

### Part C

Q5)

A)

$$1. \quad (\text{nbutanedioic acid}) / \text{nNaOH} = 1/2$$

OR for the identification of stoichiometry (5marks)

Butanedioic acid = BDA

In benzenelayer,

$$[\text{BDA}]_{\text{benzene}} = \{1/2 \times 0.05 \text{ mol dm}^{-3} \times 4.8 \text{ cm}^3\} / 50.00 \text{ cm}^3 \quad (3\text{marks})$$

$$= 2.4 \times 10^{-3} \text{ mol dm}^{-3}. \quad (4+1\text{marks})$$

In Aqueous layer,

$$[\text{BDA}]_{\text{aq}} = \{1/2 \times 0.05 \text{ mol dm}^{-3} \times 16.0 \text{ cm}^3\} / 25.00 \text{ cm}^3 \quad (2\text{marks})$$

$$= 1.6 \times 10^{-2} \text{ mol dm}^{-3} \quad (4+1\text{marks})$$

$$K_D = [\text{BDA}]_{\text{benzene}} / [\text{BDA}]_{\text{aq}} \quad (5\text{marks})$$

$$= (2.4 \times 10^{-3} \text{ mol dm}^{-3}) / (1.6 \times 10^{-2} \text{ mol dm}^{-3}) = 0.15 \text{ or } 3/20. \quad (4+1\text{marks})$$

OR

$$K_D = [\text{BDA}]_{\text{aq}} / [\text{BDA}]_{\text{benzene}}$$

$$= (1.6 \times 10^{-2} \text{ mol dm}^{-3}) / (2.4 \times 10^{-3} \text{ mol dm}^{-3}) = 6.67 \text{ or } 20/3.$$

(Note: Steps can be combined award marks accordingly)

2. Solubility,

$$[\text{BDA}]_{\text{benzene}} = [\text{BDA}]_{\text{aq}}$$

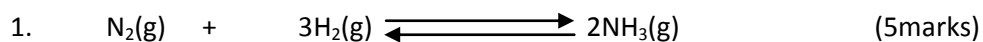
Consider a mixture having  $1.0 \text{ dm}^3$  of benzene layer and  $1.0 \text{ dm}^3$  of aqueous layer.

$$x / M_{\text{BDA}} = 0.15 (8.0 \text{ g dm}^{-3}) / M_{\text{BDA}} \quad (5\text{marks})$$

(Note: Equation can be accepted without  $M_{\text{BDA}}$ .)

$$x = 1.2 \text{ g dm}^{-3} \quad (4+1\text{marks})$$

(B)



$$\Delta S = 2 \times 191 \text{ JK}^{-1} \text{ mol}^{-1} - (193 \text{ JK}^{-1} \text{ mol}^{-1} + 3 \times 131 \text{ JK}^{-1} \text{ mol}^{-1})$$

$$= 382 - (193 + 393)$$

$$\begin{aligned}
 &= (-204 \text{ JK}^{-1} \text{ mol}^{-1}) && (4+1 \text{ marks}) \\
 \Delta H_R &= 2 \times (-46 \text{ kJ mol}^{-1}) \\
 &= (-92 \text{ kJ mol}^{-1}) && (4+1 \text{ marks})
 \end{aligned}$$

At 27°C,

$$\begin{aligned}
 \Delta G &= \Delta H - T\Delta S && (2 \text{ marks}) \\
 &= (-92) - 300 \times (-204) \times 10^{-3} \\
 &= (-30.8 \text{ kJ mol}^{-1}) && (4+1 \text{ marks})
 \end{aligned}$$

Therefore, as  $\Delta G$  is negative it is spontaneous in 27°C. (10mark)

2.

At 450°C,

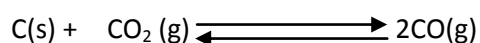
$$\begin{aligned}
 \Delta G &= (-92) - 723 \times (-204 \times 10^{-3}) \\
 &= (-92) + 147.49 \\
 &= 155.49 \text{ kJ} && (4+1 \text{ marks})
 \end{aligned}$$

Therefore, as  $\Delta G$  is positive it is non-spontaneous in 450°C. (10mark)

Reaction rate at 450°C is greater and fraction of molecules greater than activation energy also greater 450°C. Therefore, 450°C used in industries as optimum temperature as at 27°C reaction rate is very very slow (not industrially profitable). (5marks)

(c)

$$1. \quad K_P = P^2 \text{CO} / P \text{CO}_2 \quad (5 \text{ marks})$$



$$\begin{array}{lll}
 2. \quad \text{Initial mole} & 0.075 & \\
 \text{At equilibrium} & 0.075-x & 2x
 \end{array} \quad (4+1 \text{ marks})$$

$$\text{Total number of gas moles} = 0.075+x \quad (5 \text{ marks})$$

Apply  $PV = nRT$  assuming ideal behaviour,

$$0.075+x = \{8.0 \times 10^5 \text{ Pa} \times 1.0 \times 10^{-3} \text{ m}^3\} / 8 \times 10^3 \text{ J mol}^{-1} \quad (4+1 \text{ marks})$$

$$x = 0.025 \text{ mol} \quad (4+1 \text{ marks})$$

$$n_{\text{CO}} = 0.05 \text{ mol} \quad n_{\text{CO}_2} = (0.075 - 0.025) \text{ mol} = 0.05 \text{ mol} \quad (3+2 \text{ marks})$$

Therefore,

$$PCO = (2 \times 0.025 \times 8.0 \times 10^5 \text{ Pa}) / 0.1 = 0.25 \times 10^5 \text{ Pa} \quad (4+1\text{marks})$$

$$PCO_2 = (0.05 \times 8.0 \times 10^5 \text{ Pa}) / 0.1 = 0.25 \times 10^5 \text{ Pa} \quad (4+1\text{marks})$$

$$KP = (0.25 \times 10^5 \text{ Pa})^2 / 0.25 \times 10^5 \text{ Pa} \quad (4+1\text{marks})$$

$$= 0.25 \times 10^5 \text{ Pa} \quad (4+1\text{marks})$$

3. Calculate Q using pressures.

$$\begin{aligned} Q &= (2 \times 10^5 \text{ Pa})^2 / 2 \times 10^5 \text{ Pa} \\ &= 2 \times 10^5 \text{ Pa} \end{aligned} \quad (5\text{marks})$$

Q is smaller than KP, Therefore, PCO<sub>2</sub> decreases and PCO increases until Q = KP.

(5marks)

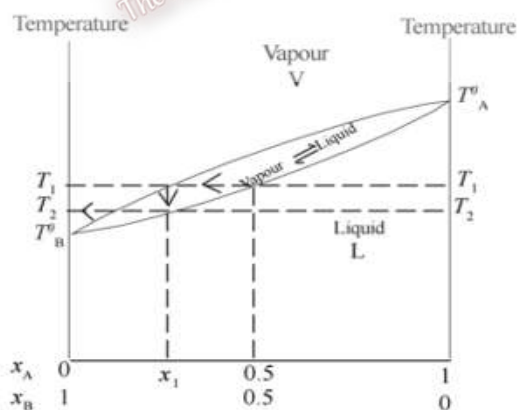
(Any other correct alternative answers)

**(Total 150marks)**

**Q6)**

**(A)**

1. Fractional distillation is the process to separate two volatile miscible components from an ideal or nearly ideal solution of them. (10marks)
2. To increase the efficiency of separating the liquids in to pure forms. (5marks)
3. Because, at one stage highest or lowest boiling point azotropic mixtures are obtained respectively. (10marks)
- 4.



V = Composition of the vapour  
L = Composition of the liquid  
 $T_A^0$  = B.p. of A  
 $T_B^0$  = B.p. of B

(15marks)

**(B)**



$$KSP = [\text{Ag}^+(\text{aq})] [\text{I}^-(\text{aq})] \quad (3\text{marks})$$

$$[\text{Ag}^+(\text{aq})] = [\text{I}^-(\text{aq})] = x$$

$$K_{SP} = x^2 \quad (2\text{marks})$$

Therefore,

$$\begin{aligned} [Ag^+(aq)] &= (5.0 \times 10^{-18})^{1/2} \\ &= 2.236 \times 10^{-9} \text{mol dm}^{-3} \text{ or } 2.2 \times 10^{-9} \text{mol dm}^{-3} \end{aligned} \quad (4+1\text{marks})$$

2. The solution is a saturated solution of AgI. (5marks)

Therefore,  $[Ag^+(aq)]$  is as same as above,  $2.23 \times 10^{-9} \text{mol dm}^{-3}$ . (5marks)

3. The product of concentrations of  $Ag^+$  and  $I^-$  must be calculated and compared with  $K_{SP}$ .

$$\begin{aligned} [Ag^+(aq)] &= (1.5 \times 10^{-4} \text{mol dm}^{-3} \times 10.00 \text{cm}^3) / 15.00 \text{cm}^3 \\ &= 1 \times 10^{-4} \text{mol dm}^{-3} \end{aligned} \quad (4+1\text{marks})$$

$$\begin{aligned} [I^-(aq)] &= (6.0 \times 10^{-4} \text{mol dm}^{-3} \times 5.00 \text{cm}^3) / 15.00 \text{cm}^3 \\ &= 2.0 \times 10^{-4} \text{mol dm}^{-3} \end{aligned} \quad (4+1\text{marks})$$

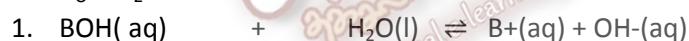
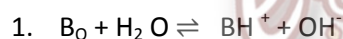
$$[Ag^+(aq)] \times [I^-(aq)] = 2.0 \times 10^{-8} \text{mol}^2 \text{dm}^{-6} > K_{SP} \quad (10\text{marks})$$

**[OR any other correct approach]**

Therefore, AgI will precipitate (slightly yellow precipitate will form). (5marks)

**(50marks)**

**(C)**



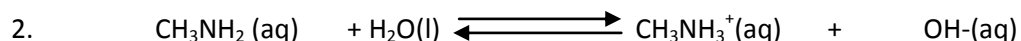
$$K_c = \frac{[B^+(aq)] \times [OH^-(aq)]}{[BOH(aq)] \times [H_2O(l)]}$$

$$K_c \times [H_2O(l)] = \frac{[B^+(aq)] \times [OH^-(aq)]}{[BOH(aq)]}$$

As  $[H_2O(l)]$  is a constant at constant temperature.

$$K_b = \frac{[B^+(aq)] \times [OH^-(aq)]}{[BOH(aq)]} \quad / \quad K_b = \frac{[BH^+][OH^-]}{[B]}$$

(10marks)



$$K_b = \frac{[CH_3NH_3^+(aq)] \times [OH^-(aq)]}{[CH_3NH_2(aq)]}$$

But,  $[CH_3NH_3^+(aq)] = [OH^-(aq)]$

Dissociation of the weak acid is negligibly small compared to initial concentration.

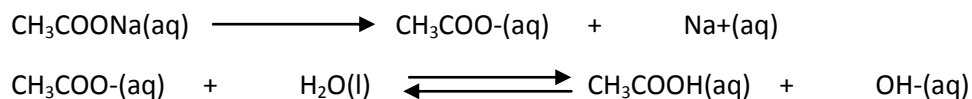
$$K_b = \frac{[OH^-(aq)]^2}{[CH_3NH_2(aq)]}$$

$$\begin{aligned} [OH^-(aq)]^2 &= K_b \times [CH_3NH_2(aq)] \\ &= 6 \times 10^{-5} \text{mol dm}^{-3} \times 0.1 \text{mol dm}^{-3} \end{aligned}$$

$$\begin{aligned}
 &= 6 \times 10^{-6} \text{mol dm}^{-3} \\
 [\text{OH}^{-}(\text{aq})] &= 2.45 \times 10^{-3} \text{mol dm}^{-3} \quad (15\text{marks})
 \end{aligned}$$



For A, When  $V_{\text{HCl}} = 0$

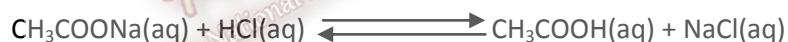


$$[\text{CH}_3\text{COOH}(\text{aq})] = [\text{OH}^{-}(\text{aq})]$$

As the degree of hydrolysis of  $\text{CH}_3\text{COO}^{-}(\text{aq})$  is very small,

$$\begin{aligned}
 K_b &= K_w / K_a = [\text{OH}^{-}(\text{aq})]^2 / [\text{CH}_3\text{COO}^{-}(\text{aq})] \\
 &= (10^{-14} \times 0.18) / (1.8 \times 10^{-5}) \text{mol dm}^{-3} \\
 [\text{OH}^{-}(\text{aq})]^2 &= 10^{-10} \text{mol}^2 \text{dm}^{-6} \\
 [\text{OH}^{-}(\text{aq})] &= 10^{-5} \text{mol dm}^{-3} \\
 \text{pOH} &= -\log_{10}[\text{OH}^{-}(\text{aq})] \\
 \text{pOH} &= 5 \\
 \text{pH} + \text{pOH} &= 14 \\
 \text{pH} &= 14 - 5 \\
 &= 9 \quad (10\text{marks})
 \end{aligned}$$

For B,



When  $V_{\text{HCl}} = 12.50 \text{cm}^3$  half equivalence point is obtained. Then,

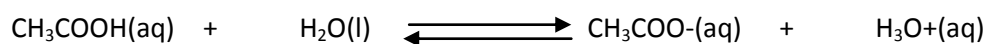
$$[\text{CH}_3\text{COONa}(\text{aq})] = [\text{CH}_3\text{COOH}(\text{aq})]$$

Neglecting the ionisation of  $\text{CH}_3\text{COOH}$  which is small,

$$\begin{aligned}
 [\text{H}_3\text{O}^{+}(\text{aq})] &= K_a \\
 &= 1.8 \times 10^{-5} \text{mol dm}^{-3} \\
 \text{pH} &= -\log_{10}[1.8 \times 10^{-5} \text{mol dm}^{-3}] \\
 \text{pH} &= 4.74 \quad (10\text{marks})
 \end{aligned}$$

For C, when  $V_{\text{HCl}} = 25.00 \text{cm}^3$

$$\begin{aligned}
 \text{CH}_3\text{COONa}(\text{aq}) \text{ in the medium} &= (0.18 / 1000) \times (25 / 50) \times 1000 \text{mol dm}^{-3} \\
 &= 0.09 \text{mol dm}^{-3}
 \end{aligned}$$



As  $\text{CH}_3\text{COOH}$  is a weak acid its degree of dissociation is negligibly small.

$$\begin{aligned} K_a &= [\text{H}_3\text{O}^+(\text{aq})]^2 / [\text{CH}_3\text{COOH}(\text{aq})] \\ [\text{H}_3\text{O}^+(\text{aq})] &= (K_a \times 0.09 \text{ mol dm}^{-3})^{1/2} \\ &= (1.8 \times 0.09)^{1/2} \text{ mol dm}^{-3} \\ &= 1.27 \text{ mol dm}^{-3} \\ \text{pH} &= -\log_{10}(1.27 \times 10^{-3}) \\ \text{pH} &= 2.89 \text{ or } \text{pH} = 2.9 \quad (10 \text{ marks}) \end{aligned}$$

For D, when  $V_{\text{HCl}} = 50.00 \text{ cm}^3$

$$\begin{aligned} [\text{HCl}(\text{aq})] \text{ in the medium} &= (0.18 / 1000) \times (50 / 75) \times 1000 \text{ mol dm}^{-3} \\ &= 0.12 \text{ mol dm}^{-3} \end{aligned}$$

As the  $[\text{H}^+]$  given by the dissociation of  $\text{CH}_3\text{COOH}$  is negligible compared to that provided by HCl,

$$\begin{aligned} \text{pH} &= -\log_{10}(1.2 \times 10^{-1}) \\ \text{pH} &= 0.92 \quad (10 \text{ marks}) \end{aligned}$$

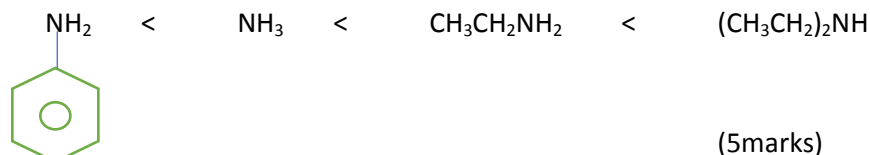
**(Total 150 marks)**

**(Q7)**

**(A) (I)**

1. Tertiary alcohols can easily form tertiary carbocations. As tertiary carbocations are more stable they easily undergo substitution reaction with concentrated HCl. (5 marks)
2. The **O-H** group of phenol and the benzene ring have very stable bond. Because, in phenol the **C-O** bond shows double bond character therefore it cannot involve in substitution reactions easily. (5 marks)

**(II)**

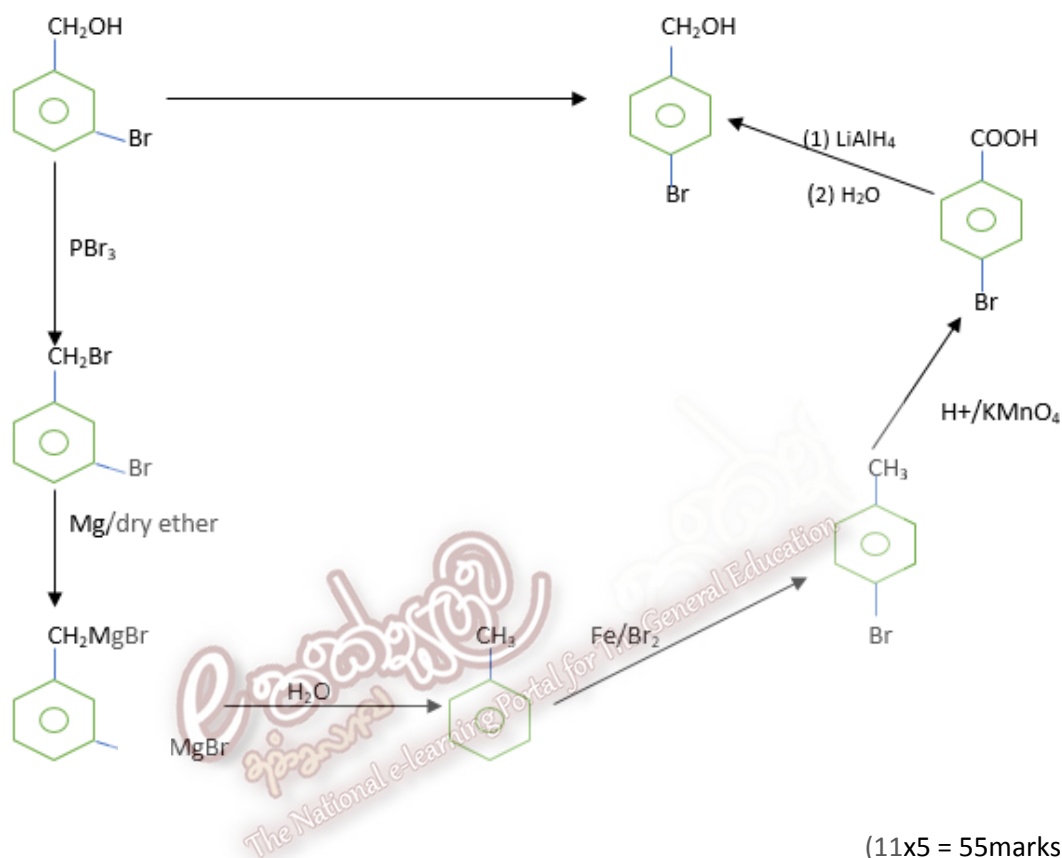


- $(\text{CH}_3\text{CH}_2)_2\text{NH}$  contains 2 electron repulsing alkyl groups. Therefore, the electron density in nitrogen is greatly increased. Basicity increases as the ability to donate lone pair increases.
- $\text{CH}_3\text{CH}_2\text{NH}_2$  has only one electron repulsing alkyl group when compared to  $(\text{CH}_3\text{CH}_2)_2\text{NH}$ . But the basic character is greater than that of  $\text{NH}_3$ .

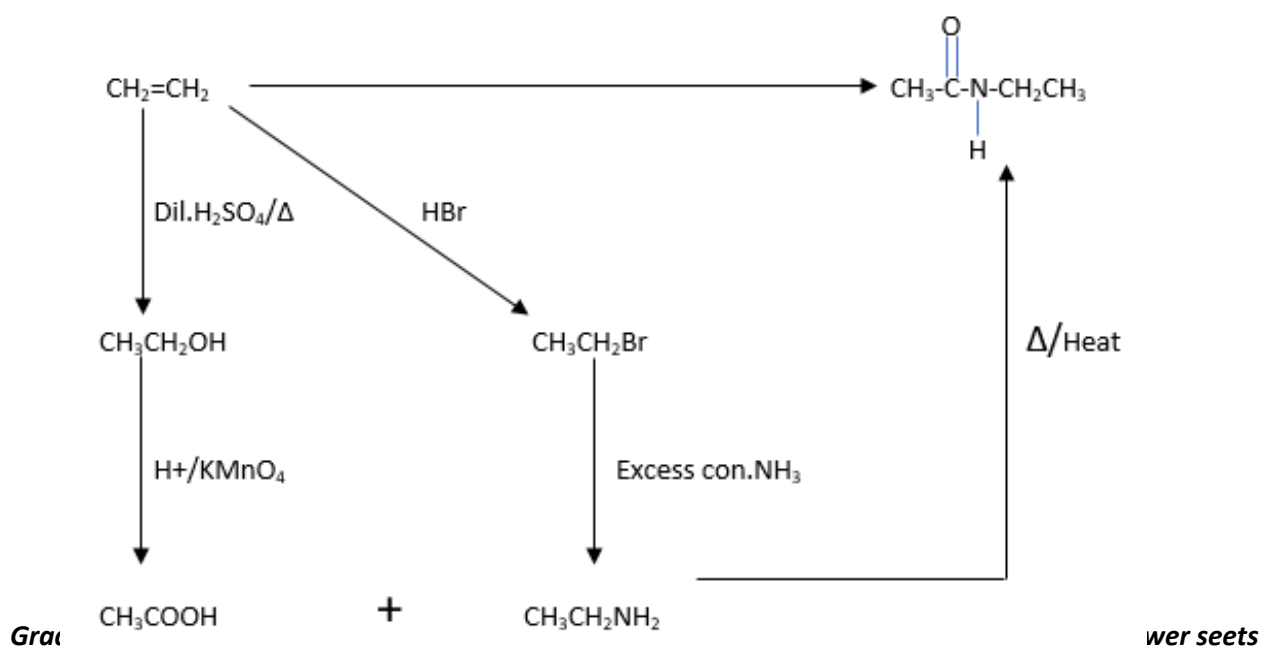
- Aniline is less basic, because the Lone pair electrons of nitrogen is stabilized by the De localisation of electrons with ( $\pi$  bond electrons) the benzene ring. Therefore, ability to donate lone pair decreases, basicity decreases.

(5x3 = 15marks)

(B)

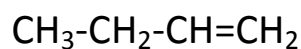
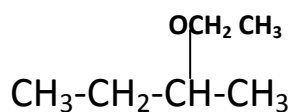


(C)

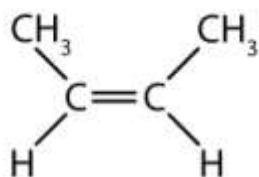


(9x5 = 45marks)

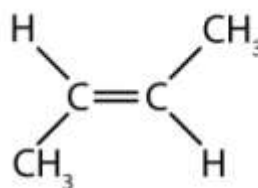
(D)



(2X5 = 10marks)



*cis*-2-butene



*trans*-2-butene

(2X5 = 10marks)

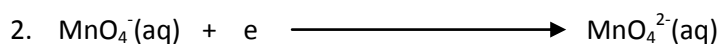
**(Total = 150marks)**

**Q8) A)**

1.

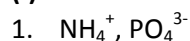


(10x5 = 50marks)

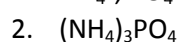


(5marks)

**(B) (I)**

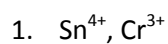


(2x5 = 10marks)

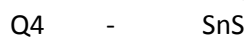


(5marks)

**(II)**



(5x2 = 10marks)



(5x4 = 20marks)

**(C)**



1. Molar mass of  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$  = 248  $\text{g mol}^{-1}$   
(3marks)
- Moles of  $\text{Na}_2\text{S}_2\text{O}_3$  = 0.620g / 248  $\text{g mol}^{-1}$   
= 0.0025mol  
(3marks)
- Concentration of  $\text{Na}_2\text{S}_2\text{O}_3$  = 0.0025 / (250  $\times 10^{-3}$ )  $\text{mol dm}^{-3}$   
(3marks)  
= 0.010  $\text{mol dm}^{-3}$   
(3marks)
2.  $\text{IO}_3^-(\text{aq}) + 5\text{I}^-(\text{aq}) + 6\text{H}^+(\text{aq}) \longrightarrow 3\text{I}_2(\text{aq}) + 3\text{H}_2\text{O}(\text{l})$   
(5marks)
- Moles of  $\text{IO}_3^-$  = 0.0024  $\times 10 \times 10^{-3}$  mol  
= 2.4  $\times 10^{-5}$  mol  
(3marks)
- Total number of  $\text{I}_2$  produced = 7.2  $\times 10^{-5}$  mol  
(3marks)
- $\text{I}_2 + 2\text{S}_2\text{O}_3^{2-} \longrightarrow \text{S}_4\text{O}_6^{2-} + 2\text{I}^-$   
OR  
 $\text{I}_3^- + 2\text{S}_2\text{O}_3^{2-} \longrightarrow \text{S}_4\text{O}_6^{2-} + 3\text{I}^-$   
(3marks)
- Moles of  $\text{S}_2\text{O}_3^{2-}$  = 0.010  $\times 7.4 \times 10^{-3}$  mol  
= 7.4  $\times 10^{-5}$  mol  
(3 $\times$ 2 = 6marks)
- Moles of  $\text{I}_2$  reacted with  $\text{S}_2\text{O}_3^{2-}$  = 3.7  $\times 10^{-5}$  mol  
(3marks)
- Therefore, moles of  $\text{I}_2$  reacted with ascorbic acid = (7.2  $\times 10^{-5}$ ) – (3.7  $\times 10^{-5}$ )  
= 3.5  $\times 10^{-5}$  mol  
(3marks)
- As in 10  $\text{cm}^3$  of fruit drink = 3.5  $\times 10^{-5}$  mol  
Therefore, in 1000  $\text{cm}^3$  = 3.5  $\times 10^{-3}$  mol  
(3marks)
- Molar mass of ascorbic acid = 176  $\text{g mol}^{-1}$  (3marks)  
Therefore,  $[\text{C}_6\text{H}_8\text{O}_6]$  = 3.5  $\times 10^{-3} \times 176 \times 10^3 \text{ mg dm}^{-3}$   
= 616  $\text{mg dm}^{-3}$  (3marks)  
= 616 ppm (3marks)  
(50marks total)

**(Total 150marks)**

**Q9)**

**(A)**

1. R1 - Air / liquid air.
- R2 - Naptha ( $\text{C}_6\text{H}_{12}$ ) / natural gas ( $\text{CH}_4$ ).
- R3 - Sea-water / Brine.
- R4 - Limestone /  $\text{CaCO}_3$ .
- R5 - Coke / C.

(5 $\times$ 2 = 10marks)



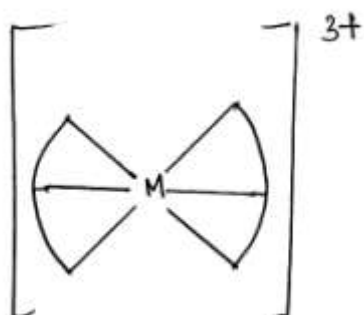
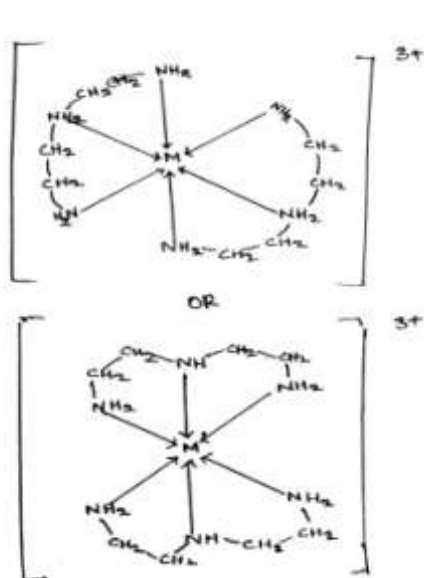
1. Smog is a yellowish haze formed by complex organic molecules which are formed using the oxides of Nitrogen  $\text{NO}_x$  unburnt hydrocarbons  $\text{C}_x\text{H}_y$  emitted by vehicle smokes in the presence of Sunlight and temperatures above  $15^\circ\text{C}$ .  
(5+3+3 = 11marks)
  2. Primary -  $\text{NO}_x$  and unburnt hydrocarbons( $\text{C}_x\text{H}_y$ ).  
Secondary – Ozone, aldehydes, PAN, PBN.  
(2+2 = 4marks)  
(4marks)
  3.  $\text{NO}_2$   
(2marks)
  4. Any suitable answers.  
(5marks)
  5. One mechanism for regulating the earth's temperature by gases around earth surface by maintaining balance between received energy from sun and energy radiated back from earth.  
(5marks)
- $\text{CO}_2$ ,  $\text{H}_2\text{O}(\text{g})$ , Methane,  $\text{N}_2\text{O}$ ,  $\text{NO}_2$ ,  $\text{SO}_2$ , CFC,  $\text{O}_3$  (5marks)
6. Respiration, deforestation, burning of fossil fuels, cement production etc.(3+3 = 6marks)
  7. Photosynthesis, dissolving in water etc. (2+2 = 4marks)
  8.  $\text{CO}_2$ ,  $\text{N}_2$  and  $\text{H}_2\text{O}$  (4marks)
  9. Platinum / Copper / Chromium oxide. (5marks)
  10. Leads to global warming, Respiratory problems/irritant, eye irritation, etc.  
(5marks)
- (60marks)**

**(Total 150marks)**

**Q10)**

**A)**

1.  $[\text{Co}(\text{NH}_3)_4(\text{SO}_4)]$  (10marks)
2.  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)\text{Cl}]\text{Cl}$  - tetraamminechloridonitrocobalt(iii) chloride. (5x2 = 10marks)  
 $[\text{Co}(\text{NH}_3)_4(\text{ONO})\text{Cl}]\text{Cl}$  - tetraamminechloridonitritocobalt(iii) chloride. (5x2 = 10marks)  
 $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{NO}_2$  - tetraamminedichloridocobalt(iii) nitrite. (5x2 = 10marks)
3.  $[\text{M}(\text{dien})_2]^{3+}$  (10marks)



(10marks)

4.  $[\text{Mn}(\text{EDTA})]^{2-}$  (10marks)

**(B)**

1. Pressure: 101.3kPa (1013Pa) /  $1 \times 10^5 \text{Pa}$ . (3marks)  
 Temperature:  $25^\circ\text{C}$  / 298K (3marks)

2. Salt Bridge. (2marks)

3. Anode, (2marks)

Mg is a stronger reducing agent than  $\text{H}_2$  and therefore, (Mg) will be oxidized.

(5marks)

4.  $\text{Mg(s)} / \text{Mg}^{2+}(\text{aq}, 1.00\text{mol dm}^{-3}) // \text{H}^+(\text{aq}, 1.00\text{mol dm}^{-3}) / \text{H}_2(\text{g}), \text{Pt(s)}$ . (10marks)

5.  $E^\ominus_{\text{Cell}} = E^\ominus_{\text{Cathode}} - E^\ominus_{\text{Anode}}$  (3marks)

$2.36\text{V} = 0.00\text{V} - E^\ominus_{\text{Anode}}$  (2marks)

$E^\ominus_{\text{Anode}} = (-2.36\text{V})$  (3marks)

6. Anode:  $\text{Mg(s)} \longrightarrow \text{Mg}^{2+}(\text{aq}) + 2\text{e}$  (3marks)

Cathode:  $2\text{H}^+(\text{aq}) + 2\text{e} \longrightarrow \text{H}_2(\text{g})$  (3marks)

7.  $\text{Mg(s)} + 2\text{H}^+(\text{aq}) \longrightarrow \text{Mg}^{2+}(\text{aq}) + \text{H}_2(\text{g})$  (5marks)

**(C)**

1.  $\text{Pb}^{2+}(\text{aq})$  (2marks)

2.  $E^\ominus_{\text{Cell}} = E^\ominus_{\text{Cathode}} - E^\ominus_{\text{Anode}}$  (3marks)

$1.53\text{V} = (-0.13\text{V}) - E^\ominus_{\text{Anode}}$  (2marks)

$E^\ominus_{\text{Anode}} = (-1.66\text{V})$  (3marks)

Therefore, unknown metal is "**Al**". (3marks)

3. Decreases. (5marks)

4.  $2\text{Al(s)} + 3\text{Pb}^{2+}(\text{aq}) \longrightarrow 2\text{Al}^{3+}(\text{aq}) + 3\text{Pb(s)}$  (5marks)

**(D)**

$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e} \longrightarrow \text{Cr}^{3+} + 7\text{H}_2\text{O}$  (2marks)

$2\text{Cr}^{3+} + 6\text{e} \longrightarrow 2\text{Cr}$  (2marks)

Mass of Cr deposited =  $(0.5\text{m}^2 \times 1 \times 10^{-5}\text{m}) \times 10^6\text{cm}^3 \times 7.28\text{gcm}^{-3}$   
 = 36.4g (3marks)

Moles of Cr deposited =  $36.4\text{g} / 52\text{gmol}^{-1}$   
 = 0.7mol (2marks)

$$\begin{aligned}
 Q &= It \\
 n &= \frac{It}{F} = 4.2 \text{ mol} = \frac{(50 \text{ A} \times t)}{96500 \text{ C mol}^{-1}} \quad (2 \text{ marks}) \\
 t &= 8106 \text{ seconds.} \quad (2 \text{ marks})
 \end{aligned}$$

**(Total 150marks)**

Marking system

M.C.Q    50x 1    = 50 Marks

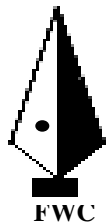
Structured 4x 100 = 400

Essay        4x 150 = 600

20        = 1000 50 Marks

total = 100 Marks





# G.C.E. A/L Examination June - 2017

Conducted by Field Work Centre, Thondaimanaru

In Collaboration with

Provincial Department of Education Northern Province

Grade:13(2017)

Chemistry

Marking Scheme

Q1)

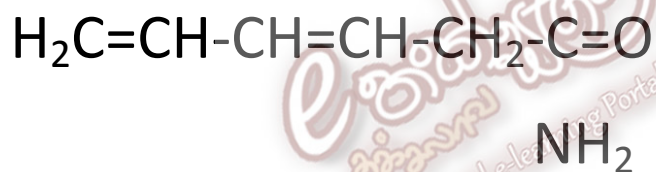
A)

1. Cl
2. H, Na, Cl
3. C
4. C, Al
5. Al

(5x2 = 10marks)

(B)

1.

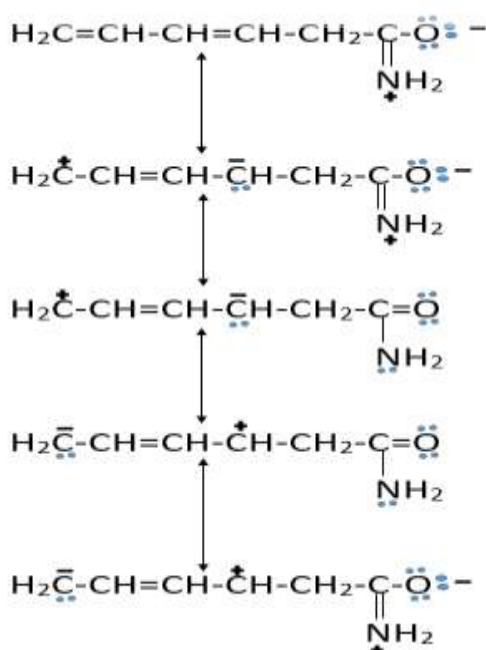


(10marks)

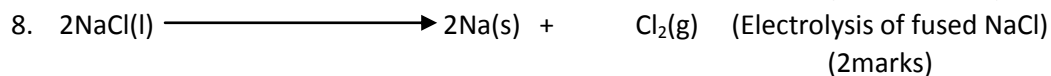
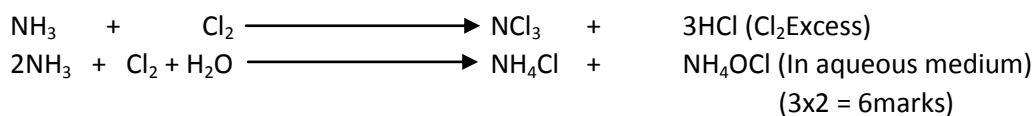
2.

(5x5 = 25marks)

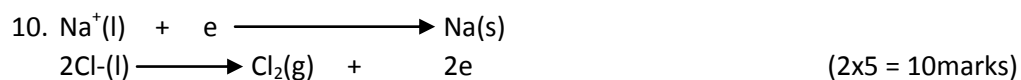
3.





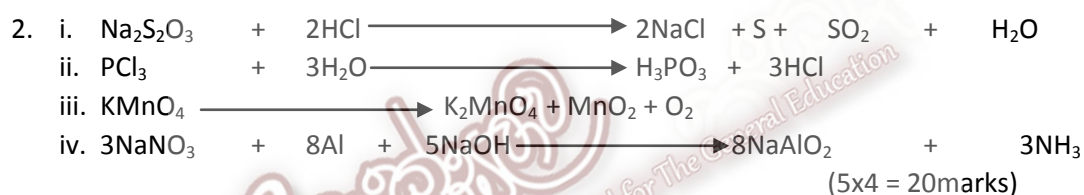


9. Carbon(graphite) electrodes.  
Electrolyte: NaCl(l) / Fused NaCl. (2x2.5 = 5marks)



(B)

1. A -  $\text{Na}_2\text{S}_2\text{O}_3$   
B -  $\text{H}_2\text{CO}_3$   
C -  $\text{PCl}_3$   
D -  $\text{KMnO}_4$   
E -  $\text{NaNO}_3$  (2x5 = 10marks)



**(Total = 100marks)**

(03)

A)

1. R1 -  $8.00 \times 10^{-4}$   
R2 -  $1.60 \times 10^{-3}$   
R3 -  $3.20 \times 10^{-3}$   
R4 -  $3.20 \times 10^{-3}$  (2.5x4 = 10marks)

2. Rate =  $k [\text{P}]^p [\text{Q}]^q [\text{R}]^r$

From Experiment 1:  $8.0 \times 10^{-4} = k [0.2]^p [0.2]^q [0.2]^r$  ..... (1)

From Experiment 2:  $16.0 \times 10^{-4} = k [0.4]^p [0.2]^q [0.2]^r$  ..... (2)

From Experiment 3:  $32.0 \times 10^{-4} = k [0.4]^p [0.4]^q [0.2]^r$  ..... (3)

From Experiment 4:  $32.0 \times 10^{-4} = k [0.2]^p [0.2]^q [0.4]^r$  ..... (4)

(1) / (2):  $1/2 = (1/2)^p$  : p = 1  
(2) / (3):  $1/2 = (1/2)^q$  : q = 1  
(1) / (4):  $1/4 = (1/2)^r$  : r = 2

Therefore,



$$\text{Rate} = k [P] [Q] [R]^2 \quad (10\text{marks})$$

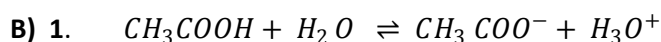
3. Overall order = 4 (10marks)

4. From equation (1),

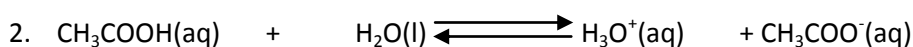
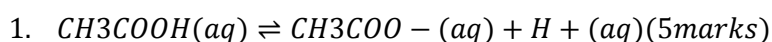
$$K = 8.0 \times 10^{-4} \text{mol dm}^{-3} \text{s}^{-1} / \{(0.2)(0.2)(0.2)^2 \text{mol}^4 \text{dm}^{-12}\}$$

$$K = 0.5 \text{mol}^{-3} \text{dm}^9 \text{s}^{-1} \quad (10\text{marks})$$

**(Note: Same answer from other equations too)**



**Or**



$$K_a = \frac{[\text{H}_3\text{O}^+(\text{aq})] \times [\text{CH}_3\text{COO}^-(\text{aq})]}{[\text{CH}_3\text{COOH}(\text{aq})]} \quad (10\text{marks})$$

**(Physical states are required)**

3. pH = 3.0

$$[\text{H}^+(\text{aq})] = 1.0 \times 10^{-3} \text{mol dm}^{-3}$$

$$K_a = (1 \times 10^{-3} \text{mol dm}^{-3})^2 / 0.10 \text{mol dm}^{-3}$$

$$= 1.0 \times 10^{-5} \text{mol dm}^{-3} \quad (10\text{marks})$$

4. Temperature of the system doesn't change.  
Hydrolysis of water itself is negligible compared to acid. (5marks)



$$K_a / K_w = \frac{[\text{H}_3\text{O}^+(\text{aq})] \times [\text{CH}_3\text{COO}^-(\text{aq})]}{[\text{CH}_3\text{COOH}(\text{aq})]}$$

$$[\text{H}_3\text{O}^+(\text{aq})] \times [\text{OH}^-(\text{aq})] \quad (10\text{marks})$$

6. pH at the equivalence point is determined by the degree of hydrolysis of the salt.

At the equivalence point  $[\text{CH}_3\text{COOH}(\text{aq})]$  nearly equal to  $[\text{OH}^-(\text{aq})]$  (5marks)

7.  $K_a / K_w = [\text{CH}_3\text{COO}^-(\text{aq})] / [\text{OH}^-(\text{aq})]^2$

$$[\text{OH}^-(\text{aq})] = \{[\text{CH}_3\text{COO}^-(\text{aq})] \times (K_w / K_a)\}^{1/2}$$

At the equivalence point  $[\text{CH}_3\text{COO}^-(\text{aq})] = [\text{salt}]$

Since pH = 9.0 at the equivalence point,  $[\text{OH}^-(\text{aq})] = 1 \times 10^{-5} \text{mol dm}^{-3}$

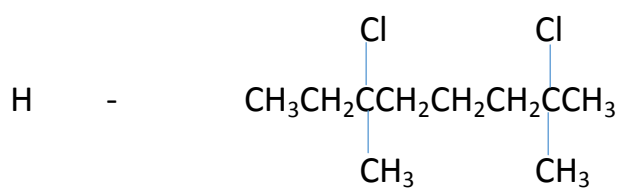
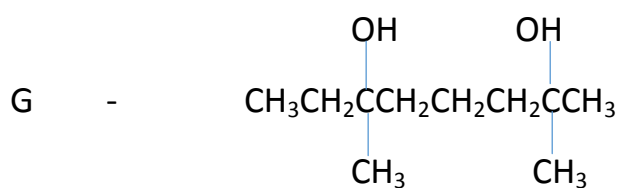
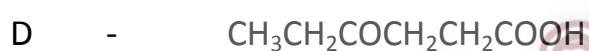
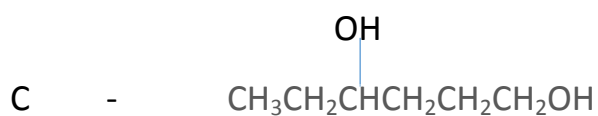
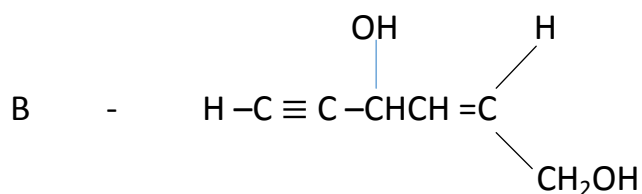
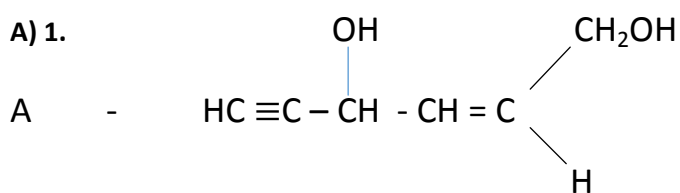
$$[\text{salt}] = \{[\text{OH}^-(\text{aq})]\}^2 \times (K_a / K_w)$$

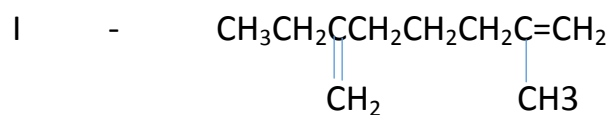
$$[\text{salt}] = (1.0 \times 10^{-5} \text{mol dm}^{-3})^2 \times (0.1 \text{mol dm}^{-3} / 1.0 \times 10^{-14} \text{mol}^2 \text{dm}^{-6})$$

$$= 0.1 \text{mol dm}^{-3} \quad (15\text{marks})$$

Q4)

A) 1.



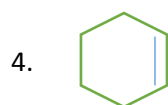


(5x12 = 60marks)

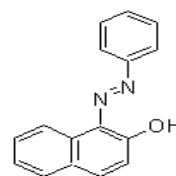
2. By the fractional distillation of the liquid mixture.

(10marks)

(B)



Y



(3x10 = 30marks)

**(Total = 100marks)**

### M.C.Q

### Answers

—

1. 3	11. 3	21. 4	31. 2	41. 1
2. 1	12. 5	22. 4	32. 2	42. 1
3. 4	13. 2	23. 2	33. 4	43. 1
4. 2	14. 4	24. 4	34. 4/5	44. 3
5. 4	15. 4	25. 4	35. 5	45. 4
6. 2	16. 5	26. 5	36. 5	46. 1
7. 2	17. 4	27. 3	37. 4	47. 4
8. 4	18. 2	28. 3	38. 3	48. 1
9. 1	19. 1	29. 3	39. 2	49. 4
10. 2	20. 2	30. 1	40. 5	50. 4

