CHEMISTRY

Paper & Solution

Code: A

Time: 3 Hrs.

Max. Marks: 100

Q 1. Write the formulae of any two oxoacids of phosphorus.

Answer:

(i) H_3PO_3 (Phosphorous acid)

(ii) H_3PO_4 (Phosphoric acid)

Q 2. Which would undergo S_N2 reaction faster in the following pair :

$C_6H_5 - CH_2 - CH_2 - Br$ and $C_6H_5 - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$

Answer:

$C_6H_5 - CH_2 - CH_2 - Br$ (due to less stearic hindrence)

Q 3. Out of $AlCl_3$ and NaCl, which is more effective in causing coagulation of a negative sol and why ?

Answer:

$AICI_3$ is more effective due to high Positive Charge density on Al^{+3} as compared to Na^+

Q 4. Write the formula of a compound in which the element Y forms ccp lattice and atoms of X occupy 1/3rd of tetrahedral voids.

Answer:

The no. of atoms Y in CCP = N no. of tetrahedral voids = 2N

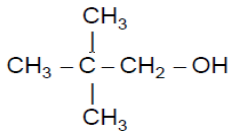
$$\text{no.of X atoms} = 2N \times \frac{1}{3}$$

$$= \frac{2}{3}N$$

$$\begin{array}{lccc} \textit{Formula} & x & : & y \\ & \frac{2}{3}N & : & N \\ = & 2 & : & 3 \end{array}$$

$$\boxed{= x_2y_3}$$

Q 5. Write the IUPAC name of the given compound :



Answer:

2, 2 - Dimethylpropan-1-ol

Q 6. Why do transition elements show variable states ? How is the variability in oxidation states of d-block different from that of the p-block elements ?

Answer:

Transition elements show variable oxidation states since in these elements there is a small energy difference between 3d and 4s orbital therefore 3d and 4s both e. participate in the bond formation hence transtion elements shows variable oxidation states. Oxidation State of P block elements both type that is positive and negative but d block elements shows only positive oxidation states.

Q 7. (i) Write down the IUPAC name of the following complex :

$[Pt(NH_3)(H_2O)CI_2]$

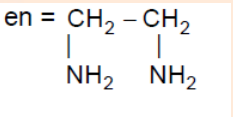
(ii) Write the formula for the following complex :

tris(ethane-1,2-diamine)chromium(III) chloride

Answer:

(i) Ammineaquadichloridoplatinum(II)

(ii) $[Cr(en)_3]Cl_3$



Q 8. Calculate the time to deposit 1.5 g of silver at cathode when a current of 1.5A was passed through the solution of $AgNO_3$. (Molar mass of Ag = 108 g mol^{-1}, 1 F = 96500 C mol^{-1})

Answer:

$$Ag^+ + e^- \longrightarrow Ag(s)$$

$\because$ 108 $gm\ Ag\ required =$ 96500 C

$$\therefore \ 1.5\ gm\ Ag\ required = \frac{96500}{108} \times 1.5$$

$$= 1340.2\ C$$

$$t = \frac{Q}{i}$$

$$t = \frac{1340.2}{1.5}$$

$$t = 893.5 \sec.$$

Q 9. Write the reagents used in the following reactions:

$(i)\ C_6H_5-CO-CH_3 \xrightarrow{?} C_6H_5-CH_2-CH_3$

$(ii)\ CH_3-COOH \xrightarrow{?} CH_3-COCI$

OR

Arrange the following compounds in increasing order of their property as indicated :

$(i)\ CH_3CHO, C_6H_5CHO, HCHO$

(reactivity towards nucleophilic addition reaction)

(ii) 2,4-dinitrobenzoic acid, 4-methoxybenzoic acid, 4-nitrobenzoic acid (acidic character)

Answer:

(i) Zn . Hg / HCl

(ii) PCl_5

Or

(i) $C_6H_5CHO < CH_3CHO < HCHO$

(ii) 4-methoxybenzoic acid < 4-nitrobenzoic acid < 2, 4-dinitrobenzoic acid

Q 10. (i) Why are aquatic species more comfortable in cold water than in warm water ?

(ii) What happens when we place the blood cell in saline water solution (hypertonic solution) ?Given reason.

Answer:

(i) aquatic species ismore comfortable in coldwater than inwarmwater it is due to themore dissolution of O_2 in cold water

(ii) Blood cell will be squeeze.

$\therefore$ dissolution of gases is a exothermic procees means at low temperature gases more dissolve in Water

Q 11. (i) Name themethod used for the refining of titanium.

(ii) What is the role of Zn in the extraction of silver ?

(iii) Reduction of metal oxide to metal becomes easier if the metal obtained is in liquid state. Why ?

Answer:

(i) vanArkelmethod

(ii) Zn displace silver form its salt solution.

$2\left[Ag(CN)_2\right]^- + Zn \longrightarrow \left[Zn(CN)_4\right]^{2-} + 2Ag_{(s)}$

(iii) Since in the liquid state ΔS = +ve

Q 12. (i) E^0 value for the Mn^{3+}/Mn^{2+} couple is positive (+ 1.5 V) whereas that of Cr^{3+}/Cr^{2+} is negative (.0.4 V). Why ?

(ii) Transitionmetals form coloured compounds.Why ?

(iii) Complete the following equation :

$2MnO_4^- + 16H^+ + 5C_2O_4^{2-} \rightarrow$

Answer:

(i) Mn^{3+}/Mn^{+2} Couple is positive

$Mn^{3+} \longrightarrow Mn^{+2}$ due to stable half filled (d^5) electronic configuration it has reduction tendency.

$Cr^{2+} \longrightarrow Cr^{3+}$ have oxidation tendency

$\because Cr^{3+}$ is more stable than Cr^{2+} due to stable t_{2g}^3 electronic Configuration.

(ii) due to d-d transition

(iii) $2MnO^- + 16H^+ + 5C_2O_4^{2-} \longrightarrow 10CO_2 + 8H_2O + 2Mn^{2+}$

Q 13. (i) What type of isomerism is shown by $[Co(NH_3)_5ONO]Cl_2$?

(ii) On the basis of crystal field theory, write the electronic configuration for $d^4 ion\ if\ \Delta_0 < P.$

(iii) Write the hybridization and shape of $[Fe(CN)_6]^{3-}$.

Answer:

(i) it shows linkage isomerism

$[Co(NH_3)_5ONO]Cl_2$ *and* $[Co(NH_3)_5NO_2]Cl_2$

(ii) If $\Delta_0 <$ P then

$d^4 \rightarrow t_{2g}^3\ e_g^1$

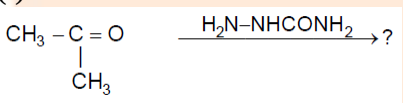
(iii) $[Fe(CN)_6]^{3-}$

hybridisation $\longrightarrow d^2sp^3$

Shape $\longrightarrow$ actahedral

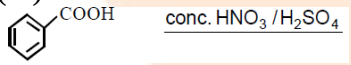
Q 14. Predict the products of the following reactions :

(i)



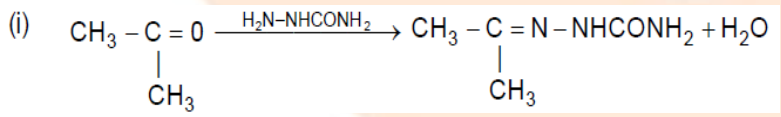
(ii) $C_6H_5 - CH_2 - CH_3 \xrightarrow[(b)H^+]{(a)KMnO_4 / KOH} ?$

(iii)



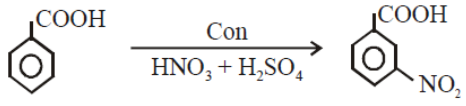
Answer:

(i)



(ii) $C_6H_5 - CH_2 - CH_3 \xrightarrow[(b)H^+]{(a)KMnO_4} C_6H_5 - COOH$

(iii)



Q 15. Write the names and structures of the monomers of the following polymers :

(i) Nylon-6,6
(ii) Bakelite
(iii) Polystyrene
Answer:

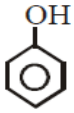
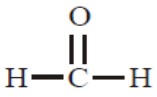
(i) Nylon 6,6

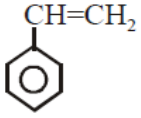
Monomer → Adipic acid, hexamethylenediamine

↓ ↓

$HOOC-(CH_2)_4-COOH$ $H_2N-(CH_2)_6-NH_2$

(ii) Bakelite

Mnoner → Phenal  , formalaldehyde 

(iii) Polystyrene Monomer —— Styrene 

Q 16.
(i) Which one of the following is a disaccharide : starch, maltose, fructose, glucose
(ii) What is the difference between acidic amino acid and basic amino acid ?
(iii) Write the name of the linkage joining two nucleotides.
Answer:

(i) Maltose
(ii) acidic amino acid have -COOH > $-NH_2$ group
where as basic amino acid have $-NH_2$ > -COOH group
(iii) Phosphodiester linkage

Q 17. Vapour pressure of water at 20°C is 17.5 mm Hg. Calculate the vapour pressure of water at 20°C when 15 g of glucose (Molar mass = 180 g mol^{-1}) is dissolved in 150 g of water.
Answer:

$P^{\circ}_A = 17.5\ mm\ Hg$ $W_A = 150\ gm$

$W_B = 15\ gm$ $M_A = 18\ gmmol^{-1}$

$M_B = 180\ gm\ mol^{-1}$

$$\frac{P^{\circ}_A - P_s}{P^{\circ}_A} = \frac{W_B \times M_A}{M_B \times W_A}$$

$$\frac{17.5 - P_s}{17.5} = \frac{15 \times 18}{180 \times 150}$$

$$\boxed{P_s = 17.325\ mm\ Hg}$$

Q 18. Examine the given defective crystal :

X^+ Y^- X^+ Y^- X^+
Y^- X^+ Y^- X^+ Y^-
X^+ Y^- X^+ e^- X^+
Y^- X^+ Y^- X^+ Y^-

Answer the following questions :
(i) Is the above defect stoichiometric or non-stoichiometric ?
(ii) Write the term used for the electron occupied site.
(iii) Give an example of the compound which shows this type of defect.

Answer:

(i) non . stoichiometric
(ii) F - Center (Ferb Centre)
(iii) NaCl in presence of excess Na

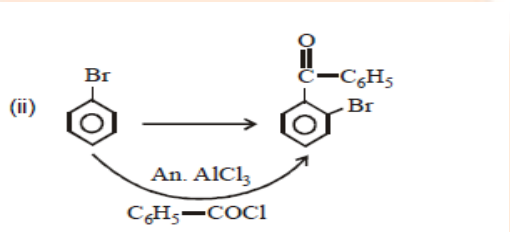
Q 19. How do you convert the following :
(i) Prop-1-ene to Propan-2-ol
(ii) Bromobenzene to 2-bromoacetophenone
(iii) 2-bromobutane to But-2-ene

OR

What happens when
(i) ethyl chloride is treated with NaI in the presence of acetone,
(ii) chlorobenzene is treated with Na metal in the presence of dry other
(iii) methyl chloride is treated with KNO_2 ? Write chemical equations in support of your answer.

Answer:

(i) $CH_3-CH=CH_2 \xrightarrow[H_2O]{H^+} CH_3-\underset{OH}{CH}-CH_3$

(ii) 

(iii) $CH_3-CH_2-\underset{Br}{CH}-CH_3 \xrightarrow[Alc\ KOH]{} CH_3-CH=CH-CH_3$

OR

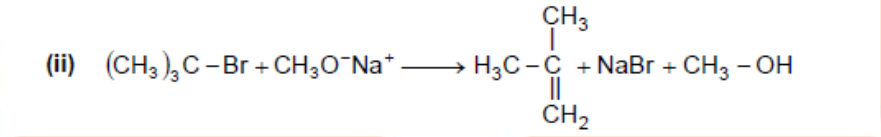
(i) $C_2H_5-Cl+NaI \xrightarrow{acetone} C_2H_5-I+NaCl$

(ii) $2C_6H_5-Cl+2Na \xrightarrow{dryether} C_6H_5-C_6H_5+2NaCl$

(iii) $CH_3-Cl+KNO_2 \longrightarrow CH_3-ONO+KCl$

Q 20. Give reasons for the following :
(i) p-nitrophenol is more acidic than p-methylphenol.
(ii) Bond length of C . O bond in phenol is shorter than that in methanol.
(iii) $(CH_3)_3C-Br$ on reaction with sodium methoxide $\left(Na^{+-}OCH_3\right)$ gives alkene as the main product and an ether.
Answer:

(i) P-nitrophenol is more acidic it is due to -I, -M effect of NO_2 group
(ii) due to resonance bond length of C – O bond in phenol is shorter than that is methanol.



Since 3° alkyl halide gives more preference for elemination reaction as compared to substution reaction

Q 21. Calculate E^0_{cell} and $\Delta_r G^0$ for the following reaction at 25°C :

$$A^{2+} + B^{+} \longrightarrow A^{3+} + B$$

Given : $K_c = 10^{10}, 1F = 96500\ C\ mol^{-1}$
Answer:

$$\Delta G^\circ = -2.303\ RT \log K_C$$
$$\Delta G^\circ = -2.303 \times 8.314 \times 298 \times \log 10^{10}$$
$$\Delta G^\circ = -57058.483\ J/mol$$
$$\boxed{= -5.7 \times 10^4}$$
$$\Delta G^\circ = -nFE^\circ_{cell}$$
$$E^\circ_{cell} = -\frac{\Delta G^\circ}{nF}$$
$$E^\circ_{cell} = \frac{-(-5.7 \times 10^{-4})}{1 \times 96500}$$
$$E^\circ_{cell} = 5.9 \times 10^{-1} V$$

Q 22. Define adsorptionwith an example.Why is adsorption exothermic in nature ?Write the types of adsorption based on the nature of forces between adsorbate and adsorbent.
Answer:

Adsorption →The accumulation of molecular species at the surface rather than in the bulk of a solid or liquid is called adsorption.

e.g. water molecules adsorbed by silicagel
* during the adsorption process there is a force of attraction between adsorbate and adsorbent hence energy is released.
* Two types
(a) Physisorption (b) Chemisorption.

Q 23. Seeing the growing cases of diabets and depression among young children,Mr. Lugani, the principal of one reputed school organized a seminor in which he invited parents and principals. They all resolved this issue by strictly banning junk food in schools and introducing healthy snacks and drinks like soup, lassi, milk, etc. in school canteens.
They also decided to make compulsory half an hour of daily physical activities for the students in the morning assembly.After sixmonths,Mr. Lugani conducted the health survey inmost of the schools and discovered a tremendous improvement in the health of the students. After reading the above passage, answer the following questions :
(i) What are the values (at least two) displayed by Mr. Lugani ?
(ii) As a student, how can you spread awareness about this issue ?
(iii) What are antidepressant drugs ? Give an example.
(iv) Name the sweetening agent used in the preparation of sweets for a diabetic patient.
Answer:

(i) (a) He is very concious towards the health of students.
(b) He is very deceplined.
(ii) As a student i am also motivate to my friend.
(iii) Phenelzine
(iv) Saccharin (ortho-sulphobenzimide)

Q 24. For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained :

t/s	0	30	60
$(CH_3\ COOCH_3$1/mol L^{-1}	0 60	0 30	0 15

(i) Show that it follows pseudo first order reaction, as the concentration of water remains constant.
(ii) Calculate the average rate of reaction between the time interval 30 to 60 seconds.

OR

(a) For a reaction A + B $\rightarrow$ P, the rate is given by
Rate = k $[A]^2[B]$
(i) How is the rate of reaction affected if the concentration of A is doubled ?
(ii) What is the overall order of reaction if B is present in large excess ?
(b) A first order reaction takes 23.1 minutes for 50% completion. Calculate the time required for 75%completion of this reaction. (Given : log 2 = 0.301, log 3 = 0.4771, log 4 = 0.6021)
Answer:

Case 1

$(I)\ K_1 = \frac{2.303}{t}\log\frac{a}{a-x}$

$K_1 = \frac{2.303}{30}\log\frac{0.60}{0.30}$

$\boxed{K_1 = \frac{2.303}{30}\log 2}$

Case 2

$K_2 = \frac{2.303}{t}\log\frac{a}{a-x}$

$K_2 = \frac{2.303}{60}\log\frac{0.60}{0.15}$

$K_2 = \frac{2.303}{60}\times 2\log 2$

$\boxed{K_2 = \frac{2.303}{30}\times\log 2}$

$K_1 = K_2$ it means it follows Pseudo first order reaction.

(II) average rate $= -\frac{\Delta R}{\Delta t}$

$= -\left(\frac{0.15-0.30}{60-30}\right)$

$= \frac{0.15}{30}$

$= \frac{1}{200}$

$\boxed{= 5\times 10^{-3}\ \text{sec}}$

OR

(a) (I)

$rate_1 = K|A|^2|B|$

$rate_2 = K|2A|^2|B|$

$rate_2 = 4K|A|^2|B|$

$\boxed{r_2 = 4r_1}$

(II) Second order

(b) For 50%Completion of reaction

$K = \frac{2.303}{t}\log\frac{N_0}{N}$

$N_0 =$ initial amount of the substance

N = amount left after t lime

$$K = \frac{2.303}{23.1}\log\frac{100}{50}$$

$$K = \frac{2.303}{23.1}\log 2 \quad \text{_____(1)}$$

For 75%Completion of reaction

$$K = \frac{2.303}{t}\log\frac{100}{25}$$

$$K = \frac{2.303}{t}\log 4$$

$$K = \frac{2.303}{t}\times 2\log 2 \quad \text{_____(2)}$$

Divide equation 1 and 2

$$\frac{\frac{2.303}{23.1}\log 2}{\frac{2.303}{t}\times 2\log 2} = \frac{K}{K}$$

t = 46.2 minute

Q 25.

(a) Account for the following :

(i) Bond angle in NH_4^+ is greater than that in NH_3.

(ii) Reducing character decreases from SO_2 to TeO_2.

(iii) $HClO_4$ is a stronger acid than HClO.

(b) Draw the structures of the following :

(i) $H_2S_2O_8$

(ii) $XeOF_4$

OR

(a) Which poisonous gas is evolved when white phosphorus is heated with conc. NaOH solution ? Write tha chemical equation.

(b) Write the formula of first noble gas compound prepared byN. Bartlett. What inspired N. Bartlett to prepare this compound ?

(c) Fluorine is a stronger oxidizing agent than chlorine. Why ?

(d) Write one use of chlorine gas.

(e) Complete the following equation : $CaF_2 + H_2SO_4 \rightarrow$

Answer:

(a)

(i) in NH_4^+ and NH_3 nitrogen is SP^3 hybridised but due to $IP-bP$ replusion bond angle $\downarrow$ in NH_3 but there is no lP in NH_4^+ hence its bond angle is $109^\circ 28'$ but in NH_3 it is 107°

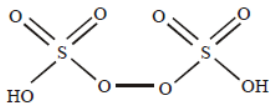
(ii) due to inert pair effect.

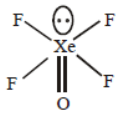
(iii) due to higher oxidation state of Cl and high oxygen content in $HClO_4$ it is more acidic then HOCl.

in $HClO_4$ O.S of Cl = +7

in HClO O.S of Cl = +1

(b)

(i) 

(ii) 

OR

$(a) P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$

* Poisonous gas is **PH_3** (Phosphine)

(b) Formula $\rightarrow Xe^+PtF_6^-$

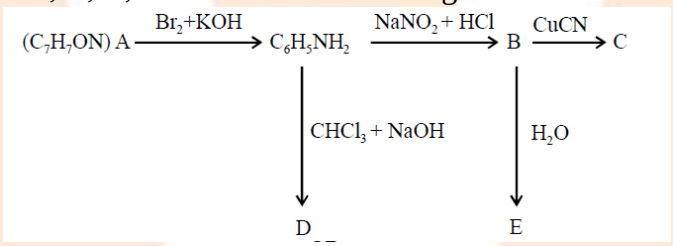
N Barlett Prepared the compound $O_2^+PtF_6^-$. He then realised that the first jonisation enthalpy of melecular oxygen $(1175\ KJ\ mol^{-1})$ was almost identical with that of xenon $(1170\ KJ\ mol^{-1})$ he made efforts to prepare same type of compound with Xe and was successful in Preparing another red colour compound $Xe^+PtF_6^-$

(c) due to low dissociation bond enthalpy and High hydration enthalpy F_2 is a strong oxidising agent.

(d) Use $\rightarrow$ In sterilising drinking water.

(e) $CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$

Q 26. An aromatic compound .A. of molecular formula C_7H_7ON undergoes a series of reactions as shown below. Write the structures of A, B, C, D and E in the following reactions :



OR

(a) Write the structures of the main products when aniline reacts with the following reagents :

(i) Br_2 water

(ii) HCl

(iii) $(CH_3CO)_2O$ / *pyridine*

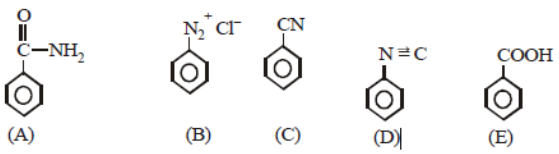
(b) Arrange the following in the increasing order of their boiling point : $C_2H_5NH_2, C_2H_5OH, (CH_3)_3N$

(c) Give a simple chemical test to distinguish between the following pair of compounds :

$(CH_3)_2 - NH$ and $(CH_3)_3N$

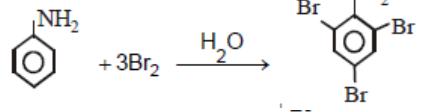
Answer:

C_7H_7OH

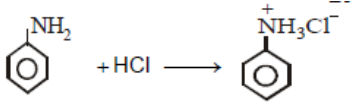


OR

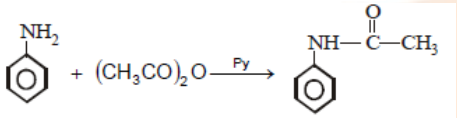
(a) (i)



(ii)

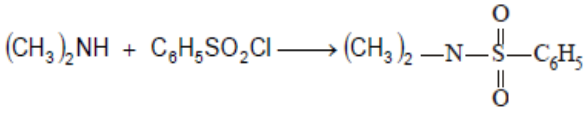


(iii)



(b) $C_2H_5-OH > C_2H_5NH_2 > (CH_3)_3N$

(c) $(CH_3)_2NH$ react with Hinsberg reagent $(C_6H_5SO_2Cl)$



$(CH_3)_3N$ does not react with Hinsberg reagent