QB365

Important Questions - Structure of Atom

11th Standard CBSE

Chemistry

Reg.No. : | | | | | | |

Time : 01:00:00 Hrs

Total Marks : 50

Section-A

1) What is the difference in the origin of cathode rays and anode rays? **1**

2) An atom having atomic mass number 13 has 7 neutrons. What is the atomic number of the atom? **1**

3) What will be the wavelength of a ball of mass 0.1 kg moving with a velocity of 10 ms^{-1} ? **1**

4) Can we apply Heisenberg's uncertainty principle to a stationary electron?why or why not? **1**

5) Nickel atom can lose two electrons and from Ni^{2+} ion. The atomic number of Ni is 28 . from which orbital will nickel lose two electrons? **1**

6) In which atom, the outermost electron can have the following set of quantum numbers? **1**

n=3,l=0,$m_1 = 0, m_2 = 1/2$

7) Why is 4s - orbital filled before 3d - orbital? **1**

8) What is the difference between ground state and excited state? **1**

9) Find energy of each of the photons which **1**

have wavelength of 0.50 $\mathring{A}$

10) Wavelengths of different radiations are given below. **1**

$\lambda(A) = 300 \quad nm, \quad \lambda(B) = 300 \quad \mu m, \quad \lambda(C) = \quad 3 \quad nm, \lambda(D) = 30\mathring{A}$

Arrange these radiations in the increasing order of their energies.

Section-B

11) Life times of the moleclues in the excited states are often measured by using pulsed radiation source of duration nearly in the nanosecond range. If the radiation source has the duration of 2 ns and the number of photons emitted during the pulse source is 2.5 X $10^{15,}$ calculate the energy of the source. **2**

12) Calculate the energy of one mole of the photons of a beam of light having wavelength 25.0 μm. **2**

13) The Vividh Bharati Station of All India Radio, Delhi, Broadcasts on a frequency of 1368 kHz(kilohertz). Calculate the wavelength of the electromagnetic radiation emitted by transmitter. Which part of the electromagnetic spectrum does it belong to? **2**

14) A porton is moving with kinetic energy 5X10^{-27} J.What is the velocity of the porton? **2**

15) Which orbital in each of the following pairs is lower in energy in a many-electron atom? **2**

3p,3d

16) A hydrogen atom has only one electron, so mutual repulsion between electrons is absent. **2**

However, in multielectron atom mutual repulsion between the electrons is significant

How does this affect the energy of an electron in the orbitals of the same principle quantum number in a multielectron atom?

17) Write the electronic configuration of $9^{F^{19}}$, $16^{S^{32}}$ $and 18^{Ar^{38}}$ and then point out the element with **2**

A maximum number of unpaired electrons.

18) In Rutherford's experiment, generally the thin foil of heavy atoms, like gold, platinum etc., have been used to be bombarded by the α -particles. **2**

If the thin foil of light atoms like aluminum etc., is used, what difference would be observed from the above results?

19) In each of the following pairs of salt, which one is more stable? **2**

Ferrous and ferric salts

Ferrous and ferric salt

20) Calculate the approximate charge in coulomb and approximate mass in kilogram of the nucleus of lithium 7 isotope. **2**

Section-C

21) Among the following pairs of orbitals, which orbital will experience the large effective nuclear charge? **5**

4d and 4f

22) Among the following pairs of orbitals, which orbital will experience the large effective nuclear charge? **5**

3d and 3p

23) A photon of wavelength 4 X 10^{-7} m strikes on metal surface, the work function of the metal being 2.13 eV. Calculate **5**

The velocity of the photoelectron (1 eV = 1.6020 X 10^{-19} J).

24) Why was the change in the Bohr model of atom is required, due to which important development(s), concept of movement of an electron in an orbit was replaced by the concept of probability of finding an electron in an orbital?What is the name given to the changed model of an atom? **5**

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Section-A

1) 1

Cathode rays originate from the cathode whereas anode rays are not obtained from the anode. They are produced from the gaseous atoms by knock out of the electrone with high speed cathode rays

2) As A=n+p p=A-n=13-7=6 Hence, atomic number, z=p=6 1

3) 1

Given mass of ball=0.1 kg velocity of moving ball=10ms^{-1}

$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34} Js}{(0.1 \quad kg)(10 \quad ms^{-1})} = 6.626 \times 10^{-34} m \qquad \left[\because \quad J = Kgm^2 s^{-2}\right]$

4) No because velocity=0 and thus , position can be measured accurately 1

5) $28^{NI} = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^8, 4s^2$; Nickel will lose 2 electrons from 4s(outermost shell) to form Ni^{2+} ion. 1

6) 1

n=3 and l=0 mean the last electron enters in 3s-orbital. Thus, the complete configuration up to 3s is $1s^2, 2s^2, 2p^6. 3s^1$. Total number of electrons =2+2+6+1=11. thus, the element is sodium

7) 1

8) 1

9) Energy, $E = \frac{hc}{\lambda}$ 1

$\lambda = 0.50\overset{\circ}{A} = 0.50 \times 10^{-10} m$

$E = \frac{6.626 \times 10^{-34} \quad Js \times 3 \times 10^8 ms^{-1}}{0.50 \times 10^{-10} m}$

=39.756x10^{-16} J

=3.975x10^{-15} J

10) (A)$\lambda = 300nm = 300 \times 10^{-9} m$ 1

(B)$\lambda = 300\mu m = 300 \times 10^{-6} m$

(C)$\lambda = 3nm = 3 \times 10^{-9} m$

(D)$\lambda = 30\overset{\circ}{A} = 30 \times 10^{-9} m = 3 \times 10^{-9} m$

$\because$ Energy, $E = \frac{hc}{\lambda} or E \propto \frac{1}{\lambda}$

$\therefore$ Increasing order of energy is B<A<C<=D

Section-B

11) Ferquency, V = $\frac{1}{Period} = \frac{1}{2 \quad ns} = \frac{1}{2 \times 10^{-9} s}$ 2

= 0.5 X 10^{9}s^{-1}

Energy of the source = Energy of 1 photon X number of photons produced

E_{source} = hv X N

= 6.626 X 10^{-34} Js X 0.5 X 10^9 s^{-1} X 2.5 X 10^{15}

= 8.28 X 10^{-10} J

12) 4780 2

13) Frequency, $\nu = \frac{c}{\lambda}$ 2

$1368 \times 10^3 Hz = \frac{3 \times 10^8 ms^{-1}}{\lambda} or \quad \lambda = \frac{3 \times 10^8 ms^{-1}}{1368 \times 10^3} Hz \quad = \quad 219.3m, \quad radiowave$

14) Mass of proton= $\frac{1.008 \times 10^{-3}}{6.02 \times 10^{23}} kg = 1.67 \times 10^{-27} kg KE = \frac{1}{2} mv^2 v = \frac{2KE}{m} = \frac{2 \times 5 \times 10^{-27}}{1.67 \times 10^{-27}} = 5.98$ 2

15) 3p<3d 2

16) 2

In a hydrogen atom, the energy of an electron is determined by the value of n and in a multielectron atom, it is determined by n+1. hence,for a given principal quantum, electrons of s,p,d and f-orbitals have different energy (for,p,d and f=0,1,2 and 3 respectively)

17) $9^{F^{19}} = 1s^2 2s^2 2p_x^2 2p_y^2 2p_z^1 16^{S^{32}} = 1s^2 2s^2 2p^6 3s^2 3p_x^2 3p_y^1 3p_z^1 18^{Ar^{38}} = 1s^2 2s^2 2p^6 3s^2 3p^6$ 2

Maximum number of unpaired electrons=2 in $16^{S^{32}}$

18) 2

Heavy atoms such as gold, platinum have nucleus. Heavy nucleus contains large amount of positive charge. When a beam of α-particles is shot at a thin gold foil, most of them pass through without much effect.

Some however, are deflected back or by small angles due to enormous repulsive force of heavy nucleus. If light aluminium foil is used, the number of α -particles deflected back or those deflected by small angles will be negligible.

19) 2

Ferrous and ferric salts In ferrous salts Fe^{2+} , the configuration is$1s^2 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}$. In ferric saltFe^{3+} ,the configuration is $1s^2 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}$As.half filled $3p^5$ Configuration is more stable therefore ferric salts are more stable than ferrous salts

20) Nucleus of Li atom has 3 protons and 4 neutrons. **2**

Charge on one proton =1.60x10^{-19} coulombs

Charge on 3 protons (i.e. charge on nucleus)

$=3 \times 1.60 \times 10^{-19} C = 4.80 \times 10^{-19} C$

Mass of proton mass of neutron $\simeq 1.67 \times 10^{-27} kg$

Mass of nucleus $=7 \times 1.67 \times 10^{-27} kg$

$=11.69 \times 10^{-27} kg$

Section-C

21) Similarly, 4d -orbital experiences large effective nuclear charge than 4 f-orbital **5**

22) in 3d and 3p -orbitals, 3p- orbital experience large effective nuclear charge **5**

23) **5**

$KE = \frac{1}{2}mv^2 = 0.97 \quad eV\frac{1}{2}mv^2 = 0.97X1.602X10^{-19}$ $[\because \quad 1 \quad eV = 1.602X10^{-19}J]\frac{1}{2}X9.11X10^{-31}kgXv^2 = 0.97X1.602X10^{-19}J$ $[\because Mass \quad of \quad 1e^- = 9.11X$

24) **5**

In Bohr model, an electron is regarded as a charged particle moving in well defined circular orbits about the nucleus. An orbit can completely be 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 the Heisenberg uncertainty principle. Further more, the wave character of the electron is not considered in Bohr model.

Therefore, concept of movement of an electron in an orbit was replaced by the concept of probability of finding electron in an orbital due to de-Broglie concept of dual nature of electron and Heisenberg's uncertainty principle.the changed model is called quantum mechanical model of the atom. [3]