ATOMIC STRUCTURE

Q.1 If wavelength of photon is 2.2×10^{-11} m, h = 6.6×10^{-34} Js, then momentum of photon is-

(A) 3×10^{-23} kg/s
(B) 1.452×10^{-44} kg/s
(C) 3.33×10^{22} kg/s
(D) 6.89×10^{43} kg/s

Q.2 The wave number of first line of Balmer series of hydrogen is 15200 cm^{-1}. The wave number of the first Balmer line of Li^{2+} ion is -

(A) 15200 cm^{-1}
(B) 60800 cm^{-1}
(C) 76000 cm^{-1}
(D) 136,800 cm^{-1}

Q.3 From the given sets of quantum numbers the one that is inconsistent with the theory is-

(A) n = 3; □ = 2; m = – 3, s = + ½
(B) n = 4' □ = 3; m = 3; s = + ½
(C) n = 2; □ = 1; m = 0; s = – ½
(D) n = 4; □ = 3; m = 2; s = + ½

Q.4 The orbital angular momentum of an electron in 2s orbital is-

(A) $+\frac{1}{2}\frac{h}{2?}$
(B) 0
(C) $\frac{h}{2?}$
(D) $\sqrt{2}\cdot\frac{h}{2?}$

Q.5 The energy of an electron in the first Bohr orbit of H atom is –13.6 eV. The possible energy value(s) of the excited state(s) for electron in Bohr orbits of hydrogen is (are)-

(A) – 3.4 eV
(B) – 4.2 eV
(C) – 6.8 eV
(D) + 6.8 eV

Q.6 The electrons, identified by quantum number n and □,
(i) n = 4, □ = 1
(ii) n = 4, □ = 0
(iii) n = 3, □ = 2
(iv) n = 3, □ = 1
can be placed in order of increasing energy, from the lowest to highest, as-

(A) iv < ii < iii < i
(B) ii < iv < i < iii
(C) i < iii < ii < iv
(D) iii < i < iv < ii

Q.7 The electronic configuration of an element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$. This represents its-

(A) Excited state (B) Ground state
(C) Cationic form (D) Anionic form

Q.8 The wave length associated with a golf ball weighing 200 g and moving at a speed of 5 m/h of the order -

(A) 10^{-10} m (B) 10^{-20} m (C) 10^{-30} m (D) 10^{-40} m

Q.9 If the nitrogen atom had electronic configuration 1s, it would have energy lower than that of the normal ground state configuration $1s^2\ 2s^2\ 2p^3$, because the electrons would be closer to the nucleus. Yet $1s^7$ is not observed because it violates-

(A) Heisenberg uncertainty principle
(B) Hund's rule
(C) Pauli's exclusion principle
(D) Bohr postulates of stationary orbits

Q.10 Identify the least stable among the following :

(A) Li^- (B) Be^- (C) B^- (D) C^-

ANSWER KEY

Q.No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	A	D	A	B	A	A	B	C	C	B

SOLUTIONS (ATOMIC STRUCTURE)

Ans.1 $P = \frac{h}{\lambda}$

$$= \frac{6.6 \times 10^{-34}}{2.2 \times 10^{-11}} = 3 \times 10^{-23} \text{ kg ms}^{-1}$$

Ans.2 For atoms/ions $\bar{\nu} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) Z^2$

For Li^{2+}, $\bar{\nu} = 15200 \times 3^2$

$= 136,800 \text{ cm}^{-1}$

Ans.3 When $\ell = 2$, $m \neq -3$.

Ans.4 For 2s orbital $\ell = 0$

angular momentum $= \sqrt{\ell(\ell + 1)}\frac{h}{2\pi} = 0$.

Ans.5 Value of energy in excited state $= -\frac{13.6}{n^2}$ eV

in which n = 2, 3, 4 etc.

Ans.6 (i) $n = 4, \ell = 1$ (4p); (ii) $n = 4, \ell = 0$ (4s)
(iii) $n = 3, \ell = 2$ (3d) (iv) $n = 3, \ell = 1$ (3p)
Order of increasing energy
3p < 4s < 3d < 4p or (iv) < (ii) < (iii) < (i).

Ans.7 It is the electronic configuration of Cr (Z = 29) in ground state.

Ans.8 Speed of golf ball, $\nu = 5\text{m/h} = \frac{5\text{m}}{60 \times 60\text{s}}$

$$= \frac{1}{720} \text{ ms}^{-1}$$

Mass of golf ball, m = 200 g = 0.2 kg

$$? = \frac{h}{m?} = \frac{6.6 \; ? \; 10^{?34} \text{ Js}}{(\frac{1}{720} \text{ ms}^{?1}) \; ? \; (0.2 \text{ kg})}$$

$$= \frac{6.6 \; ? \; 10^{?34} \; ? \; 720 \; ? \; 10}{2}$$

$$= 6.6 \times 0.36 \times 10^{-30} \text{ m}$$

Ans.10 Li (Z = 3) : $1s^2\ 2s^1$

Li^- : $1s^2\ 2s^2$

Thus, Li^- is very stable. Electron affinity of Li is 60 kJ mol^{-1}

Be (Z = 4) : $1s^2\ 2s^2$

Be^- : $1s^2\ 2s^2\ 2p^1$

Thus, Be^- will be highly unstable. Be has almost zero electron affinity.

B (Z = 5) : $1s^2\ 2s^2\ 2p^1$

B^- : $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1$

Thus B^- will not be very unstable.

Electron affinity of B is 29 kJ mol^{-1}

C (Z = 6) : $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1$

C^- : $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$

Thus, C^- is quite stable. Electron affinity of C is 12 kJ mol^{-1}.

Thus most stable is Li- and least stable is Be^-