

Structured Questions

Introduction to the Particulate Nature of Matter

Chemical Elements, Compounds & Mixtures / Separating Mixtures / Changes of State / Average Kinetic Energy

Easy (3 questions)	/18
Medium (3 questions)	/21
Hard (3 questions)	/34
Total Marks	/73

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Easy Questions

1 (a) Name of the process that occurs when a gas turns into a liquid.

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(1 mark)

(b) Name process that occurs when a solid turns into a gas without first forming a liquid.

.....
(1 mark)

(c) State the meaning of the following terms:

Compound

Heterogeneous mixture

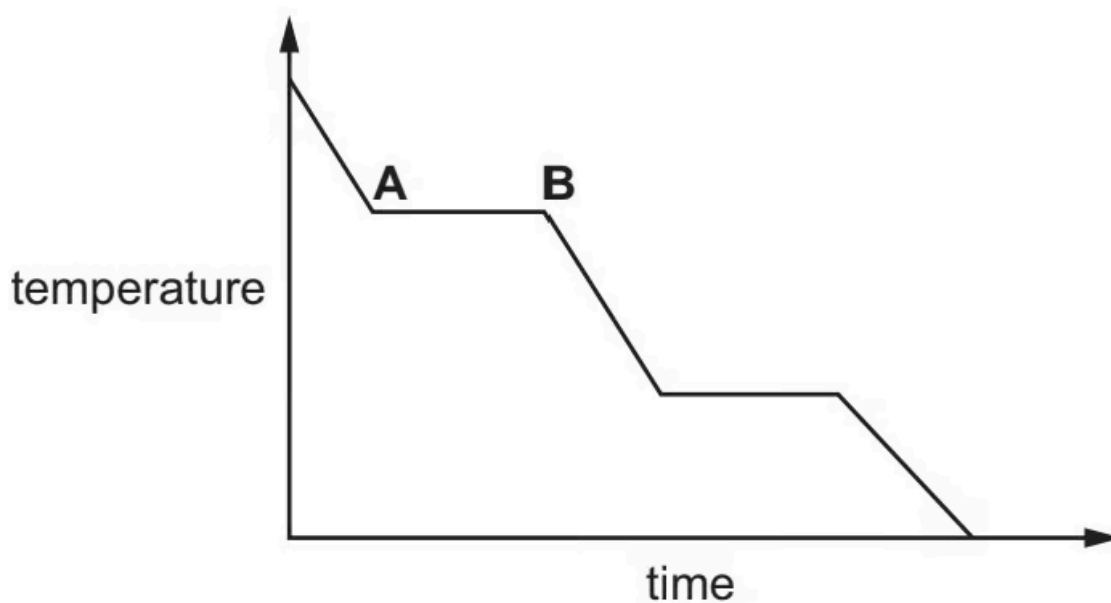
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(3 marks)

2 (a) Complete the table by adding information about solids, liquids and gases.

	particle separation	particle arrangement	type of motion
solid		regular	vibrate only
liquid	some touching		random
gas	apart	random	

(3 marks)

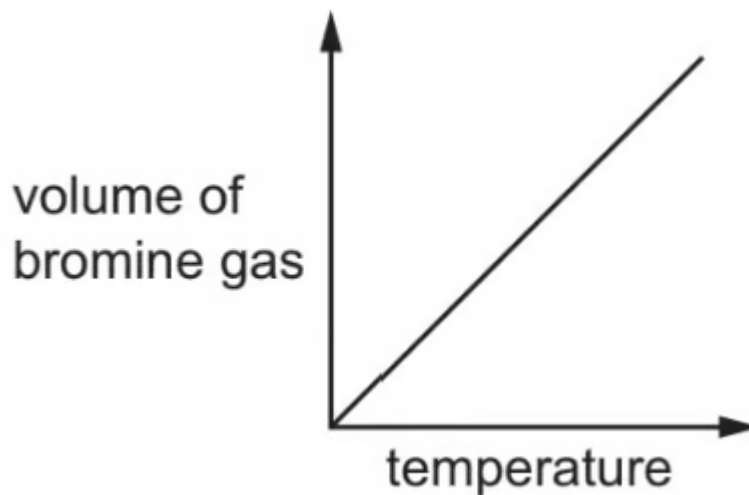
(b) The graph shows the change in temperature as a sample of a gas is cooled.



Name the change of state taking place between **A** and **B**.

(1 mark)

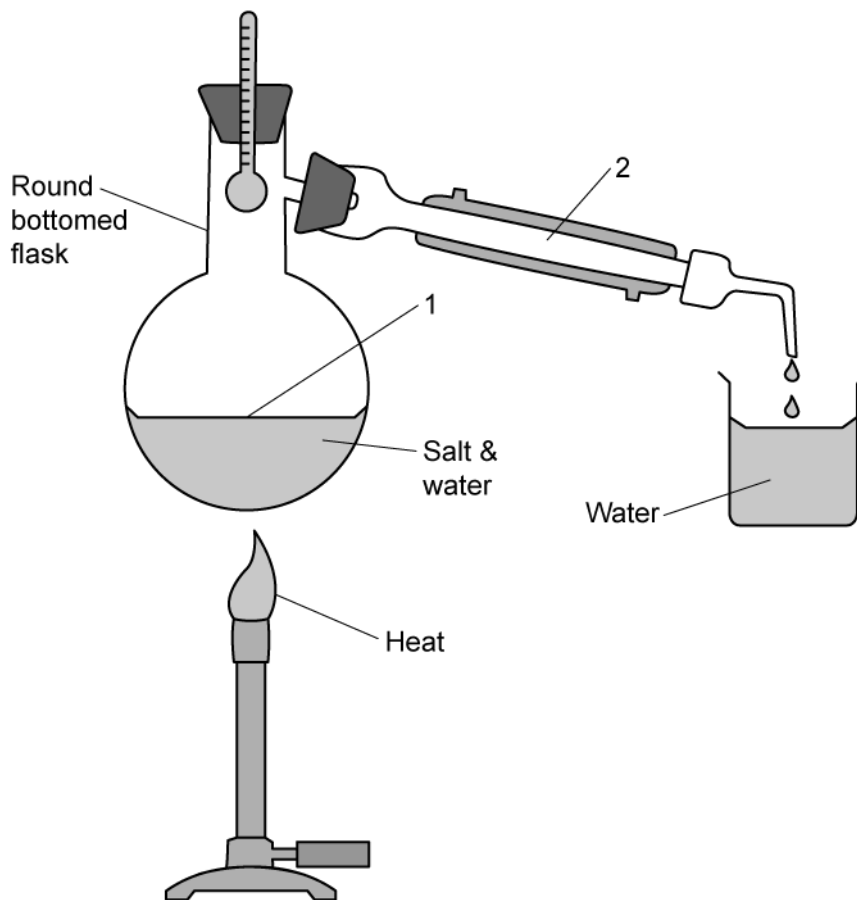
- (c) How the volume of bromine gas changes with temperature, at constant pressure, is shown in the graph.



Describe how the volume of the bromine gas changes with temperature.

(1 mark)

3 (a) A student separated water from salty water using the apparatus in the diagram below.



i) Name of this method of separation.

[1]

ii) By referring to points 1 and 2 in the diagram, describe how this technique works.

[2]

.....

.....

.....

(3 marks)

(b) A student set up similar apparatus to separate a mixture of ethanol and water. Ethanol and water have boiling points of 78 °C and 100 °C respectively.

i) State which method should be used to separate these two liquids.

[1]

ii) Describe how this method separates the two liquids. You should make reference to their boiling points.

[3]

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(4 marks)

(c) A different alcohol butanol has a melting point of -89 °C and a boiling point of 118 °C.

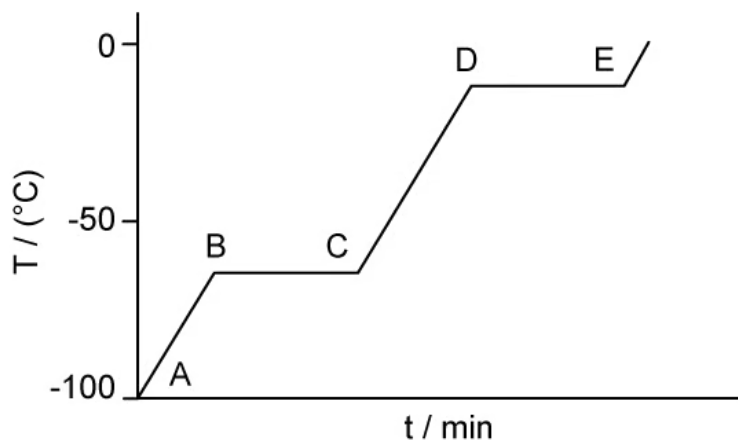
Give the state of butanol at -10 °C?

.....

(1 mark)

Medium Questions

1 (a) A sample of pure solid sulfur dioxide was slowly heated from $-100\text{ }^{\circ}\text{C}$, which is below its melting point, to $0\text{ }^{\circ}\text{C}$, which is above its boiling point. Its temperature is measured every minute and the results are represented on the graph.



- i) Complete the equation for the equilibrium present in the region BC.
 $\text{SO}_2(\text{s}) \rightleftharpoons \dots\dots\dots$ [1]
- ii) What is the physical state of SO_2 in the region after E? [1]
- iii) What would be the difference in the region BC if an impure sample of SO_2 had been used? [1]

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(3 marks)

(b) Using the graph in part (a), complete the table by comparing the separation and movement of the molecules in regions **A** to **B** with those in **C** to **D**

	A to B	C to D
separation (distance between particles)		
movement of particles	vibrate around a fixed position	
Ability to move apart		

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(2 marks)

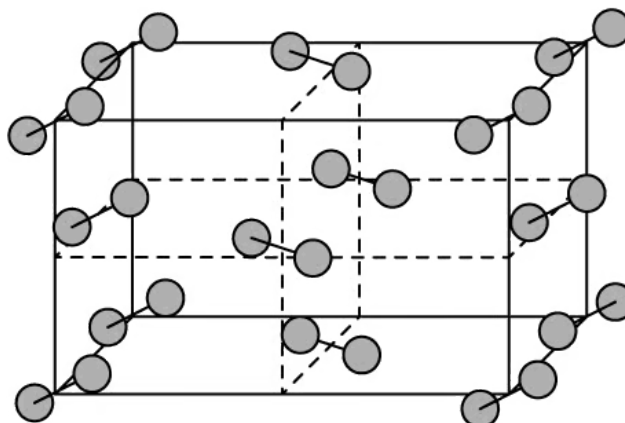
(c) Explain why the temperature remains constant between **B** and **C**.

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(1 mark)

2 (a) Solid iodine has the structure shown below.

Under standard conditions (298.15 K and 100 kPa) it will undergo sublimation



i) Write a symbol equation for the deposition of gaseous iodine and explain why this is described as a physical process [2]

ii) State and explain whether this change is exothermic or endothermic [1]

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(3 marks)

(b) Explain why gaseous iodine occupies a significantly greater volume than solid iodine.

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.....

(3 marks)

(c) State **two** physical differences between solid iodine and gaseous iodine.

(2 marks)

3 (a) During the manufacture of a commercial drink, a batch containing water, sugar, dyes and flavouring concentrates became contaminated with an unknown solid during the mixing process.

i) State the type of mixture that best describes this batch. [1]

ii) Draw a labelled set of apparatus required to isolate the solid particles in the mixture [2]

.....

.....

.....

(3 marks)

(b) i) State the method that could be used to isolate the dissolved solids, such as dyes and flavourings, from the mixture. [1]

ii) State the method that could be used to separate the dyes and flavourings once they have been isolated. [1]

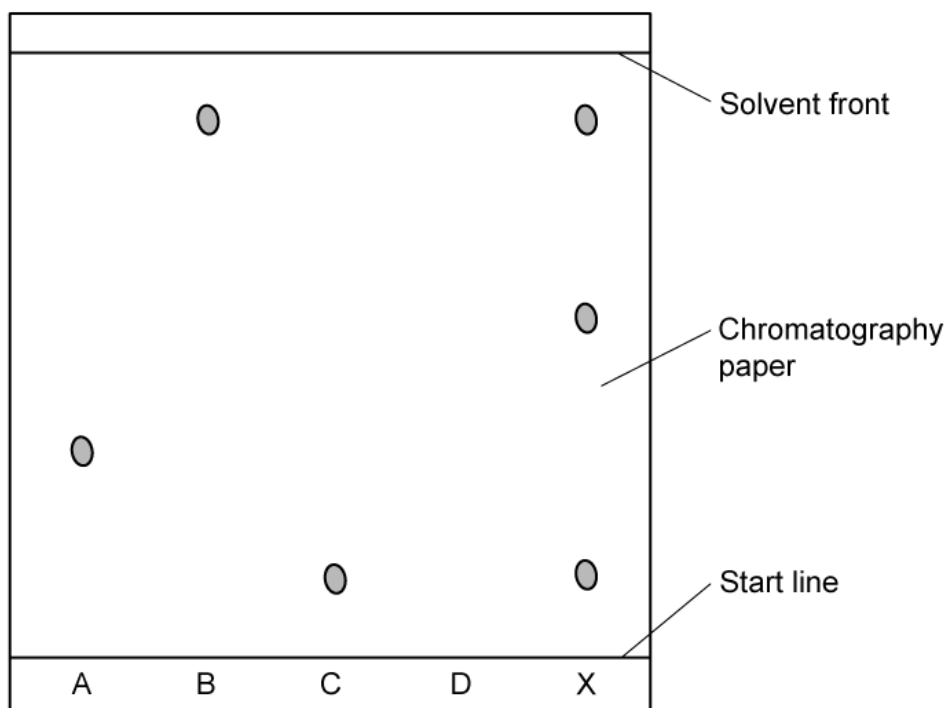
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(2 marks)

(c) Once the flavourings have been separated chromatography is used to identify them. The sample was labelled **X**.

A, B and C are reference flavourings used in this process.



- i) Identify which flavourings are present in sample **X**. [1]
- ii) Identify, giving a reason, the least soluble flavouring. [1]

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(2 marks)

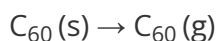
Hard Questions

1 (a) Describe how an increase in temperature affects the movement of particles in a liquid.

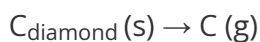
(3 marks)

(b) Carbon is an element in Group 14.

C_{60} sublimes at approximately 800 K.



Diamond also sublimes but only above 3800 K.

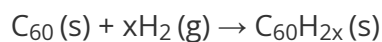


Explain, with reference to their structure and properties, why C_{60} and diamond sublime at such different temperatures.

(4 marks)

- (c) 0.144 g of C₆₀ is placed in a 100 × 10⁻⁶ m³ container of hydrogen gas at a temperature of 25 °C and a pressure of 100 kPa.

The container is heated to make the C₆₀ and hydrogen gas react. The reaction occurs as shown in the equation.



After the reaction, the container is allowed to cool to 25 °C. The pressure decreases to 20.8 kPa. All of the C₆₀ has reacted.

- i) Calculate the amount, in mols, of C₆₀ that reacts. [1]
- ii) Calculate the amount, in mols, of hydrogen gas that reacted with the C₆₀. [3]
- iii) Use your answers from (ii) and (iii) to deduce the correct balanced equation. [3]

(7 marks)

2 (a) An ink is a mixture of coloured substances dissolved in water.

A sample of ink, **K**, is known to contain three different coloured substances.

Discuss the use of the following methods to separate the coloured substances in the sample of ink, **K**.

- chromatography
- crystallisation
- filtration
- fractional distillation
- simple distillation

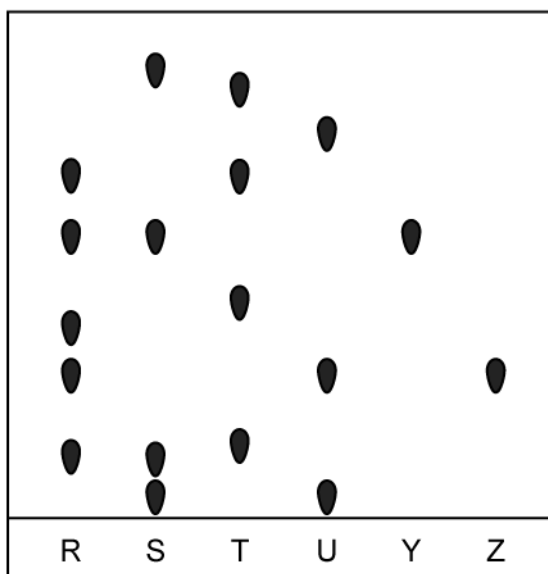
(3 marks)

(b) Chromatography can be used to separate a mixture of ions from different transition element compounds.

Two solutions, **Y** and **Z** were placed on a piece of chromatography paper.

Four samples, **R**, **S**, **T** and **U**, each containing transition element ions, were also placed on the same piece of chromatography paper.

The results of the chromatography are shown.



i) Explain the results shown for solutions **Y** and **Z**.

[1]

ii) Which sample does not contain the same ions as either solution **Y** or solution **Z**?

[1]

iii) Which sample contains the same ions as both solution **Y** and solution **Z**?

[1]

iv) Which sample has the greatest number of transition element ions?

[1]

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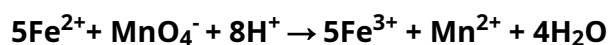
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(4 marks)

- (c) 12.2 g of hydrated iron(II) sulfate, $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ were dissolved in acidic solution and made up to a volume of 500 cm^3 . A 25.0 cm^3 sample of this solution was titrated against $0.0200 \text{ mol dm}^{-3}$ potassium manganate(VII) solution. 21.95 cm^3 of this solution were required.

The following reaction took place:



- i) Calculate the amount, in mol, of MnO_4^- [1]
- ii) Calculate the amount, in mol, of Fe^{2+} in the original sample [2]
- iii) Calculate the value of x in $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ [2]

(5 marks)

3 (a) Krypton is a gas at room temperature. Krypton atoms, are spread far apart and move in a random manner at high speed. Krypton is shipped as a liquid.

Compare the movement and arrangement of the molecules in liquid krypton to those in krypton gas.

(3 marks)

(b) A sealed container contains krypton gas.

Explain why the pressure inside the container increases when the temperature is increased.

(2 marks)

(c) Explain why gases expand to fill their containers.

(3 marks)