Chemistry Study Materials for Class 11
(NCERT Based Questions- Answers of Chapter- 02)
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Structure of Atom

THREE MARKS QUESTIONS

1. State (a)Hund's Rule of maximum Multiplicity (b) Aufbau Principle (c) n + l rule

Ans.(a) Pairing of electrons in the orbitals belonging to the same subshell (p, d or f) does not take place until each orbital belonging to that subshell has got one electron each i.e., it is singly occupied.

(b) In the ground state of the atoms, the orbitals are filled in order of their increasing energies

(c) Orbitals with lower value of (n + l) have lower energy. If two orbitals have the same value of (n + l) then orbital with lower value of n will have lower energy.

2. Write down the quantum numbers n and l for the following orbitals

a.2p b. 3d c. 5f

Ans. a. n=2, l= 1 b. n= 3, l=2 c. n= 5, l=3

3. Write the 3 points of difference between orbit and orbital.

Ans.

Orbit	orbital
1. An orbit is a well defined circular path around the nucleus in which the electrons revolve	1. An orbital is the three dimensional space around the nucleus within which the probability of finding an electron is maximum(upto 90 %)
2. It represents the planar motion of an electron around the nucleus	2. It represents the three dimensional motion of an electron around the nucleus
3. All orbits are circular and disc like	3. Different orbitals have different shapes, i.e., s-orbitals are spherically symmetrical, p-orbitals are dumb-bell shaped and so on.

4. State Heisenberg's uncertainty principle. Calculate the uncertainty in the position of an electron if the uncertainty in its velocity is 5.7×10^5 m/s.

Ans. It states that it is impossible to determine simultaneously, the exact position and exact momentum (or velocity) of an electron. The product of their uncertainties is always equal to or greater than h/4π.

$$\Delta x \times (m \times \Delta v) = h/4\pi$$

$$\Delta x = h/4\pi \times m \times \Delta v = \frac{6.6 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 5.7 \times 10^5}$$

$$= 1.0 \times 10^{-10} \text{ m}$$

5. Write 3 points of differences between electromagnetic waves and matter waves.

Electromagnetic waves	Matter waves
1. These are associated with electric and magnetic fields	1. These are not associated with electric and magnetic field.
2. They do not require any medium for propagation.	2. They require medium for propagation
3. They travel with the same speed a that of light	3. They travel with lower speeds not constant for all matter waves

6. (i) Calculate the number of electrons which will together weigh one gram.

(ii) Calculate the mass and charge of one mole of electrons

Ans. (i) Mass of one electron = 9.10939×10^{-31} kg

$\therefore$ Number of electrons that weigh 9.10939×10^{-31} kg = 1

Number of electrons that will weigh 1 g = $(1 \times 10^{-3}$kg)

$$= \frac{1}{9.10939 \times 10^{-31} \text{ kg}} \times \left(1 \times 10^{-3} \text{ kg}\right)$$

$$= 0.1098 \times 10^{-3+31}$$

$$= 0.1098 \times 10^{28}$$

$$= 1.098 \times 10^{27}$$

(ii) Mass of one electron = 9.10939×10^{-31} kg

Mass of one mole of electron = $(6.022 \times 10^{23}) \times (9.10939 \times 10^{-31}\ \text{kg})$

$= 5.48 \times 10^{-7}$ kg

Charge on one electron = 1.6022×10^{-19}coulomb

Charge on one mole of electron = $(1.6022 \times 10^{-19}\text{C}) \times (6.022 \times 10^{23})$

$= 9.65 \times 10^{4}$ C

7. Find energy of each of the photons which

(i) Correspond to light of frequency 3×10^{15}Hz.

(ii) Have wavelength of 0.50 Å.

Ans. (i) Energy (E) of a photon is given by the expression, $E = h\nu$

Where,

h = Planck's constant = 6.626×10^{-34}Js

ν = frequency of light = 3×10^{15}Hz

Substituting the values in the given expression of *E:*

$E = (6.626 \times 10^{-34}) \times (3 \times 10^{15})$ $E = 1.988 \times 10^{-18}$J

(ii) Energy (E) of a photon having wavelength (λ)is given by the expression,

$$E = \frac{hc}{\lambda}$$

h = Planck's constant = 6.626×10^{-34}Js

c = velocity of light in vacuum = 3×10^{8}m/s

Substituting the values in the given expression of *E:*

$$E = \frac{(6.626 \times 10^{-34})(3 \times 10^{8})}{0.50 \times 10^{-10}} = 3.976 \times 10^{-15}\ \text{J}$$

$$\therefore E = 3.98 \times 10^{-15}\ \text{J}$$

8. What is the wavelength of light emitted when the electron in a hydrogen atom undergoes transition from an energy level with $n = 4$ to an energy level with $n = 2$?

Ans. The $n_i = 4$ to $n_f = 2$ transition will give rise to a spectral line of the Balmer series.

The energy involved in the transition is given by the relation,

$$E = 2.18 \times 10^{-18} \left[\frac{1}{n_i^2} - \frac{1}{n_f^2} \right]$$

$$E = 2.18 \times 10^{-18} \left[\frac{1}{4^2} - \frac{1}{2^2} \right]$$

$$= 2.18 \times 10^{-18} \left[\frac{1-4}{16} \right]$$

$$= 2.18 \times 10^{-18} \times \left(-\frac{3}{16} \right)$$

Substituting the values in the given expression of *E:*

$$E = -(4.0875 \times 10^{-19} \text{ J})$$

The negative sign indicates the energy of emission. Wavelength of light emitted

$$(\lambda) = \frac{hc}{E} \qquad \left(\text{since } E = \frac{hc}{\lambda} \right)$$

Substituting the values in the given expression of λ:

$$\lambda = \frac{\left(6.626 \times 10^{-34}\right)\left(3 \times 10^{8}\right)}{4.0875 \times 10^{-19}}$$

$$\lambda = 4.8631 \times 10^{-7} \text{ m}$$

$$= 486.3 \times 10^{-9} \text{ m}$$

$$= 486 \text{ nm}$$

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