KCET PYQ 2021

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CHEMISTRY

Q1 For the reaction, $A(g) + B(g) \rightleftharpoons C(g) + D(g) \quad \Delta H = -Q$ kJ

The equilibrium constant cannot be disturbed by

(A) addition of A

(B) addition of D

(C) increasing of pressure

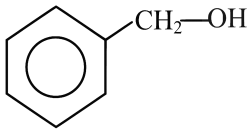
(D) increasing of temperature

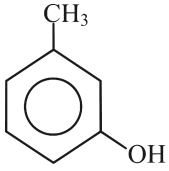
Q2 An organic compound X on treatment with PCC in dichloromethane gives the compound Y. Compound Y reacts with I_2 and alkali to form yellow precipitate of triiodomethane. The compound X is

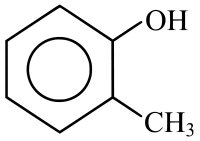
(A) CH_3CHO (B) CH_3COCH_3

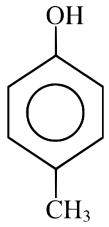
(C) CH_3CH_2OH (D) CH_3COOH

Q3 A compound 'A' (C_7H_8O) is insoluble in $NaHCO_3$ solution but dissolve in NaOH and give a characteristic colour with neutral $FeCl_3$ solution. When treated with bromine water compound 'A' forms the compound B with the formula $C_7H_5OBr_3$. 'A' is

(A) 

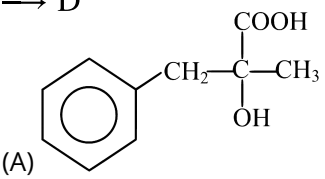
(B) 

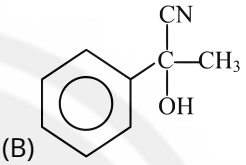
(C) 

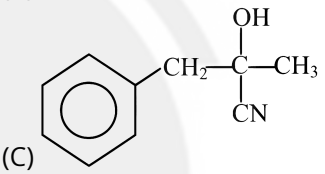
(D) 

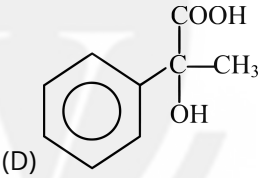
Q4 In set of reactions, identify D

$$CH_3COOH \xrightarrow{SOCl_2} A \xrightarrow[\text{Anhy. } AlCl_3]{\text{Benzene}} B \xrightarrow{HCN} C \xrightarrow{H_2O} D$$

(A) 

(B) 

(C) 

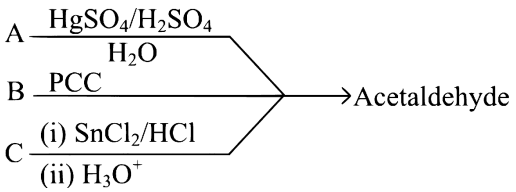
(D) 

Q5 K_a values for acids H_2SO_3, HNO_2, CH_3COOH and HCN are respectively 13×10^{-2}, 4×10^{-4}, 1.8×10^{-5} and 4×10^{-10}, which of the above acids produces stronger conjugate base in aqueous solution?

(A) H_2SO_3 (B) HNO_2

(C) CH_2COOH (D) HCN

Q6



A, B and C respectively are

(A) ethanol, ethane nitrile and ethyne

(B) ethane nitrile, ethanol and ethyne

(C) ethyne, ethanol and ethane nitrile

(D) ethyne, ethane nitrile and ethanol

Q7 The reagent which can do the conversion $CH_3\,COOH \rightarrow CH_3 - CH_2 - OH$ is

(A) $LiAlH_4$/ether (B) H_2, Pt

(C) $NaBH_4$ (D) Na and C_2H_5OH

Q8 $CH_3\,CHO \xrightarrow[(ii)\ H_3O^+]{(i)\ CH_3\,MgBr} A \xrightarrow[\Delta]{Conc.\ H_2\,SO_4} B$ A $\xrightarrow[(ii)\ H_2O,OH^-]{(i)\ B_2H_6} C$

and C are

(A) Identical

(B) Position isomers

(C) Functional

(D) Optical isomers

Q9 Which of the following is not true for oxidation?

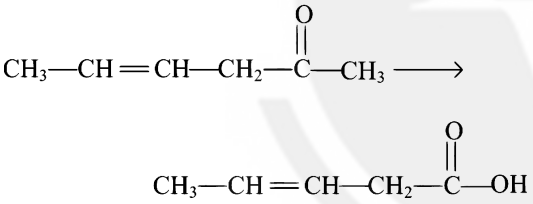
(A) Addition of oxygen

(B) Addition of electronegative element

(C) Removal of hydrogen

(D) Removal of electronegative element

Q10 Which is the most suitable reagent for the following conversion?



(A) Tollen's reagent

(B) Benzoyl peroxide

(C) I_2 and NaOH solution with subsequent acidification

(D) Sn and NaOH solution

Q11 $C_6H_5\,CH_2\,Cl \xrightarrow{Alc.\ NH_3} A \xrightarrow{2\,CH_3\,Cl} B$. The product B is

(A) N, N-dimethylphenylmethanamine

(B) N, N-dimethylbenzenamine

(C) N-benzyl-N-methylmethanamine

(D) phenyl-N-N-dimethylmethanamine

Q12 The method by which aniline cannot be prepared is

(A) nitration of benzene followed by reduction with Sn and conc. HCl

(B) degradation of benzamide with bromine in alkaline solution

(C) reduction of nitrobenzene with H_2/Pd is ethanol

(D) potassium salt of phthalimide treated with chlorobenzene followed by the hydrolysis with aqueous NaOH solution

Q13 Permanent hardness cannot be removed by

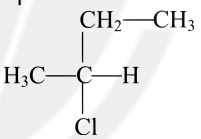
(A) using washing soda

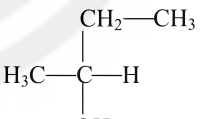
(B) Calgon's method

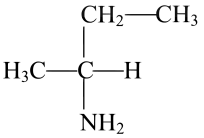
(C) Clark's method

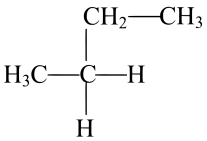
(D) ion exchange method

Q14 A hydrocarbon A (C_4H_8) on reaction with HCl gives a compound B (C_4H_9Cl) which on reaction with 1 mol of NH_3 gives compound C ($C_4H_{10}N$). On reacting with $NaNO_2$ and HCl followed by treatment with water, compound C yields an optically active compound D. The compound D is

(A) 

(B) 

(C) 

(D) 

Q15 RNA and DNA are chiral molecules, their chirality is due to the presence of

(A) D-sugar component

(B) L-sugar component

(C) chiral bases

(D) chiral phosphate ester unit

Q16 The property of the alkaline earth metals that increases with their atomic number is
(A) ionisation enthalpy
(B) electronegativity
(C) solubility of their hydroxide in water
(D) solubility of their sulphate in water

Q17 Primary structure in a nucleic acid contain 3 bases as GATGC ... The chain which is complementary to this chain is
(A) G G T G A...
(B) T G A A G...
(C) C T A C G...
(D) T T T A G...

Q18 In the detection of II group acid radical, the salt containing chloride is treated with concentrated sulphuric acid, the colourless gas is liberated. The name of the gas is
(A) hydrogen chloride gas
(B) chlorine gas
(C) sulphur dioxide gas
(D) hydrogen gas

Q19 The number of six membered and five membered rings in Buckminster fullerene respectively is
(A) 20, 12 (B) 12, 20
(C) 14, 18 (D) 14, 11

Q20 In chrysoberyl, a compound containing beryllium, aluminium and oxygen, oxide ions form cubic close packed structure. Aluminium ions occupy $\frac{1}{4}$th of octahedral voids. The formula of the compound is
(A) $BeAlO_4$ (B) $BeAl_2O_4$
(C) Be_2AlO_2 (D) $BeAlO_2$

Q21 The correct statement regarding defects in solid is
(A) Frenkel defect is a vacancy defect
(B) Schottky defect is a dislocation defect
(C) Trapping of an electron in the lattice leads to the formation of F-centre
(D) Schottky defect has no effect on density

Q22 A metal crystallises in bcc lattice with unit cell edge length of 300 pm and density 6.15 g cm^{-3} The molar mass of the metal is
(A) 50 g mol^{-1}
(B) 60 g mol^{-1}
(C) 40 g mol^{-1}
(D) 70 g mol^{-1}

Q23 Henry's law constant for the solubility of N_2 gas in water at 298 K is 1×10^5 atm. The mole fraction of N_2 in air is 0.8. The number of moles of N_2 from air dissolved in 10 moles of water at 298 K and 5 atm pressure is
(A) 4×10^{-4}
(B) 4×10^{-5}
(C) 5×10^{-4}
(D) 4×10^{-6}

Q24 A pure compound contains 2.4 g of C, 1.2×10^{23} atoms of H, 0.2 moles of oxygen atoms. Its empirical formula is
(A) C_2HO (B) $C_2H_2O_2$
(C) CH_2O (D) CHO

Q25 Choose the correct statement.
(A) K_H value is same for a gas in any solution.
(B) Higher the K_H value more the solubility of gas.
(C) K_H value increases on increasing the temperature of the solution.
(D) Easily liquefiable gases usually has lesser K_H values.

Q26 The K_H value (K bar) of argon (I), carbondioxide (II), formaldehyde (III) and methane (IV) are respectively 40.3, 167, 1.83×0^{-5} and 0.413 at 298 K. The increasing order of solubility of gas in liquid is
(A) I < II < IV < III
(B) III < IV < II < I
(C) I < III < II < IV
(D) I < IV < II < III

Q27 The vapour pressure of pure liquids A and B are 450 and 700 mm of Hg at 350 K respectively. If the total vapour pressure of the mixture is 600 mm of Hg, the composition of the mixture in the solution is

(A) $\chi_A = 0.4, \chi_B = 0.6$

(B) $\chi_A = 0.6, \chi_B = 0.4$

(C) $\chi_A = 0.3, \chi_B = 0.7$

(D) $\chi_A = 0.7, \chi_B = 0.3$

Q28 Consider the following electrodes

$P = Zn^{2+}(0.0001M)/Zn,$

$Q = Zn^{2+}(0.1M)/Zn$

$R = Zn^{2+}(0.01M)/Zn,$

$S = Zn^{2+}(0.001M)/Zn$

$E^{\circ}(Zn/Zn^{2+}) = -0.76\ V$ electrode potentials of the above electrodes in volts are in the order

(A) P > S > R > Q

(B) S > R > Q < P

(C) Q > R > S > P

(D) P > Q > R > S

Q29 The number of angular and radial nodes in 3p orbital respectively are

(A) 3,1 (B) 1,1

(C) 2,1 (D) 2,3

Q30 The resistance of 0.01 m KCl solution at 298 K is 15000. If the conductivity of 0.01 m KCl solution at 298 K is 0.1466×10^{-3} S cm^{-1}. The cell constant of the conductivity cell in cm^{-1} is

(A) 0.219 (B) 0.291

(C) 0.301 (D) 0.194

Q31 $H_2(g) + 2\,AgCl(s) \rightleftharpoons 2\,Ag(s) + 2\,HCl(aq)$ E°_{cell} at 25°C for the cell is 0.22 V. The equilibrium constant at 25°C is

(A) 2.8×10^7

(B) 5.2×10^8

(C) 2.8×10^5

(D) 5.2×10^4

Q32 For a reaction, A + 2B → Products, when concentration of B alone is increased half-life remains the same. If concentration of A alone is doubled, rate remains the same. The unit of rate constant for the reaction is

(A) s^{-1}

(B) L mol^{-1} s^{-1}

(C) mol L^{-1} s^{-1}

(D) atm^{-1}

Q33 The third ionisation enthalpy is highest in

(A) alkali metals

(B) alkaline earth metals

(C) chalcogens

(D) pnictogens

Q34 If the rate constant for a first order reaction is k, the time (t) required for the completion of 99% of the reaction is given by

(A) $t = \frac{4.606}{k}$

(B) $t = \frac{2.303}{k}$

(C) $t = \frac{0.693}{k}$

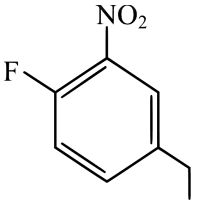
(D) $t = \frac{6.909}{k}$

Q35 The rate of a gaseous reaction is given by the expression $k[A][B]^2$. If the volume of vessel is reduced to one half of the initial volume, the reaction rate as compared to original rate is

(A) $\frac{1}{16}$ (B) $\frac{1}{8}$

(C) 8 (D) 16

Q36 The correct IUPAC name of



(A) 4-ethyl-1-fluoro-2-nitrobenzene

(B) 1-ethyl-4-fluoro-3-nitrobenzene

(C) 3-ethyl-6-fluoronitrobenzene

(D) 5-ethyl-2-fluoronitrobenzene

Q37 Higher order (> 3) reactions are rare due to
(A) shifting of equilibrium towards reactants due to elastic collisions
(B) loss of active species on collision
(C) low probability of simultaneous collision of all reacting species
(D) increase in entropy as more molecules are involved

Q38 Arrange benzene, n-hexane and ethyne in decreasing order of their acidic behaviour.
(A) Benzene > n-hexane > Ethyne
(B) n-hexane > Benzene > Ethyne
(C) Ethyne > n-hexane > Benzene
(D) Ethyne > Benzene > n-hexane

Q39 A colloidal solution is subjected to an electric field than colloidal particles move towards anode. The amount of electrolytes of $BaCl_2$, $AlCl_3$ and NaCl required to coagulate the given colloid is in the order
(A) NaCl > $BaCl_2$ > $AlCl_3$
(B) $BaCl_2$ < $AlCl_3$ > NaCl
(C) $AlCl_3$ = NaCl = $BaCl_2$
(D) $AlCl_3$ > $BaCl_2$ > NaCl

Q40 Which of the following is an incorrect statement?
(A) Hydrogen bonding is stronger than dispersion forces
(B) Sigma bonds are stronger than π-bonds
(C) Ionic bonding is non-directional
(D) σ-electrons are referred to as mobile electrons

Q41 Zeta potential is
(A) potential required to bring about coagulation of a colloidal sol.
(B) potential required to give the particle a speed of 1 cm s^{-1}
(C) potential difference between fixed charged layer and the diffused layer having opposite charges
(D) potential energy of the colloidal particles.

Q42 Which of the following compound on heating gives N_2O ?
(A) $Pb(NO_3)_2$ (B) NH_4NO_3
(C) NH_4NO_2 (D) $NaNO_3$

Q43 Which of the following property is true for the given sequence ?
$NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$?
(A) Reducing property
(B) Thermal stability
(C) Bond angle
(D) Acidic character

Q44 The correct order of boiling point in the following compounds is
(A) HF > H_2O > NH_3
(B) H_2O > HF > NH_3
(C) NH_3 > H_2O > HF
(D) NH_3 > HF > H_2O

Q45 XeF_6 on partial hydrolysis gives a compound X, which has square pyramidal geometry 'X' is
(A) XeO_3 (B) XeO_4
(C) $XeOF_4$ (D) XeO_2F_2

Q46 A colourless, neutral, paramagnetic oxide of nitrogen 'P' on oxidation gives reddish brown gas Q. Q on cooling gives colourless gas R. R on reaction with P gives blue solid S. Identify P, Q, R, S respectively
(A) N_2O, NO, NO_2, N_2O_5
(B) $N_2O, NO_2, N_2O_4, N_2O_3$
(C) NO, NO_2, N_2O_4, N_2O_3
(D) NO, NO, N_2O_4, N_2O_5

Q47 Which of the following does not represent property stated against it ?
(A) $CO^{2+} < Fe^{2+} < Mn^{2+}$ – Ionic size
(B) Ti < V < Mn – Number of oxidation states
(C) $Cr^{2+} < Mn^{2+} < Fe^{2+}$ – Paramagnetic behaviour
(D) Sc > Cr > Fe – Density

Q48 Which one of the following is correct for all elements from Sc to Cu?

(A) The lowest oxidation state shown by them is +2

(B) 4s orbital is completely filled in the ground state

(C) 3d orbital is not completely filled in the ground state

(D) The ions in +2 oxidation states are paramagnetic

Q49 When the absolute temperature of ideal gas is doubled and pressure is halved, the volume of gas

(A) will be half of original volume

(B) will be 4 times the original volume

(C) will be 2 times the original volume

(D) will be 1/4th times the original volume

Q50 Which of the following pairs has both the ions coloured in aqueous solution? [Atomic numbers of Sc = 21 Ti = 22 Ni = 28 , Cu = 29 , Mn = 25]

(A) Sc^{3+}, Mn^{2+} (B) Ni^{2+}, Ti^{4+}

(C) Ti^{3+}, Cu^{+} (D) Mn^{2+}, Ti^{3+}

Q51 For the crystal field splitting in octahedral complexes,

(A) the energy of the e_g orbitals will decrease by $(3/5)\Delta_o$ and that of the t_{2g} will increase by $(2/5)\Delta_0$

(B) the energy of the e_g orbitals will increase by $(3/5)\Delta_o$ and that of the t_{2g} will decrease by $(2/5)\Delta_o$

(C) the energy of the e_g orbitals will increase by $(3/5)\Delta_o$ and that of the t_{2g} will increase by $(2/5)\Delta_0$

(D) the energy of the e_g orbitals will decrease by $(3/5)\Delta_0$ and that of the t_{2g} will decrease by $(2/5)\Delta_0$

Q52 Peroxide effect is observed with the addition of HBr but not with the addition of HI to unsymmetrical alkene because

(A) H-I bond is stronger than H - Br and is not cleaved by the free radical

(B) HI bond is weaker than H - Br bond so that iodine free radicals combine to form iodine molecules

(C) Bond strength of HI and HBr are same but free radicals are formed in HBr

(D) All of the above

Q53 The IUPAC name of $[Co(NH_3)_5 (CO_3)]$ Cl is

(A) pentaamminecarbonatocobalt (III) chloride

(B) carbonatopentamminecobalt (III) chloride

(C) pentaamminecarbonatocobaltate (III) chloride

(D) pentaammine cobalt (III) carbonate chloride

Q54 Homoleptic complexes among the following are

$(A)\ K_3[Al(C_2O_4)_3]$

$(B)\ [CoCl_2(en)_2]^+$

$(C)\ K_2[Zn(OH)_4]$

(A) A only (B) A and B only

(C) A and C only (D) C only

Q55 The correct order for wavelengths of light absorbed in the complex ions $[CoCl(NH_3)_5]^{2+}$, $[Co(NH_3)_6]^{3+}$ and $[Co(CN)_6]^{3-}$ is

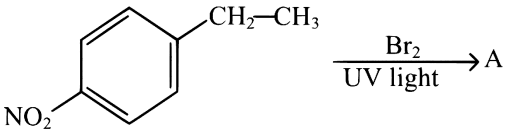
(A) $[CoCl(NH_3)_5]^{2+} > [Co(NH_3)_6]^{3+} > [Co(CN)_6]^{3-}$

(B) $[Co(NH_3)_6]^{3+} > [Co(CN)_6]^{3-} > [CoCl(NH_3)_5]^{2+}$

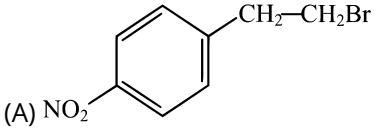
(C) $[Co(CN)_6]^{3-} > [CoCl(NH_3)_5]^{2+} > [Co(CN)_6]^{3-}$

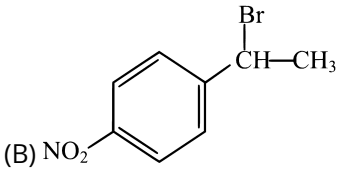
(D) $[Co(NH_3)_6]^{3+} > [CoCl(NH_3)_5]^{2+} > [Co(CN)_6]^{3-}$

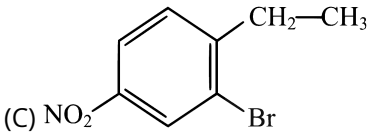
Q56

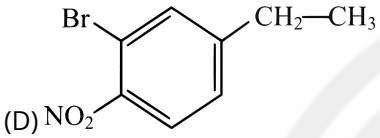


The compound A (major product) is

(A) 

(B) 

(C) 

(D) 

Q57 Bond enthalpies of A_2, B_2 and AB are in the ratio 2: 1: 2. If bond enthalpy of formation of AB is –100 kJ mol^{-1}. The bond enthalpy of B_2 is

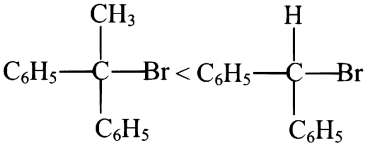
(A) 100 kJ mol^{-1}

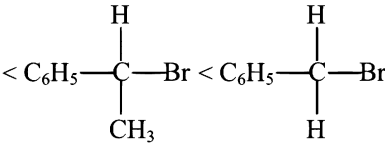
(B) 50 kJ mol^{-1}

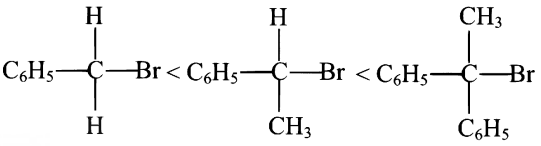
(C) 200 kJ mol^{-1}

(D) 150 kJ mol^{-1}

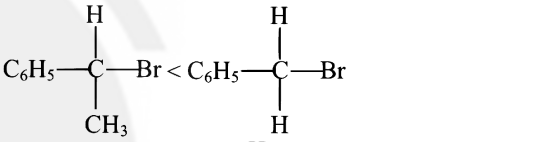
Q58 The order of reactivity of the compounds $C_6H_5\ CH_2\ Br, C_6H_5\ CH(C_6H_5)Br,$ $C_6H_5\ CH(CH_3)Br$ and $C_6H_5C(CH_3)(C_6H_5)Br$ in S_N2 reactionis

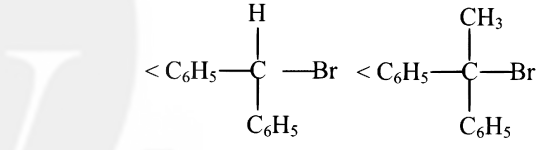


(A) 



(B) 

(C) 

(D) 

Q59 The major product of the following reaction is

$$CH_2 = CH - CH_2 - OH \xrightarrow[\text{Excess}]{HBr} \text{Product}$$

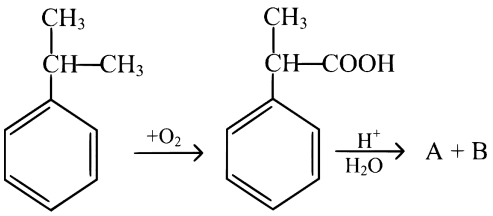
(A) $CH_3 - CHBr - CH_2Br$

(B) $CH_2 = CH - CH_2Br$

(C) $CH_3CHBr - CH_2 - OH$

(D) $CH_3 - CHOH - CH_2OH$

Q60



The product 'A' gives white precipitate when treated with bromine water. The product 'B' is treated with barium hydroxide to give the product C. The compound C' is heated strongly to form product D. The product D is

(A) 4-methylpent-3-en-2-one

(B) but-2 enal

(C) 3-methylpent-3-en-2-one

(D) 2-methylbut-2-enal

Answer Key

Q1	C
Q2	C
Q3	B
Q4	D
Q5	D
Q6	C
Q7	A
Q8	B
Q9	D
Q10	C
Q11	A
Q12	D
Q13	C
Q14	B
Q15	A
Q16	C
Q17	C
Q18	A
Q19	A
Q20	B
Q21	C
Q22	A
Q23	A
Q24	D
Q25	C
Q26	A
Q27	A
Q28	C
Q29	B
Q30	A
Q31	A
Q32	A
Q33	B
Q34	A
Q35	C
Q36	A
Q37	C
Q38	D
Q39	A
Q40	D
Q41	C
Q42	B
Q43	B
Q44	B
Q45	C
Q46	C
Q47	C
Q48	D
Q49	B
Q50	D
Q51	B
Q52	B
Q53	A
Q54	C
Q55	A
Q56	B
Q57	C
Q58	A
Q59	A
Q60	A

Hints & Solutions

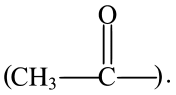
Note: scan the QR code to watch video solution

Q1 Text Solution:

For the given hypothetical reaction, $A(g) + B(g) \rightleftharpoons C(g) + D(g); \Delta H = -Q \text{ kJ}$ $\Delta n = 0$, because number of molecules of gaseous molecule on both side are equal. Thus, the equilibrium constant cannot be disturbed by increasing of pressure.

Q2 Text Solution:

Compound (Y) gives iodoform test, that means it contains acetyl group



PCC is an oxidising agent which oxidised the alcohol to aldehyde or ketone (depends upon the reactant alcohol). That means X is an alcohol.

From the given information, it is concluded that the compound X is an alcohol (which contain two carbon). Thus, the alcohol is CH_3CH_2OH.

The reaction involves are as follows:

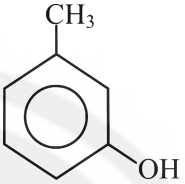
$$\underset{(X)}{CH_3CH_2OH} \xrightarrow[CH_2Cl_2]{PCC} \underset{(Y)}{CH_3CHO} \xrightarrow[NaOH]{I_2} CHI_3 + HCO^-\overset{+}{Na}$$

Q3 Text Solution:

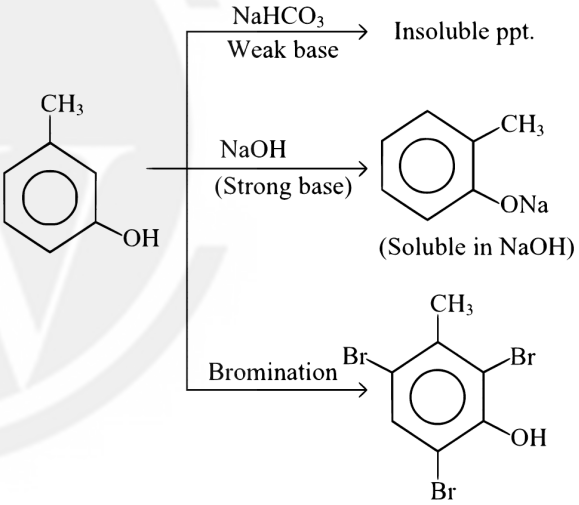
It is given in the question that, compound A gives a characteristic colour with neutral $FeCl_3$ solution and soluble in NaOH solution that means it contains a phenolic group.

Since compound 'A' when treated with Br_2 forms compound 'B' with molecular formula $C_7H_5OBr_3$ (ppt.).

Considering the given information the given compound is most likely to be m-cresol. i.e.

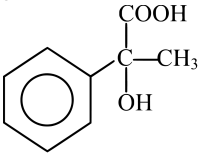


Thus, the overall reactions are as follows.

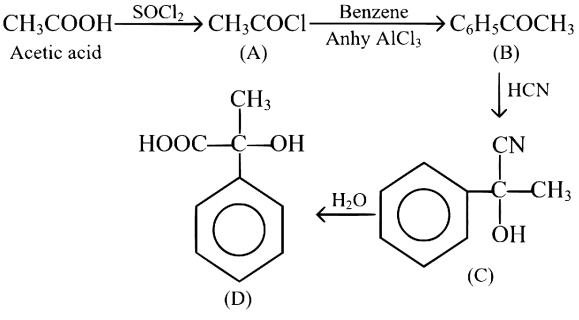


Q4 Text Solution:

In the set of the given reaction the final product D is



The overall reaction is as follows:



Q5 Text Solution:

Lower the value of K_a, lower will be the acidic strength and stronger will be the conjugate.base. Therefore, among the given acids, HCN has the lowest Ka value (i.e. 4×10^{-10})

Hence, it is the strongest conjugate base.

Q6 Text Solution:

Ethyne on reaction with $HgSO_4/H_2SO_4$ gives ethenol (i.e. CH_2 = CH - OH) which interconvert (i.e. tautomerises) to give acetaldehyde (CH_3CHO).

$$CH \equiv CH \xrightarrow[H_2SO_4]{HgSO_4} CH_2 = CH - OH \underset{\text{Tautomerises}}{\rightleftharpoons} CH_3CHO$$

PCC is an oxidising agent, which oxidised the alcohol to aldehyde. Therefore, (B) is an alcohol, i.e. ethanol.

$$CH_3CH_2OH \xrightarrow{PCC} CH_3CHO$$

Ethane nitrile on reaction with $SnCl_2$/HCl followed by acid hydrolysis give acetaldehyde.

$$CH_3CN \xrightarrow[(ii)\ H_3O^+]{(i)\ SnCl_2/HCl} CH_3CHO$$

Q7 Text Solution:

$LiAlH_4$/ether is an reducing agent, thus it can reduces carboxylic acid (in this case is acetic acid) to alcohols (in this case is ethanol). The overall reaction is as follows

$$CH_3COOH \xrightarrow{LiAlH_4\ /\ ether} CH_3CH_2OH$$

Q8 Text Solution:

The complete given reaction is as follows

$$CH_3CHO \xrightarrow[(ii)\ H_3O^+]{(i)\ CH_3MgBr} \underset{\text{Propan-2-ol (A)}}{CH_3-\overset{\overset{OH}{|}}{CH}-CH_3} \xrightarrow{\text{Conc. } H_2SO_4} \underset{\text{Prop-1-ene (B)}}{CH_2=CH-CH_3}$$

$$\xrightarrow{(i)\ B_2H_6} CH_3CH_2CH_2BH_2 \xrightarrow{CH_2=CHCH_3} (CH_3CH_2CH_2)_2BH \xrightarrow{CH_3CH=CH_3} (CH_3CH_2CH_2)_3B$$

$$\xrightarrow{(ii)\ H_2O,\ OH^-} \underset{\text{Propan-1-ol (C)}}{CH_3CH_2CH_2OH} + \underset{\text{Boric acid}}{B(OH)_3}$$

In compounds (A) and (C) only the position of -OH group is changed. Thus, compounds A and Care position isomers.

Q9 Text Solution:

From the given option only (d) option is not true for oxidation i.e. removal of electronegative element does not takes place in case of oxidation.

Q10 Text Solution:

In the given reaction $-COCH_3$ group gets oxidised to –COOH without affecting the double bond. This could occur when we use I_2 and NaOH solution with subsequent acidification. This reaction is known as iodoform reaction. The overall reaction is as follows

$$CH_3CH=CH-CH_2-\overset{\overset{O}{\|}}{C}CH_3 \xrightarrow[\text{(ii) Acidification}]{\text{(i) } I_2/NaOH} CH_3CH=CHCH_2-\overset{\overset{O}{\|}}{C}-OH$$

Q11 Text Solution:

Benzyl chloride on reaction with alc. NH_3 gives benzyl amine (A) which further on reaction with two moles of CH_3Cl give N, N-dimethyl phenylmethanamine (B).

$$\underset{\text{Benzyl chloride}}{C_6H_5CH_2Cl} \xrightarrow{\text{Alc. } NH_3} \underset{\text{(A) Benzyl amine}}{C_6H_5CH_2NH_2} \xrightarrow{2CH_3Cl} \underset{\text{(B) N, N-dimethylphenylmethanamine}}{C_6H_5CH_2N(CH_3)_2}$$

Q12 Text Solution:

Aryl halides do not undergo nucleophilic substitution with potassium phthalimide under ordinary conditions. Thus, method (d) cannot be used for preparation of aniline.

Q13 Text Solution:

Permanent hardness cannot be removed by Clark's method. This method is used for removing temporary hardness.

Q14 Text Solution:

From the given information question, addition of HCl occured on A. That means A is an alkene.

$$\underset{(A)}{C_4H_8} \xrightarrow{HCl} \underset{(B)}{C_4H_9Cl}$$

Cl in compound B is substituted by NH_2 to give compound C ($C_4H_{11}N$).

$$\underset{(B)}{C_4H_9Cl} \xrightarrow{NH_3} \underset{(C)}{C_4H_{11}N}$$

C gives a diazonium salt with $NaNO_2$/HCl which on further treatment with water give an optically active alcohol. That means C is an aliphatic amine.

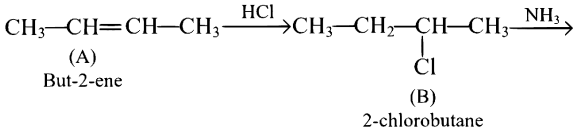
$$C \xrightarrow[(ii)H_2O]{(i)\ Na\ O_2/HCl} D\left[\text{Alcohol}\left(\text{optically active}\right)\right]$$

From the given information it is concluded that the most probable structure of A is

$$CH_3 - CH = CH - CH_3$$

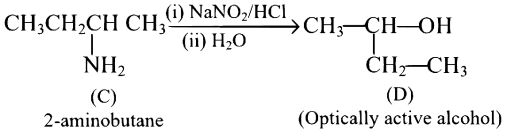
As only but-2-ene gives optically active alcohol (D) as final product.

The reactions involves are as follows.



(A) But-2-ene

(B) 2-chlorobutane

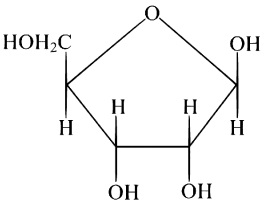


(C) 2-aminobutane

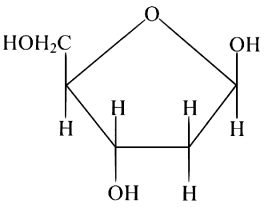
(D) (Optically active alcohol) (Butan-2-ol)

Q15 Text Solution:

RNA and DNA are chiral molecules, their chirality is due to the presence of D-sugar component.



D(−)-ribose



D(−)-2-deoxyribose

Q16 Text Solution:

The solubility of the ionic compounds (in this case is hydroxide of alkaline earth metals) depends on two factors, which are (i) lattice energy and (ii) hydration energy. Hence, solubility of alkaline earth metal increases with increase in their atomic number.

Whereas, other given properties i.e. ionisation energy, electronegativity and solubility of their sulphate in water decreases with atomic number.

Q17 Text Solution:

Primary structure in a nucleic acid contains bases as GATGC ..... . The chain which is complementary to this chain is CTACG..... .

Q18 Text Solution:

In the detecting of II group acid radical, when salt containing chloride is treated with concentrated sulphuric acid, the colourless gas is liberated. The name of the gas is hydrogen chloride gas.

Q19 Text Solution:

The number of six membered and five membered rings in Buckminster fullerence respectively is 20 and 12.

Q20 Text Solution:

Given, chrysoberyl forms ccp structure.

Oxygen occupies lattice points = N (say)

Al occupies $\frac{1}{2}$ of octahedral voids = $\frac{N}{2}$

Be occupies $\frac{1}{8}$ of tetrahedral voids = $\frac{2N}{8}$

$\therefore$ The formula of compound is

$$Be : Al : O$$

$$\frac{2N}{8} : \frac{N}{2} : N$$

$$\Rightarrow BeAl_2O_4$$

Q21 Text Solution:

The correct statements regarding defects in solid is trapping of an electron in the lattice which leads to the formation of F-centre.

Other statements are incorrect, because Frenkel defect is dislocation defect and density decreases in case of Schottky defect as it is a vacancy defect.

Q22 Text Solution:

Given, metal crystallises in bcc lattice, therefore Z = 2

Edge length = 300pm

$= 300 \times 10^{-10}$ cm

Density,

$$d = \frac{ZM}{a^3 N_A} \Rightarrow M = \frac{da^3 N_A}{Z}$$

$$= \frac{6.15 \times (300 \times 10^{-10})^3 \times 6 \times 10^{23}}{2}$$

$$= 498150000 \times 10^{-7}$$

$$= 49.82 \text{ g mol}^{-1}$$

$$\cong 50 \text{ g mol}^{-1}$$

Q23 Text Solution:

Given, Henry's law constant (K_H) for the solubility of N_2 gas in water at 298 K = 1×10^5 atm.

Mole fraction of N_2 $(\chi_{N_2}) = 0.8$

Hence, partial pressure of nitrogen,

$$p_{N_2} = p_{total} \cdot \chi_{N_2}$$

$$= 0.8 \times 5 \text{ atm}$$

$$= 4 \text{ atm}$$

According to Henry's law,

$$p_{N_2} \& = K_H \chi_{N_2}$$

$$4 = 10^5 \cdot \chi_{N_2}$$

$$\chi_{N_2} = 4 \times 10^{-5}$$

We know that, $\chi_{N_2} = \frac{n_{N_2}}{n_{N_2} + n_{H_2O}}$

$$4 \times 10^{-5} = \frac{n_{N_2}}{10} \quad (\because n_{N_2} \ll n_{H_2O})$$

$$\Rightarrow \quad n_{N_2} = 4 \times 10^{-4} \text{ moles}$$

Thus, the number of moles of N_2 from air dissolved in 10 moles of water at 295 K and 5 atm pressure is 4×10^{-4}.

Q24 Text Solution:

Moles of carbon $= \frac{w}{M} = \frac{2.4}{12} = 0.2$ mol

Moles of H in 1.2×10^{23} atoms of H

$$= \frac{1.2 \times 10^{23}}{6 \times 10^{23}}$$

$= 0.2$ mol

Moles of oxygen atoms $= 0.2$ moles

Now, simplest ratio of the moles of C, H and O is as follows

$= C : H : O$

$= 0.2 : 0.2 : 0.2 = CHO$

Thus, the empirical formula of the compound is CHO.

Q25 Text Solution:

Among the given statements only (c) statement is correct about the Henry's law constant. Other statement are incorrect because

(a) K_H is a function of the nature of the gas and solvent used, thus KH value is not same for a gas in any solution.

(b) Higher the K_H value, less the solubility of the gas.

(d) Easily liquefiable gases usually have higher K_H values.

Q26 Text Solution:

Higher is the K_H value, less is the solubility of the gas.

Given compound	K_H **value at** 298 K
Argon (I)	40.3
Carbon dioxide (II)	1.67
Formaldehyde (III)	1.83×10^{-5}
Methane (IV)	0.413

Thus, the increasing order of solubility of gas in liquid is I < II < IV < III.

Q27 Text Solution:

Given, vapour pressure of pure liquid A, p_A = 450mm of Hg

vapour pressure of pure liquid B,

$p_B^\circ = 700$ mm of Hg

Total vapour pressure,

$p_{Total} = 600$ mm of Hg

From Raoult's law, $p_{Total} = p^{\circ}_A \chi_A + p_B \chi_B$

$= p^0_A \chi_A + p^0_B (1 - \chi_A)$

$\Rightarrow 600 = 450\chi_A = 700(1 - \chi_A)$

$= 450\chi_A + 700 - 700\chi_A$

$= 700 - 250\chi_A$

$250\chi_A = 700 - 600 \Rightarrow \chi_A = \frac{100}{250}$

$\chi_A = 0.4$

$\therefore \quad \chi_B = 1 - 0.4 = 0.6$

Q28 Text Solution:

The standard potential of $Zn \mid Zn^{2+}$ half $-$ cell $= -0.76$ V

Half $-$ cell reaction, $Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$

$E_{red} = E^0_{red} - \frac{0.059}{n} \log\left[\frac{1}{Zn^{2+}}\right]$

$= -0.76 + \frac{0.059}{n} \log[Zn^{2+}]$

Lower the concentration of Zn^{2+}, lower is the E_{red} or vice $-$ versa.

Hence, the correct order is $Q > R > S > P$.

Q29 Text Solution:

For the given 3p orbital, the number of angular nodes, l = 1 (as it involve p orbital) As n = 3 and 1 = 1

∴ Number of radial nodes = n – 1 – 1

= 3 – 1 – 1 = 1

Hence, angular and radial nodes in 3p orbital respectively are 1, 1.

Q30 Text Solution:

Given, concentration of KCl solution = 0.01 m

Resistance (R) of KCl solution = 1500Ω

Conductivity (K) of 0.01 mKCl solution at 298K

= 0.1466×10^{-3} S cm^{-1}

∴ Cell constant (G*) = KR

= $0.1466 \times 10^{-3} \times 1500$

= 0.219

Q31 Text Solution:

For given reaction, E°_{cell} at $25^{\circ}C = 0.22$ V

At equilibrium, E°_{cell} & $= \frac{0.059}{n} \log K_C$

$\Rightarrow \quad \log K_C = \frac{E^{\circ}_{cell} \times n}{0.059} = \frac{0.22 \times 2}{0.059} = 7.45$

$K_C = \text{antilog } 7.45$

$= 2.8 \times 10^7$

Q32 Text Solution:

For the reaction,

A+2B → Products

Half-life ($t_{1/2}$) remains same as [B] increases for 1st order, this implies reaction is of first order w.r.t B.

Also, as [A] is doubled, rate remains constant.

∴ It is zero order w.r.t. A.

∴ Rate law expression is $k[A]^0 [B]^1$

∴ Overall order = 0 + 1 = 1

∴ Unit of k = s^{-1}

Q33 Text Solution:

The third ionisation enthalpy is highest in a alkaline earth metals because it achieves stable noble gas configuration after removal of two electrons. Further removal of electron from the completely filled orbital require high ionisation enthalpy.

Q34 Text Solution:

Given, for a first order reaction,

let initial concentration $= [R_0]$

After 99% completion, concentration

$[R] = R_0 - 0.99R_0$

$= 0.1R_0$

Using formula, $t = \frac{2303}{k} \log \frac{[R_0]}{[R]}$

$= \frac{2303}{k} \log \frac{100}{1} = \frac{4.606}{k}$

Q35 Text Solution:

Given, rate law expression (r)

$= k[A][B]^2$

Final volume (V_2) is reduced to half of initial volume (V_1) i.e. $V_2 = 1/2V_1$

∴ Final concentration $[A]$ and $[B]$ $= [2A]$ and $2[B]$

$\therefore$ Final rate $r' = k[A]^0[B]^2$

$= k[2A][2B]^2$

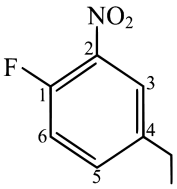
$r' = k \times 2 \times 4[A][B]^2 \Rightarrow r' = 8k[A][B]^2$

$\therefore r' = 8r$

i.e. rate increases by 8 times.

Q36 Text Solution:

The IUPAC name of



is 4-ethyl-1-fluoro-2-nitrobenzene.

Note Numbering of benzene ring is as per lowest locant sum rule.

Q37 Text Solution:

The rarity of higher order reactions (those involving more than three reacting species simultaneously) is primarily due to Option C: low probability of simultaneous collision of all reacting species.

In a chemical reaction, reactant molecules must collide with the proper orientation and sufficient energy for a reaction to occur. As the number of reactant molecules involved increases, the likelihood of all these molecules meeting at the same time and place with the correct orientation and enough energy decreases dramatically. This is why higher order reactions (those of order greater than three) are rare. The complexity and improbability of such a simultaneous occurrence make these reactions almost nonexistent under normal conditions.

Option A talks about shifting of equilibrium towards reactants due to elastic collisions. This does not directly explain why higher order reactions are rare but rather describes a possible dynamic in reactions where the collisions do not lead to reaction but rather to the dispersal of energy.

Option B involves the loss of active species on collision, which could in principle apply to any reaction order and does not specifically address the rarity of high order reactions.

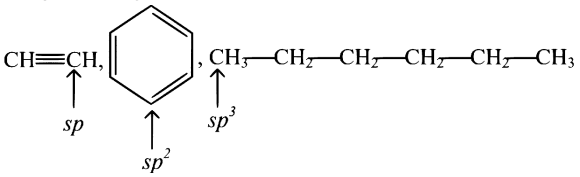
Option D suggests an increase in entropy as more molecules are involved, which may contribute to the favorability of the overall reaction but does not explain why the reactions of higher order are rare. Entropy increases with more molecules involved, but this does not inherently prevent high order reactions; it is the collision probability that is the key issue.

Therefore, the best explanation for the rarity of higher order reactions is the low probability of a simultaneous collision involving all the reactants, as described in Option C.

Q38 Text Solution:

The decreasing order of acidic behaviour is ethyne > benzene > n-hexane

Because carbon in ethyne, benzene and n-hexane are sp, sp^2 and sp^3 hybridised respectively.



∴ The carbocation formed after the removal of 'H' is more stable in sp hybridised carbon atom because of high electronegativity due to more s-character.

Q39 Text Solution:

The amount of electrolyte required to coagulate the given colloid is in order

$NaCl > BaCl_2 < AlCl_3$

Because as colloids move towards anode they must be negatively charge.

According to Hardy Schulze rule,

$$\text{Coagulation value} \propto \frac{1}{\text{Coagulating power (Charge an electrolyte)}}$$

The charge on the electrolyte; Na^+, Ba^{2+} and Al^{3+} are 1, 2 and 3 respectively.

Q40 Text Solution:

All the statements except (d) are correct.

The correct statement is π-electrons are referred to as mobile electrons.

Q41 Text Solution:

Zeta potential is potential difference between fixed charged layer and the diffused layer having opposite charges.

Q42 Text Solution:

NH_4NO_3 on heating gives nitrous oxide (N_2O). Its reaction is as follow

$$\underset{\text{Ammonium nitrate}}{NH_4NO_3} \xrightarrow{\Delta} \underset{\text{Nitrous oxide}}{N_2O(g)} + H_2O$$

Nitrous oxide is also called laughing gas.

Q43 Text Solution:

Thermal stability of the hydrides of nitrogen family decreases down the group as

$NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

Because on moving down the group size increase (from N to Bi). As a result, bond strength decreases.

Q44 Text Solution:

The correct order of boiling point of given hydrides is as follows $H_2O > HF > NH_3$ Strength of H-bonding depends upon size and electronegativity of the atom. Smaller the size of the atom, greater is the electronegativity and stronger is the H-bonding.

But each H_2O molecule has two hydrogen atom, whereas each HF molecule has only one hydrogen atom.

∴ Hydrogen bonding is more strong in H_2O molecules. While NH_3 molecules due to less electronegativity. of 'N' atom than 'F' atom is less polar and hence, have weak hydrogen bonding than HF molecules.

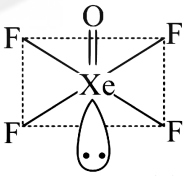
Q45 Text Solution:

XeF_6 on partial hydrolysis with water gives $XeOF_4$.

The reaction involve is as follows

$XeF_6 + H_2O \quad XeOF_4 + 2HF$

The structure of $XeOF_4$ is



Square pyramidal

Q46 Text Solution:

The complete given chemical reaction take place as follows

$$\underset{\text{Nitric oxide (P) (Colourless gas)}}{2NO(g)} + O_2 \longrightarrow \underset{\text{Nitrogen dioxide (Q) (Reddish brown gas)}}{2NO_2(g)}$$

$$\xrightarrow{\text{Cooling}} \underset{\text{Dinitrogen tetraoxide (R) (Colourless)}}{N_2O_4(g)} \xrightarrow{2NO} \underset{\text{Dinitrogen trioxide (S) (Blue solid)}}{2N_2O_3(g)}$$

Note Nitric oxide is paramagnetic as it contain unpaired electron as per molecular orbital theory.

Q47 Text Solution:

The property stated against option (c) is incorrect.

The electronic configuration of given elements (ions) are

Cr^{2+} : $[Ar]d^4$ | 1 | 1 | 1 | 1 | | (4 unpaired e^-)

Mn^{2+} : $[Ar]d^5$ | 1 | 1 | 1 | 1 | 1 | (5 unpaired e^-)

Fe^{2+} : $[Ar]d^6$ | ⇅ | 1 | 1 | 1 | 1 | (4 unpaired e^-)

It is clear from above electronic configuration that Mn^{2+} has maximum number of unpaired electrons (5).

∴ It shown maximum paramagnetic behaviours among the given ions.

Q48 Text Solution:

From Sc^{2+} to Cu^{2+} all the ions are paramagnetic in nature as they all contain unpaired electrons as shown below.

Elements	Electronic configuration	Number of unpaired electron(s)
Sc^{2+}	$[Ar]3d^1$	1
Ti^{2+}	$[Ar]3d^2$	2
V^{2+}	$[Ar]3d^3$	3
Cr^{2+}	$[Ar]3d^4$	4
Mn^{2+}	$[Ar]3d^5$	5
Fe^{2+}	$[Ar]3d^6$	4
Co^{2+}	$[Ar]3d^7$	3
Ni^{2+}	$[Ar]3d^8$	2
Cu^{2+}	$[Ar]3d^9$	1

Q49 Text Solution:

Given, final temperature (T_2) $= 2 \times (T_1)$ initial temperature

Final pressure $(p_2) = 2 \times \frac{(p_1)}{2}$ initial pressure

According to gas law,

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$$

$$\therefore \frac{p_1V_1}{T_1} = \frac{p_1 \times V_2}{2 \times 2T_1}$$

$$V_2 = 4V_1$$

∴ Volume increase by 4 times.

Q50 Text Solution:

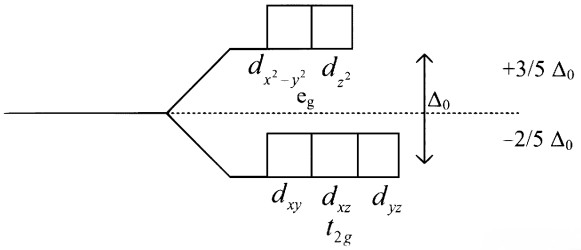
Elements	Electronic configuration	Colour
Sc^{3+}	$[Ar]3d^0$	Cololurless
Ti^{3+}	$[Ar]3d^1$	Violet
Mn^{2+}	$[Ar]3d^5$	Pink
Ni^{2+}	$[Ar]3d^8$	Green
Cu^{+}	$[Ar]3d^{10}$	Colourless
Ti^{4+}	$[Ar]3d^0$	Colourless

∴ Only option (d) (i.e. Mn^{2+}, Ti^{3+} pair) is coloured in aqueous solution.

Q51 Text Solution:

For crystal field splitting in octahedral complexes, the energy of e_g orbitals will increase by $\left(\frac{3}{5}\right)\Delta_0$ and that of t_{2g} will decrease by $\left(\frac{2}{5}\right)\Delta_0$.

The splitting of degenerate d-orbital is as follows.



Q52 Text Solution:

Peroxide effect is observed with addition of HBr but not with the addition of H - I to unsymmetrical alkene because H - I bond is weaker than H - Br bond. So, unstable iodine free radicals combine to form stable iodine molecules as

i.e.,

$$I^{\bullet} + I^{\bullet} \longrightarrow I_2$$

(Unstable) (Stable)

Free radicals

The addition of the iodine radical to the alkene is endothermic

Q53 Text Solution:

$[Co(NH_3)_5 (CO_3)]$ Cl

Oxidation state of Co(x) can be calculated

x + 0 + 0 - 3 = 0

$\therefore$ x = 3

$\therefore$ The IUPAC name is pentaamminecarbonatocabolt(III) chloride.

Q54 Text Solution:

In homoleptic complex, all the bounded ligands are identicals

$\therefore K_3\left[Al(C_2O_4)_3\right]$ and $K_2\left[Zn(OH)_4\right]$ are homoleptic complex as they contain identical ligand $i.e.\ (C_2O_4)$ and (OH).

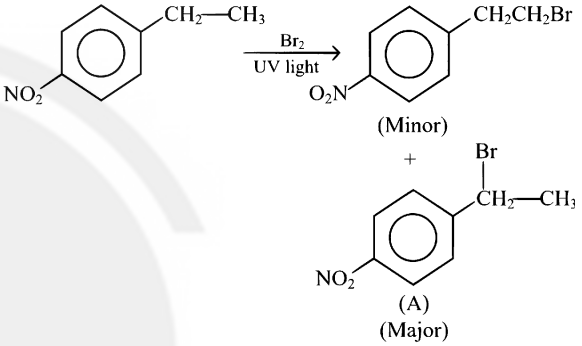
Q55 Text Solution:

Wavelengths of light absorbed is inversely proportional to strength of the ligand and order of strength of the given ligand is CN^- > NH_3 > Cl^-.

Therefore, the correct order for wavelength of light absorbed in the complex ions is $\left[CoCl(NH_3)_5\right]^{2+} > \left[Co(NH_3)_6\right]^{3+} > \left[Co(CN)_6\right]^{3-}$

Q56 Text Solution:

In the presence of UV light free radicals substitution of alkane of the given compound take place in the following way.



Q57 Text Solution:

Given, $(BE)_{A_2} : (BE)_{B_2} : (BE)_{AB} = 2 : 1 : 2$

where, BE = Bond enthalpy $(\Delta H_f)_{AB} = -100$ kJ

Let the BE of A_2, B_2 and AB be 2x, x and 2x respectively.

As we know, $\Delta_f H^\circ = \Sigma\Delta_{diss}\ H^\circ_R - \Sigma\Delta_{diss}\ H^\circ_P$

where, $\Delta_{diss}\ H^\circ$

= Enthalpy of dissociation

$\frac{1}{2}A_2 + \frac{1}{2}B_2 \rightarrow AB$

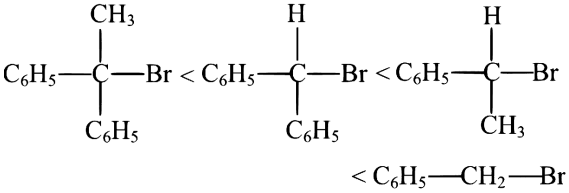
$\therefore -100 = \left(\frac{1}{2}2x + \frac{1}{2}x\right) - x$

x = 200

$\therefore$ Bond enthalpy of B_2 is 200 kJ mol^{-1}.

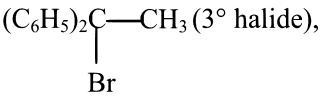
Q58 Text Solution:

The order of reactivity of given compounds in S_N2 reaction is



For S_N2 reaction, the order of reaction is inversely proportional to steric hinderance cause by bulky groups.

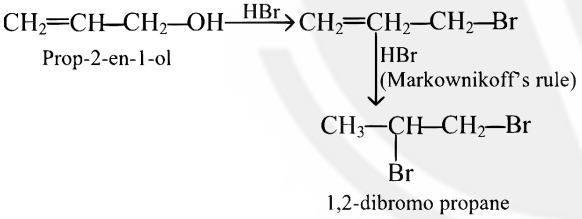
In



there are two bulky groups are present i.e. benzene group and one methyl group which provide steric hinderance for the attack of nucleophile. Hence, it is least reactive while in $C_6H_5CH_2Br$ (1° halide), the attack of nucleophile is easier due to less steric hinderance.

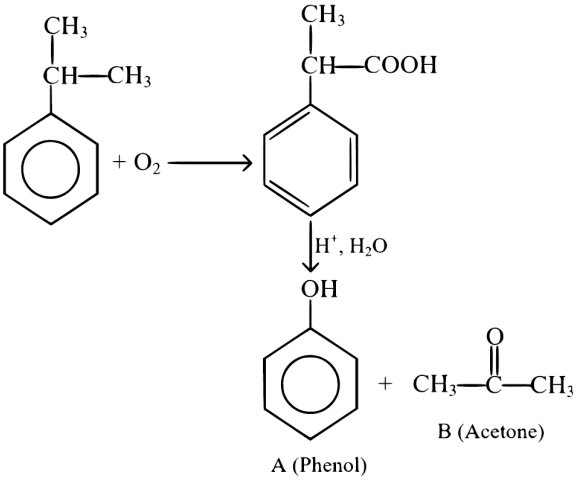
Q59 Text Solution:

The given reaction take place in following way



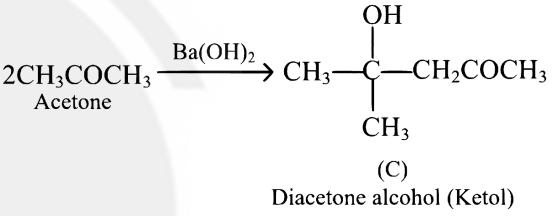
Q60 Text Solution:

The given reaction take place in following way

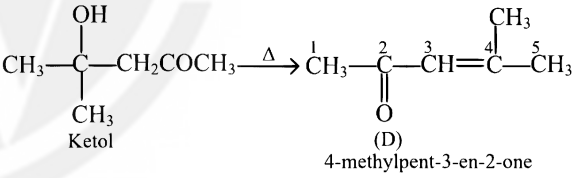


Phenol gives white ppt. with bromine water.

Acetone when treated with $Ba(OH)_2$ undergoes aldol condensation as follows



On heating further, ketol gives 4-methylpent-3-en-2-one



∴ The product D is 4-methylpent-3-en-2-one.