



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
Examiner's
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
Examiner's
Use

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

..... [1]

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

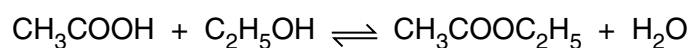
.....

..... [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.

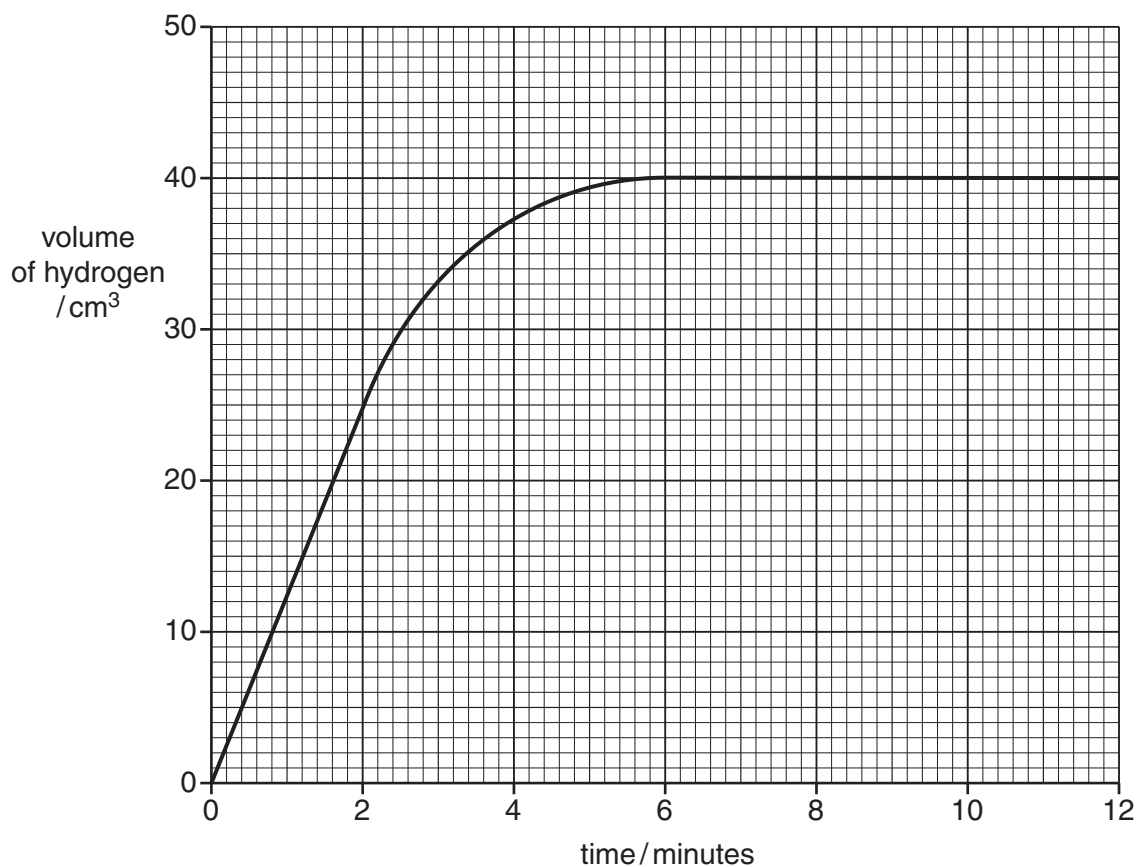
[1]

[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.

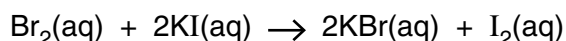
.....[1]

(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]

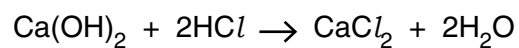
(d) Hydrochloric acid can be made by burning hydrogen in chlorine, then dissolving the product in water.

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.

For
Examiner's
Use



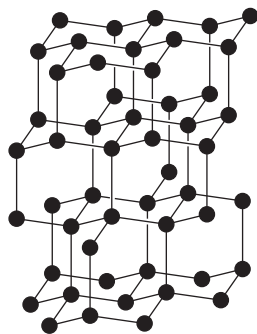
It required 6.00 cm^3 of this aqueous hydrochloric acid to neutralise 20.0 cm^3 of the calcium hydroxide solution.

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

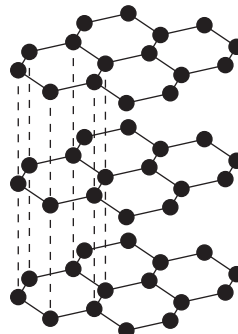
[3]

[Total: 12]

A5 Carbon and graphite are two forms of carbon.



diamond



graphite

For
Examiner's
Use

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

.....

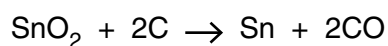
 [2]

- (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.

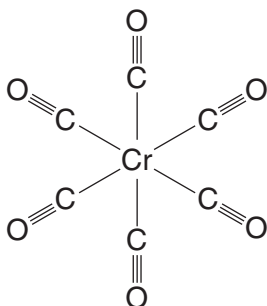
[1]

- (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.

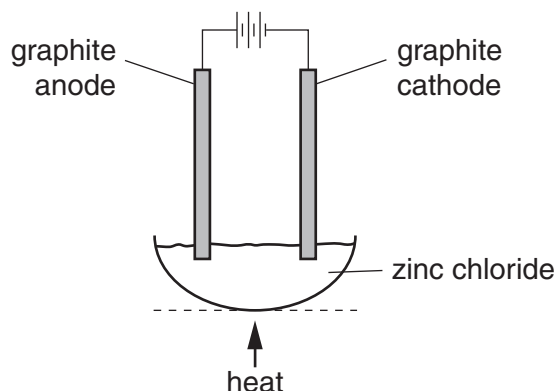
.....

.....[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]

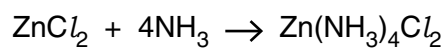
- (d)** Describe a positive test for zinc ions.

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, CH_3COOH .

[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.

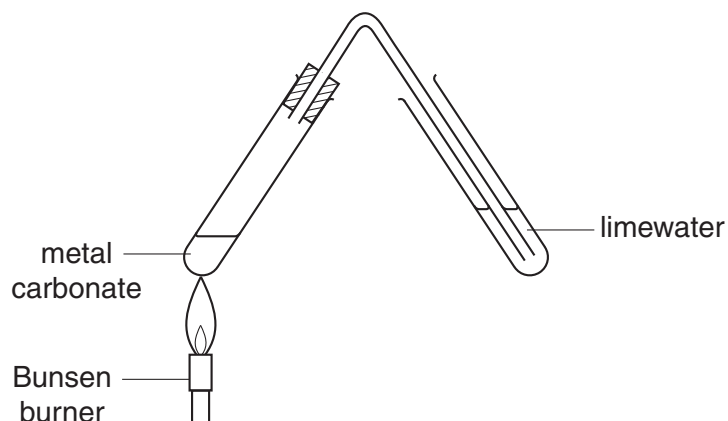


State the name given to this type of chemical reaction.

..... [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.

For
Examiner's
Use

- (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*?

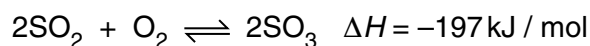
.....
.....[1]

- (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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Group																	
I	II	III						IV	V	VI	VII	0					
		1 H Hydrogen															
7 Li Lithium	9 Be Beryllium																
3	4																
23 Na Sodium	24 Mg Magnesium																
11	12																
39 K Potassium	40 Ca Calcium	45 Sc Scandium	48 Ti Titanium	51 V Vanadium	52 Cr Chromium	55 Mn Manganese	56 Fe Iron	59 Co Cobalt	59 Ni Nickel	64 Cu Copper	65 Zn Zinc	70 Ga Gallium	73 Ge Germanium	75 As Arsenic	79 Se Selenium	80 Br Bromine	84 Kr Krypton
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
85 Rb Rubidium	88 Sr Strontium	89 Y Yttrium	91 Zr Zirconium	93 Nb Niobium	96 Mo Molybdenum	101 Ru Ruthenium	106 Pd Palladium	108 Ag Silver	112 Cd Cadmium	115 In Indium	119 Sn Tin	122 Sb Antimony	127 I Iodine	131 Xe Xenon	135 Te Tellurium	153 At Astatine	154 Rn Radon
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
133 Cs Caesium	137 Ba Barium	139 La Lanthanum	178 Hf Hafnium	181 Ta Tantalum	184 W Tungsten	186 Re Rhenium	190 Os Osmium	192 Ir Iridium	195 Pt Platinum	197 Au Gold	201 Hg Mercury	204 Tl Thallium	207 Pb Lead	209 Bi Bismuth	209 Po Polonium	210 At Astatine	222 Rn Radon
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
223 Fr Francium	226 Ra Radium	227 Ac Actinium															
87	88	89															
* 58–71 Lanthanoid series																	
† 90–103 Actinoid series																	
a X b a = relative atomic mass X = atomic symbol b = atomic (proton) number																	
Key																	

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).