

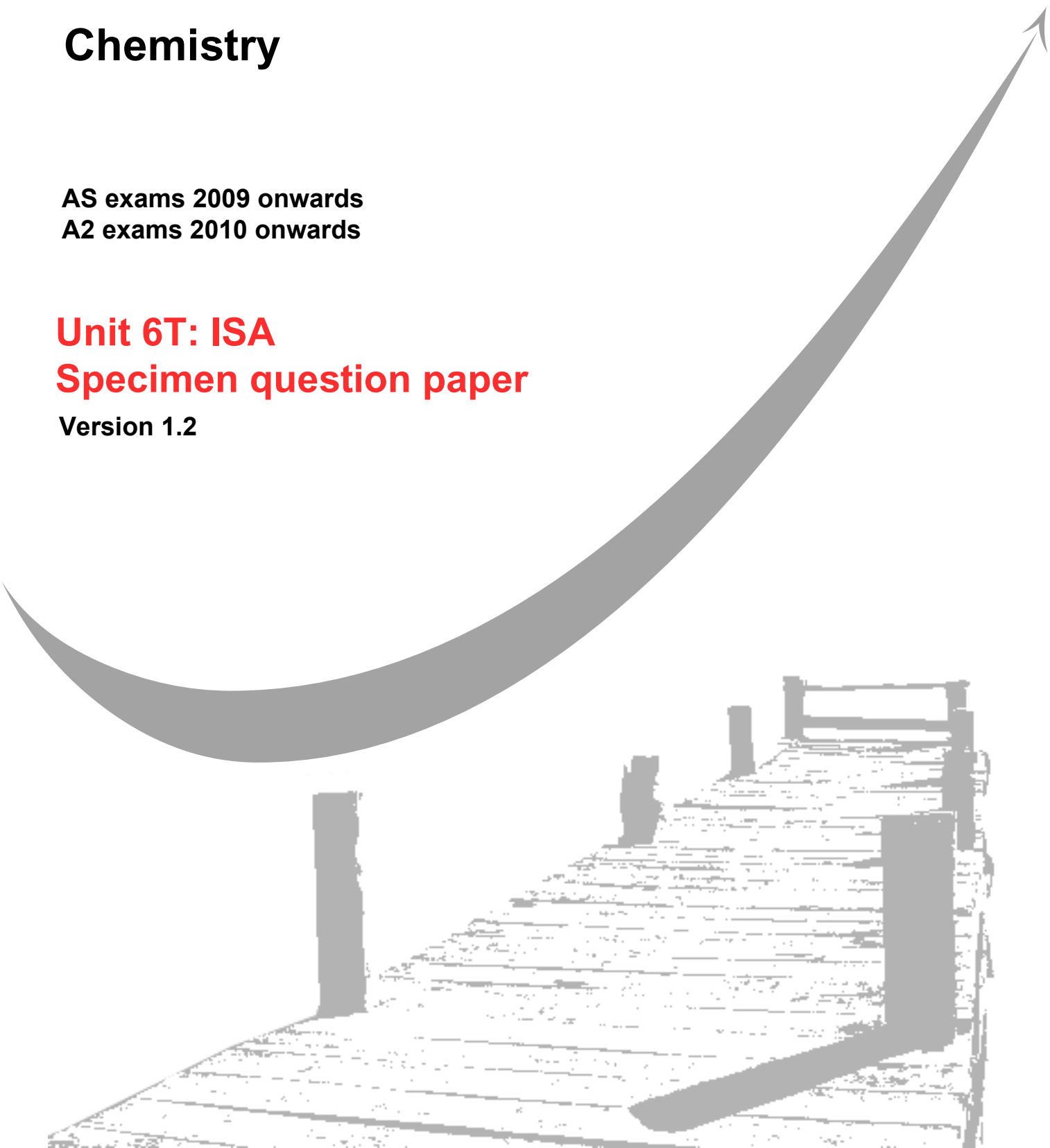
GCE
AS and A Level

Chemistry

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 6T: ISA **Specimen question paper**

Version 1.2



| | | | | | | | | | |
|---------------------|--|--|--|--|------------------|--|--|--|--|
| Surname | | | | | Other Names | | | | |
| Centre Number | | | | | Candidate Number | | | | |
| Candidate Signature | | | | | | | | | |

| |
|--------------------|
| For Examiner's Use |
|--------------------|



General Certificate of Education
Advanced Level Examination

CHEMISTRY
Investigative Skills Assessment (ISA)
Centre Assessed Unit

CHM6T

Draft Specimen Paper

| |
|---|
| <p>In addition to this paper you will require</p> <ul style="list-style-type: none"> task sheet and your candidate results sheet <p>You may use a calculator.</p> |
|---|

| For Teacher's Use | |
|-------------------|------|
| Section | Mark |
| 1 | |
| 2 | |
| TOTAL | |

Time allowed: 1 hour

Instructions

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

Information

- The maximum mark for this paper is 30.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in all answers.

Signature of Teacher marking this ISA..... Date.....

SECTION A

These questions are about identifying some organic compounds.
You should use your task sheet and your own results to answer them.

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

ANALYSING

Use your results to answer the questions below.

- 1 Which compound is most likely to contain an aldehyde functional group? State **one** observation to support your answer.

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

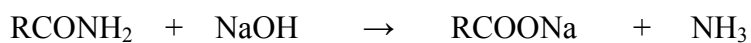
- 2 Which **two** compounds are most likely to contain a carboxylic acid functional group? State **one** observation to support your answer.

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

- 3 Which **one** of the compounds which contain a carboxylic acid functional group is most likely to also contain a primary alcohol functional group? State **one** observation to support your answer.

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

- 4 The technician has a sample of another unknown compound which he suspects might be ethanamide. An amide reacts on warming with sodium hydroxide solution as shown in the equation below.



Use this information to describe a simple test you could use to show the presence of the amide group in the unknown compound, and explain how you would show that the test was positive.

Test

.....
(1 mark)

Observation

.....
(1 mark)

| |
|---|
| 8 |
|---|

SECTION B

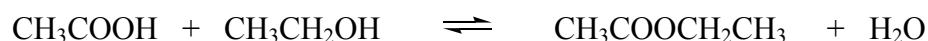
These questions are about the determination of the equilibrium constant, K_c , for an esterification reaction.

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

INTRODUCTION

Esters are often used as artificial flavourings and fragrances. Esters are usually prepared by reacting a carboxylic acid and an alcohol, even though this reaction is reversible. The determination of the equilibrium constant, K_c , for an esterification reaction is an important first step in ensuring an efficient preparation.

Ethanoic acid and ethanol react reversibly to form ethyl ethanoate and water according to the following equation.



In an experiment, a mixture of 0.420 g of ethanoic acid and 0.0100 mol of ethanol was allowed to reach equilibrium at 20 °C. The ethanoic acid remaining in the equilibrium mixture reacted exactly with 3.00 cm³ of 0.500 mol dm⁻³ sodium hydroxide solution added from a burette.

ANALYSIS

- 5 Write an expression for the equilibrium constant, K_c , for the reaction between ethanoic acid and ethanol.

.....
.....
(1 mark)

- 6 Calculate the number of moles present in 0.42 g of ethanoic acid ($M_r = 60.0$).

.....
.....
(1 mark)

- 7 Calculate the number of moles of sodium hydroxide in 3.00 cm^3 of $0.500 \text{ mol dm}^{-3}$ sodium hydroxide solution. Hence calculate the number of moles of ethanoic acid present in the equilibrium mixture.

Moles of sodium hydroxide.....
.....
(1 mark)

Moles of ethanoic acid.....
.....
(1 mark)

- 8 Use your answers from **Questions 6 and 7** to calculate the number of moles of acid that have reacted with the ethanol. State the number of moles of ester and of water present in the equilibrium mixture.

Moles of acid reacted.....
.....
(1 mark)

Moles of ester.....

Moles of water.....
(1 mark)

- 9 Calculate the number of moles of ethanol present in the equilibrium mixture and hence calculate the value of K_c .

.....
.....
.....
.....
(3 marks)

10 Assume that the maximum errors for the apparatus used in this experiment were

balance total error $\pm 0.001 \text{ g}$
burette total error $\pm 0.15 \text{ cm}^3$ (from two readings and an end-point error)

Calculate the maximum percentage error in using each piece of apparatus, and hence the maximum overall apparatus error.

.....
.....
.....
.....

(1 mark)

11 Ethyl ethanoate can also be prepared by reacting ethanol and ethanoyl chloride. State **one** commercial advantage and **one** commercial disadvantage of this method of making ethyl ethanoate.

Advantage

.....

(1 mark)

Disadvantage

.....

(1 mark)

12

EVALUATION

- 12** A data book value for K_c for this reaction is 3.92 at 20 °C. Calculate the difference between the value calculated in **Question 9** and the data book value. Express this difference as a percentage of the data book value.
(If you could not complete the calculation in **Question 9**, you should assume a value of 3.40 for K_c . This is not the correct value.)

Difference.....

Percentage
(1 mark)

- 13** Comment on the quality of the experimental result for K_c .

.....
.....
.....
.....
(1 mark)

- 14** The volume of the sodium hydroxide solution used in this titration was very small. Suggest an alternative concentration for the sodium hydroxide solution, and explain how this would improve the accuracy of the experiment.

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

- 15** State why it is necessary to maintain a constant temperature in the experiment.

.....
.....
(1 mark)

- 16** In a separate experiment, when 0.420 g of ethanoic acid was reacted with ethanol 0.536 g of ethyl ethanoate was present in the equilibrium mixture. Calculate the percentage yield of the ester, based on ethanoic acid.

.....
.....
(1 mark)

- 17 In industry a large molar excess of ethanol is sometimes used in esterification reactions. Use your understanding of equilibrium to explain why this would make the formation of the ester more profitable.

.....
.....
.....

(2 marks)

- 18 When methanol and methanoic acid react together the reaction also reaches equilibrium. The boiling points, °C, of the substances present at equilibrium are given below.

| | |
|-------------------|-----|
| methanol | 65 |
| methanoic acid | 101 |
| methyl methanoate | 32 |
| water | 100 |

Use these data to suggest a reaction temperature which would improve the yield of the ester. Explain your answer.

.....
.....
.....
.....

(2 marks)

END OF QUESTIONS

10

TASK SHEET

Reactions of some Organic compounds

During stock taking a chemistry technician discovered several unnamed solutions in the organic section of the storeroom. You have been asked to identify the functional groups present in the solutions so that their safe disposal can be arranged.

1. You are provided with **three** liquids labelled **A**, **B** and **C**, respectively.
2. Use a separate sample of each liquid in each of the following tests.
3. Perform the tests described below on each liquid in turn, recording what you **observe** in a table of your own design on the Candidate Results Sheet.
4. Where no visible change is observed, write "no visible change".

You are not required to identify the liquids or any of the reaction products in this part of the exercise.

Wear safety glasses at all times.

Assume that all of the reagents and liquids are toxic, corrosive and flammable.

Test 1

Place about 10 drops of **A** in a labelled test tube. Add 10 drops of Fehling's solution and shake the mixture. Half fill a 250 cm³ beaker with the hot water provided. Stand the test tube in the beaker for about ten minutes.

Repeat the test with **B**, and then with **C**.

While you are waiting, begin Test 2.

Test 2

Place about 10 drops of **A** in a labelled test tube. Add two drops of acidified potassium manganate(VII) solution and shake the mixture. Half fill a second 250 cm³ beaker with boiling water. Stand the test tube in the beaker for about five minutes.

Repeat the test with **B**, and then with **C**.

While you are waiting, begin Test 3.

Test 3

Place about 10 drops of **A** in a test tube. Add a small amount of solid sodium hydrogencarbonate.

Repeat the test with **B**, and then with **C**.

Test 4

Place about 10 drops of methyl orange solution in a test tube. Add a few drops of **A** and shake the mixture.

Repeat the test with **B**, and then with **C**.

**GENERAL CERTIFICATE OF EDUCATION
JUNE 200X / JUNE 200X**



ASSESSMENT and
QUALIFICATIONS
ALLIANCE

ISA CHM6T Reactions of some Organic Compounds

Candidate Results Sheet

Centre Number

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

Candidate Name

Candidate number

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

Results

Present your results in an appropriate form in the space below.