

OXFORD CAMBRIDGE AND RSA EXAMINATIONS**Advanced GCE****CHEMISTRY****2815/05**

Gases, Liquids and Solids

Wednesday

29 JANUARY 2003

Afternoon

50 minutes

Candidates answer on the question paper.

Additional materials:

Data Sheet for Chemistry

Scientific calculator

Candidate Name

Centre Number

Candidate
Number

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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	8	
2	13	
3	13	
4	11	
TOTAL	45	

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

Answer **all** the questions.

1 Trout are found in rivers and streams which have a high content of dissolved oxygen. Henry's Law gives information about how pressure affects the amount of dissolved gas.

(a) To what type of mixtures does Henry's Law apply?

.....[1]

(b) Air contains about 80% nitrogen and 20% oxygen. Water at 25 °C is allowed to come to equilibrium with air at 100 kPa pressure.

(i) What is the partial pressure of oxygen in air at 100 kPa?

.....[1]

(ii) The Henry's Law constant for oxygen at 25 °C and 100 kPa pressure is $1.3 \times 10^{-5} \text{ mol dm}^{-3} \text{ kPa}^{-1}$.

Calculate the concentration of oxygen in water under these conditions.

answer mol dm^{-3} [2]

(iii) Calculate the mass of oxygen that would be dissolved in 1.0 dm^3 of water under these conditions.

answerg [1]

(c) State **two** similarities between Henry's Law and the partition coefficient.

.....
.....
.....
.....[2]

(d) Sulphur dioxide gas is a pollutant. When it dissolves in water it does **not** obey Henry's Law. Suggest a reason for this.

.....
.....[1]

[Total: 8]

2 (a) (i) State Raoult's Law.

.....

[2]

(ii) Explain what combination of liquids obeys Raoult's Law.

.....

[2]

(b) Fig.2.1 shows the vapour pressures of mixtures of two liquids, X and Y.

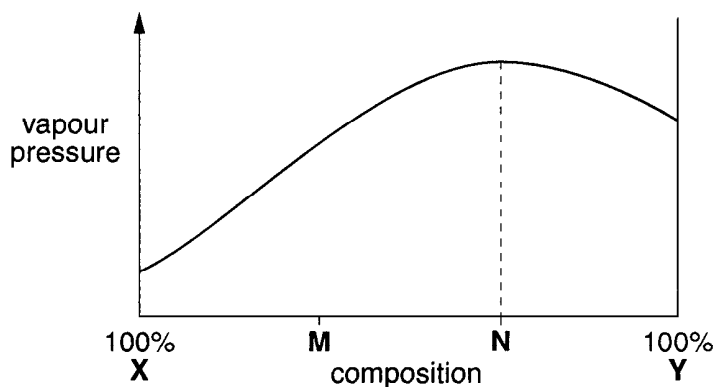


Fig.2.1

(i) State, with reasons, which of the following pairs of liquids is most likely to behave like X and Y.

- A** methanol and ethanol **B** ethanol and hexane **C** pentane and hexane

.....

[3]

(ii) What is the name given to the mixture of composition N?

.....[1]

(iii) A sample of liquid of composition M is fractionally distilled. Use Fig.2.1 to explain why the first fraction has a composition N.

.....
[1]

- (c) Fractional distillation can be used to obtain a reasonably pure sample of a liquid from a mixture of two miscible liquids.

State **two** circumstances in which fractional distillation will **not** separate two miscible liquids.

.....
.....
.....[2]

- (d) In the laboratory, fractionating columns are often packed with glass beads.

(i) What is the purpose of these?

.....
.....[1]

(ii) In an industrial fractionating column, what is used instead of glass beads?

.....
.....[1]

[Total: 13]

- (c) The molar mass of a volatile liquid can be determined by vaporising a known mass of the liquid and measuring the volume of vapour produced. In such an experiment, 0.270 g of an organic liquid produced 80.0 cm³ of vapour at 65 °C.

Calculate the molar mass of the liquid.

(pressure $p = 101\,000$ Pa; the gas constant $R = 8.31$ J K⁻¹ mol⁻¹)

molar mass g mol⁻¹ [3]

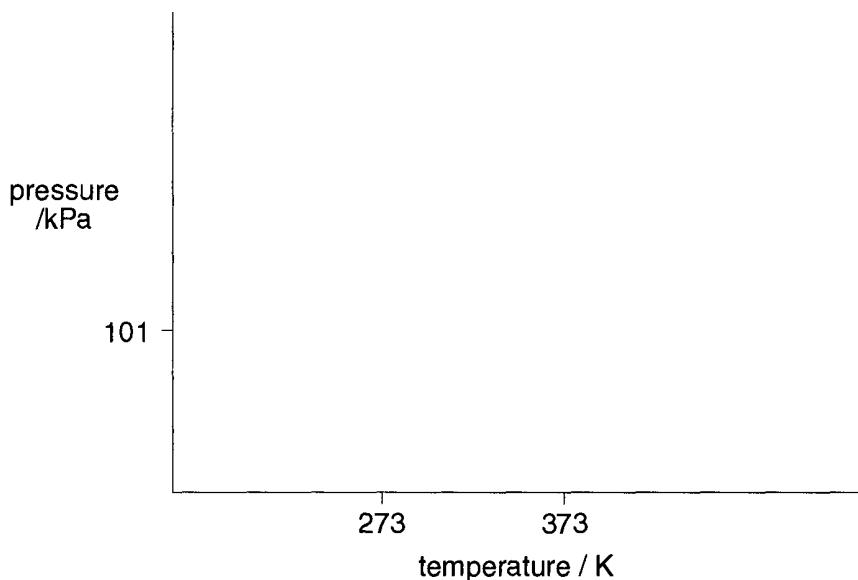
[Total: 13]

4 Water behaves in a different way to most liquids when it is cooled.

(a) (i) On the axes provided, sketch and label the phase diagram of water.

On your sketch

- label the triple point
- label the regions where ice, steam and liquid water would exist.



[4]

(ii) Water shows unusual properties when it is cooled. State **one** of these properties.

.....
[1]

(b) Suggest and explain why the 'steam' from a kettle is invisible as it leaves the spout, but can be seen a few inches away.

.....

[2]

(c) Fig. 4.1 shows the phase diagram for the zinc-cadmium system.

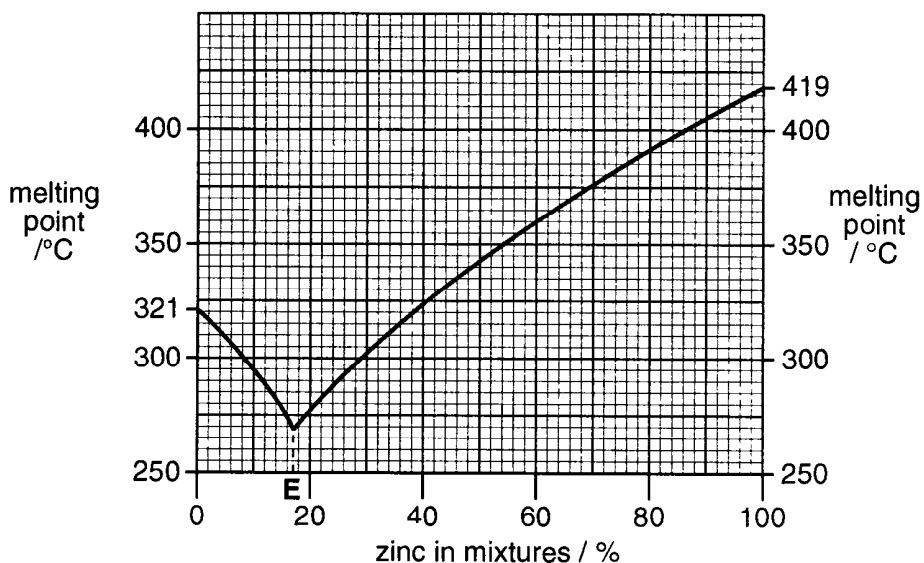


Fig. 4.1

(i) What name is given to the solid formed when a mixture of composition E is cooled?

.....[1]

(ii) Fig. 4.2 shows the cooling curve for a mixture of composition E from 350 °C to 250 °C. Label each section of the curve by stating what is taking place.

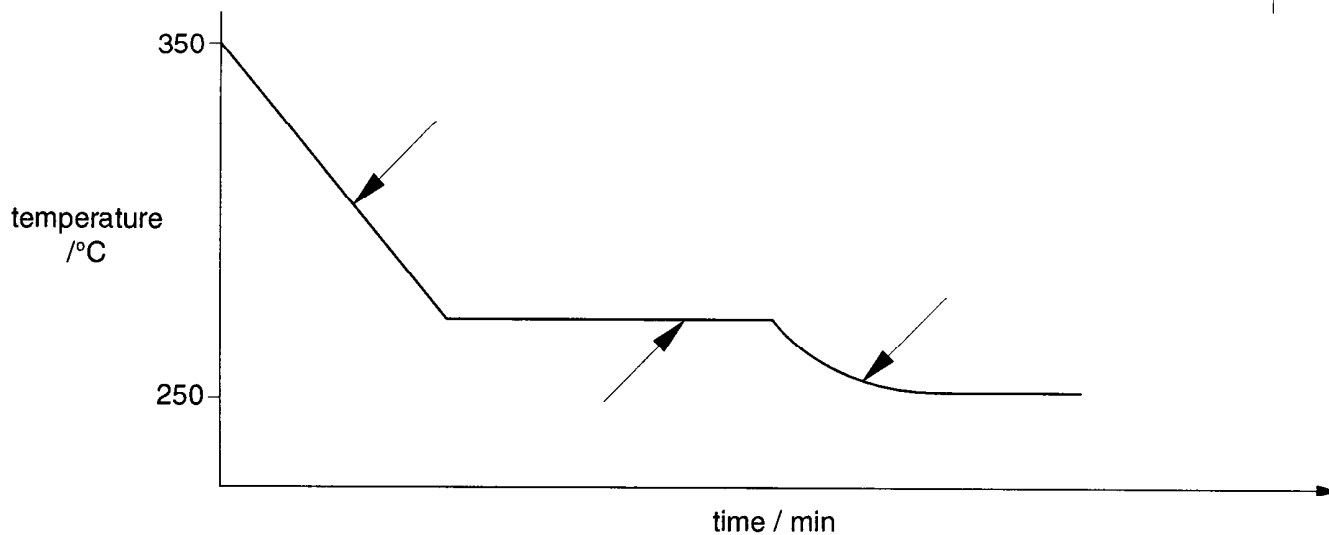


Fig. 4.2

[2]

(iii) What phases are present in a mixture containing 60% zinc at 325 °C?

.....[1]

[Total: 11]