



Rewarding Learning

General Certificate of Secondary Education
2013

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Candidate Number

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Science: Chemistry

Unit C2

Higher Tier



[GCH22]

GCH22

THURSDAY 20 JUNE, AFTERNOON

TIME

1 hour 45 minutes.

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 box, around each page or on blank pages.

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

Answer **all** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is **115**.

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 **5(a)**.

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



- (c) Oxidisers provide the oxygen needed to allow the firework to burn effectively. A common oxidiser is potassium nitrate, which thermally decomposes to produce potassium oxide, nitrogen and oxygen.

Write a balanced symbol equation for this reaction.

_____ [3]

- (d) Sparklers are hand held fireworks which contain a fuel, an oxidiser and iron powder. Often the iron powder is mixed with linseed oil to prevent it rusting.

(i) What conditions are required for iron to rust?

_____ [2]

(ii) What is the chemical name for rust?

_____ [2]

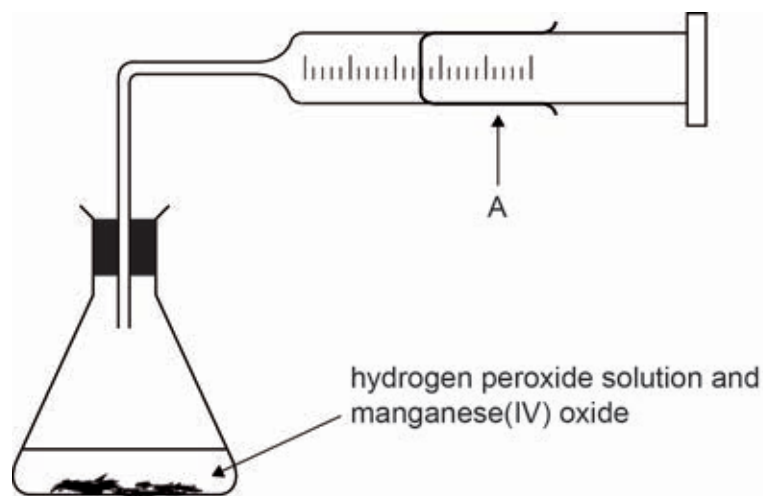
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Marks Remark

[Turn over



- 2 (a) The rate of decomposition of a solution of hydrogen peroxide using manganese(IV) oxide (manganese dioxide) can be measured using the apparatus shown below. The manganese(IV) oxide is a catalyst for the reaction.



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- (i) Name the piece of apparatus labelled A.

_____ [1]

- (ii) What is meant by the term catalyst?

_____ [3]

- (iii) Write a balanced symbol equation for the decomposition of hydrogen peroxide.

_____ [3]

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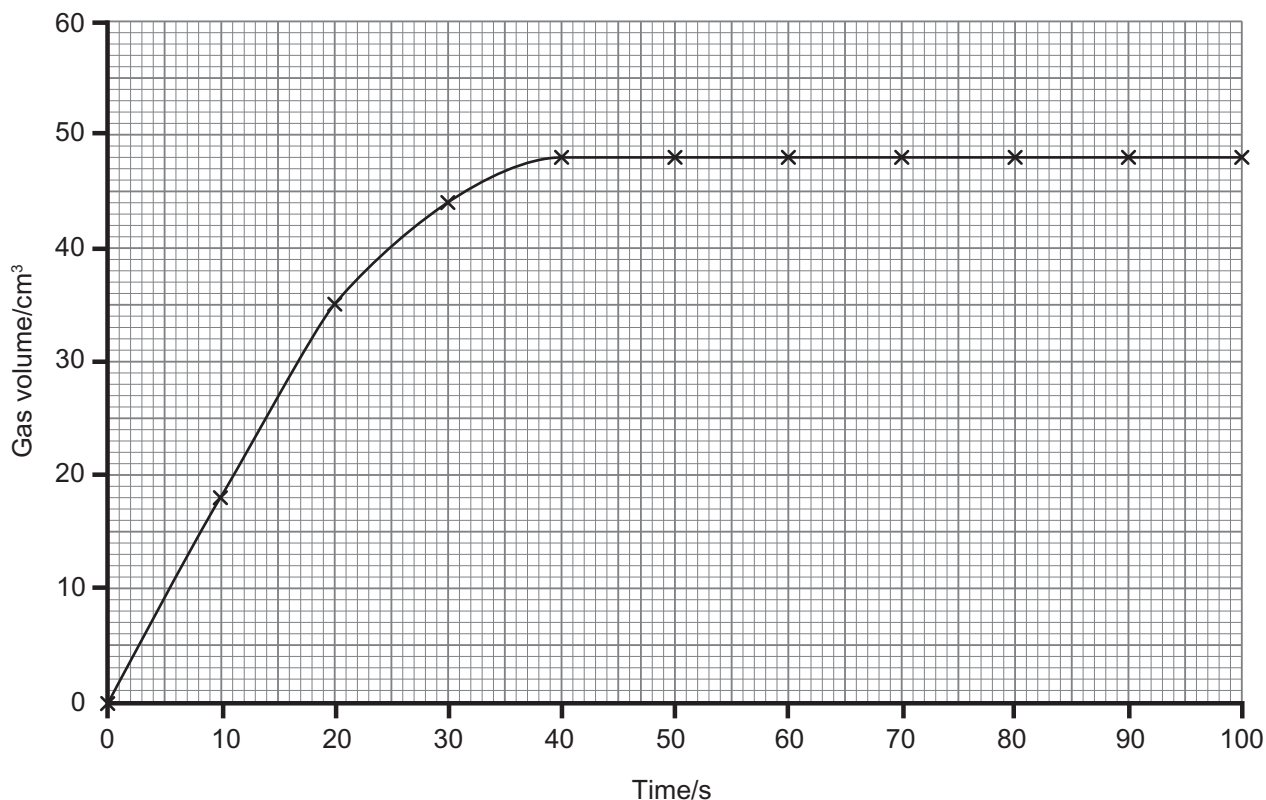
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- (b) The graph below shows data obtained at 25 °C using 25.0 cm³ of 0.16 mol/dm³ hydrogen peroxide solution with 1.0 g of solid powdered manganese(IV) oxide.



- (i) Apart from the apparatus shown in the diagram in part (a), name one other piece of equipment which would be required to collect the results used to draw the graph.

_____ [1]

- (ii) What was the total volume of gas collected?

_____ [1]

- (iii) The reaction was repeated at 40 °C with all other factors being kept the same. Sketch the graph you would expect to obtain on the axes above. [3]

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Marks	Remark



(c) The table below shows the time taken for the decomposition of hydrogen peroxide solution to be completed. 25.0 cm³ of 0.16 mol/dm³ hydrogen peroxide solution was used with 1.0 g of different powdered metal oxides as catalysts.

Metal oxide	Time for decomposition to be completed/s	Rate of decomposition/s ⁻¹ rate = $\left(\frac{1}{\text{time}}\right)$
Manganese(IV) oxide		
Copper(II) oxide	127	0.00787
Zinc oxide	360	0.00277

(i) Using the graph at 25 °C in part (b), complete the table above. [2]

(ii) State which of the metal oxides in the table is the **least** effective catalyst and explain your answer.

_____ [2]

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Marks Remark

Total Question 2

[Turn over

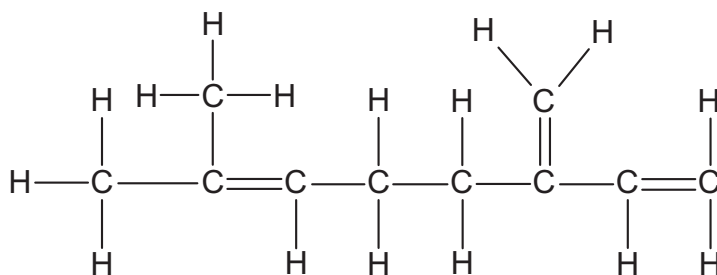


- 3 Perfume is a mixture of essential oils dissolved in a solvent. One of the essential oils used in making perfume is called myrcene.



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- (a) The structural formula of a molecule of myrcene is shown below.



- (i) Explain why a molecule of myrcene can be classified as a hydrocarbon.

_____ [1]

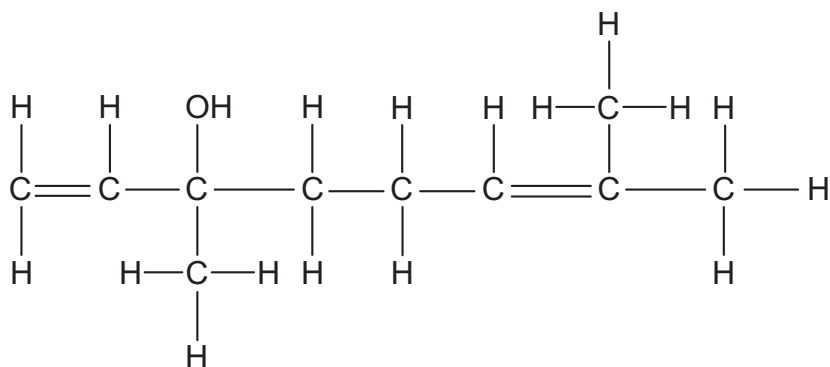
- (ii) Identify the functional group present in myrcene.

_____ [1]

Examiner Only	
Marks	Remark



(b) Linalool is another essential oil used in perfume making. It gives a sweet, lavender-like smell. The structural formula of linalool is shown below.



(i) On the structure of linalool shown above, draw a circle around the **alcohol** functional group. [1]

(ii) Like all alcohols, linalool (C₁₀H₁₇OH) undergoes complete combustion in excess air. Complete and balance the symbol equation below for this reaction.



(iii) When linalool is warmed with acidified potassium dichromate solution it is oxidised in the same way as ethanol. State the colour change which is observed in this reaction.

from _____ to _____ [2]

Examiner Only

Marks Remark



(c) Ethanol is an alcohol which is often used as a solvent in perfumes.

(i) Write the general formula for alcohols.

_____ [1]

(ii) Draw the structural formula of ethanol.

[1]

(iii) Ethene can be used to manufacture the ethanol used in perfumes. Complete the table below to give information about ethene.

Name	Molecular formula	Structural formula	State at room temperature and pressure
Ethene			

[3]

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Marks	Remark



(d) Ethanoic acid is a carboxylic acid which can be used to make other solvents. These solvents are also used in perfumes.

(i) Draw the structural formula of ethanoic acid.

[1]

(ii) State two observations you would make when magnesium reacts with ethanoic acid.

[2]

(iii) Write a balanced symbol equation for the reaction of magnesium with ethanoic acid.

[3]

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Marks Remark

Total Question 3

[Turn over



(b) X is an unknown metal. The table below gives details of some reactions of the three metals X, sodium and zinc.

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Marks	Remark

Metal	Reaction when heated in oxygen	Reaction with cold water	Reaction with dilute hydrochloric acid
X	Black coating forms on metal without burning	No reaction	No reaction
Sodium	Burns very vigorously with a yellow flame		Dangerous reaction not carried out in school laboratory
Zinc	Burns forming a yellow solid which changes to white on cooling	No reaction	Reacts steadily

(i) Suggest the name of metal X.

_____ [1]

(ii) Describe what you would observe when sodium reacts with cold water.

 _____ [3]

(iii) Write a balanced symbol equation for the reaction of sodium with water.

_____ [3]

[Turn over



- (b) 25.0 cm³ of the MOH solution were titrated with hydrochloric acid of concentration 0.125 mol/dm³ using phenolphthalein indicator. The results are shown in the table below.

	Initial burette volume/cm ³	Final burette volume/cm ³	Titre/cm ³
Rough titration	0.0	14.9	14.9
First accurate titration	14.9	28.9	14.0
Second accurate titration	28.9	42.9	14.0

- (i) Calculate the average titre.

_____ cm³ [2]

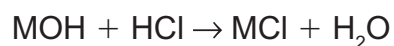
- (ii) State the colour change at the end-point.

From _____ to _____ [2]

- (iii) Calculate the number of moles of hydrochloric acid used in the titration.

_____ [2]

The balanced symbol equation for the reaction is:



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Marks Remark



(iv) Calculate the number of moles of MOH present in 25.0 cm³ of the solution in the conical flask.

_____ [1]

(v) Calculate the number of moles of MOH present in 1000 cm³ of the solution.

_____ [2]

(vi) Using the fact that 3.92 g of MOH were dissolved in 1000 cm³ and the answer to question (b)(v) above, determine the relative formula mass of MOH.

_____ [2]

Examiner Only

Marks Remark

[Turn over



- 6 (a) An investigation was carried out to compare the hardness of water samples from three towns A, B and C.

25 cm³ of each water sample were placed into three separate conical flasks and labelled A, B and C. A sample of deionised water was also tested.

Soap solution was added, 1 cm³ at a time, to each conical flask with shaking until a lasting lather formed. The total volume of soap solution added to each flask was recorded.

The experiment was repeated with fresh samples of A, B and C which had been boiled and allowed to cool, before adding the soap solution.

The results are shown in the table below.

Water sample	Volume of soap solution required to form a lather	
	before boiling (cm ³)	after boiling (cm ³)
Deionised water	2	2
A	6	6
B	8	2
C	11	7

- (i) Which of the three water samples (A, B or C) is the hardest water?

_____ [1]

- (ii) Which of the three water samples (A, B or C) contains **only** temporary hardness?

_____ [1]

- (iii) Which of the three water samples (A, B or C) contains both temporary and permanent hardness?

_____ [1]

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Marks Remark

[Turn over



7 Nitrogenous fertilisers contain ammonium compounds such as ammonium nitrate which is produced when ammonia reacts with nitric acid.

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Marks Remark

(a) (i) Write a balanced symbol equation for the reaction of ammonia with nitric acid.

_____ [2]

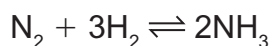
(ii) Describe how you would carry out a chemical test for the presence of ammonia gas, stating the observations you would make for a positive test.

_____ [4]

(iii) State one disadvantage of using nitrogenous fertilisers.

_____ [1]

(b) In industry ammonia gas is produced by the Haber process which involves a reversible reaction between the gases nitrogen and hydrogen.



(i) Explain what you understand by the term reversible reaction.

_____ [1]

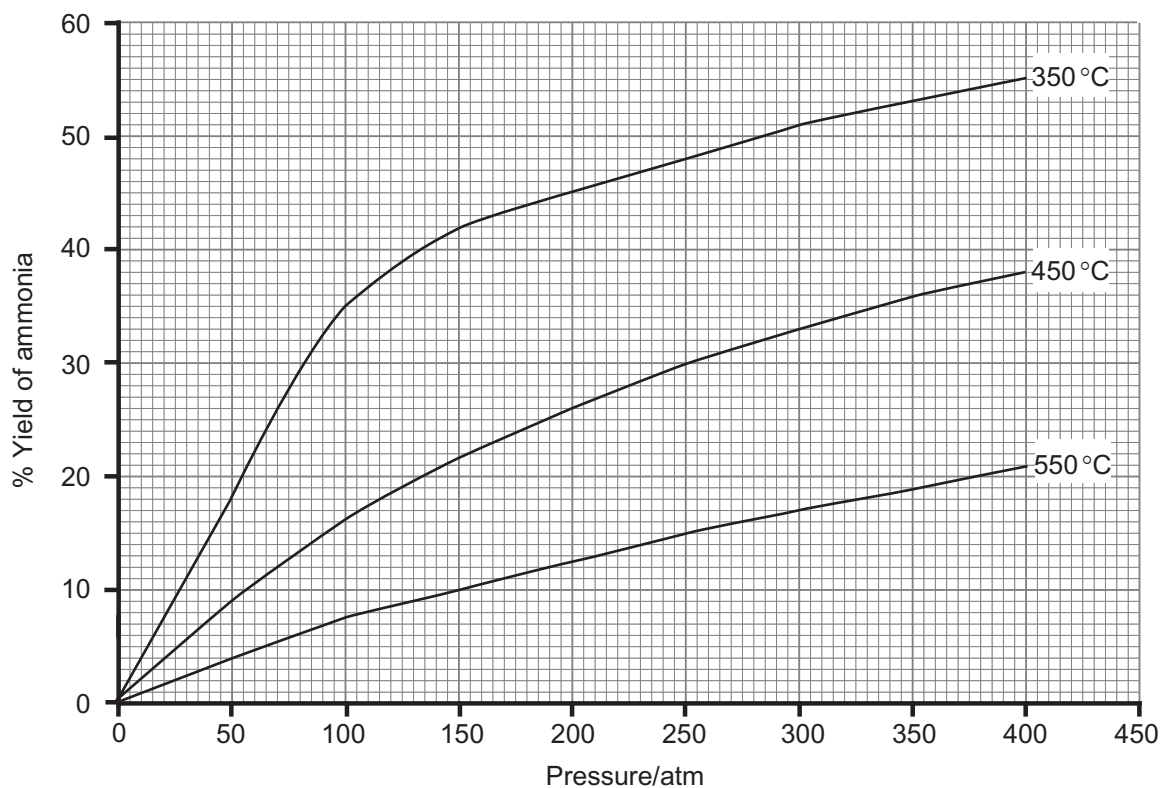
(ii) Name the catalyst used in the Haber process.

_____ [1]

[Turn over



(c) The percentage yield of ammonia produced in the Haber Process is affected by both the temperature and the pressure. The graph below shows how the percentage yield of ammonia changes with temperature and pressure.



Use the graph to answer the following questions.

- (i) State the effect of increasing temperature on the yield of ammonia at constant pressure.

_____ [1]

- (ii) 450 °C and 250 atm are commonly used conditions for the Haber Process. What is the percentage yield of ammonia using these conditions?

_____ [1]

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Marks	Remark



(iii) Suggest why industry uses 450 °C and 250 atm when it is possible to obtain a higher yield of ammonia using a lower temperature and a higher pressure.

[1]

THIS IS THE END OF THE QUESTION PAPER

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Marks Remark

Total Question 7



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Question Number	Marks
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