NATIONAL STANDARD EXAMINATION IN CHEMISTRY (NSEC) 2017-18

Date of Examination : 26TH November, 2017

Q. Paper Code : C-321 (Time 120 m.) Marks-240

A-1
ONLY ONE OUT OF FOUR OPTIONS IS CORRECT

1. At constant T and P, 5.0 L of SO_2 are reacted with 3.0 L of O_2 according to the following equation

$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

The volume of the reaction mixture at the completion of the reaction is

(A) 0.5 L (B) 8.0 L (C) 5.5 L (D) 5L

Ans. **(C)**

Sol. $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

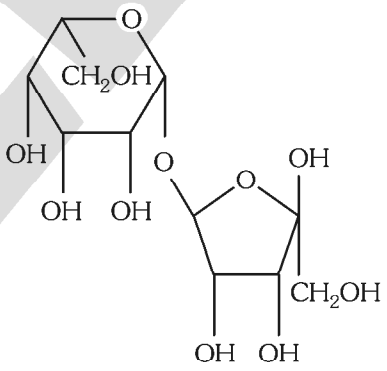
5L 3.0 L

0 3 – 2.5 5 L

= 0.5 L

Final volume = 5 + 0.5 = 5.5 L

2. The following disaccharide is made up of



(A) D-aldose and D-ketose

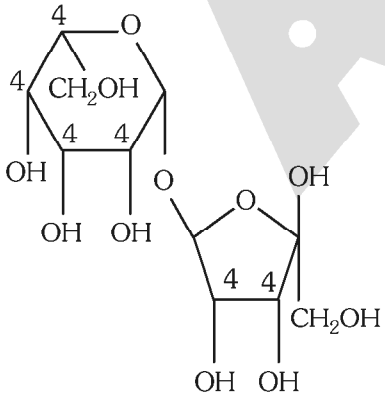
(B) L-aldose and L-ketose

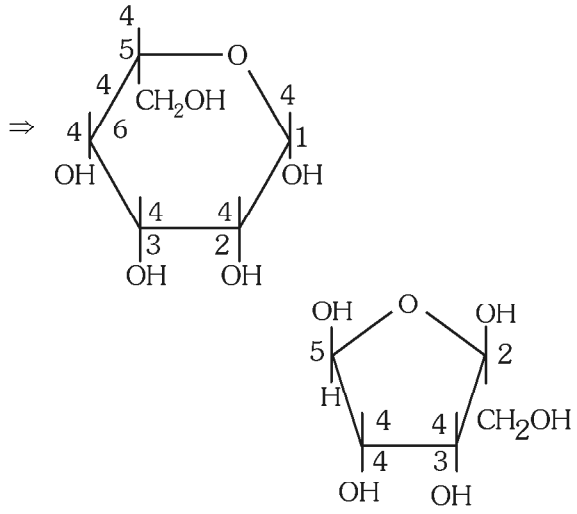
(C) D-aldose and L-ketose

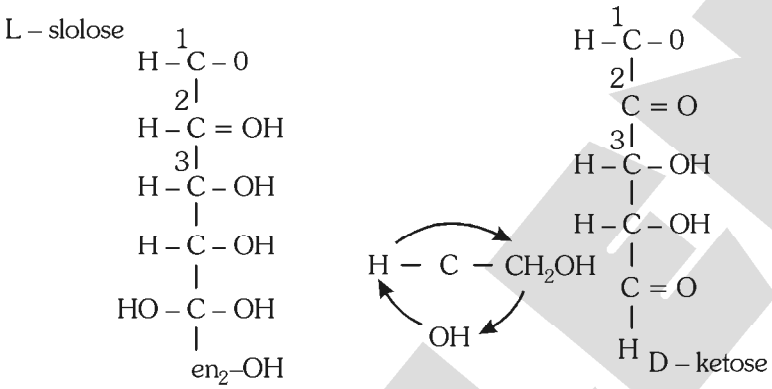
(D) L-aldose and D-ketose

Ans. **(D)**

Sol.







3. One mole of 4-nitrocatechol (4-nitro-1, 2-dihydroxybenzene) on treatment with an excess of NaH followed by one mole of methyl iodide gives –

(A) 4-nitro-1, 2-dimethoxybenzene

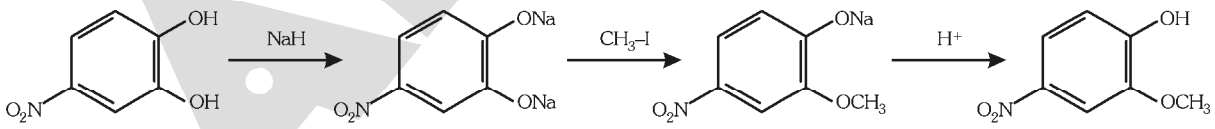
(B) 4-nitro-5-methyl-1, 2-dimethoxybenzene

(C) 2-methoxy-5-nitrophenol

(D) 2-methoxy-4-nitrophenol

Ans. **(D)**

Sol.



4. The colour changes of an indicator HIn in acid base titrations is given below

$$\underset{\text{Colour X}}{HIn(eq)} \rightleftharpoons \underset{\text{Colour Y}}{H^+(aq) + In^-(aq)}$$

Which of the following statements is correct?

(A) In a strong alkaline solution colour Y will be observed

(B) In a strongly acidic solution colour Y will be observed

(C) Concentration of In^- is higher than that of HIn at the equivalence point

(D) In a strong alkaline solution colour X is observed

Ans. **(A)**

Sol. Theory based.

5. The table below gives the results of three titrations carried out with 0.200 M HCl to determine the molarity of a given NaOH solution using phenolphthalein as indicator. NaOH was taken in the burette and HCl was taken in a conical flask for the titrations.

Titration No	$V_{HCl\ (in\ L)}$	$V_{NaOH\ (mL)}$	$M_{NaOH\ moldm^{-3}}$
I	2t.4	19.3	0.222
1l	18.6	16.8	0.221
III	22.2	2t.1	0.210

The actual molarity of the prepared NaOH solution was 0.220 $moldm^{-3}$.

Which among the following could be the reason for the wrong value obtained in titration III?

(A) Number of drops of phenolphthalein added to the titration flask was more in this titration

(B) The concentration of HCl was wrongly used as 0.250 M for the calculation of M_{NaOH}

(C) A few drops of NaOH solution were spilled outside the titration flask during titration

(D) A few drops of the neutralized solution from titration II were left behind in the flask

Ans. **(A)**

Sol. An same NaOH is casumed for phenolphlhalein

6. The solution with pH value close to 1 is

(A)10 mL of 0.1 MHCl + 90 mL of 0.1 M NaOH (B) 55 mL of 0.1 M HCl + 45 mL of 0.1 M NaOH

(C) 75 mL of 0.2 M HCl + 25 mL of 0.2 M NaOH (D) 75 mL of 0.2 M HCl + 25 mL of 0.1 M NaOH

Ans. **(C)**

Sol. $HCl + NaOH \rightarrow NaCl + NaCl + H_2O$

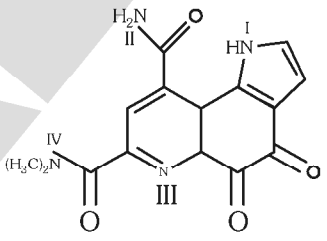
15 m moles 5 m moles

10 m moles

V = 100 ml

$M_{HCl} = 0.1$ PH = 1

7. The most basic nitrogen in the following compound is



(A) I (B) II (C) III (D) IV

Ans. **(C)**

Sol. (III) is most basic.

8. For the reaction $N_2 + 3H_2 \rightarrow 2NH_3$, the rate expression is $-d[NH_3]/dt = k[H_2][N_2]$

The correct statement is

I. The reaction is not elementary

II. The reaction is of second order

III. $-d[H_2]/dt = -d[NH_3]/dt$

(A) II only (B) I and II (C) II and III (D) I, II and III

Ans. **(B)**

Sol. $N_2 + 3H_2 \rightarrow 2NH_3 \; -\frac{d[NH_3]}{dt} = K[H_2][N_1]$

$\rightarrow$ It is not elementry $-\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$

$\rightarrow$ It is second order Rxn.

9. Which of the following is correct?

A liquid with

(A) low vapour pressure will have a low surface tension and high boiling point

(B) high vapour pressure will have high intermolecular forces and high boiling point

(C) low vapour pressure will have high surface tension and high boiling point

(D) low vapour pressure will have low surface tension and low boiling point

Ans. **(C)**

Sol. Theory based.

10. At 25° C, nitrogen exists as N_2 and phosphorous exists as P_4 because

(A) N_2 has valence electrons only in bonding and nonbonding orbitals, while P has valence electrons in both bonding and antibonding orbitals

(B) higher electronegativity of N favours formation of multiple bonds

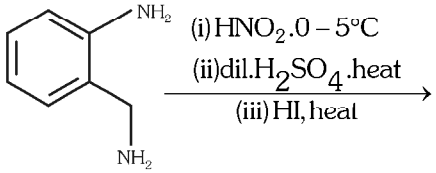
(C) bigger size of P does not favour multiple bonds

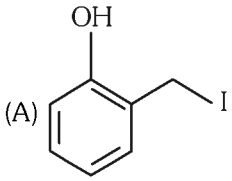
(D) P has preference to adapt structures with small bond angles

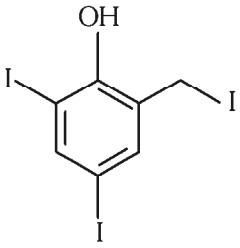
Ans. **(C)**

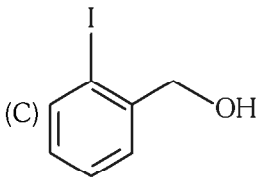
Sol. Theory based.

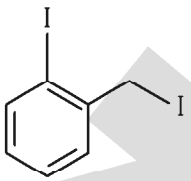
11. The produot of the following reaction is



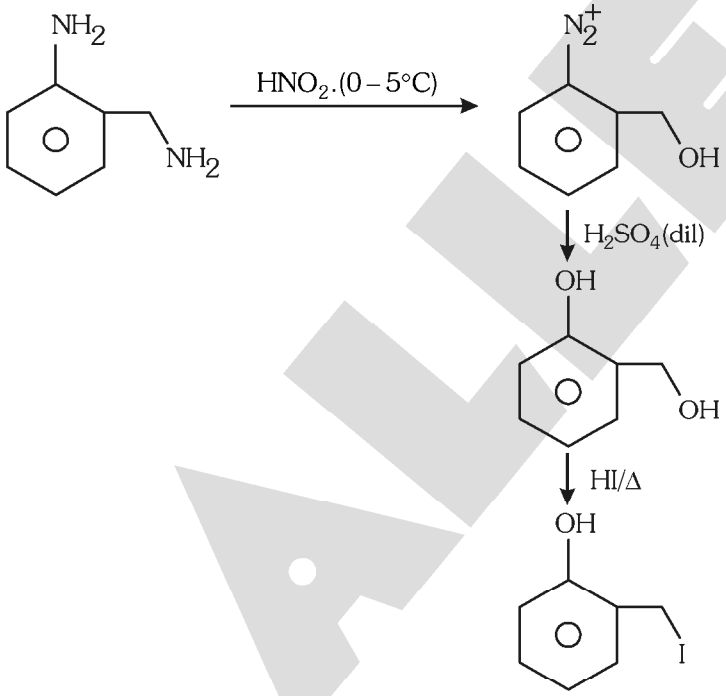
(A) 

(B) 

(C) 

(D) 

Ans. (A)

Sol. 

12. Three samples of 100 g of water (samples I, II and III), initially kept at 1 atm pressure and 298 K were given the following treatments.

Sample I was heated to 320 K and cooled to 298 K

Sample II was heated to 300 K, cooled to 273K and heated to 298 K

Sample III was heated to 373 K and cooled to 298 K

At the end of these processes, the internal energy of

(A) III is the highest

(B) II is the highest

(C) I and III are the same; II is lower than that of I and III

(D) I, II and III are the same

Ans. **(D)**

Sol. Internal energy will be same.

13. For the reaction

$5Br^-(aq) + BrO_3^-(aq) + 6H^+(aq) \rightarrow 3Br_3(aq) + 3H_2O(l)$

the rate expression was found to be $-d[BrO_3]/dt = k[Br^-]^2[BrO_3]$

Which of the following statement/s is /are correct?

I. Doubling the initial concentration of all the reactants will increase the reaction rate by a factor of 8

II. Unit of rate constant of the reaction in a buffer solution is min^{-1}

III. Doubling the concentration of all the reactanrs ar the same time will increase the reaction rate by a factor of 16

IV. rate of conversion of BrO_3^- and rate of formation of Br^- are the same

(A) I and II (B) II and III (C) II and IV (D) III only

Ans. **(D)**

Sol. $r = k[Br^-][H^+]^2\left[BrO_3^-\right]$

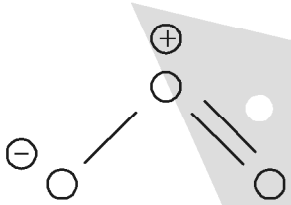
Doubling the concentration of all the reactanrs ar the same time will increase the reaction rate by a factor of 16

14. In the Lewis structure of ozone (O_3), the formal charge on the central oxygen atom is

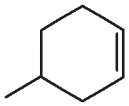
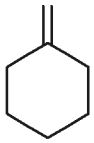
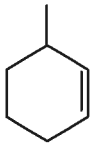
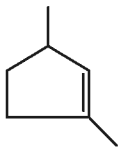
(A) +1 (B) –1 (C) 0 (D) –2

Ans. **(A)**

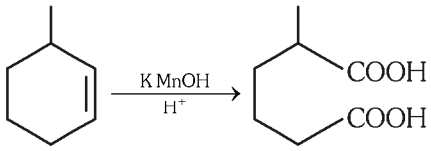
Sol.



15. Which of the following on treatment with hot concentrated acidified $KMnO_4$ will give 2-methylhexane-1, 6-dioic acid as the only organic product?

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

Ans. (C)

Sol. 

16. For the following spontaneous process

$H_2O_{(i)} \rightarrow H_2O_{(s)}$ at 268 K, which of the following is true?

(A) $\Delta S_{sys} < 0$ (B) $\Delta S_{sys} > 0$ (C) $\Delta S_{surr} < 0$ (D) $\Delta S_{sys} = -\Delta S_{surr}$

Ans. (A)

Sol. Liquid to solid entropy of system will decrease.

17. Lithium oxide (Li_2O ; molar mass = 30 g mol^{-1}) is used in space shuttles to remove water vapour according to the following reaction

$Li_2O_{(s)} + H_2O(g) \rightarrow 2LiOH_{(s)}$

If 60 kg of water and 45 kg of Li_2O are present in a shuttle

I. water will be removed completely

II. Li_2O will be the limiting reagent

III. 100 kg of Li_2O will be required to completely remove the water present

IV. 27 kg of water will remain in the shuttle at the end of the reaction

(A) II only (B) II and IV (C) III and IV (D) II, III

Ans. (D)

Sol. $Li_2O_{(s)} + H_2O(g) \rightarrow 2LiOH_{(s)}$

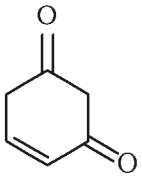
45 kg 60 kg

$\frac{45}{30} = 1.5k\,mol$ $\frac{10}{3} = 3.33k\,mol$

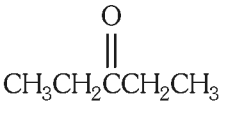
$\frac{10}{3} \times 30 = 100kg$ $\frac{5.5}{3} \times 18 = 33kg$

$1.5 \times 18 = 27$ kg

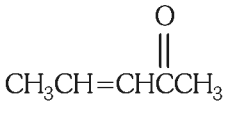
18. The order of enol content in the following molecules is -



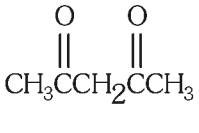
(a)



(b)



(c)



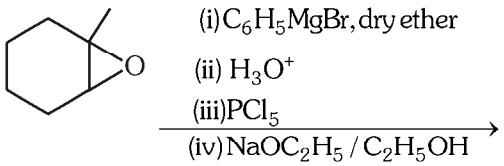
(d)

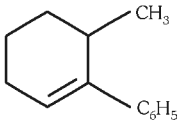
(A) a > d > c > b (B) a > c > d > b (c) a > c > b > d (D) a > b > c > d

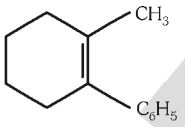
Ans. (A)

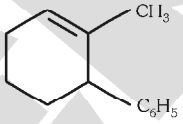
Sol. Enol content $\propto$ stability of enol

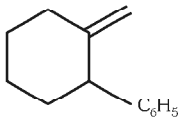
19. The product of the following reaction is



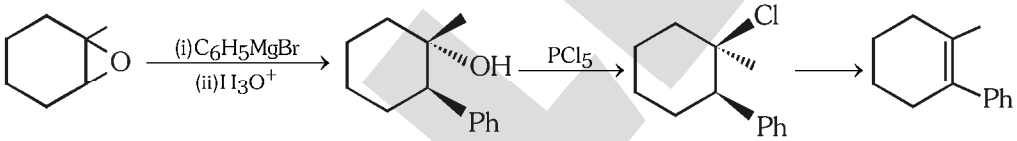
(A) 

(B) 

(C) 

(D) 

Ans. (B)

Sol. 

20. At constant volume, 6.0 mol of H_2 gas at 0° C and 100 kPa was heated to 250 kPa. The molar heat of H_2 at constant pressure (C_p) = 28.9 J mol^{-1}. (assume that the heat capacity values do not change with temperature). The final temperature of the H_2 gas and the change in entropy of the process are

(A) 273°C and 113 kJ mol^{-1} K^{-1} (B) 410° C and 158.8 J mol^{-1} K^{-1}

(C) 682.5° C and 113 J mol^{-1} K^{-1} (D) 682.5 K and 113 J mol^{-1} K^{-1}

Ans. (D)

Sol. $\frac{T_1}{T_2} = \frac{P_2}{P_2}$ (at constant mole of volume)

$\frac{273}{T_2} = \frac{100}{250}$

$T_2 = 273 \times 2.5$ K

$= 682.87$ K

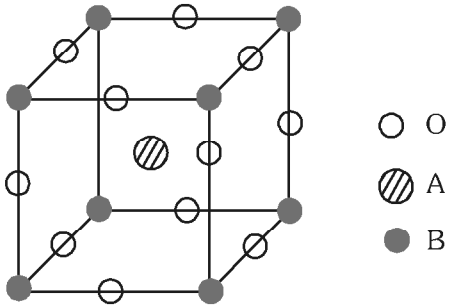
$\Delta S = nlp \ln \frac{T_2}{T_1} + nR \ln \frac{P_1}{P_2}$

$= 6 \times 28.9 \ln 2.5 + 6 \times 8.314 \ln \frac{1}{2.5}$

$= (6 \times 28.9 - 6 \times 8.314) \times 0.9$

$= 112.4$ J K^{-1} mol^{-1}.

21. The cubic unit cell of an oxide of metals A and B is as given below, in which oxygen. A and B are represented by open circles, crossed circles and dark circles respectively.



The formula of the oxide can be deduced as

(A) AB_8O_{12} (B) ABO (C) ABO_6 (D) ABO_3

Ans. (D)

Sol. $Z_B = 8 \times \frac{1}{8} = 1$

$Z_A = 1 \times 1 = 1$

$Z_O = 12 \times \frac{1}{4} = 3$

So formula is ABO_3.

22. When a metal is electroplated with silver (Ag)

(A) the metal is the anode

(B) Ag metal is the cathode

(C) the solution contains Ag^+ ions

(D) the reaction at the anode is $Ag^+ + e^- \rightarrow Ag$

Ans. (C)

Sol. The metal should be the cathode and solution should contain Ag^+ ion.

23. The energy of an electron in Bohr's orbit of hydrogen atom is –13.6 eV. The total electronic energy of a 'hypothetical' He atom in which there are no electron-electron repulsions is

(A) 27.2 eV (B) –27.2 eV (C) –108.8 eV (D) 108.8 eV

Ans. (C)

Sol. If should be –108.8 eV for the two electron system.

24. Iodine is a solid and sublimes at ordinary temperatures. This is because of

(A) weak I-I bonds

(B) strong I-I bonds

(C) lone pair-bond pair repulsions

(D) weak van der Waals forces between I_2 molecules

Ans. (D)

Sol. There will be a minimum vander waal's forces between I_2 molecules.

25. The equilibrium constants of the following isomerisation reaction at 400 K and 298 K are 2.07 and 3.42 respectively. cis-butene $\underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}}$ trans-butene

Which of the following is/are correct ?

I. The reaction is exothermic

II. The reaction is endothermic

III. At 400 K 50% of cis-butene and 50% of trans-butene are present at equilibrium

IV. Both at 298 K and 400 K, $k_1 = k_{-1}$

(A) I and IV (B) II and IV (C) I and III (D) I only

Ans. (D)

Sol. As value of equilibrium constant increases with decrease in temp. so the reaction must be exothermic.

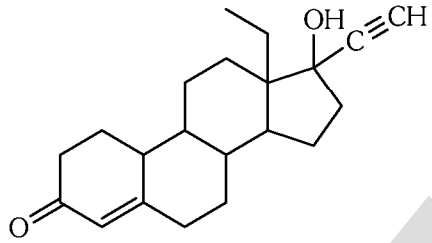
26. Which of the following will not give a straight line plot for an ideal gas ?

(A) V vs T (B) T vs P (C) V vs 1/P (D) V vs 1/T

Ans. (D)

Sol. Theory Based

27. Levonorgestrel is a commonly used contraceptive. The number of chiral centers present in this molecule is

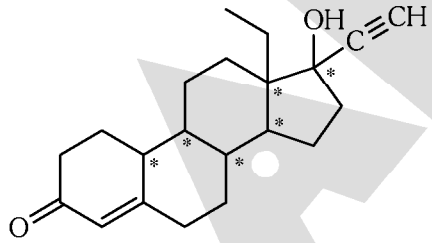


Levonorgestrel

(A) 4 (B) 5 (C) 6 (D) 7

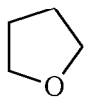
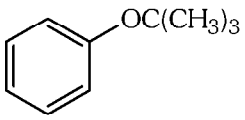
Ans. (C)

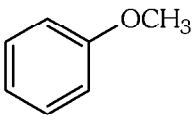
Sol.

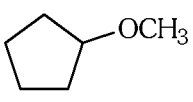


Levonorgestrel

28. Which of the following ethers cannot be prepared by Williamson Synthesis ?

(A)  (B) 

(C) 

(D) 

Ans. (B)

Sol. Ph—X & $(CH_3)_3C$ – X can not give nucleophilic substitution reaction.

29. IUPAC name of the complex ion $[CrCl_2(ox)_2]^{3-}$ is

(A) dichlorodioxalatochromium (III)
(B) dioxalatodichrlorochromate (III)
(C) dichlorodioxalatochromate (III)
(D) bisoxalaeodichlorochromate (III)

Ans. **(C)**

Sol. $[CrCl_2(ox)_2]^{3-}$

dichlorodioxalatochromate(III)

30. Sodium azide (NaN_3) is used in the airbag of cars. This is a safety device which inflates on an impact according to the reaction

$$2NaN_3 \rightarrow 2Na + 3N_2$$

An air bag of a particular car can be filled with 44.8 L of gas at STP. The mass (g) of NaN_3 required to fill this airbag completely at 298 K and 1 atm. pressure is

(A) 87 (B) 130 (C) 84 (D) 100

Ans. **(A)**

Sol. $2NaN_3 \rightarrow 2Na + 3N_2$

To produce 2 moles of N_2 we need $\frac{4}{3}$ moles of NaN_3.

So mass of NaN_3 required $= \frac{4}{3}(23 + 14 \times 3) = 86.66$ g

31. Which of the following mixtures of water and H_2SO_4 would have mass percentage of H_2SO_4 close to 30 ?

(A) 30 g H_2SO_4 + 100 g H_2O
(B) 1 mol of H_2SO_4 + 2 mol of H_2O
(C) 1 mol of H_2SO_4 + 200 g of H_2O
(D) 0.30 mol H_2SO_4 + 0.70 mol H_2O

Ans. **(C)**

Sol. mol % of $H_2SO_4 = \frac{98}{98+200} \times 100 = 32.88\%$

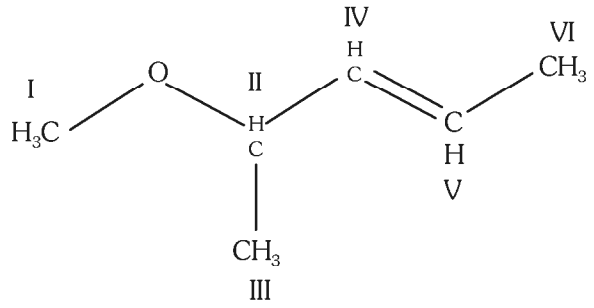
32. In chlorides, the common oxidation states of aluminium and thallium are +3 and +1 respectively because

(A) Tl-Cl bond is ionic and Al-Cl bond is covalent
(B) 6s electrons of Tl are bound more strongly than the 3s electrons of Al
(C) Tl-Cl bond is stronger than Al-Cl bond
(D) 3s electrons of Al are bound strongly than the 6s electrons of Tl

Ans. **(B)**

Sol. Due to insert pair effect.

33. In the given compound the order of ease with which hydrogen atom can be abstracted from carbons I to VI is



(A) II > VI > IV = V > I > III (B) II > I > VI > III > IV = V

(C) II > I > III > VI > IV = V (D) VI > II > I > III > IV = V

Ans. (B)

Sol. Use the table given below to answer questions 34 to 35

Reaction	**E_0/V**
$Ag \rightarrow Ag^+ + e^-$	– 0.80
$Cr^{3+} + 3e^- \rightarrow 3Cr$	– 0.74
$Zn^{2+} + 2e^- \rightarrow Zn$	– 0.76
$I_2(s) + 2e^- \rightarrow 2\ I^-$	0.54
$Co^{2+} + 2e^- \rightarrow Co$	– 0.28
$Ni^{2+} + 2e^- \rightarrow Ni$	– 0.26

34. The best reducing agent among the following is

(A) Ag^+ (B) Zn^{2+} (C) Cr^{3+} (D) I^-

Ans. (D)

Sol. I^- in SRA

35. E^0 of the given cell is

$Ni\ |(Ni^{+2}, 1.0\ M)||(Co^{+2}, 1.0\ M)|CO$

(A) + 0.02 V (B) – 0.02 V (C) – 0.54 V (D) + 0.54 V

Ans. (B)

Sol. $E^0_{cell} = E^0_{Right} - E^0_{left}$

$= -0.28 - (-0.26)$

$= 0.26 - 0.28$

$= -0.02$ V

36. Which of the following is <u>not</u> a pair of a Lewis acid and a Lewis base ?

(A) H^+, $(C_2H_5)_2O$ (B) H_2O, $AlCl_3$ (C) Fe^{3+}, CO (D) SiF_4, BF_3

Ans. (D)

Sol. SiF_4, & BF_3 both act as lewis acid.

37. The type/s of isomerism that $Co(NH_3)_4Br_2Cl$ can exhibit is/are

(A) geometric and ionisation

(B) ionisation

(C) Optical and ionisation

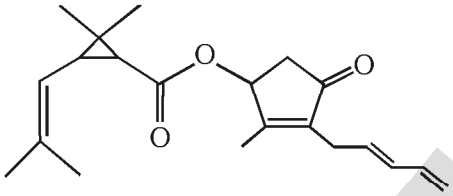
(D) Optical, ionisation and geometric

Ans. **(A)**

Sol. $[CO(NH_3)Br_2]Cl$ & $[CO(NH_3)_4ClBr]Br$ are ionisation isomer.

38. Pyrethrins are produced in chrysanthemum flowers and used as insecticides.

Structure of pyrethrin I is given below.



Pyrethrin I (molar mass = 328.0 g/mol)

The volume of 0.05 mol dm^{-3} bromine water that would react with 500 mg sample of Pyrethrin I is

(A) 12.2 cm^3 (B) 122 dm^3 (C) 122 cm^3 (D) 1.31×10^3 cm^3

Ans. **(C)**

Sol. Mole of compound = $\frac{500\times10^{-3}}{328}$

Mole of compound × 4 = moles of Br_2

$$\frac{500\times10^{-3}}{328}\times4 = 0.05\times V$$

$V = 0.1219\ L = 122\ cm^3$

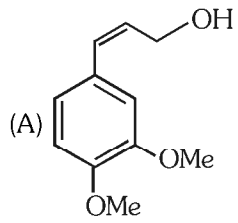
39. Coniferyl alcohol is isolated from pine trees. The following observations were made about this alcohol.

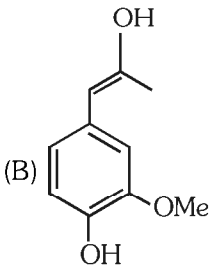
I. It forms methylated product with MeI in presence of a base

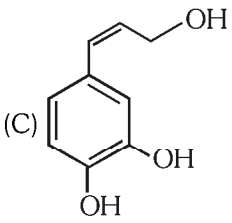
II. One equivalent of coniferyl alcohol reacts with two equivalents of benzoyl chloride

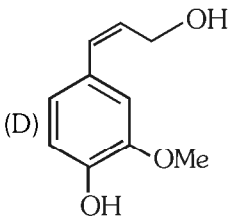
III. Upon ozonolysis, coniferyl alcohol gives a product 'Y' (M.F. $C_2H_4O_2$)

The structure of coniferyl alcohol would be

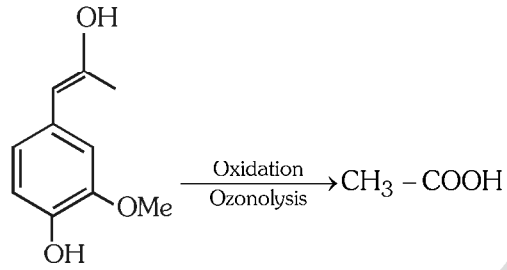
(A) 

(B) 

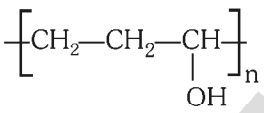
(C) 

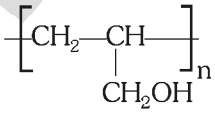
(D) 

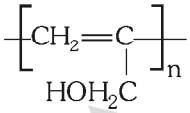
Ans. (B)

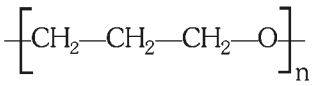
Sol. 

40. Which of the following represents a polymer of prop-2-en-l-ol ?

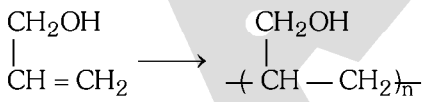
(A) 

(B) 

(C) 

(D) 

Ans. (B)

Sol. 

41. A 500 mL glass flask is filled at 298 K and 1 atm. pressure with three diatomic gases X, Y and Z. The initial volume ratio of the gases before mixing was 5:3:1. The density of the heaviest gas in the mixture is not more than 25 times that of the lightest gas. When the mixture was heated, vigorous reactions take place between X and Y and X and Z in which all the three gases were completely used up.

The gases X, Y, Z respectively are

(A) H_2, O_2, N_2 (B) H_2, O_2, Cl_2 (C) H_2, F_2, O_2 (D) O_2, H_2, F_2

Ans. **(C)**

Sol. $H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$

$H_2 + F_2 \longrightarrow 2HF$

Note : Cl_2 is 35 time heavier that H_2 and F_2 reaets vigorously. Initial ratio 5 : 3 : 1 is consistent with the above equation.

42. The reaction X + Y → Z is first order with respect to X and second order with respect to Y. The initial rate of formation of Z = R mol$^-$ dm^3 sec^{-1} when $[X]_0$ and $[Y]_0$ 0.40 mol dm^{-3} and 0.mol dm^{-3} respectively. If $[X]_0$ is halved and $[Y]_0$ is doubled, the value of the initial rate would become

(A) 4R (B) R/4 (C) R (D) 2R

Ans. **(D)**

Sol. $X + Y \rightarrow Z$

$R = K[X_0]\,[Y_0]^2$

$R' = K\left[\frac{X_0}{2}\right][2Y_0]^2$

$= \frac{K[X_0][Y_0]^2}{2} \times 4 = 2R$

43. Which one of the following statements is not correct about glucose?

(molar mass of glucose = 180 g mol^{-1})

(A) An aqueous 0.25 M solution of glucose is prepared by dissolving 45g of glucose in water to give 1000 cm^3 of solution

(B) 1.00 mmol glucose has mass of 180 mg

(C) 90.0 g glucose contain 1.8×10^{22} atoms of carbon

(D) 100 cm^{-3} of a 0.10 M solution contains 18 g of glucose

Ans. **(C & D)**

44. The van dar Waals equation for one mole of a real gas can be written as $(P + a/V^2)(V - b) = RT$. For the gases H_2, NH_3 and CH_4, the value of 'a' (bar L^{-2} mol^{-2}) are 0.2453, 4.170 and 2.253 respectively.

Which of the following can be inferred from the 'a' values ?

(A) NH_3 can be most easily liquefied

(B) H_2 can be most easily liquified

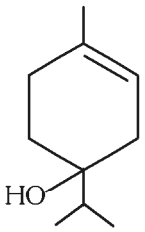
(C) value of 'a' for CH_4 is less than that of NH_3 because it has the lower molar mass

(D) intermolecular force are the strongest in hydrogen

Ans. **(A)**

Sol. Greater the value of a, greater is the case of liquification.

45. Terpinen–4–ol is an active ingredient in tea tree oil has the following structure



The correct observations for terpinen–4–ol is/are

I. It rotates the plane of plane polarized light

II. It reacts with Baeyer's reagent to from a diobromo compound

III. On reaction with NaBr and H_2SO_4, it gives form a diobromo compound

IV. On ozonolysis it gives a compound with molecular formula $C_{10}H_{18}O_3$

(A) I, II, III and IV (B) I, III and IV (C) II and III (D) III and IV

Ans. **(A)**

Sol. It has a chiral carbon.

46. The correct order of the ability of the leaving groups is

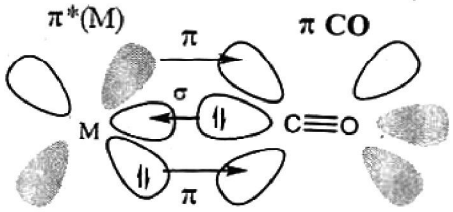
(A) $OCOC_2H_5 > OC_2H_5 > OSO_2Et > OSO_2CF_3$ (B) $OC_2H_5 > OCOC_2H_5 > OSO_2CF_3 > OSO_2Me$

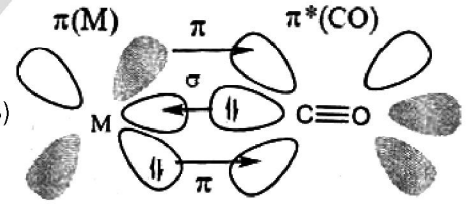
(C) $OSO_2CF_3 > OSO_2Me > OCOC_2H_5 > OC_2H_5$ (D) $OCOC_2H_5 > OSO_2CF_3 > OC_2H_5 > OSO_2Me$

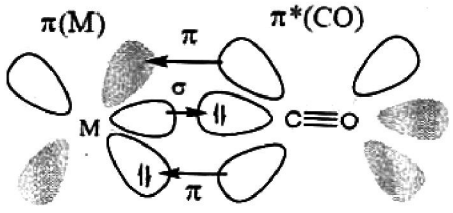
Ans. **(C)**

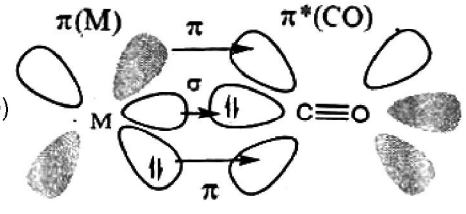
Sol. More stable anion is good leaving group.

47. Metal 'M' forms a carbonyl compound in which it is present in its lower valance state. Which of the following bonding is possible in this metal carbonyl?

(A) 

(B) 

(C) 

(D) 

Ans. **(B)**

Sol. Theory Based

48. Acetic acid (CH_3COOH) is partially dimerised to $(CH_3COOH)_2$ in the vapour phase. At a total pressure of 0.200 atm, acetic acid is 92.0% dimerized at 298 K.

The value of equilibrium constant of dimerisation under these conditions is

(A) 57.5 (B) 9.7 (C) 97 (D) 194

Ans. **(D)**

Sol. $2CH_2COOH = (CH_3COOH)_2$

$p°(1-\alpha)$ $\quad\quad$ $\frac{p°\alpha}{2}$

$$k_p = \frac{\frac{p°\alpha}{2}}{p°^2(1-\alpha)^2} = \frac{\alpha}{2p°(1-\alpha)^2}$$

$$= \frac{0.92}{2\times p°(1-0.92)^2} = \frac{0.92\times 10^3}{2\times 0.37\times 6.4}$$

$$= 194.25$$

$$p°\left(1-\frac{\alpha}{2}\right) = 0.2$$

$$p° = \frac{0.2}{1-\frac{0.92}{2}}$$

$$p° = 0.37$$

49. Silanes are silicon hydrides of general formula Si_nH_{2n+2} and have several applications. From the date given below, the bond dissociation enthalpy of Si-Si bond can be deduced as

ΔH of the reaction $2Si(s)+3H_2 \rightarrow Si_2H_6(g)$ is 80.3 kJ mol^{-1}
Bond dissociation enthalpy for H–H = 436 kJ/mol
Bond dissociation enthalpy for Si–H = 3.4 kJ/mol
$\Delta f_H[Si(g)]$ = 450 kJ/mol

(A) –304 kJ mol^{-1} (B) 384.3 kJ mol^{-1} (C) 304 kJ mol^{-1} (D) –384.3 kJ mol^{-1}

Ans. **(C)**

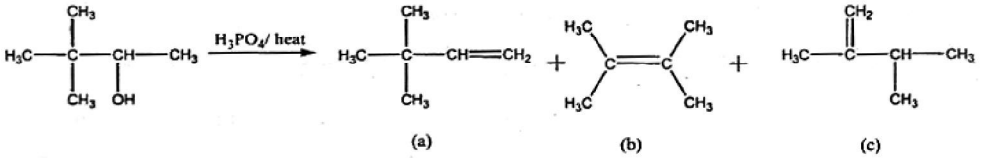
Sol. $2Si(s) + 3H_2(g) \rightarrow Si_2H_6(g)$. $\Delta H = 80.3$ kJ/mol

$80.3 = 2 \times 450 + 3 \times 436 - 6 \times 304 - BE_{Si-Si}$

$BE_{Si-Si} = 900 + 1308 - 1824 - 80.3$

$= 303.7$ kJ/mol

50. In the following reaction, three products a, b, c are obtained.



The approximates experimental yields of the three compounds were 64%, 33% and 3%. Which of the following is the correct with respect to yield and the corresponding product?

(A) (a) –33%, (b) –64%, (c) –3% (B) (a) –3%, (b) –64%, (c) –33%

(C) (a) –3%, (b) –33%, (c) –64% (D) (a) –64%, (b) –3%, (c) –33%

Ans. **(B)**

Sol. % yield $\propto$ stability of Alkene

51. Which of the following represents the correct order of dipole moment?

(A) $NH_3 > NF_3 > H_2O$ (B) $NH_3 > H_2O > NF_3$ (C) $H_2O > NH_3 > NF_3$ (D) $H_2O > NF_3 > NH_3$

Ans. **(C)**

Sol. Order of dipole moment

$H_2O > NH_3 > NF_3$

52. The best reaction sequence for the synthesis of 2-pentanone would be–

(A) $CH_3CH_2CH_2CHO \xrightarrow{CH_3MgI/ether} X \xrightarrow{H^+,H_2O}$

(B) $CH_3CH_2CH_2CN \xrightarrow{CH_3MgI/ether} X \xrightarrow{H^+,H_2O}$

(C) $CH_3CH_2CH_2CHO \xrightarrow{CH_3MgI/ether} X \xrightarrow{H^+,H_2O}$

(D) $CH_3CH_2CH_2MgI + CH_2O \xrightarrow{Ether} X \xrightarrow{H^+,H_2O}$

Ans. **(B)**

Sol.

$CH_3—CH_2—CH_2—C\equiv N$

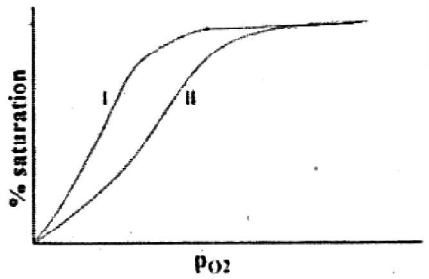
$\downarrow CH_3MgBr$

$CH_3—CH_2—CH_2—C(=NMgBr)(CH_3)$ (X)

$\downarrow H^+/H_2O$

$CH_3—CH_2—CH_2—C(=O)—CH_3$

53. Haemoglobin is a Fe containing protein for oxygen transport in the blood. The curve given below indicate the percentage saturation of haemoglobin by O_2 as a function of partial pressure of O_2



Which of the following statement/s is/are correct for the given curves?

I. In pressure of CO_2, higher po_2 is needed for a given percentage saturation

II. In presence of CO_2, lower po_2 is needed for a given percentage saturation

III. The maximum percentage saturation is not affected by the presence of CO_2

IV. In the absence of CO_2, maximum saturation of haemoglobin occurs at lower p o_2

(A) I and IV (B) II and IV (C) I, III and IV (D) II and III

Ans. **(D)**

Sol. Theory based.

54. An appropriate reagent for the conversion of 1-propanol to 1-propanal is

(A) acidified potassium dichromate (B) alkaline potassium permanganate

(C) pyridinium chlorochromate (D) acidified CrO_3

Ans. **(C)**

Sol. PCC isused for oxidation of primary alcohol to aldehyde.

55. A student performed an experiment to determine the molecular formula of a given sample of hydrated copper (II) sulphate by weighing the sample before and after heating. The formula obtained experimentally was $CuSO_4$ $5.5H_2O$ while the actual formula of the given sample is $CuSO_4.5H_2O$. Which experimental error would account for the wrongly obtained result?

(A) During heating, some of the hydrated copper (II) sulphate was lost

(B) The hydrated sample was not heated long enough to remove all the water present

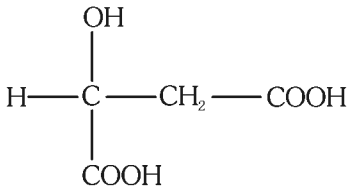
(C) Weight of the hydrated sample recorded was less than the actual weight taken

(D) The balance used in the study showed all weight consistently high by 0.10 g

Ans. **(A)**

Sol. Theory Based

56. Malic acid is a dicarboxylic acid present in apples and it has the following structure



Which of the following synthetic routes will gives (±) malic acid?

(i) $H_2C{=}CH{-}COOH \xrightarrow[\text{(iii) } HCN/H_3O^+]{\text{(i) HBr, (ii) KOH (aq.)}}$

(ii) $H_2C(Br){-}CH_2{-}COOH \xrightarrow[\text{(iii) } HCN/H_3O^+]{\text{(i) KOH (aq.), (ii) PCC}}$

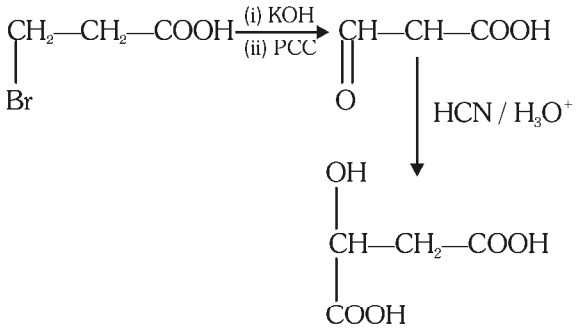
(iii) $H_3C{-}CH_2{-}COOH \xrightarrow[\text{(iii) [O], (iv) } HCN/H_3O^+]{\text{(i) Red } P/I_2\text{, (ii) NaOH (aq.)}}$

(iv) $H_2C{=}CH{-}COOH \xrightarrow[\text{(iii) } HCN/H_3O^+]{\text{(i) } B_2H_6/H_2O_2\text{, (ii) [O]}}$

(A) i and ii (B) ii (C) ii and iii (D) i and iii

Ans. **(B)**

Sol.



57. Which of the following cannot act as an oxidising agent?

(A) S^{2-} (B) Br_2 (C) HSO_4 (D) SO_3^{2-}

Ans. **(A)**

Sol. Oxidation number of Sulphur = –2 (Lowest)

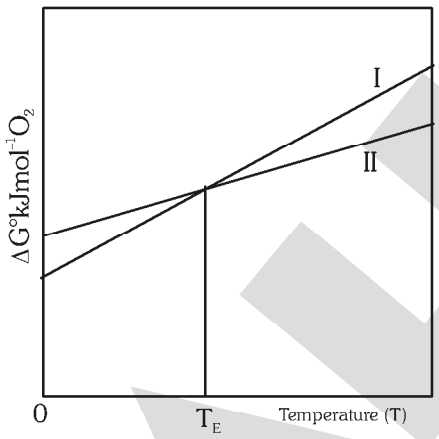
58. Ellingham diagram are plots of ΔG° vs temperature which have applications in metallurgy.

$2H_2 + O_2 = 2H_2O$ $\Delta G\ (J) = -247500 + 55.85\ T$ ... (I)

$2CO + O_2 = 2CO_2$ $\Delta G\ (J) = -282400 + 86.81\ T$ ... (II)

The Ellingham diagrams for the oxidation of H_2 (I) and CO (II) are given below.

The two lines intersect (T_E) at 1125K.



Which of the following is correct?

I. ΔG° for reaction (i) is more negative at T < 1125K

II. ΔG° for the reduction of CO is more negative at T < 1125K

III. H_2 is a better reducing agent at T > 1125K

IV. H_2 is a better reducing agent at T < 1125K

(A) I and II (B) I and III (C) III only (D) I and IV

Ans. **(C)**

Sol. Information based

59. Hydrazine used in rocket fuels can be obtained by the reaction of ammonia and hydrogen peroxide according to the following equation

$2NH_3(g) + H_2O_2(l) \rightarrow N_2H_4(l) + 2H_2O(l)$ $(\Delta H^0_{reaction} = -241$ kJ/mol)

If ΔH^0 (formation) of NH_3, H_2O_2 and H_2O are –46.1, –187.8 and –285.8kJ/mol respectively, ΔH^0 for the decomposition of hydrazine into N_2 and H_2 is

(A) 50.6 kJ/mol (B) 241 kJ/mol (C) –50.6 kJ/mol (D) 120.5 kJ/mol

Ans. (C)

Sol. $2NH_3(g) + H_2O_2(l) \rightarrow N_2H_4(l) + 2H_2O(l)$

$\Delta H^0 = \Delta H_f N_2H_4(l) + 2\Delta H_f H_2O(l) - 2\Delta H_f NH_{3(g)} - \Delta H_f H_2O_2$

$-241 = \Delta H_f N_2H_4(l) - 2 \times 285.8 + 2 \times 46.1 + 187.8$

$\Delta H_f N_2H_4(l) = 50.6$ kJ/mol

ΔH^o of decomposition of hydrazine into N_2 & H_2 will be –50.6 kJ/mol.

60. Sn^{2+} compounds like SnO and $SnCl_2$ are well known reducing agents, while PbO_2 acts as an oxidizing agent. Which of the following statements support these reactivities?

I. SnO is more stable than SnO_2

II. Sn^{4+} is more stable than Sn^{2+}

III. Pb^{4+} is more stable than Pb^{2+}

IV. Pb^{2+} is more stable than Pb^{4+}

(A) I and III (B) I, III and IV (C) II and IV (D) I, II and IV

Ans. (C)

Sol. Due to inert pair effect Pb^{+4} is 5.0 A.

61. A fuel/oxidant system consisting of N, N–dimethylhydrazine $(CH_3)_2NNH_2$ and N_2O_4 (both liquids) is used in space vehicle propulsion. The liquid components are mixed stoichiometrically so that N_2, CO_2 and H_2O are the only products. If all gases are under the same reaction conditions, number of moles of gases produced from 1 mole of $(CI I_3)_2NNI I_2$ is–

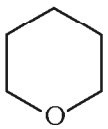
(A) 3 (B) 6 (C) 9 (D) 4.5

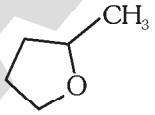
Ans. (C)

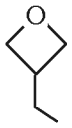
Sol. $(CH_3)_2N—NH_2 + 2N_2O_4 \rightarrow 3N_2 + 2CO_2 + 4H_2O$

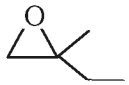
1 mol 9 mol

62. An ether (X) with molecular formula $C_5H_{10}O$ reacts with excess of hot aq. HI to give a product which on further reaction with hot NaOH in ethanol forms 1, 3 pentadiene. Structure of X is–

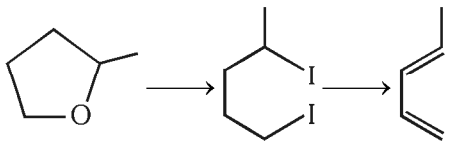
(A) 

(B) 

(C) 

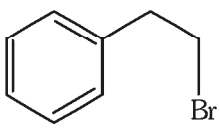
(D) 

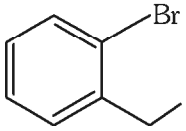
Ans. (B)

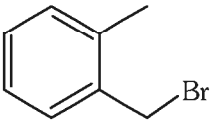
Sol. 

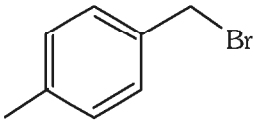
63. Compound 'Y' with molecular formula C_8H_9Br gives a precipitate on heating with alcoholic $AgNO_3$. Oxidation of 'Y' gives product 'Z' ($C_8H_6O_4$) which gives an anhydride upon heating.

Compound 'Y' is

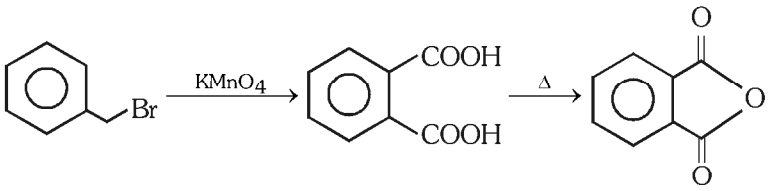
(A) 

(B) 

(C) 

(D) 

Ans. **(C)**

Sol. 

64. The observed effective magnetic moment of two octahedral complexes, $K_4[Mn(CN)_6].3H_2O$ (X) and $K_4[Mn(SCN)_6]$ (Y) are 2.18 BM and 6.06 BM, respectively. Which of the following is correct?

I. X is a low spin complex with two unpaired electrons

II. Y is a high spin complex with 5 unpaired electrons

III. X is a high spin complex with two unpaired electrons

IV. Y is a low spin complex with 5 unpaired electrons

(A) I and III (B) I, II (C) I, II and IV (D) I, II and III

Ans. **(B)**

Sol. $K_4[Mn(CN)_6].3H_2O$ (X) $\Rightarrow$ X [No. of unpaired electron = 1]

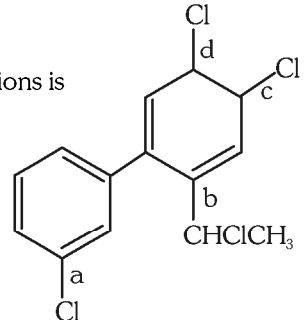
MM = 2.18 BM

low spin complex (SFL)

$K_4[Mn(SCN)_6]$ (Y)

high spin complex (wFL)

65. The increasing reactivity of the sites (a-d) in the following compound in S_N1 reactions is



(A) d > b > c > a

(B) d > c > a > b

(C) d > c > b > a

(D) c > d > b > a

Ans. **(C)**

Sol. Rate of $SN^1 \propto$ Stability of cation

66. Which of the following has the shortest bond length?

(A) O_2 (B) O_2 (C) O_2^+ (D) O_2^{2-}

Ans. **(C)**

Sol. $O_2^+ \Rightarrow$ B.O. = 2.5

Bond length $\alpha \frac{1}{\text{B.O.}}$

67. Which of the following statement/s is/are correct about weak acids in aqueous solutions?

I. When pH = pKa of a monoprotic acid, 50% of the acid is ionised

II. If pH = pKa_2 of a diprotic acid, the average charge of all the ionised species is 0.5

III. when pH = pKa + 1, 10% of the acid is ionised

IV. When pH = 7, 50% of a monobasic acid is ionised

(A) I and IV (B) I, II and IV (C) I, II and IV (D) I only

Ans. (D)

Sol. $pH = pK_a$

when 50% ionisation take place.

68. 'Iodine number' is the grams of iodine atoms (atomic mass = 127 g mol^{-1}) that can react completely with 100 g of a vegetable oil. Iodine monochloride (ICl) is a reagent used to determine iodine number. In an experiment, 25.00 cm^3 of 0.100 mol dm^{-3} ICl was added to 127g of the oil. The unreacted ICl was found to be equivalent to 40.00 cm^3 of 0010 mol dm^{-3} of $Na_2S_2O_3$.

The iodine number of the oil can be deduced as

(A) 127 (B) 100 (C) 200 (D) 50

Ans. (D)

Sol. Ml equivalent of hypo = 40 × 0.1 = 4 = Ml equivalent of ICl

m.moles of ICl = 2

Unreacted m.moles of ICl = 2.5 – 2 = 0.5

0.5 = moles × 1000

Moles of ICl = 5×10^{-4}

$\because$ 127g of vegetable oil Contain moles of ICl = 5×10^{-4}

$\therefore$ 100 g of vegetable oil Contain moles of ICl = $\frac{5\times10^{-4}}{127}\times100$

Mass of I = $\frac{5\times10^{-4}}{127}\times100\times127$ g

$= 5 \times 10^{-2}$ g

= 50 mg

69. When NiO is doped with a small quantity of Li_2O

(A) both cation and anion vacancies are generated (B) Shottky defects are generated

(C) NiO becomes an n-type semiconductor (D) NiO becomes a p-type semiconductor

Ans. (D)

Sol. The Li^+ ions occupy Ni^{2+} sites in the structure to form substitutional defects. In order to maintain charge neutraling, every Li^+ ion in the crystal must be balanced by a Ni^{3+} ion. This can be regarded as a Ni^{2+} ion together with a trapped hole. Thus it will behave as p-type seminconductor.

70. When a sample of gas kept at 20°C and 4.0 atm is heated to 40°C at constant volume

(A) average speed of the gas molecules will decrease

(B) number of collisions between the gas molecules per second will remain the same

(C) average kinetic energy of the gas will increase

(D) pressure of the gas will become 8 atm

Ans. (C)

Sol. With increase of temperature average kinetic energy of the gas will increase

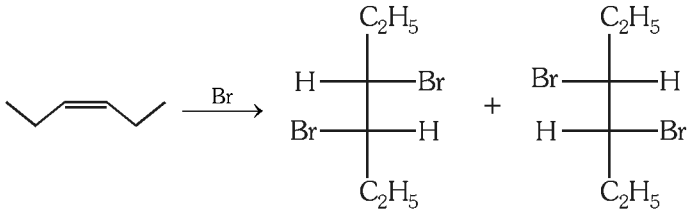
71. Addition of bromine to cis-3-hexene gives

(A) racemic dibromide (B) a mixture of diastereomeric dibromides

(C) optically active dibromide (D) meso dibromide

Ans. **(A)**

Sol.



72. An organic compound "X" forms an orange–yellow precipitate with 2,4–DNP reagent. It does not react with aqueous $[Ag(NH_3)_2]NO_3$. X on reduction with $NaBH_4$ gives a secondary alcohol and on oxidation with nitric acid yields a dicarboxylic acid containing the same number of carbon atoms. On bromination, X gives a monobromo product. On the basis of these reactions, it can be concluded that X

I. contains aldehydic carbonyl group

II. contains ketonic carbonyl group

III. contains ester carbonyl group

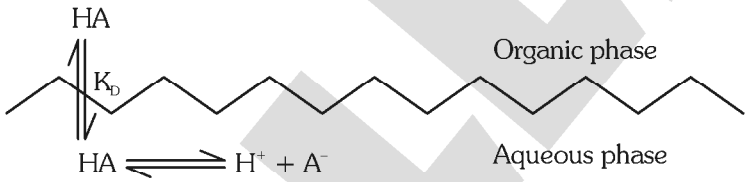
IV. does not contain C=C bonds

(A) I only (B) III and IV (C) III only (D) II and IV

Ans. **(D)**

Sol. Ketone reacts with DNP but does not give ppt with $[Ag(NH_3)_2]NO_3$

73. The undissociated form of a weak organic acid HA can be extracted from the aqueous phase into an organic phase using a water-immiscible organic solvent according to the following scheme



Which of the following is/are correct for this extraction?

I. $[HA]_{org}/[HA]_{aq}$ depends on the pH of the aqueous phase

II. HA can be efficiently extracted from basic aqueous solutions

III. $[HA]_{org}/[HA]_{aq}$ depends on the initial concentration of HA

IV. $[HA]_{org}/[HA]_{aq}+[A^-]$ depends on the pH of the aqueous phase

(A) II and IV (B) IV only (C) I only (D) III and IV

Ans. **(A)**

Sol. $K_{Distribution} = \frac{[HA]_{org.}}{[HA]_{aq.}} = \text{constant}$

$\frac{[HA]_{org.}}{[HA]_{aq.} + [A^-]_{aq.}}$ depends upon pH value.

74. The correct order of reactivity in nucleophilic substitution reaction of the following compounds a, b and c would be

$CH_3CH_2CONH_2$ (a) $CH_3CH_2COOCH_3$ (b) CH_3CH_2COCl (c)

(A) a > c > b (B) a > b > c (C) c > b > a (D) c > a > b

Ans. **(C)**

Sol. Rate $\propto$ Leaving gp. ability

75. The complex ion that does not have d electrons in the metal atom is

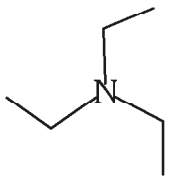
(A) $[MnO_4]^-$ (B) $[Co(NH_3)_6]^{3+}$ (C) $[Fe(CN)_6]^{3-}$ (D) $Cr(H_2O)_6]3^+$

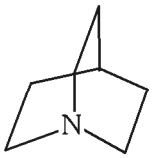
Ans. **(A)**

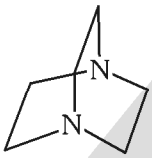
Sol. MnO_4^-

$\overset{+7}{Mn} = d^0$

76. The order in which the compounds a, b and c react with CH_3I would be


(a)


(b)

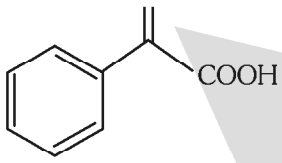

(c)

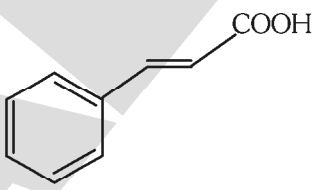
(A) a > c > b (B) b > c > a (C) c > b > a (D) b > a > c

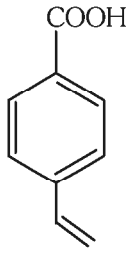
Ans. **(B)**

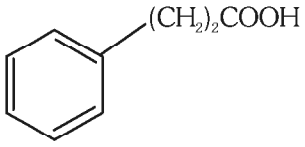
Sol. (a) is least reactive due to amine flipping.

77. An organic compound 'P' with molecular formula $C_9H_8O_2$ on oxidation gives benzoic acid as one of the products. The possible structure/s of 'P' is/are


(I)


(II)


(III)


(IV)

(A) I and III (B) II and IV (C) I and II (D) II only

Ans. **(B)**

Sol. Compounds having benzylic H atoms will give benzoic acid.

78. The energy of an electron in the ground state of H atom is –13.6eV.
The negative sign indicates that
(A) electrons are negatively charged
(B) H atom is more stable than a free electron
(C) energy of the electron in the H atom is lower than that of a free electron
(D) work must be done to make a H atom from a free electron and proton

Ans. **(C)**

Sol. Due to altractive force between proton and electron.

79. Radius of Ar atom is 145pm. The percentage volume occupied by an Ar atom at STP is
(A) 0.03 (B) 3.0 (C) 0.30 (D) 0.06

Ans. **(A)**

Sol. Volume of Ar atoms per mole

$$= \frac{4}{3}\pi(145\times10^{-10})^3 \times 6.02\times10^{23}$$

$$= 7.683\ cm^3$$

Volume of gas $= 22.4 \times 10^3$

$$= 22400\ cm^3$$

Percentage volume occupied $= = \frac{7.6836}{22400}\times100 = 0.034\%$

80. The reduction of O_2 to H_2O in acidic solution has a standard reduction potential of 1.23 V. If the pH of the acid solution is increased by one unit, half cell potential will

$$O_2(g) + 4\,H^+(aq) + 4e^- \rightarrow 2H_2O\,(I)$$

(A) decrease by 59 mV (B) increase by 59 mV
(C) decrease by 236 mV (D) increase by 236 mV

Ans. **(A)**

Sol. $E_{cell} = E^0_{cell} - \frac{0.0591}{n}\log Q$

$$Q = \frac{1}{Po_2(H^+)^4}$$

$$E_{cell} = E^0_{cell} - \frac{0.0591}{4}\log\frac{1}{Po_2.[H^+]^4}$$

$$= E^0_{cell} + \frac{0.0591}{4}\log Po_2.[H^+]^4$$

due to increase in pH by one unit $[H^+]$ will become $\frac{1}{10}$ of initial.

$$E_{cell(i)} = E^0_{cell} + \frac{0.0591}{4}\log Po_2.C_i^4$$

$$E_{cell(f)} = E^0_{cell} + \frac{0.0591}{4}\log Po_2\left(\frac{C_i}{10}\right)^4$$

$$= E^0_{cell} + \frac{0.0591}{4}\left[\log\ Po_2.C_i^4 - \log 10^4\right]$$

$$= E_{cell\,i} - \frac{0.0591}{4}\log 10^4$$

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