CBSE Class 11 Chemistry

Important Questions

Chapter 2

Structure of Atom

1 Marks Questions

1.Name the sub – atomic particles of an atom.

Ans: Electron, proton and neutron.

2.Name the scientist who first formulated the atomic structure.

Ans: John Dalton, a British teacher in 1808 first proposed a firm scientific basis known as Dalton's

atomic theory.

3.What is the e/m ratio of an electron?

Ans: According to Thomson's experiment, e/m ratio for an electron is $1.76 \times 10^{8} cg^{-1}$

4.What is the charge (e) of an electron?

Ans: From Millikan's experiment, the charge of an electron (e) is $-1.602 \times 10^{-19} C.$

5.(i) What is the mass of a proton?

(ii) What is the charge of a proton?

Ans:(i) The mass of a proton is $1.676 \times 10^{-27} kg$ or 1.676×10^{-24}

(ii) The charge of a proton is $+1.602 \times 10^{-19} C$

6.(i) What is the mass of a neutron?

(ii) What is the charge of a neutron?

Ans: (i) The mass of a neutron is $1.676 \times 10^{-24} g$

(ii) Neutron is electrically neutral i.e. it has no charge as an electron or a proton has.

7.Name the scientist who first gave the atomic model.

Ans: J.J. Thomson, in 1898 first proposed the atomic model called raising-pudding model.

8.What is an isotope?

Ans: Atoms of the same elements having same atomic number but different mass number are called isotopes.

$eg: {}_1^1H, {}_1^2H \ and \ {}_1^3H$

${}_{17}^{35}Cl, {}_{17}^{37}Cl \ / \ {}_{6}^{12}C, {}_{6}^{13}C, {}_{6}^{14}C$

9.What are isobars?

Ans: Atoms of different elements which have same mass number but different atomic nos.

eg: ${}_{6}^{14}C, {}_{7}^{14}N$

${}_{18}^{40}Ar, {}_{19}^{40}K, {}_{20}^{40}Ca$

10.What are isotones?

Ans: Atoms of different elements which contains the same number of neutron.

eg. ${}^{14}_{6}C$, ${}^{15}_{7}N$, ${}^{16}_{8}O$

11.What is an atomic number?

Ans: Atoms of different elements which contains the same number of neutron.

eg. ${}^{14}_{6}C$, ${}^{15}_{7}N$, ${}^{16}_{8}O$

12.What is a mass number?

Ans: Maas number of an element is the sum of number of proton and neutron present in the nucleus of an atom.

13.Give the drawbacks of J.J. Thomson's experiment.

Ans: (i) It could not explain the origin of the spectral lines of hydrogen and other atoms,

(ii) It failed to explain scattering of $\alpha - particles$ in Rutherford's scattering experiment.

14.Why Rutherford's model could not explain the stability of an atom?

Ans: According to the electromagnetic theory of Maxwell, charged particles when accelerated should emit electromagnetic radiation. Therefore, an electron in an orbit will emit radiation; the orbit will then continue to shrink which does not happen in an atom.

15.Define photoelectric effect.

Ans: It is the phenomenon in which the surface of alkali metals like potassium and calcium emit electrons when a beam of light with high frequency is made to fall on them.

16.How does the intensity of light effect photoelectrons?

Ans: The number of electron ejected and kinetic energy associated with them depend on the

brightness of light.

17.What is threshold frequency?

Ans: The minimum frequency below which photo electric effect is not observed is called threshold frequency (v_o)

18.Name the scientist who demonstrated photoelectric effect experiment.

Ans: In 1887, H. Hertz demonstrated photo electric effect.

19.What did Einstein explain about photoelectric effect?

Ans: Einstein in 1905 was able to explain the photoelectric effect using Planck's quantum theory of electromagnetic radiation.

20.Calculate energy of 2mole of photons of radiation whose frequency is $5\times10^{14}Hz.$

Ans: Energy (E) of one photon = E = hv

Where $h=6.626\times10^{-34}Js$

$v=5\times10^{14}s^{-1}$

$\therefore E=\left(6.626\times10^{-34}\times5\times10^{14}\right)$

$=3.313\times10^{-19}J$

Energy of 2 mole of photon $=\left(3.313\times10^{-19}J\right)\times\left(2\times6.022\times10^{23}mol^{-1}\right)$

$=3990.2kJmol^{-1}$

21.States Heisenberg's Uncertainty Principle.

Ans: It states that It is impossible to determine simultaneously the exact position and exact momentum (or velocity) of an electron.

22..How would the velocity be effected if the position is known?

Ans: If the position of the electron is known with high degree of accuracy (Δx is small), then the velocity of the electron will be uncertain $\left(\Delta(V_x) \text{is large.}\right)$.

23.We don't see a car moving as a wave on the road why?

Ans: According to de Broglie's relation, $\lambda = {}^{h}/_{mv}$ *i.e.* $\lambda \alpha \frac{1}{m}$ the mass of the car is very large and its wavelength (λ) or wave character is negligible. Therefore, we do not see a car moving like a wave.

24.Give the de – Broglie's relation.

Ans: According to de Broglie, every particle in motion is associated with a wavelength and other wave characteristics. He deduced the relation that wavelength (λ) of a particle in motion is equal to the Planck's constant (h) divided by the momentum (p) of the particle.

i.e. $\lambda = \frac{h}{p} = \frac{1}{mv}$

Where m is the mass, v is the velocity after particles

25.Calculate the uncertainty in the velocity of a wagon of mass 4000kg whose position is known accurately of $\pm 10m$

Ans: Uncertainty in velocity (Δv) is given by

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

$$= \frac{6.6\times10^{-34}\, kgm^2 s^{-1}}{4\times\frac{22}{7}\times4\times10^{3}\, kg\times(\pm10m)}$$

$= 1.3 \times 10^{-39} ms^{-1}$

∴ The uncertainty in the velocity of the wagon is $= 1.3 \times 10^{-39} ms^{-1}$

26.What is the physical significance of ψ^2 up?

Ans: ψ^2 represent probability of finding an electron.

27.Which orbital is non – directional?

Ans:S – orbital is spherically symmetrical i. e it is non – directional.

28.What is the meaning of quantization of energy?

Ans: Quantization of energy means the energy of energy levels can have some specific values and not all the values.

29.Why is energy of 1s electron lower than 2s electron?

Ans.1s electron being close to the nucleus experiences more force of attraction than 2s–electron which is away from the nucleus.

30.What is nodal surface or nodes?

Ans: The region where the probability of finding an electron is zero i. e. $Y^2 = 0$

31.How many spherical nodal surfaces are there in 4s – sub-shell?

Ans: In ns orbital, the number of spherical nodal surfaces are(n – 1), hence is 4s (4 – 1) = 3 nodal surfaces are present.

CBSE Class 12 Chemistry

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Chapter 2

Structure of Atom

2 Marks Questions

1.What is the mass (m) of an electron?

Ans: mass of an electron (m) = $\frac{e}{\left(e/m\right)}$

$$= \frac{1.602 \times 10^{-19} C}{1.76 \times 10^{8} C g^{-1}}$$

$$= 9.10 \times 10^{-28} g$$

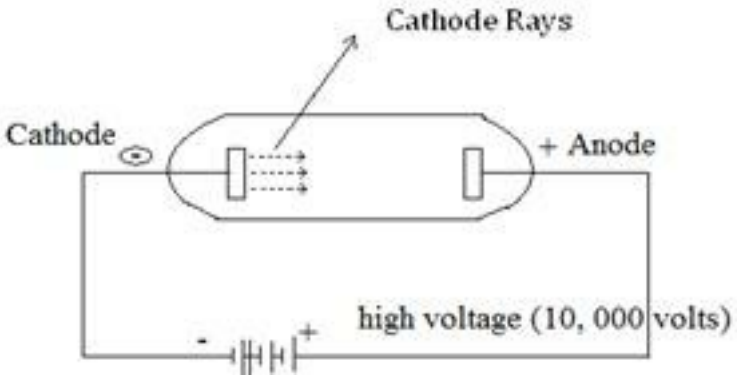
$$= 9.1 \times 10^{-31} kg$$

So, the mass of an electron is $= 9.1 \times 10^{-31} kg$ or $1/1837$ th of the mass of a hydrogen atom.

2.Which experiment led to the discovery of electrons and how?

Ans: The cathode ray discharge tube experiment performed by J.J. Thomson led to the discovery of negatively charged particles called electron.

A cathode ray tube consists of two thin pieces of metals called electrodes sealed inside a glass tube with sealed ends. The glass tube is attached to a vacuum pump and the pressure inside the tube is reduced to 0.01mm. When fairly high voltage (10, 000V) is applied across the electrodes, invisible rays are emitted from the cathode called cathode rays. Analysis of this rays led to the discovery electrons.



3.Give the main properties of canal ray experiment.

Ans: The canal ray experiment led to the discovery of –

(i) The anode rays, travel in straight line

(ii) They are positively charged as they get deflected towards the –ve end when subjected to an electric and magnetic field.

(iii) They depend upon the nature of gas present in the cathode tube.

(iv) The charge to mass ration (e/m) of the particle is found to depend on the gas from which they originate.

(v) They are also material particles

The analysis of these proportions led to the discovery of positively charged proton.

4.Find out atomic number, mass number, number of electron and neutron in an element $^{40}_{20}\times$ **?**

Ans: The mass no. of $\times$ is 40

The atomic no. of $\times$ is 20

No. of proton is = Z – A = 40 – 20 = 20

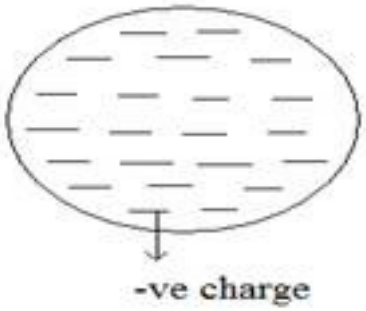
No. of electron its (A) = 20

No. of proton is (A) = 20

5.Give the main features of Thomson's Model for an atom.

Ans: J.J. Thomson proposed that an atom consists of a spherical sphere (radius of about 10^{-10}m)in which the positive charges are uniformly distributed the electrons are embedded into it in such a manner so as to give stable electrostatic arrangement.

This model is also called raisin pudding model.



6.What did Rutherford conclude from the observations of $\alpha - ray$ scattering experiment?

Ans: Rutherford proposed the nuclear model of an atom as

(i) The positive charge and most of the mass of an atom was concentrated in an extremely small region. He called it nucleus.

(ii) The nucleus is surrounded by electrons that move around the nucleus with a very high speed in orbits.

(iii) Electron and nucleus are held together by electrostatic forces of attraction.

7.What is the relation between kinetic energy and frequency of the photoelectrons?

Ans: Kinetic energy of the ejected electron is proportional to the frequency of the electromagnetic radiation.

8.What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition, n = 4 to n = 2 of He^+ spectrum?

Ans: For the Balmer transition, n = 4, to n = 2 in a He^+ ion, we can write.

$$\frac{1}{\lambda} = Z^2 R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

$$= Z^2 R_H \left(\frac{1}{2^2} - \frac{1}{4^2} \right)$$

$$= \frac{3}{4} R_H \text{ --------} (i)$$

For a hydrogen atom

$$\frac{1}{\lambda} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \text{------} (ii)$$

Equating equation (ii) and (i), we get

$$\frac{1}{n_1^2} - \frac{1}{n_2^2} = \frac{3}{4}$$

This equation gives $n_1 = 1$ and n = 2. Thus the transition n = 2 to n = 1 in hydrogen atom will have same wavelength as transition, n = 4 to n = 2 in He^+

9.Spectral lines are regarded as the finger prints of the elements. Why?

Ans: Spectral lines are regarded as the finger prints of the elements because the elements can be identified from these lines. Just like finger prints, the spectral lines of no two elements resemble each other.

10.Why cannot the motion of an electron around the nucleus be determined accurately?

Ans: Because there is an uncertainty in the velocity of moving electron around the nucleus (Heisenberg's Uncertainty Principle).

11.Calculate the uncertainty in the momentum of an electron if it is confined to a linear region of length 1×10^{-10}.

Ans: According to uncertainty Principle

$$\Delta x.\Delta p = \frac{h}{4\pi}$$

$$or, \Delta p = \frac{h}{4\pi\Delta x}$$

$$or, \Delta p = \frac{6.626\times10^{34}\,kgm^2s^{-1}}{4\times3.143\times10^{-10}\,m)}$$

$$= 5.27\times10^{-26}\,kgms^{-1}$$

12.Give the mathematical expression of uncertainty principle.

Ans: Mathematically, it can be given as

$$\Delta x\times\Delta p_x \geq h/4\pi$$

$$or, \Delta x\times\Delta(mv_x) \geq h/4\pi$$

$$or, \Delta x\times\Delta V_x \geq h/4\pi m$$

Where Δx is the uncertainty in position and $\Delta p_x\ (\Delta v_x)$ is the uncertainty in momentum (or velocity) of the particle.

13.Which quantum number determines

(i) energy of electron

(ii) Orientation of orbitals.

Ans. (i) Principal quantum number (n), and

(ii) Magnetic quantum number (m).

14.Arrange the electrons represented by the following sets of quantem number in decreasing order of energy.

1. **n = 4, l = 0, m = 0, s = +1/2**
2. **n = 3, l = 1, m = 1, s = -1/2**
3. **n = 3, l = 2, m = 0, s = +1/2**

Ans.(i) Represents 4s orbital

(ii) Represents 3p orbital

(iii) Represents 3d orbital

(iv) Represents 3s orbital

The decreasing order of energy 3d > 4s > 3p > 3s

n = 3, l = 0, m = 0, s = -1/2

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3 Marks Questions

1.What designations are given to the orbitals having

(i) n = 2, l = 1 (ii) n = 2, l = 0 (iii) n = 4, l = 3

(iv) n = 4, l = 2 (v) n = 4, l = 1?

Ans. (i) Here, n = 2, and l = 1

Since l = 1 it means a p-orbital, hence the given orbital is designated as 2p.

(ii) Here, n = 2 and l = 0

Since l = 0 means s – orbital, hence the given orbital is 2s.

(iii) Here, n = 4 and l = 3

Since, l = 3 represents f – orbital, hence the given orbital is a 4f orbital.

(iv) Here, n = 4 and l = 2

Since, l = 2 represents d – orbital, hence the given orbital is a 4d – orbital.

(v) n = 4 and l = 1

since, l = 1 means it is a p – orbital, hence the given orbital can be designated as – 4p orbital.

2.Write the electronic configuration of (i) Mn^{4+}, (ii) Fe^{3+} (iii) Cr^{2+} and Zn^{2+} Mention the number of unpaired electrons in each case.

Ans.(i) Mn (z = 25), Mn^{4+} (z = 21)

The electronic configuration of Mn^{4+} to Given by

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^3$

As the outermost shell 3d has 3 electrons, thus the number of unpaired

electrons is 3.

(ii) Fe (z = 26), Fe^{3+} (z = 23)

The electronic configuration of Fe^{3+} is given lay

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$

The number of unpaired electron is 5.

(iii) Cr (z = 24), Cr^{2+} (z = 22)

The electronic configuration of Cr^{2+} is

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4$

The number of unpaired electron is 4.

(iv) Zn (z = 30), Zn^{2+} (z = 28)

The electronic configuration of Zn^{2+} is

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}$

The number of unpaired electron is 0.