Unit Test-1

Hints & Solutions

Solution Paper-1

1. [B,C,D]

1st excitation energy 3 –

$$24 = 13.6\left(\frac{1}{1^2}-\frac{1}{2^2}\right)z^2$$

$\Rightarrow z^2 = 2.3529$ and $z = 1.5339$

I.E. $= 13.6 \times z^2 = 32$ eV

$$\text{B.E.} = -E_4 = 13.6 \times \frac{z^2}{16}\ \text{eV} = 2\text{eV}$$

2nd excitation energy

$$= 13.6\, z^2\left(\frac{1}{1^2}-\frac{1}{3^2}\right)$$

$$= 32 \times \frac{8}{9}\ \text{eV} = \frac{32\times 8}{9}\text{eV}$$

Excitation energy = Excitation potential

$$= \frac{32\times 8}{9}\ \text{Volt}$$

2. [A,B]

Atom may be He^+ or Li^{2+}.

If no of photons absorbed = no. of photons emitted then excited state of ions is 1st excited state.

So energy absorbed by $He^+ = 13.6 \times 2^2$

$$=\left(\frac{1}{1^2}-\frac{1}{2^2}\right) = 40.80\ \text{V}$$

energy absorbed by $Li^{2+} = 13.6\times 3^2\left(\frac{1}{1^2}-\frac{1}{2^2}\right)=$

91.8 eV

3. [A,B]

$$\text{B.E.} = 13.6 \times \frac{z^2}{4^2}$$

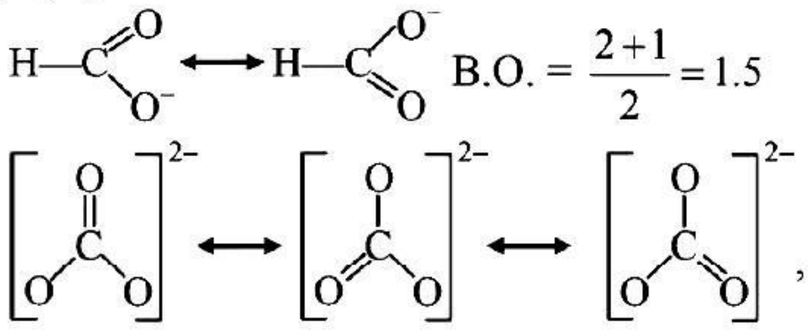
$$\Rightarrow z^2 = \frac{16}{13.6} \times \text{B.E} = \frac{16}{13.6} \times 13.6 \Rightarrow z = 4$$

I.E. from 2nd excited state

$$= 13.6 \times \frac{z^2}{3^2} = 13.6 \times \frac{4^2}{3^2}\ \text{eV}$$

$= 24.178$ eV

4. [C,D]

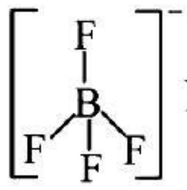


$$\text{B.O.} = \frac{2+1}{2} = 1.5$$

$$\text{B.O.} = \frac{2+1+1}{3} = \frac{4}{3} = 1.33$$

C—O bond length in $HCOO^-$ is less than C—O bond length in CO_3^{2-}

5. [A,C]



No. of σ bonds in $[BF_4]^- = 4$

$\Rightarrow$ B.O. of $NO^+ = 3.0$, i.e., one sigma bond and two π bonds

$\therefore$ No. of π bodns = 2

No. of σ bonds = 5

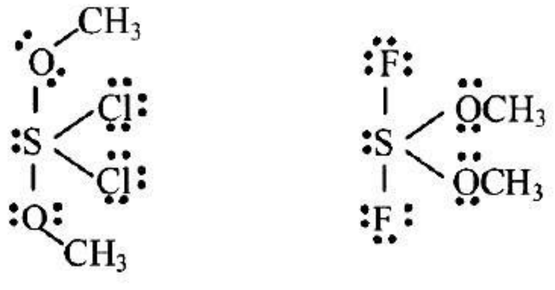
$\Rightarrow$ B.O. of $NO^+ = 3.0$

and B.O. of NO = 2.5

$\Rightarrow$ NO^+ is diamagnetic and BF_4^- is also diamagnetic

$\Rightarrow$ B—F bonds are longer in BF_4^- than in BF_3 due to absence of pπ-pπ back bonding in $[BF_4]$

6. [A,B,C,D]



7. [B,C]

Due to incomplete octet.

8. [5]

$$IE = 13.6 \times \frac{z^2}{n^2}\ eV$$

$z = 4$, so this is Be^{3+}

Atomic mass of Be is 5.

9. [1]

$r_{covalent} = r_A + r_B - 7\,(\Delta x)^2$

$= 100 + 50 - 7 \times (1.9)^2 pm$

$= 1.25$ Å

10. [6]

Energy of e^- ejected from He^+ ion

$= Ep - I.E._{He^+}$

$= (67.15 - 54.4)$ eV $= 12.75$ eV

Let e^- of H-atom goes to n^{th} orbit after being stroken by e^- of He^+ ion then

$12.75 = E_n - E_1$

$$= -13.6 \times \frac{1}{n^2} + 13.6 = 13.6\left(1 - \frac{1}{n^2}\right)$$

$$\Rightarrow 1 - \frac{1}{n^2} = \frac{12.75}{13.60}$$

$$\Rightarrow \frac{1}{n^2} = 1 - \frac{1275}{1360} = \frac{85}{1360}$$

$$\Rightarrow n^2 = \frac{1360}{85} = 16 \Rightarrow n = 4$$

So no. of diff. spectral line obtained by H-atom

$$= \frac{n(n-1)}{2} = \frac{4 \times 3}{2} = 6$$

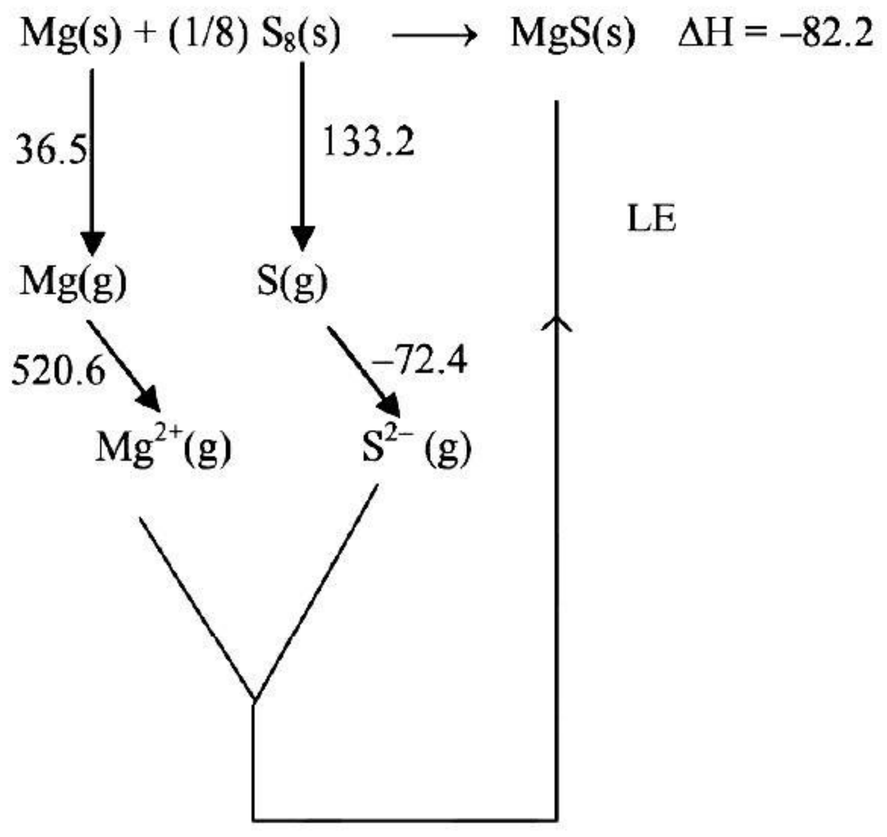
11. [5]

$$V = 2.18 \times 10^6 \times \frac{Z}{4}\ m/sec$$

$$\Rightarrow 2.725 \times 10^6 = 2.18 \times 10^6 \times \frac{Z}{4}$$

$$\Rightarrow Z = 5$$

12. [7]



$36.5 + 133.2 + 520.6 - 72.4 + LE = -82.2$

or $LE = -82.2 + 72.4 - 36.5 - 133.2 - 520.6$

or $LE = -700.1$ kcal/mol.

$\therefore$ energy released due to formation of lattice $\simeq$ 700 kcal/mol

13. [B]

<u>2s orbital</u>

No. of radial node $= n - \ell - 1 = 2 - 0 - 1 = 1$

14. [C]

<u>For He^+ ion</u>

$He^+ = 1s^1$ it has non directional characteristics

15. [A]

<u>For 1s orbital</u>

There is no radial node

So Ψ function will be $\psi_{n,\ell,m} \propto \left(\frac{Z}{a_o}\right)^{3/2} e^{-\frac{Zr}{a_o}}$

Energy $\frac{E_{2\to4}}{E_{2\to6}} = \frac{27}{32}$

16. [D]

Theory based

17. [D]

Theory based

18. [D]

Theory based

Solution Paper-2

1. [B]

It is not true direction of overlapping because overlapping occur's in only e^-.

2. [D]

H_2S is more acidic than H_2O. It is due to the fact than H–S bond is weaker than H–O bond.

3. [C]

Suppose the no. of electrons in ion = x

$$\text{no. of neutrons in ion} = x + \frac{30.4}{100} \times x$$

$$= x + 0.304x$$

$$= 1.304x$$

Number of electrons in neutral atom = x + 3

Number of protons in neutral atom = x + 3

Mass number = P + x

$56 = x + 3 + 1.304\,x$

$53 = 2.304\,x$

$$x = \frac{53}{2.304} = 23$$

no. of protons = 23 + 3 = 26 $\Rightarrow$ $^{56}_{26}Fe^{+3}$

4. [C]

Atomic number of fluorine = 9.

5. [D]

$$\lambda = \sqrt{\frac{150}{V}}$$

or $\lambda\sqrt{V}$ = constant

$$\sqrt{V}d\lambda + \frac{\lambda}{2\sqrt{V}}dV = 0$$

$$-\frac{d\lambda}{\lambda} = \frac{1}{2}\frac{dV}{V}$$

$$\frac{1}{100} = \frac{1}{2}\frac{dV}{V}$$

$$\frac{dV}{V} = \frac{2}{100}$$

or % increase in V = 2%

6. [C]

$IP_1 \Rightarrow$ Li Be B C

$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow$

$IP_2 \Rightarrow$ He Li Be > B

I IP↑ I

$\therefore$ so Li > B > C > Be

7. [C]

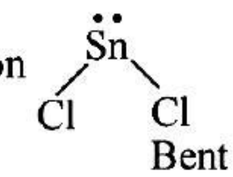
$$\text{Force} = \frac{kq_1q_2}{r^2} \Rightarrow F \propto \frac{1}{r^2}$$

and $\because r \propto n^2$

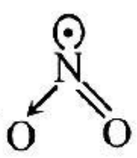
$$\therefore F \propto \frac{1}{n^4}$$

8. [B,D]

$SnCl_2 \rightarrow Sp^2$ hybridisation



$\cdot NO_2 \rightarrow$



Bent

Rest are linear.

9. [B,C]

$(SiH_3)_3\dot{N}$ lone paire electron participate in back donation.

10. [C,D]

$M^{+2} = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^3$

$\therefore M = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^3\,4s^2$

For d-block group no. = no. of e^- in 3d + no. of e^- 4s

= 3 + 2 = 5

11. [A,B,C]

$_{24}Cr = [Ar]^{18}\,3d^5\,4s^1$ (exceptional configuration)

'm' can have values from $-\ell$ to $+\ell$

'Ag' $\rightarrow$ $[Kr]^{36}$ $4d^{10}\,5s^1$

$\downarrow \qquad \downarrow$

$18 \rightarrow +1/2 \quad S = +1/2$

$18 \rightarrow -1/2 \quad S = -1/2$

$N = \overset{\oplus}{N} = \overset{\ominus}{N}-H$ HN_3, $H \rightarrow +1$, $N_3^{\ominus} \rightarrow x = -1/3$

12. [A, D]

$E_3 = E_1 + E_2 \Rightarrow h\nu_3 = h\nu_1 + h\nu_2$

$$\frac{hc}{\lambda_3} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2} \Rightarrow \lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_1 + \lambda_2}$$

13. [A,B,D]

fact

14. [A,B,C]

$$mvr = \frac{nh}{2\pi}$$

D is not correct

15. [A]

$$\frac{\Delta E_{3\to2}}{\Delta E_{3\to1}} = \frac{E_3 - E_2}{E_3 - E_1} = \frac{3.4 - 1.5}{13.6 - 1.5} = \frac{1.9}{12.1}$$

16. [B]

$h\nu = h\nu_1 + h\nu_2 \qquad hc\,\frac{1}{\lambda} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$

$$\Rightarrow \nu = \nu_1 + \nu_2 \Rightarrow \frac{1}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$$

17. [B]

I $\rightarrow$ Size of 'P' < Size of 'Al'

II $\rightarrow$ Size of 'As' < Size of 'Ga'

III $\rightarrow$ Size of 'P' < Size of 'As'

IV $\rightarrow$ Size of 'Al' $\simeq$ Size of 'Ga'

18. [A]

Order of $IE_1 \rightarrow P > As > Ga > Al$