# Solved Examples

**Ex.1** Complete the following table –

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Atom  / ion | Atomic  Number  (Z) | Mass No. (A) | Proton (p) | Neutron (n) | Elect ron  (e) |
| Al3+ | 13 |  |  | 14 |  |
| Cu | 29 | 63 |  |  |  |
| Mg2+ | 12 | 24 |  |  |  |
| Sr |  | 88 | 38 |  |  |

**Sol.** (i) Atomic number (Z) = 13 = Number of

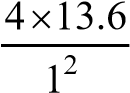
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|  |  | protons |
|  |  | Number of electrons = 13 –3 = **10** |
|  |  | Mass number = n + p = 14 + 13 = **27** |
|  |  | (ii) Atomic number = Number of protons |
|  |  | = Number of electrons = **29** |
|  |  | Mass number = n + p = **63** |
|  |  | since p = 29  |
|  |  |   n = 63 – p = 63 – 29 = **34** |
|  |  | (iii) Number of protons = Z = **12** & Number of electrons = 12 – 2 = 10 |
|  |  | Mass number = n + p = 24  |
|  |  |   n = 24 – p = 24 – 12 = **12** |
|  |  | (iv) Number of electrons = Number of protons  = Z = 38 |
|  |  | Mass number = n + p = 88  |
|  |  |   n = 88 – p = 88 – 38 |
|  |  | = **50** |
| **Ex.2** | | An oil drop has 6.39 × 10– 19 C charge. Find out the number of electrons in this drop - |
| **Sol.** | | Charge on oil drop = 6.39 × 10– 19 C |
|  | | Now we know that |
|  | | 1.602 *×* 10– 19 C is the charge on one electron |
|  | |  6.39 *×* 10– 19 C will be charge on  6.391019  = 19  1.60210 |
|   | | = **4 electrons** |
| **Ex.3** | | Find out the number of waves made by a Bohr electron in one complete revolution in its 3rdorbit of hydrogen atom *–* |
| **Sol.** | | Total no. of waves |
|  | | Total distance 2  = = r wavelength of one wave  |
|  | | Velocity of the electron in 3rd orbit = 3h  2mr |



|  |  |
| --- | --- |
|  | Here m = mass of electron |
|  | r = radius of 3rd orbit |
|  | According to de-Broglie equation |
|  | h h 2   = = × mr = 2r mv m 3h 3 |
|  | 2  = r × 3 = **3**  2r |
| **Ex.4** | The ionization energy of He+ is 19.6 × 10–18 J atom–1. The energy of the first stationary state of Li+2 will be *-* |
|  | (A) 21.2 × 10–18 J/atom |
|  | (B) 44.10 × 10–18 J/atom |
|  | (C) 63.2 × 10–18 J/atom |
|  | (D) 84.2 × 10–18 J/atom **(Ans. B)** |
| **Sol.** | E1 for Li+2 = E1 for H × Z2 Li = E1 for H × 9 |
|  | E1 for He+ = E1 for H × Z2 He = E1 for H × 4 |
|  | 9 or E1 for Li+2 = 4 E1 for He+ |

= 19.6 × 10–18 ×

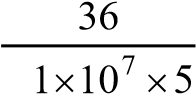
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| --- | --- |
|  | = **44.10 × 10–18 J/atom** |
| **Ex.5** | The ionization energy of hydrogen atom is  13.6 eV. What will be the ionization energy of He+ *-* |
| **Sol.** | He+ is a hydrogen like species i.e. the electron is ionised from first orbit. |
|  | Z2E  Ionization energy of He+ = n2 H |

= 

|  |  |
| --- | --- |
|  | = **54.4 eV** |
| **Ex.6** | The ionization energy of H-atom is 13.6 eV.  The ionization energy of Li+2 ion will be *-* |
|  | (A) 13.6 eV |
|  | (B) 27.2 eV |
|  | (C) 54.4 eV |
|  | (D) 122.4 eV **(Ans D)** |
| **Sol.** | E1 for Li+2 = E1 for H × Z2 [for Li, Z = 3] |
|  | = 13.6 × 9 = **122.4 eV** |

|  |  |
| --- | --- |
| **Ex.7** | Which transition of the Hydrogen spectrum would have the same wave length as the Balmer transition, n = 4 to n = 2 of He+ spectrum *-* |
|  | (A) n2 = 2 to n1 = 1 |
|  | (B) n2 = 3to n1 = 1 |
|  | (C) n2 = 4 to n1 = 2 |
|  | (D) n2 = 5 to n1 = 3 **(Ans. A)** |
| **Sol.** | For He+ ion, we have |
|  | 1   = RHZ2  112  n122    n |
|  | = RH[2]2 212  412    |
|  | 3  = RH …(A)  4 |
|  | Now for H atom |
|  | 1  1 1   = RH n12  n22  …(B)    |
|  | Equating equs (A) and (B) we have |
|  | 1 1 3 n12 – n22 = 4 |
|  | Obviously n1 = 1 and n2 = 2. Hence the transition n = 2 to n = 1 in hydrogen atom will have the same wave length as the transition n = 4 to n = 2 in He+ species. |
| **Ex.8** | Given R = 1.0974 × 107 m–1 and h = 6.626 ×  10– 34 Js. The ionization energy of one mole of  Li+2 ions will be as follows - |
|  | (A) 11240 KJ mole–1 |
|  | (B) 11180 KJ mole–1 |
|  | (C) 12350 KJ mole–1 |
|  | (D) 15240 KJ mole–1 **(Ans. B)** |
| **Sol.** | The expression of Ionization energy is - |
|  |   E = RZ2 hc |
|  | For Li+2 ion, Z = 3, hence |
|   |   E = (1.0974 × 107 m–1) × (9) |
|  | × (6.626 × 10–34 J.S.) × (3 × 108 ms–1) |
|  | = 1.964 × 10–17 J |
|  | For one mole of ions, we have |
|  |  E’ = NA . E |
|  | = (6.023 x 1023 mol–1) (1.964 x 10–17 J) |
|  | = 1.118 x 107 J mol–1 |

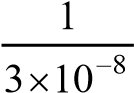
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|  | Now we know that |
|  | c  E = h = h ×   |
|  | = 6.1055341037108 =3.03 × 10–19 J 6.62   |
|  |  Energy corresponding to 1g atom of  hydrogen |
|  | = 3.03 × 10– 19 × 6.02 × 1023 |
|  | = 18.25 × 104 J = **182.5 KJ** |
| **Ex.10** | Estimate the difference in energy between 1st and 2nd Bohr orbit for a H atom. At what minimum atomic no., a transition from n = 2 to n = 1 energy level would result in the emission of X-ray with  = 3.0 × 10–8 m. Which hydrogen spectrum like species does this atomic no. corresponds to *–* |
| **Sol.** | E1 for H = – 13.6 eV |
|  |  E2 for H = ( – 13.6/22)= – 13.6/4 = – 3.4 eV |
|  |  E2 – E1 = – 3.4 – ( – 13.6) = **+ 10.2 eV** |
|  | Also for transition of H like atom ; |
|  |  = 3.0 × 10– 8 m |
|  | = RH . Z2 112  212  1    |

 = 1.1 × 107 × 

= = 6.55 × 10– 7 m

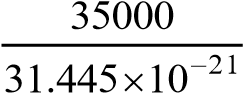
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| **Ex.9** | Calculate the energy emitted when electron of 1.0 g atom of hydrogen undergo transition giving the spectral line of lowest energy in the visible region of its atomic spectrum *-* |
|  | (RH  = 1.1 × 107 m–1, c = 3 × 108 ms–1, h = 6.62 × 10–34 Js). |
| **Sol.** | The spectral line lies in the visible region i.e., it corresponds to the Balmer series i.e. n1 = 2 and hence n2 = 3, 4, 5, etc. |
|  | For lowest energy n2 = 3 |
|  | Substituting the values in the following relation. |
|  | 1 = RH  112  n122    n |
|  | = 1.1 × 107 × 14  19 |

1.

 = 1.09 × 107 × Z2 × 

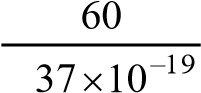
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| = 11180 KJ mol–1 |  | Z2 = 4 and **Z = 2** | |
|  |  | ATOMIC STRUCTURE | **31** |

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| --- | --- |
| **Ex.11** | The shortest wave length in H spectrum of Lyman series when RH = 109678 cm–1 is *-* |
|  | (A) 1215.67 Å (B) 911.7 Å |
|  | (C) 1002.7 Å (D) 1127.30 Å  **(Ans B)** |
| **Sol.** | For Lyman series n1 = 1 |
|  | For shortest ‘’ of Lyman sereis the energy differnece in two levels showing transition should be maximum (i.e. n2 = ). |
|  | 1 = RH 112  12     |
|  | = 109678 |
|  |   = 911.7 × 10– 8 |
|  | = **911.7 Å** |
| **Ex.12** | The energy of an electron in the second and third Bohr orbits of the hydrogen atom is  – 5.42 × 10–12 ergs and – 2.41 × 10– 12 erg respectively. Calculate the wavelength of the emitted radiation when the electron drops from third to second orbit *-* |
| **Sol.** | Here, h = 6.62 × 10– 27 erg |
|  | E3 = – 2.41 × 10– 12 erg |
|  | E2 = – 5.42 × 10– 12 erg |
|  | E = E3 – E2 |
|  | = – 2.41 × 10– 12 + 5.42 × 10– 12 |
|  | Now we know that, E = h*v* |
|  | c  *v =*  = E = 3.01101227   h 6.6210 |
|  |  = 3.10012710312108 . 6.62   |
|  |  = 6.6 × 10–5 cm |
|  | Since, 1Å = 10–8 cm |
|  |  = 6.6 × 103 Å |
| **Ex.13** | Find the number of quanta of radiations of frequency 4.75 × 1013 sec–1, required to melt 100 g of ice. The energy required to melt 1 g of ice is 350 J *–* |
| **Sol.** | E = nh*v* |
| = n × 6.62 × 10– 34 J sec × 4.75 × 1013 sec–1  = n × 31.445 × 10– 21 J  Energy required to melt 100 g ice = 350 J × 100  = 35000 J  n × 31.445 × 10– 21 = 35000 | |

n =  = **1113 × 1021**

|  |  |
| --- | --- |
| **Ex.14** | Calculate the number of photons emitted in 10 hours by a 60 W sodium lamp |
|  | (of photon = 5893 Å) - |
| **Sol.** | Energy emitted by sodium lamp in one sec. |
|  | = Watt. × sec = 60 × 1 J |
|  | Energy of photon emitted = hc   |
|  | = 6.6255893103410310.0108  – |
|  | = 3.37 × 10– 19 J |

 No. of photons emitted per sec. =

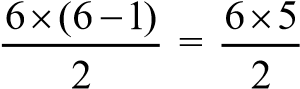
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|  |  No. of photons emitted in 10 hours |
|  | = 17.8 × 1019 × 10 × 60 × 60 |
|  | = **6.41 × 1024** |
| **Ex.15** | Calculate the wavelength of a moving electron having 4.55 × 10– 25 J of kinetic energy- |
| **Sol.** | Kinetic energy = (½mu2) = 4.55 × 10–25 J |
|  | 2   u2 = 4.55103125  9.10810 |
|  | u = 103 m sec–1 |
|  | h 6.6251034    = = 31 103  mu 9.10810  |
|  | = **7.27 × 10– 7 meter** |
| **Ex.16** | The minimum energy required to overcome the attractive forces electron and surface of Ag metal is 7.52 × 10– 19 J. What will be the maximum K.E. of electron ejected out from Ag which is being exposed to U.V. light of  = 360 Å |
|  | (A) 36.38 × 10– 19 Joule |
|  | (B) 6.92 × 10–19 Joule |
|  | (C) 57.68 × 10– 19 Joule |
|  | (D) 67.68 × 10– 19 Joule  **(Ans. B)** |
| **Sol.** | hc  Energy absorbed =   |
|  | = 6.62536010271038.01010   |
|  | = 5.52 × 10–11 erg |
|  | **=**  5.52 × 10–18 Joule |
|  | = ( 7.52 × 10–19) – ( **.** 552 × 10–19) |
|  | = 6.92 × 10–19 Joule |

|  |  |
| --- | --- |
| **Ex.17** | In hydrogen atom , an electron in its normal state absorbs two times of the energy as if requires to escape (13.6 eV) from the atom. The wave length of the emitted electron will be – |
|  | (A) 1.34 × 10–10 m (B) 2.34 × 10–10 m |
|  | (C) 3.34 × 10–10 m (D) 4.44 × 10–10 m |
|  | **(Ans C)** |
| **Sol.** | Energy absorbed by an atom |
|  | = 2 × 13.6 = 27.2 eV |
|  | Energy consumed in escape |
|  | = 13.6 eV |
|  | Energy converted into K.E. |
|  | = 13.6 × 1.6 × 10–19 J |

2KE 2(13.61.61019) v = m = 9.11031

|  |  |
| --- | --- |
|  | = 2.18 × 106 ms–1 |
|  | h 6.63 34   = = 9.110 31102.1106 mv  |
|  | = **3.34 × 10–10 m** |
| **Ex.18** | Show that the wavelength of a 150 g rubber ball moving with a velocity 50 m sec–1 is short enough to be observed - |
| **Sol.** | h    = mu |
|  | Given u = 50 m sec–1 |
|  | = 50 × 102 cm sec– ; m = 150 g |
|  | 6.6251027    = 2 = **8.83 × 10– 33 cm**  1505010 |
|  | The wavelength is much smaller than the  of visible region and thus it will not be visible. |
| **Ex.19** | If an electron is present in n = 6 level. How many spectral lines would be observed in case of H atom *–* |
|  | (A) 10 (B) 15 (C) 20 (D) 25  **(Ans B)** |
| **Sol.** | The no. of spectral lines is given by 1) n(n  2 |
|  | when n = 6 then, the no. of spectral lines |

=  = 15

**Ex.20** An electron beam can undergo diffraction by crystals. Through what potential should a beam of electrons be accelerated so that its

 mu2 = eV

and  = muh or u = mh or u2 = h22 2

 m 

1 h2

  2 m × 2 2 = eV m 

1 h2 1 h2

or V = 2 m × 2 2 e = 2 × m2 e

m  

Substituting the values, we get

## V = × (6.621034)2

9.1081031(1.541010)21.6021019

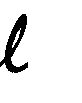
= **63.3 volt**

**Ex.21** What designation will you assign to an orbital having following quantum number *–*

(a) n = 3, = 1, m = –1 (b) n = 4, = 2, m = +2

1. n = 5, = 0, m = 0
2. n = 2, = 1, m = 0

**Sol.** (a) Since = 1 corresponds to p-orbital and m



= –1 shows orientation either in x or y axis, thus this orbital refers to 3px or 3py

1. 4dxy or 4dx2y2
2. 5s (d) 2pz

**Ex.22** How many electrons in a given atom can have the following quantum numbers –

1. n = 4, = 1



1. n = 2, = 1, m = – 1, s = + ½
2. n = 3
3. n = 4,  = 2, m = 0

**Sol.** (a)  = 1 refers to p - subshell which has three orbitals (px, py and pz) each having two electrons. Therefore, total number of electrons are **6**.

1.  = 1 refers to p - subshell, m = – 1 refers to px or py orbital whereas, s = +½ indicate for only 1 electron.
2. For n = 3,  = 0, 1, 2

Total number of electrons for any energy level is given by

2n2 i.e. 2 × 32 = 18 electrons

|  |  |  |  |
| --- | --- | --- | --- |
| **Sol.** | wavelength becomes equal to 1.54 Å-  We know that | Number of electrons are **2.** | |
|  |  | ATOMIC STRUCTURE | **33** |

1.  = 2 means d-subshell and m = 0 refer to dz2 orbital **Ex.23** Which of the following set of quantum numbers are not permitted -
   1. n = 3, = 2, m = – 1, s = 0



* 1. n = 2, = 2, m = +1, s = – ½
  2. n = 3, = 2. m = – 2, s = + ½

|  |  |
| --- | --- |
| **Sol.** | (a) This set of quantum number is not permitted as value of ‘s’ cannot be zero. |
|  | (b) This set of quantum number is not permitted as the value of ‘*l* ’ cannot be equal to ‘n’. |
|  | (c) This set of quantum number is permitted. |
| **Ex.24** | Naturally occuring boron consists of two isotops whose atomic weights are 10 and 11 The atomic weight of natural boron is 10.8 Calculate the percentage of each isotope in natural boron- |
| **Sol.** | Let the percentage of isotope with atomic wt. 10 = x |
|  | Percentage of isotope with atomic wt. |
|  | 11 = 100 – x |
|  | m  Average atomic wt. = 1x1  m2x2  x1  x2 |
|  | or Average atomic wt. |
|  | x  = 10(100 x)11  100 |
|  | 10.81 = 10(100 x)11 x = 20 x  100 |
|  |  % of isotope with atomic wt. 10 = **20** |
|  | % of isotope with atomic wt. 11 = 100 - x = **80** |
| **Ex.25** | From the following list of atoms, choose the isotopes, isobars and isotones - |
|  | 168 O ,1939K , 23592 U,1940K , 147 N , 188O , 146C ,  40Ca , 23892 U 20 |
| **Sol.** | Isotopes : |
|  | (168O ,188O ), (1939K ,1940K ), ( 23592U, 23892U,) |
|  | Isobars : (1940K , 4020Ca ) , (147N ,146C ) |
|  | Isotones : (1939K , 4020Ca ), (146C ,168O ) |
| **Ex.26** | Atomic radius is the order of 10– 8 cm. and nuclear radius is the order of 10–13 cm. Calculate what fraction of atom is occupied by nucleus- |

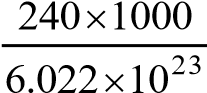
**Sol.** Volume of nucleus = (4/3) r3 = (4/3)  × (10–13)3 cm3

volume of atom=4/3 r3 = (4/3) × (10– 8)3 cm3

|  |  |
| --- | --- |
|  |  24  Vatom 10 |
|  | or **Vnucleus = 10– 15 × Vatom** |
| **Ex.27** | Nitrogen atom has Atomic number 7 & oxygen has Atomic number 8. Calculate the total number of electrons in nitrate ion *-* |
| **Sol.** | No. of electrons in NO3– |
|  | = (Electrons in N) + (3 × electrons in O) |
|  | + [1(due to negative charge)] |
|  | = **7 + 3 × 8 + 1 = 32** |
| **Ex.28** | Calculate the velocity of an electron revolving in the second orbit of a hydrogen atom from the given data. |
|  | For hydrogen ; Z = 1, n = 1. |
|  | 2  *v*1 = e2  h |
|  | 2  = (3.146.63)(410.8271010)2   |
|  | = 2.19 × 108 cm/s. |
| **Sol.** | *v*1 = 2.19 × 108 cm/s |
|  | *v*  We have, *vn* = 1 .  *n* |
|  | 2.19108   *v*2 =  2 |
|  | = **1.09 × 108 cm/s.** |
| **Ex.29** | The uncertainty in the momentum of a particle is 2.5 × 10–16 g cm s–1. With what accuracy can its position be determined? |
|  | (h = 6.625 × 10–27 erg. s, i.e., g cm2 s–1) |
| **Sol.** | h  x. p =  4 |
|  | h 1  or x = ×  4 p |
|  | 6.6251027gcm2s1  =  43.14(2.51016gcms1) |
|  | = **2.11 × 10–12 cm.** |

Vnucleus = 1039 = 10–15

|  |  |
| --- | --- |
| **Ex.30** | The uncertainties in the position and velocity of a particle are 10–10 m and 5.27 × 10–24 m s–1 respectively. Calculate the mass of the particle.  (h = 6.625 × 10–34 J.s) |
| **Sol.** | h  We have, x. (m v) =  4 |
|  | h 1  or m = ×  4 x.v |
|  | 6.625  = 1010m34)(5(kg.27.m102s124) ms1)  43.14(10 |
|  | = **0.10 kg.** |
| **Ex.31** | How many photons of light having a wavelength of 4000 Å are necessary to provide 1 J of energy ? |
|  | (h = 6.63 × 10–34 J . s, c = 3 × 108 m/s) |
| **Sol.** | hc  Energy of a photon = hv =   |
|  | (6.63  = (10400034J.10s)(310m10)8m/s)   |
|  | = 4.97 × 10–19 J. |
|  |  number of photons required |
|  | 1J = 4.9710 19J = **2.01 × 1018**.   |
| **Ex.32** | The iodine molecule dissociates into atoms after absorbing light of 4500 Å if one quantum of radiation is absorbed by each molecule. Calculate the kinetic energy of iodine atoms. (Bond energy of I2 = 240 kJ mol–1) |
| **Sol.** | Bond energy per molecule of I2 |

= J = 3.984 × 10–19 J.

hc

Energy absorbed =



= 6.6261034 103108 = 4.417 × 10–19 J.

## 450010

 KE of one I2 molecule

= 4.417 × 10–19 – 3.984 × 10–19 J

= 4.33 × 10–20 J

ATOMIC STRUCTURE

**35**

4.331020

KE of one I atom =

2

= **2.165 × 10–20 J**.

|  |  |
| --- | --- |
| **Ex.33** | The ionization energy of He+ is 19.6 × 10–18 J atom–1. Calculate the energy of the first stationary state of Li2+. |
| **Sol.** | Energy of the first orbit of Li2+ |
|  | (EHe+)1 = –Z2He (constant) |
|  | (ELi2+)1 = –Z2Li (constant) |
|  | (ELi2+)1 = Z22Li (EHe+)1 ZHe |
|  | 32  = 2 × 19.6 × 10–18 J atom–1  2 |
|  | = **44.1 × 10–18 J atom–1** |
| **Ex.34** | Calculate the wavelength and energy of the radiation emitted for the electronic transition from infinity () to stationary state first of the hydrogen atom. (RH = 1.09678 × 107 m–1, h = 6.6256 × 10–34 J-s) |
| **Sol.** | n1 = 1, n2 =  |
|  | 1  1 1   = RH n12  n22     |
|  | 1 7  12  12  .  = 1.09678 × 10   1   |
|  |  = 9.11 × 10–8 m |
|  | E = hv = h × c/ |
|  | (C = 3 × 108 m sec–1) |
|  | = 9.11101034 83108 6.6256   |
|  | = **2.18 × 10–21 kJ**. |
| **Ex.35** | Calculate the momentum of a moving particle which has a de-Broglie wave length of 2 Å. |
| **Sol.** | According to de-Broglie equation |
|  | h   =  p |
|  | h  p =   |
|  | = 101034 6.62  210 |
|  | = **3.31 × 10–24 Kg ms–1** |

|  |  |
| --- | --- |
| **Ex.36** | A cricket ball weighing 100 g is to be located with 0.1 Å. What is the uncertainty in its velocity ? |
| **Sol.** | h  x . m v =  4 |
|  | x = Location of ball = 0.1 Å = 0.1 × 10–10 m |
|  | m = Mass of ball = 100 g = 0.1 kg |
|  | v = Uncertainty in velocity |
|  | h = 6.626 × 10–34 Js |
|  | 0.1 × 10–10 × 0.1 × v = 1034 6.626  43.14 |
|  | v = **0.527 × 10–22 ms–1** |
| **Ex.37** | A compound of Nickel has a magnetic moment of 2.79 BM. Write the electronic configuration of the nickel ion in this compound. |

**Sol.** As µ = n(n2)

2.79 = n(n2)

On solving, n = 2

As there are two unpaired electrons so Ni is in Ni2+ state. Hence its configuration is written as

**28Ni2+ : [Ar]3d8**

|  |  |
| --- | --- |
| **Ex.38** | A bulb emits light of  4500 Å. The bulb is rated as 150 watt and 8 per cent of the energy is emitted as light. How many photons are emitted by the bulb per second ? |
| **Sol.** | hc  Energy of one photon =   |
|  | = 4500103410310108J 6.625   |
|  | = 4.42 × 10–19 J |

Energy emitted by the bulb = 150 ×  J n × 4.42 × 10–19 = 150 ×

n = **27.2 × 1018**

|  |
| --- |
| **LEVEL # 1** |

|  |  |
| --- | --- |
| Questions based on | **Dalton’s, Rutherford’s atomic model Fundamental Particles** |
| **Q.1** | The study of cathode rays (i.e. electronic discharge through gases) shows that - (A) Alpha particles are heavier than protons   1. All forms of matter contain electrons 2. All nuclei contain protons 3. e/m is constant |
| **Q.2** | Proton is -   1. Nucleus of deuterium 2. Ionised hydrogen molecule 3. Ionised hydrogen atom 4. An -particle |
| **Q.3** | Which is not deflected by magnetic field -  (A) Neutron (B) Electron and Neutron  (C) Proton (D) Electron |
| **Q.4** | According to Dalton’s atomic theory, an atom can –   1. Be created 2. Be destroyed 3. Neither be created nor destroyed 4. None |
| **Q.5** | Rutherford’s experiment on scattering of alpha particles showed for the first time that atom has-  (A) Electrons (B) Protons  (C) Nucleus (D) Neutrons |
| **Q.6** |  - particles are represented by –  (A) Lithium atoms (B) Helium nuclei  (C) Hydrogen nucleus (D) None of these  **Bohr’s Atomic Model** |
| Questions based on |

**,**

**Q.7**  The energy of electron in first Bohr’s orbit of H-atom is –13.6 eV. What will be its potential energy in n = 4th orbit -

(A) – 13.6 eV (B) –3.4 eV

**Q.8** The frequency of line spectrum of sodium is 5.09 x 1014 sec–1. Its wave length (in nm) will be - [c = 3 × 108 m/sec]-

(A) 510 nm (B) 420 nm

(C) 589 nm (D) 622 nm

**Q.9** The spectrum of He-atom may be considered

similar to the spectrum of -

(A) H (B) Li+ (C) Na (D) He+

**Q.10** Supposing the energy of fourth shell for hydrogen atom is - 50 a.u. (arbitrary unit). What would be its ionization potential -

(A) 50 (B) 800 (C) 15.4 (D) 20.8

**Q.11** Supposing the ionization energy of hydrogen atom is 640 eV. Point out the main shell having energy equal to – 40 eV -

(A) n = 2 (B) n = 3

(C) n = 4 (D) n = 5

**Q.12** A 1-kW radio transmitter operates at a frequency of 880 Hz. How many photons per

second does it emit -

(A) 1.71 x 1021 (B) 1.71 x 1033

(C) 6.02 x 1023 (D) 2.85 x 1026

**Q.13** On Bohr’s stationary orbits -

* 1. Electrons do not move
  2. Electrons move emitting radiations
  3. Energy of the electron remains constant
  4. Angular momentum of the electron is h/2

**Q.14**  The value of Bohr radius of hydrogen atom is -

(A) 0.529x 10–7cm(B) 0.529x 10-8cm

(C) 0.529x 10-9cm (D) 0.529x 10–10 cm

**Q.15** On the basis of Bohr’s model, the radius of the

3rd orbit is -

(A) Equal to the radius of first orbit

(B)Three times the radius of first orbit

* 1. Five times the radius of first orbit
  2. Nine time the radius of first orbit

**Q.16**  The correct expression derived for the energy of an electron in the nth energy level is for H-atom-

22me4 22me4 n n2h2 n – nh2

(A) E = (B) E =

22me2 22me4

(C) En = – 2h2 (D) En= – n2h2

|  |  |  |
| --- | --- | --- |
| (C) –0.85 eV | (D) –1.70 eV | |
|  | ATOMIC STRUCTURE | **37** |

n

**Q.17** Ionization energy for hydrogen atom in ergs, Joules and eV respectively is -

1. 21.8 x 10–12 , 218 x 10–20 , 13.6
2. 13.6 x 218 x 10–20, 21.8 x 10–13
3. 21.8 x 10–20, 13.6 , 21.8 x 10–13
4. 21.8 x 10–13, 13.6, 21.8 x 10–20

**Q.18**  The velocity of an electron in the third orbit of hydrogen atom -

(A) 7.28 x107 cm sec–1 (B) 7.08 x 107 cm sec–1

(C) 7.38 x 107cm sec–1  (D) 7.48 x107cm sec–1

**Q.19** The ionization energy of a hydrogen atom is 13.6eV. The energy of the third-lowest electronic level in doubly ionized lithium ion

(Z = 3) is -

(A) –28.7 eV (B) –54.4 eV

(C) –122.4 eV (D) –13.6 eV

**Q.20** Difference between Cl atom and Cl– ion is of :

1. Proton
2. Neutron
3. Electron
4. Proton and electron

**Q.21** For ionising an excited hydrogen atom, the energy required in eV will be -

(A) 3.4 or less (B) More than 13.6

(C) Little less than 13.6 (D) 13.6

**Q.22** A gas absorbs a photon of 300 nm and then reemits two photons. One photon has a wavelength 600 nm. The wavelength of second photon is -

(A) 300 nm (B) 400 nm

(C) 500 nm (D) 600 nm

**Q.23** The energy of a photon of radiation having wavelength 300 nm is -

(A) 6.63 × 10–29 J (B) 6.63 × 10–19 J

(C) 6.63 × 10–28 J (D) 6.63 × 10–17 J

**Q.24** For H– atom, the energy required for the removal of electron from various sub-shells is given as under–

3 s

0

3

p

3

d

E

1

n =



E

2

E

3

0

0

The order of the energies would be –

(A) E1 > E2 > E3 (B) E3 > E2 > E1  (C) E1 = E2 = E3  (D) None of these

### Questionsbased on Hydrogen Sperctrum

**Q.25** The wave number of the first line of Balmer series of hydrogen is 15200 cm–1. The wave number of the first Balmer line of Li2+ ion is-

(A) 15200cm–1  (B) 60800 cm–1

(C) 76000 cm–1 (D) 136800 cm–1

**Q.26** The wavelength of the third line of the Balmer series for a hydrogen atom is -

21 100

(A) (B)

100RH 21 RH

(C) 21RH (D) 21RH

100 100

**Q.27** Wave number of a spectral line for a given transition is x cm–1 for He+ , then its value for Be3+ for the same transition is -

(A) 4x cm–1  (B) x cm–1

(C) x/4 cm–1  (D) 2x cm–1

**Q.28** A photon was absorbed by a hydrogen atom in its ground state and the electron was promoted to the fifth orbit. When the excited atom returned to its ground state, visible and other quanta were emitted. Other quanta are -

(A) 2  1 (B) 5  2

(C) 3  1 (D) 4  1

**Q.29** Wave-length of the first line of Paschen Series

hydrogen spectrum is  1  912Å-

 R 

(A) 18761(Å) (B) 2854 (Å)

(C) 3452 (Å) (D) 6243 (Å)

**Q.30** Electronic transition in He+ ion takes from n2 to n1 shell such that :

2n2 + 3n1 = 18 ….(i)

2n2 – 3n1 = 6

Then what will be the total number of photons emitted when electrons transit to n1 shell ?

(A) 21 (B) 15

(C) 20 (D) 10

**Q.31** If the shortest wavelength in Lyman series of H atom is x, then longest wavelength in Balmer

series of He+ is -

9x 36x x 5x (A) (B) (C) (D)

5 5 4 9

**Q.32** Which of the following expressions represents the spectrum of Balmer series(If n is the principal quantum number of higher energy level) in Hydrogen atom -

1. ~~v~~  R(n –1)(2 n 1) cm1

n

1. ~~v~~  R(n –42n)(2n  2) cm1
2. ~~v~~  R(n –n2)(2 n 2) cm1
3. ~~v~~  R(n –1)(2n 1) cm1

4n

Questions

### based on Quantum Numbers

**Q.33** The maximum number of electrons in a principal shell is -

1. 2n (B) 2n2 (C) 2 (D) 2 n

**Q.34** Which of the following statements concerning the four quantum numbers is false - (A) n gives idea of the size of an orbital

1.  gives the shape of an orbital
2. m gives the energy of the electron in the orbital
3. s gives the direction of spin of the electron in an orbital

**Q.35** How many electrons can fit into the orbitals that comprise the 3rd quantum shell n = 3 -

(A) 2 (B) 8

(C) 18 (D) 32

**Q.36** The shape of the orbital is given by -

1. Spin quantum number
2. Magnetic quantum number
3. Azimuthal quantum number
4. Principal quantum number

**Q.37** The set of quantum numbers not applicable for an electron in an atom is –

1. n = 1,  = 1, m = 1, s = + 1/2
2. n = 1,  = 0, m = 0, s = + 1/2
3. n = 1,  = 0, m = 0, s = – 1/2
4. n = 2,  = 0, m = 0, s = + 1/2

**Q.38** Maximum number of electrons in a subshell is given by -

(A) (2+ 1) (B) 2(2 +1)

(C) (2 +1)2 (D) 2(2+ 1)2

**Q.39** The magnetic quantum number for valence electron of sodium atom is -

(A) 3 (B) 2

(C) 1 (D) Zero

**Q.40** Which one of the following represents an impossible arrangement –

n  m s

(A) 3 2 –2 1/2 (B) 4 0 0 1/2

* + 1. 3 2 –3 1/2
    2. 5 3 0 1/2

**Q.41** The set of quantum number for the 19th electron in chromium is -

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

**Q.42** The electronic configuration together with the quantum number of last electron for lithium is -

* + 1. 1s22s1 2, 0, 0 + 
    2. 1s22s1 2, 0, 0 +  or – 
    3. 1s22s02p1 2, 1, 0 ± 
    4. 2s22s1 2,1, 0 ± 

**Q.43** Four sets of values of quantum numbers

(n, , m and s) are given below. Which set does not provide a permissible solution of the wave equation -

(A) 3, 2, –2,  (B) 3, 3, 1, – 

(C) 3, 2, 1,  (D) 3, 1, 1, 

### Questions Shapes of orbitals, Nodal Plane & based on surface

**Q.44** Which of the following sets of quantum numbers is correct for an electron in 4 f-orbital?

1. n = 4, *l* = 3, m = +4, s = + 
2. n = 4, *l* = 4, m = –4, s = – 
3. n = 4, *l* = 3, m = +1, s = + 
4. n = 3, *l* = 2, m = –2, s = + 

**Q.45** In which of the following pairs is the probability of finding the electron in xy-plane zero for both orbitals ?

(A) 3dyz,4dx2–y2 (B) 2pz,dz2

(C) 4dzx, 3pz  (D) All of these

**Q.46** For 4py orbital : There are - nodal plane = ........ and azimuthal quantum number  =

(A) 1, 0 (B) 0, 1 (C) 1, 1 (D) 2, 1

**Q.47** The maximum probability of finding electron in

the dxy orbital is -

1. Along the x axis
2. Along the y axis
3. At an angle of 45º from the x and y axis
4. At an angle of 90º from the x and y axis

Questions

### basedon Electronic Configuration

**Q.48** An electron has a spin quantum number + 1/2 and a magnetic quantum number –1. It cannot be present in -

(A) d-Orbital (B) f-Orbital

(C) s-Orbital (D) p-Orbital

**Q.49** If the electronic structure of oxygen atom is

2p

|  |  |  |
| --- | --- | --- |
|  |  |  |

written as 1s2, 2s2 it would violate-

1. Hund’s rule
2. Paulis exclusion principle (C) Both Hund’s and Pauli’s principles (D) None of these

**Q.50** The energy of an electron of 2py orbital is -

1. Greater than 2px orbital
2. Less than 2pz orbital
3. Equal to 2s orbital
4. Same as that of 2px and 2pz orbitals

**Q.51** The number of unpaired electrons in carbon atom is -

(A) 2 (B) 4 (C) 1 (D) 3

**Q.52** When 4 d orbital is complete, the newly entering electrons goes in to -

(A) 5f (B) 5s

(C) 5p (D) 6d Orbital

d

|  |  |  |
| --- | --- | --- |
|  |  |  |

p

s

**Q.53** 

The above configuration is not correct as it

violates -

* 1. Only Hund’s rule
  2. Only Pauli’s exclusion principle
  3. (n + ) rule
  4. (Hund + Pauli) rule

**Q.54** Which of the following elements is represented by the electronic configuration -

2p















2

s









1

s

(A) Nitrogen (B) Fluorine

(C) Oxygen (D) Neon

**Q.55** The electronic configurations of 24Crand 29Cuare abnormal -

* 1. Due to extra stability of exactly half filled and exactly fully filled sub shells
  2. Because they belong to d-block
  3. Both the above (D) None of the above

**Q.56** The electronic configuration of chromium

(Z = 24) is -

(A) [Ne]3s23p63d44s2 (B) [Ne] 3s23p63d54s1

(C) [Ne]3s23p63d14s2 (D) [Ne] 3s23p64s24p4

**Q.57** The number of d-electrons in Fe2+ (At. no. 26) is

not equal to that of the –-

* 1. p-Electrons in Ne (At. No. 10)
  2. s-Electrons in Mg (At No. 12)
  3. d-Electrons in Fe atom

* 1. p-Electrons in Cl¯ ion (At. No. 17)

Questions

### based onDe-Broglie, Heisen berg’s Concept

**Q.58** In an electron microscope, electrons are accelerated to great velocities. Calculate the wavelength of an electron travelling with a velocity of 7.0 megameters per second . The mass of an electron is 9.1×10-28 g -

(A) 1.0 × 10–13m (B) 1.0 × 10–7m

(C) 1.0 m (D) 1.0 × 10–10m

**Q.59** A 200g cricket ball is thrown with a speed of

3.0 x 103 cm sec–1. What will be its de Broglie’s wavelength - [h = 6.6 x 10–27g cm2 sec–1]

(A) 1.1 x 10–32 cm (B) 2.2 x 10–32 cm

(C) 0.55 x 10–32 cm (D) 11.0 x 10–32 cm

**Q.60** Which is the de-Broglie equation -

(A) h = p (B) h = p–1

(C) h = p–1 (D) h = p + 

**Q.61** Which of the following has the largest de Broglie wavelength given that all have equal velocity -

(A) CO2 molecule (B) NH3 molecule

(C) Electron (D) Proton

**Q.64** Which of the following is the most correct expression for Heisenberg's uncertainty principle

h h

(A) x. p = (B) x. p 

4 4 h h

(C) x. p  (D) x. v 

4 4

**Q.65** The Heisenberg uncertainty principle can be applied to -

(A) A cricket ball (B) A foot ball

(C) A jet aeroplane (D) An electron

**Q.66** Velocity of helium atom at 300 K is 2.40 x 102

**Q.62** A ball has a mass of 0.1 kg its velocity is meter per sec. What is its wave length -

(mass number of helium is 4)

40 m/s, find out de Broglie wave length -

(A) 1.66 x 10–34m (B) 2 x 10–34 m (A) 0.416 nm (B) 0.83 nm

34 m (D) 4 × 10–34 m (C) 803 Å (D) 8000Å

(C) 3 x 10–

**Q.63** If the uncertainty of position for an electron is

zero, what is the uncertainty of the momentum-

(A) Zero (B) 

|  |  |  |
| --- | --- | --- |
| (C) h | (D) Infinite | |
|  | ATOMIC STRUCTURE | **41** |

# LEVEL # 2

**Q.1** The wave character of electron was experimentally verified by -

(A) de - Broglie (B) A. Einstein

(C) Germer (D) Schrodinger

**Q.2** Which of the following is not possible ?

1. n = 2, *l* = 1, m = 0
2. n = 2, *l* = 0, m = –1
3. n = 3, *l* = 0, m = 0
4. n = 3, *l* = 1, m = –1

**Q.3** What is the maximum number of electrons in an atom that can have the quantum numbers n = 4, m = +1 ?

(A) 4 (B) 15

(C) 3 (D) 6

**Q.4** Arrange the orbitals of H-atom in the increasing order of their energy -

3px, 2s, 4dxy , 3s, 4pz , 3py , 4s

1. 2s < 3s = 3px = 3py < 4s = 4pz = 4dxy
2. 2s < 3s < 3px = 3py < 4s = 4pz = 4dxy
3. 2s < 3s < 3px = 3py < 4s = 4pz = 4dxy
4. 2s < 3s < 3px = 3py < 4s < 4pz < 4dxy

**Q.5** Electron, Proton and Neutron were respectively discovered by -

1. James Chadwick, John Dalton, J.J.

Thomson

1. J.J. Thomson, Goldstein, John Dalton
2. J.J. Thomson, William Crookes, Goldstein (D) J.J. thomson, Goldstein , James Chadwick

**Q.6** If the I.P. of Li+2 is 122.4 eV. Find out 6th I.P. of carbon -

(A) 122.4 × 4eV (B) 122.4 × 2eV

(C) 122.4 × 3eV (D) 122.4 × 5eV

|  |  |  |  |
| --- | --- | --- | --- |
| (C) Protons = W – N | (D) Electrons = W | (B)  | |
|  |  | ATOMIC STRUCTURE | **42** |

**Q.7** If W is the mass number and N is the atomic number of an element, the number of - (A) Electrons = W – N (B) Neutrons = W – N

**Q.8** It is known that atoms contain protons, neutrons and electrons. If the mass of neutron is assumed to be half of its original value whereas that of electron is assumed to be twice of this original value. The atomic mass of 6C12 will be -

1. Twice
2. 75% less
3. 25% less
4. One-half of its original value

**Q.9**  The energy difference between two electronic states is 46 .12 kcal /mole. What will be the frequency of the light emitted when an electron drops from the higher to the lower energy state

(Planck' constant = 9.52 x 10-14 kcal sec mole -1)

(A) 4.84 x 10 15 cycles sec -1 (B) 4.84 x 10 -5 cycles sec-1

1. 4.84x 10-12 cycles sec-1
2. 4.84 x 10 14 cycles sec-1

**Q.10** If the kinetic energy of an electron is increased 4 times, the wavelength of the de Broglie wave associated with it would become :

1. 4 times
2. 2 times
3.  times
4.  times

**Q.11**  Multiple of fine structure of spectral lines is due to-

1. Presence of main energy levels
2. Presence of sub- levels (C) Presence of electronic configuration

(D) Is not a characteristics of the atom.

**Q.12** The quantum number not obtained from the

Schrodinger’s wave equation is -

(A) n

1. m
2. s

**Q.13** Wave mechanical model of the atom depends upon-

1. de-Broglie concept of dual nature of

electron

1. Heisenberg uncertainty principle
2. Schrodinger uncertainty principle
3. All

**Q.14** The correct Schrodinger's wave equation for an electron with total energy E and potential energy V is given by -

1. x22 + y22 + 2z2 + mh822 (E–  0 V) =

2 2 2 8m

1.  2 + 2 + z2 + h2 (E–V)  = 0 x y 

## 2 2 2 82m

1. x2 + y2 + z + 2 (E–V)  = 0

2 h

1. None of the above.

**Q.15** Calculate total no. of e– having m = 0 in Cr atom -

(A) 12 (B) 13 (C) 5 (D) 24 **Q.16** Which orbital is dumb-bell shaped -

(A) s-Orbital (B) p-Orbital

(C) d-Orbital (D) f-Orbital

**Q.17** Which of the following subshell can accommodate as many as 10 electrons -

(A) 2d (B) 3d

(C) 3dxy (D) 3dz2

**Q.18** "No two electrons in an atom can have the same set of four quantum numbers. "This principle

was enunciated by -

(A) Heisenberg (B) Pauli (C) Maxwell (D) de Broglie.

**Q.19** How many spherical nodes are present in a 4s orbital in hydrogen atom -

(A) 0 (B) 1 (C) 2 (D) 3

**Q.20** Minimum core charge is shown by the atom -

(A) O (B) Na

(C) N (D) Mg

**Q.21** I.P. of hydrogen atom is equal to 13.6 eV. What is the energy required for the process :

He+ + energy — He+2 + e–

**Q.22** If elements with principal quantum number n > 4 is not allowed in nature, the number of

possible elements would be -

(A) 60 (B) 32 (C) 64 (D) 50

**Q.23** If the value of (n + ) is not > 3, then the maximum number of electrons in all the orbitals would be -

(A) 12 (B) 10 (C) 2 (D) 6

**Q.24** It is not possible to explain the Pauli's exclusion principle with the help of this atom -

(A) B (B) Be

(C) C (D) H

**Q.25** Uncertainty in position and momentum are equal. Uncertainty in velocity is -

(A) (B)



2

h

m

2

1



h



h

(C) Both (D)

**Q.26** For any H like system, the ratio of velocities of

I, II & III orbit i.e. V1 : V2 : V3 will be -

(A) 1 : 2 : 3 (B) 1 : 1/2 : 1/3

(C) 3 : 2 : 1 (D) 1 : 1 : 1

**Q.27** How fast is an electron moving if it has a wavelength equal to the distance it travels in one second -

(A) (B)

m

h

p

h

h

m

)

KE

(

2

h

(C) (D)

**Q.28** Which of the following is isotone of 3276Ge

(A) 3277Ge (B) 3378As

(C) 3477Se (D) 3478Se

**Q.29** The correct statement(s) about Bohr’s orbits of hydrogen atom is/are -

 n2h2 

1. r = 42me2 



1. K.E. of the electron = –1/2 (P. E. of the electron)
2. Angular momentum (L) = n  h 

 2 

|  |  |  |
| --- | --- | --- |
| (A) 2 × 13.6 eV  (C) 4 × 13.6 eV | (B) 1 × 13.6 eV  (D) None of these | |
|  | ATOMIC STRUCTURE | **43** |

1. All the above

**Q.30** In centre-symmetrical system, the orbital angular momentum, a measure of the momentum of a particle travelling around the nucleus, is quantised. Its magnitude is - h h

(A) (1) 2 (B) (1) 2

h h

(C) s(s 1) (D) s(s –1)

2 2

**Q.31** Each orbital has a nodal plane. Which of the following statements about nodal planes are not true -

1. A plane on which there is zero probability that the electron will be found
2. A plane on which there is maximum probability that the electron will be found
3. Both
4. None

**Q.32** n and l values of an orbital ‘A’ are 3 and 2, of another orbital ‘B’ are 5 and 0. The energy of =

1. B is more than A
2. A is more than B
3. A and B are of same energy
4. None

**Q.33** If Hund’s rule is followed, magnetic moment of Fe2+, Mn+ and Cr all having 24 electrons will be in order -

(A) Fe2+ < Mn+ < Cr (B) Fe2+ < Cr = Mn+

(C) Fe2+ = Mn+ < Cr (D) Mn2+ =Cr <Fe2+

**Q.34** The ionisation potential of the hydrogen atom is 13.6 eV. The energy needed to ionise a hydrogen atom which is in its second excited state is about :

(A) 13.6 eV (B) 10.2 eV

(C) 3.4 eV (D) 1.5 eV

**Q.35** Magnetic moments of V(Z = 23), Cr(Z = 24), Mn(Z = 25) are x, y, z. Hence -

(A) x = y = z (B) x < y < z

(C) x < z < y (D) z < y < x

**Q.36** The uncertainty in the position of an electron moving with a velocity of 1 × 104 cm s–1 (accurate up to 0.011%) will be :

(A) 1.92 cm (B) 7.68 cm

(C) 0.528 cm (D) 3.8 cm

**Q.37** The ratio of (E2 – E1) to (E4 – E3) for the hydrogen atom is approximately equal to -

(A) 10 (B) 15

(C) 17 (D) 12

ATOMIC STRUCTURE

**44**

**Q.38** Consider the following ions -

(1) Ni2+  (2) Co2+ (3) Cr2+ (4) Fe3+

(Atomic numbers : Cr = 24, Fe = 26, Co = 27,

Ni = 28)

The correct sequence of the increasing order of the number of unpaired electrons in these ions

is-

(A) 1, 2, 3, 4 (B) 4, 2, 3, 1

(C) 1, 3, 2, 4 (D) 3, 4, 2, 1

**Q.39** What are the values of the orbital angular momentum of an electron in the orbitals 1s, 3s,

3d and 2p -

(A) 0, 0, 6 , 2  (B) 1, 1, 4, 2

(C) 0, 1, 6, 3 (D) 0, 0, 20, 6

**Q.40** In an atom two electrons move around the nucleus in circular orbits of radii R and 4R. The ratio of the time taken by them to complete one revolution -

(A) 1 : 4 (B) 4 : 1

(C) 1 : 8 (D) 8 : 7

**Q.41** A beam of electrons is accelerated by a potential difference of 10000 volts. The wavelength of

the wave associated with it will be -

(A) 0.0123 Å (B) 1.23 Å

(C) 0.123 Å (D) None of these

**Q.42** If the number of electrons in p-orbital are two, then which one of the following is in accordance with Hund’s rule -

(A) p2x p0y p0z (B)p0x p2y p0z

(C) p0x p0y p2z (D) p1x p1y p0z

**Q.43** If there are six energy levels in H–atom then the number of lines in its emission spectrum in ultra voilet region will be -

(A) 6 (B) 5 (C) 4 (D) 3

**Q.44** Magnetic moment of X3+ ion of 3d series is 35 BM. What is atomic number of X3+ ?

(A) 25 (B) 26 (C) 27 (D) 28

**Q.45** An electron is moving with the velocity equal to 10% of the velocity of light. Its de-Broglie wave length will be -

(A) 2.4 × 10-12cm (B) 2.4 × 10-18cm (C) 2.4 × 10–9cm (D) None of these

**Q.46** Correct set of four quantum numbers for the **Q.54** Which element is represented by the following valence (outer most) electron of rubidium electronic configuration -

(Z = 37) is -

(A) 5,0,0, +  (B) 5,1,0, + 

(C) 5,1,1, +  (D) 5,0,0, – 

**Q.47** Ratio of time period of electron in first and second orbit of H-atom would be -

(A) 1 : 18 (B) 1 : 8 (C) 1 : 2 (D) 2 : 1

**Q.48** If x is the velocity of an electron in first Bohr’s orbit. What would be the velocity of the electron in third Bohr’s orbit - x x

(A) (B) (C) 3x (D) 9 x

9 3

**Q.49** The following graph between 2 probability density and distance from the nucleus represents-



2

r

(A) 2s (B) 3s (C) 1s (D) 2p

**Q.50** The wave length of the last line of Paschen series would be -

(A) 9540 Å (B) 8204 Å (C) 3650 Å (D) 912 Å

**Q.51** The wavelength of X-ray is 10-6 cm. Its frequency in Giga Hertz (GHz) will be (Hint : 1

Giga = 109)

(A) 3 × 107 (B) 3 × 109

(C) 3 × 1010 (D) 3 × 108

**Q.52** Which electronic level would allow the hydrogen atom to absorb a photon but not to emit a photon

(A) 3s (B) 2p (C) 2s (D) 1s

**Q.53** Pauli’s exclusion principle states that -

1. Nucleus of an atom contains no negative charge
2. Electrons move in circular orbits around the nucleus
3. Electrons occupy orbitals of lowest energy
4. All the four quantum numbers of two electrons in an atom cannot be equal.

2p

|  |  |  |
| --- | --- | --- |
|  |  |  |

2s

1s 



(A) Nitrogen (B) Oxygen

(C) Fluorine (D) Neon

**Q.55** When an electron jumps from L to K shell -

1. Energy is absorbed
2. Energy is released
3. Energy is neither absorbed nor released
4. Energy is sometimes absorbed and some times released

**Q.56** The orbital diagram in which ‘Aufbau principle’

is violated is -

2s 2p

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  | |  |
|  |  |  |

1. 
2. 

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  | |  |
|  |  |  |

1. 
2. 

**Q.57** d6 configuration will result in total spin of -

(A) 3/2 (B) ½ (C) 2 (D) 1

**Q.58** Bohr’s model can explain -

1. The spectrum of only hydrogen atom
2. The spectrum of the atoms of all the elements
3. The spectrum of only sodium atom
4. The spectrum of atomic or ionic species having one electron.

**Q.59** The mass number of dipositive Zn ion is 70. The total number of neutrons is -

(A) 34 (B) 40 (C) 36 (D) 38

**Q.60** The energy required to separate an electron from the level n = 3 of a H-atom is 9.69 × 10–19 Joules. What will be its energy in first excited state -

–19 J (B) – 99.6910–19 J

(A) – 9 × 9.69 × 10

4

(C)  × 9.69 × 10–19 J (D) None of these

**Q.61** When beryllium is bombarded with alpha particles (Chadwick’s experiment) extremely penetrating radiations which can not be deflected by electrical or magnetic field are given out. These are -

(A) A beam of protons (B) Alpha rays

1. A beam of neutrons
2. A beam of neutrons and protons

**Q.62** The potential energies of first, second and third

Bohr’s orbits of He + cation are E1, E2 and E3.

The correct sequence of these energies is -

(A) E1 > E2 > E3 (B) E1 = E2 > E3

(C) E1 = E2 = E3 (D) E3 > E2 > E1

**Q.63** When an electron transit form n = 4 to n = 2, then emitted line in spectrum will be :

1. First line of Lyman series
2. Second line of Balmer series
3. First line of Paschen series
4. Second line of Paschan series

**Q.64** In which of the following orbital diagrams are both Pauli's exclusion principle and Hund's rule violated ?

|  |  |  |
| --- | --- | --- |
|  |  |  |

1. 

|  |  |  |
| --- | --- | --- |
|  |  |  |

1. 

|  |  |  |
| --- | --- | --- |
|  |  |  |

1. 

|  |  |  |
| --- | --- | --- |
|  |  |  |

### (D) 

**Q.65** Which of the following graphs correspond to one node ?

(A) (B)



r



r



r



r

(C) (D)

**Q.66** The number of elliptical orbits excluding circular orbits in the N-shell of an atom is -

(A) 3 (B) 4 (C) 2 (D) 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| moment 1.73 B. M. | The | electronic **Q.79** | The number of orbitals in n = 3 are - | |
|  |  |  | ATOMIC STRUCTURE | **46** |

**Q.67** A compound of vanadium has a magnetic configuration of vanadium ion in the compound

is -

(A) [Ar] 3d2  (B) [Ar] 3d1  (C) [Ar] 3d3  (D) [Ar] 3d04s1

**Q.68** How many lines in the spectrum will be observed when electrons return from 7th shell to 2nd shell ?

(A) 13 (B) 14 (C) 15 (D) 16  **Q.69** In Ca atom how many e– contain m = 0

(A) 12 (B) 8 (C) 10 (D) 18

**Q.70** In Ne how many e– contain m = –1

(A) 4 (B) 2 (C) 0 (D) 1

**Q.71** What is ratio of time periods (T1 / T2) in second orbit of hydrogen atom to third orbit of He+ ion?

(A)  (B)  (C)  (D) 

**Q.72** The number of electrons in Na, having n+ = 3

(A) 4 (B) 6 (C) 7 (D) 8

**Q.73** Which orbital has 1 nodal plane -

(A) s (B) p (C) d (D) f

**Q.74** How many s electrons are there in Cu+ -

(A) 2 (B) 4 (C) 6 (D) 10

**Q.75** If the total energy of an electron in a hydrogen atom in excited state is –3.4 eV, then the de Broglie wavelength of the electron is -

(A) 3.3 × 10–10 m (B) 6.6 × 10–10 m

(C) 3.3 × 1010 m (D) 9.3 × 10–12 m

**Q.76** The correct set of quantum numbers to the unpaired electron of fluorine atom -

(A) n = 3,  = 0, m = 0 (B) n = 3,  = 1, m = 1

(C) n = 2,  = 0, m = 0 (D) n = 2,  = 1, m = 1

**Q.77** Which of the following statement is correct - (A) Number of angular nodes = n – – 1

1. Number of radial nodes = 
2. Total number of nodes = n – 1
3. All

**Q.78** The total energy associated per quanta with light of wavelength 600 nm -

(A) 3.3 × 10–12 erg (B) 3.3 × 10–6 erg

(C) 6.6 × 10–12 erg (D) 6.6 × 10–6 erg

(A) 1 (B) 3

(C) 5 (D) 9

**Q.80** The number of revolution/sec. made by electron in 3rd orbit of hydrogen atom -

(A) 4.88 × 1014 (B) 2.44 × 1014

(C) 9.9 × 1014 (D) 2.44 × 1012

**Q.81** Angular and spherical nodes in 3s -

(A) 1, 1 (B) 1, 0

(C) 2, 0 (D) 0, 2

**Q.82** The magnetic moment of V4+ ion -

(A) 1.73 (B) 1.41 (C) 3.46 (D) 2

**Q.83** Which orbital represents the following set of quantum numbers n = 3,  = 0, m = 0, s = +1/2 -

(A) 3p (B) 2s

(C) 3s (D) 2p

**Q.84** The number of unpaired electrons in Zn+2 -

(A) 0 (B) 1 (C) 2 (D) 3

**Q.85** The uncertainty in velocity of electron having uncertainty in its position of 1Å -

(A) 5.8 × 105 m/s (B) 5.8 × 106 m/s

(C) 5.8 × 107 m/s (D) 5.8 × 108 m/s

**Q.86** If ionisation energy of hydrogen atom is

13.6 eV. I.E. of Li+2 will be -

(A) 13.6 eV (B) 10.4 eV

(C) 40.8 eV (D) 122.4 eV

**Q.87** The wavelength of third lyman series of hydrogen atom is approximately -

(A) 1 × 10–7 m (B) 1 × 10–8 m

(C) 1 × 10–6 m (D) 1 × 10–5 m

**Q.88** The number of waves made by a Bohr electron in one complete revolution in its 3rd orbit -

(A) 1 (B) 2 (C) 3 (D) 4

**Q.89** If potential energy of an electron in hydrogen atom is –x eV, then its kinetic energy will be -

(A) x eV (B) –x eV

(C) 2x eV (D) x/2 eV

# LEVEL # 3

**Q.1** An atom has x energy level, then total number of lines in its spectrum are :

1. 1 + 2 + 3 ...............(x + 1)
2. 1 + 2 + 3 ...............(x2)
3. 1 + 2 + 3 ................(x – 1)
4. (x + 1) (x + 2) (x + 4)

**Q.2** The figure indicates the energy level diagram for the origin of six spectral lines in emission spectrum (e.g. line no. 5 arises from the transition from level B to X) which of the following spectral lines will not occur in the absorption spectrum :

C

B

X

A

1

2

3

4

5

6

(A) 1, 2, 3 (B) 3, 2

(C) 4, 5, 6 (D) 3, 2, 1

**Q.3** The graphical representation of energy of e– and atomic number is :

(

A

)

Z

2

E

(

B

)

Z

2

E

(

C

)

Z

2

E

(

D

)

Z

2

E

**Q.4** Which of the following transition nei ther shows absorption nor emission of energy in case of Hydrogen atom :

(A) 3px  3s (B) 3dxy  3dyz

(C) 3s  3dxy (D) All the above

**Q.5** When the value of principal quantum number ‘n’ is 3, the permitted value of azimuthal quantum numbers  and magnetic quantum numbers ‘m’ are -

(A)  m

* 1. 0
  2. +1, 0, –1
  3. +2, +1, 0, –1, –2

(B) m

0 1

* 1. +2, 1, –2
  2. + 3, + 3, +2, 1, –2, – 3

(C) m

* 1. 0
  2. 1, 2, 3, 2, 0, 1, 2
  3. +3, +2, 1, –2 , –3

(D) m

* 1. 0, 1
  2. 0, 1, 2
  3. 0, 1, 2, 3

**Q.6** An electron, a proton and an alpha particle have kinetic energies of 16E, 4E and E respectively. What is the qualitative order of their de Broglie wavelengths -

(A) e > p =  (B) p =  > e

(C) p < e >  (D)  < e < p

**Q.7** How many d-electrons in Cu+ (At. No. = 29)

can have the spin quantum number  1  ?

 2

(A) 3 (B) 7 (C) 5 (D) 9

**Q.8** Compared to the mass of lightest nucleus the mass of an electron is only :

(A)  (B)  (C)  (D)

**Q.9** An orbital with  = 0 is Symmetrical about the:

(A) x-axis only (B) y-axis only

(C) z-axis only (D) The nucleus

**Q.10** The nucleus of an atom is located at x = y = z = 0. If the probability of finding an s-orbital electron in a tiny volume around x = a, y = z = 0 is 1 x 10–5, what is the probability of finding the electron in the same sized volume around x =

z = 0, y = a -

(A) 1 x 10–5 (B) 1 x 10–5 x a

(C) 1 x 10–5 x a2 (D) 1 x 10–5 x a–1

**Q.11** Which orbital is represented by wave function 310

(A) 3 dxy (B) 3 pz (C) 4 s (D) 4 dz2

**Q.12** Find out ratio of following for photon

(max.)Lyman : (max.)Brakett - (A) 1 : 16 (B) 16 : 1 (C) 1 : 4 (D) 4 : 1

**Q.13** Let mass of electron is half, mass of proton in two times and mass of neutron is three fourth of original. The find out new atomic wt. of O16 atom:

(A) increases by 37.5% (B) remain constant

(C) increases by 12.5% (D) decreases by 25%

**Q.14** Which of the following is correct radial probability distribution various

orbitals ?

3

s

r

1

s

r

curve

for

4

p

r

3

p

r

(A) 4r22dr (B) 2 2

4r  dr

(C) 4r22dr (D) 4r22dr

**Q.15**  The energies E1 and E2 of two radiations are 25 eV and 50 eV respectively. The relation between their wavelengths i.e. 1and 2 will be:

1

(A) 1 = 2 2 (B) 1 = 2

(C) 1 = 22 (D) 1 = 42

**Q.16** The momentum of a photon with energy 20 eV

is -

* + 1. 10.66 x 10–27 Kg m sec–1
    2. 10.55 x 10–27 Kgm sec–1
    3. 10.60 x 10–27 Kgm sec–1
    4. 10.80 x 10–27 Kgm sec–1

**Q.17** Electron corpuscular nature is not connected with -

* + 1. Diffraction phenomenon
    2. Photo electric effect
    3. Compton effect
    4. Mechanical effect by cathode rays

**Q.18** The nitride ion in lithium nitride is composed of:

* + 1. 7 protons + 10 electrons
    2. 10 protons + 10 electrons
    3. 7 protons + 7 protons
    4. 10 protons + 7 electrons

**Q.19** The emission spectrum of hydrogen is found to satisfy the expression for the energy change. E (in joules) such that E = 2.18 × 10–18

 1 1 

 2 – 2 J .Where n1=1, 2, 3....and n2 = 2, 3,

n1 n2 

4... The spectral lines that correspond to Paschan series have :

* + 1. n1 = 1 and n2 = 2, 3, 4
    2. n1 = 3 and n2 = 4, 5, 6
    3. n1 = 1 and n2 = 3, 4, 5 (D) n1 = 2 and n2 = 3, 3, 5

**Q.20** The number of neutron in tritium is :

(A) 1 (B) 2 (C) 3 (D) 0

**Q.21** The energy difference between the states n = 2 and n = 3 is E eV, in hydrogen atom. The ionisation potential of H atom is -

(A) 3.2 E (B) 5. 6E (C) 7.2 E (D) 13.2 E **Passage :**

Orbital is the region in an atom where the probability of finding the electron is maximum. It represents three-dimensonal motion of an electron around the nucleus. Orbitals do not specify a definite path according to the uncertainty principle. An orbital is described with the help of wave function . Whenever an electron is described by a wave function, we say that an electron occupies that orbital. Since many wave functions are possible for an electron, there are many atomic orbitals in an atom. Orbitals have different shapes; except s-orbitals, all other orbitals have directional character. Number of spherical nodes in an orbital is equal to (n––1). Orbital angular momentum of an electron is (1).

**Q.22** The nodes present in 5p orbital are -

* + 1. one planar, five spherical
    2. one planar, four spherical
    3. one planar, three spherical
    4. four spherical

**Q.23** When an atom is placed in a magnetic field, the possible number of orientations for an orbital of azimuthal quantum number 3 is - (A) three (B) one (C) five (D) seven

**Q.24** Orbital angular momentum of *f*-electrons is-

(A) 2 (B) 3 (C) 12 (D) 2

**Q.25** Which of the following orbitals has/have two nodal planes ?

(A) dxy (B) dyz

(C) dxz (D) All of these

**True or False :**

**Q.26** The species Na+, Mg2+, Al3+, O2– and F– are iso-electronic.

**Q.27** The nuclear reaction 94Be42 He 126 C10 n was used by Curie to discover neutron.

**Q.28** Lyman series of hydrogen spectrum lies in the visible region.

**Q.29** All the four quantum numbers have been derived from Schrodinger wave equation.

**Q.30** The outer electronic configuration of chromium atom is 3d44s2.

**Q.31** The electron density in xy plane of 3dx2–y2 orbital is zero.

**Q.32** All the atomic orbitals are directional in nature.

**Q.33** The designation of an orbital, n = 4 and = 0 is

4s.

**Q.34** Chromium atom has six unpaired electrons.

**Q.35** The energies of various subshells in the same shell are in the order of s > p > d > *f*.

**Each of the questions given below consists of Statement – I and Statement – II. Use the following Key to choose the appropriate answer.**

* 1. **If both Statement - I and Statement - II are true but Statement - II is not the correct explanation of Statement – I.**
  2. **If both Statement- I and Statement- II are true, and Statement - II is the correct explanation of Statement– I.**
  3. **If Statement - I is true but Statement - II is false.**
  4. **If Statement - I is false but Statement - II is true.**

**Q.36 Statement I :** 2p orbitals do not have any spherical node.

|  |  |  |  |
| --- | --- | --- | --- |
| principal quantum number. | (B) 1s | (Q) Radial node = 0 | |
|  |  | ATOMIC STRUCTURE | **50** |

**Statement II :** The number of nodes in p-orbitals is given by (n – 2) where n is the

**Q.37 Statement I :** All p-orbitals have only one planar node.

**Statement II :** The number of radial nodes depends on the principal quantum number only.

**Q.38 Statement I :** Hydrogen has one electron in its orbit but it produces several spectral lines.

**Statement II :** There are many excited energy levels available.

**Q.39 Statement I :** The 19th electron in potassium atom enters into 4 s-orbital and not the

3d-orbital.

**Statement II :** (n + ) rule is followed for determining the orbital of the lowest energy state.

**Q.40 Statement I :** The free gaseous Cr atom has six unpaired electrons.

**Statement II :** Half-filled s-orbital has greater stability.

**Q.41 Statement I :** The electronic configuration of the nitrogen atom is represented as

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  | |  |
|  |  |  |

  and not as

 

**Statement II :** The electronic configuration of the ground state of an atom is the one which has the greatest multiplicity.

**Q.42 Statement I :** For n = 3,  = 0, 1 and 2 and m may be 0; 0, ± 1 and 0, ± 1 and ± 2.

**Statement II :** For each value of n, there are 0 to (n – 1) possible values of  and for each value of , there are 0 to ±  values of m.

**Q.43 Statement I :** The graph between 4r2dr 2 with r of 2s, 3p, 4d & 5f orbitals are identical in shape.

**Statement II :** The number of planar nodes present in these orbitals is different.

**Q.44 Statement I :** 2px, 2py and 2pz each have one nodal plane.

**Statement II :** These orbital are degenerate orbitals.

**Column Matching :**

**Q.45** **Column-I Column-II**

(A) 2s (P) Angular node = 1

* + 1. 2p (R) Radial node = 1 (C) n = 5  n = 2 (R) 6 lines in the
    2. 3p (S) Angular node = 0 spectrum

**Q.46** **Column-I Column-II**  (D) n = 6  n = 2 (S) Spectral lines in

* + 1. n = 6  n = 3 (P) 10 lines in the infrared region

spectrum

* + 1. n = 7  n = 3 (Q) Spectral lines in visible region

**ANSWER KEY**

**LEVEL # 1**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Q.No.** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| **Ans.** | D | C | A | C | C | B | D | C | B | B | C | B | C | B | D | D | A | A | D | C |
| **Q.No.** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** | **40** |
| **Ans.** | A | D | B | C | D | B | A | A | A | D | A | B | B | C | C | C | A | B | D | C |
| **Q.No.** | **41** | **42** | **43** | **44** | **45** | **46** | **47** | **48** | **49** | **50** | **51** | **52** | **53** | **54** | **55** | **56** | **57** | **58** | **59** | **60** |
| **Ans.** | A | B | B | C | C | C | C | C | A | D | A | C | D | D | A | B | D | D | A | A |
| **Q.No.** | **61** | **62** | **63** | **64** | **65** | **66** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Ans.** | C | A | D | B | D | A |

**LEVEL # 2**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Q.No.** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| **Ans.** | C | B | D | A | D | A | B | C | D | C | B | D | D | C | A | B | B | B | D | B |
| **Q.No.** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** | **40** |
| **Ans.** | C | A | A | D | D | B | A | D | D | A | B | A | B | D | C | C | B | A | A | C |
| **Q.No.** | **41** | **42** | **43** | **44** | **45** | **46** | **47** | **48** | **49** | **50** | **51** | **52** | **53** | **54** | **55** | **56** | **57** | **58** | **59** | **60** |
| **Ans.** | C | D | B | B | C | A | B | B | A | B | A | D | D | C | B | B | C | D | B | B |
| **Q.No.** | **61** | **62** | **63** | **64** | **65** | **66** | **67** | **68** | **69** | **70** | **71** | **72** | **73** | **74** | **75** | **76** | **77** | **78** | **79** | **80** |
| **Ans.** | C | D | B | D | B | A | B | C | A | B | B | C | B | C | B | D | C | A | D | B |
| **Q.No.** | **81** | **82** | **83** | **84** | **85** | **86** | **87** | **88** | **89** |  |  |  |  |  |  |  |  |  |  |  |
| **Ans.** | D | A | C | A | A | D | A | C | D |

**LEVEL # 3**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Q.No.** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| **Ans.** | C | C | D | D | A | A | C | C | D | A | B | B | A | A | C | A | A | A | B | B |
| **Q.No.** | **21** | **22** | **23** | **24** | **25** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Ans.** | C | C | D | C | D |

**26.** True **27.** False **28.** False **29.** False **30.** False **31.** False **32.** False **33.** True **34.** True

|  |  |
| --- | --- |
| **35.** False **36.** B **37.** C **38.** B **39.** B | **40.** C **41.** B **42.** B **43.** A |
| **44.** A **45.** A  S,R; B  Q,S; C  Q,P; D  P,R | **46.**  A  R,S; B  P,S; C  R,Q; D  P,Q |