OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY

2815/05

Gases, Liquids and Solids

| Wednesday | **30 JANUARY 2002** | Afternoon | 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 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	9	
2	8	
3	17	
4	11	
TOTAL	45	

This question paper consists of 8 printed pages.

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[Turn over

2

Answer **all** questions.

1 The kinetic-molecular model is used to explain the behaviour of gases.

    (a) **(i)** State **two** basic assumptions of the kinetic theory when applied to an ideal gas.

....

....

....

....[2]

        (ii) Suggest why neither of these assumptions is valid at either low temperature or high pressure.

....

....

....

....[2]

    (b) Suggest why hydrogen chloride is a less ideal gas than helium.

....

....[1]

    (c) State and explain what would happen to **(i)** the **vapour pressure** and **(ii)** the **boiling point** of water if an immiscible liquid such as hexane was added to it.

        (i) vapour pressure: ....

....

....[2]

        (ii) boiling point: ....

....

....[2]

[Total : 9]

3

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

....

....[1]

(ii) State **two** conditions under which this law applies.

....

....[2]

(b) An organic compound **E** is four times more soluble in a solvent **X** than in water.

(i) Define *partition coefficient* in terms of this statement.

....

....[1]

(ii) A 10.0 g sample of **E** dissolved in 100 cm^3 of water is extracted with 100 cm^3 of solvent **X**. What mass of **E** is extracted into **X**?

[1]

(iii) Calculate the total mass of **E** that would have been extracted by successively using two 50 cm^3 portions of solvent **X**.

[3]

[Total : 8]

[Turn over

4

3 Fig. 3.1 shows the *temperature/liquid composition* and *temperature/vapour composition* curves for mixtures of benzene and methylbenzene.
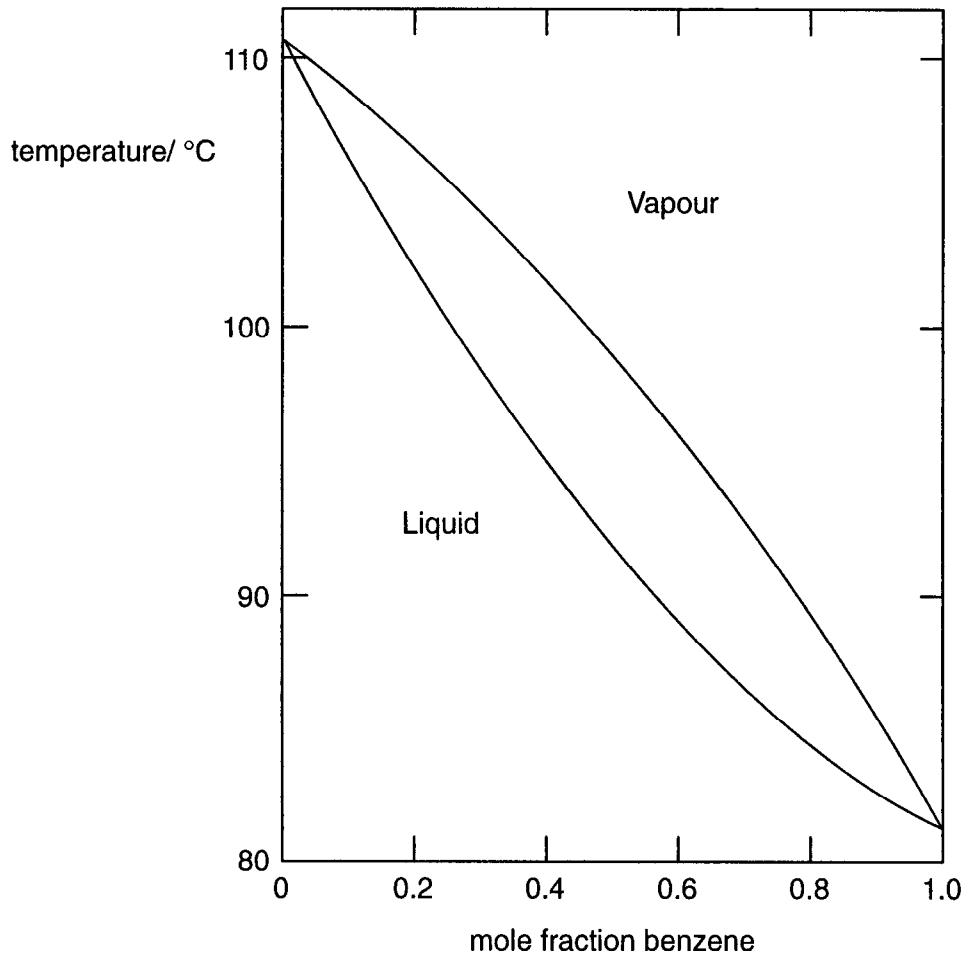
Fig. 3.1

(a) Use Fig. 3.1 to estimate the boiling point of methylbenzene.

.... [1]

(b) Benzene and methylbenzene form an *ideal mixture*.
Explain the meaning of the term *ideal mixture*.

....

....

....

....[2]

5

(c) An ideal mixture can be separated by fractional distillation.

(i) State **two** features you would expect to find in a laboratory fractionation apparatus.

....

....

....

....[2]

(ii) Other than in size, suggest **one** way in which a laboratory column differs from a fractionating column at an oil refinery.

....

....[1]

(d) **(i)** Explain what is meant by the term *theoretical plate.*

....

....[1]

(ii) The number of theoretical plates required for fractionation can be determined by graphical means. Using Fig. 3.1, estimate the number of theoretical plates needed to produce a distillate of at least 0.95 mole fraction of benzene from a mixture of benzene and methylbenzene containing 0.2 mole fraction of benzene. Show how you arrive at your answer.

Number of theoretical plates ....

....

....

....[2]

(iii) If the difference in the boiling points of the liquids being separated is greater, what effect will this have on the number of theoretical plates for such a separation? Give a reason for your answer.

....

....

....[2]

[Turn over

(e) Under certain conditions *steam distillation* is used to separate volatile liquids. Outline the principle on which this is based, and give a reason for its use.

....

....

....[2]

(f) Sea water has a higher boiling point and lower freezing point than distilled water. Explain these differences. You may draw a sketch if you wish.

boiling points ....

....

....

....

freezing points ....

....

....

....[4]

[Total : 17]

4 Copper and silver form a eutectic when the mole percentage of copper is 40%.

(a) Sketch the phase diagram for mixtures of copper (m.p. 1081 °C) and silver (m.p. 960 °C). All the points and areas should be clearly labelled.

[4]

(b) *(In this part, one mark is available for the quality of written communication.)*
Explain how the phase diagram can be experimentally determined using suitable mixtures of copper and silver. Indicate how the experimental observations relate to the corresponding points on the phase diagram.

....

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....

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....

....[6]

[Turn over

8

(c) Suggest, with a reason, the effect on the lowest melting point of the copper-silver system of adding lead (m.p. 324 °C) as a third component.

....

....

....[1]

[Total : 11]