3) $(2.188 \times 10^6) \text{ Kms}^{-1}$
 (2) $\frac{3}{4}(2.188 \times 10^6) \text{ ms}^{-1}$ (4) $(2.188 \times 10^3) \text{ Kms}^{-1}$

Q.37 Angular momentum in second Bohr orbit of H-atom is x . Then find out angular momentum in 1st excited state of Li^{2+} ion.

- (1) $3x$ (2) $9x$ (3) $\frac{x}{2}$ (4) x

TYPE 7 : Bohr's Model — Energy

Q.38 What is the energy associated with 3rd energy shell of hydrogen atom?

- (1) -2.18×10^{-18} J (3) -0.726×10^{-18} J
 (2) -0.342×10^{-19} J (4) -2.42×10^{-19} J

Q.39 The ionisation energy of a hydrogen atom is 13.6 eV. The energy of the ground level in doubly ionised lithium is

- (1) -28.7 eV (2) -54.4 eV (3) -122.4 eV (4) -13.6 eV

Q.40 Ionisation energy of He^+ is 19.6×10^{-18} J atom⁻¹. The energy of the first stationary state ($n = 1$) of Li^{2+} is [AIEEE-2010]

- (1) 8.82×10^{-17} J atom⁻¹ (3) -4.41×10^{-17} J atom⁻¹
 (2) 4.41×10^{-16} J atom⁻¹ (4) -2.2×10^{-15} J atom⁻¹

Q.41 First shell energy of He^+ ion is -54.4 eV. Then energy of its second shell is

- (1) -54.4 eV (2) -13.6 eV (3) -27.2 eV (4) $+27.2$ eV

Q.42 The energy of second Bohr orbit of the hydrogen atom is -328 kJ/mol. Hence the energy of fourth Bohr orbit should be

- (1) -41 kJ/mol (3) -164 kJ/mol
 (2) -1312 kJ/mol (4) -82 kJ/mol

Q.43 The energy of H-atom in n^{th} orbit is E_n , then energy in n^{th} orbit of singly ionised helium atom will be

- (1) $4E_n$ (2) $E_n/4$ (3) $2E_n$ (4) $E_n/2$

Q.44 The energy levels for ${}_Z\text{A}^{(+Z-1)}$ can be given by

- (1) E_n for $\text{A}^{(+Z-1)} = Z^2 \times E_n$ for H (3) E_n for $\text{A}^{(+Z-1)} = \frac{1}{Z^2} \times E_n$ for H
 (2) E_n for $\text{A}^{(+Z-1)} = Z \times E_n$ for H (4) E_n for $\text{A}^{(+Z-1)} = \frac{1}{Z} \times E_n$ for H

Q.45 $E_n = -313.6/n^2$ kcal/mole. If the value of $E = -34.84$ kcal/mole, then to which of the following values does 'n' correspond?

- (1) 3 : 2 : 1 (3) 36 : 9 : 4
(2) 9 : 4 : 1 (4) 1 : 4 : 9

Q.55 Which of the following is the energy of a possible excited state of hydrogen? [JEE-Main(offline) 2015]

- (1) -3.4 eV (2) $+6.8\text{ eV}$ (3) $+13.6\text{ eV}$ (4) -6.8 eV

TYPE 9: Bohr's Model — Ionisation Potential and Excitation Potential

Q.56 The ionisation energy of H-atom (in the ground state) is $x\text{ kJ}$. The energy required for an electron to jump from 2nd to 3rd orbit will be

- (1) $x/6$ (3) $7.2x$
(2) $5x$ (4) $5x/36$

Q.57 If the ionisation potential of an atom is 20 V , its first excitation potential will be

- (1) 5 V (2) 10 V (3) 15 V (4) 20 V

Q.58 If the ionization energy of hydrogen is $313.8\text{ kcal per mole}$, then the energy of the electron in 2nd excited state will be

- (1) -112.2 kcal/mole (3) -313.8 kcal/mole
(2) -78.45 kcal/mole (4) -35 kcal/mole

Q.59 The ionisation energy for the H-atom is 13.6 eV , then the required energy to excite it from the ground state to next higher state will be (in eV)

- (1) 3.4 (2) 10.2 (3) 12.1 (4) 1.5

Q.60 The ionization energy for the hydrogen atom is 13.6 eV . The required energy in eV to excite it from the ground state to 1st excited state is

- (1) 10.2 eV (2) 3.4 eV (3) 13.6 eV (4) 1.51 eV

Q.61 The ionisation potential of the hydrogen atom is 13.6 eV . The energy needed to ionise a hydrogen atom which is in its second excited state is about

- (1) 13.6 eV (2) 10.2 eV (3) 3.4 eV (4) 1.5 eV

Q.62 The ionization enthalpy of hydrogen atom is $1.312 \times 10^6\text{ J mol}^{-1}$. The energy required to excite the electron in the atom from $n = 1$ to $n = 2$ is [AIEEE-2008]

- (1) $8.51 \times 10^5 \text{ J mol}^{-1}$ (3) $7.56 \times 10^5 \text{ J mol}^{-1}$
 (2) $6.56 \times 10^5 \text{ J mol}^{-1}$ (4) $9.84 \times 10^5 \text{ J mol}^{-1}$

Q.63 The energy needed to excite a hydrogen atom from its ground to its third excited state is

- (1) 12.1 eV (2) 10.2 eV (3) 0.85 eV (4) 12.75 eV

Q.64 The energy required to excite an electron of H-atom from first orbit to second orbit is

- (1) $\frac{3}{4}$ of its ionisation energy
 (2) $\frac{1}{2}$ of its ionisation energy
 (3) $\frac{1}{4}$ of its ionisation energy
 (4) None

Q.65 The ionisation energy for excited hydrogen atom in eV will be

- (1) 13.6 (3) Greater than 13.6
 (2) Less than 13.6 (4) 3.4 or less

Q.66 The energy required to escape the electron from ground state of H is 13.6 eV, then the same for 1st excited state of H atom is

- (1) 3.4 eV (2) 13.6 eV (3) 27.2 eV (4) Can't say anything

TYPE 10: Bohr's Model —Miscellaneous Excitation Potential

Q.67 Energy required to remove an e^- from M shell of H-atom is 1.51 eV, then energy of first excited state will be

- (1) -1.51 eV (3) -3.4 eV
 (2) $+1.51 \text{ eV}$ (4) -13.6 eV

Q.68 The correct order of energy difference between adjacent energy levels in H atom is

- (1) $E_2 - E_1 > E_3 - E_2 > E_4 - E_3$ (3) $E_4 - E_3 > E_3 - E_2 > E_2 - E_1$
 (2) $E_2 - E_1 > E_4 - E_3 > E_3 - E_2$ (4) $E_3 - E_2 > E_4 - E_3 > E_2 - E_1$

Q.69 Which of the following electronic transition in a hydrogen atom will require the largest amount of energy?

- (1) $n = 1$ to $n = 2$ (3) $n = 1$ to $n = \infty$
 (2) $n = 2$ to $n = 3$ (4) $n = 3$ to $n = 5$

Q.70 How much energy would be required by an electron while moving from ground state to 3rd excited state of He^+ ion?

- (1) 40.8 eV (2) 10.2 eV (3) 51 eV (4) 48.35 eV

Q.71 A single electron orbits a stationary nucleus ($z = 5$). The energy required to excite the electron from third to fourth Bohr orbit will be

- (1) 4.5 eV (2) 8.53 eV (3) 25 eV (4) 16.53 eV

Q.72 An hydrogen atom (ionisation energy 13.6 eV) jumps from third excited state to first excited state. The energy of photon emitted in the process is

- (1) 1.89 eV (3) 12.09 eV
(2) 2.55 eV (4) 12.75 eV

Q.73 First excitation potential of H atom is

- (1) 10.2 eV (2) 3.4 eV (3) 0 (4) -3.4 eV

Q.74 A single electron orbits a stationary nucleus of charge $+Ze$, where Z is a constant. It requires 47.2 eV to excite electron from second Bohr orbit to third Bohr orbit. Find the value of Z .

- (1) 1 (2) 3 (3) 5 (4) 4

Q.75 If the binding energy of the electron in a hydrogen atom is 13.6 eV, the energy required to remove the electron from the first excited state of Li^{++} is [JEE-Main(online) 2014]

- (1) 13.6 eV (2) 30.6 eV (3) 122.4 eV (4) 3.4 eV

Q.76 The binding energy of electron in ground state of hydrogen atom is 13.6 eV. The energies required to eject out an electron from three lowest states of He^+ will be (in eV)

- (1) 13.6, 10.2, 3.4 (3) 13.6, 27.2, 40.8
(2) 13.6, 3.4, 1.5 (4) 54.4, 13.6, 6

Q.77 2nd separation energy of an electron in H atom is

- (1) 27.2 eV (2) 1.57 eV (3) 3.4 eV (4) 13.6 eV

TYPE 11: Bohr's Model — Total, kinetic and potential Energy

Q.78 The ratio between kinetic energy and the total energy of the electron of hydrogen atom according to Bohr's model is

- (1) 2 : 1 (2) 1 : 1 (3) 1 : -1 (4) 1 : 2

Q.79 The ratio of potential energy and total energy of an electron in a Bohr orbit of hydrogen-like species is

- (1) 2 (2) -2 (3) 1 (4) -1

Q.80 Kinetic and potential energy (in eV) of electron present in second Bohr's orbit of hydrogen atom are respectively

(Energy of first Bohr's orbit = -13.6 eV)

[NCERT Pg. 46]

- (1) $-13.6, -27.2$ (3) $3.4, -6.8$
 (2) $-1.51, -3.02$ (4) $3.02, -1.51$

Q.81 In hydrogen atom, energy of electron in 2nd Bohr's orbit is -3.4 eV. The kinetic energy of electron in this orbit is

- (1) -3.4 eV (2) $+3.4$ eV (3) -6.8 eV (4) $+1.7$ eV

Q.82 Match the following:

- | | |
|---|--------------------------------|
| (A) Energy of ground state of He^+ | (i) $+6.04$ eV |
| (B) Potential energy of I orbit of H-atom | (ii) -27.2 eV |
| (C) Kinetic energy of II excited state of He^+ | (iii) 8.72×10^{-18} J |
| (D) Ionisation potential of He^+ | (iv) -54.4 eV |
- (1) A-(i), B-(ii), C-(iii), D-(iv) (3) A-(iv), B-(ii), C-(i), D-(iii)
 (2) A-(iv), B-(iii), C-(ii), D-(i) (4) A-(ii), B-(iii), C-(i), D-(iv)

Q.83 In hydrogen atom, energy of first excited state is -3.4 eV. Then find out KE of same orbit of hydrogen atom.

- (1) $+3.4$ eV (3) -13.6 eV
 (2) $+6.8$ eV (4) $+13.6$ eV

Q.84 Potential energy is -27.2 eV in second orbit of He^+ , then calculate double of total energy in first excited state of hydrogen atom.

- (1) -13.6 eV (2) -54.4 eV (3) -6.8 eV (4) -27.2 eV

Q.85 If the potential energy (PE) of hydrogen electron is -3.02 eV then in which of the following excited level is electron present?

- (1) 1st (2) 2nd (3) 3rd (4) 4th

Q.86 Going from K-shell to N-shell in case of H-atom

- (1) Kinetic energy decreases (3) Potential energy decreases
 (2) Total energy decreases (4) None of these

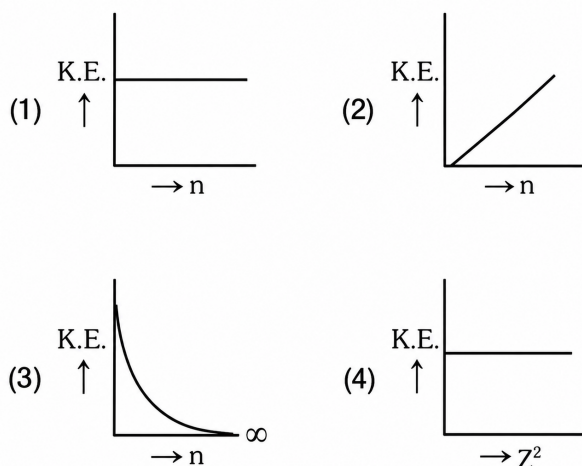
Q.87 Which is not a correct order of energy for 1, 2nd & 3rd orbit?

- (1) $E_1 > E_2 > E_3$ (3) $(KE)_1 > (KE)_2 > (KE)_3$
 (2) $(PE)_1 < (PE)_2 < (PE)_3$ (4) '1' & '3' both

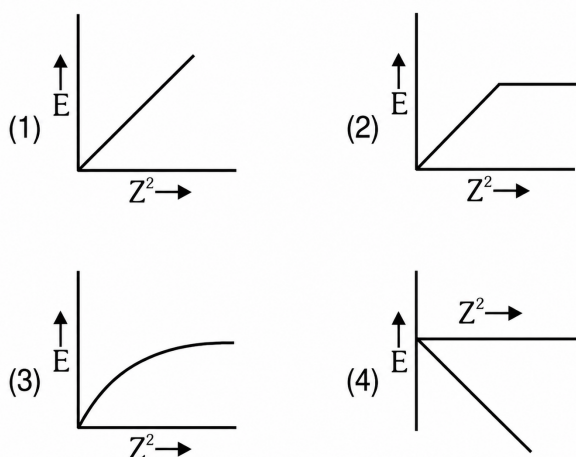
Q.88 The ionisation potential of a singly ionised helium ion is equivalent to

- (1) Kinetic energy of first orbit (3) Average energy in orbits
 (2) Energy of last orbit (4) Maximum energy in orbits

Q.89 Which of the following is a correct graph (K.E. vs quantum number n)?



Q.90 The graphical representation of energy of electron and atomic number is



TYPE 12 : Theoretical questions

Q.91 Bohr theory is not applicable for

- (1) He^+ (2) Li^{2+} (3) Be^+ (4) H

Q.92 Which of the following is wrong for Bohr model?

- (1) It establishes stability of atom
 (2) It is contradicted with Heisenberg uncertainty principle
 (3) It explains the concept of spectral lines
 (4) e^- behaves as particle & wave

Q.93 Which of the following is not among shortcomings of Bohr's model?

- (1) Bohr theory could not account for the fine lines in the atomic spectrum.
 (2) Bohr theory was unable to account for the splitting of the spectral lines in the presence of magnetic field.
 (3) Bohr theory failed for He atom.
 (4) It did not give information about energy level.

Q.94 Bohr's model is applicable to explain

- (1) Zeeman effect
 (2) Stark effect
 (3) Bond formation of H_2
 (4) Hydrogen spectrum

Q.95 Based on equation $E = -2.178 \times 10^{-18} \text{ J} \left(\frac{Z^2}{n^2} \right)$, certain conclusions are written. Which of them is not correct?

- (1) For $n = 1$, the electron has a more negative energy than it does for $n = 6$ which means that the electron is more loosely bound in the smallest allowed orbit.
 (2) The negative sign in equation simply means that the energy of electron bound to the nucleus is lower than it would be if the electrons were at infinite distance from the nucleus.
 (3) Larger the value of n , the larger is the orbit radius.
 (4) Equation can be used to calculate the change in energy when the electron changes orbit.

Q.96 Bohr's model is based upon

- (1) Heisenberg's principle
 (2) de Broglie's concept
 (3) Schrodinger's wave equation
 (4) Planck's quantum theory

Q.97 Who modified Bohr's theory by introducing elliptical orbits for electron path?

- (1) Rutherford
 (2) Thomson
 (3) Hund
 (4) Sommerfield

Q.98 If a photon of energy 14 eV is incident on an H-atom, what is true?

- (1) Atom will be ionised and electron will have a kinetic energy of 14 eV
 (2) Atom will be ionised and electron will have a kinetic energy of 0.4 eV
 (3) Photon passes through atom without interacting with it
 (4) More than one electrons will make transitions

Q.99 An electron of energy 10.8 eV is incident on an H-atom. Then

