NATIONAL STANDARD EXAMINATION
IN CHEMISTRY (NSEC) 2016-17

Date of Examination : 27TH November, 2016

Q. Paper Code : C323

1. The kinetic energy of an electron that has a wavelength of 10 nm is

(a) 2.4×10^{-21} J   (b) 4.8×10^{-21} J   (c) 2.4×10^{-29} J   (D) 4.8×10^{-29} J

Ans. (a)

Sol. $\lambda = \dfrac{h}{\sqrt{2KEm}} \Rightarrow V = 1.224$

$KE = 1.6 \times 10^{-19} \times 1.224$

$10 \times 10^{-19} = \dfrac{6.62 \times 10^{-34}}{\sqrt{2KE.9.1 \times 10^{-31}}}$

$\sqrt{2KE} = \dfrac{6.62 \times 10^{-31}}{\left(\sqrt{91 \times 10^{-30}}\right) \times 10^{-8}}$

$KE = 2.4 \times 10^{-21}$ J

2. Which of the following compounds contain 3–centered 2–electron bonding ?

(i) $[BeF_2]_n$ (ii) $[Be(CH_3)_3]_n$ (iii) $[BeCl_2]_n$ (iv) $[BeH_2]_n$

(a) (i) and (ii)   (b) (ii) and (iii)   (c) (ii) and (iv)   (d) (iii) and (iv)

Ans. (c)

Sol. 3c–2e bonds are present in $[Be(CH_3)_3]_n$ and $[BeH_2]_n$.

3. 3–Methylpentane on monochlorination gives four possible products. The reaction follows free radical mechanism. The relative reactivities for replacement of –H are $3° : 2° : 1° = 6 : 4 : 1$.
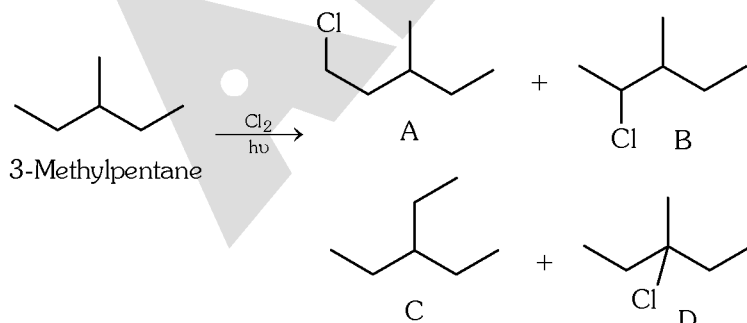
Relative amounts of **A, B, C** and **D** formed are

(a) 6/31, 16/31, 6/31, 3/31   (b) 16/31, 6/31, 6/31, 3/31

(c) 6/31, 16/31, 3/31, 6/31   (d) 6/31, 3/31, 6/31, 16/31

Ans. (c)

Sol.

$$\begin{array}{cccc} 6 & 4 & 3 & 1 \\ 1 & 4 & 1 & 6 \\ \hline 6 : & 16 : & 3 : & 6 \end{array}$$
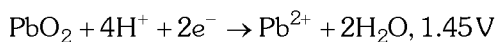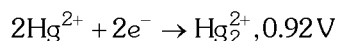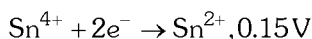
$$\frac{6}{31}, \frac{16}{31}, \frac{3}{31}, \frac{6}{31}$$

4. White phosphorous on reaction with NaOH gives PH_3 and

(a) Na_2HPO_3 (b) NaH_2PO_2 (c) NaH_2PO_3 (d) Na_3PO_4

Ans. (b)

Sol. $P_4 + NaOH \longrightarrow PH_3 + Na_2H_2PO_2$

5. Give the E_0 values for the half reactions :

$$Sn^{4+} + 2e^- \rightarrow Sn^{2+}, 0.15\,V \qquad\qquad 2Hg^{2+} + 2e^- \rightarrow Hg_2^{2+}, 0.92\,V$$

$$PbO_2 + 4H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O,\ 1.45\,V$$

(a) Sn^{2+} is a stronger oxidizing agent than Pb^{4+} (b) Sn^{2+} is a stronger reducing agent that Hg_2^{2+}

(c) Hg^{2+} is a stronger oxidizing agent than Pb^{4+} (d) Pb^{2+} is a stronger reducing agent than Sn^{2+}

Ans. (b)
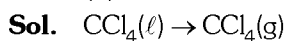
Sol. -0.15 & -0.92

Sn^{2+} has more tendency to get oxidized than Hg_2^{2+}.

6. For the conversion $CCl_4(\ell) \rightarrow CCl_4(g)$ at 1 bar and 350 K, the correct set of thermodynamic parameters is (Boiling point of CCl_4 is 77°C)

(a) $\Delta G = 0, \Delta S = +ve$ (b) $\Delta G = 0, \Delta S = -ve$ (c) $\Delta G = -ve, \Delta S = 0$ (d) $\Delta G = -ve, \Delta S = +ve$

Ans. (a)

Sol. $CCl_4(\ell) \rightarrow CCl_4(g)$

350 K → B.P. of $CCl_4(\ell)$ so it is an equilibrium condition for which $\Delta G = 0$ and liquid to gas conversion $\Delta S = +ve$.

7. How many isomers are possible for complex $[Co(ox)_2Cl_2]^+$?

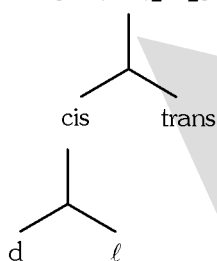(a) 1   (b) 3   (c) 2   (d) 4

Ans. (b)

Sol.

$[Co(OX)_2Cl_2]^+$

cis   trans

d ℓ

8. The compound that will not react with silver perchlorate under normal conditions is

(a) 3–bromocyclopropene   (b) tetraethyl ammonium chloride

(c) tetramethylammonium hydroxide   (d) polyvinyl chloride

Ans. (d)

Sol. PVC is organic polymer.

9. The conductivity of 0.10 M KCl solution at 298 K is 1.29×10^{-2} S cm^{-1}. The resistance of this solution is found to be 28.44 Ω. Using the same cell, the resistance of 0.10 M NH$_4$Cl solution is found to be 28.50 Ω. The molar conductivity of NH$_4$Cl solution in S cm^2 mol^{-1} is

(a) 0.130   (b) 13   (c) 130   (d) 1300

Ans. (c)

Sol. $K = 1.29 \times 10^{-2}$ $R = 28.44$

$$\lambda_m = \frac{F \times 1000}{M} = \frac{\left(\dfrac{1}{R} \times \dfrac{\ell}{A}\right) \times 1000}{M}$$

$$\because \quad K = 1.29 \times 10^{-2} = \frac{1}{28.44} \times \frac{\ell}{A}$$

$$\frac{\ell}{A} = 1.29 \times 10^{-2} \times 28.44 \quad ; \quad \text{So} \quad \lambda_m = \frac{1}{28.50} \times \frac{1.29 \times 10^{-2} \times 28.44 \times 1000}{0.5} = 130$$

10. Consider a compound CsXY$_2$ where X and Y are halogens. Which of the following statement/s is/are correct ?

(i) X and Y have different oxidation states.

(ii) For Y with lower atomic number than X, X can assume oxidation states higher than normal.

(iii) Such compounds exists because Cs$^+$ has a high charge to size ratio.

(a) Only (i)   (b) (i) and (ii)   (c) Only (ii)   (d) (i) and (iii)

Ans. (b)

Sol. $Cs^+(XY_2)^{-1}$

Where X must have lesser EN as compared to Y.

11. Match the compounds given in list I with their characteristic reactions in list II.

List I (Compound)		List II (Reaction)
(1)	Tertbutyl amine	(a) Liberation of ammonia on heating with aq.NaOH
(2)	2–methyl–2–pentanol	(b) Effervescence with NaHCO$_3$
(3)	2,4,6–trinitrophenol	(c) Foul smell with chloroform in alkaline condition
(4)	Cyclohexane carboxamide	(d) Formation of an water insoluble compound on treatement with conc. HCl and ZnCl$_2$

(a) (1) - (a), (2) - (c), (3) - (d), (4) - (b)   (b) (1) - (c), (2) - (d), (3) - (b), (4) - (a)

(c) (1) - (a), (2) - (b), (3) - (c), (4) - (d)   (d) (1) - (c), (2) - (a), (3) - (b), (4) - (c)

Ans. (b)

Sol. (1) $(CH_3)_3C{-}NH_2 \xrightarrow{CHCl_3 / KOH} \underset{\text{Foul smell}}{(CH_3)_3C - NC}$

(2) $\xrightarrow{ZnCl_2 / HCl}$ Oily layer (Lucas test)

(3) $\xrightarrow{NaHCO_3}$ + CO$_2$ + H$_2$O


(4) $\xrightarrow{NaOH / H_2O}$ NH$_3$
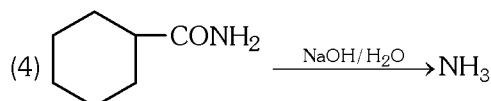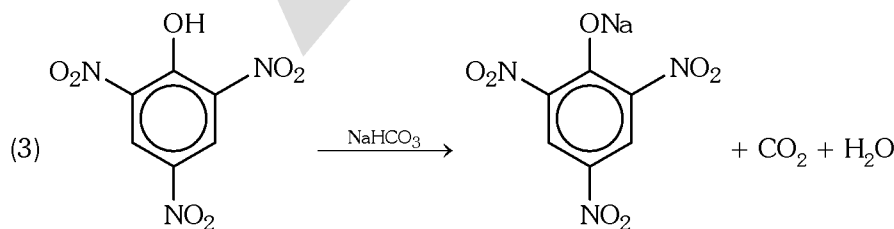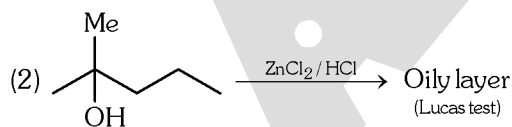
12. Which of the following statements is not correct regarding the galvanic cells ?

(a) Oxidation occurs at the anode

(b) Ions carry current inside the cell

(c) Electrons flow in the external circuit from cathode to anode

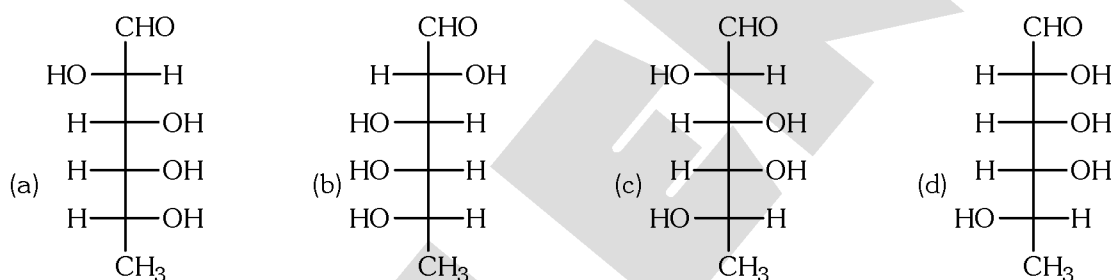(d) When the cell potential is positive, the cell reaction is spontaneous

Ans. **(c)**

Sol. Theory based.

13. L–Fucose with the following planar representation is a sugar component of the determinants of the A, B, O blood group type.
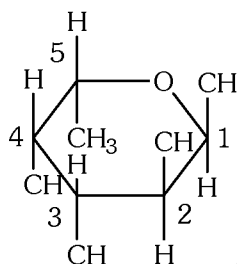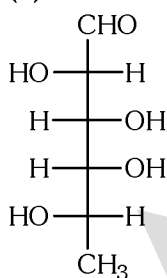

The open chain structure of L–Fucose can be represented as

Ans. **(c)**

Sol.

14. In ammonia the bond angle is 107°48' while in SbH_3 the bond angle is about 91°18'. The correct explanation among the following is/are

(a) The orbitals of Sb used for the formation of Sb–H bond are almost pure p–orbitals.

(b) Sb has larger size compared to N.

(c) Sb has more metallic character than N.

(d) All the statement are correct.

Ans. **(a)**

Sol. Apply Drago's rule.

15. Equal masses of ethane and hydrogen gas are present in a container at 25°C. The fraction of the total pressure exerted by ethane gas is

(a) 1/2   (b) 1/16   (c) 15/16   (d) 1/8

Ans. **(b)**

Sol. $C_2H_6 = 1$ gm

$H_2 = 1$ gm

$$P_{C_2H_6} = \dfrac{\dfrac{1}{30}}{\dfrac{1}{30} \times \dfrac{1}{2}} \times 1$$

$$= \dfrac{1}{30} \times \dfrac{30}{16} = \dfrac{1}{16}$$

16. The volume of nitrogen evolved on complete reaction of 9 g of ethylamine with a mixture of $NaNO_2$ and HCl at 273°C and 1 atm pressure is

(a) $11.2 \, dm^3$ (b) $5.6 \, dm^3$ (c) $4.48 \, dm^3$ (d) $22.4 \, dm^3$

Ans. (c)

Sol. $C_2H_5NH_2 \xrightarrow{NaNO_2/HCl} C_2H_5OH + N_2 + H_2O$

1 mole   1 mole

$\dfrac{9}{45} = \dfrac{1}{5}$ $\dfrac{1}{5}$ mole

Volume of $N_2 = \dfrac{1}{5} \times 22.4 = 4.48 \, dm^3$
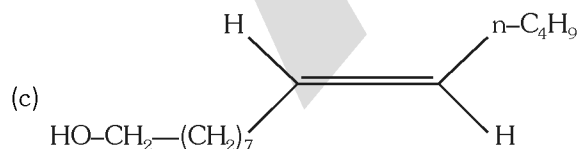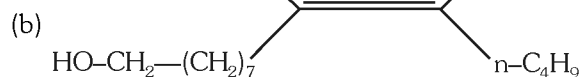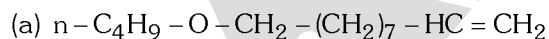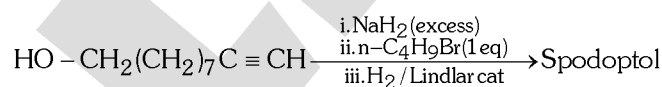
17. The electrons identified by quantum numbers n and l, (i) n = 4, l = 1, (ii) n = 4, l = 0, (iii) n = 3, l = 2, (iv) n = 3, l = 1 can be placed in order of increasing energy from lowest to highest as

(a) (iv) < (ii) < (iii) < (i)   (b) (ii) < (iv) < (i) < (iii)

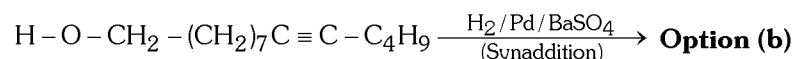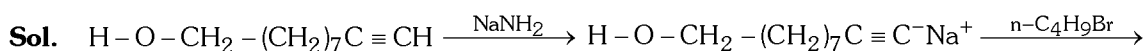(c) (i) < (iii) < (ii) < (iv)   (d) (iii) < (i) < (iv) < (ii)

Ans. (a)

Sol. Orbital energy $\propto$ n + ℓ.

18. Spodoptol, a sex attractant, produced by a female fall armyworm moth, can be prepared as follows. The structure of Spodoptol is (pKa: terminal alkynes ~25, alcohols ~ 17)

$$HO - CH_2(CH_2)_7 C \equiv CH \xrightarrow[\substack{i.NaH_2(excess) \\ ii.n-C_4H_9Br(1eq) \\ iii.H_2/Lindlar\,cat}]{} Spodoptol$$

(a) $n - C_4H_9 - O - CH_2 - (CH_2)_7 - HC = CH_2$ (b)

(c)

(d) $HO-CH_2-(CH_2)_{12}-CH_3$

Ans. (b)

Sol. $H - O - CH_2 - (CH_2)_7 C \equiv CH \xrightarrow{NaNH_2} H - O - CH_2 - (CH_2)_7 C \equiv C^- Na^+ \xrightarrow{n-C_4H_9Br}$
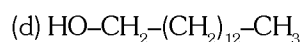
$H - O - CH_2 - (CH_2)_7 C \equiv C - C_4H_9 \xrightarrow[(Syn\,addition)]{H_2/Pd/BaSO_4}$ **Option (b)**

19. Passing H_2S gas into a mixture of Mn^2, Ni^{2+}, Cu^{2+} and Hg^{2+} in an acidified aqueous solution precipitates

(a) CuS and HgS   (b) MnS and CuS   (c) MnS and NiS   (d) NiS and HgS

Ans. (a)

Sol. Only 2nd group cations are precipitated in acidic medium with H_2S.

20. Battery acid (H_2SO_4) has density 1.285 g cm^{-3}. 10.0 cm^3 of this acid is diluted to 1 L. 25.0 cm^3 of this diluted solution requires 25.0 cm^3 of 0.1 N sodium hydroxide solution for neutralization. The percentage of sulphuric acid by mass in the battery acid is

(a) 98   (b) 38   (c) 19   (d) 49

Ans. (b)

Sol. ml_{eq} ^ NaOH = $25 \times 0.1 = 2.5$

25 ml diluted solution required the $ml_{eq} = 2.5$

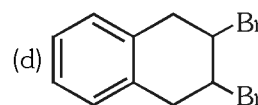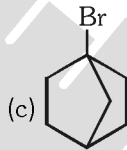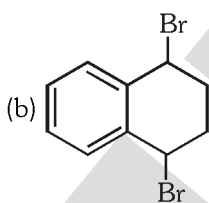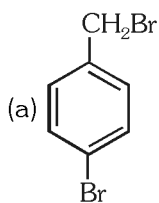$$1000 \text{ ml} \ldots\ldots\ldots\ldots = \frac{2.5 \times 1000}{25} = 100$$

$$100 = 10 \times N_{H_2SO_4}$$

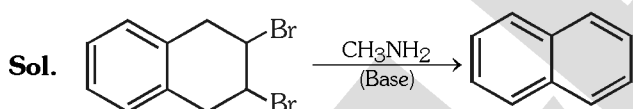$$N_{H_2SO_4} = 10 \qquad \text{Let (w\% by mass)}$$

$$M_{H_2SO_4} = 5 = \frac{w}{98} \times \frac{1000}{\frac{100}{1.285}}$$

$$w = \frac{5 \times 98}{12.85} = 38$$

21. The compound that reacts fastest with methylamine is

(a)   (b)   (c)   (d)

Ans. (d)

Sol.

$$\xrightarrow[\text{(Base)}]{CH_3NH_2}$$

22. HgO is prepared by two different methods: one shows yellow colour while the other shows red colour. The difference in colour is due to difference in

(a) electronic d–d transitions   (b) particle size

(c) Frenkel defect   (d) Schottkey defect

Ans. (b)

Sol. Due particle size.

23. The pH of a 1.0×10^{-3} mol L^{-1} solution of a weak acid HA is 3.60. The dissociation constant of the acid is

(a) 8.4×10^{-8} (b) 8.4×10^{-6} (c) 8.4×10^{-5} (d) 8.4×10^{-2}
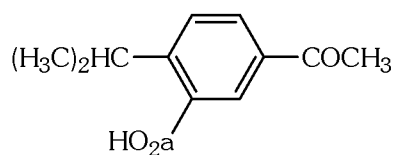
Ans. (c)

Sol. $[H^+] = C\alpha = \dfrac{5}{2} \times 10^{-4}$

$$1 \times 10^{-3} \alpha = \frac{5}{2} \times 10^{-4}$$

$$\alpha = \frac{5}{2} \times 10^{-1} = 0.25$$

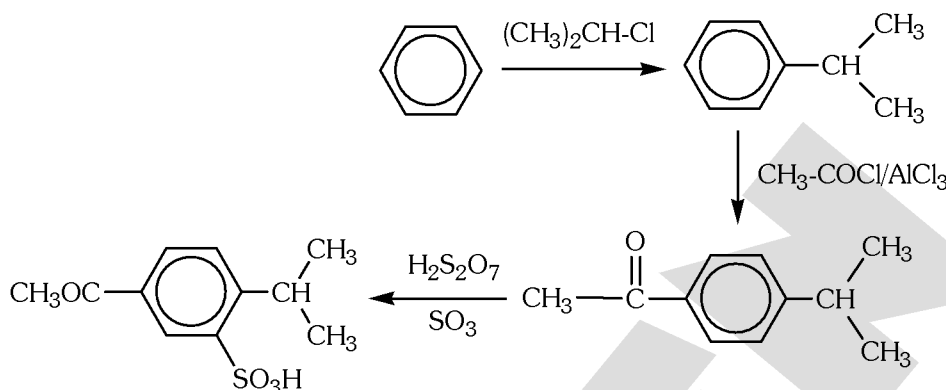$$K_a = \frac{C\alpha^2}{1-\alpha} \Rightarrow K_a = 8.4 \times 10^{-5}$$

24. The best sequence of reactions for preparation of the following compound from benzene is

(a) (i) $CH_3COCl/AlCl_3$ (ii) Oleum (iii) $(CH_3)_2CH\text{-}Cl$ (1 mole)/$AlCl_3$
(b) (i) $(CH_3)_2CH\text{-}Cl$ (1 mole)/$AlCl_3$ (ii) $CH_3COCl/AlCl_3$ (iii) Oleum
(c) (i) Oleum (ii) $CH_3COCl/AlCl_3$ (iii) $(CH_3)_2CH\text{-}Cl$ (1 mole)/$AlCl_3$
(d) (i) $(CH_3)_2CH\text{-}Cl$ (1 mole)/$AlCl_3$ (ii) Oleum (iii) $CH_3COCl/AlCl_3$

Ans. (b)

Sol.

25. Which reaction is spontaneous at all temperatures at standard pressure and concentration?
(a) Exothermic reaction with a decrease in entropy
(b) Exothermic reaction with an increase in entropy
(c) Endothermic reaction with a decrease in entropy
(d) Endothermic reaction with an increase in entropy

Ans. (b)

Sol. $\Delta G = \Delta H - T\Delta S$
$= - \ - \ (+)$
$= -\,ve$

**26.** The IUPAC name of the following compound is
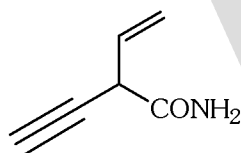
(a) 3-Aminocarbonylpent-1-en-4-yne
(b) 2-Ethenylbut-3-yn-1-amide
(c) 2-Ethynylbut-3-en-1-amide
(d) 3-Aminocarbonylpent-4-en-1-yne

Ans. (c)

Sol. 2-Ethynylbut-3-en-1-amide

27. NaOH solution is added dropwise to HCl solution and the conductance of the mixture is measured after addition of each drop. The variation of conductance with volume of NaOH added is as shown below.
The statement that is not true for the above is
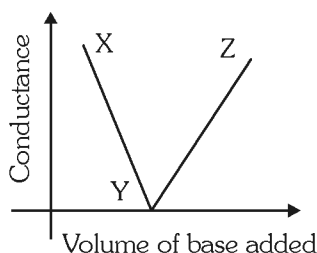
(a) decrease in conductance from X→Y is due to decrease in $[H^+]$.
(b) point Y represents the eqivalence point of titration
(c) Na^+ has the higher equivalence conductance than H_3O^+.
(d) Segment YZ represents the conductance due to ions from NaCl and NaOH in solution.

Ans. **(c)**

Sol. Na^+ has the higher equivalence conductance than H_3O^+ is incorrect.

28. A colorless water-soluble compound on strong heating liberates a brown colored gas and leaves a yellow residue that turns white on cooling. An aqueous solution of the original solid gives a white precipitate with $(NH_4)_2S$. The original solid is

(a) $Zn(NO_3)_2$ (b) $Ca(NO_3)_2$ (c) $Al(NO_3)_3$ (d) $NaNO_3$

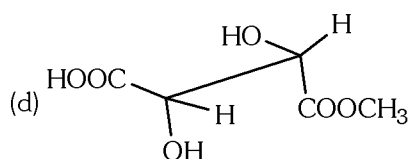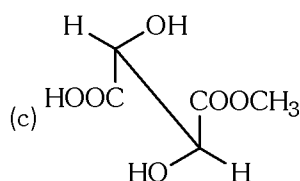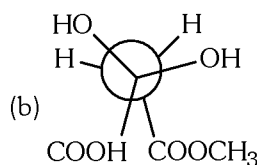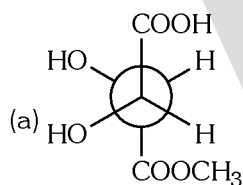**Ans.** **(a)**

Sol. Colour of ZnS is white.

29. The following compounds are heated (i) KNO_3, (ii) $Cu(NO_3)_2$, (iii) $Pb(NO_3)_2$, (iv) NH_4NO_3. Which of the folliwng statetment/s is/are correct?

(a) (ii) and (iii) liberate NO_2 (b) (iv) liberates N_2O
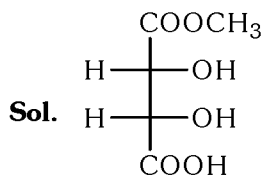(c) (i), (ii) and (iii) liberate O_2 (d) All statements are correct

Ans. **(d)**

Sol. All are correct.

30. The diastereoisomer (stereoisomer that is not a mirror image) of 'X' is

Ans. **(c)**

Sol.

$$
\begin{array}{c}
\text{COOCH}_3 \\
\text{H}\!-\!\!\!\stackrel{\displaystyle|}{}\!\!\!-\!\text{OH} \\
\text{H}\!-\!\!\!\stackrel{\displaystyle|}{}\!\!\!-\!\text{OH} \\
\text{COOH}
\end{array}
$$
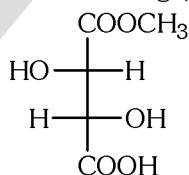
diastereomer of x.

31. Given $\Delta_r H° = -54.08$ kJ mol^{-1} and $\Delta_r S° = 10.0$ J mol^{-1} at 25°C, the value of $\log_{10}K$ for the reaction $A \rightleftharpoons B$ is

(a) 3.4   (b) 10   (c) 0.53   (d) 113

Ans. (b)

Sol.
$$
\begin{aligned}
\Delta G° &= \Delta H° - T\Delta S° \\
&= -54.08 \times 10^3 - 298 \times 10 \\
&= -54080 - 2980 \\
&= -51100 \text{ Joule}
\end{aligned}
$$

$$
\Delta G° = -2.303 \, RT \log_{10}K \Rightarrow \log_{10}K = \frac{51100}{2.303 \times 8.314 \times 298} = 8.95
$$

32. Which of the complexes has the magnetic moment of 3.87 B.M.?

(a) $[Co(NH_3)_6]^{3+}$

(b) $[CoF_6]^{3-}$

(c) $[CoCl_4]^{2-}$

(d) $[Co(dmg)_2]$ square planar complex (dmg = dimethyl glyoxime)

Ans. (c)

Sol. $\mu = \sqrt{n(n+2)}$ BM = 3.87

n = 3

So ans should be ($[CoCl_4]^{2-}$).

33. For a gaseous reaction, $A + B \rightarrow$ Products, the energy of activation was found to be 2.27 kJ mol^{-1} at 273 K. The ratio of the rate constant (k) to the frequency factor (A) at 273 K is
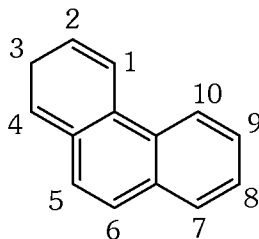
(a) 0.368   (b) 3.68   (c) 4.34   (d) 0.434

Ans. (a)

Sol. $\dfrac{k}{A} = e^{-Ea/RT}$

$$
= e^{-\frac{2.27 \times 10^3}{8.314 \times 273}} = e^{-1} = \frac{1}{e} = 0.368
$$

34. In the case of dibromo derivatives of the following compound, the derivative having highest energy has the bromo substituents in positions

(a) 1, 2   (b) 2, 3   (c) 4, 5   (d) 1, 10

Ans. (d)

Sol. Max repulsion at 1 and 10.

35. The ionization energy of a certain element is $412 \, kJ \, mol^{-1}$. When the atoms of this element are in the first excited state, however, the ionization energy is only $126 \, kJ \, mol^{-1}$. The region of the electromagnetic spectrum in which the wavelength of light emitted in a transition from the first excited state to the ground state is :

(a) Visible   (b) UV   (c) IR   (d) X-Ray

Ans. (c)

Sol. $\Delta E = 412 - 126$

$= 286 \, kJ/mol$

$= 47.6 \times 10^{-20} \, J/atom$

$$\Delta E = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{\Delta E}$$

$$\lambda = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{47.67 \times 10^{-20}}$$

$= 4153.5 \, A°$

so visible region

36. The reaction of an olefin with HBr can proceed by ionic as well as radical mechanism. The reaction in the presence of light takes place by radical mechanism, as

(a) The free energy of the reaction in radical mechanism is higher than in ionic mechanism.

(b) Ionic mechanism requires a catalyst while radical mechanism does not.

(c) In the presence of light the activation energy of the reaction is lower than that for ionic mechanism.

(d) A radical reaction has very low activation energy as compared to that for the corresponding ionic reaction

Ans. (c)

Sol. In the presence of light lower activation energy is invovled.

37. The correct statements is/are

I. Soap is excellent for cleaning, 100% broken down by bacteria in rivers and hence has no further environmental damaging repercussion.

II. Soap forms an insoluble precipitate/scum when hard water containing calcium and magnesium ion is used.

III. Soaps can used for cleaning under acidic solution.

(a) Only I   (b) Only II   (c) Only III   (d) I and III

Ans. (b)

Sol. Only II is correct

38. The kinetic data recorded at 278 K for the reaction

$$NH_4^+ (aq) + NO_2^- (aq) \longrightarrow N_2(g) + 2H_2O(l) \text{ is}$$
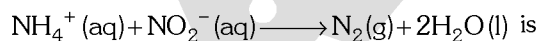
Set No.	$[NH_4^+]/M$	$[NO_2^-]/M$	Rate of reaction. MS^{-1}
1.	0.24	0.10	7.2×10^{-6}
2.	0.12	0.10	3.6×10^{-4}
3.	0.12	0.15	5.4×10^{-6}

The kinetic rate expression and the unit of rate constant (k) of the above reaction are respectively

(a) $k[NH_4^+] [NO_2^-]$ and Ms^{-1} (b) $k[NH_4^+]$ and s^{-1}

(c) $k[NH_4^+] [NO_2^-]$ and $M^{-1}s^{-1}$ (d) $k[NO_2^-]$ and s^{-1}

Ans. (c)

Sol. $n \rightarrow$ order of reaction

$$\frac{r_1}{r_2} = \left(\frac{c_1}{c_2}\right)$$

order w.r.t. NH_4

$$\frac{7.2 \times 10^{-6}}{3.6 \times 10^{-6}} = \left(\frac{0.24}{0.12}\right)^n$$

$n = 1$

Order w.r.t. NO_2^-

$$\frac{3.6 \times 10^{-6}}{5.4 \times 10^{-6}} = \left(\frac{0.1}{0.15}\right)^n$$

$n = 1$

so rate equation $-\dfrac{dx}{dt} = k[NH_4^+][NO_2^-]$

unit of $k = (molarity)^{1-n} \, s^{-1}$
$= (molarity)^{1-2} \, s^{-1} = M^{-1} s^{-1}$

39. Which of the following statements is not true for Ce^{3+} and Yb^{3+}?
(a) Both absorb in UV region
(b) Both absorb f-f transition
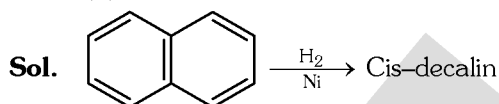(c) Both shows 4f to 5d transition
(d) Both ions are colorless

Ans. (d)
Ce^{3+} has one unpaired electron so coloured

40 Complete catalytic hydrogenation of naphthalene gives decalin ($C_{10}H_{18}$). The number of isomers of decalin formed and the total number of isomers of decalin possible are respectively
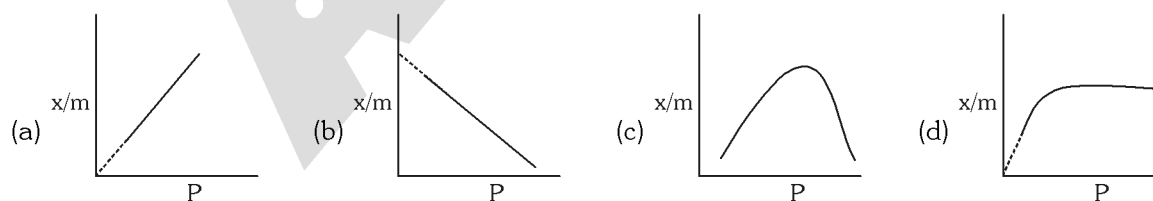(a) 1, 2   (b) 2, 2   (c) 2, 4   (d) 3, 4

Ans. (c)

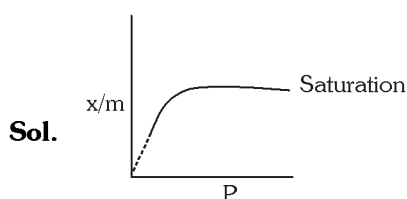**Sol.**

$\xrightarrow[\text{Ni}]{H_2}$ Cis–decalin

Cis–decalin is chiral.

41. The mass of argon adsorbed per unit mass of carbon surface is plotted against pressure. Which of the following plots is correct if x and m represent the masses of argon and carbon respectively? (..... represents extrapolated area)

Ans. (d)

Sol.

42. In a process n-propyl chloride is reacted with sodium butanoate in an aqueous medium. After the reaction diethyl ether is added and the solution is shaken. The two layers are separated. The incorrect statement with respect to this procedure is :
(a) The reaction gives a solid product which precipitates in the aqueous solution
(b) The reaction takes place in the aqueous medium
(c) The product is extracted in diethyl ether and the organic layer is the upper layer.
(d) The salt formed in the reaction remains in aqueous medium.

Ans. (a)

Sol. Both compounds are soluble in water.

43. Which of the following statement about ammonium cerium (IV) nitrate, $(NH_4)_2[Ce(NO_3)_6]$ is false?
(a) NO_3 acts as a monodentate ligand
(b) The Ce atom has coordination number of 12
(c) The shape of the complex ion is icosahedron
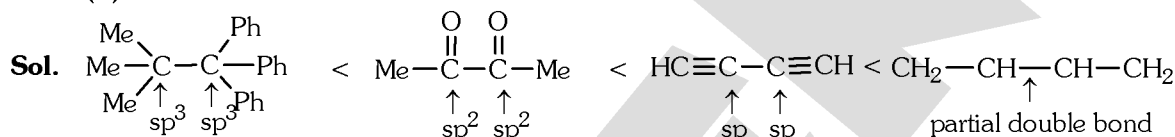(d) The solution is used as oxidizing agent

Ans. (b)

Sol. The Ce atom has coordination number of 12

44. The correct order of the magnitude of bond energy (kJ/mol) of the central C–C bond in the following compounds is :
(i) $CH_2 = CH–CH = CH_2$　　(j) $Me_3C–CPh_3$　　(k) $MeCO–CO–Me$　　(l) $CH\equiv C–C\equiv CH$
(a) $k > i > l > j$　　(b) $j > k > l > i$　　(c) $i > j > k > l$　　(d) $l > i > k > j$

Ans. (d)

Sol.

$$\underset{sp^3 \quad sp^3}{\underset{Me}{\overset{Me}{\underset{|}{\overset{|}{C}}}}-\underset{Ph}{\overset{Ph}{\underset{|}{\overset{|}{C}}}}-Ph} \quad < \quad \underset{sp^2 \quad sp^2}{Me-\overset{O}{\overset{||}{C}}-\overset{O}{\overset{||}{C}}-Me} \quad < \quad \underset{sp \quad sp}{HC\equiv C-C\equiv CH} \quad < \quad CH_2-CH-CH-CH_2$$

partial double bond

45. Which one of the following information about the compounds is correct?

Compound	Oxidation state of P	No. of P—OH bond	No. of P—H bonds	No. of P=O bonds
[I] H_3PO_2 Hypophosphorous acid	1+	2	1	0
[II] $H_4P_2O_5$ Pyropophosphorous acid	3+	2	2	2
[III] $H_4P_2O_6$ Hypophosphoric acid	4+	2	2	2
[IV] $H_4P_2O_7$ Pyrophosphoric acid	5+	3	1	4

(a) I　　(b) III　　(c) IV　　(d) II

Ans. (d)

Sol. $H_4P_2O_5$

$$HO-\overset{O}{\overset{||}{\underset{|}{\underset{H}{P}}}}-O-\overset{O}{\overset{||}{\underset{|}{\underset{H}{P}}}}-OH$$
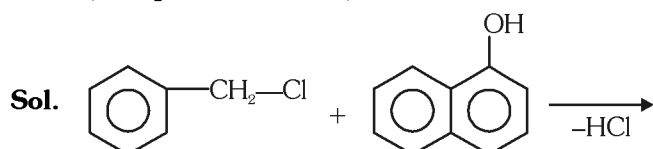
Bond
P – O ⇒ 2
P – H ⇒ 2
P = O ⇒ 2
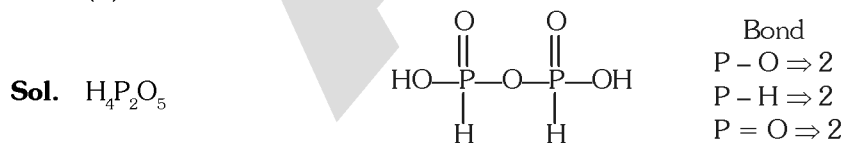
46. The best method of preparntion of 2-bonzyloxynaphthalene is a base catalysed reaction of–
(a) benzyl chloride and 1-anphthol
(b) 1-chloromethylnaphthalene and phenol
(c) 1-chloronaphthalene and benzyl alcohol
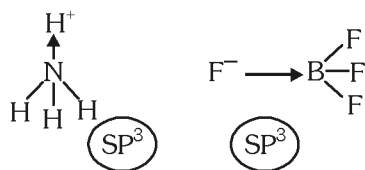(d) benzyl a alcohol and 1-naphthol

Ans. (No option is correct)

Sol.

47. The pair that is isostructural (i.e. having the same shape and hybridization) is–

(a) NF_3 and BF_3 (b) BF_4^- and NH_4^+ (c) BCl_3 and $BrCl_3$ (d) NH_3 and NO_3^-

Ans. **(b)**

**Sol.** $NH_4^{\oplus}$ & $BF_4^{\ominus}$

Both are tetrahedral

48. A group which departs from the substrate in a nucleophilic substitution reaction is called a leaving group. The ease of departure is determined by the acidity of the conjugate acid of the leaving group; higher the acidity better is the leaving group. The correct order of the reactivity of the following compounds in a given nucleophilic reaction is–

(a) $R{-}Cl > R{-}OCOCH_3 > R{-}OSO_2CH_3 > RI$ (b) $R{-}OSO_2CH_3 > R{-}Cl > R{-}OCOCH_3 > ROH$

(c) $R{-}I > RNH_3 > R{-}OCOCH_3 > R{-}OSO_2CH_3$ (d) $R{-}Br > R{-}OSO_2CH_3 > R{-}OCOCH_3 > ROCH_3$

Ans. **(d)**

Sol. Weaker the base better the leaving group.

49. Compound 'X' in the following reaction is

Ans. **(c)**

Sol.
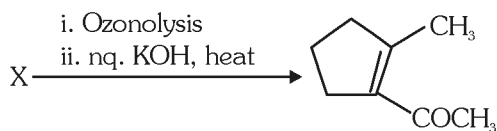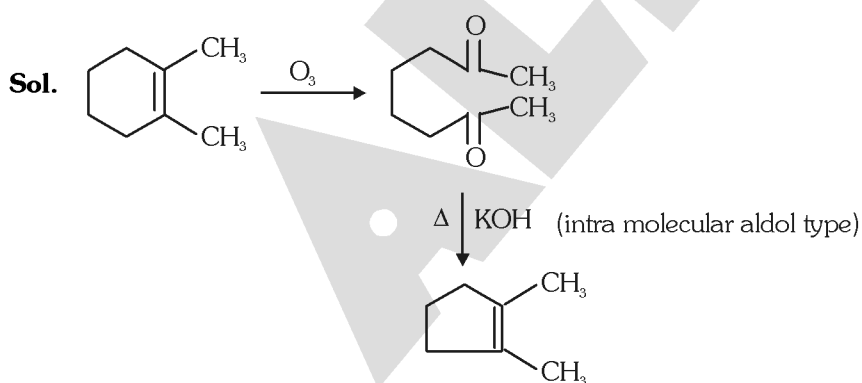
50. A toxic element is to be removed from drinking water by adsorption on activated charcoal. At low concentrations, the rate constant for adsorption is $1.8 \times 10^{-5}\,s^{-1}$. The time required to reduce the concentration of the toxic element to 10% of its initial concentration is–

(a) $1.28 \times 10^5\,s$ (b) $5.85 \times 10^3\,s$

(c) $1.28 \times 10^6\,s$ (d) cannot be calculated from the given data

Ans. **(a)**

Sol. $k = \dfrac{2.303}{t} \log_{10} \dfrac{100}{10}$

$$k = \frac{2.303}{t} \log_{10} 10$$

$$1.8 \times 10^5 = \frac{2.303}{t}$$

$$t = \frac{2.303}{1.8 \times 10^{-5}}$$

$$= \frac{2.303}{1.8} \times 10^{-5} \Rightarrow 1.28 \times 10^5 \text{ sec.}$$

51. Assuming that Hund's rule is violated by the diatomic molecule B_2, its bond order and magnetic nature will be respectively

(a) 1, diamagnetic   (b) 1, paramagnetic   (c) 2, diamagnetic   (d) 2, paramagnetic

Ans. (a)

Sol. $B_2 \quad \sigma 1s^2 \sigma*1s^2 \sigma 2s^2 \sigma*2s^2 \pi 2p_x^2 = \pi 2p_y$

$$\frac{6-4}{2} = 1$$

52. In a cubic crystal structure, divalent metal-ion is located at the body-centered position, the smaller tetravalent metal ions are located at each corner and the O^{2-} ions are located half way along each of the edges of the cube. The number of nearest neighbors for oxygen is–

(a) 4   (b) 6   (c) 2   (d) 8

Ans. (b)

Sol. Nearest neighbors for edge ccenters are corners.

53. Organic compounds sometimes adjust their electronic as well as steric structures to attain stability. Among the following, the compound having highest dipole moment is


Ans. (d)

Sol. $6\pi e^-$ Aromaticity.
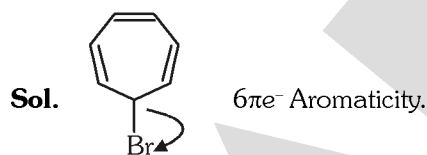
54. Cyanide ion is a very good complexing agent and also functions as a reducing agent. Hence many cyanide complexes of metals are known. Addition of an aqueous solution of KCN to a solution of copper sulphate yields a white precipitate which is soluble in excess of aqueous KCN to form the complex

(a) $[Cu(CN)_4]^{1-}$ (b) $[Cu(CN)_4]^{2-}$ (c) $[Cu(CN)_4]^{3-}$ (d) $[Cu(CN)_4]^{4-}$

Ans. (c)

Sol. $CuSO_4 + KCN \xrightarrow{\text{Excess}} [Cu(CN)_4]^{3-}$

Stable complex
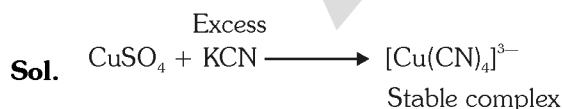
55. When a certain metal was irradiated with light of frequency 3.2×10^{16} Hz, the photoelectrons emitted had twice the kinetic energy as did the photoelectrons emitted when the same metal was irradiated with light of frequency 2.0×10^6 Hz. the v_0 of the metal is

(a) 2.4×10^{16} Hz   (b) 8.0×10^{16} Hz   (c) 8.0×10^{15} Hz   (d) 7.2×10^{16} Hz

Ans. (c)

Sol. $v = 3.2 \times 10^{16}$ Hz

$v = v_0 + K.E_{max\,1}$

$3.2 \times 10^{16} = v_0 + KE_1$

$2 \times 10^{16} = v_0 + \dfrac{KE_1}{2}$

$3.2 \times 10^{16} - v_0 = KE_1$

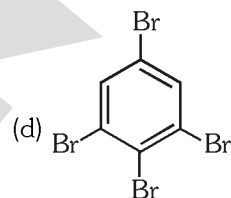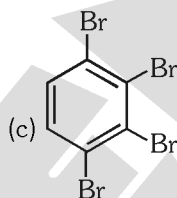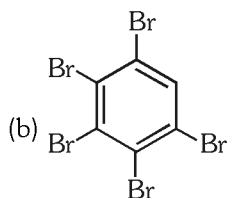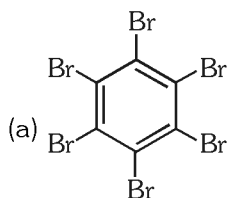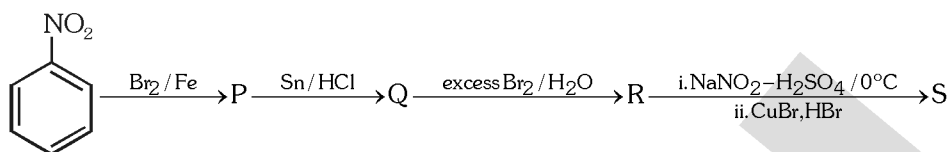$2 \times 10^{16} - v_0 = \dfrac{KE_1}{2}$

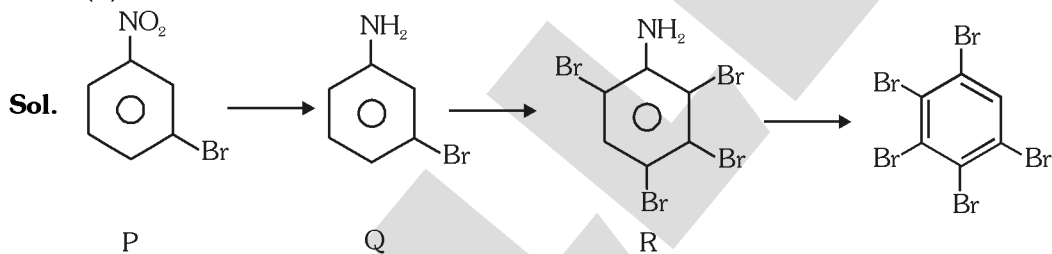$\dfrac{3.2 \times 10^{16} - v_0}{2 \times 10^{16} - v_0} = \dfrac{2}{1}$

$4 \times 10^{16} - 2v_0 = 3.2 \times 10^{16} - v_0$

$v_0 = 8 \times 10^{15}$ Hz

56. The major product 'S' of the following reaction sequence is–

(a) (b) (c) (d)

Ans. (b)

Sol.

P   Q   R

57. 1.250 g of metal carbonate (MCO_3) was treated with 500 mL of 0.1 M HCl solution. The unreacted HCl required 50.0 mL of 0.500 M NaOH solution for neutralization. Identify the metal M
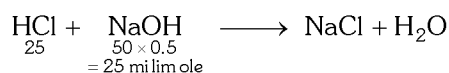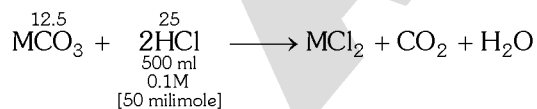
(a) Mg   (b) Ca   (c) Sr   (d) Ba

Ans. (c)

Sol. 1.25 g $MCO_3 \xrightarrow{\ HCl\ }$

$$\underset{12.5}{MCO_3} + \underset{\substack{500\,ml \\ 0.1M \\ [50\,milimole]}}{\underset{25}{2HCl}} \longrightarrow MCl_2 + CO_2 + H_2O$$

$$\underset{25}{HCl} + \underset{\substack{50 \times 0.5 \\ = 25\,milimole}}{NaOH} \longrightarrow NaCl + H_2O$$

$$\underset{12.5\,milimole}{MCO_3} \Rightarrow \dfrac{1.25}{Mw} = 12.5 \times 10^{-3}$$

$$Mw = \dfrac{1.25}{12.5 \times 10^{-3}} = 100$$

58. An electron beam can undergo diffraction by crystals which proves the wave nature of electrons. The potential required for a beam of electrons to be accelerated so that its wavelength becomes equal to 0.154 nm is-

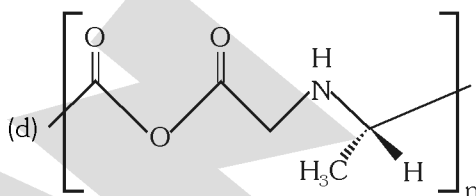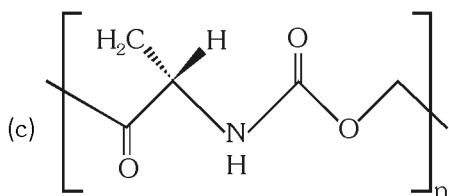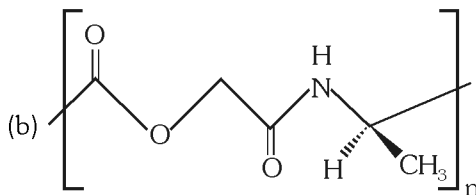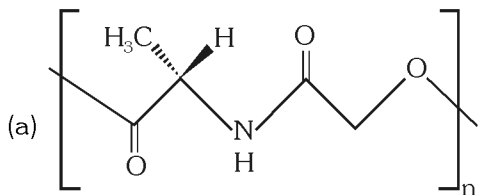(a) 63.5 V (b) 31.75 V (c) 635 V (d) 127 V

Ans. (a)

Sol. $\lambda = \sqrt{\dfrac{150}{v}}$

0.154 nm $= \lambda$

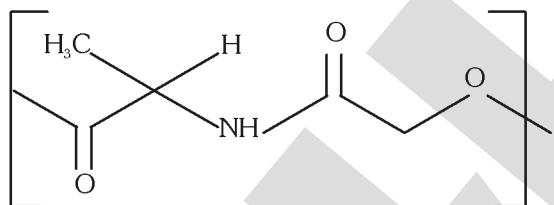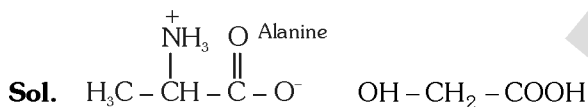$\lambda = 0.154 \times 10^{-9}$m   [1nm = 10 Å, 1 Å = 10^{-1}nm]

$\lambda = 154 \times 10^{-12}$m

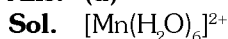**59.** A biodegradable alternating copolymer of L-alanine and glycolic acid (HO–CH_2–COOH) is

(a) ... (b) ... (c) ... (d) ...

Ans. (a)

Sol.

60. In which of the following complexes the metal ion has the lowest ionic radius?

(a) $[Ti(H_2O)_6]^{2+}$ (b) $[V(H_2O)_6]^{2+}$ (c) $[Cr(H_2O)_6]^{2+}$ (d) $[Mn(H_2O)_6]^{2+}$

Ans. (d)

Sol. $[Mn(H_2O)_6]^{2+}$

61. In cold climate, the water in a radiator of a car gets frozen causing damage to the radiator. Ethylene glycol is used as an antifreezing agent. The amount of ethylene glycol that should be added to 5 kg of water to prevent it from freezing at –7°C is

(Given : K_f for water = 1.86 K mol^{-1}kg; Molar mass of ethylene glycol = 62 g mol^{-1})

(a) 1165 g (b) 46.7 g (c) 116.7 g (d) 93.4 g

Ans. (a)

Sol. $W_{ethylene\ glycol}$
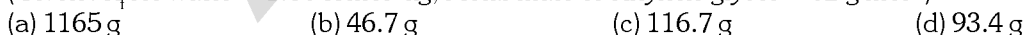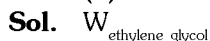
$W_{solvent} = 5$ kg

$K_f = 1.86$

$\Delta T_f = K_f . m . i$

$$7 = 1.86 \times \frac{gm}{6L} \times \frac{1}{5}$$

$$gm = \frac{7 \times 62 \times 5}{1.86} = 1166 \, gm$$

62. The ratio of the energy of the electron itr gound state of hydrogen atom to that of the electron in the first excited state of Be^{3+} is
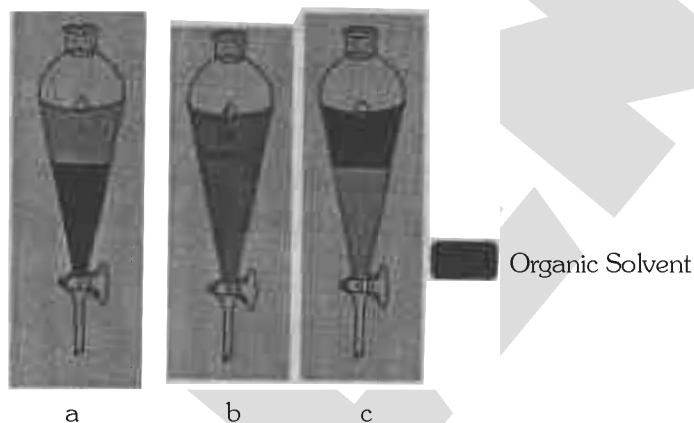
(a) 1 : 4   (b) 1 : 8   (c) 1 : 16   (d) 4 : 1

Ans. (a)

Sol. $H_{(n = 1)}$ $-13.6 \, ev$

$Be^{3+}_{(n = 2)}$ $-3.4 \times 4^2 = -13.6$

$$\frac{-13.6}{-54.4} = 1 : 4$$

63. Water insoluble, but organic solvent soluble, dye is dissolved in three organic solvents and taken in three separating funnels, a, b and c. To each solution, water is added, shaken, and kept undistrubed. The solvents in separating funnels a, b and c from the following are respectively–

Organic Solvent

a   b   c

(a) a : EtOH; b : CCl_4; c : EtOAc   (b) a : CCl_4, b : EtOH; c : EtOAc
(c) a : EtOAc; b : CCl_4; c ; EtOH   (d) a : CCl_4; b : EtOAc; c : EtOH

Ans. (b)

Sol. H_2O is completely soluble in EtOH

64. P, Q, R and S are four metals whose typical reactions are given below.

(i) Only Q and R react with dilute HCl to give H_2 gas.
(ii) When Q is added to a solution containing the ions of the other metals, metallic P, R and S are formed.
(iii) P reacts with concentrated HNO_3 but S does not.

The correct order of their reducing character is–

(a) S < P < R < Q   (b) S < R < P < Q   (c) R < Q < P < S   (d) Q < P < S < R

Ans. (a)

Sol. S < P < R < Q

65. If a dilute solution of aqueous NH_3 is saturated with H_2S then the product formed is–

(a) $(NH_4)_2S$ (b) NH_4HS (c) $(NH_4)_2S_x$ (d) $NH_4OH + S$

Ans. (b)

Sol. dil. aq. solution of $NH_3 + H_2S \longrightarrow NH_4HS$

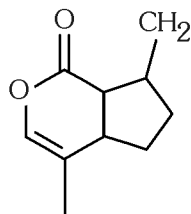**66.** Three Faradays of electricity are passed through aqueous solutions of $AgNO_3$, $NiSO_4$ and $CrCl_3$ kept in three vessels using inert electrodes. The ratio (in moles) in which the metals Ag, Ni and Cr are deposited is–

(a) 1 : 2 : 3   (b) 3 : 2 : 1   (c) 6 : 3 : 2   (d) 2 : 3 : 6

Ans. (c)

Sol.

AgNO$_3$	NiSO$_4$	CrCl$_3$
Ag$^+$	Ni^{2+}	Cr^{3+}

$3Ag^+ \rightarrow 2Ag$ $Ni^{+2} + 2e^- \rightarrow Ni$ $Cr^{+3} + 3e^- \rightarrow Cr$

3   3/2   3e$^-$ 1   3e$^-$

Ag	Ni	Cr
3	1.5	1
6 :	3 :	2
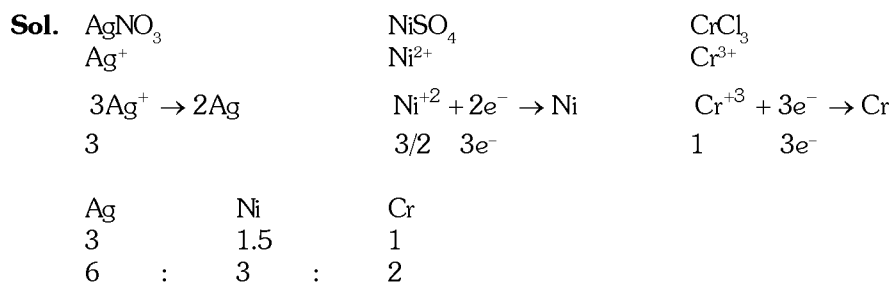
67. Nepetalactone (X) is isolated s an oil ftom Catnip.

The number of chiral carbon atoms and the amount of KOH consumed by 83 mg of Nepatalactone are respectively

(a) 3, 50 mg   (b) 2, 56 mg   (c) 3, 56 mg   (d) 3. 28 mg

Ans. **(d)**

Sol. 65 mg of KOH reacts with 154 mg of nepatalactone 83 mg of nepatalactone reacts with 30.18 mg.

68. Number of P–S single bonds, and P–S double bonds (P=S) in P$_4$S$_{10}$ are respectively

(a) 10, 6   (b) 16, 0   (c) 14, 2   (d) 12, 4

Ans. **(d)**

69. If the solubility product of iron(III) hydroxide is 1.8×10^{-37}, the pH of saturated solution of iron(III) hydroxide in distilled water is close to
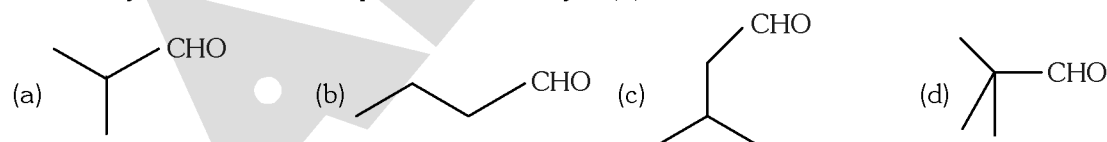
(a) 4   (b) 5   (c) 7   (d) 9

Ans. **(a)**

Sol. $27s^4 = 1.8 \times 10^{-37}$

$s = 2.85 \times 10^{-10}$

pH = 4.455 $\simeq$ 4

70. An alkyl halide (X) on reaction with ethanolic sodium hydroxide forms an alkene (Y) which on further reaction with HBr gives the same alkyl halide. The alkene (Y) on reaction with HBr peroxide followed by reaction with Mg metal followed by reaction with HCN produces an aldehyde (Z). Z is

Ans. **(b or c)**

Sol. As molecular formula of X is not given.

71. HClO$_4$ is a stronger acid than HClO. The correct statement is

(a) ClO$_4^-$ ion is more stabilized than ClO$^-$

(b) ClO$_4^-$ ion has higher hydration energy than ClO$^-$

(c) HClO$_4$ is better solvated in water than HClO.

(d) In HClO$_4$ H is attached to Cl, while in HClO it is attached to O.

Ans. **(a)**

Sol. ClO$_4^-$ is more resonace stabilised than ClO$^-$.

72. For an elementary rearrangement reaction A → P, the following data recorded at 303 K, when $[P]_0 = 0$

Set No.	$[A]_0/mol\ L^{-1}$	Rate of converstion of A/mol $L^{-1}\ min^{-1}$
1	0.340	0.100
2	0.170	0.050
3	0.085	0.025

If the equilibrium constant of the raction is 1.12 at 303 K, the rate constant for the reaction P → A is

(a) 0.263 min^{-1} (b) 0.294 min^{-1} (c) 0.526 min^{-1} (d) 0.588^{-1}

Ans. (a)

Sol. From the data, the order of the reaction is found to be 1.

$$K_f = \frac{0.1\ mol\ L^{-1}\ min^{-1}}{0.34\ mol\ L^{-1}} = 0.263\ min^{-1}$$

73. Compound P on treatment with CH_2N_2 (diazomethane) produces compound Q. Compound Q on reaction with HI produces two alkyl iodides R and S. Alkyl iodide S with higher number of carbon atoms on reaction with KCN followed by hydrolysis gives 3-methylbutanoic acid. The compound P is

(a) 2-butanol   (b) 1-butanol   (c) 2-methyl-2-propanol   (d) 2-methyl-l-propanol
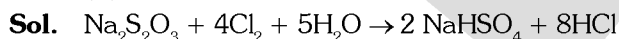
Ans. (d)

Sol.
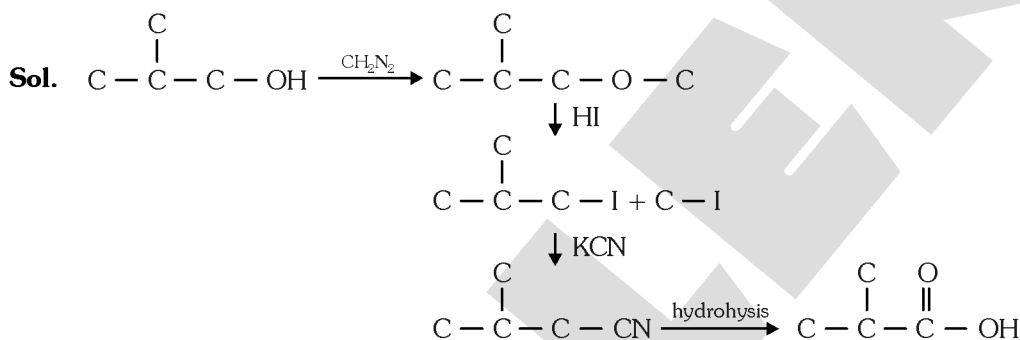
74. I_2 reacts with aqueous $Na_2S_2O_3$ to give $Na_2S_4O_6$ and NaI. The products of reaction of Cl_2 with aqueous $Na_2S_2O_3$ are

(a) $Na_2S_4O_6$ + NaCl   (b) $NaHSO_4$ + HCl   (c) $NaHSO_3$ + HCl   (d) $NaHSO_3$ + NaCl

Ans. (b)

Sol. $Na_2S_2O_3 + 4Cl_2 + 5H_2O \rightarrow 2\ NaHSO_4 + 8HCl$

75. The standard potentials (E°) of MnO_4^-/Mn^{2+} and MnO_2/Mn^{2+} half cells in acidic medium are 1.51 V and 1.23 V respectively at 298 K. The standard potential of MnO_4^-/MnO_2 half-cell in acidic medium at the same temperature is

(a) 5.09 V   (b) 1.70 V   (c) 0.28 V   (d) 3,34 V

Ans. (b)

Sol.

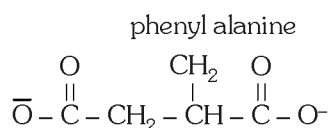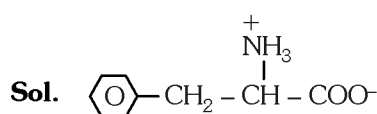|	
$MnO_4^- \rightarrow Mn^{+2}$	$-5 \times F \times 1.51$
$Mn^{+2} \rightarrow MnO_2$	$2 \times F \times 1.23$
$MnO_4^- \rightarrow MnO_2$	$-3 \times F \times 1.23$

$E° = 1.69$
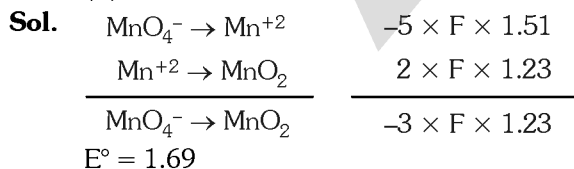
76. Aspartame (X) is an artificial sweetening agent and is 200 times sweeter than suger. It is an ester of the dipeptide of
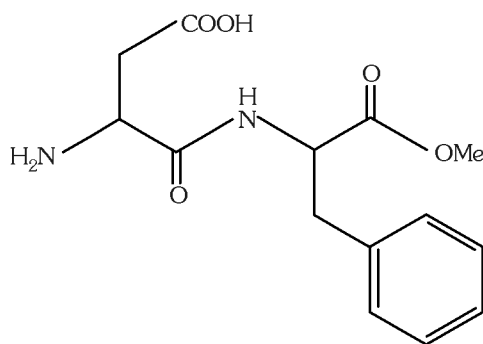
(a) alanine and phenylalanine

(b) aspartic acid and alanine

(c) phenylalanine and glycine

(d) aspartic acid and phenylalanine

Ans. **(d)**

Sol.

phenyl alanine

$$\overline{O} - \overset{O}{\overset{||}{C}} - CH_2 - \overset{CH_2}{\overset{|}{CH}} - \overset{O}{\overset{||}{C}} - O^-$$

77. Which one of the following reactions is correct?

(a) $[Fe(CO)_5] + 2NO \rightarrow [Fe(CO)_2(NO)_2] + 3CO$

(b) $[Fe(CO)_5] + 2NO \rightarrow [Fe(CO)_3(NO)_2] + 2CO$

(c) $[Fe(CO)_5] + 3NO \rightarrow [Fe(CO)_2(NO)_3] + 3CO$

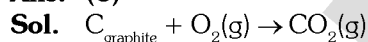(d) $[Fe(CO)_5] + 3NO \rightarrow [Fe(CO)_3(NO)_3] + 2CO$

Ans. **(a)**

Sol. Fact based.

78. Standard molar enthalpy of formation of $CO_2(g)$ is equal to–

(a) Zero

(b) The standard molar enthalpy of combustion of carbon (graphite)

(c) The standard molar enthalpy of combustion of C(g)

(d) The standard molar enthalpy of combustion of CO(g)

Ans. **(b)**

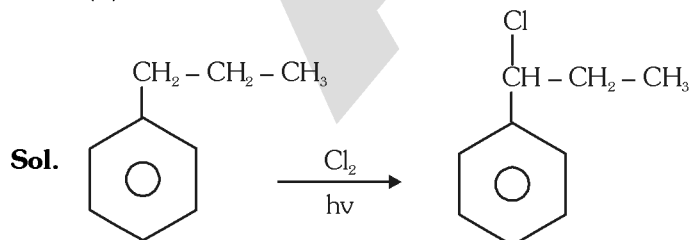**Sol.** $C_{graphite} + O_2(g) \rightarrow CO_2(g)$

$\Delta H°$ for the above reaction is both $\Delta H_f°$ of CO_2 and $\Delta H°_{Comb}$ of $C_{graphite}$

79. The reaction of 1-phenylpropane with limited amount of chlorine in the presence of light gives mainly

(a) 4-chloropropylbenzene

(b) 1-chloro-1-phenylpropane

(c) 3-chloro-1-phenylpropane

(d) 2-chloro-1-phenylpropane

Ans. **(b)**

Sol.

80. An ionic solid LaI_2 shows electrical conduction due to presence of–

(a) La^{2+} and $2I^-$

(b) La^{3+}, $2I^-$ and e^-

(c) La^{2+}, I_2 and $2e^-$

(d) La^{3+}, I_2 and $3e^-$

Ans. **(b)**

Sol. LaI_2 exist as

La^{+3}, $2I^-$ and $1e^-$