Plus One Chemistry Chapter Wise Important Questions Chapter 2 Structure of Atom

Question 1.
Dual nature of matter was proposed by Louis-de- Broglie. (March – 2009)
a) Calculate the de-Broglie wavelength associated with an electron with velocity 1.6 x 10^6 ms^{-1}.
b) State Pauli's exclusion principle and Hund's rule of maximum multiplicity.
Answer:

b) Pauli's Exclusion Principle : No two electrons in an atom can have same set of four quantum number equal.
Hund's rule : Electron pairing in orbitals of same energy will not take place until each available orbital of a given subshell is singly occupied.

a) $\lambda = h/mv$ $\quad v = 1.6 \times 10^6 m/s$

$m = 9.1 \times 10^{-21} Kg$

$$\lambda = \frac{6.625 \times 10^{-34}}{9.1 \times 10^{-21} \times 1.6 \times 10^6} = \frac{6.625 \times 10^{-34}}{9.1 \times 10^{-15} \times 1.6}$$

$$\frac{6.625 \times 10^{-34}}{14.56 \times 10^{-15}} = 0.45501 \times 10^{-19}$$

$= 4.55 \times 10^{-20} m$

Question 2.
Neils Bohrwasthe first to explain
quantitatively the general features of hydrogen atom structure and its spectrum. (March – 2010)
a) Give the main postulates of Bohr's model.
b) Find the maximum number of emission lines, when the excited electron of hydrogen atom in n=6, drops to the ground state (n=1).
c) Calculate the wave number of radiation due to transition of an electron from fourth orbit to second orbit (R_H = 109677cm^{-1}).
Answer:
a)

- The electrons in an atom revolve around the nucleus only in certain selected circular paths; called orbits.
- As long as an electron remains in a particular orbit, it does not loss or gain energy. This means that the energy of the electron in a particular orbit remains constant.
- Only those orbits are permitted in which the angular momentum of the electron is a whole number of multiple of h/2π, where h is Plank's constant.
- Energy is emitted or absorbed by an atom only when an electron in it moves from one orbit to another.

Question 3.
During Rutherford u-ray experiment, it was observed that most of the u-particles passed through the Gold-foil without any deflection, a small fraction deflected by small angles and very few bounced back. (Say – 2010)

a) What are the main conclusions made by Rutherford?
b) Give the atom model proposed by him.
c) What are the main drawbacks of this model and how Niels Bohr overcame these defects in his model?
Answer:
a)

- Since most of the α-particles passed through the foil without undergoing any deflection, there must be very large empty space within the atom.
- Since α-particles are heavy positively charged particles, they can be deflected only if they come close to some heavy positively charged mass within the atom. The α-particles deflected were those which passed very close to this positively body. Rutherford called this positive centre are nucleus.
- α -particles which make direct collision with the nucleus are deflected through large angles. Since the no. of such α-particles is very small, the nucleus of the atom must be occupying a very small space.

b) $6 \rightarrow 5$, $6 \rightarrow 4$, $6 \rightarrow 3$, $6 \rightarrow 2$, $6 \rightarrow 1$ (5 lines); $5 \rightarrow 4$, $5 \rightarrow 3$, $5 \rightarrow 2$, $5 \rightarrow 1$ (4 lines); $4 \rightarrow 3$, $4 \rightarrow 2$, $4 \rightarrow 1$ (3 lines); $3 \rightarrow 2$, $3 \rightarrow 1$ (2 lines); $2 \rightarrow 1$ (1 line)

Maximum numberof emission lines = 15

c) $\frac{1}{\lambda}=R\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$

Here $n_1=2$ $n_2=4$ $R=109677 cm^{-1}$

$$\frac{1}{\lambda}=109677\left[\frac{1}{2^2}-\frac{1}{4^2}\right]$$

$$=109677\left[\frac{1}{4}-\frac{1}{16}\right] \quad =109677\left[\frac{3}{16}\right]$$

$$\lambda=\frac{16}{109677 x 3}=4.86 x 10^{-5} cm$$

$\lambda = 4.86 \times 10^{-5} \times 10^{-2} m = 4.86 \times 10^{-7} m$

$= 486 \times 10^{-9} m = 486 nm$

b) He bombarded a very thin gold foil with a stream of +vely charged α -particles emitted from a radioactive substance. A circular screen coated with zinc sulphide was placed around the foil to detect the deflection suffered by a -particles. When an α -particle strips this screen a flash of light is given out. The following observations were made from these experiments.

- Most of α -particles passed through gold foil without any deflection.
- A few α -particles are deflected through small angles.

c) Rutherford's model failed to explain the stability of atom. According to Bohr's model an electron revolving in a particular orbit cannot loss energy therefore the problems of lossing energy by the electron and falling into the nucleus does not arise.

Question 4.
Based on his α-ray scattering experiment, Rutherford proposed the nuclear model of an atom. (March – 2011)
a) Give the main postulates of Rutherford's atom model.
b) Write the important demerits of the Rutherford model.
c) The threshold frequency γ_0 for a metal is $6.2 \times 10^3\ s^{-1}$. Calculate the K.E. emitted of an electron when the radiation fo frequency $v = 8.7 \times 10^{14}\ s^{-1}$ strikes the metal.
Answer:
a) i) The entire positive charge of an atom is localised in a very small region at the centre of the atom called nucleus.
ii) The electrons are revolving around the nucleus through extra nuclear regions.
iii) The space between nucleus and extranuclear region is emply.
b) This model connot explain the stability of the atom.
c) $KE = 1/2\ mv^2$
$= h\gamma - h\gamma_0$
$= h(\gamma - \gamma_0) = 6.625 \times 10^{-34}\ [(8.7 \times 10^{14}) - (6.2 \times 10^4)]$

Question 5.
The electron in an atom are designed by a set of quantum numbers labeled as n, I, m and s. (Say – 2011)
a) Give the values of n, I, m and sforthe valence elec-tronofsodium atom (atomic number= 11)
b) Which of the following set of quantum numbers are not allowed?
i) n = 3, I = 3, m = -3, s = + 1/2
ii) n = 2, I = 1, m = 0, s = – 1/2
iii) n = 1, I = 0, m = 0, s = + 1/2
iv) n = 0, I = 0, m = 0, s = + 1/2
c) State Pauli's exclusion principle
Answer:
a) Na (Z = 11) – $1s^2\ 2s^2\ 2p^6\ 3s^1$
∴ n = 3, I = 0, m = 0, s = + 1/2
b) i)and iv) are not allowed.
In i) 1' can have values from O to 2.
In iv) 'n' cannot be zero.
c) It states that no two electrons in an atom can have the same set of four quantum numbers.
OR
It states that only two electrons may exist in the same orbitaI and these electrons must have opposite spin.

Qn. 6.
The results of Rutherford's α-ray scattering experiment were quite unexpected. (Say – 2011)
a) Write the observahon of Rutherford's α-ray scattering experiment which leads to the conclusion that most of the space in an atom is empty.

b) Mention any one drawback of Rutherford's nudear model of an atom.
Answer:
a) The experimental observation, of Rutherford's α- ray scattering experiment. Most of the α-particles passed straight through the foil, he suggested that most of the space in an atom is empty.
b) Rutherford model has two defects.

- It cannot explain the stability of atom.
- It failed to explain line spectrum.

Question 7.
The photon has a momentum as well as a wavelength. (Say – 2011)
a) Which property of matter is revealed in the above statement?
b) A photon has a mass of 8.6 x 10^{-30}kg. Calculate the wavelength. [Planck's constant, h = 6.626 x 10^{-34} Js]
OR
Heisenberg's uncertainty principle rules out the existence of definite paths for electrons and other similar particles.
a) State Heisenberg's uncertainty principle.
b) Calculate the uncertainty in the velocity of a cricket ball of mass 130g, if the uncertainty in its position is of the order of 1.2 A°.
Answer:
a) Dual Behaviour of matter ie particle character as well as wave character. This means that like photon electrons also have momentum as well as wavelength.

OR
b) $\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}}{8.6 \times 10^{-30} \times 3 \times 10^{8}} = 0.2568 \times 10^{-12} m$

a) Heisenberg's uncertainty principle state that it is impossible to determine both the position and momentum of a microscopic moving partide like eectron simultaneously and accurately.

Qn. 8.
a) In order to specify the size,energy, shape and orientation of orbitals and spin of the electrons, we need 4 quantum numbers.
i) Write the 4 quantum numbers. (say – 2012)
ii) Represent the orbital with the following quantum numbers, n = 4 and I = 0.
b) State the rules behind the electronic configuration in an atom.
Answer:
a) Four quantum numbers are
1) 1) Principle quantum number (n)
2) Azimuthal quantum number (I)

$\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$

b) $\Delta x \cdot m\Delta v = \frac{h}{4\pi}$

Δv = ?

m = 130g

Δx = $1.2A^0$

$\Delta v = \frac{h}{\Delta x \cdot m \cdot 4\pi}$

$= \frac{6.626 \times 10^{-34}}{1.2 \times 10^{-10} \times 0.130 \times 4 \times 3.14}$

$= 3.38 \times 10^{-24} ms^{-1}$.

3) Magnetic quantum number (m)
4) Spin quantum number (s)
2) n = 4 I = 0 represent 4s – orbital

b) 1) Aufbau Principle
Electrons are added progressively to the vari-ous orbitals in their order of increasing energy starting with the orbital of lowest energy.
2) Pauli's Exclusin Principle . No two electrons in the same atom can have the same values for all the four quantum numbers.
3) Hund's rule of Maximum Multiplicity
Pairing of electrons in orbitals of same energy will not take place until each orbital is singly occupied with one electron, (ie. with parallel spin)

Qn. 9.
The photo electric effect was first observed by nu Hertz. (March – 2013)
a) The number of electrons ejected in the photoelectric effect is proportional to of light used. (frequency, intensity)
b) Select the correct statement related to the photo electric effect:
i) Threshold frequency is the maximum frequency required to cause photo electric emission from a particular metal.
ii) The kinetic energy of the photoeleçtrons is directly proportional to the frequency of incadent light
iii) Work function isthe same forall metals
Answer:
a) Intensity
b) Correct statement is (ii)

Question 10.
The general features of the structure of a hydrogen atom and hydrogen-like species were quantitatively explained by Neils Bohr. (March – 2013)
a) Write any postulate of the Bohr's model of the hydrogen atom
b) Calculate the radius of the second orbit of Li^{2+}. (Express the answer in nm)
OR
The dual behaviour of matter.was proposed by the French physicist, de Broglie.
a) State the dual behaviour of matter.
b) A moving electron has a de Broglie wavelength of 7×10^{-7}m. Calculate its kinetic energy. (Plank's constant = 6.626×10^{-34} Js, Mass of an electron = 9.1×10^{-31} kg).
Answer:
a) Postulate of Bohr's model of the H – atom
1) An atom consists of a small heavy positively changed nucleus at the centre and the electrons revolve around the nucleus in certain fixed circular paths called orbit.
2) As long as the electron remains in an orbit it does not lose or gain energy.
3) Only those orbits are permitted in which the angular momentum of the electron is a whole number multiple of $h/2\pi$ where 'h' is Planck's constant.
4) Energy is emitted or absorbed by an atom only when an electron moves from one orbit

to another.
b) $Sn = n^2 \times 0.0529\ A^0$
$= 2^2 \times 0.0529\ A^0$
$= 4 \times 0.0529$
$= 0.2116\ A^0$
$= 0.2116 \times 10^{-9}$ nm
OR
a) Matter can behave as particle as well as wave. Dual nature of matter.

Question 11.
a) A large number of orbitals are possible in an atom. Using s, p, d or f notation describe the orbital with the following quantum numbers. (Say – 2013)
i) n = 4, 1 = 0
ii) n = 3, 1 = 2
b) The Balmer series of lines in the hydrogen spectrum appear in the visible region of the electro-magnetic spectrum. Calculate the wave number of the second line in the Balmer series. (Rydberg constant for hydrogen is 109677 cm^{-1})
c) Bohr model of hydrogen atom contradicts dual behaviour of matter and Heisenberg's uncertainty principle. Justify.
Answer:

b) $\lambda = 7 \times 10^{-7}\ m$

$$\lambda = \frac{h}{mv}$$

$$\therefore mv = \frac{h}{\lambda} \quad \therefore V = \frac{h}{\lambda m}$$

$$\therefore V = \frac{6.626 \times 10^{-34}\ Js}{7 \times 10^{-7}\ m \times 9.1 \times 10^{-31}\ Kg}$$

c) Bohr's model of hydrogen atom ignores dual behaviour of matter. In this model electron is considered only as a material particle. Its wave character is not considered. Also Bohr's model contradicts the Heisenberg's uncertainty principle in the sense that electron is considered as a charged particle moving in well-defined circular orbits about the nucleus. The orbits can be completely defined only if both the position and the velocity of the electron are known exactly at the same time. This is not possible according to Heisenberg's uncertainty principle.

a) i) 4s
ii) 3d

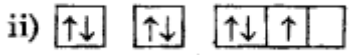
b) $\bar{\upsilon} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] cm^{-1}$

$= 109677 \left[\frac{1}{2^2} - \frac{1}{4^2}\right] cm^{-1} = 20564\ cm^{-1}$

Question 12.
a) The number of electrons, protons and neutrons in a species are equal to 18,16 and 16 respectively. Assign the proper symbol to the species. (March – 2014)
b) Write any two drawbacks of the Rutherford model of an atom.
c) Among the following electronic configurations, which one is correct?

Substantiate your answer.
Answer:
a) Atomic number = 16.
Hence, the element is sulphur (S).

Mass number = 16 + 16 = 32
Charge = 16 – 18 = -2 ,
∴ the symbol is 3216S2–

i) 
ii) 
iii) 

b) 1) It could not explain the stability of atom.
2) It says nothing about the electronic structure of atoms i.e., how the electrons are distributed around the nucleus and what are the energies of these electrons.

Question 13.
a) Write the subshellwise electronic configurations of the following elements: (August – 2014)
i) Cu (Z = 29)
ii) Cr (Z = 24)
Give reason for the extra stability of these atoms.
b) Canal rays were discovered by discharge tube experiments conducted in a modified cathode ray tube. Give any two characteristics of canal rays.
c) A microscope with suitable photons is employed to locate an electron in an atom within a distance Qf 0.4A. What is the uncertainty involved in the measurement of its velocity?
Answer:
a) i) Cu (Z = 29) – $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$
ii) Cr (Z = 24) – $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$
The completely filled and half filled sub-shells are stable are stable due to the following reasons:
1) Symmetrical distribution of electrons – the completely filled or half filled sub-shells have symmetrical distribution of electrons. They have equal energy but differeent spatial disribution. Their shielding of one another is relatively small and the electrons are more strongly attracted by the nucleus.

2) Exchange energy – It is the energy released when the electrons tend to exchange their po-sitions. The number of exchanges that can take place is maximum when the sub-shell is either half filled or cmpletely filled. As a result the exchange energy is maximum and so is the stability.

b) 1) They are positively charged gaseous ions.
2) The charge to mass ratio of the particles depends on the gas from which these originate.

c) i) iii) 

Question 14.
a) The number of protons, electrons and neutrons in a species are equal to 17,18 and 18 respectively. Which of the following will be the proper symbol of this species? (March – 2015)

c) $\Delta x.\ m\Delta v = \frac{h}{4\pi}$

$$\Delta v = \frac{h}{4\pi\ \Delta x\ m}$$

$$\Delta v = \frac{6.626 \times 10^{-34}\ Js}{4 \times 3.14 \times 0.4 \times 10^{-10} m \times 9.11 \times 10^{-31} kg}$$

$$= 1.45 \times 10^6\ m\ s^{-1}$$

b) i) Give any two postulates of

rutherford's nuclear model of an atom.
ii) Write the two main drawbacks of Rutherford's atomic model.

i) $^{35}_{17}Cl$ ii) $^{35}_{17}Cl^-$ iii) $^{36}_{17}Cl$ iv) $^{36}_{17}Cl^-$

OR

a) Representation of the orbital with quantum numbers n = 3, 1 = 1 is .....
i) 3 s
ii) 3d
iii) 3p
iv) 1s

b) i) Which of the following sets of quantum numbers are NOT possible?

1) $n = 2, l = 2, m_l = 0, m_s = +\frac{1}{2}$
2) $n = 1, l = 0\ m_l = 0, m_s = +\frac{1}{2}$
3) $n = 3, l = 2, m_l = -3, m_s = +\frac{1}{2}$
4) $n = 2, l = 1, m_l = 1, m_s = +\frac{1}{2}$

ii) Justify your answer.

Answer:

ii) 3517Sl

b) i) 1) The positive charge and most of the mass of the atom is densely concentrated in extremely small region called nucleus.
2) The nucleus is surrounded by electrons that move around the nucleus with a very high speed in circular paths called orbits,

ii) 1) Rutherford model cannot explain the stability of an atom on the basis of Maxwell's theory of electromagnetic radiations.
2) Rutherford model says nothing about the electronic structure of atoms .i.e., how the electrons are distributed around the nucleus and what are the energies of these electrons.

OR

a) iii) 3p

b) i) 1) $n = 2, \ell = 2, m_\ell = 0, m_s = +\frac{1}{2}$
3) $n = 3, \ell = 2, m_\ell = -3, m_s = +\frac{1}{2}$

ii) 'l' can have 'n' values from 0 to (n-1). Thus, for n = 2,'l' can have values 0 and 1. Hence l = 2 is not possible.
'ml' can have (2l + 1) values ranging from -1 through 0 to + l. For l = 2, ml(= -2,-1, 0, 1, 2. Hence, ml = -3 is not possible.

Question 15.
In the photoelectric effect experiment certain soft metals are exposed to light of particular frequency. Write any two observations of the photoelectric effect experiment. (Say – 2015)
Answer:

- The electrons are ejected from the metal surface as soon as the beam of light strikes the surface.
- The number of electrons ejected is proportional to the intensity or brightness of light.

Question 16.
The quantum numbers provide valuable information regarding electrons in an atom. (Say – 2015)
a) Which one of the following statements is CORRECT about quantum numbers?
i) The principal quantum number can have fractional values.
ii) The magnetic quantum number defines the three-dimensional shape of the orbital.
iii) The magnetic quantum number determines the size of the orbital.
iv) Spin quantum number gives information about the spatial orientation of the orbital with respect to a standard set of coordinate axes.
b) A photon has a wavelength of 3.5 A. Calculate its mass. (Planck's constant h = 6.626 x 10^{-34} Js. Velocity of light = 3 x 10^{8} ms^{-1})
OR
The uncertainly principle contributed significantly in the formulation of the quantum mechanical model of atom.
a) Which one of the following statements is CORRECT about the uncertainty principle?
i) The exact position and exact mementum of an electron in an atom can be determined simultaneously.
ii) It is a consequence of the dual behaviour of matter and radiation.
iii) It is significant only for motion of microscopic objects and is negligible forthat of macroscopic objects.
iv) It supports the existance of definite paths or trajectories of electrons and other similar particles.

b) An electron is moving with a velocity of 2.5 x 10^{6} ms^{-1}. If the uncertainty in its velocity is 0.1%, calculate the uncertainty in its position. (Planck's constant, h = 6.826 x 10^{-34} Js, Mass of the electron = 9.1 x 10^{-31} kg)
Answer:
a) ii) The magnetic quantum number defines the three-dimensional shape of the orbital.

OR
a) ii) It is a consequence of the dual behaviour of matter and radiation. &
iii) It is significant only for the motion of microscopic objects and is negligible for that of macroscopic objects.

b) $m = \frac{h}{\lambda v}$

$m = \frac{6.262 \times 10^{-34} Js}{3.5 \times 10^{-10} m \times 3 \times 10^{8} ms^{-1}}$

$= 6.3105 \times 10^{-31} kg$

Question 17.
Atomic orbitals are precisely distinguished by what are known as quantum numbers. (March – 2016)
a) Name the four quantum numbers.
b) Represent the orbitals given below.
i) n = 1, 1 = 0
ii) n = 2, 1 = 1

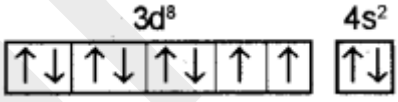
b) $\Delta x = \frac{h}{4\pi m \Delta v}$

$= \frac{6.262 \times 10^{-34} Js}{4 \times 3.14 \times 9.1 \times 10^{-31} kg \times 2.5 \times 10^{3} ms^{-1}}$

$= 2.3189 \times 10^{-6} m$

c) The number of unpaired electrons present in Ni is ..... (Atomic number of Ni =

28)
i) 2
ii) 0
iii) 1
iv) 3
Answer:
a) 1) Principal quantum number (n)
2) Azimuthal/Orbital angular momentum/Subsidiary quantum number (I)
3) Magnetic orbital quantum number (m)
4) Electron spin quantum number (m)
b) i) 2s
ii) 2p
c) 2
[Eledsonic configuration of Ni(Z = 28) is $[Ar]3d^8\ 4s^2$
i.e.,



Question 18.
Bohr was the first to explain the structure of hydrogen atom and spectrum. (Say – 2016)
a) Give the main postulates of Bohr model of atom.
b) Calculate the wavelength of the first line in the Lyman series of the hydrogen spectrum. ($R= 109677\ cm^{-1}$)
OR
a) There are some rules governing the filing of elec-tron in orbitals. State and explain Hund's rule of maximum multiplicity.
b) Quantum number gives address of electrons. Explain the quantum number which determines:
i) Distance of electron from nucleus.
ii) The orbital angular momentum of electron,
Answer:
a) i) The electron in hydrogen atom can move around the nucleus in a circular path of fixed radius and energy. These paths are called or-bits, stationary states or allowed energy states. These orbits are arranged concentri-cally around the nucleus.
ii) The energy of the electron in the orbit does not change with time. However, the electron will move from a lower stationary state to a higher stationary state when required amount of energy is absorbed by the electron or energy is emitted when electron moves from higher stationary state to lower stationary state. The energy change does not take place in a continuous manner.
iii) The frequency of radiation absorbed or emitted when transition occurs between two stationary states that differ in energy by ΔE, is given by

$$\upsilon = \frac{\Delta E}{h} = \frac{E_2 - E_1}{h}$$

where E_1 and E_2 are the energies of the lower and higher allowed energy states respectively. This expression is known as Bohr's frequency rule.
iv) The angular momentum of an electron in a given stationary state can be expressed as

in equation,

Thus an electron can move only in those orbits for which its angular momentum is integral multiple of h/2π that is why only certain fixed orbits are allowed.

$$m_e vr = n\frac{h}{2\pi} \qquad n = 1, 2, 3....$$

b) According to Rydbergs equation,

$$\bar{\upsilon} = \frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] cm^{-1}$$

OR

a) Hund's rule of maximum multiplicity states that pairing of electrons in the orbitals belonging to the same subshell does not take place until each orbital belonging to that subshell has got one electron each i.e. it is singly occupied.

$$\bar{\upsilon} = \frac{1}{\lambda} = 109677\left[\frac{1}{1^2} - \frac{1}{2^2}\right] cm^{-1}$$

$$= 109677\left[1 - \frac{1}{4}\right] cm^{-1}$$

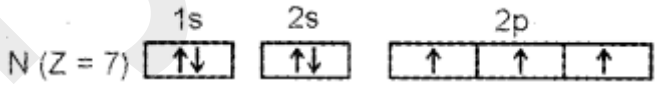
$$= 109677\left[\frac{3}{4}\right] cm^{-1} = 82257.75\ cm\text{-}1$$

$$\therefore \lambda = \frac{1}{82257.75\ cm^{-1}} = 1.22 \times 10^{-5}\ cm$$

Since there are three p, five d and seven f orbitals, therefore, the pairing of electrons will sart in the p, d and f orbitals with the entry of 4th, 6th and 8th ' electron respectively.

This rule helps in writing the ground state configurations of those atoms which have partially filled p, d or f subshells.

e.g. Electronic configuration of nitrogen. Here all the electons in the 2p level remain unpaired to give half filled configuration with extra stability, in accordance with Hund's rule of maximum multiplicity.



b) i) Principal quantum number (n): It is a positive integer with value of n = 1,2,3 It determines the size and to large extent the energy of the orbital. For hydrogen atom and hydrogen like species (He+, Li^{2+},... etc.) energy and size of the orbital depends only on 'n'. It also identifies the shell. With increase in the value of 'n', the number of allowed orbital increases and are given by 'n^2'. All the orbitals of a given value of 'n' constitutes a single shell of atom and are represented by the letters K (n = 1), L (n = 2), M (n = 3), N (n = 4)....Size and energy of an orbital increases with increase of 'n'.

ii) Azimuthal/Orbital angular momentum! Subsidiary quantum number (l): It defines the three-dimensional shape of the orbital. For a given value of n, l can have n values ranging from O to n – 1, i.e., for a given value of n, the possible value of are: = 0,1,2 (n – 1) Each subshell in a principal shell is assigned an t value i.e., fors-sbushell (l = 0), for p- subshell (l = 2), for d-subshell (l = 2) and so on.

Question 19.

a) i) Write the electronic configuration of chromium (Z = 24) (March – 2017)

ii) Find the number of electrons in the subshells with the azimuthal quantum number I =

2.

iii) Represent the orbital with quantum numbers n=1 and l=0

b) Give the mathematical representation of Heisenberg's uncertainty principle and its one important significance.

Answer:

a) i) $_{24}Cr - 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

OR

$_{24}Cr - [Ar]\ 3d^5\ 4s^1$

ii) 10 (*Explanation*: $\ell = 2$ denotes the d sub-shell.

Number of orbitals = $(2\ell + 1)$

$= 2 \times 2 + 1$

$= 5$

$\therefore$ Number of electrons = $5 \times 2 = 10$]

iii) 1s

b) Mathematical form of Heisenberg's uncertainty principle is

$$\Delta x \times \Delta p_x \geq \frac{h}{4\pi}$$

OR

$$\Delta x \times m\Delta v_x \geq \frac{h}{4\pi}$$

OR

$$\Delta x \times \Delta v_x \geq \frac{h}{4\pi m}$$

Where,

Δx = uncertainty in position of the particle

Δp_x = uncertainty in momentum of the particle

Δv_x = uncertainty in velocity of the particle

m = mass of the particle

h = Planck's constant

The most important implication of the Heisenberg's uncertainty principle is that it rules out existence of definite paths or trajectories of electrons and other similar particles.

The effect of uncertainty principle is significant only for motion of microscopic objects and is negligible forthat of macroscopic objects.

In dealing with milligram-sized or heavier objects, the associated uncertainties are hardly of any real consequence.

It therefore, means that the precise statements of the position and momentum of electrons have to be replaced by the statements of probability that the electron has at a given position and momentum.

We hope the Kerala Plus One Chemistry Chapter Wise Previous Questions Chapter 2 Structure of Atom help you. If you have any query regarding Kerala Plus One Chemistry Chapter Wise Previous Questions Chapter 2 Structure of Atom, drop a comment below and we will get back to you at the earliest.