1. ATOMIC STRUCTURE

PREVIOUS EAMCET BITS

1. The wavelengths of electron waves in two orbits is 3 :5. The ratio of kinetic energy of electron will be **(E-2009)**

   1) 25 : 9 2) 5 : 3 3) 9 : 25 4) 3 : 5

   Ans: 1

Sol: According to de-Broglie equation

$\lambda = \frac{h}{nv}$ But $\lambda_1 : \lambda_2 = 3:5$

$\therefore\ v_1 : v_2 = 5:3$

K.E = $\frac{1}{2}mv^2$ $KE_1 : KE_2$

$= 5^2 : 3^2 = 25:9$

2. With increases in principal quantum number n the energy difference between adjacent energy levels in hydrogen atom **(M-2009)**

   1) increases 2) decreases 3) remain constant

   4) decreases for lower values of n and increases for higher values of n

   Ans: 2

Sol: $E_n = \frac{-13.6}{n^2} ev$

As value of n increases the energy difference between adjacent levels decreases.

3. An electronic transition in hydrogen atom results in the formation of H_α line of hydrogen in Lyman series, the energies associated with the electron in each of the orbits involved in the transition (in kcal mol^{-1}) are **(E-2008)**

   1) $-313.6. -34.84$ 2) $-313.6 - 78.4$ 3) $-78.4, -34.83$ 4) $-78.4, -19.6$

   Ans: 2

Sol: H_α line in Lyman series mean electron transition is from n = 2 to n = 1 orbit.

$E_1 = \frac{-313.6}{1^2} = -313.6\ k.cal\,mole^{-1}$

$E_2 = \frac{-313.6}{2^2} = -78.4\ k.cal\,mole^{-1}$

4. The velocities of two particles A and B are 0.05 and 0.02 ms^{-1} respectively. The mass of B is five times the mass of A. The ratio of their de-Broglie's wavelength is **(E-2008)**

   1) 2 : 1 2) 1 : 4 3) 1 : 1 4) 4 : 1

   Ans: 1

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

$\lambda_A = \frac{h}{m \times 0.05}$ $\lambda_B = \frac{\lambda}{5m \times 0.02}$

$\frac{\lambda_A}{\lambda_B} = \frac{5m \times 0.02}{m \times 0.05} = 2:1$

5. The wavelength (in A°) of an emission line obtained for Li^{2+} during electronic transition from n_2 = 2 to n_1= 1 is (R = Rydberg constant) **(M-2008)**

1) $\frac{3R}{4}$ 2) $\frac{27R}{4}$ 3) $\frac{4}{3R}$ 4) $\frac{4}{27R}$

Ans: 4

Sol: For Li^{2+} $\bar{v} = 3^2 R\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{27R}{4}$

$\lambda = \frac{4}{27R}$

6. Match the following **(M-2008)**

List – I	List – II
A) $mvr = \frac{nh}{2\pi}$	i) Paschen series
B) Infra-red	ii) Electron total energy
C) $\lambda = \frac{n}{p}$	iii) de-Broglie equation
D) $\frac{-e^2}{2r}$	iv) Schrodinger equation
	v) Bohr's equation

	A	B	C	D		A	B	C	D
1)	v	ii	iii	i	2)	iii	ii	v	iv
3)	v	i	iii	ii	4)	iv	i	ii	iii

Ans: 3

Sol: A) $mvr = \frac{nh}{2\pi}$ Bohr's equation A – (v)

B) Infrared - Paschen series B – (i)

C) $\lambda = \frac{n}{p}$ - de-Broglie equation C = iii

D) $\frac{-e^2}{2r}$ - total energy of electron D - ii

7. What is the wave number of 4^{th} line in Balmer series of Hydrogen spectrum ? ($R = 1,09,677 cm^{-1}$) **(M-2007)**

1) $24,630\ cm^{-1}$ 2) $24,360\ cm^{-1}$ 3) $24,730\ cm^{-1}$ 4) $24,372\ cm^{-1}$

Ans: 4

Sol: 4^{th} line in Balmer series mean electron transition from 6^{th} orbit to 2^{nd} orbit.

$= 109677\left(\frac{1}{2^2} - \frac{1}{6^2}\right)$

$= 109677\left(\frac{1}{4} - \frac{1}{36}\right)$

$= 109677\left(\frac{9-1}{36}\right)$

$\bar{\gamma} = 109677 \times \frac{8}{36} = 24,372\ cm^{-1}$

8. The atomic number of an element '<u>M</u>' is 26. How many electrons are present in the M-shell of the element in its $\underline{M^{3+}}$ state ? **(M-2007)**

1) 11 2) 15 3) 14 4) 13

Ans: 4

Sol: $Z = 26 = Fe = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

$$Fe^{3+} = \underset{K}{\underline{1s^2}}\,\underset{L}{\underline{2s^2 2p^6}}\,\underset{M}{\underline{3s^2 3p^6 3d^5}}$$

$\therefore$ Electron in M shell = 13

9. The wavelength of a spectral line emitted by hydrogen atom in the Lyman Series is $\frac{16}{15R}$ cm. What is the value of n_2 ? (R = Rydberg constant) **(E-2007)**

1) 2 2) 3 3) 4 4) 1

Ans: 3

Sol: Equation for Lyman series

$$\bar{v} = \frac{1}{\lambda} = R\left[\frac{1}{1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{15R}{16} = R\left[\frac{1}{1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{1}{n_2^2} = 1 - \frac{15}{16} = \frac{1}{16}$$

$n_2 = 4$

10. The maximum number of sub levels, orbitals and electrons in 'N' shell of an atoms respectively **(E-2007)**

1) 4, 12, 32 2) 4, 16, 30 3) 4, 16, 32 4) 4, 32, 64

Ans: 3

Sol: N shell has four (s, p, d, f) sub levels
N shell has 16 orbitals (1s, 3p, 5d, 7f)
N shell has 32 electron (16 x 2 = 32)

11. The energy of a photon is 3 x 10^{-12} ergs, Its wavelength in nm **(E-2006)**

1) 662 2) 1324 3) 66.2 4) 6.62

Ans: 1

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

$$= \frac{6.62\times10^{27}\ \text{erg sec}\times 3\times10^{10}\,\text{cms}^{-1}}{3\times10^{-12}\,\text{erg}}$$

$\lambda = 6.62\times10^{-5}\,\text{cm} = 662\,\text{nm}$

12. What is the correct order of spin only magnetic moment (in BM) of Mn^{+2} and V^{+2} is **(E - 2006)**

1) $Mn^{2+} > V^{2+} > Cr^{2+}$ 2) $V^{2+} > Cr^{2+} > Mn^{2+}$

3) $Mn^{2+} > Cr^{2+} > V^{2+}$ 4) $Cr^{2+} > V^{2+} > Mn^{2+}$

Ans: 3

Sol. Spin only magnetic moment = $\sqrt{n(n+2)}$ B.M

N = number of unpaired electron
Magnetic moment is proportional to number of unpaired electron.

Number of unpaired electron in $Mn^{2+} = 5$
Number of unpaired electron in $Cr^{2+} = 4$
Number of unpaired electron in $V^{2+} = 2$

13. The angular momentum of an electron present in the excited state of Hydrogen is $\frac{1.5h}{\pi}$. The electron present in **(M-2006)**
1) Third orbit 2) Second orbit 3) Fourth orbit 4) Fifth orbit
Ans: 1

Sol. Angular momentum = $\frac{nh}{2\pi} = \frac{1.5h}{\pi}$
n = 3

14. What is the wavelength (in m) of a particle of mass 6.62×10^{-29} g moving with a velocity of $10^3\,ms^{-1}$? $\left(h = 6.62\times10^{-34}\text{ j.s.}\right)$ **(M-2005)**
1) 6.62×10^{-4} 2) 6.62×10^{-3} 3) 10^{-5} 4) 10^5
Ans: 3

Sol. m = 6.62×10^{-29} g
$= 6.62\times10^{-32}$ kg
$v = 10^3\,ms^{-1}$
de-Broglie equation
$\lambda = \frac{h}{mv} = \frac{6.625\times10^{-34}}{6.62\times10^{-32}\times10^3} = 10^{-5}\,m$

15. What is the lowest energy of the spectral line emitted by the hydrogen atom in the Lyman series? (h=Plank constant; C=Velocity of light; R=Rydberg constant). (**M-2005**)
1) $\frac{5hcR}{36}$ 2) $\frac{4hcR}{3}$ 3) $\frac{3hcR}{4}$ 4) $\frac{7hcR}{144}$
Ans: 3

Sol. Lyman series equation $= \bar{v} = \frac{1}{\lambda} = R\left[\frac{1}{1^2} - \frac{1}{n_2^2}\right]$
Lowest energy is emitted when electron moves from n= 2 to n = 1
$\bar{v} = R\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{3}{4}R$
$E = h\nu = hc\bar{v} = hc\times\frac{3}{4}R = \frac{3hcR}{4}$

16. **Assertion(A):**The spin only magnetic moment of SC^{3+} is 1.73 BM.
Reason(R): The spin only magnetic (in BM) of an ion is equal to $\sqrt{n(n+2)}$ where n is the number of unpaired electrons present in the ion. **(M-2005)**
The correct answer is :
1) Both (A) and (R) are true and (R) is the correct explanation of (A)
2) Both (A) and (R) true and (R) is not the correct explanation of (A)
3) (A) is true but (R) is not true
4) (A) is not true but (R) is not true

Ans: 4

Sol. Sc^{3+} has zero unpaired electron. So its spin only magnetic moment in BM is zero

Spin only magnetic moment $\mu_s = \sqrt{n(n+2)}$

Where n = no of unpaired electron

17. An electron is moving in Bohr's orbit. Its deBrogile wavelength is λ. What is the circumference of the fourth orbit ? **(E-2005)**

1) $2/\lambda$ 2) 2λ 3) 4λ 4) $4/\lambda$

Ans: 3

Sol. $2\pi r = n\lambda$

n = 4

$\therefore\ 2\pi r = 4\lambda$

18. The atomic numbers of elements X,Y and Z are 19, 21 and 25 respectively. The number of electrons present in the M shells of these elements follow the order. **(E-2005)**

1) Z>X>Y 2) X>Y>Z 3) Z>Y>X 4) Y>Z>X

Ans: 3

Sol. $X = 19 = 1s^2 2s^2 2p^6 \underbrace{3s^2 3p^6}_{\text{M shell}} 4s^1$

$Y = 21 = 1s^2 2s^2 2p^6 \underbrace{3s^2 3p^6 3d^1}_{\text{M shell}} 4s^2$

$Z = 25 = 1s^2 2s^2 2p^6 \underbrace{3s^2 3p^6 3d^5}_{\text{M shell}} 4s^2$

$\therefore$ Z > Y > X

19. Which of the following pair of ions have same paramagnetic moment ? **(E-2004)**

1) Cu^{+2}, Ti^{+3} 2) Mn^{+2}, Cu^{+2} 3) Ti^{+4}, Cu^{+2} 4) Ti^{+3}, Ni^{+2}

Ans:1

Sol. $Cu^{2+}(3d^9)$ and $Ti^{3+}(3d^1)$ have one unpaired electron each. So they have same para magnetic moment.

20. Which of the following elements has least number of electrons in its M shell **(E-2004)**

1) K 2) Mn 3) Ni 4) Sc

Ans: 1

Sol. $K = 19 = 1s^2 2s^2 2p^6 \underbrace{3s^2 3p^6}_{M} 4s^1$ k has only 8 electron in M shell

21. The values of four quantum numbers of valence electrons an element X $n = 4, 1 = 0, m = 0$, $s = \frac{1}{2}$. The element is

(M-2004)

1) K 2) Ti 3) Na 4) Sc

Ans: 1

Sol. The given quantam numbers indicate the valence electron is in 4s orbital.

Valance electron of K is in 4s orbital

22. An element has 2 electrons in K shell, 8 electrons in L shell, 13 electrons in M shell and one electron in N shell. The element is **(M-2004)**

1) Cr 2) Fe 3) V 4) Ti

Ans: 1

Sol. Electronic configuration of given element 2, 8, 13, 1. This indicate the element is chromium

23. If the wave length of an electromagnetic radiation is 2000 A°. What is the energy in ergs ? **(E-2003)**

1) 9.94×10^{-12} 2) 9.94×10^{-10} 3) 4.97×10^{-12} 4) 4.97×10^{-19}

Ans: 1

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

$=\frac{6.63\times10^{-27}\text{erg sec}\times3\times10^{10}\text{cm sec}^{-1}}{2000\times10^{-8}\text{cm}}$

$=9.94\times10^{-12}$ erg

24. If the electron of a hydrogen atom is present in the first orbit, the total energy of the electron is **(E-2003)**

1) $-e^2/r$ 2) $-e^2/r^2$ 3) $-e^2/2r$ 4) $-e^2/2r^2$

Ans: 3

Sol. Total energy of electron in 1st orbit $=\frac{-e^2}{2r}$

25. Which one of the following expressions represent the electron probability function (D) **(M-2003)**

1) $4\pi r\,dr\,\psi^2$ 2) $4\pi r^2\,dr\,\psi$ 3) $4\pi r^2\,dr\,\psi^2$ 4) $4\pi r\,dr\,\psi$

Ans: 3

Sol. D function is $=4\pi r^2.dr.\varphi^2$ = probability function

26. The total number of electrons present in all the S orbitals, all the P orbitals and all the d orbitals of caesium ion are respectively. **(M-2003)**

1) 6, 26, 10 2) 10,24,20 3) 8, 22, 24 4) 12, 20, 23

Ans: 2

Sol. $C_s^+=55-1=54$

$=1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6$

Total s electron = 10

Total p electron = 24

Total d electron = 20

27. The atomic number of an element is 35. What is the total number of electrons present in all the P-orbitals of the ground state atom of the element **(M-2003)**

1) 6 2) 11 3) 17 4) 23

Ans: 3

Sol. $(Z=35)1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$

P electron = 17

28. The calculated magnetic moment (in Bohr magneton) of Cu^{2+} ion is (**E-2002**)

1) 1.73 2) 0 3) 2.6 4) 3.4

Ans: 1

Sol. $Cu^{2+}=[Ar]3d^9$

$\mu_s = \sqrt{n(n+2)} = \sqrt{3} = 1.732 B.M$
n = number of unpaired electrons

29. Which one of the following statement is ***not*** correct ? **(E-2002)**
1) Rydberg's constant and wave number have same units
2) Lyman series of hydrogen spectrum occur in the ultraviolet region
3) The angular momentum of the electron in the ground state hydrogen atom is equal to $\frac{h}{2\pi}$
4) The radius of first Bohr orbit of hydrogen atom is 2.116 x 10^{-8} cm.
Ans: 4

Sol. Radius of 1st orbit = 0.529×10^{-8} cm
Therefore 4 is wrong answer

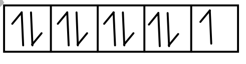
30. How many 'd' electrons are present in Cr^{2+} ion ? **(M-2002)**
1) 4 2) 5 3) 6 4) 3
Ans: 1

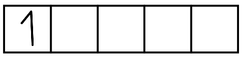
Sol. $Cr = [Ar] 4s^1 3d^5$
$Cr^{2+} = [Ar] 3d^4$
$\therefore$ the number of d electrons = 4

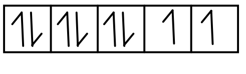
31. Which one of the following statements is correct? **(M-2002)**
1) 2's' orbital is spherical with two nodal planes
2) The de Broglie wavelength (λ) of a particle of mass 'm' and velocity 'V' is equal to mV/h
3) The principal quantum number (n) indicates the shape of the orbital
4) The electronic configuration of phosphorous is given by [Ne] $3s^2\ 3p^1_x\ 3p^1_y\ 3p^1_z$
Ans: 4

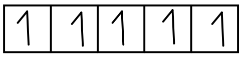
Sol. Electronic configuration of p is
$[Ne] 3s^2 3p_x^1 3p_y^1 3p_z^1$
Alternate 4 is correct
All other are wrong

32. Which one of the following ions exhibit highest magnetic moment? **(E-2001)**
1) Cu^{2+} 2) Ti^{3+} 3) Ni^{2+} 4) Mn^{2+}
Ans: 4

Sol. $Cu^{2+} = [Ar] 4s^0\ 3d^9$  $\rightarrow$ 1 unpaired electron

$Ti^{3+} = [Ar] 4s^0\ 3d^1$  $\rightarrow$ 1 unpaired electron

$Ni^{2+} = [Ar] 4s^0\ 3d^8$  $\rightarrow$ 2 unpaired electrons

$Mn^{2+} = [Ar] 4s^0\ 3d^5$  $\rightarrow$ 5 unpaired electrons

Magnetic moment increases with increase in number of unpaired electron.
Mn^{2+} has more number of unpaired electron
$\therefore$ it has highest magnetic moment.

33. The energy of an electron present in Bohr's second orbit of hydrogen atom is_ ______ **(E-2001)**

1) -1312J $atom^{-1}$ 2) -328kJ mol^{-1} 3) -328 J mol^{-1} 4) -164kJ mol^{-1}

Ans: 2

Sol. $E_n = \frac{-1312}{n^2} \text{kJ mole}^{-1}$

$E_2 = \frac{-1312}{4} = -328 \text{kJ mole}^{-1}$

34. In the ground state, an element has 13 electrons in its "M-shell". The element is________ **(E-2001)**

1) Copper   2) Chromium   3) Nickel   4) Iron

Ans: 2

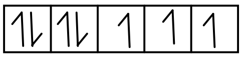
Sol. $Cr = 1s^2 2s^2 2p^6 \underbrace{3s^2 3p^6 3d^5}_{\text{M shell}} 4s^1$

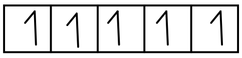
Cr has 13 electron in M shell

35. Which one of the following is a diamagnetic ion? **(M-2001)**

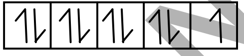
1) Co^{2+} 2) Cu^{2+} 3) Mn^{2+} 4) Sc^{3+}

Ans:4

Sol. $Co^{2+} = [Ar] 4s^0 3d^7$ 

$Mn^{2+} = [Ar] 4s^0 3d^5$ 

$Sc^{3+} = [Ar] 4s^0 3d^0$ 

$Cu^{2+} = [Ar] 4s^0 3d^9$ 

Diamagnetic ion should have no unpaired electrons only Sc^{3+} in has all the electron paired. So it in diamagnetic.

36. Which one of the following pairs of ions have the same electronic configuration? **(M-2001)**

1) Cr^{+3}, Fe^{+3} 2) Fe^{+3},Mn^{+2} 3) Fe^{+3},CO^{+3} 4) Sc^{+3},Cr^{+3}

Ans: 2

Sol. $Fe^{3+} = [Ar] 3d^5$

$Mn^{2+} = [Ar] 3d^5$

37. The atomic number (Z) on an element is 25. In its ground state how many electrons are present in the "N" shell? **(M-2001)**

1) 13   2) 2   3) 15   4) 3

Ans: 2

Sol. Z = 25

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$

N = 4^{th} orbit

$\therefore$ In 4^{th} orbit 2 electrons are present

38. What are the values of n_1 and n_2 respectively for H_β line in the Lyman series of hydrogen atomic spectrum? **(E-2000)**

1) 3 and 5   2) 2 and 3   3) 1 and 3   4) 2 and 4

Ans: 3

Sol. H_β line is formed when e^- jumps from 3rd orbit to 1st orbit in lyman series

$\therefore\ n_1 = 1 \quad n_2 = 3$

39. How many electrons are present in the M-shell of an atom of the element with atomic number Z=24? **(E-2000)**

1) 5 2) 6 3) 12 4) 13

Ans: 4

Sol. Z = 24 = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$

M shell = 3rd orbit

$\therefore$ In M shell 13 electron are present

40. The probability of finding an electron in an orbital is approximately? **(M-2000)**

1) 95% 2) 50% 3) 60% 4) 25%

Ans: 1

Sol. The probability of finding an electron in an orbital is approximately 95%.

41. What is the wavelength of H_β line the Balmer series of hydrogen spectrum?

(R = Rydberg constant) **(M-2000)**

1) 36/5R 2) 5R/36 3) 3R/16 4) 16/3R

Ans: 4

Sol. $n_1 = 2\ n_2 = 4$

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

$$\Rightarrow\ \bar{\upsilon} = R\left[\frac{1}{2^2} - \frac{1}{4^2}\right] \Rightarrow \bar{\upsilon} = R\left[\frac{1}{4} - \frac{1}{16}\right]$$

$$\Rightarrow \bar{\upsilon} = R\left[\frac{3}{16}\right] \Rightarrow \bar{\upsilon} = \frac{3R}{16}$$

$$\lambda = \frac{1}{\bar{\upsilon}} = \frac{16}{3R}$$