

## UNIT 3 CHEMISTRY 2005 TRIAL EXAMINATION SOLUTIONS

### SECTION A: MULTIPLE CHOICE QUESTIONS

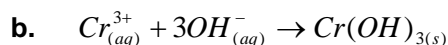
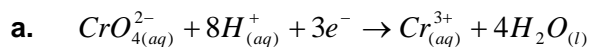
	Answer		Answer
Question 1	B	Question 11	C
Question 2	B	Question 12	B
Question 3	A	Question 13	D
Question 4	B	Question 14	A
Question 5	C	Question 15	D
Question 6	A	Question 16	D
Question 7	D	Question 17	D
Question 8	C	Question 18	B
Question 9	B	Question 19	C
Question 10	B	Question 20	D

### SECTION B – SHORT ANSWER QUESTIONS

#### QUESTION 1

- a. (i) Random errors.  
(ii) Systematic errors.
- b. (i) D  
(ii) E  
(iii) A  
(iv) C  
(v) B

## QUESTION 2



c. (i)  $n(Cr(OH)_3) = \frac{m}{M} = \frac{0.563}{102.996} = 0.005466 \text{ mol}$

$$\therefore n(Cr^{3+}) = 0.005466 \text{ mol}$$

$$m(Cr^{3+}) = n \times M = 0.005466 \times 51.996 = 0.28422 = 0.284 \text{ g}$$

(ii)  $0.28422 \text{ g} / 20 \text{ ml} = 0.28422 \times 50 \text{ g} / 20 \times 50 \text{ ml} = 14.2 \text{ g} / 1000 \text{ ml} = 14.2 \text{ g} / L$

(iii) All of  $CrO_{4(aq)}^{2-}$  is converted to  $Cr_{(aq)}^{3+}$ .

All of  $Cr_{(aq)}^{3+}$  precipitated as  $Cr(OH)_3$ .

d. (i) So that a sharp end point is obtained (when a strong acid is titrated against a “strong base, a sharp end point is obtained). This improves accuracy of results by minimising the titration error (difference in volume between end point and equivalence point).

(ii)  $n = cV = 0.100 \times 0.02136 = 0.002136 \text{ mol} = 0.00214 \text{ mol}$

(iii)  $n(NaOH) = 2 \times n(H_2SO_4) = 2 \times 0.002136 = 0.004272 \text{ mol} = 0.00427 \text{ mol}$

(iv)  $n(NaOH)_{initial} = n(\text{reacted with } Cr^{3+}) + n(\text{reacted with } H_2SO_4)$   
 $= 3 \times n(Cr(OH)_3) + 0.004272$   
 $= 0.005466 + 0.004272 = 0.02067 \text{ mol}$

$$c = \frac{n}{V} = \frac{0.02067}{0.02} = 1.0335 = 1.03 \text{ M}$$

### QUESTION 3

- a. (i) So that sample components can be carried through the column.  
(ii) Any inert (unreactive) gas such as  $N_2$  or  $He$ .  
(iii) The carrier gas collects the vapourised sample and enters the liquid stationary phase, where the sample components undergo a continual process of adsorption and desorption and separate in accordance with their relative affinities for the phases.
- b. (i) The functional group of carboxylic acids contains 3 polar covalent bonds (as opposed to 2 polar covalent bonds in the hydroxyl functional group of the alcohols. The net strength of forces between the carboxylic acids and the stationary phase will be greater, resulting in longer retention times.  
(ii) Propanol  
(iii) Propanoic acid
- c. Organic compounds are burned in a  $H_2 - O_2$  flame. The ions produced are attracted to an electrode and cause a current to flow. The intensity or size of the current is recorded as a series of peaks.

### QUESTION 4

a. 
$$K_c = \frac{[H_2SO_{5(l)}][H_2O_{(l)}]}{[H_2O_{2(l)}][H_2SO_{4(l)}]}$$

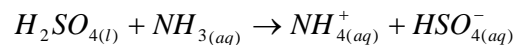
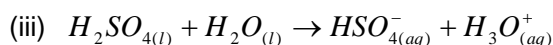
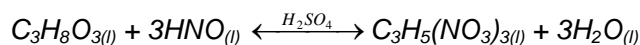
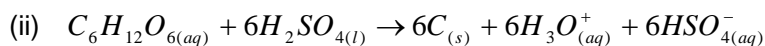
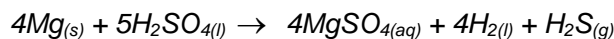
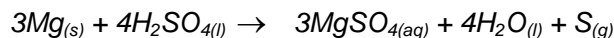
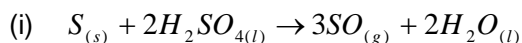
b.

	$H_2O_2$	$H_2SO_4$	$H_2SO_5$	$H_2O$
Initial Ratio	1	2.5	0	1.8
Mole Transferred	0.7 ↓	0.7 ↓	0.7 ↑	0.7 ↑
Eq Mole	0.3	1.8	0.7	2.5

$$K_c = \frac{0.7 \times 2.5}{0.3 \times 1.8} = 3.2$$

- c. (i) Net forward reaction.  
(ii) Decreases (reactant concentration decreases, hence collision frequency decreases, hence forward reaction rate decreases).  
(iii) Lower.  
(iv) Lower.

d. Possible answers include:



## QUESTION 5

$$a. \quad (i) \quad K_a = \frac{[HCOO^-][H^+]}{[HCOOH]}$$

$$\text{Assume: } [HCOOH]_{eq} = [HCOOH]_{initial} = 0.5 M$$

$$[HCOO^-] = [H^+]$$

$$\therefore K_a = \frac{[H^+]^2}{[HCOOH]} = 1.6 \times 10^{-4}$$

$$[H^+] = \sqrt{K_a \times [HCOOH]}$$

$$= 1.6 \times 10^{-4} \times 0.5$$

$$= 8.9 \times 10^{-3} M$$

$$pH = -\log(8.94 \times 10^{-3}) = 2.05 = 2.1$$

$$(ii) \quad \% \text{ ionisation} = \frac{[H^+]}{[HCOOH]_{initial}} \times 100\%$$

$$[H^+] = \sqrt{K_a \times [HCOOH]} = \frac{8.9 \times 10^{-3} M}{0.50 M} \times 100\% = 1.78 = 1.8\%$$

b. (i)  $[H^+] = \sqrt{1.6 \times 10^{-4} \times 0.005} = 8.944 \times 10^{-4} \text{ M}$

$$\% \text{ ionisation} = \frac{[H^+]}{[HCOOH]_{\text{initial}}} \times 100\% = \frac{8.944 \times 10^{-4}}{0.005} \times 100 = 17\%$$

(ii) When the dilution was performed, the system partially compensated for the change by favouring the reaction that would create the greater number of particles. A net forward reaction occurred – resulting in an increased hydrolysis (percentage ionisation) of  $HCOOH$ .

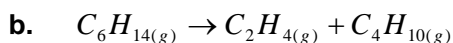
c. The student's statement is incorrect.

The degree of ionisation is not a good measure of acid strength, as weak acids will show increasingly higher percentage ionisations as their solutions are diluted to a greater degree i.e. even a weak acid can display a high percentage ionisation.

A strong acid is better defined as a species that displays a high equilibrium constant for its reaction with water.

## QUESTION 6

a. Crude oil evaporates in a fractionating tower. Different hydrocarbon compounds in the crude oil have different boiling points. Their vapours condense at different temperatures in the tower, and are collected as either purer liquids or gases. Each fraction contains hydrocarbons with different numbers of carbon atoms and each of these have different uses.



c. (i) High equilibrium yields of ethene will be favoured by higher temperatures and lower pressures.

(ii) Products of cracking are easier to control. With higher temperatures, overcracking can occur.

(iii) Non polar molecule

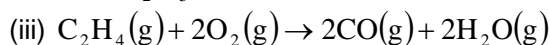
Flammable gas

Highly reactive due to presence of double bond.

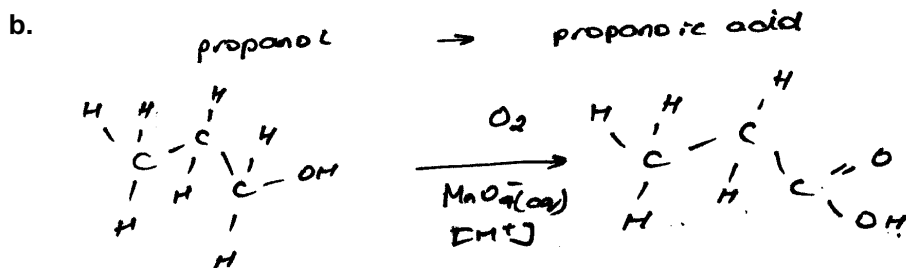
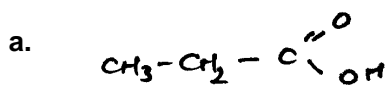
d. (i) A is  $H_{2(g)}$  (half mark).

D is a strong base such as  $NaOH$  (half mark).

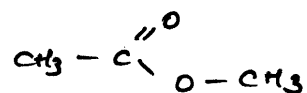
(ii) B is  $C_2H_5OH$  (half mark), catalyst is  $H_3PO_4$  (half mark).



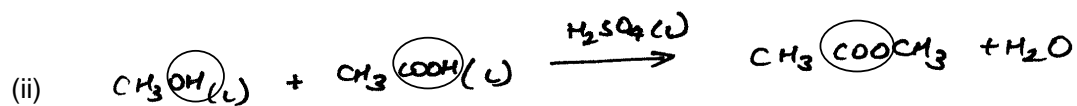
QUESTION 7



c. (i)



methyl ethanoate



(iii) Circled above (half a mark per functional group – maximum 1 mark).