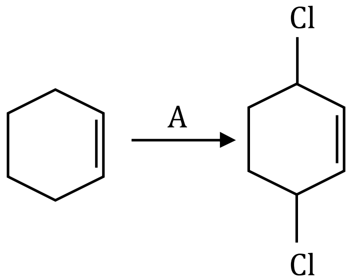
1. 

Identify the reagent(s) 'A' and condition(s) for the reaction

(1) A = HCl; Anhydrous $AlCl_3$

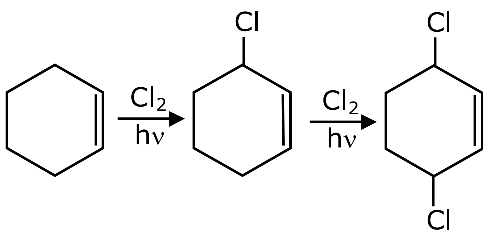
(2) A = HCl, $ZnCl_2$

(3) A = Cl_2, dark, Anhydrous $AlCl_3$

(4) A = Cl_2; UV light

Ans. **(4)**

Sol.



2. The INCORRECT statement regarding the structure of C_{60} is:

(1) It contains 12 six-membered rings and 24 five-membered rings.

(2) Each carbon atom forms three sigma bonds.

(3) The five-membered rings are fused only to six-membered rings.

(4) The six-membered rings are fused to both six and five-membered rings.

Ans. **(1)**

Sol. it contain 12 five membered ring & 20 six membered ring

3. Match List-I with List-II:

	List-I Test/Reagents/Observation(s)		**List-II Species detected**
(a)	Lassaigne's Test	(i)	Carbon
(b)	Cu(II) oxide	(ii)	Sulphur
(c)	Silver nitrate	(iii)	N, S, P and halogen
(d)	The sodium fusion extract gives black precipitate with acetic acid & lead acetate	(iv)	Halogen Specifically

The correct match is:

(1) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

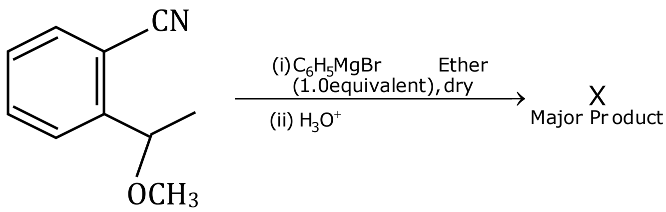
(2) (a)-(i), (b)-(iv), (c)-(iii), (d)-(ii)

(3) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

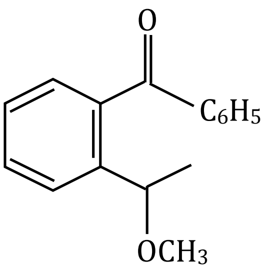
(4) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

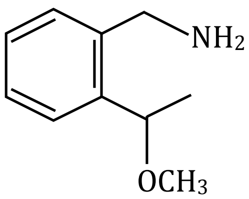
Ans. **(1)**

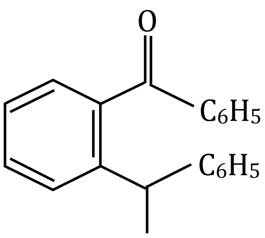
Sol. (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

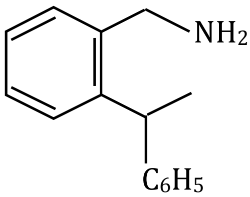
4. 

The structure of X is:

(1) 

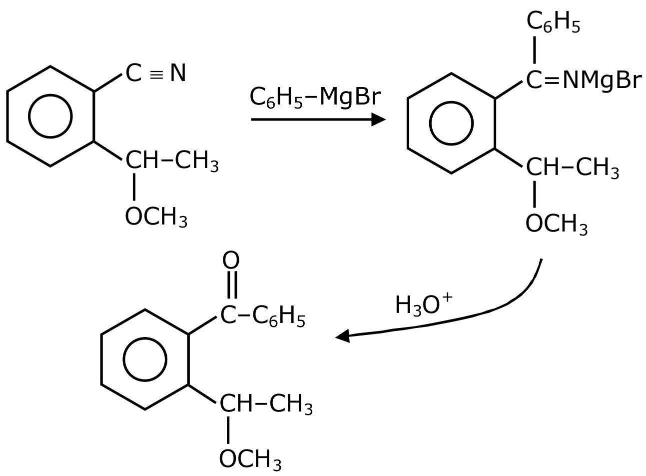
(2) 

(3) 

(4) 

Ans. **(1)**

Sol.



5. Ammonolysis of Alkylhalides followed by the treatment with NaOH solution can be used to prepare primary, secondary and tertiary amines. The purpose of NaOH in the reaction is:

(1) to remove basic impurities

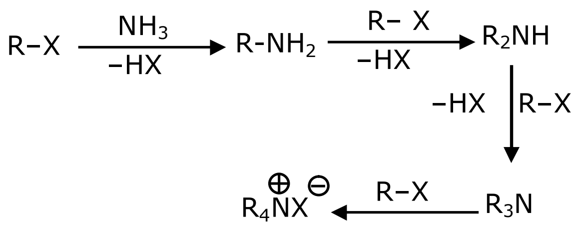
(2) to activate NH_3used in the reaction

(3) to increase the reactivity of alkyl halide

(4) to remove acidic impurities

Ans. (4)

Sol.



During the reaction HX (acid) is form

Hence, we use NaOH to remove this acidic impurities

6. Arrange the following metal complex/compounds in the increasing order of spin only magnetic moment. Presume all the three, high spin system.

(Atomic numbers Ce = 58, Gd = 64 and Eu = 63)

(a) $(NH_4)_2[Ce(NO_3)_6]$ (b)$Gd(NO_3)_3$ and (c)$Eu(NO_3)_3$

Answer is:

(1)(a)<(c)<(b) (2)(a)<(b)<(c)

(3)(c)<(a)<(b) (4)(b)<(a)<(c)

Ans. (1)

Sol. $(NH_4)_2\ [Ce(NO_3)_6]$ (n = 0) $\Rightarrow$ μ= 0 B.M

$Eu\ (NO_3)_3$ (n = 6) $\Rightarrow$ μ = 6.93 B.M

$Gd(NO_3)_3$ (n = 7) $\Rightarrow$ μ = 7.94 B.M

7. Identify the elements X and Y using the ionisation energy values given below:
Ionization energy (kJ/mol)

	1^{st}	2^{nd}
X	495	4563
Y	731	1450

(1) X = F; Y = Mg (2) X = Mg; Y = F
(3) X = Na; Y = Mg (4) X = Mg; Y = Na

Ans. **(3)**

Sol. 2^{nd} I. E of Alkali metals is higher than their respective period.

8. The INCORRECT statements below regarding colloidal solutions is:
(1) A colloidal solution shows colligative properties.
(2) An ordinary filter paper can stop the flow of colloidal particles.
(3) A colloidal solution shows Brownian motion of colloidal particles.
(4) The flocculating power of Al^{3+} is more than that of Na^+.

Ans. **(2)**

Sol. Colloidal solutions can pass through ordinary filter paper but cannot pass through special filter collodial solution coated paper.

9. The characteristics of elements X, Y and Z with atomic numbers, respectively, 33, 53 and 83 are:
(1) X and Z are non-metals and Y is a metalloid.
(2) X and Y are metalloids and Z is a metal
(3) X, Y and Z are metals.
(4) X is a metalloid, Y is a non-metal and Z is a metal.

Ans. **(4)**

Sol.

Atomic No.		**Element**
(1) 33	$\longrightarrow$	As (Metalloid)
(2) 53	$\longrightarrow$	I (Non metal)
(3) 83	$\longrightarrow$	Bi (Metal)

10. The exact volumes of 1 M NaOH solution required to neutralise 50 mL of 1 M H_3PO_3 solution and 100 mL of 2 M H_3PO_2 solution, respectively, are:
(1) 100 mL and 50 mL (2) 50 mL and 50 mL
(3) 100 mL and 100 mL (4) 100 mL and 200 mL

Ans. **(4)**

Sol. (1) $2NaOH + H_3PO_3 \longrightarrow Na_2HPO_3 + 2H_2O$
100m mole   50m mole
100m mole = M × V_{ml}
100m mole = 1 × V_{ml}
V_{ml} = 100 ml

(2) $NaOH + H_3PO_2 \longrightarrow NaH_2PO_2 + H_2O$
200m mole   200m mole
200m mole = M × V_{ml}
V_{ml} = 200 ml

11. Which of the following reduction reaction CANNOT be carried out with coke?

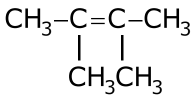
(1) $Fe_2O_3 \rightarrow Fe$ (2) $ZnO \rightarrow Zn$

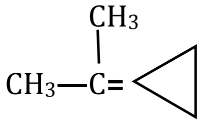
(3) $Al_2O_3 \rightarrow Al$ (4) $Cu_2O \rightarrow Cu$

Ans. **(3)**

Sol. Al is extracted by electrolytic reduction of Al_2O_3

12. An unsaturated hydrocarbon X on ozonolysis gives A. Compound A when warmed with ammonical silver nitrate forms a bright silver mirror along the sides of the test tube. The unsaturated hydrocarbon X is:

(1) $CH_3-C\equiv C-CH_3$ (2) 

(3) $HC\equiv C-CH_2-CH_3$ (4) 

Ans. **(3)**

Sol.

$$CH_3CH_2\equiv CH \xrightarrow[\text{(ii) } H_2O]{\text{(i) } O_3} CH_3CH_2COOH + H-\overset{O}{\overset{||}{C}}-OH$$

$$HCOOH \xrightarrow[\text{Tollen's reagent}]{[Ag(NH_3)_2]^+} CO_2\uparrow + H_2O + 2Ag\downarrow$$

13. **Statement-I:** Sodium hydride can be used as an oxidising agent.

Statement-II: The lone pair of electrons on nitrogen in pyridine makes it basic:

Choose the CORRECT answer from the options given below:

(1) Statement I is true but statement II is false

(2) Both statement I and statement II are false

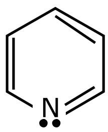
(3) Both statement I and statement II are true

(4) Statement I is false but statement II is true

Ans. **(4)**

Sol. ⇒ NaH is used as reducing agent.

⇒ The ℓp on nitrogen in pyridine makes it basic



14. Which of the following polymer is used in the manufacture of wood laminates?

(1) Melamine formaldehyde resin (2) *cis*-poly isoprene

(3) Phenol and formaldehyde resin (4) Urea formaldehyde resin

Ans. **(1)**

Sol. Melamine formaldehyde resin is used in the manufacture of wood laminates.

15. The correct statements about H_2O_2 are:
(A) used in the treatment of effluents.
(B) used as both oxidising and reducing agents.
(C) the two hydroxyl groups lie in the same plane.
(D) miscible with water.
Choose the correct answer from the options given below:
(1) (A), (C) and (D) only
(2) (A), (B) and (D) only
(3) (A), (B), (C) and (D)
(4) (B), (C) and (D) only

Ans. (2)

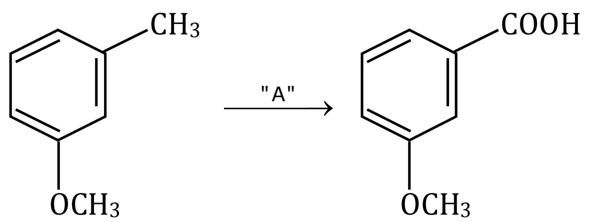
Sol. (1) In H_2O_2 oxidation of oxygen is-1 Therefore acts both as O.A and R.A.
(2) H_2O_2 is miscible in water due to inter molecular H-Bonding.
(3) H_2O_2 has open book structure in which both –OH group are not in same plane.

16. The green house gas/es is (are):
(A) Carbon dioxide
(B) Oxygen
(C) Water vapour
(D) Methane
Choose the most appropriate answer from the options given below:
(1) (A) and (B) only
(2) (A), (C) and (D) only
(3) (A) and (C) only
(4) (A) only

Ans. (2)

Sol. The green house gases are CO_2, CH_4 & H_2O vapour.

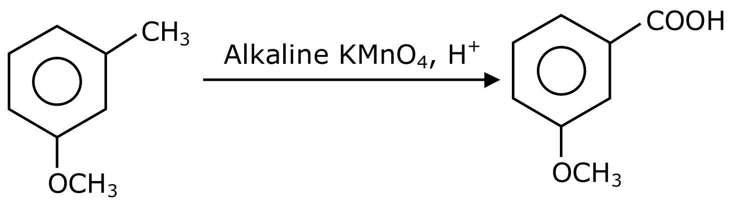
17.



In the above reaction, the reagent "A" is:
(1) $NaBH_4$, H_3O^+
(2)HCl, Zn–Hg
(3) Alkaline $KMnO_4$, H^+
(4) $LiAlH_4$

Ans. (3)

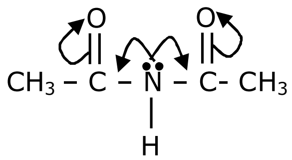
Sol.



18. Which of the following is least basic?
(1) $(CH_3CO)_2\ddot{N}H$
(2) $(CH_3CO)\ddot{N}HC_2H_5$
(3) $(C_2H_5)_3\ddot{N}$
(4) $(C_2H_5)_2\ddot{N}H$

Ans. **(1)**

Sol.



Due to higher resonance, ℓp of N is not available for accept H^+

So it is least basic.

19. Fex_2 and Fey_3 are known when x and y are:

(1)x=Cl, Br, I and y=F, Cl, Br, I

(2) x=F, Cl, Br, I and y=F, Cl, Br

(3)x=F, Cl, Br, I and y=F, Cl, Br, I

(4) x=F, Cl, Br and y =F, Cl, Br, I

Ans. **(2)**

Sol. FeI_3, does not react because of I^- being very good reducing agent.

20. The secondary structure of protein is stabilised by:

(1)van der Waals forces

(2) Peptide bond

(3) Hydrogen bonding

(4)glycosidic bond

Ans. **(3)**

Sol. The secondary structure of protein stablised by H-bonding.

Section-B

1. At 25ºC, 50 g of iron reacts with HCl to form $FeCl_2$. The evolved hydrogen gas expands against a constant pressure of 1 bar. The work done by the gas during this expansion is __________ J. (Round off to the Nearest Integer).

[Given: R = 8.14 J mol^{-1} K^{-1}. Assume, hydrogen is an ideal gas]

[Atomic mass of Fe is 55.85 u]

Ans. **2218**

Sol. $Fe + 2HCl \longrightarrow FeCl_2 + H_2(g)$

50g

Moles of Fe = $\frac{50}{55.85}$ mol = moles of H_2

$W_{irrev} = -P_{ext}.\ \Delta V$

$= -\text{moles of } H_2 \times RT$

$= -\frac{50}{55.85} \times 8.314 \times 298$

$= -2218.05$ J

Nearest integer = 2218

2. A 5.0 m $moldm^{-3}$ aqueous solution of KCl has a conductance of 0.55 mS when measured in a cell of cell constant 1.3 cm^{-1}. The molar conductivity of this solution is ____________ mSm^2mol^1.

(Round off to the Nearest Integer).

Ans. **14**

Sol. $G_{KCl} = 0.55$ mS $= 55 \times 10^{-5}$s

Cell constant = ℓ/A = 1.3 cm^{-1}

λ_M = ??
$R = G(\ell/A) = 55 \times 10^{-5} \times 1.3\ \text{Scm}^{-1}$

$\lambda_M = \frac{K \times 1000}{\text{Molarity}} = \frac{55 \times 1.3 \times 10^{-5} \times 1000}{5 \times 10^{-3}}$

$\lambda_M = 11 \times 1.3 \times 10 = 11 \times 13 = 143\ \text{S cm}^{+2}\text{mol}^{-1}$

$\lambda_M = \frac{143 \times 1000 \times 10^{-3}\text{S}}{(10^{-2}\,\text{M})^{-2}}\text{mol}^{-1}$

$\lambda_M = 143 \times 1000 \times 10^{-4}(\text{m.S})\text{m}^2.\text{mol}^{-1}$
= 14.3
Ans. λ_M = 14 Nearest integer

3. The number of orbitals with n = 5, $m_1 = +2$ is ________. (Round off to the Nearest Integer).

Ans. **3**

Sol. For n = 5
$\ell = 0, 1, 2, 3, 4$
$\ell = 2 \rightarrow m = -2, -1, 0, +1, +2$
$\ell = 3 \rightarrow m = -3, -2, -1, 0, +1, +2, +3$
$\ell = 4 \rightarrow m = -4, -3, -2, -1, 0, +1, +2, +3, +4$
Total no. of orbitals = 3

4. A and B decompose via first order kinetics with half-lives 54.0 min and 18.0 min respectively. Starting from an equimolarnon reactive mixture of A and B, the time taken for the concentration of A to become 16 times that of B is __________ min. (Round off to the Nearest Integer).

Ans. **108**

Sol. $A \xrightarrow{1^{st}\text{ order}} t_{1/2}(A) = 54$ $\quad$ $B \xrightarrow{1^{st}\text{ order}} t_{1/2}(B) = 18$

$A_0 = B_0 = N_0$

$A_t = \frac{A_0}{2^t / 54}$ $\quad$ $B_t = \frac{B_0}{2^t / 18}$

$A_t = 16.B_t$

$\frac{A_0}{2^t / 54} = 16 \times \frac{B_0}{2^t / 18}$ $\quad$ $2^{t/18 - t/54} = 16$

$2^{2t/54} = 16 = 2^4$ $\quad$ $2t/54 = 4$

t = 108 min

5. $[Ti(H_2O)_6]^{3+}$ absorbs light of wavelength 498 nm during a d–d transition. The octahedral splitting energy for the above complex is ________ $\times 10^{-19}$ J. (Round off to the Nearest Integer).
$h = 6.626 \times 10^{-34}$Js; $c = 3 \times 10^8\text{ms}^{-1}$.

Ans. **(4)**

Sol. $\Delta_0 = \frac{hc}{\lambda_{abs}} = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{498 \times 10^{-9}}$

$= \frac{6.626 \times 3}{498} \times 10^{-17} = 0.0399 \times 10^{-17} = 3.99 \times 10^{-19} \simeq 4 \times 10^{-19}$ J

6. Sulphurous acid (H_2SO_3) has $Ka_1 = 1.7 \times 10^{-2}$ and $Ka_2 = 6.4 \times 10^{-8}$. The pH of 0.588 M H_2SO_3 is _________. (Round off to the Nearest Integer).

Ans. **5**

Sol. $H_2SO_3\,(aq) \rightleftharpoons HSO_3^-(aq) + H^+(aq)$

0.588M = C $\quad C\alpha_1 \quad C\alpha_1 + C\alpha_1\alpha_2$

$HSO_3^-(aq) \rightleftharpoons H^+(aq) + SO_3^{2-}(aq)$

$C\alpha_1(1-\alpha_2) \quad C\alpha_1\alpha_2 + C\alpha_1 \quad C\alpha_1\alpha_2$

$$\alpha_1 = \sqrt{\frac{1.7\times10^{-2}}{0.588}} = \sqrt{\frac{17}{289\times2}}$$

Therefore $\dfrac{\alpha_1 << 1}{(1-\alpha_1)\simeq 1}$

Hence $\alpha_2 << 1$ & $(1-\alpha_2) \simeq 1$

$\therefore [H^+] = C\alpha_1$

$= \sqrt{Ka_1 \times C} = \sqrt{17\times10^{-3}\times0.588}$

$= 99.98 \times 10^{-3}$

pH = 1.99 + 3

= 4.99 ≃ 5

7. In Duma's method of estimation of nitrogen, 0.1840 g of an organic compound gave 30 mL of nitrogen collected at 287 K and 758 mm of Hg pressure. The percentage composition of nitrogen in the compound is __________. (Round off to the Nearest Integer).

[Given: Aqueous tension at 287 K = 14 mm of Hg]

Ans. **19**

Sol. Moles of $N_2 = \dfrac{(758-14)}{760} \times \dfrac{30\times10^{-3}}{0.0821\times287}$

$= 1.246 \times 10^{-3}$ mol

mass of N $= 1.246 \times 10^{-3} \times 28$

mass % of 'N' $= \dfrac{\text{mass of 'N'}}{\text{total mass}} \times 100$

$= \dfrac{1.246\times28\times10^{-3}}{0.184}\times100$

$= \dfrac{124.6\times28}{0.184}\% = 18.96\%$

≃ 19%

8. Ga (atomic mass 70 u) crystallizes in a hexagonal close packed structure. The total number of voids in 0.581 g of Ga is ________ $\times 10^{21}$. (Round off to the Nearest Integer).

[Given: $N_A = 6.023 \times 10^{23}$]

Ans. **15**

Sol. No. of moles of Ga = $\frac{0.581}{70}$

No. of atoms of Ga = $\frac{0.581}{70} \times N_A$

$\therefore$ Total number of voids = $\frac{0.581}{70} \times N_A \times 3$

= $0.0249 \times 6 \times 10^{23}$

= 15×10^{21}

(As there are one octahedral void and two tetrahedral voids per atom)

9. When 35 mL of 0.15 M lead nitrate solution is mixed with 20 mL of 0.12 M chromic sulphate solution, _________ $\times 10^{-5}$ moles of lead sulphate precipitate out. (Round off to the Nearest Integer).

Ans. 525

Sol. $3Pb(NO_3)_2$ + $Cr_2(SO_4)_3$

35ml 20 ml

0.15M 0.12M

= 5.25 m mol = 2.4 m mol

$3\,PbSO_4 \downarrow + 2Cr(NO_3)_3$

Moles of $PbSO_4$ = moles of $Pb(NO_3)_2$

= 5.25 m mol

= 525×10^{-5} mol

Ans. 525

10. At 363 K, the vapour pressure of A is 21 kPa and that of B is 18 kPa. One mole of A and 2 moles of B are mixed. Assuming that this solution is ideal, the vapour pressure of the mixture is _______ kPa. (Round off to the Nearest Integer).

Ans. 19

Sol. $X_A = \frac{1}{1+2} = \frac{1}{3}$ $X_B = \frac{2}{3}$

P_A^o = 21 kPa P_B^o = 18 kPa

$P_{total} = P_A^o X_A + P_B^o X_B$

$= 21 \times \frac{1}{3} + 18 \times \frac{2}{3}$

= 7 + 12

= 19 kPa