

Centre Number						Candidate Number					
Surname						Other Names					
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Candidate Signature						Date					

For Teacher's Use	
Section	Mark
PSA	
Task	
Section A	
Section B	
TOTAL (max 50)	



General Certificate of Education
Advanced Level Examination
June 2011

Chemistry

CHM6T/P11/test

Unit 6T A2 Investigative Skills Assignment

For submission by 15 May 2011

For this paper you must have: <ul style="list-style-type: none"> the Periodic Table/Data Sheet provided at the end of this paper the Task Sheet and your Candidate Results Sheet a ruler with millimetre measurements a calculator. 	Time allowed <ul style="list-style-type: none"> 1 hour
Instructions: <ul style="list-style-type: none"> Use black ink or black ball-point pen. Fill in the boxes at the top of this page. Answer all questions. You must answer the questions in the space provided. Do not write outside the box around each page or on blank pages. Do all rough work in this book. Cross through any work you do not want to be marked. 	Information <ul style="list-style-type: none"> The marks for questions are shown in brackets. The maximum mark for this paper is 30. You will be marked on your ability to: <ul style="list-style-type: none"> organise information clearly use scientific terminology accurately.
Details of additional assistance (if any). Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page. Yes <input type="checkbox"/> No <input type="checkbox"/>	

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I confirm that the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied that to the best of my knowledge the work produced is solely that of the candidate.

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Section A

These questions are about the task, Determination of an equilibrium constant.
You should use your Task Sheet and your Candidate Results Sheet to answer them.

Answer **all** questions in the spaces provided.

- 1** Record the average titre from your Candidate Results Sheet.
-
- (1 mark)
- 2** The concentration of sodium hydroxide solution was $0.100 \text{ mol dm}^{-3}$.
- Use your answer from Question **1** to calculate the amount, in moles, of sodium hydroxide required to neutralise all of the acid in 25.0 cm^3 of the diluted equilibrium mixture.
-
-
- (1 mark)
- 3** Use your answer to Question **2** to calculate the total amount, in moles, of H^+ ions in the whole sample of undiluted equilibrium mixture (250 cm^3 of diluted equilibrium mixture).
-
-
- (1 mark)
- 4** The mixture you prepared and allowed to reach equilibrium contained 2.00 cm^3 of 1.00 mol dm^{-3} sulfuric acid as a catalyst.
- 4 (a)** Calculate the amount, in moles, of H^+ ions in the sulfuric acid. Assume that the sulfuric acid is completely dissociated.
-
-
-
- (1 mark)
- 4 (b)** Use your answers to Question **3** and Question **4 (a)** to calculate the amount, in moles, of propanoic acid in the whole sample of undiluted equilibrium mixture.
-
- (1 mark)

5 The equation for the reaction occurring in the mixture is given below.



5 (a) The original 7.00 cm³ sample of propanoic acid used to prepare the equilibrium mixture contained 0.0940 mol of CH₃CH₂COOH

Use your answer to Question 4 (b), to calculate the amount, in moles, of propanoic acid that has reacted at equilibrium.

(If you were unable to complete the calculation in Question 4 (b) assume that the amount of propanoic acid in the whole sample of undiluted equilibrium mixture was 0.0258 mol. This is **not** the correct answer.)

.....
(1 mark)

5 (b) The original 7.00 cm³ sample of ethanol used to prepare the equilibrium mixture contained 0.102 mol of CH₃CH₂OH

Use this information and your answer to Question 5 (a) to calculate the amount, in moles, of ethanol remaining at equilibrium.

.....
(1 mark)

5 (c) Use your answer to Question 5 (a) to deduce the amount, in moles, of CH₃CH₂COOCH₂CH₃ and the amount, in moles, of H₂O formed at equilibrium.

CH₃CH₂COOCH₂CH₃

.....

.....

H₂O

.....

.....
(2 marks)

6 Suggest the main reason why the actual amount of water in the equilibrium mixture is greater than that deduced in Question 5 (c).

.....

.....
(1 mark)

Turn over ►

- 7 In another experiment, at a fixed temperature, a different equilibrium mixture contained the following amounts, in moles, of each component.

$\text{CH}_3\text{CH}_2\text{COOH}$	$\text{CH}_3\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3$	H_2O
0.0424	0.0525	0.0745	0.0813

- 7 (a) Write an expression for the equilibrium constant, K_c , for the reaction given in Question 5.

.....

.....

.....

(1 mark)

- 7 (b) Use the data in the table above to calculate a value for the equilibrium constant, K_c , at this fixed temperature.
Record your answer to the appropriate precision.

.....

.....

.....

(2 marks)

- 8 If the mixture is uncovered during the time it is left to reach equilibrium, some of the ester formed will evaporate.
Explain why a smaller volume of sodium hydroxide would then be required in the titration compared with the volume for the covered mixture.

.....

.....

.....

(2 marks)

Section B

Answer **all** questions in the spaces provided.

9 Propanoic acid can be made from propan-1-ol by oxidation using acidified potassium dichromate(VI). Propanal is formed as an intermediate during this oxidation.

9 (a) State the colour of the chromium species after the potassium dichromate(VI) has reacted.

.....
(1 mark)

9 (b) Describe the experimental conditions and the practical method used to ensure that the acid is obtained in a high yield. Draw a diagram of the assembled apparatus you would use.

Conditions

Apparatus

(4 marks)

9 (c) Describe the different experimental conditions necessary to produce propanal in high yield rather than propanoic acid.

.....
.....
(2 marks)

Turn over ►

10 Propan-1-ol is a volatile, flammable liquid.
Give **one** safety precaution that should be used during the reaction to minimise this hazard.

.....
(1 mark)

11 A student followed the progress of the oxidation of propan-1-ol to propanoic acid by extracting the organic compounds from one sample of reaction mixture.

11 (a) Give a chemical reagent which would enable the student to confirm the presence of propanal in the extracted compounds.
State what you would observe when propanal reacts with this reagent.

Reagent

Observation

.....
(2 marks)

11 (b) Give a chemical reagent that would enable the student to confirm the presence of propanoic acid in the extracted compounds.
State what you would observe when propanoic acid reacts with this reagent.

Reagent

Observation

.....
(2 marks)

12 Predict which **one** of the compounds, propan-1-ol, propanal and propanoic acid will have the highest boiling point. Explain your answer.

Prediction

Explanation

.....
(3 marks)

END OF QUESTIONS

GCE Chemistry Data Sheet

Table 1

Infrared absorption data

Bond	Wavenumber /cm ⁻¹
N-H (amines)	3300 – 3500
O-H (alcohols)	3230 – 3550
C-H	2850 – 3300
O-H (acids)	2500 – 3000
C≡N	2220 – 2260
C=O	1680 – 1750
C=C	1620 – 1680
C-O	1000 – 1300
C-C	750 – 1100

Table 2

¹H n.m.r. chemical shift data

Type of proton	δ/ppm
ROH	0.5 – 5.0
RCH ₃	0.7 – 1.2
RNH ₂	1.0 – 4.5
R ₂ CH ₂	1.2 – 1.4
R ₃ CH	1.4 – 1.6
	2.1 – 2.6
	3.1 – 3.9
RCH ₂ Cl or Br	3.1 – 4.2
	3.7 – 4.1
	4.5 – 6.0
	9.0 – 10.0
	10.0 – 12.0

Table 3

¹³C n.m.r. chemical shift data

Type of carbon	δ/ppm
	5 – 40
	10 – 70
	20 – 50
	25 – 60
	50 – 90
	90 – 150
	110 – 125
	110 – 160
	160 – 185
	190 – 220

Turn over ►

