WAKISSHA JOINT MOCK EXAMINATIONS
MARKING GUIDE
Uganda Advanced Certificate of Education
UACE August 2019
CHEMISTRY P525/1

SECTION A (46marks)

1 (a) (i) Expts 1 and 2

Let the order be x.

Give ½ if explanation us

$$\left(\frac{0.05}{0.01}\right)^{x} = \frac{1.760 \times 10^{-5}}{3.520 \times 10^{-6}}$$

$5x = 5 \therefore x = 1$

(ii) Expts 1 and 3.

Let the order with respect to $B\bar{r}$

$$\left(\frac{0.02}{0.01}\right)^{1} \times \left(\frac{0.02}{0.05}\right)^{y} = \frac{2.816 \times 10^{-6}}{3.520 \times 10^{-6}}$$

$2 \times 0.4^{y} = 0.8$; $y = 1$

(iii) Expts 1 and 4

Let the order be z

$$\left(\frac{0.04}{0.01}\right)^{1} \times \left(\frac{0.02}{0.05}\right)^{1} \times \left(\frac{0.04}{0.02}\right)^{z} = \frac{2.2528 \times 10^{-5}}{3.520 \times 10^{-6}}$$

$4 \times 0.4 \times 2^{z} = 6.4$; $Z = 2$

(b) (i) Overall order = 1 + 1 + 2 = 4 rej 4 if (a) wrong

½

(ii) Rate = $K[BrO_3^-][Br^-][H^+]^2$

(c) $K = \dfrac{Rate}{[BrO_3^-][Br^-][H^+]^2}$

$$= \frac{3.520 \times 10^{-6}}{0.01 \times 0.05 \times 0.02^2}$$

$= 17.6\ mol^{-3}dm^9s^{-1}$

TOTAL =

2. (a) Black solid turns white

(b) $PbS_{(s)} + 4H_2O_{2(aq)} \longrightarrow PbSO_{4(s)} + 4H_2O_{(l)}$ $\frac{-1}{2}$ for

(c) Green precipitate (insoluble in excess alkali). 0½

$Fe^{2+}(aq) + 2\bar{O}H(aq) \longrightarrow Fe(OH)_{2(s)}$ 1½

(d) Effervescence of a colourless gas that forms dense white fumes with conc. HCl. ½

$8Al_{(s)} + 3NO_{3(aq)}^{-} + 5\bar{O}H_{(aq)} + 18H_2O_{(l)} \rightarrow 8Al(OH)_{4(aq)}^{-} + 3NH_{3(g)}$ 1½

06 Marks

(a) (i)

	C	:	H	:	O	
No of moles	$\frac{41.379}{12}$	:	$\frac{3.448}{1}$	:	$\frac{100-(41.379+3.448)}{16}$	
Moles	3.44825	:	3.44800	:	3.44831	02
Simplest Ratio	$\frac{3.44825}{3.44825}$	:	$\frac{3.44800}{3.44800}$	:	$\frac{3.44831}{3.44831}$	
	1	:	1	:	1	

Empirical formula of Q CHO.

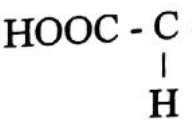
(ii) $(12+1+16)n = 116$

$29n = 116$

$n = 4$

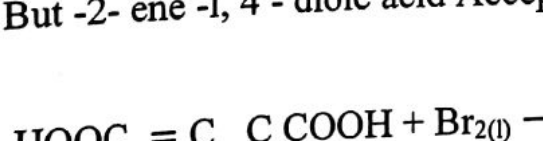
Molecular formula of Q $C_4H_4O_4$ 01

(b) (i)



But -2- ene -l, 4 - dioic acid Accept Butene - 1, 4 - dioic acid. 01

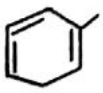
(ii)



rej - $Br_{2(aq)}$ 01

05 marks

(a) (i) Fehling's solution (and heat) rej – $CuSO_4/NaOH_{(aq)}$



- No observable change. 1½

CH_3CH_2CHO – Reddish brown (red) precipitate.

If reagent wrong rej – observation

(ii) Reagent

Sodium nitrite and Hydrochloric acid. Rej- nitrous acid.

Concentrated *HCl*

Observation

$(CH_3)_2NH$ - Yellow oily liquid or yellow oil. | dense white fumes

CH_3CH_3 - No observable change. | No observable change. 1½

(b) $CH_3CH_2CHO + 2Cu^{2+}_{(aq)} + 4\bar{O}H_{(aq)} \rightarrow CH_3CH_2COOH + Cu_2O_{(s)} + 2H_2O_{(l)}$ 01

$(CH_3)_2NH \xrightarrow{NaNO_2|Conc.\ HCl} (CH_3)_2N - N = O$ $Cu^{2+}/\bar{O}H$ reject. 01

05 marks

5. (a) (i) $Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$ 01

(ii) Anode

$4\bar{O}H_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + 4e^-$

(b) $Q = I \times t$ 01

$= 0.45 \times 5.96 \times 60 \times 60$

$= 9{,}655.2$ C

3.1767g of Cu produced by 9655.2C

63.5g of Cu produced $\left(\frac{63.5X9655.2}{3.1767}\right)$C

$= 193{,}000.66$ C.

$560cm^3$ of Oxygen evolved b 9655.2C.

$22400cm^3$ of Oxygen evolved $\left(\frac{22400\ X\ 9655.2}{560}\right)$C 03

$= 386{,}208$ C.

$Q_{(cu)} : Q(O_2) = 193{,}000.66 : 386{,}208$

$= \frac{193{,}000.66}{193{,}000.66} : \frac{386{,}208}{193{,}000.66}$

$= 1 : 2$

6. (a) CO_2, SiO_2 and PbO. 05Marks 1½

(b) (i) $CO_2 > SiO_2 > PbO$ or $PbO < SiO_2 < CO_2$ ½

(ii) $PbO_{(s)} + 2\,HNO_{3\,(aq)} \longrightarrow Pb(NO_3)_{2(aq)} + H_2O_{(l)}$ 01

(c) CO_2 and SiO_2 - Covalent

PbO – Ionic|Electrovalent.

04 ma

7. (a) (i) $Kp = \frac{P^2_{NO} \times P_{O_2}}{P^2_{NO_2}}$ or $Kp = \frac{(PNO)^2 \times (PO_2)}{(PNO_2)^2}$ rej-[ ] 01

(ii) Position of equilibrium shifts from right to the left. ↓ 01

$\frac{-1}{2}$ if from right missing

(b) $2NO_{2(g)} \rightleftharpoons 2NO_{(g)} + O_{2\,(g)}$

initial 2n – –

Eqm $2n(1-\alpha)$ $2n\alpha$ $n\alpha$

Total moles $= n(2 + \alpha)$ $\alpha = 25\ \%$

$P_{NO2} = \frac{2(1-0.25)\ X\ 20}{2+0.25} = 13.33$ atm. ↓ ↓

$P_{NO} = \frac{2(0.25)}{2+0.25} \times 20 = 4.444$ atm 2½

$P_{O2} = \frac{0.25}{2.25} \times 20$ ↓ $= 2.222$ atm.

$K_P = \frac{4.444^2\ x\ 2.222}{13.33^2}$ ↓

$= 0.246963$ atm. ↓ ignore units

4½ marks

8. (a) $CH_3CH = CH_2 \xrightarrow{HBr/\ CH_3OOCH_3} CH_3CH_2CH_2Br$ ↓

$CH_3O\text{-}OCH_3 \longrightarrow 2CH_3\dot{O}$ ↓ Arrows for hemolytic cleawage must be shown 02½

$CH_3O\text{-}H\text{-}Br \longrightarrow CH_3OH + B\dot{r}$ ↓

$CH_3CH{=}CH_2\ \dot{B}r \longrightarrow CH_3\dot{C}H\ CH_2Br$ ↓

$CH_3\dot{C}HCH_2Br + HBr \longrightarrow CH_3CH_2CH_2Br + \dot{B}r$ ↓

$CH_3\dot{C}HCH_2Br\ H\text{-}Br \longrightarrow$

(b) $(CH_3)_3\,C\text{-}Br \xrightarrow{KOH_{(aq)}\ /Heat} (CH_3)_3C\text{-}OH$ ↓

$KOH_{(aq)} \rightarrow K^+_{(aq)} + \bar{O}H_{(aq)}$ ↓

$(CH_3)_3C\text{-}Br \underset{Slow}{\rightleftharpoons} (CH_3)_3\dot{C} + Br^-$ ↓ rej - -Br and $\rightleftharpoons$ missing

$(CH_3)_3\dot{C} \leftarrow :\bar{O}H \longrightarrow (CH_3)_3C\text{-}OH$ ↓

04½

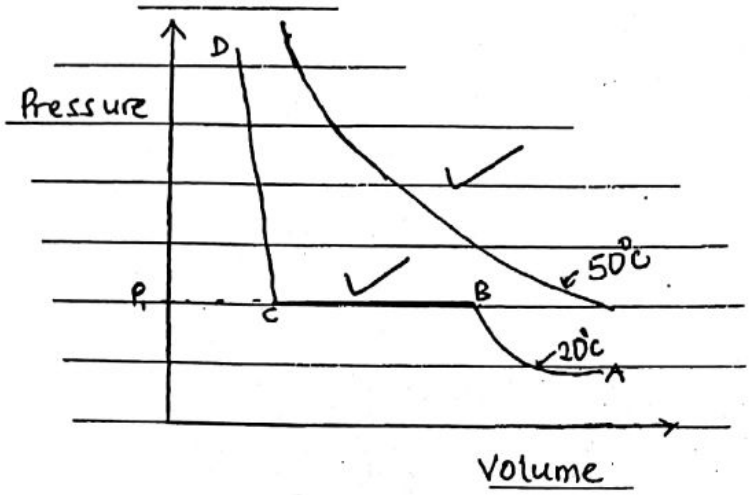
9. (a) Critical temperature

The temperature of a gas above which it cannot be liquidified by compression (increase in pressure) alone. liquefied

OR

The temperature at and above which the vapour of a substance cannot be liquidified, no matter how much pressure is applied.

(b)



Reject if axes wrong/missing

11.

(c) (i) At 20°C, increase in pressure decreases the volume along AB until P_1 at point B when carbondioxode starts to liquefy. The pressure remains constant along BC until all gas liquefies at C. Pressure along CD increases rapidly with a very small change in volume since liquids are incompressible. 02

(ii) At 50°C since the temperature is above critical temperature. (31°C) 01

06marks

SECTION B (54marks)

(a) (i) Water and the substance being steam distilled are immiscible hence they vapourise independently, each component exerting its own vapour pressure.

The total pressure above the mixture is the sum of the saturated vapour pressures of the pure components which balances atmospheric pressure at a temperature below the boiling point of either pure component. 03

(ii)
- Bromobenzene is volatile and it exerts significant vapour pressure near the boiling point of water.
- The impurities are non-volatile
- Bromobenzene has high relative formula mass 1½

(b) Vapour pressure of C_6H_5Br = 760 – 680 = 80 mmHg

or

RFM of C_6H_5Br = 156.9 RFM of H_2O = 18

Let the mass of C_6H_5Br in the distillate be xg.

$$PH_2O = \frac{moles\ of\ water}{moles\ of\ C_6H_5Br}$$

$$\frac{680}{80} = \frac{15.345/18}{x/156.9}$$

$$x = \frac{15.345 \times 80 \times 156.9}{18 \times 680}$$

$$= 15.73615g$$

$$\%purity = \frac{15.73615}{20.0} \times 100$$

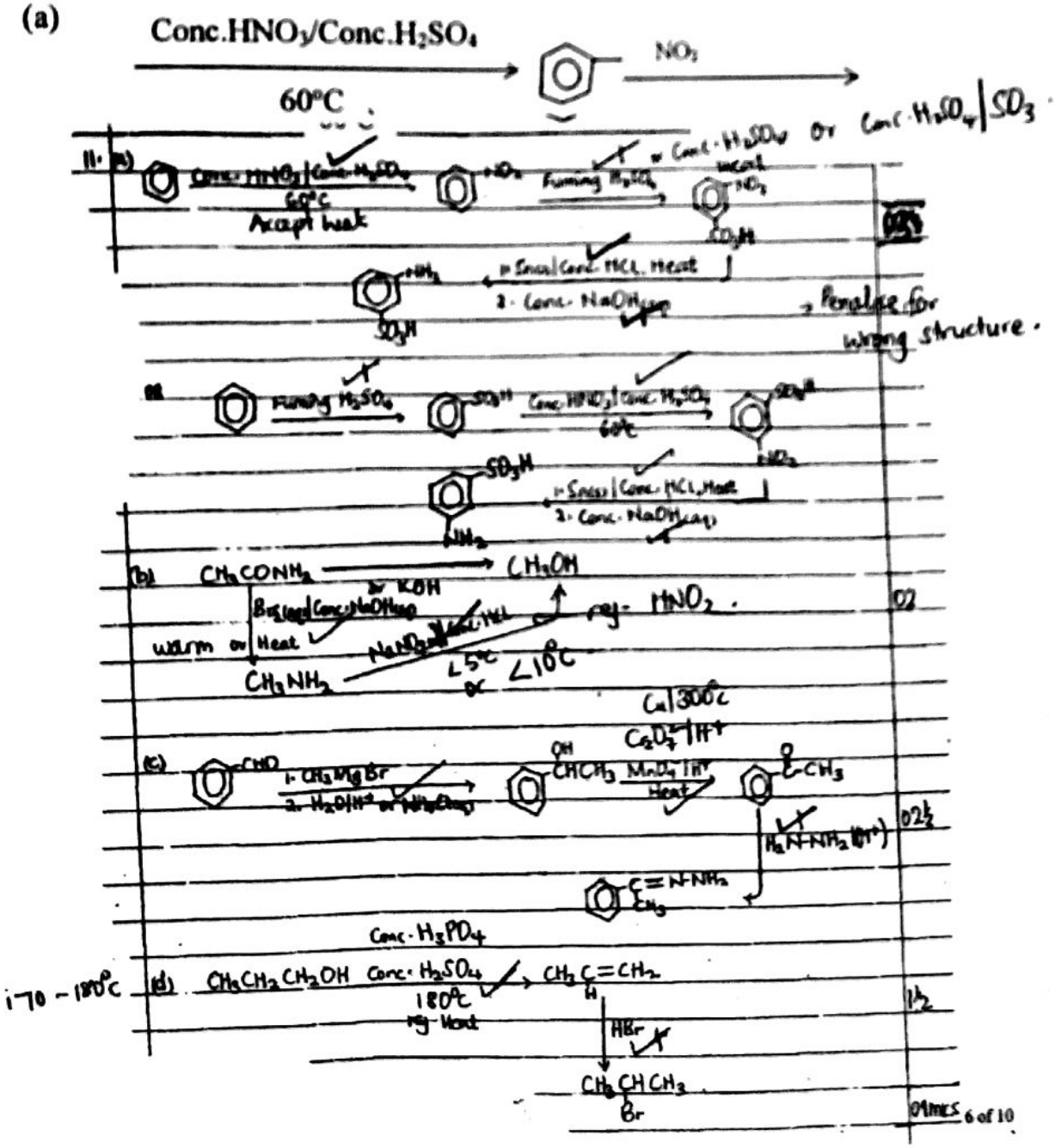
$$= 78.681\%$$

03½

(c) 01

- Distillation takes place at a lower temperature **09 marks**
- Prevents decomposition of thermally sensitive compounds/near their boling points.

11. (a)



12. (a) (i) Both exists as diatomic molecules with simple molecular structure.
The Vanderwaals forces between chlorine molecules are stronger than those between Fluorine molecules of lower relative molecular mass. 02
(RFM F_2 = 38.0 RFM of Cl_2 = 70.8)

(ii) The Fluorine atom is smaller and the bond energy of F-F is lower than the bond energy of Cl-Cl. The fluoride ions have higher charge density hence (a more negative enthalpy of hydration than chloride ions). Fluorine more readily gains electrones to form stable fluoride ions. The reduction of chlorine to its ions (Cl^-) is less feasible. 02

(b) (i)

$$2F_{2(g)} + 4\bar{O}H_{(aq)} \rightarrow 4F^-_{(aq)} + O_{2(g)} + 2H_2O_{(l)}$$
$$2F_{2(g)} + 4NaOH_{(aq)} \rightarrow 4NaF_{(aq)} + O_{2(g)} + 2H_2O_{(l)}$$ Ignore state 02
$$3Cl_{2(g)} + 6\bar{O}H_{(aq)} \rightarrow 5Cl^-_{(aq)} + ClO^-_{3(aq)} + 3H_2O_{(l)}$$

(ii) $C_{(s)} + 2F_{2(g)} \rightarrow CF_{4(g)}$ 01

(c) (i) White precipitate, dissolves in ammonia to form a colourless solution 01

$$Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$$

$$AgCl_{(s)} + 2NH_{3(aq)} \rightarrow Ag(NH_3)^+_{2(aq)} + Cl^-_{(aq)}$$ **09 marks**

$Ag^+_{(aq)} + 2NH_{3(aq)} \longrightarrow Ag(NH_3)^+_2 - rej.$

13. (a) Electrolytic conductivity
The conductance of a (given volume) of solution containing an electrolyte placed between electrodes 1m 1cm apart and of cross-sectional area $1m^2$+$1cm^2$ unit cross sectional area
OR The reciprocal of resistivity of an electrolyte./solution.
Rej – K = $\frac{1}{\rho}$

(b) (i) Copper (II) sulphate is a strong electrolyte which fully dissociates in water to produce a high concentration of copper (ii) and sulphate ions . 01

$CuSO_4(aq) \longrightarrow Cu^{2+}(aq) + SO_4^{2-}(aq)$ 1½

(ii) Along BC- Addition of excess sodium hydroxide which is a strong electrolyte dissociating fully, to produce, many hydroxide ions with very high mobility. 1½

(c) Moles of $\bar{O}H$ ions = $\frac{20\times0.1}{1000}$

$$Cu^{2+}_{(aq)} + 2\bar{O}H_{(aq)} \rightarrow Cu(OH)_{2(s)}$$

Moles of Cu^{2+} reacted $= {}^{1}/_{2} \times 2.0 \times 10^{-3}$ $02^{1}/_{2}$

$= 1.0 \times 10^{-3}$

$\left[CuSO_{4_{(aq)}}\right] = \frac{1000 \times 1.0 \times 10^{-3}}{25} = 0.04\ moldm^{-3}$

(d) (i)

$$\Lambda_c = \frac{K}{C}$$

$$= \frac{1.536 \times 10^{-2} \times 1000}{0.04}$$ Rej- if units wrong 01

$$= 384\Omega^{-1}cm^2mol^{-1}$$

(ii) Dilution increases the molar conductivity of copper (II) sulphate
The copper (II) ions and sulphate ions (are far apart) reducing ionic interference hence increasing ionic mobility. $1^{1}/_{2}$

09

01

14. (a) $Ksp = \left[Ag^+\right]^2\left[CrO_4^{2-}\right]$

(b) Moles of $Fe^{2+} = \frac{24 \times 0.001}{1000} = 2.40 \times 10^{-5}$

Moles of $CrO_4^{2-} = 2 \times {}^{1}/_{6} \times 2.40 \times 10^{-5}$

$= 8.0 \times 10^{-6}$ 04

$\left[CrO_4^{2-}\right] = \frac{1000}{20} \times 8.0 \times 10^{-6} = 0.0004M$

$\left[Ag^+\right] = 2 \times 0.0004 = 0.0008M$

$Ksp = 0.0008^2 \times 0.0004$ Ignore units(deny ½ units wrong)

$= 2.56 \times 10^{-10} mol^3 dm^{-9}$ $^{1}/_{2}$

(c) (i) Solubility decreases $^{1}/_{2}$

(ii) Solubility increases

(d) Ammonia reacts with silver ions to form a soluble complex of diammine silver (i) ions

$Ag^+_{(aq)} + 2NH_{3_{(aq)}} \rightarrow Ag(NH_3)^+_{2_{(aq)}}$

The reaction decreases the concentration of silver ions in the saturated solution. To restore the Ksp, more solid silver chromate dissolves. 03

09 marks

15. (a) (i) Froth floatation.

(ii) When the powdered ores are agitated with water containing an oil (frothing agent.) the high density impurities become wet and sink to the bottom while the low density ores and the oil float as a froth. 01

(b) (i) $\frac{-1}{2}$ *for states*

$2ZnS_{(s)} + 3O_{2(g)} \rightarrow 2ZnO_{(s)} + 2SO_{2(g)}$

$2CuFeS_{2(s)} + 4O_{2(g)} \rightarrow Cu_2S_{(s)} + 2FeO_{(s)} + 3SO_{2(g)}$ 01

01

(ii) Copper – Electrolysis of copper (II) sulphate solution using impure copper as the anode. $1\frac{1}{2}$

Zinc – Vacuum distillation / re- distillation.

(c) (i) Not feasible

(ii) $1\frac{1}{2}$

$E^{\theta}_{cell} = E^{\theta}_{RHE} - E^{\theta}_{LHE}$

$= ^{-} 0.76 - 0.34$

$= ^{-} 1.10 volts$

The emf of the cell generated is negative. $1\frac{1}{2}$

(d) Zinc _ making alloys e.g Brass Accept any other correct

02

Copper – Electrical wires **09marks**

16. (a) No of C atoms = 1

No of H atoms = 2.5×2 = 5

Let the number of Nitrogen atoms be x

RFM of CH_5Nx = 15.5×2

12 + 5×1 + 14x = 31

x = 1 02

W - CH_5N

(b) CH_3NH_2 01

(c) (i) The highly electronegative nitrogen atom in CH3NH2 is covalently bonded to hydrogen hence the molecules are held by strong intermolecular hydrogen bonds which require a lot of heat energy to be broken. 02

(ii) W Ionizes in water to release hydroxide ions which make the solution alkaline.

$CH_3NH_2 + H_2O_{(l)} \rightleftharpoons CH_3\overset{+}{N}H_{3(aq)} + \bar{O}H_{(aq)}$

(d) (i) Green precipitate soluble in excess aqueous ammine to form a blue Solution. 01

$Ni^{2+}_{(aq)} + 2\,\bar{O}H_{(aq)} \longrightarrow Ni(OH)_{2(S)}$ 01

09 marks

$Ni(OH)_{2(S)} + 6CH_3NH_2(aq) \longrightarrow [Ni(CH_3NH_2)6]^{2+} + 2\bar{0}\,H_{(aq)}$

17. (a) (i) Physical property of a solution which is directly proportional to the concentration of non-volatile solute particles but independent of their chemical nature. 01

(ii) - Freezing point depression.
- Elevation in boiling point.
- Osmotic pressure.

Penalize for extra ½

(b) 01

Concentration of Y($moldm^{-3}$)	0.00	0.10	0.20	0.30	0.40	0.50
Vapour pressure (KNm^{-2})	16.000	15.971	15.942	15.914	15.880	15.860
Δ P (KNm^{-2})	0.000	0.029	0.058	0.086	0.120	0.140

(i) See graph – axes - Plotting (at least) – 01 - shape – ½ 03

(ii) Slope $= \frac{0.156-0.02}{0.55-0.07}$

$= 0.28333\ KNm^{-2}mol^{-1}dm^3$

$$0.28333 = \frac{P_x^{\theta} \times RFM\ of\ X}{1000 \times 1.0}$$ 03

$$0.28333 = 16.0 \times RFM\ of\ X$$

$$RFM\ of\ X = \frac{0.28333 \times 1000}{16.00}$$

$= 17.708$

(iii) Y is non-volatile Any 2 01
The solutions are dilute
Solute Y does not dissociate or associate in X

09 marks

END