SWINBURNE COLLEGE

Answers

PATHWAYS PROGRAMS –

Teaching Period: 1 **Year:** 2008

Subject Code(s): LFSE003

Full Subject Title: CHEMISTRY

Teacher: Peter Dunne

Student Name:

_____

Student ID:

_____

Reading Time: 15 **minutes**

Exam Duration: 120 minutes

DO NOT START WRITING YOUR ANSWERS UNTIL YOU HAVE READ THE INSTRUCTIONS OVERLEAF

☐ QUESTION & ANSWER BOOKLET

EXAMINER'S USE ONLY

Questions	Marks	Student Result
1	~~8~~ 10	
2	8	
3	12	
4	4	
5	9	
6	4	
7	3	
8	~~8~~ 11	
9	8	
10	4	
11	8	
12	5	
13	5	
14	4	
15	5	
16	8	
17	6	
Final Mark	114	

READ BEFORE COMMENCING

INSTRUCTIONS:

1. **You should attempt all questions**

2. **Do not use pencil.** Papers submitted in pencil will not be accepted for marking.

3. Write your answers in the space provided.

4. Should you wish to repeat an answer:

   a) Cancel the answer you do not wish the examiner to mark.

   b) Write your revised answer in the space provided for this at the end of the answer booklet. Make sure that the answer is numbered correctly.

5. Do not remove any staples from this paper.

6. Silent battery operated, non-programmable calculators may be used.

7. Candidates may refer to a Foreign Language Translation Dictionary provided that it is not annotated or does not contain definition words. Candidates must **NOT** use electronic dictionaries.

8. Data sheets will be provided one at end

This paper carries 50% of Final Assessment in this subject. Semester assessment carries 50%. You must pass both the exam and the semester assessment to pass the subject.

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Question 1 (2 + 2+2+2+2= ~~8~~ marks)

(a) Write chemical formulae for the following:

~~Sodium oxide~~ Na_2O (2)

Copper(1) sulphate Cu_2SO_4

(b) Write the chemical names for the following

MgF_2 magnesium fluoride (2)

FeS iron II sulphide

c) Balance the following equations

~~$C_2H_2 + O_2 \rightarrow CO_2 + H_2O$~~ $C_2H_2 + \frac{5}{2}O_2 \rightarrow 2CO_2 + H_2O$ (2)

$Mg + N_2 \rightarrow Mg_3N_2$ $3Mg + N_2 \rightarrow Mg_3N_2$

d) Write a balanced **molecular** equation for the following reaction:
A solution of sodium carbonate is reacted with a solution of lead(11) nitrate to form a precipitate of lead(11) carbonate and a sodium nitrate solution (2)

$$Na_2CO_3(aq) + Pb(NO_3)_2(aq) \rightarrow PbCO_3(s) + 2NaNO_3(aq)$$

(e) Write a balanced ionic equation for the following reaction :
Dilute hydrochloric acid reacts with a solution of potassium hydroxide to form water and a solution of potassium chloride

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

(2)

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Question 2 (2+3+ 3=8 marks)

Elemental phosphorus is produced by treating rock phosphate, $Ca_3(PO_4)_2$, with carbon and silicon dioxide according to the following equation:

$$2Ca_3(PO_4)_2(l) + 6SiO_2(l) + 10C(s) \rightarrow P_4(g) + 6CaSiO_3(l) + 10\,CO(g)$$

(a) If the rock phosphate used contains only 85% calcium phosphate, how much rock phosphate is needed to produce 500 kg of phosphorus, P_4 ? (2)

$n_{P_4} = \frac{500 \times 1000}{4 \times 31} = 4032.26$ mol

Since 2 mol $Ca_3(PO_4)_2 \rightarrow$ 1 mol P_4

$n_{Ca_3(PO_4)_2}$ needed $= 4032.26 \times \frac{2}{1} = 8064.52$ mol

$3 \times Ca$ 120
$2 \times P$ 62
$8 \times O$ 128
310

$\therefore$ mass of $Ca_3(PO_4)_2 = n \times M = 8064.52 \times 310\,g = 2{,}500{,}000\,g$

$\therefore$ mass of rock phosphate $= \frac{100}{85} \times 8064.52 \times 310\,g = 2941.2$ kg

(b) What volume of CO gas forms at 30 deg C and 98 kPa pressure if 1500 gram of SiO_2 is used ? (3)

$n_{SiO_2} = \frac{1500}{60} = 25$ mol

Since 6 mol $SiO_2 \rightarrow$ 10 mol CO

$n_{CO} = \frac{10}{6} \times 25 = 41.67$ mol

$T = 30\,^\circ C = 303K$

$P = 98$ kPa

$R = 8.31$

$V = \frac{nRT}{P}$

$= \frac{41.67 \times 8.31 \times 303}{98}$

$= 1070.5$ l

Si 28
$2 \times O$ 32
60

(c) 10.0 g of magnesium is reacted with 52.6 g of chlorine gas to form magnesium chloride according to the equation : $Mg(s) + Cl_2(g) \rightarrow MgCl_2(s)$

What mass of magnesium chloride forms ? (3)

$n_{Mg} = \frac{10.0}{24.3} = 0.412$ mol

$n_{Cl_2} = \frac{52.6}{71} = 0.741$ mol

Thus Cl_2 is in excess

Since 1 mol $Mg \rightarrow$ 1 mol $MgCl_2$

$n_{MgCl_2} = 0.412$ mol

mass of $MgCl_2 = n \times M = 0.412 \times 95.3$

$= 39.26$ g

Mg 24.3
$2 \times Cl$ 71
95.5

Question 3 (3+2+1+2+1+3= 12 marks)

(a) Briefly explain the principles underlying atomic absorption spectroscopy (AAS)

In AAS, light of a particular wavelength for each element is absorbed by atoms of the element so that electrons can jump to higher energy levels (3)

(b) Explain why light of different energies is absorbed by different elements

Each element has different energy levels and so the energy needed to lift an electron to a higher energy level is different. (2)

(c) Give a practical use of AAS

analysis of copper in water etc (1)

(d) The concentration of cadmium in a sample of polluted soil can be measured using AAS. A mass of 1.20g of the sample is heated with 10 ml of nitric acid and filtered. To determine the concentration of cadmium, a cathode lamp for cadmium was fitted into the AAS instrument. Standard solutions of various concentrations of cadmium were prepared and the absorbance in each of these solutions was measured. The results are shown in the table:

Concentration(ppm)	absorbance
5.0	2.1
10	3.9
15	5.9
20	8.1

(i) Graph these results on the graph paper provided (2)

(ii) The measured absorbance of the solution formed from the soil sample was 3.5 . Determine the concentration of cadmium in ppm, in the 10 ml sample

8-3 ppm (1)

(iii) Calculate the percentage by mass of cadmium in the soil sample

$$\text{mass of Cd} = 8\text{-}3 \times \frac{10}{1000}\ \text{mg} = 0\text{-}083\ \text{mg}$$

$$\%\,\text{Cd} = \frac{0\text{-}083 \times 10^{-3}}{1\text{-}2} \times 100$$

$$= 0\text{-}0069\,\%$$

(3)

Question 4 (2+2=4marks)

A student has been asked to prepare 200 ml of a standard solution of 0.100M sodium carbonate

(a) What mass of pure sodium carbonate (Na_2CO_3) is needed ? (2)

$2 \times Na\ 46$
$1 \times C\ 12$
$3 \times O\ 48$
106

$n_{Na_2CO_3} = CV = 0.100 \times 0.200 = 0.02$ mol

mass of $Na_2CO_3 = 0.02 \times 106 = 2.12$ g

(b) The sodium carbonate is a primary standard. List two properties for a primary standard.

pure
stable
high formula mass
etc

} 2 of these (2)

Question 5 (2+1+2+2+2=9 marks)

When sodium carbonate solution is treated with phosphoric acid the following reaction occurs:

$3Na_2CO_3(aq) + 2H_3PO_4(aq) \rightarrow 2Na_3PO_4(aq) + 3CO_2(g) + 3H_2O(l)$

20.0ml of 0.143M H_3PO_4 reacted with 18.49 ml of Na_2CO_3

(a) How many mole of H_3PO_4 was used in the reaction?

$n_{H_3PO_4} = CV = 0.143 \times 0.02 = 0.00286$ mol (2)

(b) How many mole of Na_2CO_3 must have reacted ?

$n_{Na_2CO_3}$ needed $= \frac{3}{2} \times 0.00286$ mol $= 0.00429$ mol (1)

(c)What was the molarity of the Na_2CO_3 solution ?

$C_{Na_2CO_3} = \frac{n}{V} = \frac{0.00429}{0.01849} = 0.232$ M (2)

(d) The procedure used to do the reaction is known as a titration. What equipment would be needed for the titration ?

burette, pipette, conical flask, indicator, burette stand, wash bottle etc. (2)

(e) Why are titrations often repeated three times ? (2)

* to eliminate human error
* to minimise random errors such as parallax errors

Question 6 (2+2=4 marks)

(a) Calculate the oxidation number of S in each of the following:

SO_3 +6

$S_2O_3^{2-}$ +2 (2)

(b) For the reaction $Cl_2 + 2KI \rightarrow 2KCl + I_2$

which reactant is the reductant ? Give a reason

KI is the reductant as the oxidation number of I increases from −1 to 0 (2)

Question 7 (3 marks)

When an acidified solution of OCl^- is reacted with H_2S, the OCl^- is reduced to Cl^- and the H_2S is oxidised to SO_2

Write down the partial ionic equations for the oxidation and reduction and hence write the overall ionic equation

reduction $OCl^- + 2H^+(aq) + 2e \rightarrow Cl^- + H_2O$ (3)

oxidation $H_2S + 2H_2O \rightarrow SO_2 + 6H^+(aq) + 6e$

overall $3OCl^- + 6H^+(aq) + H_2S + 2H_2O \rightarrow 3Cl^- + 3H_2O + SO_2 + 6H^+$

or $3OCl^- + H_2S \rightarrow 3Cl^- + H_2O + SO_2$

Question 8 (2+3+3=~~8~~ 6 11 marks)

For the exothermic reaction $Fe^{3+}(aq) + SCN^-(aq) \rightarrow Fe(SCN)^{2+}(aq)$

(a) write an expression for Kc for the above reaction

$$K_c = \frac{[Fe(SCN)^{2+}]}{[Fe^{3+}][SCN^-]}$$ (2)

(b) If 0.06 mol of $Fe^{3+}(aq)$ and 0.13 mol of SCN^- are initially added to 500 ml of water and at equilibrium, 0.03 mol of $FeSCN^{2+}$ are present, calculate a value for the equilibrium constant

	Fe^{3+} +	SCN^- →	$FeSCN^{2+}$
initial	0.06 mol	0.13 mol	0 mol
final	0.06 − 0.03 = 0.03 mol	0.13 − 0.03 = 0.10 mol	0.03 mol

(3)

$$K_c = \frac{\left(\frac{0.03}{0.5}\right)}{\left(\frac{0.03}{0.5}\right) \times \left(\frac{0.10}{0.5}\right)} = 5$$

(c) Giving reasons, explain whether this reaction would shift to the right or the left if

(i) more $Fe^{3+}(aq)$ is added — to right as Fe^{3+} is used up

(ii) water is added — to left as there are 2 moles of reactants but only 1 mole of products in the equation

(iii) the temperature is decreased — to right as reaction is exothermic

3x2 =(6)

Question 9 (2+2+4=8 marks)

Calculate the pH of the following solutions

(a) 2 M $H_2SO_4(aq)$ $pH = -\log_{10}[H^+(aq)] = -\log_{10} 4 = -0.6$ (2)

(b) 0.1 M KOH(aq) $[H^+(aq)] = \frac{10^{-14}}{[OH^-]} = \frac{10^{-14}}{0.1} = 10^{-13}$

$pH = -\log_{10} 10^{-13} = 13$ (2)

(c) 0.10M CH_3COOH

(note: CH_3COOH is a weak acid and $Ka(CH_3COOH) = 1.7 \times 10^{-5}$)

$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$

$Ka = \frac{[CH_3COO^-][H_3O^+]}{[CH_3COOH]} = 1.7 \times 10^{-5}$

Assume $[CH_3COOH] \simeq 0.10$

$[CH_3COO^-] \simeq [H_3O^+]$

$\therefore \frac{[H_3O^+]^2}{0.10} = 1.7 \times 10^{-5}$ (4)

$\therefore [H_3O^+] = \sqrt{1.7 \times 10^{-6}} = 0.0013$

$\therefore pH = -\log_{10} 0.0013$

$= 2.88$

Question 10 (2+2=4 marks).

(a) Briefly explain, using an equations, how SO_3 is made into sulphuric acid in the Contact Process

SO_3 is dissolved in conc. H_2SO_4 $\quad SO_3(g) + H_2SO_4(l) \rightarrow H_2S_2O_7(l)$ (oleum)

water is added to dilute oleum $\quad H_2S_2O_7(l) + H_2O(l) \rightarrow 2H_2SO_4$ (2)

(b) When SO_2 is converted to SO_3 in the contact process , V_2O_5 is used. What is the function of the V_2O_5 and how does it work ?

V_2O_5 is a catalyst, which speeds up the reaction but is not changed. (2)

It helps by adsorbing the reactants and helps break bonds and form new bonds.

It lowers the activation energy for the reaction.

Question 11(4 + 2+ 1+1 = 8marks)

(a)Explain, using equations how ethene is obtained from crude oil

(1) crude oil $\xrightarrow{\text{fractional distillation}}$ C_3H_8 (propane) + C_2H_6 (ethane) + other fractions

(2) thermal cracking (4)

eg $C_3H_8(g) \xrightarrow{\text{high T}} C_2H_4(g) + CH_4(g)$ (ethene)

or $C_2H_6(g) \xrightarrow{\text{high T}} C_2H_4(g) + H_2(g)$

(b)Ethene can undergo an addition reaction with water to form ethanol

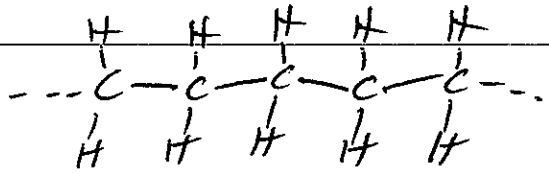
(i) write an equation for this reaction

$C_2H_4 + H_2O \rightarrow C_2H_5OH$ (2)

(ii) explain the meaning of an addition reaction

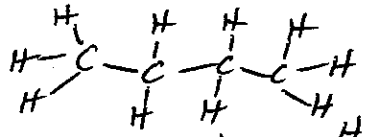
In addition, the unsaturated carbon to carbon double bond is broken to form a saturated carbon – carbon single bond and the molecule adds across the unsaturated bond. (1)

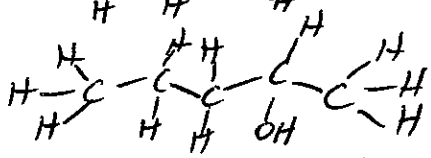
(c) Draw the structural formula of a part of the polymer that forms when ethene undergoes polymerisation

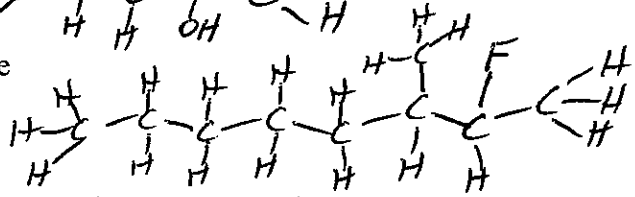
 (1)

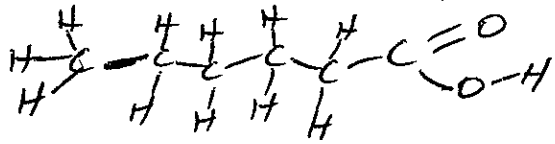
Question 12 (5 marks)

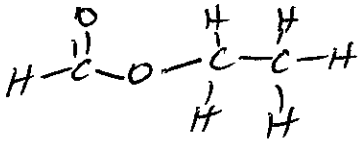
Draw structural formulae for the following compounds

(a) propane 

(b) 2-pentanol 

(c) 2-fluoro-3-methyl-octane  (5)

(d) hexanoic acid 

(e) ethyl methanoate 

Question 13 (5marks)

Name the following organic compounds

(a) $CH_2=CH-CH_3$ propene

(b) CH_4 methane

(c) CH_3OH methanol

(d) HCOOH methanoic acid

(e) $CH_3CH_2NH_2$ ethanamine (or ethylamine)

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Question 14 (2+2=4marks)

Give equations, showing all the reactants needed, for the following preparations:

(a) preparation of chloroethane from ethane

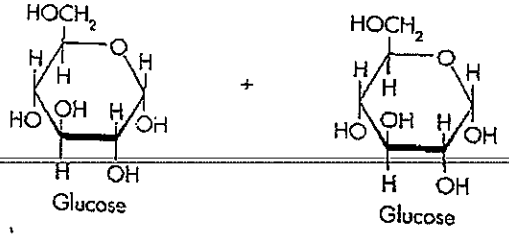
$C_2H_6(g) \xrightarrow[UV\ light]{Cl_2} C_2H_5Cl$ (2)

(b) preparation of ethanoic acid from ethanol

$C_2H_5OH \xrightarrow[\text{or acidified } Cr_2O_7^{2-}]{\text{acidified } MnO_4^-} CH_3COOH$ (2)

Question 15(2+2+1=5 marks)

(a) Complete the equation below:



(2)

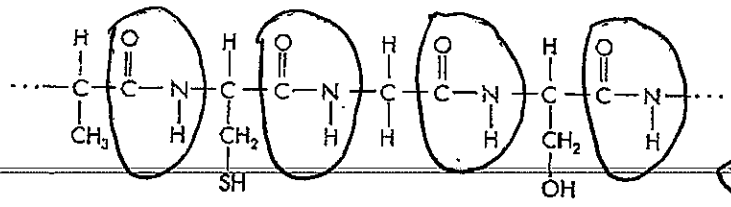
(b) Is this reaction an addition or condensation reaction ?Explain your answer (2)

condensation reaction as two functional groups react to form a new linkage (an ether link) and a small molecule (H_2O) is eliminated.

(c) why do we need disaccharides in our diet ?

energy (1)

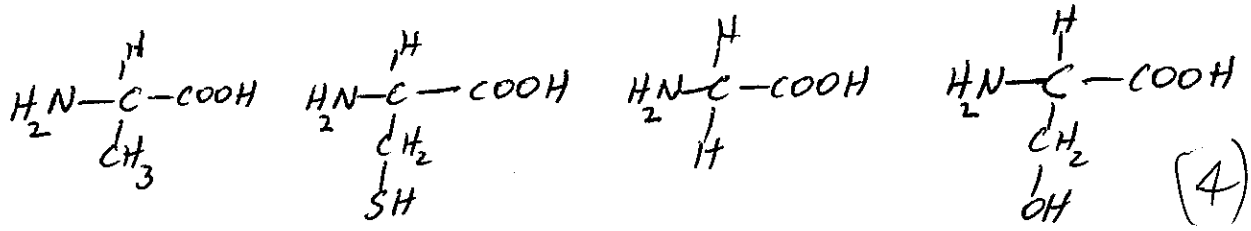
Question 16 (2+4+1+1=8 marks)
Part of a protein is shown below:



(2)

(a) Circle the peptide linkages in this part of the protein chain

(b) Write the formulae of the four amino acids that made up this part of the chain

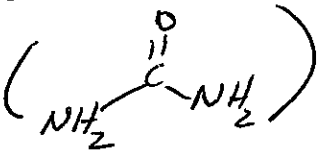


(4)

(c) Why do we need protein in our diet?

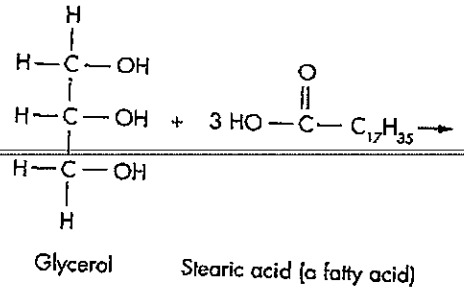
growth and repair (1)

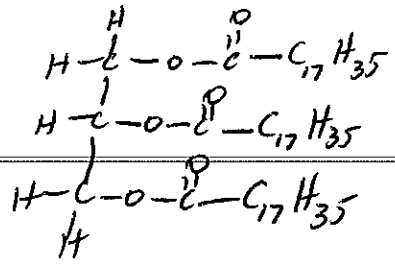
(d) How does the body dispose of unwanted nitrogen atoms ?

as urea  (1)

Question 17 (2+2+1+1=6marks)

(a) Complete the following equation to show the formation of a fat





(2)

(b)Is this fat saturated or unsaturated ? Explain your answer

saturated as all bonds are single C—C bonds

(2)

(c) What is the name of the linkage bond that forms between glycerol and fatty acids

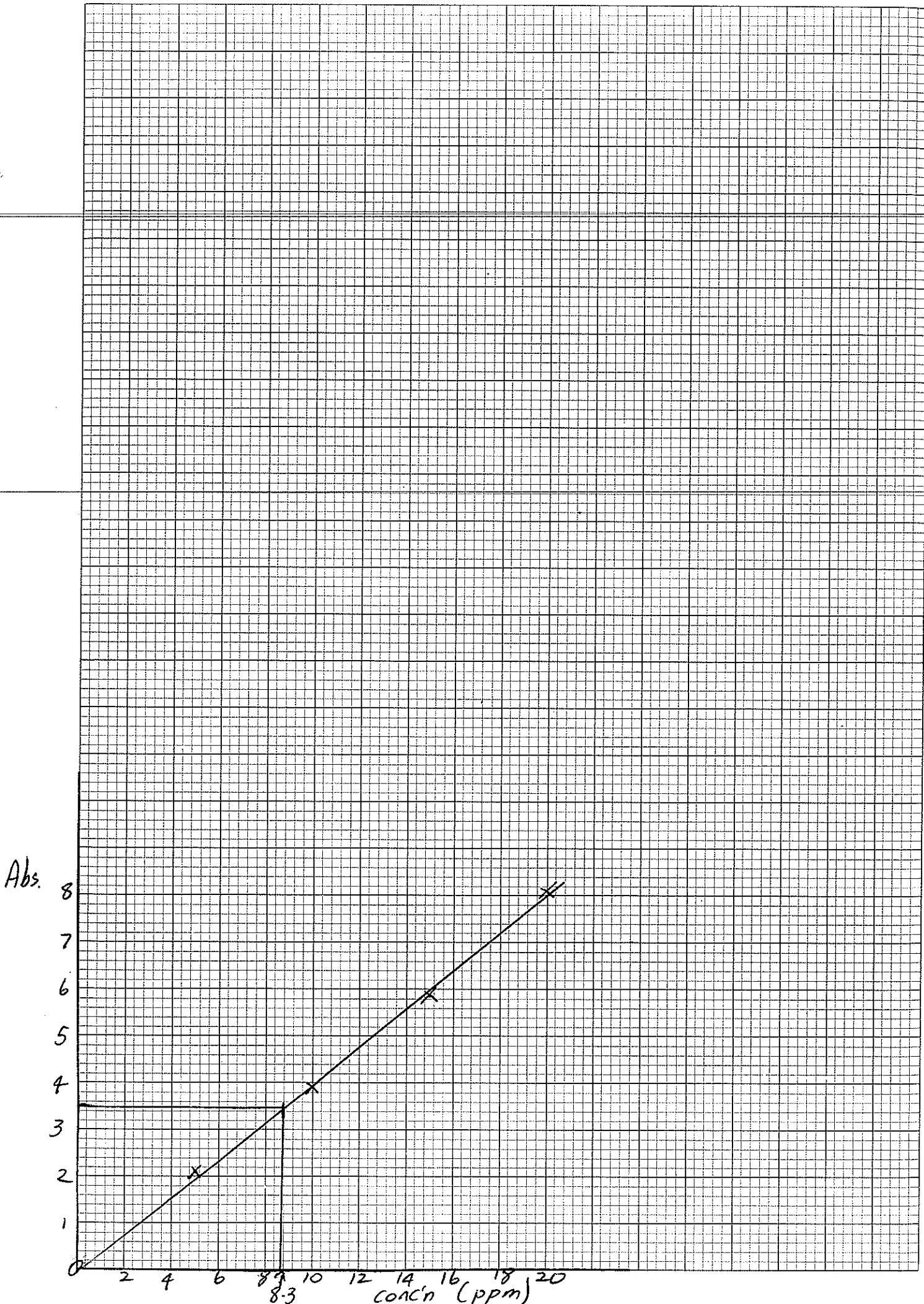
ester

(1)

(d) How does bile assist in the digestion of fats?

bile helps emulsify the fats

(1)


Abs.
0
1
2
3
4
5
6
7
8
2
4
6
8.3
10
12
14
16
18
20
Conc'n (ppm)