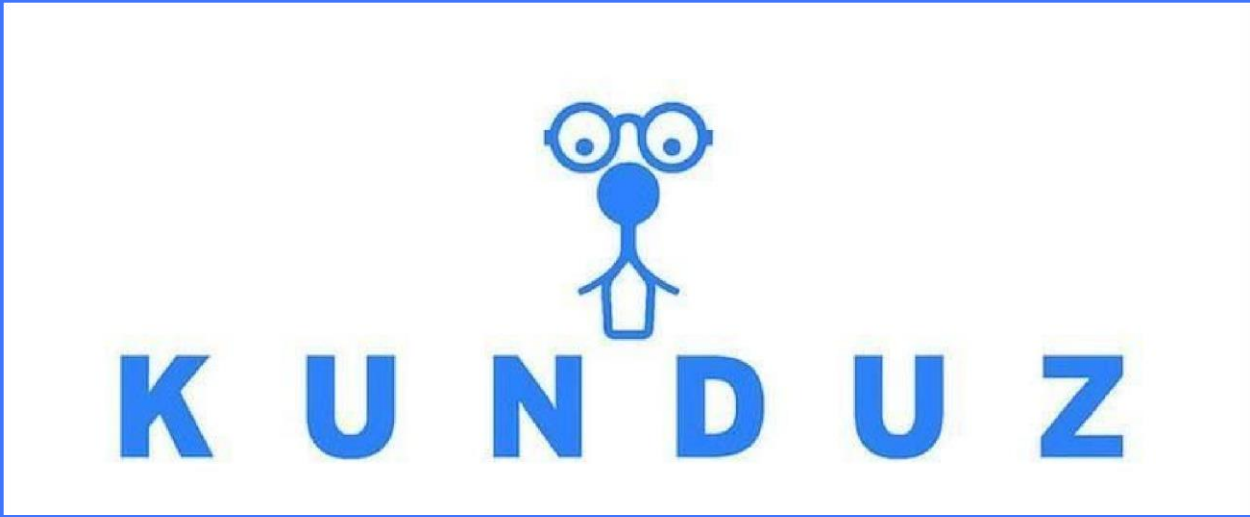
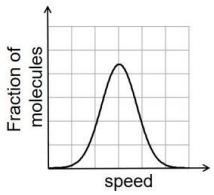


JEE Advanced Chemistry paper 1 solutions prepared by KUNDUZ tutors

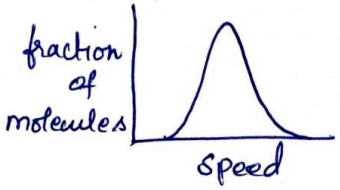
Visit Kunduz.com

Question number	Question and Answers
1	

Q.1 If the distribution of molecular speeds of a gas is as per the figure shown below, then the ratio of the most probable, the average, and the root mean square speeds, respectively, is



(A) 1 : 1 : 1
(B) 1 : 1 : 1.224
(C) 1 : 1.128 : 1.224
(D) 1 : 1.128 : 1



The given graph shows the symmetrical distribution of speed. Thus, the most probable velocity and the average speed are equal.

$$v_{MP} = \sqrt{\frac{2kT}{m}}$$

$$v_{avg} = \sqrt{\frac{8kT}{\pi m}} = \sqrt{\frac{2.55kt}{m}}$$

$$v_{mp} = v_{avg}$$

But v_{RMS} will be always greater than v_{ag}.

$$v_{RMS} = \sqrt{\frac{3kT}{m}}.$$

Ans: 1 : 1 : 1.224 (option B)

2

Q.2 Which of the following liberates O_2 upon hydrolysis?

(A) Pb_3O_4 (B) KO_2 (C) Na_2O_2 (D) Li_2O_2

Lead tetroxide (Pb_3O_4) is insoluble in water

$$2KO_2 + 2H_2O \rightarrow 2KOH + H_2O_2 + O_2\uparrow$$

$$Na_2O_2 + 2H_2O \rightarrow 2NaOH + H_2O_2$$

$$Li_2O_2 + 2H_2O \rightarrow 2LiOH + H_2O_2$$

ans: option (B) KO_2

3

Q.3 A colorless aqueous solution contains nitrates of two metals, **X** and **Y**. When it was added to an aqueous solution of NaCl, a white precipitate was formed. This precipitate was found to be partly soluble in hot water to give a residue **P** and a solution **Q**. The residue **P** was soluble in aq. NH_3 and also in excess sodium thiosulfate. The hot solution **Q** gave a yellow precipitate with KI. The metals **X** and **Y**, respectively, are

(A) Ag and Pb
(B) Ag and Cd
(C) Cd and Pb
(D) Cd and Zn

Ans: Ag and Pb (option A)

X- $AgNO_3$; Y = $Pb(NO_3)_2$

$AgNO_3$ (+) $Pb(NO_3)_2$ $\xrightarrow{NaCl}$ $AgCl\downarrow + PbCl_2\downarrow$ white ppt

↓ heated.

$AgCl\downarrow$ (P) residue + $PbCl_2$ hot solution (Q)

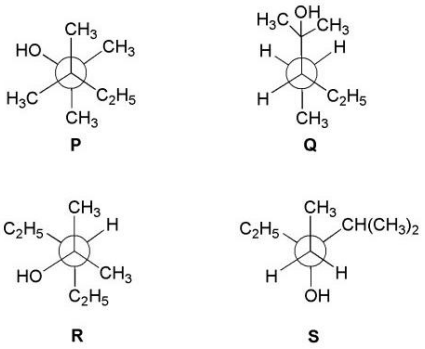
$AgCl + 2NH_3 \rightarrow [Ag(NH_3)_2Cl]$
(P) (aq)

$AgCl + 2Na_2S_2O_3 \rightarrow Na_3[Ag(S_2O_3)_2] + NaCl$
(P) (excess) Thiosulphate

$PbCl_2 + 2KI \rightarrow PbI_2\downarrow + 2KCl$
(Q) yellow ppt

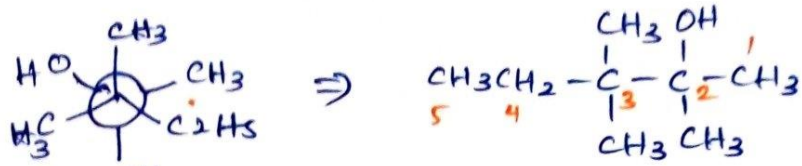
4

Q.4 Newman projections **P**, **Q**, **R** and **S** are shown below:

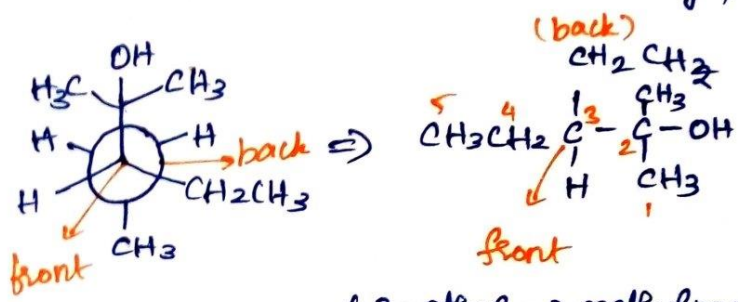


Which one of the following options represents identical molecules?

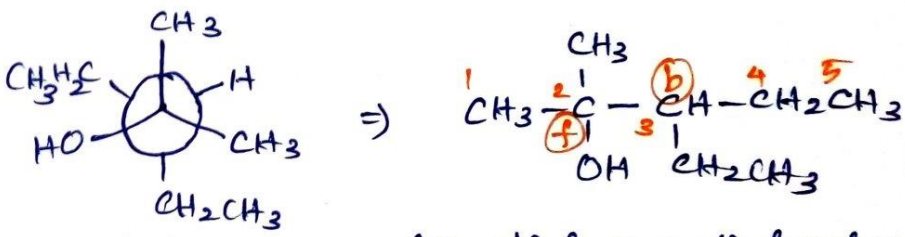
(A) **P** and **Q**
(B) **Q** and **S**
(C) **Q** and **R**
(D) **R** and **S**



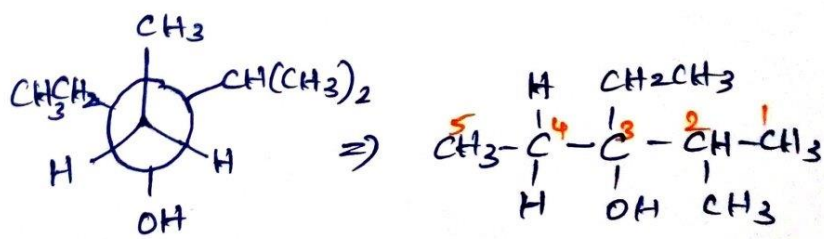
(2,3,3-trimethylpentan-2-ol)



(3-ethyl-2methylpentan-2-ol)



(3-ethyl-2-methylpentan-2-ol)

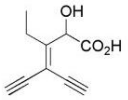


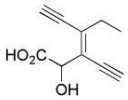
(3-ethyl-2-methylpentan-3-ol)

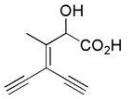
ans: Q and R (option c)

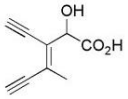
5

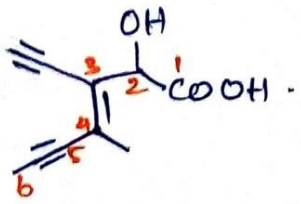
Q.5 Which one of the following structures has the IUPAC name 3-ethynyl-2-hydroxy-4-methylhex-3-en-5-ynoic acid?

(A) 

(B) 

(C) 

(D) 



Substituents - 4-methyl
3-ethynyl
2-hydroxy.

Functional group- acid

Parent name : hex-3-en-5-yne.

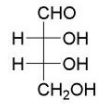
Iupac name :

3-ethynyl-2-hydroxy-4-methylhex-3-en-5-ynoic acid.

ans: option (D)

6

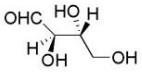
Q.6 The Fischer projection of D-erythrose is shown below.

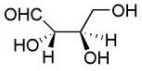


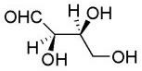
D-Erythrose

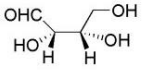
D-Erythrose and its isomers are listed as **P**, **Q**, **R**, and **S** in **Column-I**. Choose the correct relationship of **P**, **Q**, **R**, and **S** with D-erythrose from **Column II**.

Column-I

P. 

Q. 

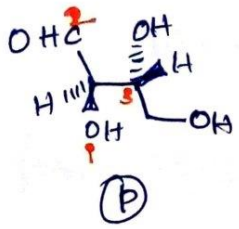
R. 

S. 

Column-II

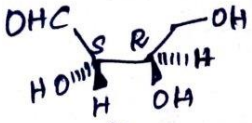
1. Diastereomer
2. Identical
3. Enantiomer

(A) **P**→2, **Q**→3, **R**→2, **S**→2
(B) **P**→3, **Q**→1, **R**→1, **S**→2
(C) **P**→2, **Q**→1, **R**→1, **S**→3
(D) **P**→2, **Q**→3, **R**→3, **S**→1



(P)

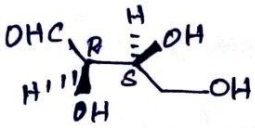
(R, R)



(Q)

(S, R)

ans: option (C)



(R)

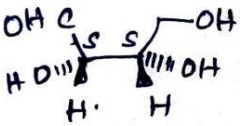
(R, S)

P → 2

Q → 1

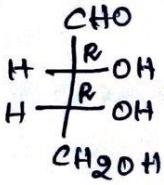
R → 1

S → 3



(S)

(S, S)



(R,R)

(D-erythrose)

Hint:

If the both the carbon configuration is changed, then it is enantiomer.

If only one config is changed ⇒ Diastereomer.

(Q) and (R) are Diastereomers with D-esthyrose.

(S) is enantiomer with D-erythrose and (P) is the same isomer.

7

Q.7 In thermodynamics, the $P-V$ work done is given by

$$w = -\int dV\, P_{ext}.$$

For a system undergoing a particular process, the work done is,

$$w = -\int dV \left(\frac{RT}{V-b} - \frac{a}{V^2}\right).$$

This equation is applicable to a

(A) system that satisfies the van der Waals equation of state.
(B) process that is reversible and isothermal.
(C) process that is reversible and adiabatic.
(D) process that is irreversible and at constant pressure.

$$W = -\int dV P_{ext} \quad -(1)$$

from Vander waal's equation for 1 mole gas

$$\left(P + \frac{a}{V^2}\right)(V-b) = RT$$

$$P = \left(\frac{RT}{(V-b)} - \frac{a}{V^2}\right) \quad -(2)$$

for reversible process

$$P_{ext} = P_{gas}.$$

Sub (2) in (1)

$$W = -\int dV \left(\frac{RT}{V-b} - \frac{a}{V^2}\right)$$

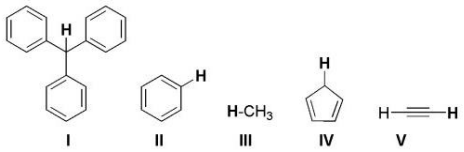
So $P = P_{ext}$ only for reversible process.

Thus options A, B, and C are correct.

ans: A, B, C.

8

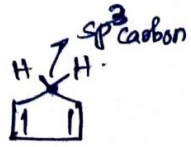
Q.8 With respect to the compounds **I-V**, choose the correct statement(s).



(A) The acidity of compound **I** is due to delocalization in the conjugate base.
(B) The conjugate base of compound **IV** is aromatic.
(C) Compound **II** becomes more acidic, when it has a -NO_2 substituent.
(D) The acidity of compounds follows the order **I** > **IV** > **V** > **II** > **III**.

(A) Ph–CH(Ph)–Ph ⇌ Ph–C⊖(Ph)–Ph (conjugate base)

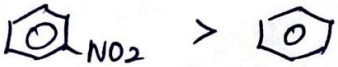
resonance stabilised.
(delocalisation)

(B) 

(non-aromatic) ⇌  (conjugate base)

Aromatic
(all sp^2 carbons)

(C) presence of electron withdrawing group, increases the acidity of compound



(more acidic)

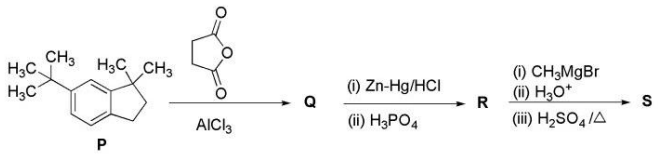
(D) The given order is wrong.

Correct order : IV > V > I > II > III

ans: options A, B, C are correct statements.

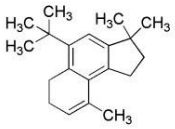
9

Q.9 In the reaction scheme shown below, **Q**, **R**, and **S** are the major products.

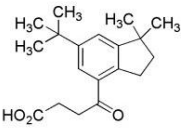


The correct structure of

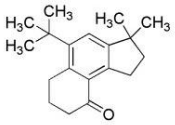
(A) **S** is



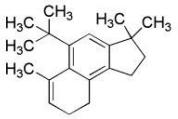
(B) **Q** is

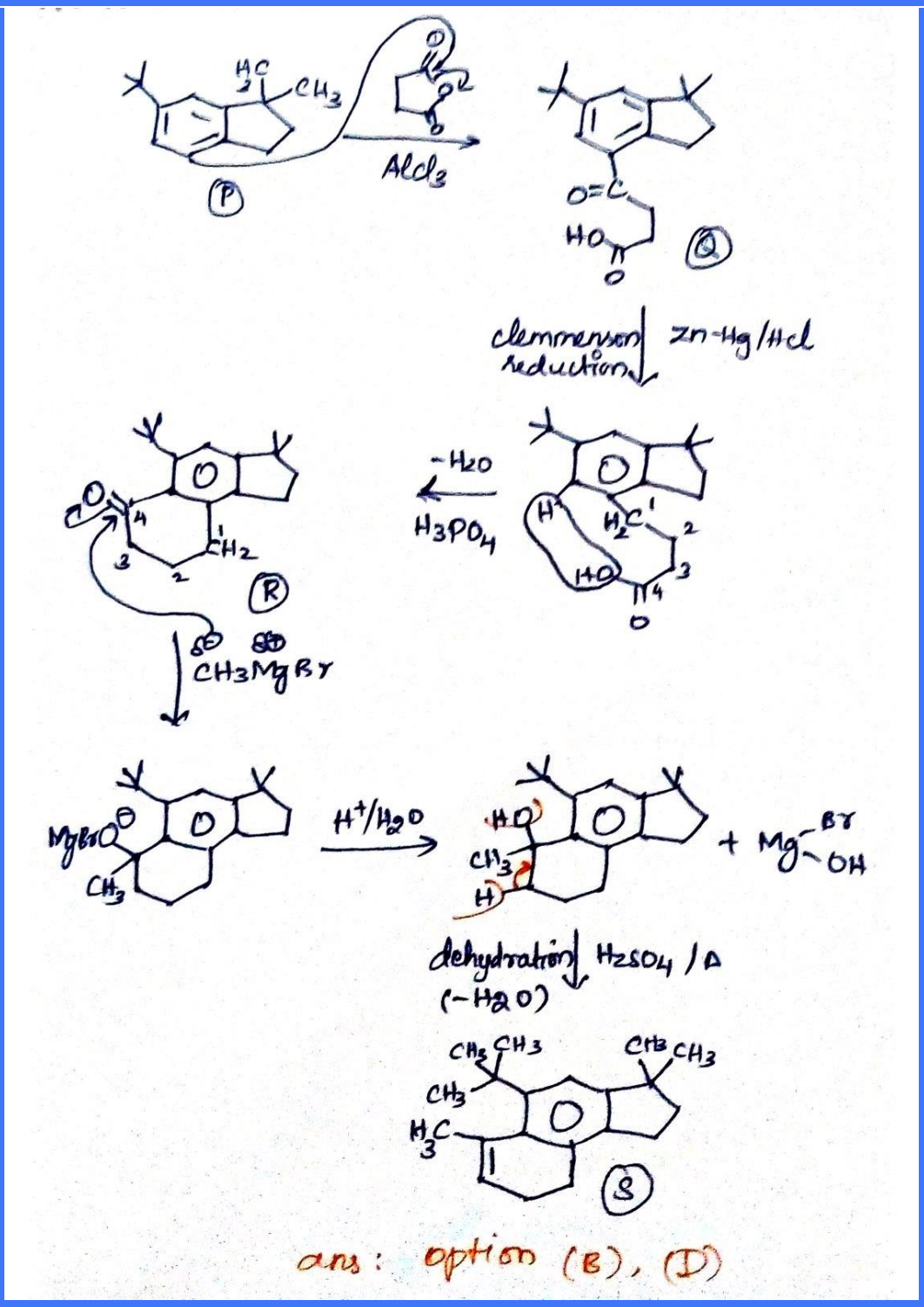


(C) **R** is



(D) **S** is





ans: option (B), (D)

10

Q.10 Choose the correct statement(s) among the following:

(A) $[FeCl_4]^-$ has tetrahedral geometry.

(B) $[Co(en)(NH_3)_2Cl_2]^+$ has 2 geometrical isomers.

(C) $[FeCl_4]^-$ has higher spin-only magnetic moment than $[Co(en)(NH_3)_2Cl_2]^+$.

(D) The cobalt ion in $[Co(en)(NH_3)_2Cl_2]^+$ has sp^3d^2 hybridization.

$[Fe\,Cl_4]^-$ $\quad x = -1 + 4 = 3$

$Fe = 3d_6 4s^2$

$Fe^{3+} = 3d^5 4s^0$

$[Fe\,Cl_4]^-$ = 

Cl^- ligands

Cl - weak ligand

hybridisation = sp^3

shape - tetrahedral

$\mu_{spin\ only} = \sqrt{n(n+2)}$

$[Fe\,Cl_4]^- \Rightarrow n = 5$ (unpaired $e^\ominus$)

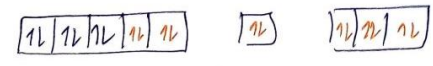
$[Co\,en\,(NH_3)_2\,Cl_2]^+$

$x + 0 + 0 - 2 = 1$

$x = 3$

$Co = 3d^7 4s^2$

$Co^{3+} - 3d^6$

$[Co\,en\,(NH_3)_2\,Cl_2]^+$ = 

en - bidentate

hybridization - d^2sp^3 (octahedral)

$n = 0$ (D is incorrect)

$[Fe\,Cl_4]^-$ has high magnetic moment than Co complex

$(n=5)$ $\quad (n=0)$

$[Co(en)(NH_3)_2\,Cl_2]^+$ has 3 geometrical isomers. B is incorrect

Ans: option A and C.

11

Q.11 With respect to hypochlorite, chlorate and perchlorate ions, choose the correct statement(s).

(A) The hypochlorite ion is the strongest conjugate base.

(B) The molecular shape of only chlorate ion is influenced by the lone pair of electrons of Cl.

(C) The hypochlorite and chlorate ions disproportionate to give rise to identical set of ions.

(D) The hypochlorite ion oxidizes the sulfite ion.

Hypochlorite ion = $ClO^{\ominus}$

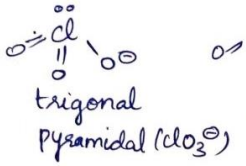
chlorate ion = $ClO_3^{\ominus}$

Perchlorate ion = $ClO_4^{\ominus}$.

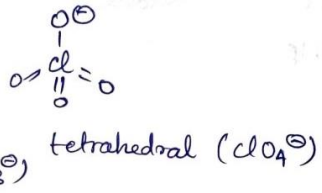
(A) conjugate base order: $ClO^{\ominus} > ClO_3^{\ominus} > ClO_4^{\ominus}$

hypochlorite ion (strongest base)

(B) $Cl-O^{\ominus}$ linear ($ClO^{\ominus}$)



trigonal pyramidal ($ClO_3^{\ominus}$)



tetrahedral ($ClO_4^{\ominus}$)

There is no lone pair effect on perchlorate or hypochlorite ion. The bond angle in chlorate ion ($ClO_3^{\ominus}$) changes due to the presence of lone pair on chlorine.

(C) $3ClO^{\ominus} \rightarrow 2Cl^{\ominus} + ClO_3^{\ominus}$

(hypochlorite)

$4ClO_3^{\ominus} \rightarrow 3ClO_4^{\ominus} + Cl^{\ominus}$.

(chlorate)

They don't give identical set of ions.

(D) $ClO^{\ominus} + \overset{+4}{S}O_3^{2-} \longrightarrow \overset{+6}{S}O_4^{2-} + Cl^{\ominus}$

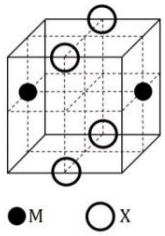
(hypochlorite) (sulphate)

sulphur is oxidized from +4 to +6 by $ClO^{\ominus}$ ion.

ans: option A, B, D

12

Q.12 The cubic unit cell structure of a compound containing cation M and anion X is shown below. When compared to the anion, the cation has smaller ionic radius. Choose the correct statement(s).



(A) The empirical formula of the compound is MX.

(B) The cation M and anion X have different coordination geometries.

(C) The ratio of M-X bond length to the cubic unit cell edge length is 0.866.

(D) The ratio of the ionic radii of cation M to anion X is 0.414.

cation M is present in the face centres and anion X is present at the edge centres.
(In figure given, only 2 cations and 4 anions are present)

At face centre, $2 \times \frac{1}{2} = 1$

At edge centre $= 4 \times \frac{1}{4} = 1$

Empirical formula = MX.

(B) coordination numbers of both cation M and anion X at face and edge centres are 8. (same)

(C) bond length of M-X bond $= AB = \frac{\sqrt{3}a}{2}$

$$\frac{AB}{a} = \frac{\sqrt{3}}{2} = 0.866$$

where a = cubic unit cell edge.

(D) $r_M : r_X = (\sqrt{3}-1) : 1 = 0.732 : 1.0$ (for co-ordination no = 8).

ans: statements A and C are correct.

13

Q.13 5.00 mL of 0.10 M oxalic acid solution taken in a conical flask is titrated against NaOH from a burette using phenolphthalein indicator. The volume of NaOH required for the appearance of permanent faint pink color is tabulated below for five experiments. What is the concentration, in molarity, of the NaOH solution?

Exp. No.	Vol. of NaOH (mL)
1	12.5
2	10.5
3	9.0
4	9.0
5	9.0

formula:

No. of moles = $\frac{\text{weight}}{\text{Mol. wt}}$.

Molarity = $\frac{\text{No. of moles}}{\text{Volume}}$.

n-factor of oxalic acid ($H_2C_2O_4$) = 2

n-factor of NaOH = 1

No. of equivalents of oxalic acid = No. of eq of NaOH.

no. of moles × n factor = no. of moles × n-factor

Molarity × volume × n-factor = Molarity × Volume × n-factor

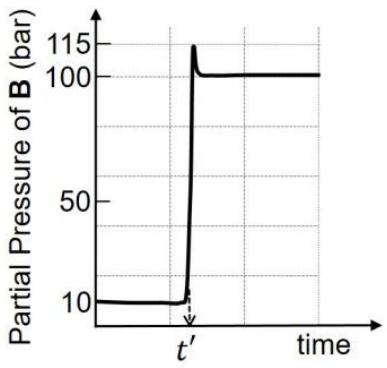
$5 \times 0.1 \times 2 = M \times 9 \times 1$

$M = \frac{1}{9} = 0.11M$

Ans: 0.11M

14

Q.14 Consider the reaction **A** ⇌ **B** at 1000 K. At time t', the temperature of the system was increased to 2000 K and the system was allowed to reach equilibrium. Throughout this experiment the partial pressure of **A** was maintained at 1 bar. Given below is the plot of the partial pressure of **B** with time. What is the ratio of the standard Gibbs energy of the reaction at 1000 K to that at 2000 K?



$$A \rightleftharpoons B$$

given:

$t_1 = 1000K$; $t_2 = 2000K$

$P_A = 1bar$ (throughout)

$P_B = 10$ bar at 1000K

$P_B = 100bar$ at 2000K.

Soln:

$$K_{eq} = \frac{[B]}{[A]}$$

$$K_{1000} = \frac{10}{1} = 10$$

$$K_{2000} = \frac{100}{1} = 100$$

$$\Delta G^\circ = -RT \ln K_{eq}.$$

$$\frac{\Delta G^\circ_{1000}}{\Delta G^\circ_{2000}} = \frac{(-RT \ln K_{eq})_{1000}}{(-RT \ln K_{eq})_{2000}}$$

$$= \frac{1000 \times \ln 10}{2000 \times \ln 100}$$

$$= \frac{2302.58}{9210.34} = 0.2499$$

$$= 0.25$$

Ans = 0.25

15

Q.15 Consider a 70% efficient hydrogen-oxygen fuel cell working under standard conditions at 1 bar and 298 K. Its cell reaction is

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l).$$

The work derived from the cell on the consumption of 1.0×10^{-3} mol of $H_2(g)$ is used to compress 1.00 mol of a monoatomic ideal gas in a thermally insulated container. What is the change in the temperature (in K) of the ideal gas?

The standard reduction potentials for the two half-cells are given below.

$$O_2(g) + 4H^+(aq) + 4e^- \rightarrow 2\,H_2O(l), \quad E^0 = 1.23\ V,$$

$$2H^+(aq) + 2e^- \rightarrow H_2(g), \quad E^0 = 0.00\ V.$$

Use $F = 96500\ C\ mol^{-1}, R = 8.314\ J\ mol^{-1}\ K^{-1}$.

Given:

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O \quad E^\circ = 1.23V$

$2H^+ + 2e^- \rightarrow H_2 \quad E^\circ = 0.00V$

$F = 96500\ C$

$R = 8.314\ J mol^{-1} K^{-1}$

Efficiency = 70%

insulated container $\Rightarrow q = 0$

$E^\circ_{cell} = 1.23 - 0.00 = 1.23V$

$\Delta G^\circ_{cell} = -nFE^\circ_{cell}$

$= -2 \times 96500 \times 1.23$

$= -237390\ J$

Work derived from the fuel cell $= \frac{70}{100} \times -\Delta G^\circ_{cell} \times 10^{-3}$

$= 166.173\ J.$

we know, $w = \Delta U$ [when $q = 0$]

$\Delta U = nC_V \Delta T \quad \left[C_V = \frac{3R}{2}\right]$

$w = nC_V \Delta T$ $n = 1$ (monoatomic gas)

$166.173 = 1 \times \frac{3}{2} \times 8.314 \times \Delta T$

$\Delta T = \frac{166.173 \times 2}{3 \times 8.314} = 13.325$

$\Delta T = 13.33.$

ans = 13.33

16

Q.16 Aluminium reacts with sulfuric acid to form aluminium sulfate and hydrogen. What is the volume of hydrogen gas in liters (L) produced at 300 K and 1.0 atm pressure, when 5.4 g of aluminium and 50.0 mL of 5.0 M sulfuric acid are combined for the reaction?
(Use molar mass of aluminium as 27.0 g mol^{-1}, $R = 0.082$ atm L mol^{-1} K^{-1})

$2Al + 3H_2SO_4 \longrightarrow Al_2(SO_4)_3 + 3H_2$.

To find: volume of H_2 produced.

no. of moles of Al taken $= \frac{wt}{Mol.wt} = \frac{5.4g}{27} = 0.2$.

No. of moles of H_2SO_4 taken $= \frac{50 \times 5.0}{1000} = 0.25$

(no. of moles = Molarity × volume)

$\frac{0.2}{2}$ moles of Al > $\frac{0.25}{3}$ moles of H_2SO_4

$\Rightarrow$ H_2SO_4 is the limiting reagent.

3 moles of H_2SO_4 = 3 moles of H_2.

0.25 moles of H_2SO_4 = x moles of H_2

$x = \frac{3 \times 0.25}{3} = 0.25$ moles of H_2 is produced.

Volume of H_2 formed $= \frac{nRT}{P}$ $(PV = nRT)$

Given:
[T = 300K
R = 0.082 atm L mol^{-1} K^{-1}]

$V = \frac{0.25 \times 0.082 \times 300}{1}$

$= 6.15$ L

Ans: 6.15 L

17

Q.17 $^{238}_{92}U$ is known to undergo radioactive decay to form $^{206}_{82}Pb$ by emitting alpha and beta particles. A rock initially contained 68×10^{-6} g of $^{238}_{92}U$. If the number of alpha particles that it would emit during its radioactive decay of $^{238}_{92}U$ to $^{206}_{82}Pb$ in three half-lives is $Z \times 10^{18}$, then what is the value of Z?

$$^{238}U_{92} \longrightarrow {}^{206}Pb_{82} + 8\,{}^{4}\alpha_{2} + 6\beta^{\circ}\text{ particle}$$

In radioactive decay from U^{238} to Pb^{206}, 8 α-particles (He) and 6 β particles are emitted out

Let initial no. of moles of U^{238}_{92} be $a = \frac{68\times10^{-6}\text{ g (wt)}}{238\text{ (Mol. wt)}}$

Moles of U^{238}_{92} decayed in $3\,t_{1/2} = \frac{\text{Initial moles}}{(2)^n}$

where n = no. of half-life period

$$= \frac{a}{(2)^3} = \frac{a}{8} \quad -(1)$$

	U_{92}^{238}	$\longrightarrow$	Pb_{82}^{206}	+ 8 α	+ 6 β
$t=0$	a		0	0	0
$t=3t_{1/2}$	$a-x$		x	$8x$	$6x$

$\Rightarrow (a-x) = \frac{a}{8}$

moles of U^{238} decayed in $3t_{1/2}$

$$x = a - \frac{a}{8} = \frac{7a}{8}$$

No. of α-particle emitted = $(8x) \times N_A$ (Avagadro No.)

$$= 8 \times \frac{7a}{8} \times 6.022 \times 10^{23}$$

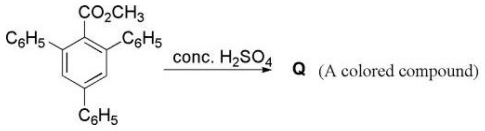
$$= \frac{7 \times 68 \times 10^{-6} \times 6.022 \times 10^{23}}{238}$$

$$= 1.2044 \times 10^{18}$$

$\Rightarrow x = 1.2044$ (Ans)

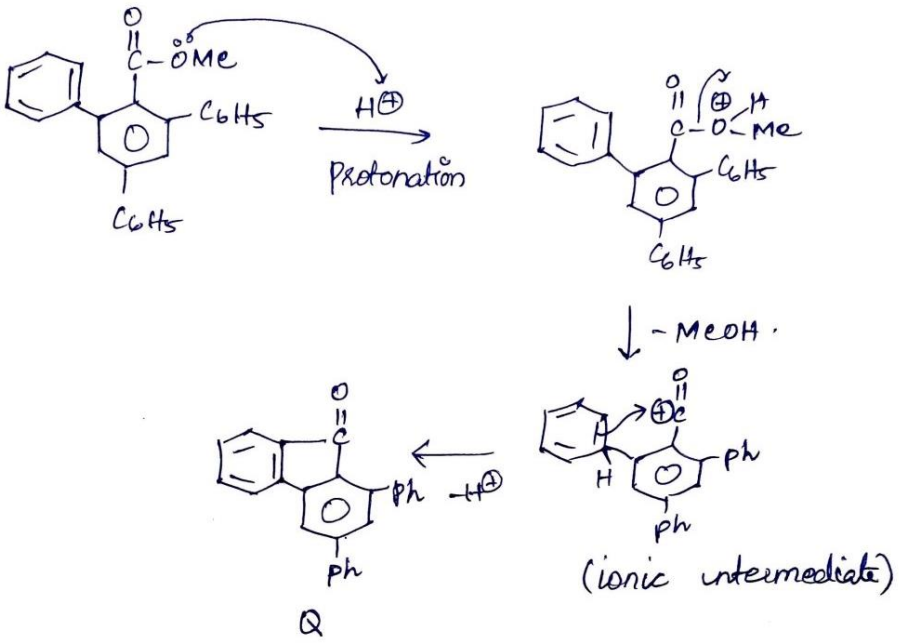
18

Q.18 In the following reaction, compound **Q** is obtained from compound **P** via an ionic intermediate.



P

What is the degree of unsaturation of **Q**?



degree of Unsaturation $= C - \frac{H}{2} - \frac{X}{2} + \frac{N}{2} + 1$

X = halogen

$= 25 - \frac{16}{2} + 1$

$= 26 - 8 = 18$.

Ans = 18

Enrolling yourself for coaching classes has long been considered the first step towards cracking JEE. However, this trend is starting to slip. Recent studies show that, for the students who cleared the JEE Main/Advance, the number of students who had joined a coaching class is lower than the number of students who managed the feat with self-study.

Preparation for JEE Main/Advance requires a lot of hard work and determination. Be ready to even go through many sleepless nights, missed birthdays and extracurriculars to finish the vast JEE syllabus. But simply completing the syllabus is not enough! If you want to have an edge over your counterparts you need to step up your game. This means practicing a variety of problems and revising diligently while following a meticulous study plan that recognizes your strengths and takes care of all your weaknesses. To get your doubts solved or questions checked there is no better place than Kunduz.

Click to download Kunduz app for free

Ask first five questions for free



