



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CHEMISTRY

5070/22

Paper 2 Theory

October/November 2010

1 hour 30 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Write your answers in the spaces provided in the Question Paper.

Section B

Answer any **three** questions.

Write your answers in the spaces provided in the Question Paper.

A copy of the Periodic Table is printed on page 20.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	
B6	
B7	
B8	
B9	
Total	

This document consists of **17** printed pages and **3** blank pages.



Section A

Answer **all** the questions in this section in the spaces provided.

The total mark for this section is 45.

For
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Use

A1 (a) Choose from the following list of metals to answer the questions below.

aluminium
iron
lead
magnesium
potassium
silver
vanadium

Each metal can be used once, more than once or not at all.

Which metal

- (i)** reacts with cold water to form an alkaline solution,
..... [1]
- (ii)** forms a protective oxide layer on its surface,
..... [1]
- (iii)** is the catalyst used in the industrial manufacture of ammonia,
..... [1]
- (iv)** is a sacrificial metal used to prevent iron pipes from rusting,
..... [1]
- (v)** is in Period 5 of the Periodic Table?
..... [1]

(b) Draw a labelled diagram to show the structure of a typical metal.

[2]

[Total: 7]

A2 Ethanol can be made both by fermentation and by the addition of steam to ethene.

For
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- (a) (i)** Name the organic compound required for fermentation.

..... [1]

- (ii)** State the conditions under which fermentation most readily takes place.

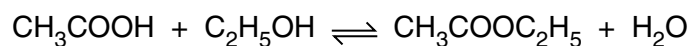
.....

..... [2]

- (b)** Write an equation for the reaction between steam and ethene.

[1]

- (c)** Ethanol, C_2H_5OH , reacts with ethanoic acid, CH_3COOH .



- (i)** Name the compound $CH_3COOC_2H_5$.

..... [1]

- (ii)** What name is given to this type of chemical reaction?

..... [1]

- (d) (i)** Name the third member of the alcohol homologous series.

..... [1]

- (ii)** Draw the structural formula of this compound, showing all atoms and bonds.

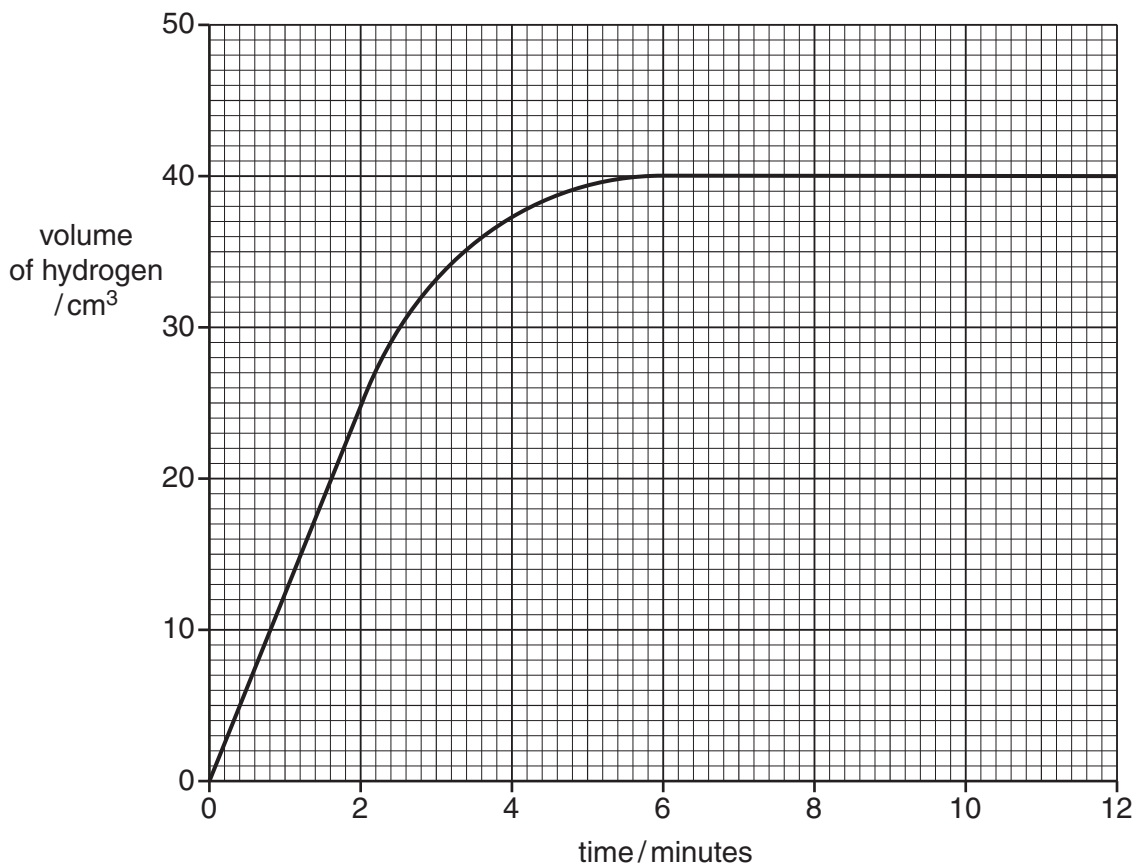
[1]

[Total: 8]

A3 A student measured the volume of hydrogen produced over time when small pieces of zinc reacted with excess sulfuric acid.

The results are shown in the graph below.

For
Examiner's
Use



(a) Use the information from the graph to calculate the average speed of reaction in the first two minutes.

[1]

(b) Explain why the reaction stopped after 6 minutes.

..... [1]

(c) Copper catalyses this reaction.

(i) On the axes above, sketch a line to show the expected results for the catalysed reaction. [1]

(ii) Explain how a catalyst changes the speed of reaction.

..... [1]

(d) Explain, using ideas about colliding particles, what happens to the speed of this reaction when larger particles of zinc are used.

*For
Examiner's
Use*

.....
.....
..... [2]

(e) Explain, using ideas about colliding particles, what happens to the speed of this reaction when the temperature of the reaction mixture is increased.

.....
.....
..... [2]

[Total: 8]

A4 Chlorine, bromine and iodine are non-metals in Group VII of the Periodic Table. Their molecules are diatomic.

For
Examiner's
Use

(a) What do you understand by the term *diatomic*?

..... [1]

(b) (i) Describe the trend in colour of the Group VII elements down the Group.

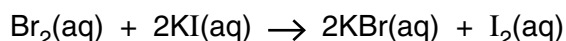
..... [1]

(ii) In what physical state do the following elements exist at room temperature and pressure?

bromine

iodine [2]

(c) Aqueous bromine reacts with aqueous potassium iodide.



(i) Write an ionic equation for this reaction.

[1]

(ii) Describe a positive test for iodide ions.

test

observation [2]

(iii) Explain why aqueous bromine does not react with aqueous potassium chloride.

.....

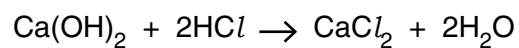
..... [1]

(d) Hydrochloric acid can be made by burning hydrogen in chlorine, then dissolving the product in water.

Give the formulae for the ions present in hydrochloric acid.

..... [1]

- (e) An aqueous solution of calcium hydroxide was titrated with 0.0150 mol/dm^3 hydrochloric acid.



It required 6.00 cm^3 of this aqueous hydrochloric acid to neutralise 20.0 cm^3 of the calcium hydroxide solution.

Calculate the concentration, in mol/dm^3 , of the calcium hydroxide solution.

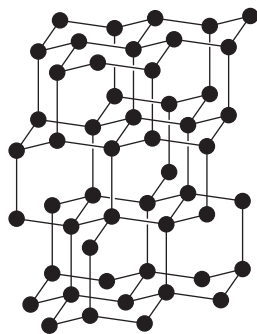
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[3]

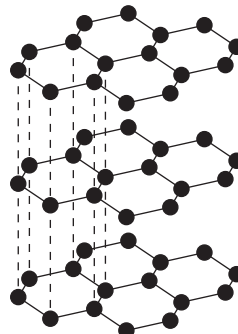
[Total: 12]

A5 Carbon and graphite are two forms of carbon.

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diamond



graphite

- (a) (i) Describe **two** differences in the structure of diamond and graphite.

.....

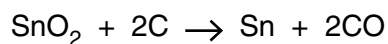
 [2]

- (ii) Explain, in terms of their structure, why graphite is soft but diamond is hard.

.....

 [2]

- (b) Tin is extracted by heating tin(IV) oxide, SnO_2 , with carbon in a furnace.



- (i) How does this equation show that tin(IV) oxide gets reduced?

.....
 [1]

- (ii) Explain why carbon monoxide must not be allowed to escape from the furnace.

..... [1]

- (c) Carbon monoxide can be formed by the reduction of carbon dioxide with red-hot carbon.

- (i) Write an equation for this reaction.

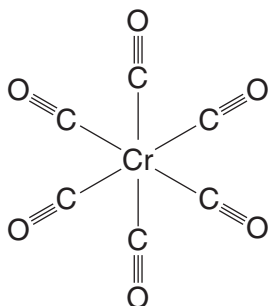
[1]

- (ii) Carbon monoxide has a triple covalent bond.
Draw the electronic structure of carbon monoxide. Show only the outer electrons.

For
Examiner's
Use

[2]

- (iii) Carbon monoxide reacts with chromium to form chromium carbonyl.
The structure of chromium carbonyl is shown below.



Write the empirical formula for chromium carbonyl.

..... [1]

[Total: 10]

Section B

Answer **three** questions from this section in the spaces provided.

The total mark for this section is 30.

For
Examiner's
Use

B6 The carbon cycle regulates the amount of carbon dioxide in the atmosphere.

(a) Explain how the processes of photosynthesis and respiration help to regulate the amount of carbon dioxide in the atmosphere.

.....
.....
.....
.....
..... [3]

(b) Methane is an atmospheric pollutant which contributes to global warming.

(i) Suggest **two** possible consequences of an increase in global warming.

.....
..... [2]

(ii) Write an equation for the complete combustion of methane.

[1]

(iii) Methane is generally unreactive. Apart from combustion, state one other chemical reaction of methane.

..... [1]

(c) Methane is a member of the alkane homologous series.

*For
Examiner's
Use*

(i) Describe how the boiling points of unbranched alkanes vary with the size of their molecules.

.....
.....[1]

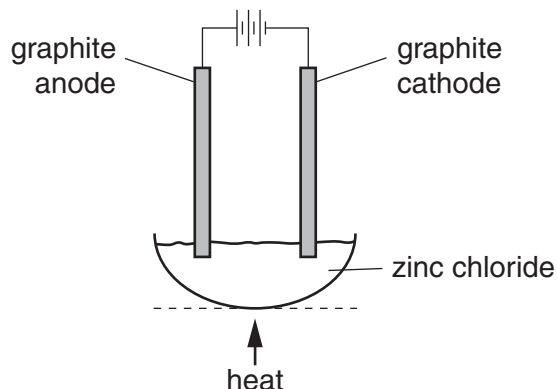
(ii) Alkanes can be cracked to form alkenes.
State the conditions required for cracking alkanes.

.....
.....[2]

[Total: 10]

B7 Zinc chloride is an ionic solid. It can be electrolysed using the apparatus shown below.

*For
Examiner's
Use*



(a) Explain why zinc chloride conducts electricity when molten, but not when solid.

.....
 [2]

(b) Predict the products of this electrolysis at

the anode,
 the cathode. [1]

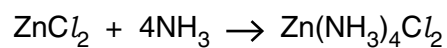
(c) When a dilute aqueous solution of zinc chloride is electrolysed, hydroxide ions are converted to oxygen at the anode. Write the ionic equation for this reaction.

[2]

(d) Describe a positive test for zinc ions.

test
 observations
 [3]

- (e) Solid zinc chloride absorbs ammonia to form tetrammine zinc chloride, $\text{Zn}(\text{NH}_3)_4\text{Cl}_2$.



Calculate the maximum yield, in grams, of tetrammine zinc chloride formed when 3.4 g of zinc chloride reacts with excess ammonia.

For
Examiner's
Use

[2]

[Total:10]

B8 Magnesium is a reactive metal.

For
Examiner's
Use

- (a) (i)** Name the products formed when magnesium reacts with steam.

..... [1]

- (ii)** Write the equation for the reaction of magnesium with ethanoic acid, CH₃COOH.

[2]

- (b)** Magnesium chloride is a soluble salt.

Describe how you can make pure dry crystals of magnesium chloride from magnesium carbonate.

.....
.....
.....
.....
..... [3]

- (c)** The equation shows the reaction which occurs when magnesium carbonate is heated.

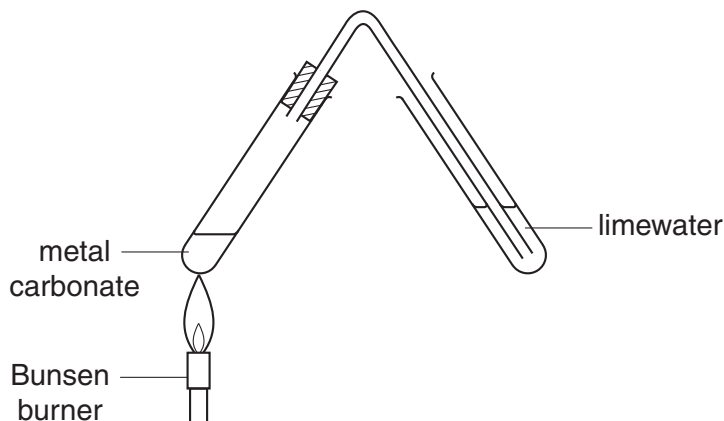


State the name given to this type of chemical reaction.

..... [1]

- (d) A student compared the action of heat on three solid metal carbonates. She heated each carbonate using the apparatus shown below. In each case, she recorded the length of time taken for the limewater to turn milky.

For
Examiner's
Use



- (i) State one factor that must be kept constant if the speeds of reaction are to be compared in a fair way.

..... [1]

- (ii) The time taken for the limewater to turn milky for each metal carbonate is shown in the table.

metal carbonate	time taken for the limewater to turn milky / s
copper carbonate	10
magnesium carbonate	40
zinc carbonate	24

Describe and explain these results in terms of the reactivity of the metals.

.....

 [2]

[Total: 10]

B9 Sulfur dioxide is a gas which contributes to acid rain.

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- (a) (i) State one source of sulfur dioxide in the atmosphere.

.....[1]

- (ii) Acid rain can cause lakes to become acidic. This may cause fish and plants in the water to die.

Describe one **other** environmental problem caused by acid rain.

.....[1]

- (b) Acid rain is a solution of dilute sulfuric acid.

The acidity in lakes can be neutralised by adding powdered calcium carbonate.

- (i) Write an equation, including state symbols, for the reaction of calcium carbonate with sulfuric acid.

[2]

- (ii) State one industrial use of sulfuric acid.

.....[1]

- (iii) Sulfuric acid is a strong acid.

What do you understand by the term *strong acid*?

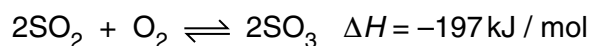
.....
.....[1]

- (c) Sulfuric acid is manufactured by the Contact process.

Name the raw materials used in the first stage of the Contact process.

.....[1]

- (d) The equation shows the second stage of the Contact process.



- (i) State the meaning of the symbol ΔH .

.....[1]

- (ii) Predict and explain the effect of increasing the temperature on the position of equilibrium in this reaction.

.....
.....
.....[2]

[Total: 10]

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DATA SHEET
The Periodic Table of the Elements

		Group										
		I	II	III	IV	V	VI	VII	VIII	IX	X	
		1 H Hydrogen										
7	9	3 Li Lithium	4 Be Beryllium	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon	11 Na Sodium	12 Mg Magnesium	13 Al Aluminium
19	20	19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper
37	38	37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver
55	56	55 Cs Caesium	56 Ba Barium	57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium
87	88	87 Fr Francium	88 Ra Radium	89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium
103	104	103 Lr Lawrencium	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium
121	122	121 Uu Ununium	122 Uu Ununium	123 Uu Ununium	124 Uu Ununium	125 Uu Ununium	126 Uu Ununium	127 Uu Ununium	128 Uu Ununium	129 Uu Ununium	130 Uu Ununium	131 Uu Ununium

* 58–71 Lanthanoid series
† 90–103 Actinoid series

Key

a	X	
	X	a = relative atomic mass
	X	X = atomic symbol
	X	b = atomic (proton) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).