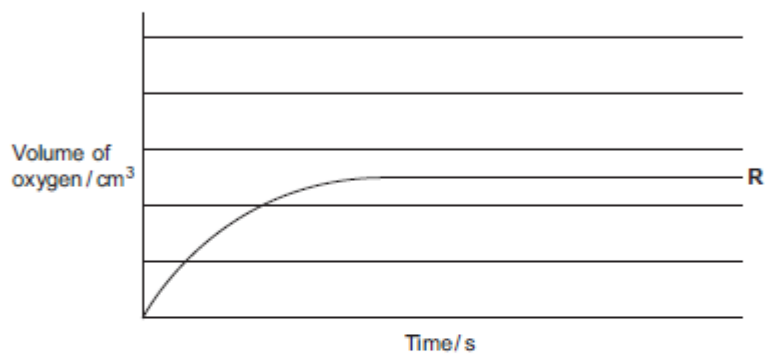


Cherry Hill Tuition AQA Chemistry AS. Paper 8

- 1 A student carried out an experiment to determine the rate of decomposition of hydrogen peroxide into water and oxygen gas. The student used 100 cm^3 of a 1.0 mol dm^{-3} solution of hydrogen peroxide at 298 K and measured the volume of oxygen collected. Curve **R**, in each of **Figures 1, 2** and **3**, shows how the total volume of oxygen collected changed with time under these conditions.

- 1 (a) Draw a curve on **Figure 1** to show how the total volume of oxygen collected will change with time if the experiment is repeated at 298 K using 100 cm^3 of a 2.0 mol dm^{-3} solution of hydrogen peroxide.

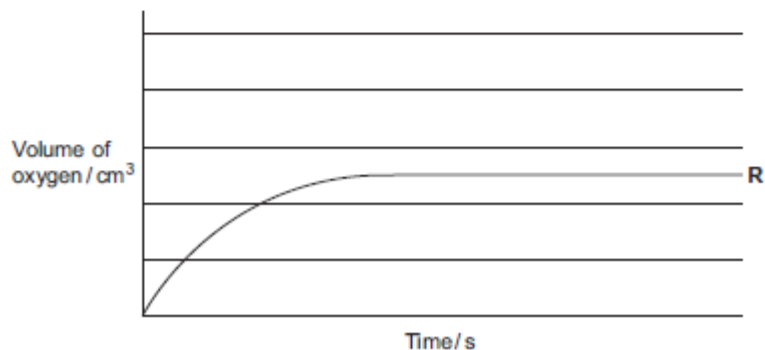
Figure 1



(2 marks)

- 1 (b) Draw a curve on **Figure 2** to show how the total volume of oxygen collected will change with time if the experiment is repeated at 298 K using 100 cm^3 of a 0.4 mol dm^{-3} solution of hydrogen peroxide.

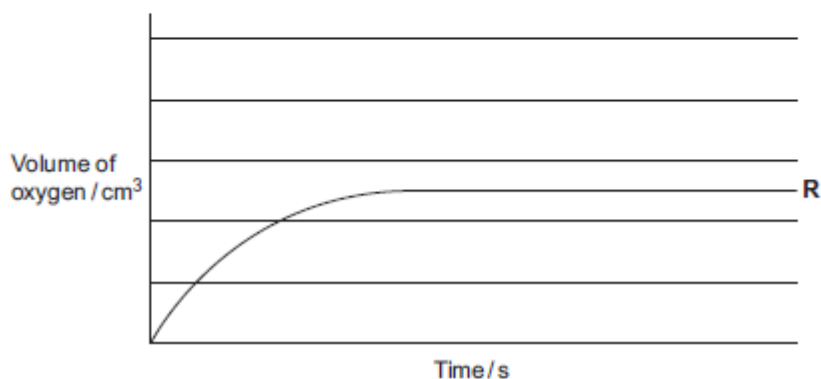
Figure 2



(2 marks)

- 1 (c) Draw a curve on **Figure 3** to show how the total volume of oxygen collected will change with time if the **original** experiment is repeated at a temperature higher than 298 K. You should assume that the gas is collected at a temperature of 298 K.

Figure 3



(2 marks)

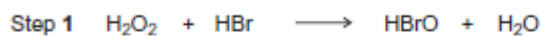
- 1 (d) Explain why the slope (gradient) of curve **R** decreases as time increases.

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(2 marks)

(Extra space)

- 1 (e) The student discovered that hydrogen peroxide decomposes at a faster rate when a few drops of aqueous hydrogen bromide are added to the solution. The student found on the Internet that this decomposition is thought to proceed in two steps as shown by the following equations.



- 1 (e) (i) Write an equation for the overall reaction.

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 (1 mark)

- 1 (e) (ii) Give **one** reason, other than the increase in rate of reaction, why the student was able to deduce that hydrogen bromide behaves as a catalyst in this two-step reaction.

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 (1 mark)

- 2(a) Hexane can react with chlorine under certain conditions as shown in the following equation.



- (a) (i) Both the products are hazardous. The organic product would be labelled 'flammable'. Suggest the most suitable hazard warning for the other product.

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(1 mark)

- (a) (ii) Calculate the percentage atom economy for the formation of $\text{C}_6\text{H}_{13}\text{Cl}$ ($M_r = 120.5$) in this reaction.

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The element nitrogen forms compounds with metals and non-metals.

- 3(a) Nitrogen forms a nitride ion with the electron configuration $1s^2 2s^2 2p^6$. Write the formula of the nitride ion.

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(1 mark)

- (b) An element forms an ion Q with a single negative charge that has the same electron configuration as the nitride ion. Identify the ion Q.

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(1 mark)

- (c) Use the Periodic Table and your knowledge of electron arrangement to write the formula of lithium nitride.

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(1 mark)

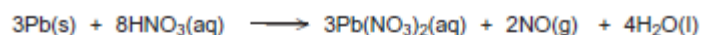
- (d) Calcium nitride contains 81.1% by mass of the metal. Calculate the empirical formula of calcium nitride. Show your working.

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(3 marks)

- (e) Write an equation for the reaction between silicon and nitrogen to form silicon nitride, Si_3N_4 .

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(1 mark)

- 4 The metal lead reacts with warm dilute nitric acid to produce lead(II) nitrate, nitrogen monoxide and water according to the following equation.



- (a) In an experiment, an 8.14 g sample of lead reacted completely with a 2.00 mol dm^{-3} solution of nitric acid.

Calculate the volume, in dm^3 , of nitric acid required for complete reaction.
Give your answer to 3 significant figures.

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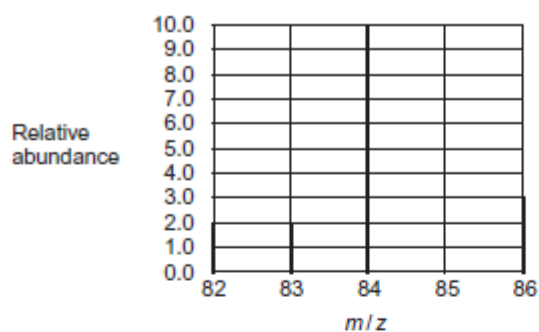
(3 marks)

(Extra space)

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5 The mass spectrum of a sample of krypton taken from a meteorite is shown below.



5(a) Use this spectrum to calculate the relative atomic mass of this sample of krypton. Give your answer to one decimal place.

Explain why the value you have calculated is slightly different from the relative atomic mass given in the Periodic Table.

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(4 marks)

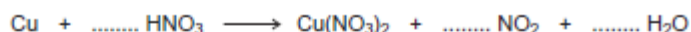
(Extra space)

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6 A sample of nitrogen dioxide gas (NO₂) was prepared by the reaction of copper with concentrated nitric acid.

(a) (i) Balance the equation for the reaction of copper with concentrated nitric acid.



(1 mark)

(a) (ii) Give the oxidation state of nitrogen in each of the following compounds.

HNO₃

NO₂

(2 marks)

(a) (iii) Deduce the half-equation for the conversion of HNO₃ into NO₂ in this reaction.

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(1 mark)

(b) The following equilibrium is established between colourless dinitrogen tetroxide gas (N₂O₄) and dark brown nitrogen dioxide gas.



(b) (i) Give two features of a reaction at equilibrium.

Feature 1

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Feature 2

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(2 marks)

(b) (ii) Use Le Chatelier's principle to explain why the mixture of gases becomes darker in colour when the mixture is heated at constant pressure.

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(2 marks)

(b) (iii) Use Le Chatelier's principle to explain why the amount of NO_2 decreases when the pressure is increased at constant temperature.

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(2 marks)

7 This question is about the extraction of titanium from titanium(IV) oxide by a two-stage process.
The first stage in the process produces titanium(IV) chloride. In the second stage, titanium(IV) chloride is converted into titanium.
The enthalpy change for the second stage can be determined using Hess's Law.

- (a) Give **one** reason why titanium is **not** extracted directly from titanium(IV) oxide using carbon.

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(1 mark)

- (b) Give the meaning of the term *enthalpy change*.

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(1 mark)

- (c) State Hess's Law.

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(1 mark)

- (d) Define the term *standard enthalpy of formation*.

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(3 marks)

- (e) The following standard enthalpy of formation data refer to the second stage in the extraction of titanium.

	TiCl ₄ (g)	Na(l)	NaCl(s)	Ti(s)
$\Delta H_f^\ominus / \text{kJ mol}^{-1}$	-720	+3	-411	0

- (e) (i) State why the value for the standard enthalpy of formation of Na(l) is **not** zero.

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(1 mark)

- (e) (ii) Use data from the table to calculate a value for the standard enthalpy change of the following reaction.



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(3 marks)

- (e) (iii) State the role of sodium in this reaction.

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(1 mark)