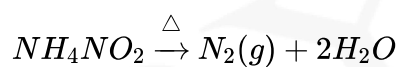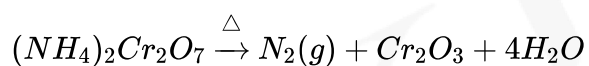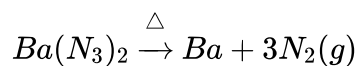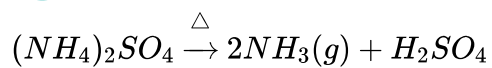1. The compound that does not produce nitrogen gas by thermal decomposition is:

   ✔ **A.** $(NH_4)_2SO_4$

   ✖ **B.** $Ba(N_3)_2$

   ✖ **C.** $(NH_4)_2Cr_2O_7$

   ✖ **D.** NH_4NO_2

$(NH_4)_2SO_4 \xrightarrow{\triangle} 2NH_3(g) + H_2SO_4$

$Ba(N_3)_2 \xrightarrow{\triangle} Ba + 3N_2(g)$

$(NH_4)_2Cr_2O_7 \xrightarrow{\triangle} N_2(g) + Cr_2O_3 + 4H_2O$

$NH_4NO_2 \xrightarrow{\triangle} N_2(g) + 2H_2O$

2. The half life period $(t_{1/2})$ of a reaction is halved as the initial concentration of the reactant is doubled. What is the order of the reaction ?

✗ A. Zero

✗ B. First

✔ C. Second

✗ D. Pseudo first

For a general reaction,
$A \rightarrow \text{Product(s)}$

$$t_{1/2} = \frac{1}{k(n-1)} \left[\frac{2^{n-1} - 1}{[A]_0^{n-1}} \right]$$

Since the temperature remains constant, only thing that changes is the initial concentration.

$$t_{1/2} \propto \frac{1}{[A]_0^{n-1}} \ldots \ldots eqn(1)$$

When the initial concentration of reactant is doubled, the half life period is halved.
$\therefore$

$$\frac{1}{2}t_{1/2} = \frac{1}{[2A]_0^{n-1}} \ldots \ldots eqn(2)$$

Dividing equation (1) by (2), we get,

$$\frac{t_{1/2}}{\frac{1}{2}t_{1/2}} = \frac{1/[A]_0^{n-1}}{1/[2A]_0^{n-1}}$$

$2 = 2^{n-1}$
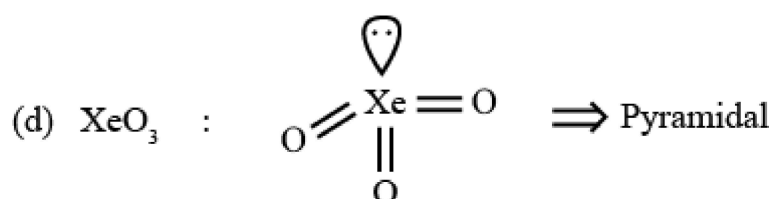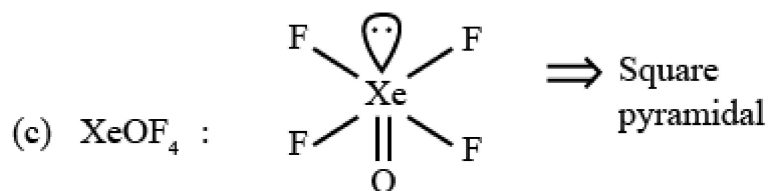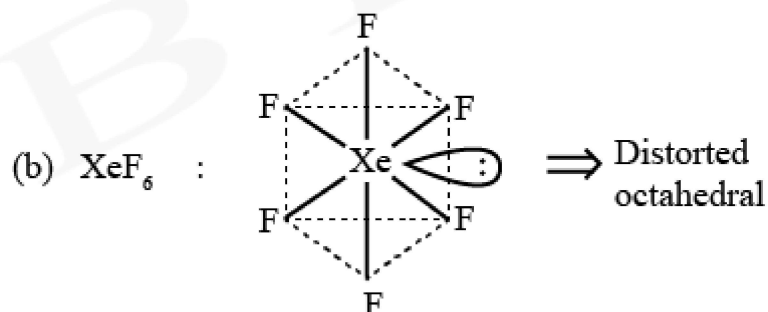$\Rightarrow 2^1 = 2^{n-1}$
so that,
$n - 1 = 1$
$n = 2$
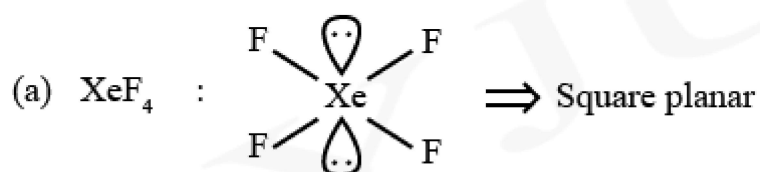The reaction is of the second order.

3. Match the Xenon compound in Column-I with its structure in Column-II and assign the correct code:

Column - I	Column - II
1. XeF_4	a. Pyramidal
2. XeF_6	b. Square planar
3. $XeOF_4$	c. Distorted octahedral
4. XeO_3	d. Square pyramidal

✔ **A.** 1-b, 2-c, 3-d, 4-a

✘ **B.** 1-a, 2-d, 3-b, 4-c

✘ **C.** 1-b, 2-d, 3-c, 4-a

✘ **D.** 1-b, 2-d, 3-c, 4-a

(a) XeF_4 : $\Rightarrow$ Square planar

(b) XeF_6 : $\Rightarrow$ Distorted octahedral

(c) $XeOF_4$: $\Rightarrow$ Square pyramidal

(d) XeO_3 : $\Rightarrow$ Pyramidal

4. Which of the statements for a catalyst is correct?

ⓧ **A.** Catalyst may form intermediates with the reactants

ⓧ **B.** The surface of a catalyst adsorbs reactants

✔ **C.** It does not alter energy of activation

ⓧ **D.** Action of enzyme catalyst is always specific

In the presence of a catalyst, reactants choose another path with lower E_a (activation energy). The lower the value of E_a, faster will be the rate of a reaction.
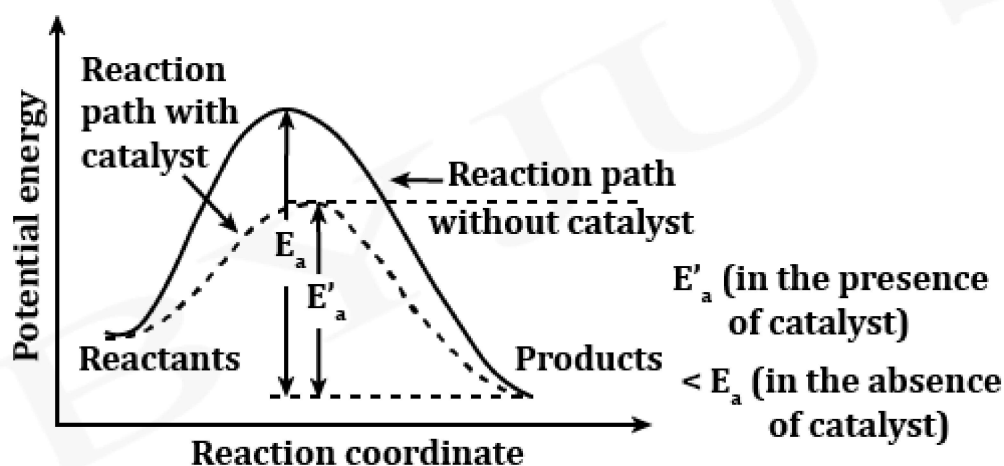
5. In a first order reaction, if the time taken for completion of 50 percent of the reaction is t seconds, then the time required for completion of 99.9 percent of the reaction is

     ✗ **A.** $2\,t$

     ✔ **B.** $10\,t$

     ✗ **C.** $4\,t$

     ✗ **D.** $3\,t$

We know that for a first order reaction, the time taken for completion of $50\ \%$ is $t = \dfrac{0.693}{k}$

$$\Rightarrow k = \frac{0.693}{t}$$

When $99.9\ \%$ is completed, then $0.1\ \%$ or $\dfrac{1}{1000}$ of the reactant will be left.

The rate equation of first order reaction is

$$kt' = 2.303 \log \frac{A_0}{A_t}$$

$$\Rightarrow \frac{0.693}{t} \times t' = 2.303 \log \frac{a}{a/1000}$$

$$\Rightarrow \frac{0.693}{t} \times t' = 2.303 \times 3$$

$$\Rightarrow t' = 10\,t$$

6. The rate of a chemical reaction doubles for every $10°C$ rise of temperature. If the temperature is raised by $50°C$, the rate of the reaction increases by about:

❌ **A.** 64 times

❌ **B.** 10 times

❌ **C.** 24 times

✔ **D.** 32 times

The rate of a chemical reaction doubles for every $10°C$ rise of temperature. If the temperature is raised by $50°C$, the rate of the reaction increases by about 32 times.

$$\frac{50}{10} = 5$$

$$2^5 = 32$$

7. A solution containing $62\ g$ ethylene glycol in $250\ g$ water is cooled to $-10°C$. If K_f for water is $1.86\ K\ kg\ mol^{-1}$, the amount of water $(in\ g)$ separated as ice is

   ✔ **A.** 64

   ✘ **B.** 32

   ✘ **C.** 16

   ✘ **D.** 48

Freezing point depression of a solution is given by,
$\triangle T_f = K_f \times m$
where,
$\triangle T_f$ is the depression in freezing point.
K_f is molal depression constant.
m is molality of solution.

$$\text{Molality (m)} = \frac{\dfrac{w_{\text{solute}}}{M} \times 1000}{W_{\text{solvent}}}$$

where,
w is weight of solute
W is weight of solvent
M is molar mass of the solute

$$\Rightarrow 10 = 1.86 \times \frac{62 \times 1000}{62 \times W_{solvent}}$$

$$\Rightarrow W_{solvent} = \frac{1.86 \times 1000}{10}$$

$$= 186\ g$$

Give amount of $H_2O\ is\ 250\ g$

$\therefore$ The amount of water separated as ice,
$= 250 - 186 = 64\ g$

8. A set of solutions is prepared using $180\ g$ of water as a solvent and $10\ g$ of different non-volatile solutes $A,\ B\ and\ C$. The relative lowering of vapour pressure in the presence of these solutes are in the order [Given, molar mass of $A = 100\ g\ mol^{-1}; B = 200\ g\ mol^{-1};\ C = 10,000\ g\ mol^{-1}$]

- ✖ **A.** $A > C > B$
- ✖ **B.** $C > B > A$
- ✔ **C.** $A > B > C$
- ✖ **D.** $B > C > A$

Relative lowering in vapour pressure $(\mathrm{RLVP}) = \dfrac{\Delta P}{P_o} = \dfrac{n}{n+N}$

$n \rightarrow$ moles of solutes
$N \rightarrow$ moles of solvent

$$n_A = \frac{\dfrac{10}{100}}{\dfrac{10}{100}+\dfrac{180}{18}} = \frac{0.1}{10.1} = \frac{1}{101}$$

$$n_B = \frac{\dfrac{10}{200}}{\dfrac{10}{200}+\dfrac{180}{18}} = \frac{0.05}{10.05} = \frac{1}{201}$$

$$n_C = \frac{\dfrac{10}{10000}}{\dfrac{10}{10000}+\dfrac{180}{18}} = \frac{10^{-3}}{10}$$
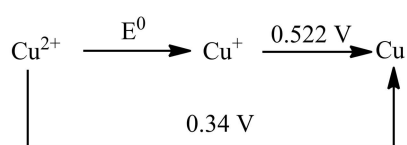
From the above relation,

$RLVP\,(A) > RLVP\,(B) > RLVP\,(C)$
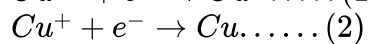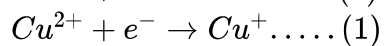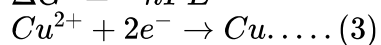
Hence, option (c) is correct.

9. Given that the standard potentials (E^0) of Cu^{2+}/Cu and Cu^+/Cu are $0.34\ V$ and $0.522\ V$ respectively, the E^0 of Cu^{2+}/Cu^+ is-

- ✔ **A.** $+0.158\ V$
- ✗ **B.** $0.182\ V$
- ✗ **C.** $-0.158\ V$
- ✗ **D.** $-0.182\ V$

$\Delta G^0 = -nFE^0$

$Cu^{2+} + 2e^- \rightarrow Cu.....(3)$

$Cu^{2+} + e^- \rightarrow Cu^+.....(1)$

$Cu^+ + e^- \rightarrow Cu......(2)$

Adding equation (1) and (2), we get (3)

$\Delta G_3^0 = \Delta G_1^0 + \Delta G_2^0$

$2 \times 0.34 = E_1^0 + 1 \times 0.522$

$E_1^0 = 0.68 - 0.522$

$E_1^0 = 0.158\ V$

Hence, option (a) is correct.

10. The parameters of the unit cell of a substance are,
$a = 2.5,\ b = 3.0,\ c = 40,\ \alpha = 90°,\ \beta = 120°,\ \gamma = 90°$
The crystal system of the substance is:

✔ **A.** Monoclinic

✘ **B.** Hexagonal

✘ **C.** Orthorhombic

✘ **D.** Triclinic

For 3D-space lattice, there are seven unique and basic unit-cell shapes (primitive unit cells) with varying elements of symmetry in a three-dimensional space.

Almost all the crystals found in nature, confirm to one of the seven crystal systems.

The seven crystal systems are:

Crystal system	Edge lengths	Angles
Cubic	$a = b = c$	$\alpha = \beta = \gamma = 90^o$
Tetragonal	$a = b \neq c$	$\alpha = \beta = \gamma = 90^o$
Orthorhombic	$a \neq b \neq c$	$\alpha = \beta = \gamma = 90^o$
Hexagonal	$a = b \neq c$	$\alpha = \beta = 90^o; \gamma = 120^o$
Rhombohedral	$a = b = c$	$\alpha = \beta = \gamma \neq 90^o$
Monoclinic	$a \neq b \neq c$	$\alpha = \gamma = 90^o; \beta \neq 90^o$
Triclinic	$a \neq b \neq c$	$\alpha \neq \beta \neq \gamma \neq 90^o$

Monoclinic $a \neq b \neq c, \alpha = \gamma = 90°,\ \beta \neq 90°$

11. $CsCl$ crystallises in body centred cubic lattice. If $'a'$ is its edge length then which of the following expressions is correct?

    (×) **A.** $r_{Cs^+} + r_{Cl^-} = 3a$

    (×) **B.** $r_{Cs^+} + r_{Cl^-} = \dfrac{3a}{2}$

    (✓) **C.** $r_{Cs^+} + r_{Cl^-} = \dfrac{\sqrt{3}}{2}a$

    (×) **D.** $r_{Cs^+} + r_{Cl^-} = \sqrt{3}a$
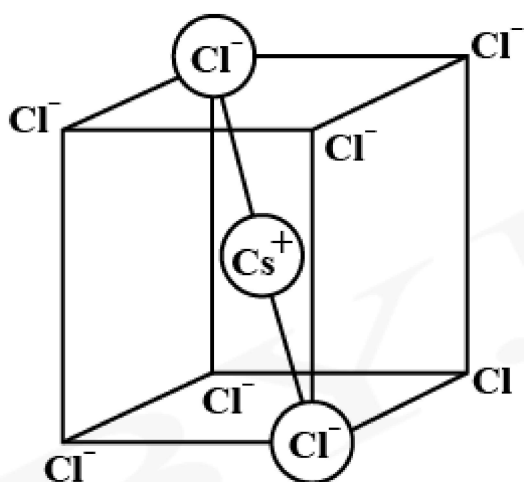
$$2r_{Cl^-} + 2r_{Cs^+} = \sqrt{3}a$$
$$r_{Cl^-} + r_{Cs^+} = \frac{\sqrt{3}a}{2}$$

12. Consider the follwoing reduction processes :
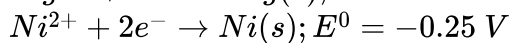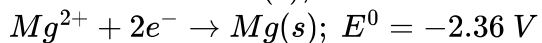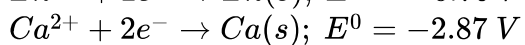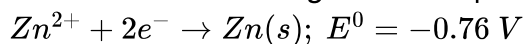
$Zn^{2+} + 2e^- \rightarrow Zn(s); \; E^0 = -0.76 \; V$
$Ca^{2+} + 2e^- \rightarrow Ca(s); \; E^0 = -2.87 \; V$
$Mg^{2+} + 2e^- \rightarrow Mg(s); \; E^0 = -2.36 \; V$
$Ni^{2+} + 2e^- \rightarrow Ni(s); E^0 = -0.25 \; V$

The reducing power of the metals increases in the order :

✗ **A.** $\quad Ca < Zn < Mg < Ni$

✔ **B.** $\quad Ni < Zn < Mg < Ca$

✗ **C.** $\quad Zn < Mg < Ni < Ca$

✗ **D.** $\quad Ca < Mg < Zn < Ni$

More the value of reduction potential higher will be the oxidising power of metal and lower will be the reducing power of metal.
Here, Ca^{2+}/Ca couple has the least value of reduction potential so it readily go oxidation and its reducing power is high.

Thus, order of reducing power of metal is
$Ni < Zn < Mg < Ca$

13. The rate of a certain biochemical reaction at physiological temperature (T) occurs 10^6 times faster with enzyme than without. The change in the activation energy upon adding enzyme is

⊗ **A.** $-6RT$

⊗ **B.** $+6RT$

⊗ **C.** $+6(2.303)RT$

✔ **D.** $-6(2.303)RT$

The rate constant of a reaction is given by

$$k = Ae^{-\frac{E_a}{RT}}$$
where,
k : Rate constant
E_a : Activation energy (in J/mol)
R : Gas constant
T : Temperature of reaction (in Kelvin(K))
A : Arrhenius factor or frequency factor or pre-exponential factor. It is constant, specific to a particular reaction

The rate constant in presence of catalyst is given by

$$k' = Ae^{-E_a'/RT}$$

$$\frac{k'}{k} = e^{-(E_a'/RT)}$$
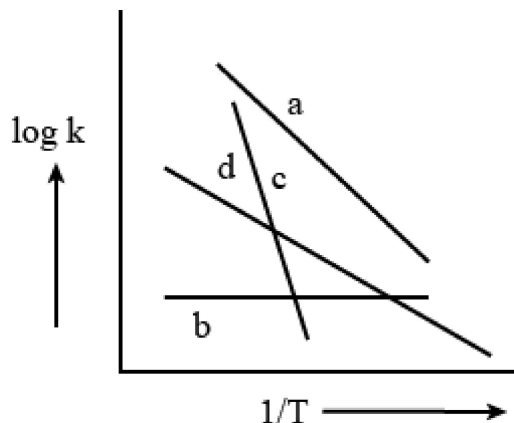
$$10^6 = e^{-(E_a' - E_a)/RT}$$

$$\ln 10^6 = -\frac{(E_a' - E_a)}{RT}$$

$$E_a' - E_a = -6(2.303)RT$$
Option (d) is correct

14. Consider the following plots of rate constant versus $\frac{1}{T}$ for four different reactions. Which of the following orders is correct for the activation energies of these reactions?

(✗) **A.** $E_b > E_a > E_d > E_c$

(✓) **B.** $E_c > E_a > E_d > E_b$

(✗) **C.** $E_a > E_c > E_d > E_b$

(✗) **D.** $E_b > E_d > E_c > E_a$

Denoting activation energy by E_x

$K = Ae^{\frac{-E_x}{RT}}$

$\log \text{K} = \log \text{A} - \frac{E_x}{2.303RT} \quad \ldots \ldots (1)$

Here, the graph given in the question is of a straight line and we know that the equation of straight line is

$y = mx + c \quad \ldots \ldots (2)$

Comparing equation 1 with 2 we get,

$\text{Slope} = \frac{-E_x}{2.303R}$

So, from the graph we can conclude that the line with the most negative slope will have the maximum activation energy value.

The correct order will be

$E_c > E_a > E_d > E_b$

15. Which of the following statement is correct?

    ✕ **A.** Nature of the gases affect adsorption of gases on solids.

    ✕ **B.** Nature of adsorbent do not affect adsorption of gases on solids

    ✕ **C.** Nature of adsorbent affects adsorption of gases on solids

    ✔ **D.** Both (a) and (c)

    Factor Affecting Adsorption of Gases on Solids
    Nature of the gases :
    The easily liquefiable gases (HCl, NH_3, Cl_2, etc) are adsorbed more than the gases like $(H_2, N_2, O_2, etc.)$

    Nature of adsorbent: Extent of adsorption is directly proportional to the surface area of solid. So, finely divided adsorbents are more efficient than normal one.
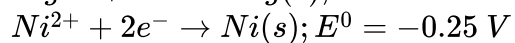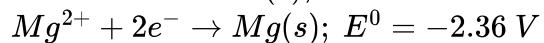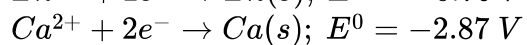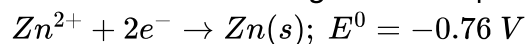   Example:
    Activated charcoal, clay etc. can adsorb gases which are easily liquified. Gases such as H_2, N_2 and O_2 are generally adsorbed on finely divided transition metals Ni and Co

    To increase the adsorbing power of adsorbents. They are subdivided into smaller pieces thus increasing their surface area and hence the adsorbing power.

16. Consider the follwoing reduction processes :
$Zn^{2+} + 2e^- \rightarrow Zn(s); \; E^0 = -0.76 \; V$
$Ca^{2+} + 2e^- \rightarrow Ca(s); \; E^0 = -2.87 \; V$
$Mg^{2+} + 2e^- \rightarrow Mg(s); \; E^0 = -2.36 \; V$
$Ni^{2+} + 2e^- \rightarrow Ni(s); E^0 = -0.25 \; V$

The reducing power of the metals increases in the order :

   ✖   **A.** $Ca < Zn < Mg < Ni$

   ✔   **B.** $Ni < Zn < Mg < Ca$

   ✖   **C.** $Zn < Mg < Ni < Ca$

   ✖   **D.** $Ca < Mg < Zn < Ni$

More the value of reduction potential higher will be the oxidising power of metal and lower will be the reducing power of metal.
Here, Ca^{2+}/Ca couple has the least value of reduction potential so it readily go oxidation and its reducing power is high.
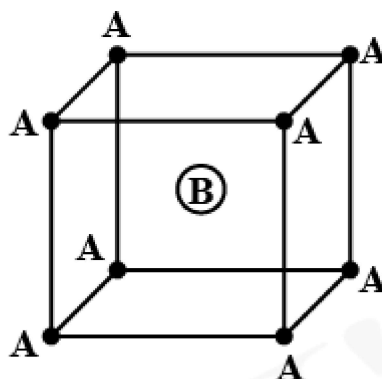
Thus, order of reducing power of metal is
$Ni < Zn < Mg < Ca$

17. Consider the bcc unit cells of the solids 1 and 2 with the position of atoms as shown below. The radius of atom B is twice that of atom A. The unit cell edge length is 50% more in solid 2 than in 1. What is the approximate packing efficiency in solid 2?
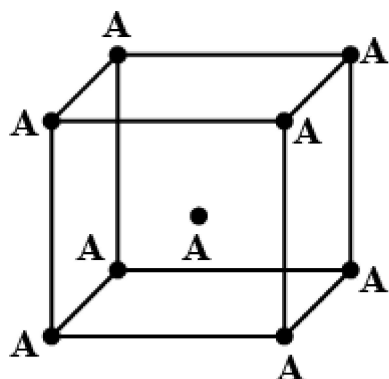
Solid 1   Solid 2

(✗) **A.** 45%

(✗) **B.** 65%

(✗) **C.** 75%

(✔) **D.** 90%
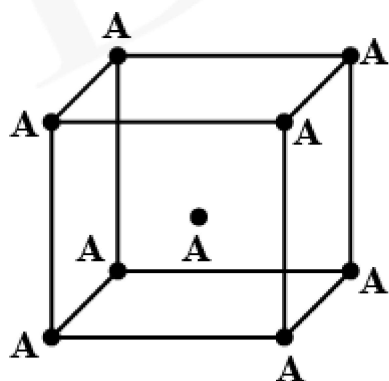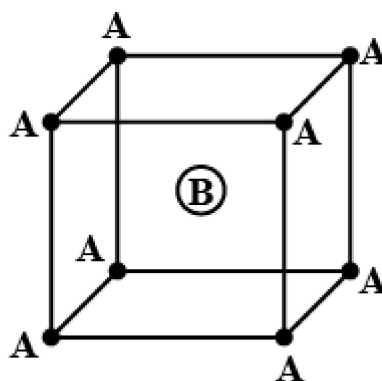
Solid 1   Solid 2

Volume occupied by atoms in solid 2
$$= \frac{4}{3}\pi r^3 + \frac{4}{3}\pi(2r)^3 = 12\pi r^3$$

Relationship between edge length (a) and radius of atom (r):
$$6r = \sqrt{3}a \Rightarrow a = \frac{6r}{\sqrt{3}}$$

Packing efficiency $= \dfrac{12\pi r^3}{\left(\dfrac{6r}{\sqrt{3}}\right)^3} \times 100 = 90\%$

18. In Freundlich adsorption isotherm, slope of AB line is :
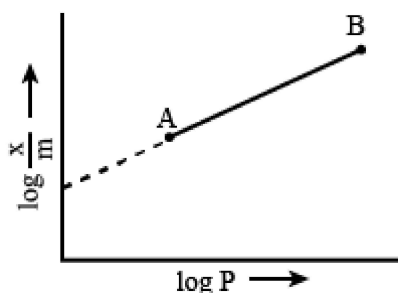
- (×) **A.** n with $(n = 0.1 \ to \ 0.5)$

- (✓) **B.** $\frac{1}{n}$ with $\left(\frac{1}{n} = 0 \ to \ 1\right)$

- (×) **C.** log n with $(n > 1)$

- (×) **D.** $log \frac{1}{n}$ with $(n < 1)$

According to Freundlich adsorption isotherm

$$\frac{x}{m} = k.\, P^{1/n} (n > 1)$$

$$log\frac{x}{m} = log k + \frac{1}{n}log P$$

So, in the plot of $log\dfrac{x}{m}$ vs log P, the slope is $\dfrac{1}{n}$,

$where \ \dfrac{1}{n}$ varies from 0 to 1 (since, n >1)

Hence, option (b) is correct.

19. The set having ions which are coloured and paramagnetic both is

   ✔ **A.** Cu^{2+}, Cr^{3+}, Sc^{+}

   ✘ **B.** Cu^{+}, Zn^{2+}, Mn^{4+}

   ✘ **C.** Sc^{3+}, V^{5+}, Ti^{4+}

   ✘ **D.** $Ni^{2+}, Mn^{7+}, Hg^{2+}$

To show colour and paramagnectic behaviour, the ion must have unpaired electron(s)

$Cu^{2+} - 3d^9 \ (one \ unpaired \ e^-)$

$Cr^{3+} - 3d^3 \ (three \ unpaired \ e^-)$

$Sc^{+} - 3d^2 \ (two \ unpaired \ e^-)$

$Cu^{+} and \ Zn^{2+} - 3d^{10}(no \ unpaired \ e^-)$

$Hg^{2+} - 5d^{10}(no \ unpaired \ e^-)$

$Sc^{3+}, V^{5+}, Ti^{4+} and \ Mn^{7+} - 3d^{0}(no \ unpaired \ e^-)$
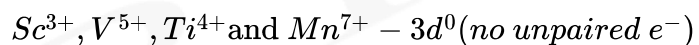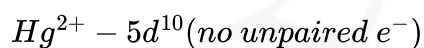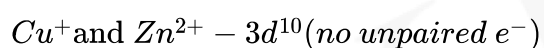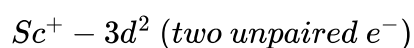
Hence, option (a) is correct.

20. The correct order of following $3d$ metal oxides, according to their oxidation number is

   (a) CrO_3
   (b) Fe_2O_3
   (c) MnO_2
   (d) V_2O_5
   (e) Cu_2O

   ✔ A. (a) > (d) >(c)>(b)>(e)

   ✘ B. (d) >(a)>(b)>(c)>(e)

   ✘ C. (a)>(c)>(d)>(b)>(e)

   ✘ D. (c)>(a)>(d)>(e)>(b)

   Oxidation state of oxygen is -2.

Metal oxide	Oxidation number
CrO_3	+6
Fe_2O_3	+3
MnO_2	+4
V_2O_5	+5
Cu_2O	+1

   $a > d > c > b > e$

   Hence, option (a) is correct.

21. A copper complex crystallising in a CCP lattice with a cell edge of $0.4518\ nm$ has been revealed by employing X-ray diffraction studies. The density of a copper complex is found to be $7.62\ g\ cm^{-3}$.
The molar mass of copper complex is _____
$g\ mol^{-1}$. (Nearest integer) [Given : $N_A = 6.022 \times 10^{23}\ mol^{-1}$]

Accepted Answers

106 106.0 106.00

Solution:

Given: the density of a copper complex =
$7.62\ g\ cm^{-3}, N_A = 6.022 \times 10^{23}\ mol^{-1}, a = 0.4518\ nm, Z = 4$
We know the $d = \dfrac{Z \times M}{a \times N_A}$
CCP lattice has a fcc structure:
For a fcc unit cell, atoms are present at corners as well as face centres :
Number of atoms in unit cell $= \left(8 \times \dfrac{1}{8}\right) + \left(6 \times \dfrac{1}{2}\right) = 4$

$7.62 = \dfrac{4 \times M}{(0.4518 \times 10^{-7})^3 \times 6.022 \times 10^{23}}$

$M = 105.8\ g/mol$

22. C_6H_6 freezes at 5.5^0C . The temperature at which a solution of 10 g of C_4H_{10} in 200 g of C_6H_6 freeze in ^0C is (nearest integer)
(The molal freezing point depression constant of C_6H_6 is $5.12^0C/m$)

Accepted Answers

1   1.0   1.00

Solution:

$\Delta T_f = iK_f m$
m is molality i.e. number of moles of solute dissolved per kg of solvent

$i = 1 \quad \text{for} \quad C_4H_{10}; T_f^0 = 5.5°C$

$m = \dfrac{10 \times 1000}{58 \times 200} = \dfrac{50}{80}$

$K_f = 5.12°C/m$

$\Delta T_f = 5.12 \times \dfrac{50}{58} = 4.41°C$

$T_f^0 - T_f = 4.41$

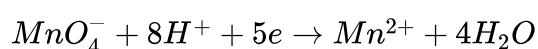$T_f = 5.50 - 4.41 = 1.09 \approx 1°C$

23. The magnitude of the change in oxidising power of the MnO_4^-/Mn^{2+} couple is $x \times 10^{-4}V$, if the H^+ concentration is decreased from $1\,M$ to $10^{-4}M$ 25^oC . (Assume concentration of MnO_4^- and Mn^{2+} to be same on change in H^+ concentration) . The value of x is: (Rounded off to the nearest integer)

$$\left[\text{Given;}\frac{2.303RT}{F} = 0.059\right]$$

Accepted Answers

37763776.03776.00

Solution:

$$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$$

$$E_{MnO_4^-/Mn^{2+}} = E^o{}_{MnO_4^-/Mn^{2+}} - \frac{0.059}{5}\log\frac{[Mn^{2+}]}{[MnO_4^-][H^+]^8}$$

If $[H^+] = 1M$

then $\backslash E_{MnO_4^-/Mn^{2+}} = E^o{}_{MnO_4^-/Mn^{2+}} - \frac{0.059}{5}\log\frac{[Mn^{2+}]}{[MnO_4^-]}$

If $[H^+] = 10^{-4}M$

$$E_{MnO_4^-} = E^0{}_{MnO_4^-/Mn^{2+}} - \frac{0.059}{5}\log\frac{[Mn^{2+}]}{[MnO_4^-]} - \frac{0.059}{5}\log\ 10^{32}$$

Magnitude of change in oxidising power :

$= 3776 \times 10^{-4}$

$x = 3776$

24. The number of 4f electrons in the ground state electronic configuration of Gd^{2+} is _____.
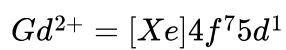
    [Atomic number of Gd $= 64$]

    Accepted Answers

    7   7.0   7.00

    Solution:

    Atomic number of Gd is 64

    Electronic configuration of Gd is $[Xe]4f^7 5d^1 6s^2$

    $Gd^{2+} = [Xe]4f^7 5d^1$

25. How many structures are correct from below

    (i) In diborane 12 valence e^- are involved in bonding

    (ii) In diborane, two boron and four terminal hydrogen, lie in the same plane.

    (iii) Diborane has ethane-like structure

    (iv) In diborane, bridging bonds are 3-centre 2- electron bond

    Accepted Answers

    3   3.0   3.00

    Solution:

    Now, by looking at the structure of diborane, we can see that there are 12 valence electrons that are involved in bonding. 8 valence electrons are used in the four non-bridging hydrogen bonds and four valence electrons are shared in forming 3-centered 2-electron bonds. Therefore, statement 'a' and 'd' are correct.

    (B). In diborane, maximum six atoms, two boron and four terminal hydrogen, lie in the same plane. By looking at the structure of diborane, we can see that two boron atoms and the four terminal hydrogen atoms of the molecule are in the same plane and the bridging hydrogen atoms lie above and below this plane. Therefore, statement (b) is also correct.

    (C). Diborane has ethane-like structure: The structure of ethane has a single bond between the two carbon atoms but in diborane, there are bridged hydrogen-boron bonds. Therefore, it does not have an ethane-like structure. Hence, this is not correct.
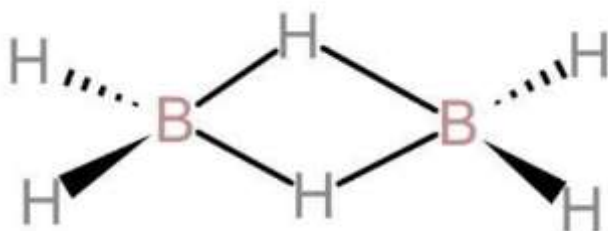
    Therefore, the correct statements are (i), (ii) and (iv).

26. 1 molal aqueous solution of an electrolyte A_2B_3 is 60% ionised . The boiling point of the solution at 1 atm in K is (Rounded -off to the nearest integer)
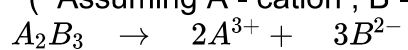
$$\left[K_b \ for \ (H_2O) = 0.53 \ K \ mol^{-1}\right]$$

Accepted Answers

375 375.0 375.00

Solution:

(Assuming A - cation , B - anion)
$A_2B_3 \quad \rightarrow \quad 2A^{3+} + \quad 3B^{2-}$
$1 - 0.6 \qquad 2 \times 0.6 \quad 3 \times 0.6$

$\therefore$ van't Hoff factor $= 1 - 0.6 + 1.2 + 1.8 = 3.4$

$\Delta T_b = i \times K_b \times m$

$\Delta T_b = 3.4 \times 0.52 \times 1 = 1.768$

$T_b - 373 = 1.768$

$T_b = 374.77 \approx 375 (\text{Nearest integer})$

27. CO_2 gas adsorbs on charcoal following Freundlich adsorption isotherm. For a given amount of charcoal, the mass of CO_2 adsorbed becomes 64 times when the pressure of CO_2 is doubled. the value of n in the Freundlich isotherm equation is $x \times 10^{-2}$. The value of x (Round off to the Nearest integer)

Accepted Answers

17   17.00   17.0

Solution:

According to Freundlich adsorption isotherm:

$$\frac{x}{m} = kp^{\frac{1}{n}} \quad \ldots (i)$$

When pressure in doubled,

$$64\frac{x}{m} = k(2p)^{\frac{1}{n}} \quad \ldots (ii)$$

Dividing eq (ii) by eq(i):

$$64 = \frac{(2p)^{\frac{1}{n}}}{(p)^{\frac{1}{n}}} = (2)^{\frac{1}{n}}$$

$$64 = (2)^{\frac{1}{n}}$$

$$\frac{1}{n} = 6$$

$$n = \frac{1}{6} = 16.67 \times 10^{-2} = 17 \times 10^{-2}$$

$x = 17$ (Nearest integer)

28. The molar conductivities at infinite dilution of barium chloride, sulphuric acid and hydrochloric acid are 280, 860 and 426 S $cm^{(2)}$ mol^{-1} respectively. The molar conductivity at infinite dilution of barium sulphate is ___ S cm^2 mol^{-1}. (Round off to the Nearest Integer)

Accepted Answers

288 288.0 288.00

Solution:

$\Lambda^{\infty}(BaCl_2) = 280\ S\ cm^2\ \text{mol}^{-1}$

$\Lambda^{\infty}(H_2SO_4) = 860\ S\ cm^2\text{mol}^{-1}$

$\Lambda^{\infty}(HCl) = 426\ S\ cm^2\text{mol}^{-1}$

$\Lambda^{\infty}(BaSO_4) = \Lambda^{\infty}(BaCl_2) + \Lambda^{\infty}(H_2SO_4) - 2\Lambda^{\infty}(HCl)$

$\Lambda^{\infty}(BaSO_4) = 280 + 860 - 2 \times 426$

$\Lambda^{\infty}(BaSO_4) = 288\ S\ cm^2\ \text{mol}^{-1}$

29. A copper complex crystallising in a CCP lattice with a cell edge of $0.4518\ nm$ has been revealed by employing X-ray diffraction studies. The density of a copper complex is found to be $7.62\ g\ cm^{-3}$.
The molar mass of copper complex is _____ $g\ mol^{-1}$. (Nearest integer) [Given : $N_A = 6.022 \times 10^{23}\ mol^{-1}$]

Accepted Answers

106 106.0 106.00

Solution:

Given: the density of a copper complex = $7.62\ g\ cm^{-3}, N_A = 6.022 \times 10^{23}\ mol^{-1}, a = 0.4518\ nm, Z = 4$
We know the $d = \dfrac{Z \times M}{a \times N_A}$
CCP lattice has a fcc structure:
For a fcc unit cell, atoms are present at corners as well as face centres :

$\text{Number of atoms in unit cell} = \left(8 \times \dfrac{1}{8}\right) + \left(6 \times \dfrac{1}{2}\right) = 4$

$7.62 = \dfrac{4 \times M}{(0.4518 \times 10^{-7})^3 \times 6.022 \times 10^{23}}$

$M = 105.8\ g/mol$

30. In the ground state of atomic $Fe(Z = 26)$, the spin-only magnetic moment is $x \times 10^{-1} BM$.
(Round off to the Nearest Integer).

Accepted Answers

49   49.0   49.00

Solution:

$Fe(Z = 26)$
Electrons configuration :
$[Ar]4s^2 3d^6$

Unpaired electrons:
$n = 4$

$\therefore \mu = \sqrt{4(4 + 2)} = \sqrt{24} BM$

$\mu = 4.89$

$\mu = 49 \times 10^{-1} B.M$
$x = 49$