OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY 2815/05

Gases, Liquids and Solids

Tuesday **24 JUNE 2003** Morning 50 minutes

Candidates answer on the question paper.
Additional materials:
Data Sheet for Chemistry
Scientific calculator

Candidate Name	Centre Number	Candidate Number

TIME 50 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry*.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	14	
2	11	
3	8	
4	12	
TOTAL	45	

This question paper consists of 10 printed pages and 2 blank pages.

Registered Charity Number: 1066969
[Turn over

For Examiner's Use

Answer **all** the questions.

1 **(a)** Helium is a noble gas whose properties approach those of an ideal gas. Under some conditions, helium does not behave as an ideal gas.

State and explain **two** conditions under which helium does **not** behave as an ideal gas.

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.....

.....

.....[4]

(b) Put the following gases in decreasing order of ideality, giving a reason for your sequence.

carbon dioxide **neon** **nitrogen**

.....

.....

.....[2]

(c) In this question, one mark is available for the quality of written communication.

Substance **X** is a solid at room temperature. Using the kinetic-molecular model, explain what happens when **X** is heated to well above its boiling point.

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.....[5]

Quality of Written Communication [1]

For Examiner's Use

(d) Explain why a solid alloy such as brass is harder than either of its components, copper and zinc.

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.....

.....[2]

[Total: 14]

[Turn over

For Examiner's Use

2 **(a)** **(i)** State *Henry's Law.*

.....

.....

.....[2]

(ii) Under some conditions, Henry's Law is **not** obeyed. Suggest two conditions under which Henry's Law is **not** obeyed.

.....

.....

.....[2]

(iii) The solubility of gases decreases as temperature rises. Explain why this happens.

.....

.....

.....[2]

(b) The Henry's Law constant, K_h, for carbon dioxide in water at 25 °C is 3.4×10^{-4} mol dm^{-3} kPa^{-1}.

(i) Calculate the number of **moles** of carbon dioxide that will dissolve in 1.0 dm^3 of water at 25 °C, and 5.0 kPa pressure.

[1]

(ii) Calculate the **volume** of carbon dioxide that dissolves under these conditions.
$R = 8.31\ J\ K^{-1}\ mol^{-1}$

answer ..... m^3

[2]

(iii) Carbon dioxide is used in the production of carbonated water. This water is slightly acidic. Suggest why this should be the case.

.....

.....

.....[2]

[Total: 11]

For Examiner's Use

3 **(a)** Fig. 3.1 shows part of the phase diagram for the water-sodium chloride system. The lowest melting point is $-23\,°C$ when the concentration of sodium chloride is $5.0\,mol\,dm^{-3}$.

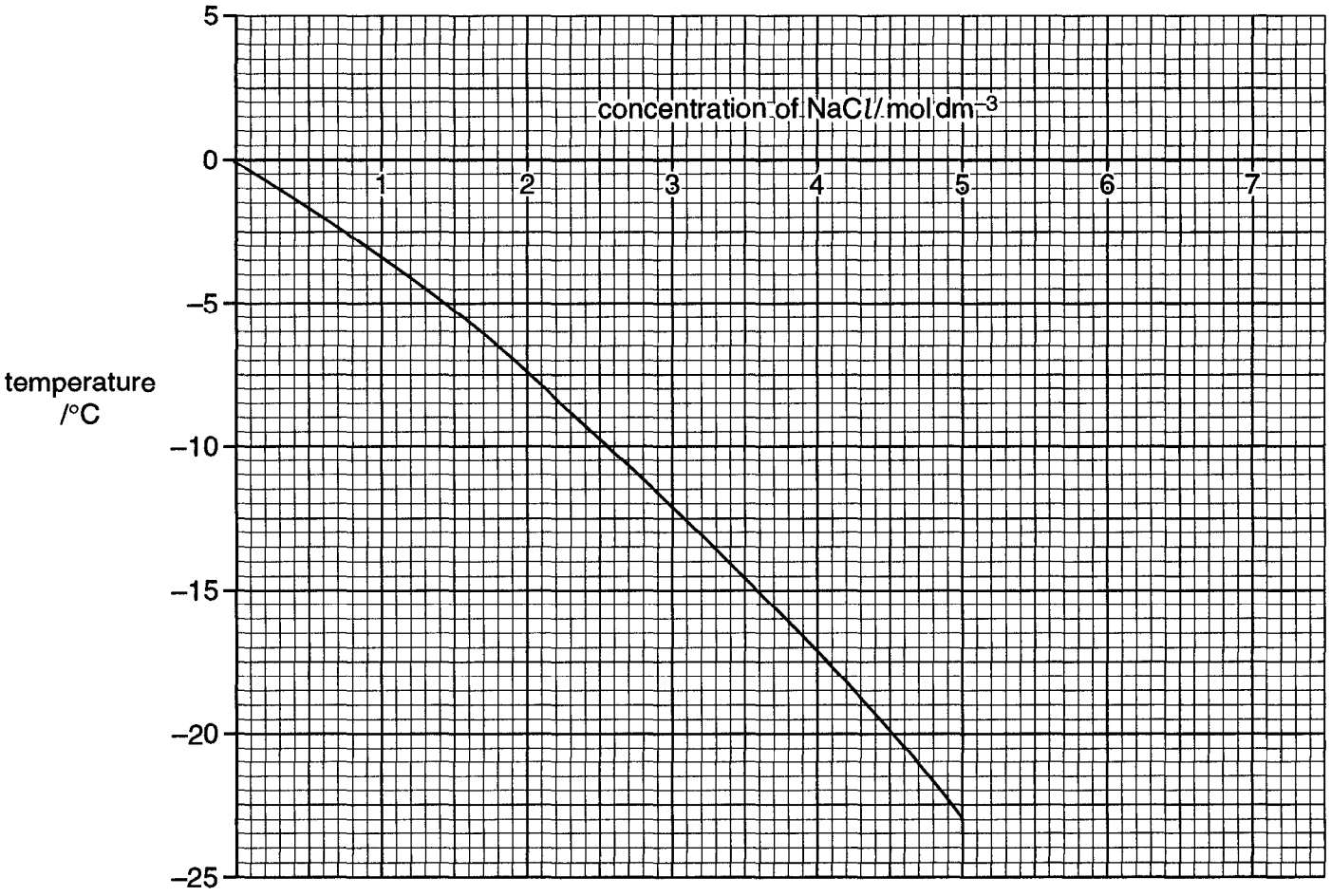

Fig. 3.1

(i) On Fig. 3.1, add a sketch of the curve you would expect at concentrations of sodium chloride above $5.0\,mol\,dm^{-3}$. [1]

(ii) State what this part of the phase diagram represents.

.....

.....[1]

(b) Fig. 3.2 shows the cooling curve for aqueous sodium chloride of concentration 2.5 mol dm^{-3} initially at 5 °C.

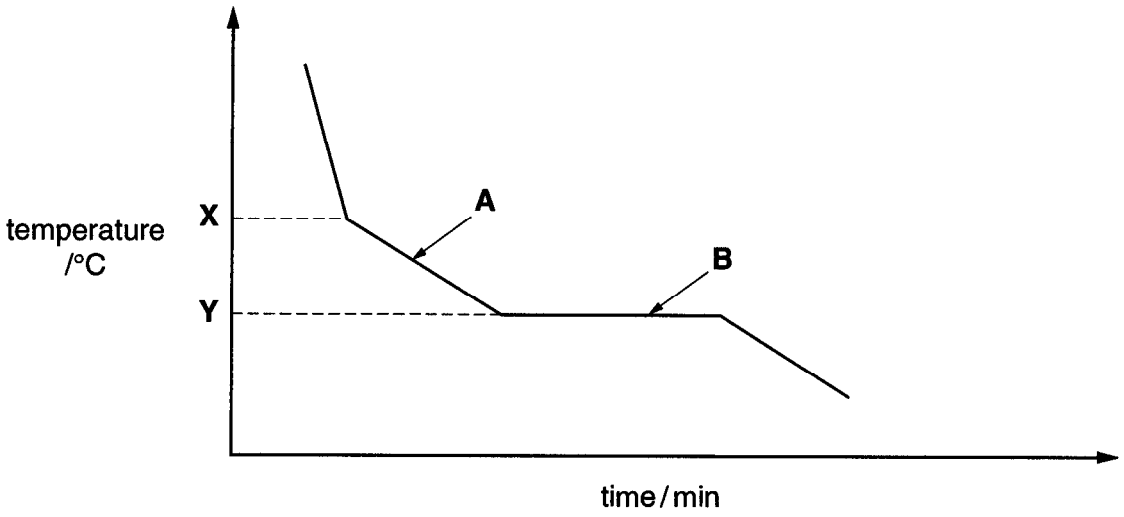

Fig. 3.2

(i) What happens at points **A** and **B** in Fig. 3.2?

A .....

B .....[2]

(ii) Use Fig. 3.1 to determine the temperatures indicated by the points **X** and **Y** in Fig. 3.2.

X .....

Y ..... [2]

(c) Rock salt (impure sodium chloride) is used to treat icy roads in the UK, but is less effective in more northerly countries, such as Sweden. Suggest reasons for this

.....

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.....[2]

[Total: 8]

[Turn over

For Examiner's Use

4 **(a)** Draw a labelled diagram of the apparatus used for fractional distillation in the laboratory.

[3]

(b) The table below gives information for different mixtures of propanone and ethanol.

boiling point of liquid / °C	56	58	60	64	66	69	73	78
mole fraction of propanone in vapour in equilibrium with boiling liquid	1.00	0.87	0.76	0.61	0.52	0.38	0.22	0.00

(i) Use the data to plot the vapour curve for propanone on Fig. 4.1. The liquid curve is already shown.

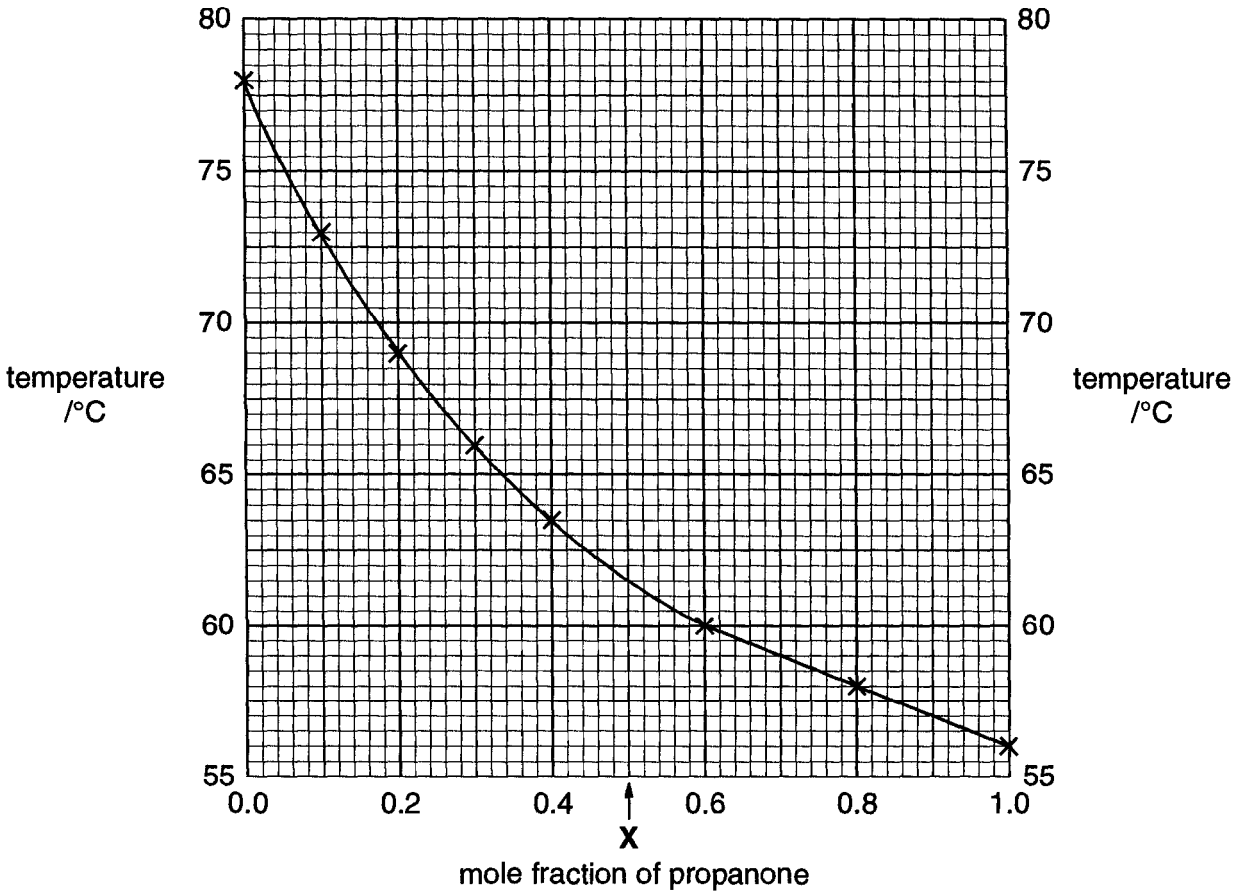

Fig. 4.1

[1]

(ii) Construct lines on Fig. 4.1 showing at least two stages for what happens when a mixture **X** is fractionally distilled. [2]

(iii) Deduce the number of theoretical plates required to produce a solution containing 0.9 mole fraction of propanone from the mixture **X**.

..... plates [1]

(c) Some combinations of liquids form what is called an *azeotropic mixture*.
State **two** properties of this mixture.

1. .....

.....

2. .....

.....[2]

(d) Some materials which decompose close to their boiling point may be purified using *steam distillation*.

(i) State **one** example of a substance purified in this way.

.....[1]

(ii) Explain how steam distillation is able to reduce the boiling point of such materials.

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.....[2]

[Total: 12]