



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

5070/23

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]

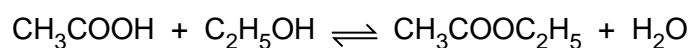
(ii) State the conditions under which fermentation most readily takes place.

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

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

[1]

(c) Ethanol, C₂H₅OH, reacts with ethanoic acid, CH₃COOH.



(i) Name the compound CH₃COOC₂H₅.

..... [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]

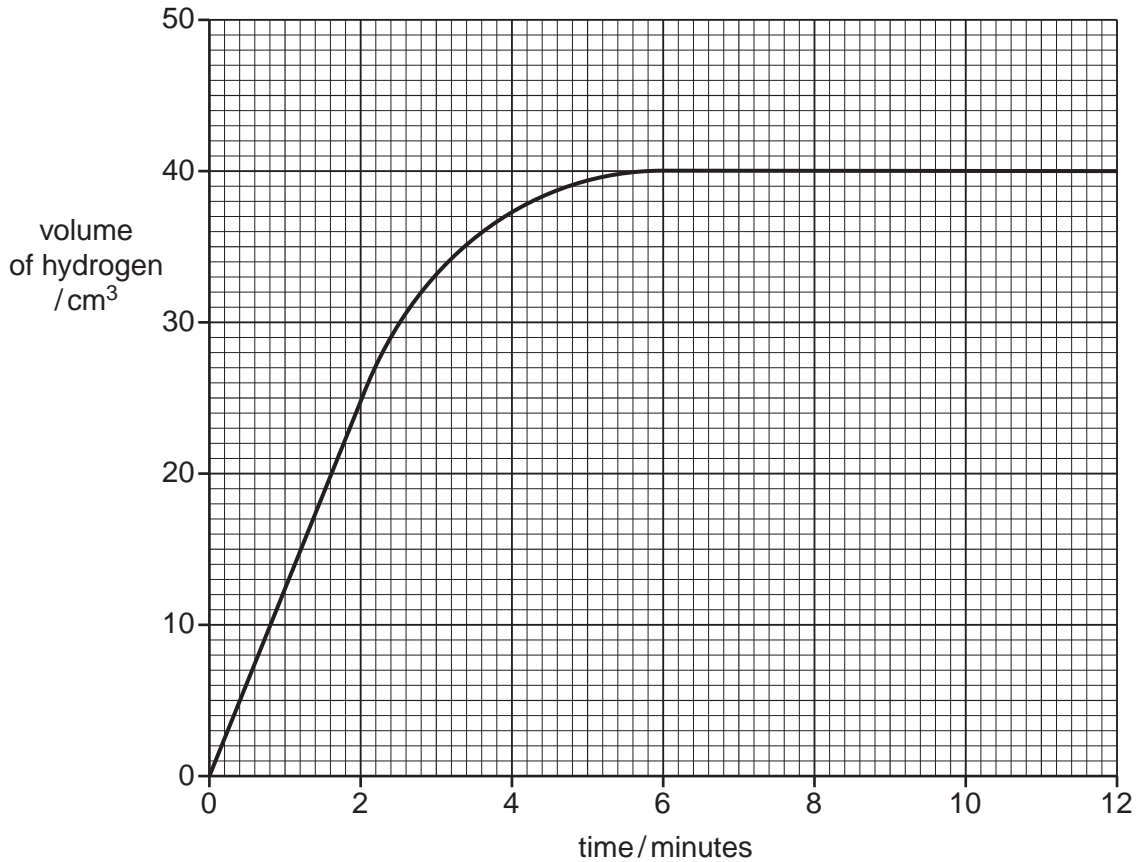
(ii) Draw the structural formula of this compound, showing all atoms and bonds.

[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.



(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.

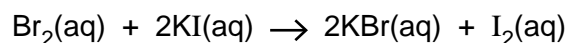
..... [1]

(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.

.....

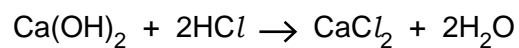
..... [1]

(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.

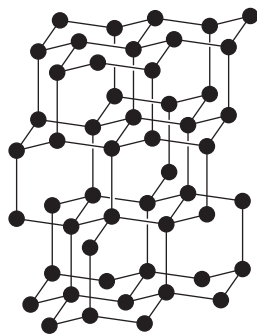
For
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Use

[3]

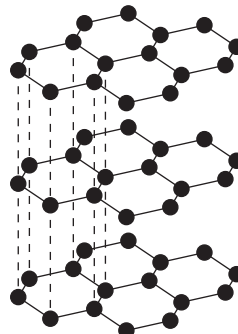
[Total: 12]

A5 Carbon and graphite are two forms of carbon.

For
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Use



diamond



graphite

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

.....

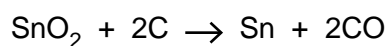
 [2]

- (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, SnO₂, 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.

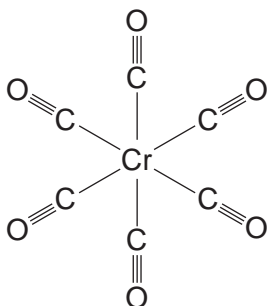
[1]

- (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]

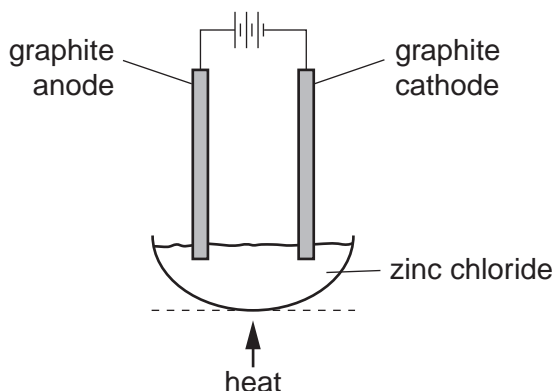
(ii) Alkanes can be cracked to form alkenes.
State the conditions required for cracking alkanes.

.....
.....[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]

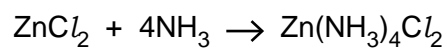
(d) Describe a positive test for zinc ions.

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.

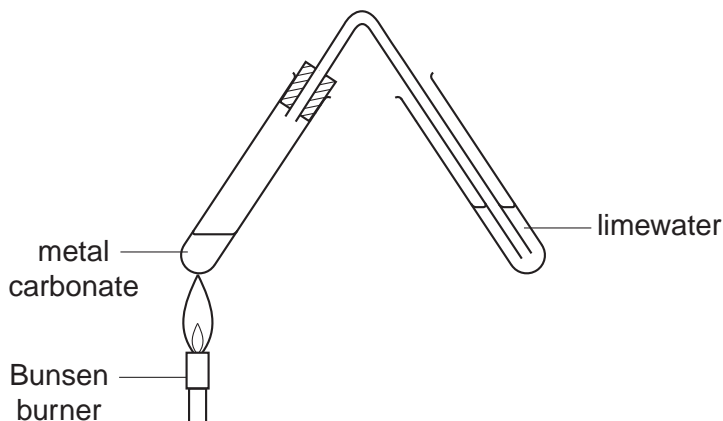


State the name given to this type of chemical reaction.

..... [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.

For
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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*?

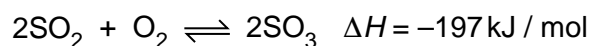
.....
.....[1]

- (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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DATA SHEET The Periodic Table of the Elements

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7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18	19 F Fluorine 9	20 Ne Neon 10	21 Na Sodium 11	22 Mg Magnesium 12	23 Al Aluminium 13	24 Si Silicon 14	25 P Phosphorus 15	26 S Sulfur 16	27 Cl Chlorine 17	28 Ar Argon 18	29 K Potassium 19	30 Ca Calcium 20	31 Sc Scandium 21	32 Ti Titanium 22	33 V Vanadium 23	34 Cr Chromium 24	35 Mn Manganese 25	36 Fe Iron 26	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	58 Ce Cerium 58	59 Pr Praseodymium 59	60 Nd Neodymium 60	61 Pm Promethium 61	62 Sm Samarium 62	63 Eu Europium 63	64 Gd Gadolinium 64	65 Tb Terbium 65	66 Dy Dysprosium 66	67 Ho Holmium 67	68 Er Erbium 68	69 Tm Thulium 69	70 Yb Ytterbium 70	71 Lu Lutetium 71	72 Fr Francium 87	73 Ra Radium 88	74 Ac Actinium 89	75 Th Thorium 90	76 Pa Protactinium 91	77 U Uranium 92	78 Np Neptunium 93	79 Pu Plutonium 94	80 Am Americium 95	81 Cm Curium 96	82 Bk Berkelium 97	83 Cf Californium 98	84 Es Einsteinium 99	85 Fm Fermium 100	86 Md Mendelevium 101	87 No Nobelium 102	88 Lr Lawrencium 103	89 Fr Francium 87	90 Ra Radium 88	91 Ac Actinium 89	92 Th Thorium 90	93 Pa Protactinium 91	94 U Uranium 92	95 Np Neptunium 93	96 Pu Plutonium 94	97 Am Americium 95	98 Cm Curium 96	99 Bk Berkelium 97	100 Cf Californium 98	101 Es Einsteinium 99	102 Fm Fermium 100	103 Md Mendelevium 101	104 No Nobelium 102	105 Lr Lawrencium 103	106 Fr Francium 87	107 Ra Radium 88	108 Ac Actinium 89	109 Th Thorium 90	110 Pa Protactinium 91	111 U Uranium 92	112 Np Neptunium 93	113 Pu Plutonium 94	114 Am Americium 95	115 Cm Curium 96	116 Bk Berkelium 97	117 Cf Californium 98	118 Es 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Berkelium 97	219 Cf Californium 98	220 Es Einsteinium 99	221 Fm Fermium 100	222 Md Mendelevium 101	223 No Nobelium 102	224 Lr Lawrencium 103	225 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89	228 Th Thorium 90	229 Pa Protactinium 91	230 U Uranium 92	231 Np Neptunium 93	232 Pu Plutonium 94	233 Am Americium 95	234 Cm Curium 96	235 Bk Berkelium 97	236 Cf Californium 98	237 Es Einsteinium 99	238 Fm Fermium 100	239 Md Mendelevium 101	240 No Nobelium 102	241 Lr Lawrencium 103	242 Fr Francium 87	243 Ra Radium 88	244 Ac Actinium 89	245 Th Thorium 90	246 Pa Protactinium 91	247 U Uranium 92	248 Np Neptunium 93	249 Pu Plutonium 94	250 Am Americium 95	251 Cm Curium 96	252 Bk Berkelium 97	253 Cf Californium 98	254 Es Einsteinium 99	255 Fm Fermium 100	256 Md Mendelevium 101	257 No Nobelium 102	258 Lr Lawrencium 103	259 Fr Francium 87	260 Ra Radium 88	261 Ac Actinium 89	262 Th Thorium 90	263 Pa Protactinium 91	264 U Uranium 92	265 Np Neptunium 93	266 Pu Plutonium 94	267 Am Americium 95	268 Cm Curium 96	269 Bk Berkelium 97	270 Cf Californium 98	271 Es Einsteinium 99	272 Fm Fermium 100	273 Md Mendelevium 101	274 No Nobelium 102	275 Lr Lawrencium 103	276 Fr Francium 87	277 Ra Radium 88	278 Ac Actinium 89	279 Th Thorium 90	280 Pa Protactinium 91	281 U Uranium 92	282 Np Neptunium 93	283 Pu Plutonium 94	284 Am Americium 95	285 Cm Curium 96	286 Bk Berkelium 97	287 Cf Californium 98	288 Es Einsteinium 99	289 Fm Fermium 100	290 Md Mendelevium 101	291 No Nobelium 102	292 Lr Lawrencium 103	293 Fr Francium 87	294 Ra Radium 88	295 Ac Actinium 89	296 Th Thorium 90	297 Pa Protactinium 91	298 U Uranium 92	299 Np Neptunium 93	300 Pu Plutonium 94	301 Am Americium 95	302 Cm Curium 96	303 Bk Berkelium 97	304 Cf Californium 98	305 Es Einsteinium 99	306 Fm Fermium 100	307 Md Mendelevium 101	308 No Nobelium 102	309 Lr Lawrencium 103	310 Fr Francium 87	311 Ra Radium 88	312 Ac Actinium 89	313 Th Thorium 90	314 Pa Protactinium 91	315 U Uranium 92	316 Np Neptunium 93	317 Pu Plutonium 94	318 Am 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Neptunium 93	419 Pu Plutonium 94	420 Am Americium 95	421 Cm Curium 96	422 Bk Berkelium 97	423 Cf Californium 98	424 Es Einsteinium 99	425 Fm Fermium 100	426 Md Mendelevium 101	427 No Nobelium 102	428 Lr Lawrencium 103	429 Fr Francium 87	430 Ra Radium 88	431 Ac Actinium 89	432 Th Thorium 90	433 Pa Protactinium 91	434 U Uranium 92	435 Np Neptunium 93	436 Pu Plutonium 94	437 Am Americium 95	438 Cm Curium 96	439 Bk Berkelium 97	440 Cf Californium 98	441 Es Einsteinium 99	442 Fm Fermium 100	443 Md Mendelevium 101	444 No Nobelium 102	445 Lr Lawrencium 103	446 Fr Francium 87	447 Ra Radium 88	448 Ac Actinium 89	449 Th Thorium 90	450 Pa Protactinium 91	451 U Uranium 92	452 Np Neptunium 93	453 Pu Plutonium 94	454 Am Americium 95	455 Cm Curium 96	456 Bk Berkelium 97	457 Cf Californium 98	458 Es Einsteinium 99	459 Fm Fermium 100	460 Md Mendelevium 101	461 No Nobelium 102	462 Lr Lawrencium 103	463 Fr Francium 87	464 Ra Radium 88	465 Ac Actinium 89	466 Th Thorium 90	467 Pa Protactinium 91	468 U 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