



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

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CENTRE
NUMBER

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CHEMISTRY

0620/22

Paper 2

October/November 2013

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may need to use a 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.

Answer **all** questions.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 16.

You may lose marks if you do not show your working or if you do not use appropriate units.

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.

This document consists of **15** printed pages and **1** blank page.



- 1 (a) Choose from the list of compounds below to answer the following questions.

ammonia
ammonium chloride
calcium carbonate
calcium oxide
copper(II) sulfate
ethane
iron(II) chloride
methane
water

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

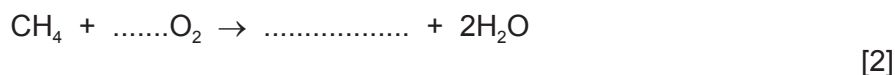
Which compound:

- (i) is an alkaline gas, [1]
- (ii) is a gas contributing to climate change, [1]
- (iii) is a salt containing only non-metals, [1]
- (iv) turns blue cobalt chloride paper pink, [1]
- (v) reacts with an acid to release carbon dioxide, [1]
- (vi) gives a light blue precipitate when aqueous sodium hydroxide is added to a solution of its aqueous ions? [1]

- (b) What is the meaning of the term *compound*?

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

- (c) Complete the following symbol equation for the complete combustion of methane in oxygen.



[Total: 9]

- 2 (a) The table describes the reactivity of some metals with hydrochloric acid.

| metal | observations |
|-----------|----------------------------------------------------------------------------------|
| calcium | Many bubbles produced. Reaction mixture may boil. |
| magnesium | Steady stream of bubbles produced. Reaction mixture gets hot. |
| sodium | Many bubbles produced. May explode. |
| zinc | Slow stream of bubbles produced. Reaction mixture rises slightly in temperature. |

Put these metals in order of their reactivity.

least reactive $\xrightarrow{\hspace{15em}}$ most reactive

[2]

- (b) Complete the word equation for the reaction of magnesium with hydrochloric acid.

magnesium + hydrochloric acid \rightarrow +

.....

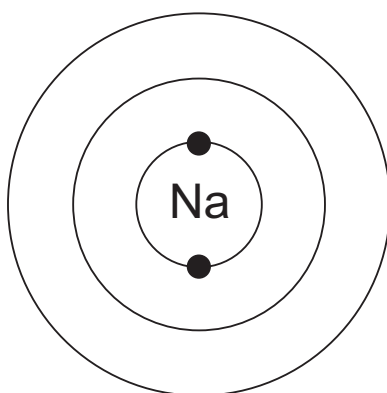
[2]

- (c) When magnesium reacts with hydrochloric acid, magnesium atoms lose electrons. What type of magnesium particle is formed? Put a ring around the correct answer.

covalent **ion** **molecule** **proton**

[1]

- (d) Complete the diagram to show the electronic structure of a sodium atom.



[2]

- (e) A student added large lumps of zinc to 20 cm³ of 2 mol/dm³ hydrochloric acid. She carried out the reaction at 15 °C. She measured the volume of gas given off at various time intervals.

(i) Draw a labelled diagram of the apparatus she could use for this experiment.

[3]

(ii) Describe **three** different things she could do to increase the rate of this reaction.

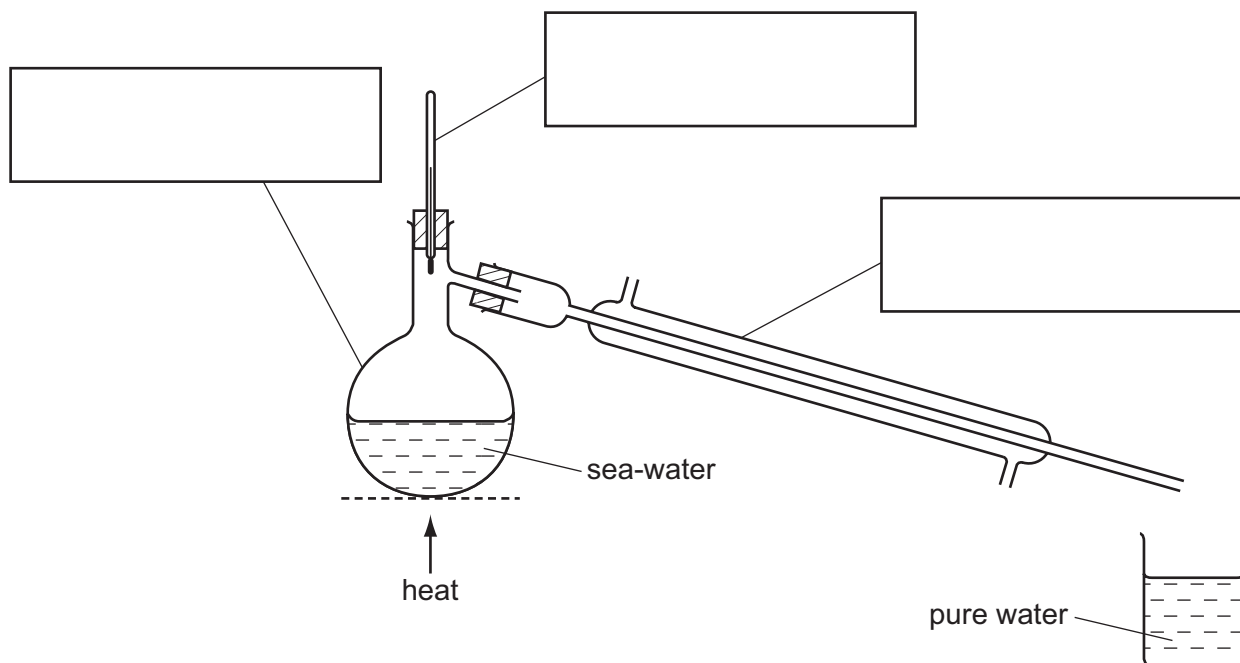
1.

2.

3. [3]

[Total: 13]

- 3 The diagram below shows the apparatus which can be used to obtain pure water from sea-water.



- (a) State the name of this process.

..... [1]

- (b) Label the boxes on the diagram above with the correct names of the pieces of apparatus shown. [3]

- (c) Complete the following sentences using words from the list below.

boils **condenses** **cools** **freezes**
higher **lower** **melts**

Water has a boiling point than salt. When a solution of salt is heated strongly, the water and escapes as steam. When the steam cools, it back to liquid water. [3]

(d) The table shows the concentration of the seven most abundant compounds in sea-water.

| compound | ions present | concentration in g/m ³ |
|--------------------|----------------------------------------------------|--------------------------------------|
| calcium carbonate | Ca ²⁺ and CO ₃ ²⁻ | 100 |
| calcium sulfate | Ca ²⁺ and SO ₄ ²⁻ | 1 800 |
| magnesium chloride | Mg ²⁺ and Cl ⁻ | 6 800 |
| magnesium sulfate | | 5 700 |
| potassium bromide | K ⁺ and Br ⁻ | 100 |
| potassium chloride | K ⁺ and Cl ⁻ | 800 |
| sodium chloride | Na ⁺ and Cl ⁻ | 28 000 |

(i) Which negative ion is present in the greatest concentration in sea-water?

..... [1]

(ii) Which positive ion is present in the lowest concentration in sea-water?

..... [1]

(iii) Write the formulae of the **two** ions present in magnesium sulfate.

..... [2]

[Total: 11]

- 4 (a) Match the compounds on the left with the statements on the right.
The first one has been done for you.

| | |
|---------------|-----------------------------------------------|
| butane | a hydrocarbon containing four carbon atoms |
| poly(ethene) | it decolourises bromine water |
| ethene | it is the main constituent of natural gas |
| methane | it contains a -COOH functional group |
| ethanoic acid | it has a very long chain of carbon atoms |

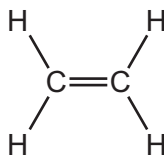
[4]

- (b) Methane and ethene are hydrocarbons.

- (i) What is meant by the term *hydrocarbon*?

..... [1]

- (ii) The structure of ethene is shown below.



Use this structure to explain why ethene is an unsaturated hydrocarbon.

..... [1]

- (c) Molecules of ethene react together at high temperature and pressure to form poly(ethene).

Which **one** of the following words best describes the molecules of ethene in this reaction?
Put a ring around the correct answer.

acids **alkanes** **monomers** **polymers**

[1]

(d) Ethanoic acid can be made by the oxidation of ethanol.

(i) What is meant by the term *oxidation*?

..... [1]

(ii) Ethanol can be made by fermentation.
Complete the word equation for fermentation.

..... $\xrightarrow{\text{yeast}}$ + ethanol
.....

[2]

[Total: 10]

5 (a) Explain why metals are often used in the form of alloys.
In your answer, write about

- the structure of an alloy,
- why alloys are often more useful than pure metals.

.....

.....

.....

.....

..... [3]

(b) Iron is a transition element.

(i) Which two of the following statements about iron are correct?

Tick **two** boxes.

A freshly-cut surface of iron is green in colour.

Iron exists in only one oxidation state in its compounds.

Iron has a high density.

Iron has a giant covalent structure.

Iron has a high melting point.

[2]

(ii) Describe **one** method of rust prevention and explain how it works.

method

how this works

..... [2]

(c) Iron is used as a catalyst in the Haber process for making ammonia.

(i) What does the term *catalyst* mean?

..... [1]

(ii) Describe a test for ammonia.

test

result [2]

- (iii) Ammonia is used to make fertilisers.
Explain why farmers need to add fertilisers to the soil.

*For
Examiner's
Use*

.....

.....

..... [2]

[Total: 12]

- 6 (a) Garlic is a vegetable that is often used in cooking. It has a strong smell. A student is cutting up garlic in the kitchen.



After a time, the smell of the garlic travels all over the house even though there are no currents of air.

Use the kinetic particle theory to explain why the smell of garlic travels all over the house.

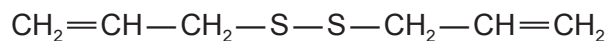
.....

.....

.....

..... [3]

- (b) The smell of garlic is due to a compound containing sulfur. The structure of this compound (compound **A**) is shown below.

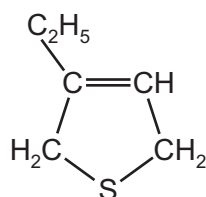


compound **A**

- (i) Write the molecular formula for this compound.

..... [1]

- (ii) Another organic sulfur compound (compound **B**) is shown below.



compound **B**

By comparing the formulae of compound **A** and compound **B**, how can you tell that compound **A** has the higher relative molecular mass?

You are not required to do any mathematical calculations.

.....

..... [2]

(c) An isotope of sulfur has a nucleon number of 34 and an atomic number of 16.

(i) How many neutrons are there in one atom of this isotope of sulfur?

..... [1]

(ii) What is meant by the terms

isotope,

..... [1]

nucleon number? [1]

(iii) Some fuels contain sulfur as a contaminating substance.
Complete the following sentences using words from the list below.

- | | | | |
|-----------------|-----------------|-----------------|-----------------|
| coal | dioxide | hydrogen | monoxide |
| nitrogen | oxidised | reduced | water |

Fuels such as contain sulfur.

When these fuels burn, the sulfur is to sulfur

This reacts with in the atmosphere to form an acidic solution. [4]

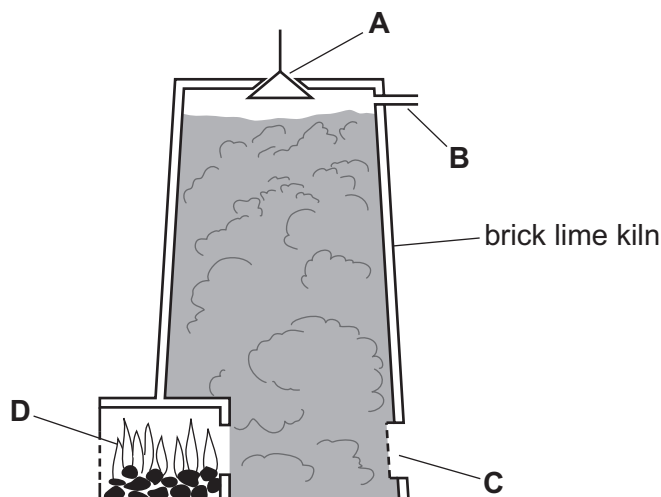
(iv) Describe and explain the effect of acid rain on buildings made of limestone.

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

[Total: 15]

- 7 The diagram shows a kiln for making lime (calcium oxide) from limestone (calcium carbonate).

For
Examiner's
Use



- (a) (i) Which letter on the diagram above shows
where the limestone is added,
- where the waste gases exit from the kiln? [2]

- (ii) Complete the symbol equation for the decomposition of limestone.



[1]

- (iii) When 50 g of calcium carbonate is decomposed, 28 g of calcium oxide is formed.
Calculate the minimum mass of calcium carbonate needed to produce 8.4 g of
calcium oxide.

[1]

- (b) The table below shows the temperatures at which some Group II carbonates decompose.

| Group II carbonate | temperature at which Group II carbonates decompose / °C |
|---------------------|---------------------------------------------------------|
| beryllium carbonate | 100 |
| magnesium carbonate | 350 |
| calcium carbonate | 900 |

- (i) Describe the pattern in the ease of decomposition of Group II carbonates.

..... [1]

(ii) Predict the decomposition temperature of barium carbonate.

..... °C [1]

(c) Lime is calcium oxide.

(i) State **one** use of lime.

..... [1]

(ii) What type of oxide is calcium oxide?

..... [1]

(iii) Calculate the relative formula mass of calcium oxide.
Use your Periodic Table to help you.

[1]

(d) Calcium is extracted from its compounds by electrolysis.
Suggest why calcium is extracted by electrolysis rather than by reduction with carbon.

..... [1]

[Total: 10]

DATA SHEET
The Periodic Table of the Elements

| | | Group | | | | | | | | | | | | | | | | | | | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--------------------------------------|----------------------------------------|----------------------------------------|--------------------------------------|--------------------------------------|-------------------------------------|-------------------------------------|----------------------------------------|----------------------------------------|--------------------------------------|----------------------------------------|-------------------------------------|--------------------------------------|--|----------|----------|----------|------------|--------------------------|-------------------|----------------------------|
| I | II | III | IV | V | VI | VII | 0 | | | | | | | | | | | | | | | |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | 1 H Hydrogen 1 | 11 B Boron 5 | 12 C Carbon 6 | 14 N Nitrogen 7 | 16 O Oxygen 8 | 19 F Fluorine 9 | 20 Ne Neon 10 | 27 Al Aluminium 13 | 28 Si Silicon 14 | 31 P Phosphorus 15 | 32 S Sulfur 16 | 35.5 Cl Chlorine 17 | 40 Ar Argon 18 | | | | | | | | |
| 39 K Potassium 19 | 40 Ca Calcium 20 | 55 Mn Manganese 25 | 56 Fe Iron 26 | 59 Co Cobalt 27 | 59 Ni Nickel 28 | 64 Cu Copper 29 | 65 Zn Zinc 30 | 70 Ga Gallium 31 | 73 Ge Germanium 32 | 75 As Arsenic 33 | 79 Se Selenium 34 | 80 Br Bromine 35 | 84 Kr Krypton 36 | | | | | | | | | |
| 85 Rb Rubidium 37 | 88 Sr Strontium 38 | 91 Zr Zirconium 40 | 101 Ru Ruthenium 44 | 103 Rh Rhodium 45 | 106 Pd Palladium 46 | 108 Ag Silver 47 | 112 Cd Cadmium 48 | 115 In Indium 49 | 119 Sn Tin 50 | 122 Sb Antimony 51 | 128 Te Tellurium 52 | 127 I Iodine 53 | 131 Xe Xenon 54 | | | | | | | | | |
| 133 Cs Caesium 55 | 137 Ba Barium 56 | 181 Ta Tantalum 73 | 190 Os Osmium 76 | 192 Ir Iridium 77 | 195 Pt Platinum 78 | 197 Au Gold 79 | 201 Hg Mercury 80 | 204 Tl Thallium 81 | 207 Pb Lead 82 | 209 Bi Bismuth 83 | 210 Po Polonium 84 | 210 At Astatine 85 | 222 Rn Radon 86 | | | | | | | | | |
| 87 Fr Francium | 88 Ra Radium | 226 Ra Radium | 227 Ac Actinium | 89 † | † | † | † | † | † | † | † | † | † | | | | | | | | | |
| *58-71 Lanthanoid series | | | | | | | | | | | | | | | | | | | | | | |
| †90-103 Actinoid series | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 5%;"></td> <td style="width: 5%;">a</td> <td style="width: 5%;">X</td> <td style="width: 5%;">b</td> </tr> <tr> <td>Key</td> <td>a = relative atomic mass</td> <td>x = atomic symbol</td> <td>b = proton (atomic) number</td> </tr> </table> | | | | | | | | | | | | | | | | a | X | b | Key | a = relative atomic mass | x = atomic symbol | b = proton (atomic) number |
| | a | X | b | | | | | | | | | | | | | | | | | | | |
| Key | a = relative atomic mass | x = atomic symbol | b = proton (atomic) number | | | | | | | | | | | | | | | | | | | |
| 140 Ce Cerium 58 | 141 Pr Praseodymium 59 | 144 Nd Neodymium 60 | 152 Eu Europium 63 | 157 Gd Gadolinium 64 | 159 Tb Terbium 65 | 162 Dy Dysprosium 66 | 165 Ho Holmium 67 | 167 Er Erbium 68 | 169 Tm Thulium 69 | 173 Yb Ytterbium 70 | 175 Lu Lutetium 71 | 232 Th Thorium 90 | 238 U Uranium 92 | 238 Pu Plutonium 94 | | | | | | | | |
| 150 Sm Samarium 62 | 152 Eu Europium 63 | 157 Gd Gadolinium 64 | 159 Tb Terbium 65 | 162 Dy Dysprosium 66 | 165 Ho Holmium 67 | 167 Er Erbium 68 | 169 Tm Thulium 69 | 173 Yb Ytterbium 70 | 175 Lu Lutetium 71 | 103 La Lanthanum 57 | 104 Ce Cerium 58 | 105 Pr Praseodymium 59 | 106 Nd Neodymium 60 | 107 Pm Promethium 61 | | | | | | | | |
| 108 Ba Barium 56 | 109 La Lanthanum 57 | 103 La Lanthanum 57 | 104 Ce Cerium 58 | 105 Pr Praseodymium 59 | 106 Nd Neodymium 60 | 107 Pm Promethium 61 | 108 Ba Barium 56 | 109 La Lanthanum 57 | 110 Ce Cerium 58 | 111 Pr Praseodymium 59 | 112 Nd Neodymium 60 | 113 Pm Promethium 61 | 114 Sm Samarium 62 | 115 Eu Europium 63 | | | | | | | | |
| 101 Sc Scandium 21 | 102 Y Yttrium 39 | 104 Ce Cerium 58 | 105 Pr Praseodymium 59 | 106 Nd Neodymium 60 | 107 Pm Promethium 61 | 108 Ba Barium 56 | 109 La Lanthanum 57 | 110 Ce Cerium 58 | 111 Pr Praseodymium 59 | 112 Nd Neodymium 60 | 113 Pm Promethium 61 | 114 Sm Samarium 62 | 115 Eu Europium 63 | 116 Gd Gadolinium 64 | | | | | | | | |

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

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