



Rewarding Learning

General Certificate of Secondary Education

Centre Number

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Candidate Number

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GCSE Chemistry

Unit 2

Higher Tier



[GCM22]

GCM22

Assessment

TIME

1 hour 30 minutes.

Assessment Level of Control:

Tick the relevant box (✓)

Controlled Conditions	
Other	

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages.

Complete in black ink only. **Do not write with a gel pen.**

Answer **all six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Question **3(b)**.

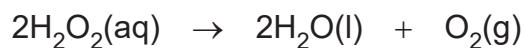
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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24GCM2201

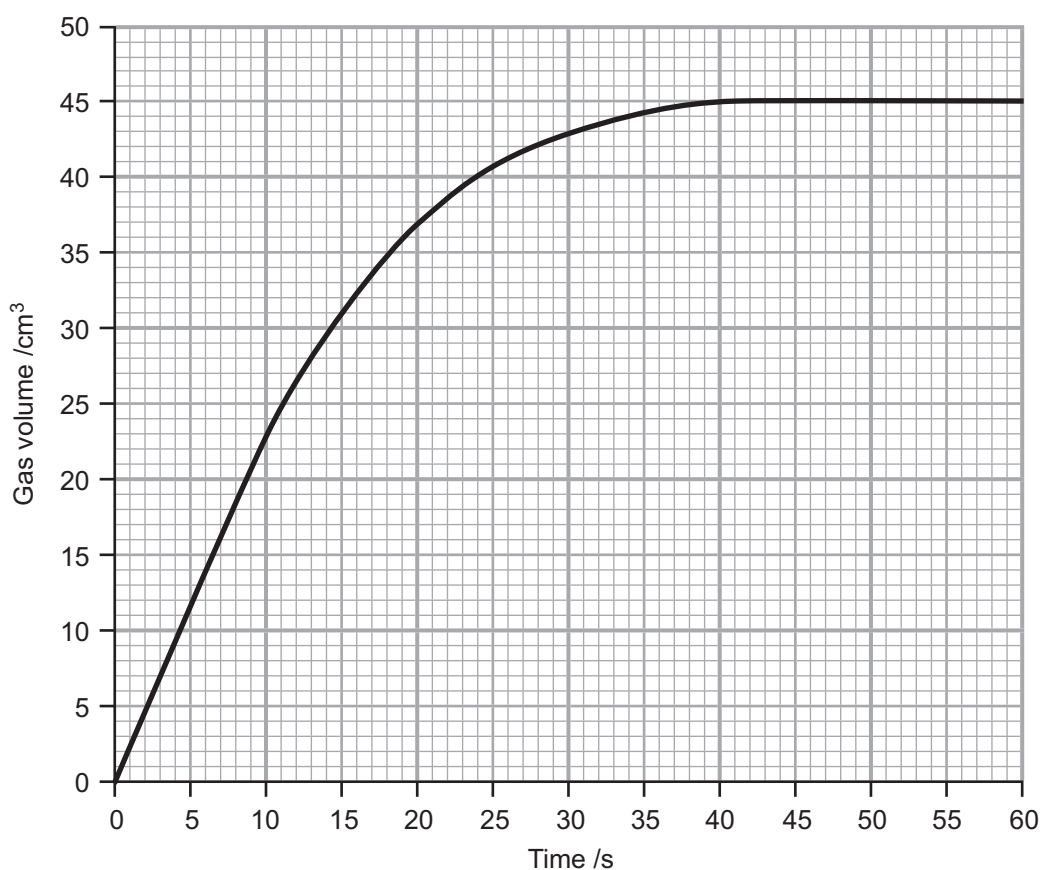
- 1 Hydrogen peroxide decomposes in the presence of a catalyst to form oxygen and water. The equation for the decomposition is:



- (a) Explain how a catalyst increases the rate of reaction.

[2]

- (b) 25.0 cm³ of 0.15 mol/dm³ hydrogen peroxide solution were placed in a conical flask with 1.0 g of a suitable catalyst and the gas volume measured over a period of 60 seconds. The reaction was carried out at 25°C and the results obtained are plotted in the graph below.



(i) At what time did the reaction finish?

_____ [1]

(ii) What was the total volume of gas produced in this reaction?

_____ [1]

(iii) On the graph, sketch the line you would expect to obtain if the experiment was repeated using 25.0 cm^3 of 0.1 mol/dm^3 hydrogen peroxide solution with 1.0 g of the same catalyst at 25°C . [2]

(iv) The rate of decomposition of hydrogen peroxide is increased at a higher temperature. Explain, in terms of particles, how increasing the temperature increases the rate of reaction.

_____ [3]

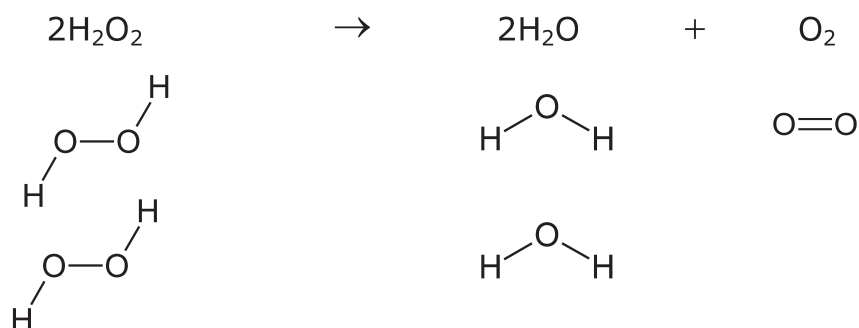
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(c) The table below gives the bond energy in kJ for some covalent bonds.

Bond	Bond energy /kJ
O—O	146
O=O	496
O—H	463

The covalent bonds which are present in the reactants and products are shown below the equation for the decomposition of hydrogen peroxide.



(i) Calculate the energy change for the decomposition of hydrogen peroxide.

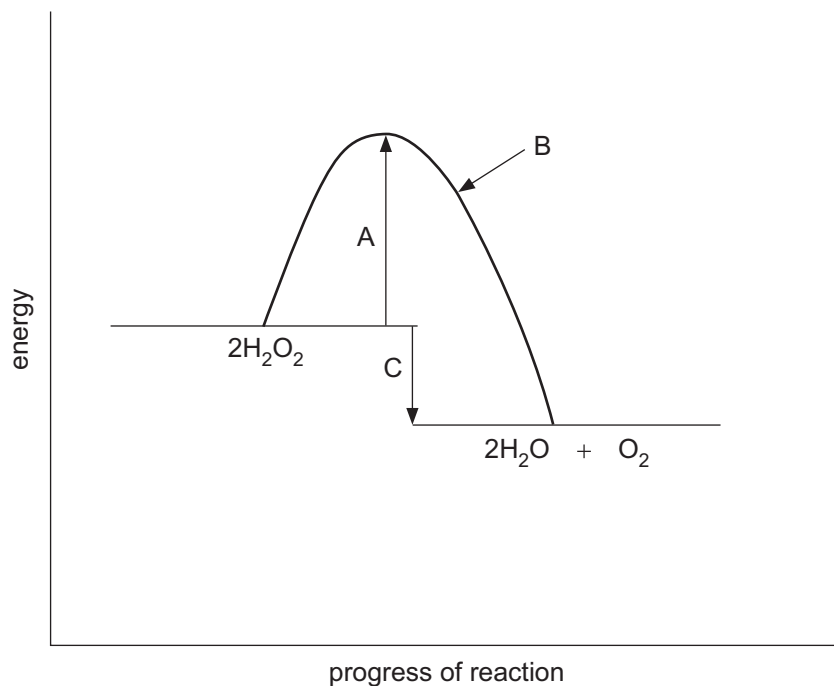
Energy change = _____ kJ [4]



(ii) Explain whether the decomposition of hydrogen peroxide is endothermic or exothermic from the energy change calculated in (c)(i).

[1]

(d) A reaction profile for the decomposition of hydrogen peroxide is shown on the axes below.



What labels should be placed at A, B and C on the reaction profile?

A _____

B _____

C _____ [3]

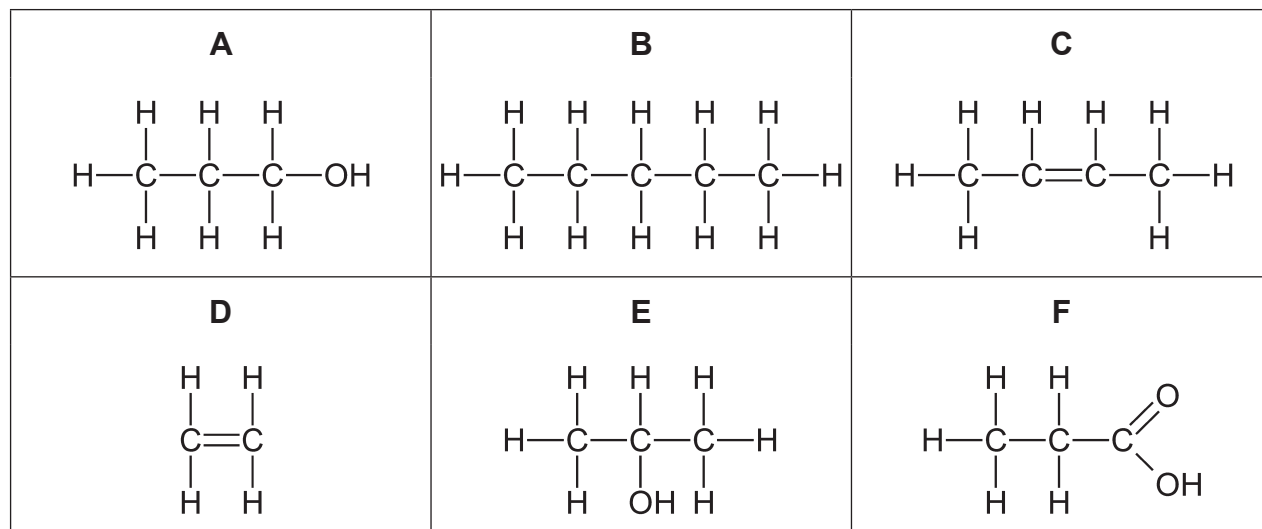
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2 The structural formulae of six organic compounds are shown below. They are labelled **A**, **B**, **C**, **D**, **E** and **F**.



(a) (i) Write the molecular formula of **B** and name the homologous series to which it belongs.

_____ [2]

(ii) Which organic compounds (**A**, **B**, **C**, **D**, **E** and **F**) are hydrocarbons?

_____ [1]

(iii) Which two organic compounds (**A**, **B**, **C**, **D**, **E** and **F**) have the same molecular formula?

_____ [1]



(iv) Name a reagent which could be used to convert **A** into **F** and state the type of reaction occurring.

Reagent: _____

Type of reaction: _____ [2]

(v) Name compounds **E** and **F**.

E _____

F _____ [2]

(vi) Write a balanced symbol equation for the complete combustion of **C**.

_____ [3]

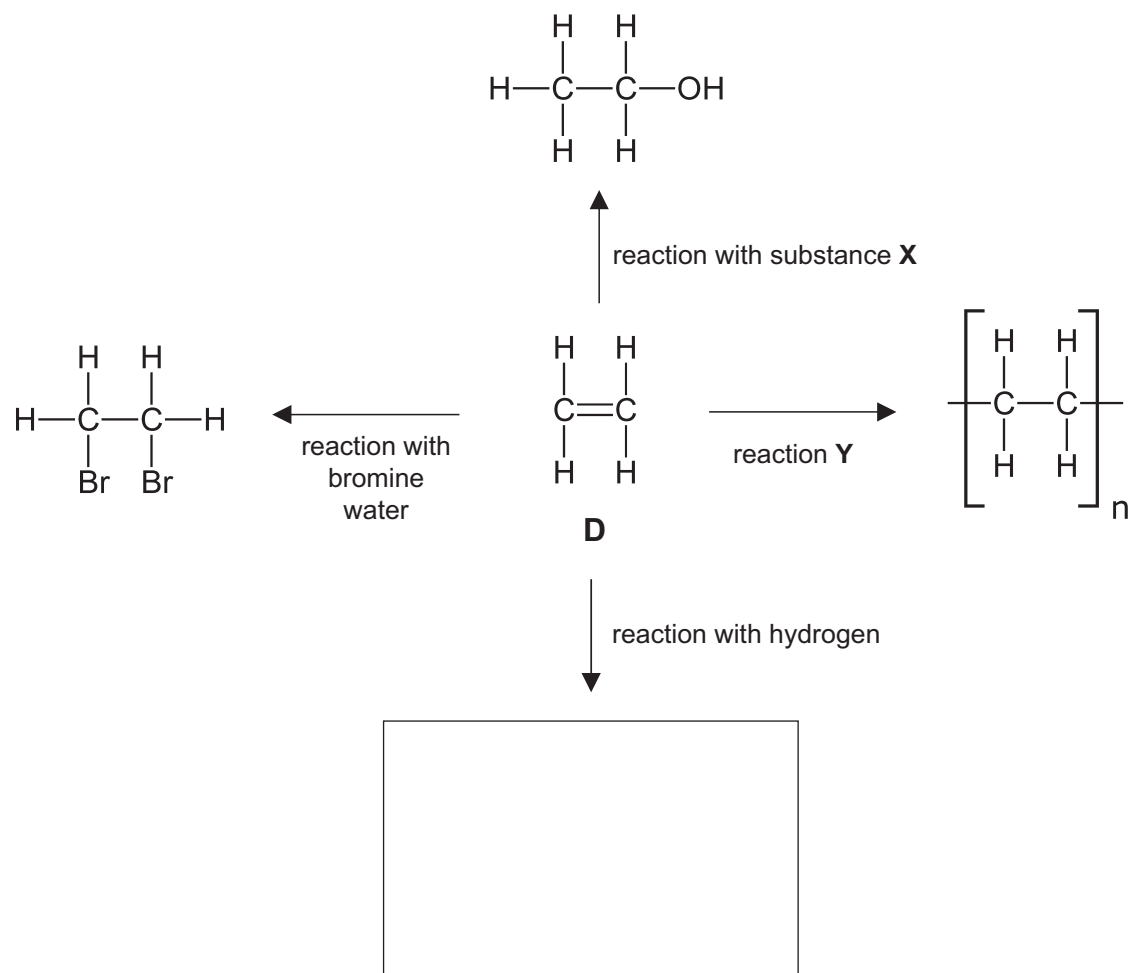
(vii) Draw the structural formula of another organic compound which has the same molecular formula as **C** and name the compound.

Name: _____ [2]

[Turn over



(b) Some reactions of organic compound **D** are shown below.



(i) Name substance **X**.

_____ [1]

(ii) What is observed when **D** reacts with bromine water?

_____ [2]



(iii) Name the type of reaction occurring in reaction Y.

_____ [2]

(iv) In the box in the diagram, draw the structural formula for the product formed from the reaction of D with hydrogen. [1]

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3 Metals such as copper, iron and aluminium are extracted from ores which contain compounds of the metals.

(a) Complete the table below.

Metal	Name of ore	Major metal compound present in the ore
copper	chalcopyrites	copper(II) sulfide
iron		
aluminium		

[4]



4 When sulfur burns in air, sulfur dioxide is formed. Sulfur dioxide contributes to the formation of acid rain.

(a) (i) Write a balanced symbol equation for sulfur burning in air. Include state symbols.

_____ [3]

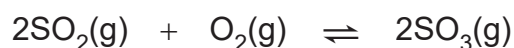
(ii) Describe the appearance of sulfur.

_____ [2]

(iii) What is the colour of the flame observed when sulfur burns in air?

_____ [1]

(b) The equation for the conversion of sulfur dioxide to sulfur trioxide is given below. The energy change for the forward reaction is -196 kJ . The catalyst used is vanadium(V) oxide.



(i) State and explain how the yield of sulfur trioxide would change if the temperature was increased.

_____ [3]



(ii) State and explain how the yield of sulfur trioxide would change if the pressure was increased.

[3]

(iii) Write the formula for vanadium(V) oxide.

[1]

(c) State two negative environmental effects of acid rain.

1. _____

2. _____

[2]

[Turn over



(d) Some oxides of metallic and non-metallic elements are given in the table below.

water	carbon dioxide	sulfur dioxide
magnesium oxide	carbon monoxide	copper(II) oxide

(i) Name one oxide from the table which is black.

_____ [1]

(ii) Write a balanced symbol equation for the reaction of copper with oxygen to form copper(II) oxide.

_____ [3]

(iii) Name one basic oxide from the table.

_____ [1]

(iv) Name one colourless gaseous oxide from the table which is toxic.

_____ [1]

(v) Name one gaseous oxide from the table which reacts with water to form carbonic acid.

_____ [1]





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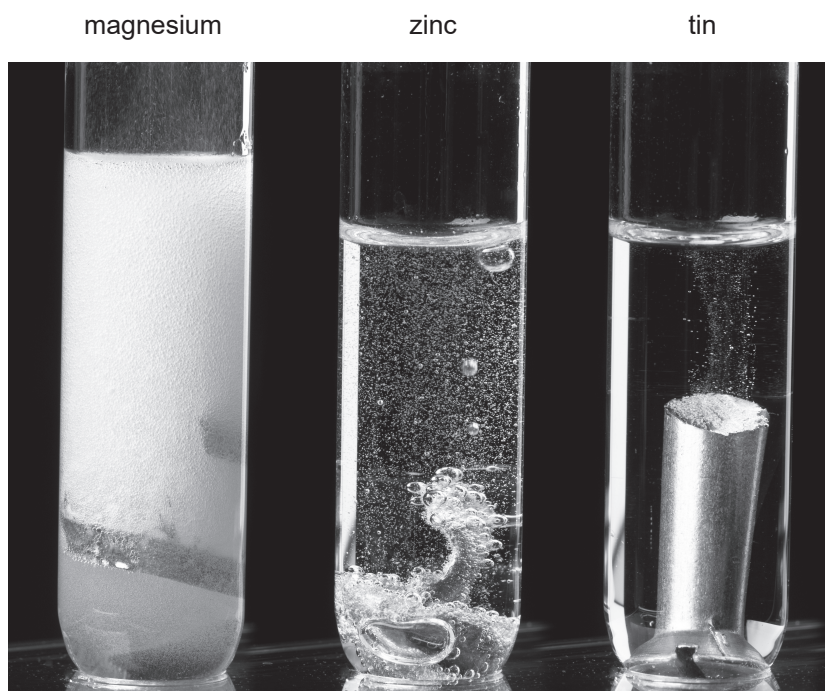
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24GCM2215

- 5 (a) The image below shows three metals (magnesium, zinc and tin) reacting with hydrochloric acid. Bubbles of hydrogen gas are observed in all reactions.



- (i) Suggest why the reaction between tin and hydrochloric acid would not be used to prepare a gas jar of hydrogen in the laboratory.

_____ [1]

- (ii) Write a balanced symbol equation for the reaction between zinc and hydrochloric acid.

_____ [3]



(iii) Explain which metal (magnesium, zinc or tin) is most reactive.

[1]

(iv) State one physical property of hydrogen gas.

[1]

(b) Hydrogen gas is also produced during the electrolysis of dilute sulfuric acid. The other electrolysis product is oxygen.

(i) Name the electrode at which hydrogen is produced.

[1]

(ii) Write a half equation for the formation of oxygen during the electrolysis.

[3]

(iii) Describe the test for oxygen gas.

[1]

[Turn over



(c) Ammonia is produced from the reversible reaction of nitrogen with hydrogen.

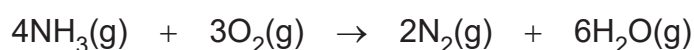
(i) Write a balanced symbol equation for this reversible reaction.

_____ [3]

(ii) Explain why nitrogen is unreactive.

_____ [2]

(d) Ammonia reacts with oxygen forming nitrogen and water according to the balanced symbol equation below. A mixture of 40 cm³ of ammonia and 40 cm³ of oxygen were allowed to react.



(i) Calculate the volume of oxygen gas left over when the reaction had occurred.

volume of oxygen gas = _____ cm³ [2]



(ii) Calculate the volume of nitrogen gas formed.

volume of nitrogen gas = _____ cm³ [1]

(iii) Calculate the percentage atom economy in this reaction if nitrogen is the desired product. Give your answer to 1 decimal place.

percentage atom economy = _____ % [2]

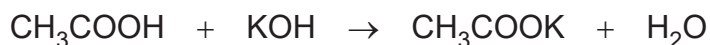
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24GCM2219

- 6 25.0 cm³ of a solution of ethanoic acid were placed in a conical flask and titrated against 0.045 mol/dm³ potassium hydroxide solution using phenolphthalein indicator. The balanced symbol equation for the reaction is:



- (a) State the colour change at the end-point.

From _____ to _____ [2]

- (b) Name the piece of apparatus used to place the ethanoic acid solution into the conical flask.

_____ [1]

- (c) What is the chemical name of CH₃COOK?

_____ [1]

- (d) The results of the titration are given in the table below.

	Initial burette reading /cm ³	Final burette reading /cm ³	Titre /cm ³
Rough titration	0.3	21.2	
First accurate titration	21.2	41.1	
Second accurate titration	20.7	40.8	

- (i) Complete the table.

[1]



(ii) Calculate the average titre.

average titre = _____ cm³ [2]

(iii) Calculate the concentration of the ethanoic acid solution in mol/dm³.

concentration = _____ mol/dm³ [3]

(iv) Calculate the concentration of the ethanoic acid solution in g/dm³.

concentration = _____ g/dm³ [1]

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Question Number	Marks
1	
2	
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Examiner Number

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