

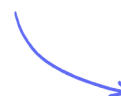
## Structured Questions

# 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
<b>Total Marks</b>	<b>/73</b>

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# Easy Questions

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

.....  
(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
<b>solid</b>		regular	vibrate only
<b>liquid</b>	some touching		random
<b>gas</b>	apart	random	

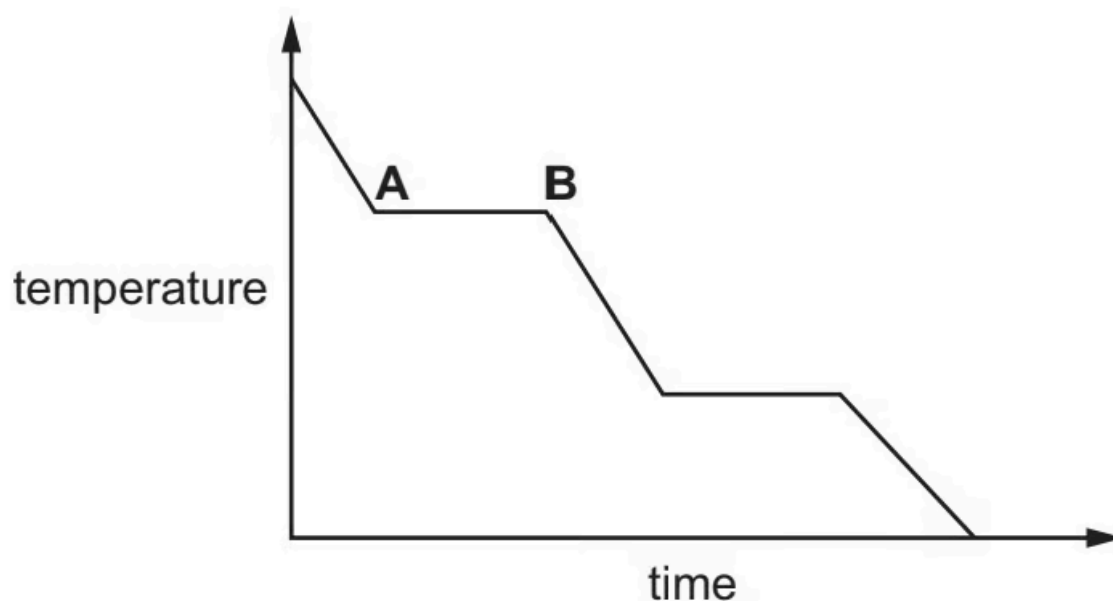
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(3 marks)

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

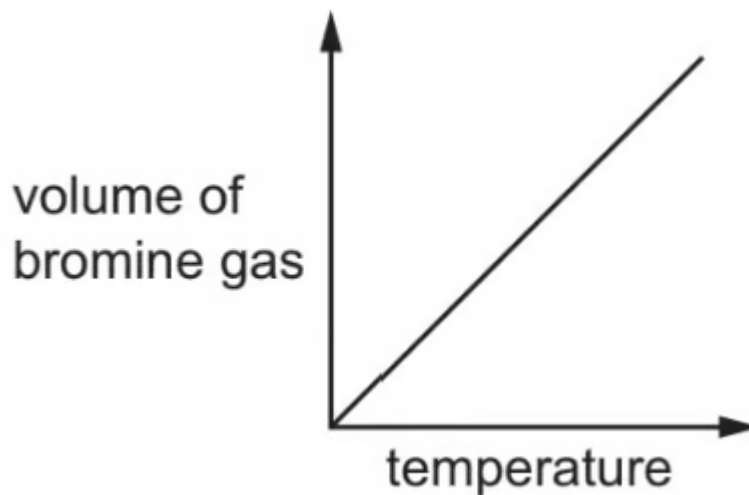


Name the change of state taking place between **A** and **B**.

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(1 mark)

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

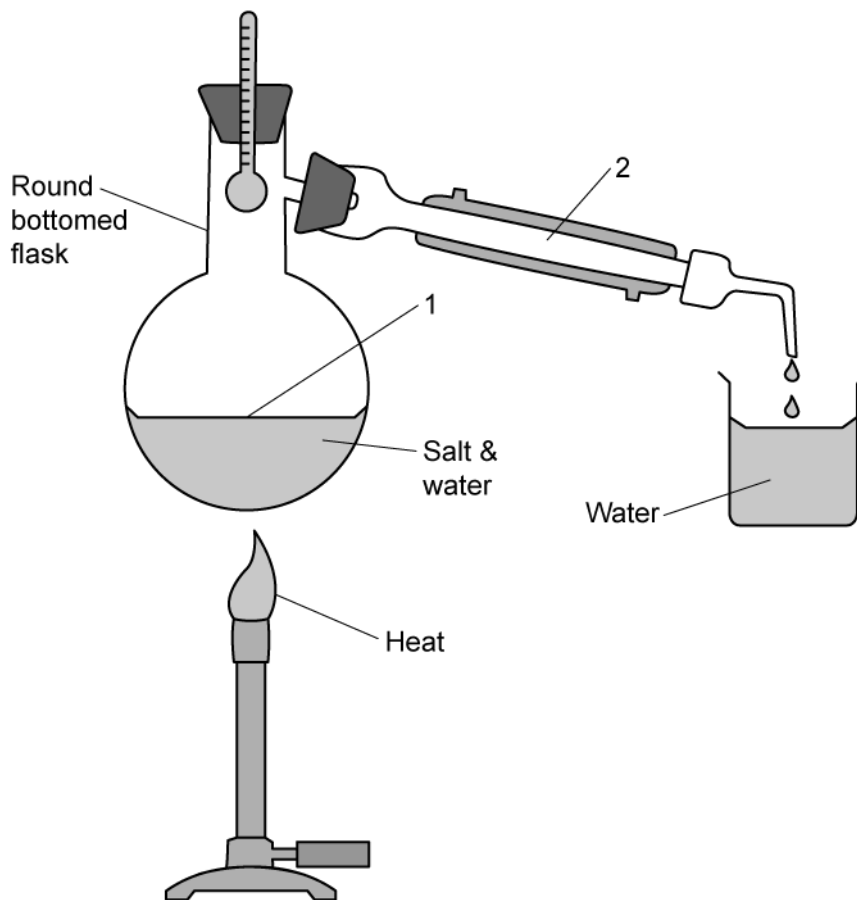


Describe how the volume of the bromine gas changes with temperature.

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(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.

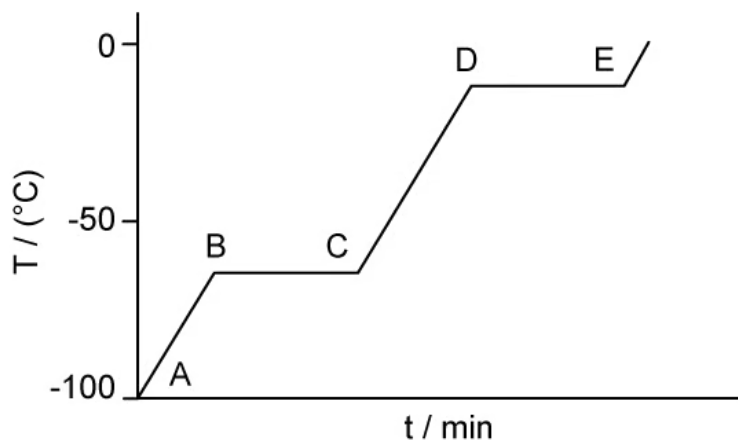
Give the state of butanol at -10 °C?

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**(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  $\text{SO}_2$  in the region after E? [1]
- iii) What would be the difference in the region BC if an impure sample of  $\text{SO}_2$  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**

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

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.....  
**(2 marks)**

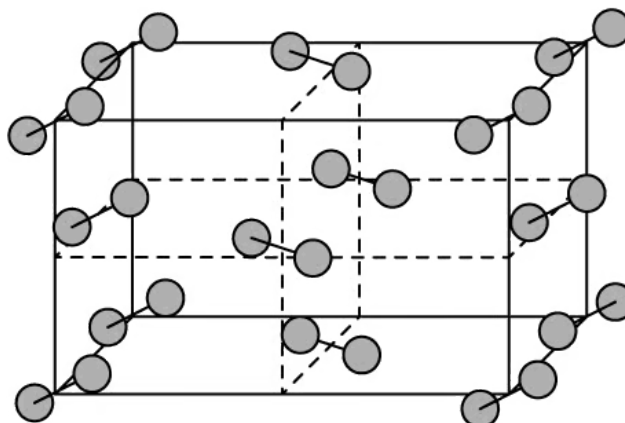
**(c)** Explain why the temperature remains constant between **B** and **C**.

.....  
**(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.

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(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]

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**(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]

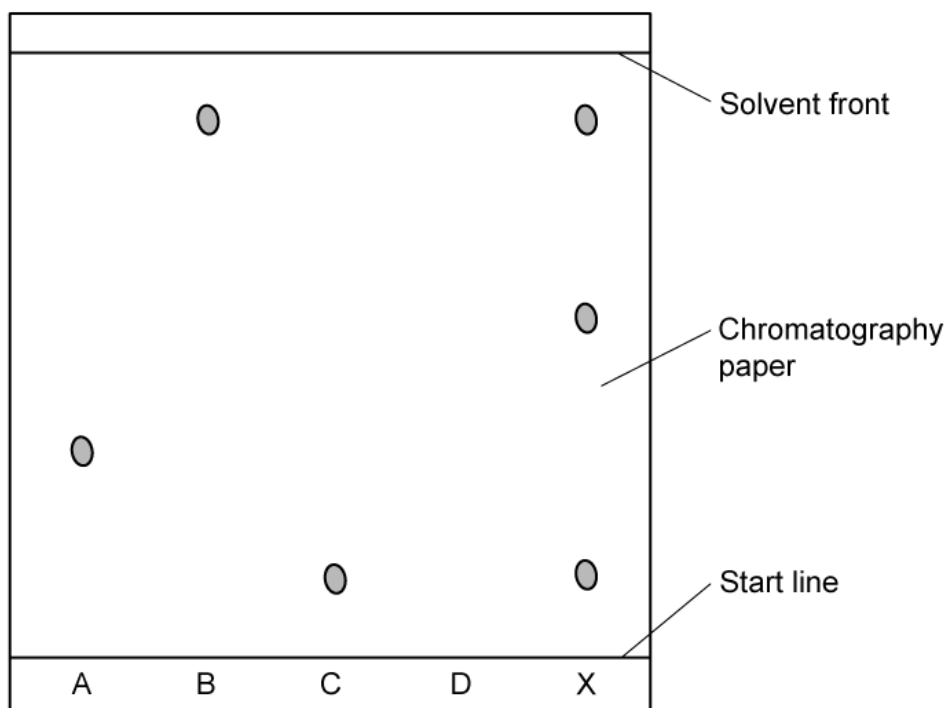
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**(2 marks)**

**(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.

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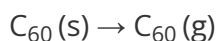
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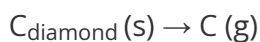
(3 marks)

(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.

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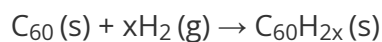
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(4 marks)

- (c) 0.144 g of  $C_{60}$  is placed in a  $100 \times 10^{-6} \text{ m}^3$  container of hydrogen gas at a temperature of  $25 \text{ }^\circ\text{C}$  and a pressure of 100 kPa.

The container is heated to make the  $C_{60}$  and hydrogen gas react. The reaction occurs as shown in the equation.



After the reaction, the container is allowed to cool to  $25 \text{ }^\circ\text{C}$ . The pressure decreases to 20.8 kPa. All of the  $C_{60}$  has reacted.

- i) Calculate the amount, in mols, of  $C_{60}$  that reacts. [1]
- ii) Calculate the amount, in mols, of hydrogen gas that reacted with the  $C_{60}$ . [3]
- iii) Use your answers from (ii) and (iii) to deduce the correct balanced equation. [3]

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**(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

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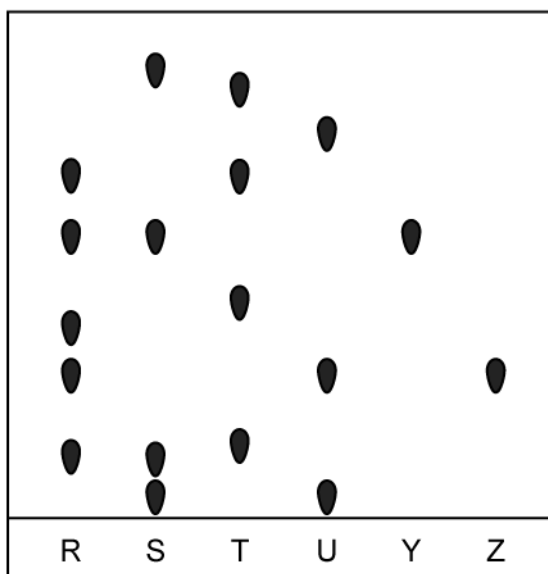
**(3 marks)**

**(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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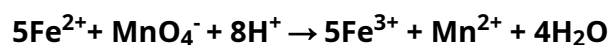
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**(4 marks)**



- (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  $500 \text{ cm}^3$ . A  $25.0 \text{ cm}^3$  sample of this solution was titrated against  $0.0200 \text{ mol dm}^{-3}$  potassium manganate(VII) solution.  $21.95 \text{ cm}^3$  of this solution were required.

The following reaction took place:



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

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(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.

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**(3 marks)**

**(b)** A sealed container contains krypton gas.

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

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**(2 marks)**

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

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**(3 marks)**