**H2 CHEMISTRY PRELIMS SUGGESTED SOLUTIONS**
**PAPER II**

**1 (a) (i)** **Nucleophilic addition.** [1]

**(ii)** **The gas is HF.** [1]

**(iii)**

$$COF_2(g) + H_2O(l) \rightarrow 2HF(g) + CO_2(g)$$

[1]

**(b) (i)** **Amt of NaOH that has reacted**

$$= \frac{25.00}{1000} \times 0.100$$

$$= 2.50 \times 10^{-3} \text{ mol}$$

[1]

**(ii)** $1CO_2 \equiv 2HF$
$1CO_2 \equiv 2OH^-$
$2HF \equiv 2OH^-$

**No of moles of $CO_2$ produced**
**= ½ x ½ x (25.0/ 1000) x 0.100**
$= 6.25 \times 10^{-4}$ **moles**

[3]

**(iii)** $PV = nRT$
$V = nRT / P$
$= (6.25 \times 10^{-4})(8.314)(273+30) / 1.01 \times 10^5$
$= 1.559 \times 10^{-5} m^3$
$= 1.56 \times 10^{-5} m^3$

[1]

**(iv)**

**Mass of $COF_2$ = $6.25 \times 10^{-4}$ x Mr = $6.25 \times 10^{-4}$ x 66.0 = 0.0413 g**

[1]

**(c) (i)**

| | $2\ COF_2$ | ⇔ | $CO_2$ | + | $CF_4$ |
|---|---|---|---|---|---|
| Initial / mol | *0.500* | | *0* | | *0* |
| Change / mol | *-2x* | | *+x* | | *+x* |
| Eqm / mol | *0.500 – 2x* | | *x* | | *x* |

$$\frac{x^2/V^2}{(0.500-2x)^2/V^2} = 2.00$$

**Solving, x = 0.1847 mol [1]**
**No of moles of $COF_2$ that remains undissociated at eqm**
**= 0.500 – 2(0.1847)**
**= 0.131 mol**

[4]

**(ii)** **There is no change in the yield of $CO_2$.**
**There are equal number of moles of gaseous products and reactants.** [2]

**2** **(a)** **X** = Mg

**Y** = Ca or Sr or Ba

Reason: Reducing power increases down the group. [2]

**(b)** High melting point of MgO [1]

**(c)** **(i)** $SiO_2$ does not dissolve in water.
pH ≈ 7

$Na_2O$ dissolves readily in water to give a colourless solution.
$Na_2O + H_2O \rightarrow 2NaOH$

pH ≈ 13-14

CaO dissolves sparingly in water.
$CaO + H_2O \rightleftharpoons Ca(OH)_2$

pH ≈ 9-12

[5]

**(ii)** The basic metal oxide will react / undergo **neutralisation** with the acidic $SO_2$.
**OR**
Acid-base reaction [1]

**(d)** **(i)**

- $Br_2$ has a **smaller electron cloud size** than $I_2$.
- electron cloud of $Br_2$ is **less polarisable**
- **weaker Van der Waals' forces between the molecules**
- More energy is required to overcome the interaction between $I_2$ molecules, leading to a higher boiling point.

[2]

**(ii)**

- $Cl^-$ has one more electron; hence its **p/e ratio is smaller**
- **attraction of the nucleus for the outer electrons is weaker**. Therefore it has a bigger radius.
- **OR electron-electron repulsion**

[2]

**(e)** Disproportionation
$3Cl_2(g) + 6OH^-(aq) \rightarrow 5Cl^-(aq) + ClO_3^-(aq) + 3H_2O(l)$
Smell of $Cl_2$ disappears **OR**
greenish-yellow/pale green/green colour of $Cl_2$ disappears (hard to observe)

[2]

**3 (a) (i)** **Slow decolourisation of reddish brown solution of bromine. OR Intensity of reddish brown color of bromine fades with time.** [2]

**White fumes of HBr.**

**(ii)** **Free radical is a particle with <u>an unpaired electron / a lone electron</u>.** [1]

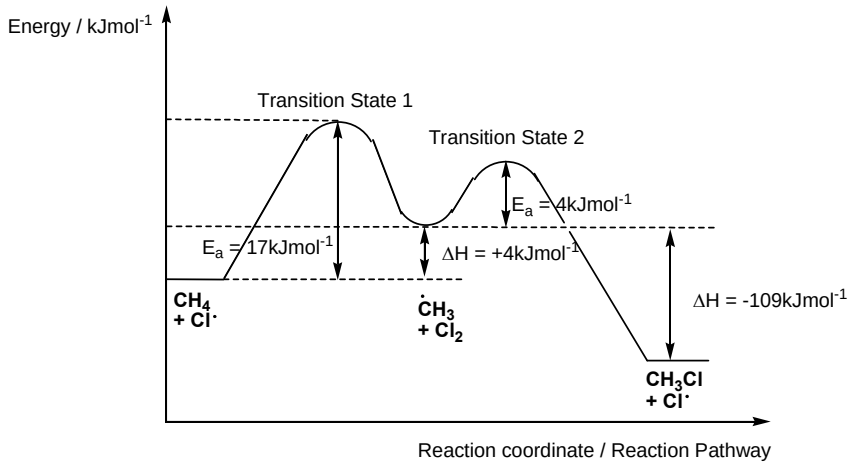
**(b) (i)**

$$CH_4 + Cl^{\bullet} \longrightarrow \dot{C}H_3 + HCl$$

$$\dot{C}H_3 + Cl_2 \longrightarrow CH_3Cl + Cl^{\bullet}$$

[2]

**(ii)**




[4]

**(iii)** **Propagation step 1 because it has higher activation energy.** [2]

**(c) (i)** **<u>Comparing Experiment I & II where [$CH_3Cl$] is constant</u>**
**As concentration of [KOH] increased by 1.5 times, initial rate also increased by 1.5 times. Hence 1st order with respect to KOH.**

**<u>Comparing Experiment I & III where [KOH] is constant</u>**

$$\frac{Rate_{expt1}}{Rate_{expt3}} = \frac{k[CH_3Cl]^n_{expt1}[KOH]_{expt1}}{k[CH_3Cl]^n_{expt3}[KOH]_{expt3}}$$

$$\frac{0.024}{0.096} = \frac{k[0.10]^n[0.10]}{k[0.20]^n[0.20]}$$

$$\frac{1}{4} = \left(\frac{1}{2}\right)^n \times \frac{1}{2}$$

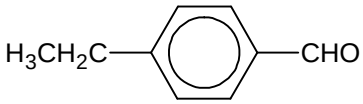
$$n = 1$$

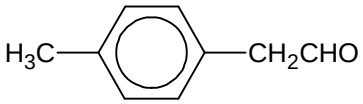
**Hence 1st order with respect to $CH_3Cl$.**

**Rate equation = k [$CH_3Cl$][KOH]** [3]

**(ii)** **$HCOO^-K^+$** [1]

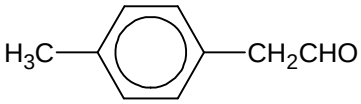
**4 (a) (i)**

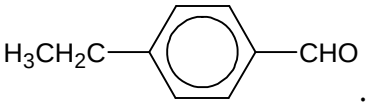



Reagents: Fehling's solution

Condition: warm

Observation: Brick-red precipitate formed for 


but not for 

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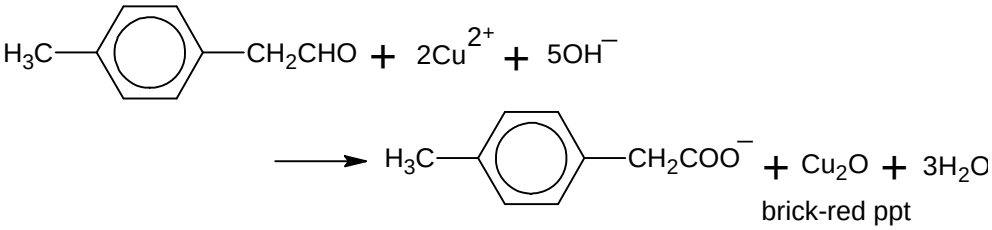
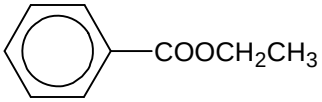
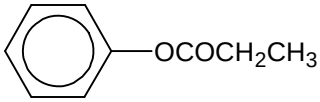
Balanced Equation:




[3]

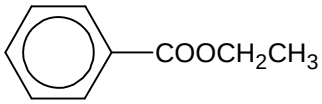
**(ii)**

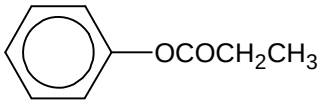


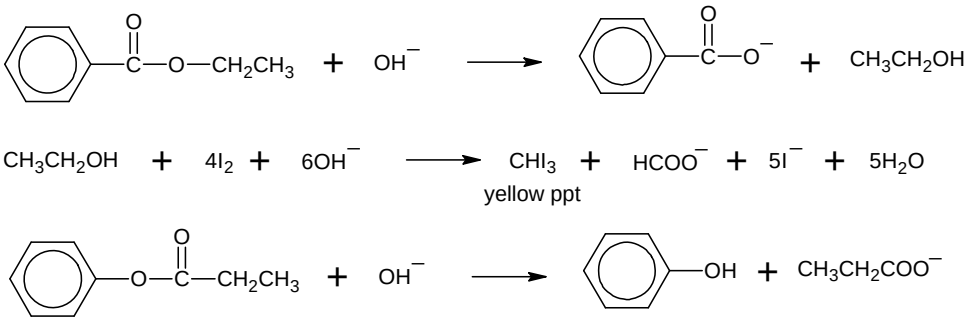

Step 1: NaOH(aq), heat

Step 2: $I_2$(aq), NaOH(aq), warm

Observation: Yellow precipitate formed for 

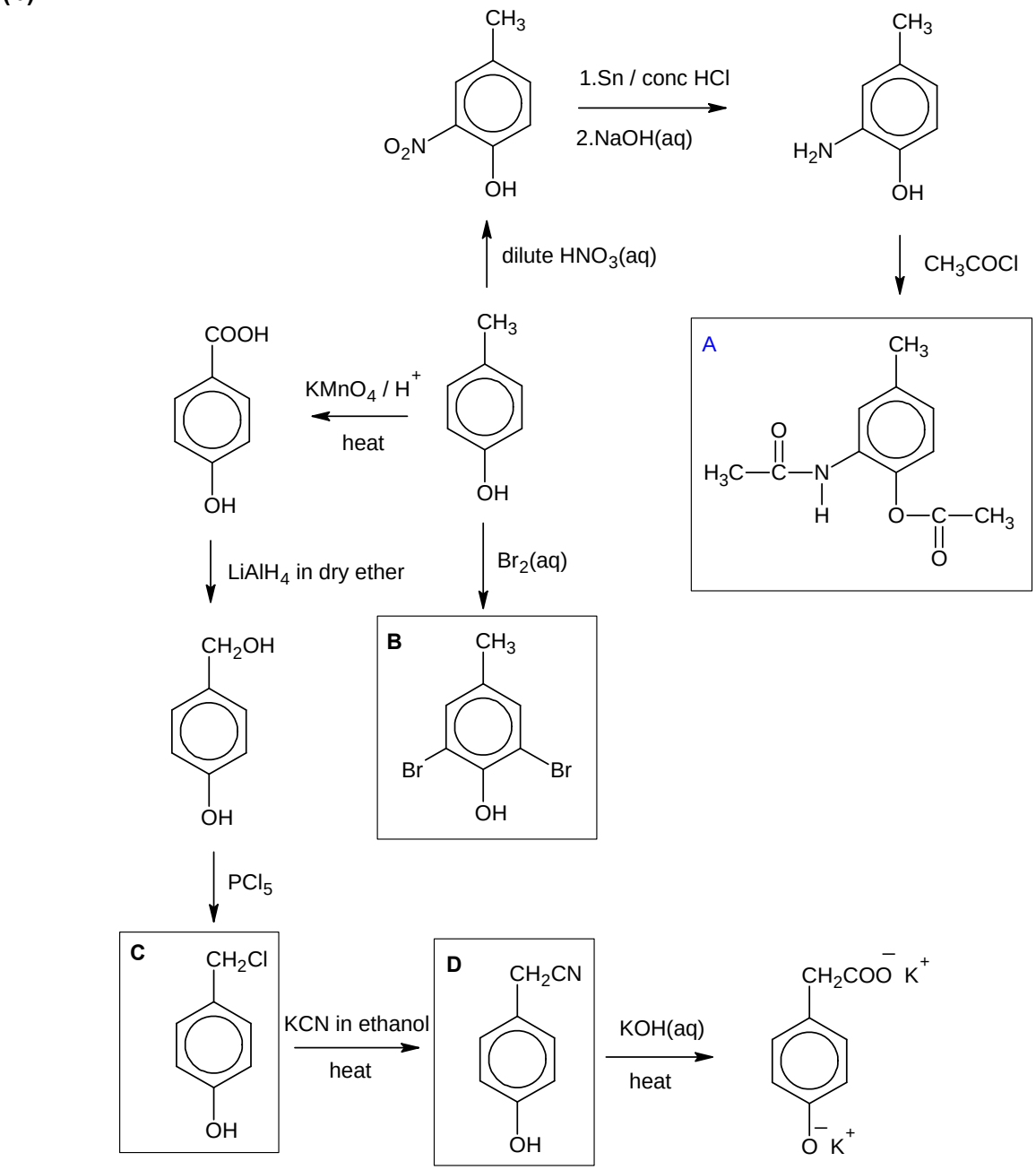

but not for 

Balanced Equation:




[3]

**(b)**



**Step 1:**

Reagent(s): Sn, conc HCl

Condition(s): Heat under reflux

**Step 2:**

Reagent(s): Dilute $HNO_3$(aq)

Condition(s): Room temperature

**Step 3:**

Reagent(s): $KMnO_4$, dilute $H_2SO_4$(aq)

Condition(s): Heat under reflux

**Step 4:**

Reagent(s): KCN

Condition(s): Ethanol, Heat under reflux

**Step 5:**

Reagent(s): KOH(aq)

Condition(s): Heat under reflux [9]