SOLUTION TO IIT–JEE 2005, (SCREENING)

MEMORY BASED QUESTIONS

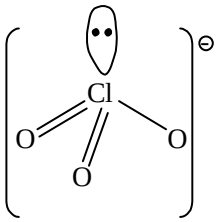
CHEMISTRY

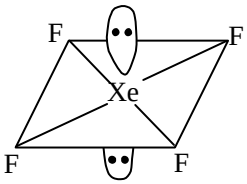
29. Which species has the maximum number of lone pair of electrons on the central atom?

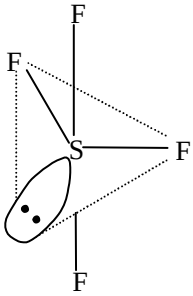
(a) $[ClO_3]^-$ (b) XeF_4

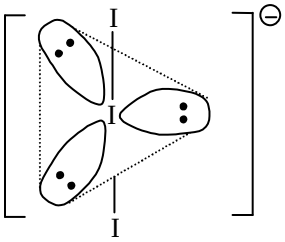
(c) SF_4 (d) $[I_3]^-$

Sol.









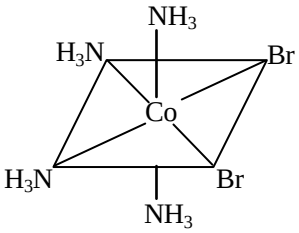
∴ (d)

30. Which kind of isomerism is exhibited by octahedral $Co(NH_3)_4Br_2Cl$?

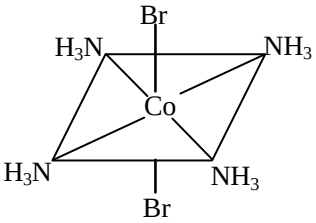
(a) Geometrical and Ionization (b) Geometrical and Optical

(c) Optical and Ionization (d) Geometrical only

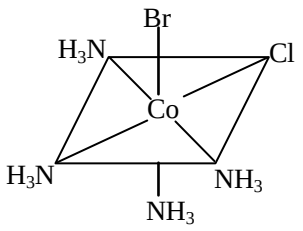
Sol. $Co(NH_3)_4Br_2Cl$ will show both geometrical and ionization isomerism. $[Co(NH_3)_4Br_2]Cl$ and $[Co(NH_3)_4BrCl]Br$ are ionization isomers and geometrical isomers are



cis



Trans



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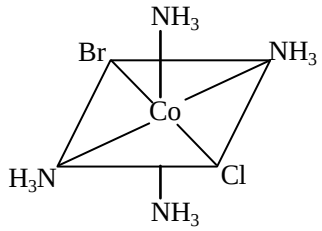


Trans

∴ (a)

31. Which is the most thermodynamically stable allotropic form of phosphorus?

(a) red (b) white
(c) black (d) yellow

Sol. The ignition temperature of black phosphorus is highest among all allotropes.

∴ (c)

32. Which ore contains both iron and copper?

(a) Cuprite (b) Chalcocite
(c) Chalcopyrite (d) malachite

Sol. Cuprite: Cu_2O
Chalcocite: Cu_2S
Chalcopyrite: $CuFeS_2$
Malachite: $Cu(OH)_2.CuCO_3$

∴ (c)

33. Which of the following is not oxidized by O_3 ?

(a) KI (b) $FeSO_4$
(c) $KMnO_4$ (d) K_2MnO_4

Sol. $KMnO_4$ will not be oxidized further by ozone as manganese is already present in its highest possible oxidation state i.e. +7.

∴ (c)

34. Which one of the following statement for order of reaction is not correct?

(a) Order can be determined experimentally.
(b) Order of reaction is equal to sum of the powers of concentration terms in differential rate law.
(c) It is not affected with the stoichiometric coefficient of the reactants.
(d) Order cannot be fractional.

Sol. Order of a reaction can be fractional.

∴ (d)

35. How will you convert butan–2–one to propanoic acid?

(a) Tollen's reagent (b) Fehling's solution
(c) $NaOH/I_2/H^+$ (d) $NaOH/NaI/H^+$

Sol.

$$C_2H_5-\underset{\underset{O}{||}}{C}-CH_3 + I_2 + NaOH \longrightarrow C_2H_5CO_2^-Na^+ + CHI_3$$

$$C_2H_5CO_2^-Na^+ \xrightarrow{H^+} C_2H_5COOH + Na^+$$

$\therefore$ (c)

36. Which BLUE LIQUID is obtained on reacting equimolar amounts of two gases at –30°C?

(a) N_2O (b) N_2O_3

(c) N_2O_4 (d) N_2O_5

Sol. $NO(g) + NO_2(g) \xrightarrow{-30°C} \underset{\text{(BLUE)}}{N_2O_3(l)}$

$\therefore$ (b)

37. Which of the following resonating structures of 1–methoxy–1,3–butadiene is least stable?

(a) $\overset{\ominus}{C}H_2 - CH = CH - CH = \overset{\oplus}{O} - CH_3$

(b) $CH_2 = CH_2 - \overset{\ominus}{C}H - CH = \overset{\oplus}{O} - CH_3$

(c) $\overset{\ominus}{C}H_2 - \overset{\oplus}{C}H - CH = CH - O - CH_3$

(d) $CH_2 = CH - \overset{\ominus}{C}H - \overset{\oplus}{C}H - O - CH_3$

Sol. The octet of all atoms are complete in structures that of option (a) and (b). In structure that of option (d) electron deficiency of positively charged carbon is duly compensated by lone pair electrons of adjacent oxygen atom while such neighbour group support is not available in structure that of option (c).

$\therefore$ (c)

38. The ratio of the rate of diffusion of helium and methane under identical condition of pressure and temperature will be

(a) 4 (b) 2

(c) 1 (d) 0.5

Sol. $$\frac{r_{He}}{r_{CH_4}} = \sqrt{\frac{M_{CH_4}}{M_{He}}}$$

$$= \sqrt{\frac{16}{4}} = 2$$

$\therefore$ (b)

39. When PbO_2 reacts with conc. HNO_3 the gas evolved is

(a) NO_2 (b) O_2

(c) N_2 (d) N_2O

Sol. PbO_2 is a powerful oxidizing agent and liberate O_2 when treated with acids. So, O_2 gas will be evolved.

$\therefore$ (b)

40. In which of the following crystals alternate tetrahedral voids are occupied?

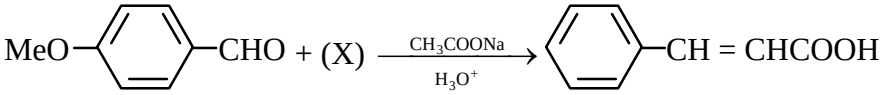
(a) NaCl (b) ZnS

(c) CaF_2 (d) Na_2O

Sol. In ZnS structure, sulphide ions occupy all FCC lattice points while Zn^{2+} ions are present in alternate tetrahedral voids.

$\therefore$ (b)

41.



The compound (X) is

(a) CH_3COOH (b) $BrCH_2 - COOH$

(c) $(CH_3CO)_2O$ (d) CHO – COOH

Sol. This is an example of Perkin's reaction.

Therefore, (X) is Acetic anhydride.

$\therefore$ (c)

42. The elevation in boiling point of a solution of 13.44 g of $CuCl_2$ in 1 kg of water using the following information will be

(Molecular weight of $CuCl_2$ = 134.4 and K_b = 0.52 K $molal^{-1}$)

(a) 0.16 (b) 0.05

(c) 0.1 (d) 0.2

Sol. $\Delta T_b = i.K_b.m$

$$CuCl_2 \longrightarrow Cu^{2+} + 2Cl^-$$

1	0	0
$(1-\alpha)$	α	2α

$i = 1 + 2\alpha$

Assuming 100% ionization

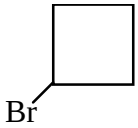
So, i = 3

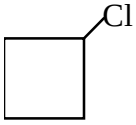
$\Delta T_b = 3 \times 0.52 \times 0.1$

$= 0.156 \approx 0.16$

$\therefore$ (a)

43. What would be the product formed when 1–Bromo–3–chloro cyclobutane reacts with two equivalents of metallic sodium in ether?

(a) 

(b) 

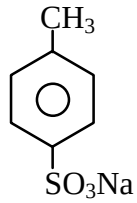
(c)

(d)

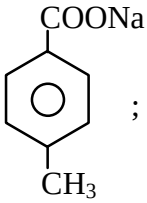
Sol. This is a Wurtz's type reaction and the only obvious choice is

∴ (d)

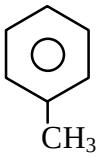
44. 4–methyl benzene sulphonic acid reacts with sodium acetate to give

(a) 

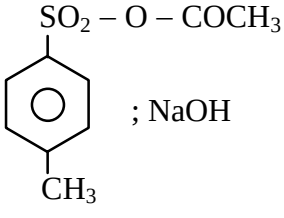
; CH_3COOH

(b) 

; SO_3

(c) 

; SO_3

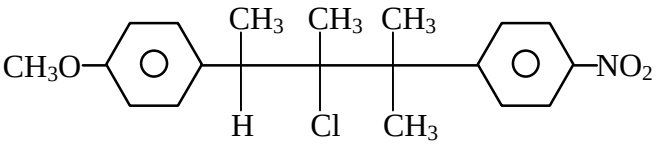
(d) 

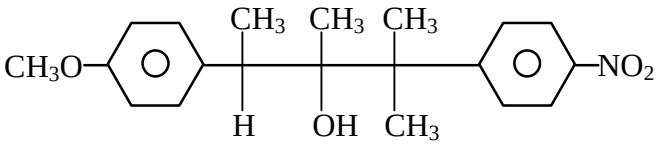
; NaOH

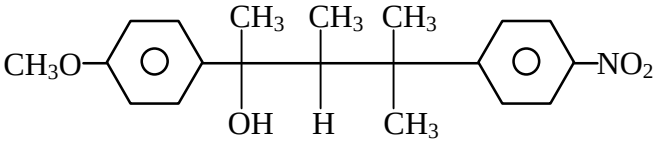
Sol. 4–methyl benzene sulphonic acid is stronger than acetic acid thus it will release acetic acid from sodium acetate.

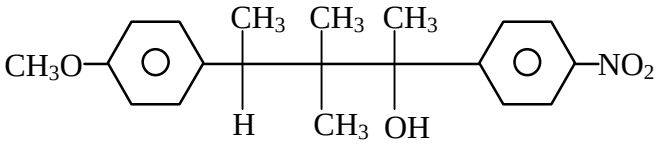
∴ (a)

45. The following compound on hydrolysis in aqueous acetone will give



(K): 

(L): 

(M): 

(a) Mixture of (K) and (L)
(b) Mixture of (K) and (M)
(c) Only (M)
(d) Only (K)

Sol. The product (K) is formed through simple nucleophilic substitution while major product (L) is formed through $\sim H^-$ shift via S_N1 reaction and methoxy group stabilizes the carbocation intermediate of product (L).

∴ (a)

46. 0.1 mole of CH_3NH_2 ($K_b = 5 \times 10^{-4}$) is mixed with 0.08 mole of HCl and diluted to one litre. What will be the H^+ concentration in the solution?

(a) 8×10^{-2} M (b) 8×10^{-11} M
(c) 1.6×10^{-11} M (d) 8×10^{-5} M

Sol.

CH_3NH_2 + HCl	$\longrightarrow$	$CH_3NH_3^+Cl^-$	
0.1	0.08	0	
0.02	0	0.08	(Basic buffer solution)

$$pOH = pK_b + \log \frac{0.08}{0.02}$$
$$= pK_b + 0.602$$
$$= 3.30 + 0.602$$
$$= 3.902$$
$\therefore$ pH = 10.09
$[H^+] = 7.99 \times 10^{-11} \approx 8 \times 10^{-11}$ M
$\therefore$ (b)

47. The rusting of iron takes place as follows

$2H^+ + 2e^- + ½O_2 \longrightarrow H_2O(l)$; E° = +1.23 V
$Fe^{2+} + 2e^- \longrightarrow Fe(s)$; E° = –0.44 V
Calculate ΔG° for the net process

(a) –322 kJ mol^{-1} (b) –161 kJ mol^{-1}
(c) –152 kJ mol^{-1} (d) –76 kJ mol^{-1}

Sol.

$Fe(s) \longrightarrow Fe^{2+} + 2e^-$; ΔG_1^o
$2H^+ + 2e^- + ½O_2 \longrightarrow H_2O(l)$; ΔG_2^o

$Fe(s) + 2H^+ + ½O_2 \longrightarrow Fe^{2+} + H_2O$; ΔG_3^o

Applying, $\Delta G_1^o + \Delta G_2^o = \Delta G_3^o$

$\Delta G_3^o = (-2F \times 0.44) + (-2F \times 1.23)$

$\Delta G_3^o = -(2 \times 96500 \times 0.44 + 2 \times 96500 \times 1.23)$

$\Delta G_3^o = -322310$ J

$\therefore \Delta G_3^o = -322$ kJ

$\therefore$ (a)

48. Name of the structure of silicates in which three oxygen atoms of $[SiO_4]^{4-}$ are shared is

(a) Pyrosilicate (b) Sheet silicate
(c) Linear chain silicate (d) Three dimensional silicate

Sol. Two dimensional sheet structures are formed when three oxygen atoms of each $[SiO_4]^{4-}$ tetrahedral are shared.

$\therefore$ (b)

49. Lyophilic sols are

(a) Irreversible sols.

(b) They are prepared from inorganic compound.

(c) Coagulated by adding electrolytes.

(d) Self–stabilizing.

Sol. Lyophilic sols are self stabilizing because these sols are reversible and are highly hydrated in the solution.

$\therefore$ (d)

50. Which pair of compounds is expected to show similar colour in aqueous medium?

(a) $FeCl_2$ and $CuCl_2$ (b) $VOCl_2$ and $CuCl_2$

(c) $VOCl_2$ and $FeCl_2$ (d) $FeCl_2$ and $MnCl_2$

Sol. Colour of transition metal ion salt is due to d–d transition of unpaired electrons of d–orbital. Metal ion salt having similar number of unpaired electrons in d–orbitals shows similar colour in aqueous medium.

V^{4+}: $[Ar]3d^1$ | ↑ | | | | |

Cu^{2+}: $[Ar]3d^9$ | ↑↓ | ↑↓ | ↑↓ | ↑↓ | ↑ |

Number of unpaired electrons = 1

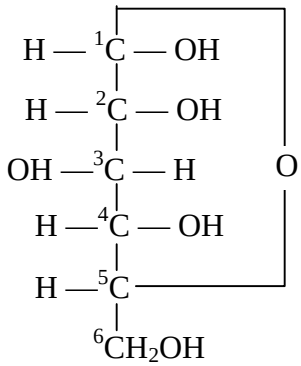
$\therefore$ (b)

51. The two forms of D–glucopyranose obtained from the solution of D–glucose are called

(a) Isomer (b) Anomer

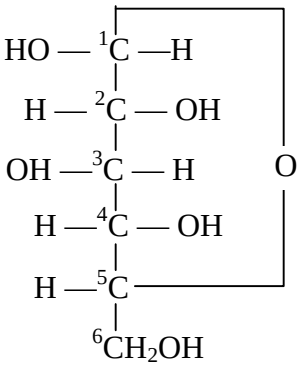
(c) Epimer (d) Enantiomer

Sol.



α - D(+) - Glucopyranose

&



β - D(+) - Glucopyranose

Two form of D–Glucopyranose are α–D(+)–Glucopyranose and β–D(+)–Glucopyranose. These are anomers (a pair of stereoisomers which differ in configuration only around C_1 are called anomers).

∴ (b)

52. The number of radial nodes of 3s and 2p orbitals are respectively.

(a) 2, 0 (b) 0, 2

(c) 1, 2 (d) 2, 1

Sol. Number of radial nodes = (n – *l* – 1)

For 3s: n = 3, *l* = 0 (Number of radial node = 2)

For 2p: n =2, *l* = 1 (Number of radial node = 0)

∴ (a)

53. A metal nitrate reacts with KI to give a black precipitate which on addition of excess of KI convert into orange colour solution. The cation of the metal nitrate is

(a) Hg^{2+} (b) Bi^{3+}

(c) Pb^{2+} (d) Cu^{+}

Sol. $Bi(NO_3)_3(aq) + 3KI(aq) \longrightarrow \underset{\text{Black}}{BiI_3(s)} + 3KNO_3(aq)$

$BiI_3(s) + KI(aq) \longrightarrow \underset{\text{Orange colour}}{K[BiI_4]}$

∴ (b)

54. When phenyl magnesium bromide reacts with t–butanol, the product would be

(a) Benzene (b) Phenol

(c) t–butyl benzene (d) t–butyl phenyl ether

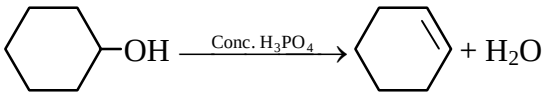
Sol. $(CH_3)_3COH + PhMgBr \longrightarrow PhH + (CH_3)_3COMgBr$

∴ (a)

55. The best method to prepare cyclohexene from cyclohexanol is by using

(a) Conc. HCl + $ZnCl_2$ (b) Conc. H_3PO_4

(c) HBr (d) Conc. HCl

Sol. 

Because conc. H_3PO_4 acts as a dehydrating agent.

∴ (b)

56. When one mole of monoatomic ideal gas at T K undergoes adiabatic change under a constant external pressure of 1 atm changes volume from 1 litre to 2 litre. The final temperature in Kelvin would be

(a) $\frac{T}{2^{(2/3)}}$ (b) $T + \frac{2}{3 \times 0.0821}$

(c) T (d) $T - \frac{2}{3 \times 0.0821}$

Sol. $TV^{\gamma-1} = K$

$T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$

$T_1V_1^{2/3} = T_2V_2^{2/3}$

$T(1)^{2/3} = T_2(2)^{2/3}$

$T_2 = \frac{T}{2^{(2/3)}}$

$\therefore$ (a)