OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY 2815/05

Gases, Liquids and Solids

Tuesday **25 JUNE 2002** Morning 50 minutes

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

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	10	
2	11	
3	13	
4	11	
TOTAL	45	

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

Registered Charity Number. 1066969
[Turn over

Answer **all** questions.

1 Most salts are more soluble in hot water than in cold water, but the actual values of the solubility can vary enormously from salt to salt. The solubility of potassium chloride in water at temperatures between 0 °C and 100 °C is given in the Table below. Some values of the mole fraction of potassium chloride in these solutions are also given.

temperature/°C	0	10	15	20	40	60	80	100
solubility/g per 100 g of water	28.0	31.2	32.8	34.2	40.0	45.8	51.3	56.3
mole fraction KC*l*	0.063	0.070		0.076	0.088	0.099	0.110	0.120

(a) (i) Explain what is meant by the *mole fraction of potassium chloride* in a solution.

[1]

(ii) Determine the mole fraction of water in the solution at 40 °C.

[1]

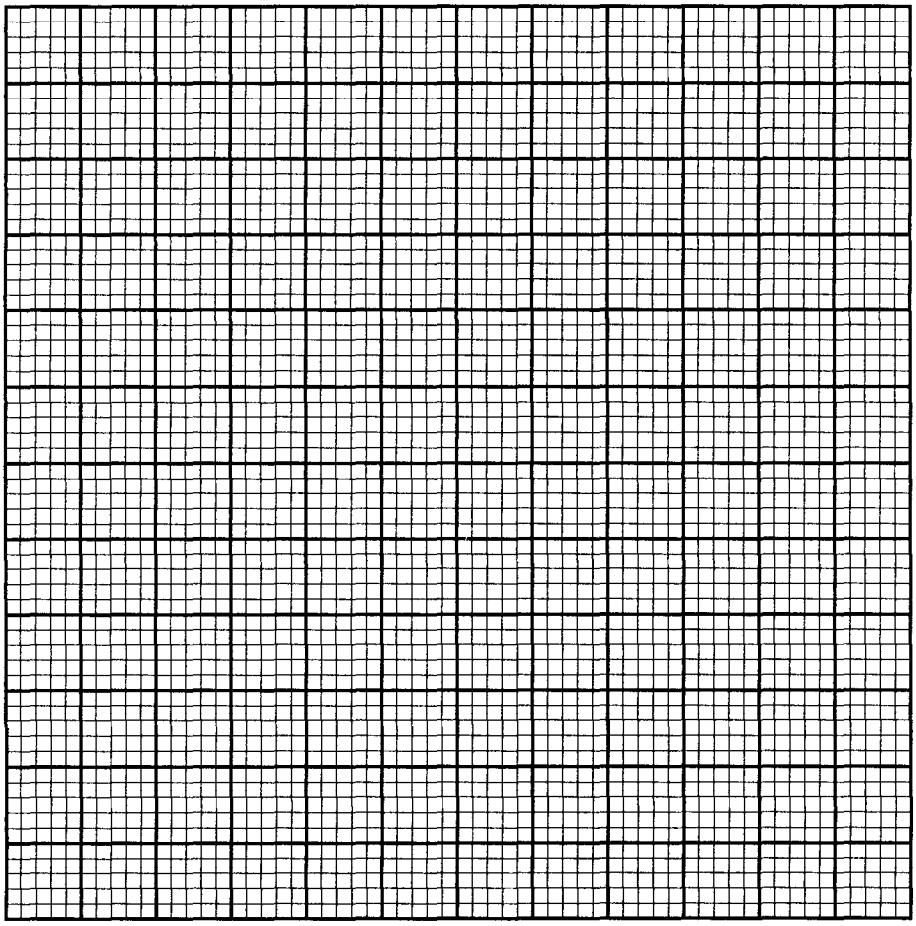
(iii) Using the *Data Sheet*, calculate the mole fraction of potassium chloride in a saturated solution at 15 °C. Show your working.

[2]

For Examiner's Use

The lowest temperature that the liquid phase of the potassium chloride/water system can reach is –14 °C at a mole fraction of 0.053. This is the cryoscopic point and it is comparable to the eutectic point. The freezing points of potassium chloride solutions of lower mole fraction are given by joining the cryoscopic point with a straight line to the freezing point of pure water.

(b) Use the grid below to draw the phase diagram for the system potassium chloride/water.



[3]

(c) What substance(s) first form(s) as solid when each of these solutions of different mole fraction of KC*l* is cooled?

(i) 0.025 .....

(ii) 0.053 .....

(iii) 0.080 .....

[3]

[Total : 10]

[Turn over

2 In the perfume industry a large number of essential oils, which are often esters, are extracted from plant materials. Several methods have been used to extract these oils. The main problem in extracting these oils is their tendency to decompose; hence these extractions are generally based on either solvent extraction or steam distillation.

(a) One of the early methods of obtaining perfumes was to spread fat onto a surface and press flower petals into the fat. This process involves partition. Suggest how this process would work.

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.....[2]

(b) The pure essential oils can be obtained from the fat by mixing with ethanol, after the procedure described in **(a)**. Suggest how the essential oils could be recovered from the ethanol solution.

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.....[2]

(c) An alternative early process was to mix the petals with water and boil the mixture. This gave a poor yield due to decomposition of the essential oils. Suggest why the oils decompose under these conditions.

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.....[1]

(d) Modern extraction processes use steam distillation. Sketch and label the apparatus you would use to carry out such a distillation in the laboratory.

[3]

(e) Explain the principle of steam distillation of two immiscible liquids.

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.....[2]

(f) Suggest why steam distillation gives less decomposition and consequently an improved yield of essential oils, compared with boiling the plant material with water.

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.....[1]

[Total : 11]

For Examiner's Use

3 **(a)** The Gas Constant, R, has the value $8.31\,J\,K^{-1}\,mol^{-1}$. Using symbols, write an expression for the Ideal Gas Equation.

.....[1]

(b) State **two** assumptions made about ideal gases, which are not true for a gas such as carbon dioxide.

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.....[2]

(c) Put the gases ammonia, helium and nitrogen in order of **increasing** 'ideality'.

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least ideal most ideal [2]

(d) Explain why gases do not behave in an 'ideal' way at high pressures.

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.....[2]

(e) The cylinder in a car engine has a volume of 500 cm^3 when the piston is at the bottom of its stroke. At this point the pressure is reduced to 95.0 kPa and the reduced pressure causes the fuel/air mixture to move into the cylinder. At the top of its stroke, the piston has compressed the gases to 25 cm^3.
Calculate the pressure of the gases at this point. You should assume that the temperature is constant throughout.

[2]

(f) 0.186 g of motor fuel was vaporised, and had a volume of 100 cm^3 at 95.0 kPa and 700 K. Calculate the relative molecular mass of the fuel.

[3]

(g) In Kenya ethanol is mixed with gasoline to produce motor fuel. One problem this can cause is that the fuel absorbs water. Suggest why the addition of ethanol causes water to be dissolved in the fuel.

.....[1]

[Total : 13]

For Examiner's Use

4 *(In this question 1 mark is awarded for quality of written communication.)*

(a) Discuss the advantages of using an alloy rather than one of its pure metal components, with reference to **each** of the following:

(i) the use of tin and lead in solders;

(ii) the use of nickel and copper in coinage metals.

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[6]

Quality of Written Communication [1]

For Examiner's Use

(b) Sketch the shape of the eutectic diagram for tin and lead. Points of interest and the areas of your diagram should be labelled.
[Actual values of any points on your diagram are **not** expected.]

[4]

[Total : 11]