**Cambridge International Examinations**
Cambridge International General Certificate of Secondary Education

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| CANDIDATE NAME | |

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**CHEMISTRY** **0620/32**

Paper 3 (Extended) **February/March 2015**

**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 on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, 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 12.
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.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **11** printed pages and **1** blank page.


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CAMBRIDGE International Examinations

**1** For each of the following, give the name of an element from Period 3 (sodium to argon), which matches the description.

**(a)** an element which is gaseous at room temperature and pressure

..... [1]

**(b)** an element that is added to water to kill bacteria

..... [1]

**(c)** an element that forms a basic oxide of the type XO

..... [1]

**(d)** an element used as an inert atmosphere in lamps

..... [1]

**(e)** an element that forms an amphoteric oxide

..... [1]

**(f)** an element that reacts vigorously with cold water to produce hydrogen

..... [1]

[Total: 6]

**2** **(a)** Define the term *isotope*.

.....

..... [2]

**(b)** The table gives information about four particles, **A**, **B**, **C** and **D**.

Complete the table.
The first line has been done for you.

| particle | number of protons | number of electrons | number of neutrons | nucleon number | symbol or formula |
|---|---|---|---|---|---|
| **A** | 6 | 6 | 6 | 12 | C |
| **B** | 11 | 10 | 12 | | |
| **C** | 8 | | 8 | | $O^{2-}$ |
| **D** | | 10 | | 28 | $Al^{3+}$ |

[7]

[Total: 9]

**3** Ammonia is manufactured by the Haber process. Nitrogen and hydrogen are passed over a catalyst at a temperature of 450 °C and a pressure of 200 atmospheres.

The equation for the reaction is as follows.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The forward reaction is exothermic.

**(a)** State **one** use of ammonia.

..... [1]

**(b)** What is the meaning of the symbol $\rightleftharpoons$?

..... [1]

**(c)** What are the sources of nitrogen and hydrogen used in the Haber process?

nitrogen .....

hydrogen .....
[2]

**(d)** Name the catalyst in the Haber process.

..... [1]

**(e)** **(i)** If a temperature higher than 450 °C was used in the Haber process, what would happen to the **rate** of the reaction? Give a reason for your answer.

.....

.....

..... [2]

**(ii)** If a temperature higher than 450 °C was used in the Haber process, what would happen to the **yield** of ammonia? Give a reason for your answer.

.....

.....

..... [2]

**(f)** **(i)** If a pressure higher than 200 atmospheres was used in the Haber process, what would happen to the **yield** of ammonia? Give a reason for your answer.

.....

.....

..... [2]

**(ii)** Explain why the rate of reaction would be faster if the pressure was greater than 200 atmospheres.

.....

..... [1]

**(iii)** Suggest **one** reason why a pressure higher than 200 atmospheres is not used in the Haber process.

.....

..... [1]

**(g)** Draw a dot-and-cross diagram to show the arrangement of the outer (valency) electrons in one molecule of ammonia.

[2]

**(h)** Ammonia acts as a base when it reacts with sulfuric acid.

**(i)** What is a base?

..... [1]

**(ii)** Write a balanced equation for the reaction between ammonia and sulfuric acid.

..... [2]

[Total: 18]

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**4** **(a)** A compound **X** contains 82.76% of carbon by mass and 17.24% of hydrogen by mass.

**(i)** Calculate the empirical formula of compound **X**.

[2]

**(ii)** Compound **X** has a relative molecular mass of 58.

Deduce the molecular formula of compound **X**.

[2]

**(b)** Alkenes are unsaturated hydrocarbons.

**(i)** State the general formula of alkenes.

..... [1]

**(ii)** State the empirical formula of alkenes.

..... [1]

**(c)** What is meant by the term *unsaturated hydrocarbon*?

*unsaturated* .....

.....

*hydrocarbon* .....

.....

[2]

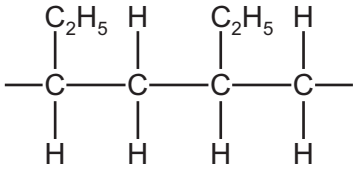
**(d)** Describe a test that would distinguish between saturated and unsaturated hydrocarbons.

reagent .....

observation (saturated hydrocarbon) .....

observation (unsaturated hydrocarbon) .....
[3]

**(e)** Addition polymers can be made from alkenes. The diagram shows part of an addition polymer.




**(i)** Draw a circle on the diagram to show one repeat unit in this polymer. [1]

**(ii)** Give the structure and the name of the monomer used to make this polymer.

structure

name ..... [2]

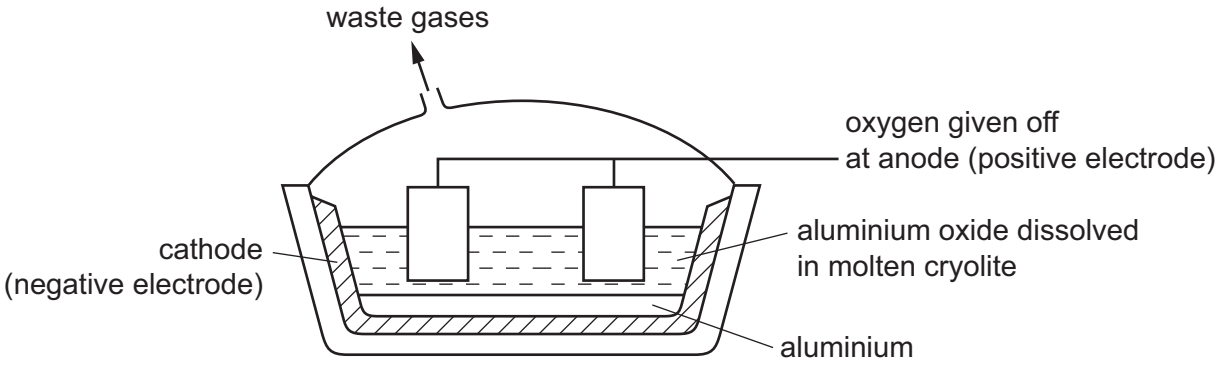
**(iii)** Give the structure of an isomer of the alkene in **(e)(ii)**.

[1]

[Total: 15]

**5** Aluminium and iron are extracted from their ores by different methods.

Aluminium is extracted from its purified oxide ore by electrolysis.




**(a)** What is the name of the ore of aluminium which consists mainly of aluminium oxide?

..... [1]

**(b)** The electrodes are both made of the same substance.

Name this substance.

..... [1]

**(c)** Aluminium oxide is dissolved in molten cryolite before it is electrolysed.

Give **two** reasons why aluminium oxide dissolved in molten cryolite is electrolysed rather than molten aluminium oxide alone.

.....

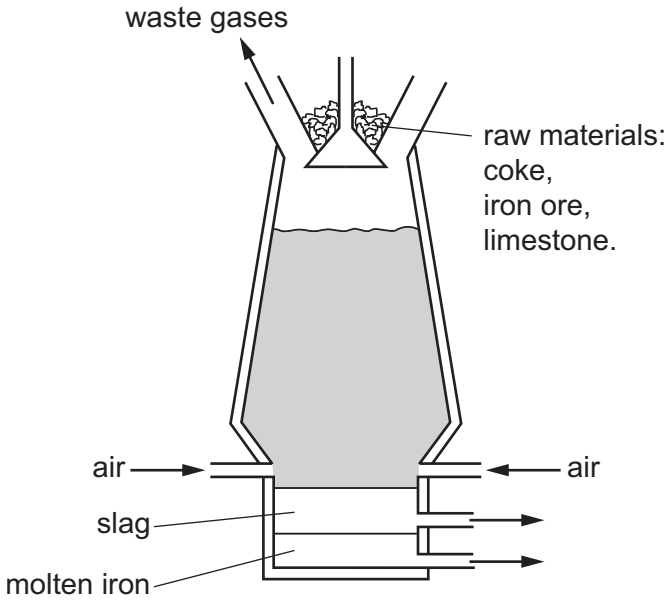
..... [2]

**(d)** Write the **ionic** equations for the reactions at the electrodes in this electrolysis.

anode (positive electrode) .....

cathode (negative electrode) .....
[2]

**(e)** Iron is extracted from its oxide ore by reduction using carbon in a blast furnace.




**(i)** Place the elements aluminium, carbon and iron in order of reactivity with the **least** reactive element first.

..... [1]

**(ii)** Use your answer to **(e)(i)** to explain why iron is extracted by reduction using carbon but aluminium is not.

.....

..... [1]

**(f)** What is the name of the ore of iron which consists mainly of iron(III) oxide?

..... [1]

**(g)** Write balanced equations for the reactions occurring in the blast furnace which involve

**(i)** the complete combustion of coke (carbon),

..... [1]

**(ii)** the production of carbon monoxide from carbon dioxide,

..... [1]

**(iii)** the reduction of iron(III) oxide,

..... [1]

**(iv)** the formation of slag.

..... [1]

[Total: 13]

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**6** A student is told to produce the maximum amount of copper from a mixture of copper and copper(II) carbonate.

The student adds the mixture to an excess of dilute sulfuric acid in a beaker and stirs the mixture with a glass rod. The copper(II) carbonate reacts with the sulfuric acid, forming a solution of copper(II) sulfate but the copper does not react with the sulfuric acid.

The student then

- removes the unreacted copper from the mixture,
- converts the solution of copper(II) sulfate into copper by a series of reactions.

**(a)** Describe **two** things that the student would observe when the mixture is added to the dilute sulfuric acid.

.....

..... [2]

**(b)** Describe how the student can produce pure dry copper from the mixture of copper and copper(II) sulfate solution.

.....

.....

.....

..... [3]

**(c)** The student then adds sodium hydroxide solution to the copper(II) sulfate solution to produce copper(II) hydroxide.

**(i)** Describe what the student would observe.

..... [1]

**(ii)** Write an **ionic** equation for this reaction.

..... [1]

**(d)** After separating the copper(II) hydroxide from the mixture, the copper(II) hydroxide is heated strongly. The copper(II) hydroxide decomposes into copper(II) oxide and steam.

**(i)** Write an equation for the decomposition of copper(II) hydroxide. Include state symbols.

..... [2]

**(ii)** Name a non-metallic element that can be used to convert copper(II) oxide into copper.

..... [1]

[Total: 10]

**7** Ethanol is manufactured from glucose, $C_6H_{12}O_6$, by fermentation according to the following equation.

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

**(a)** State the conditions required for this reaction.

.....

..... [2]

**(b)** In an experiment, 30.0 g of glucose was fermented.

**(i)** Calculate the number of moles of glucose in 30.0 g.

..... mol [2]

**(ii)** Calculate the maximum mass of ethanol that could be obtained from 30.0 g of glucose.

..... g [2]

**(iii)** Calculate the volume of carbon dioxide at room temperature and pressure that can be obtained from 30.0 g of glucose.

..... $dm^3$ [1]

**(c)** Ethanol can also be manufactured from ethene.

**(i)** Name the raw material which is the source of ethene.

..... [1]

**(ii)** Write a balanced equation for the manufacture of ethanol from ethene.

..... [1]

[Total: 9]

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# DATA SHEET
## The Periodic Table of the Elements

| Group I | Group II | | | | | | | | | | | Group III | Group IV | Group V | Group VI | Group VII | Group 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 **H** Hydrogen 1 | | | | | | | | | | 4 **He** Helium 2 |
| 7 **Li** Lithium 3 | 9 **Be** Beryllium 4 | | | | | | | | | | | 11 **B** Boron 5 | 12 **C** Carbon 6 | 14 **N** Nitrogen 7 | 16 **O** Oxygen 8 | 19 **F** Fluorine 9 | 20 **Ne** Neon 10 |
| 23 **Na** Sodium 11 | 24 **Mg** Magnesium 12 | | | | | | | | | | | 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 | 45 **Sc** Scandium 21 | 48 **Ti** Titanium 22 | 51 **V** Vanadium 23 | 52 **Cr** Chromium 24 | 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 | 89 **Y** Yttrium 39 | 91 **Zr** Zirconium 40 | 93 **Nb** Niobium 41 | 96 **Mo** Molybdenum 42 | **Tc** Technetium 43 | 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 | 139 **La** Lanthanum 57 * | 178 **Hf** Hafnium 72 | 181 **Ta** Tantalum 73 | 184 **W** Tungsten 74 | 186 **Re** Rhenium 75 | 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 | **Po** Polonium 84 | **At** Astatine 85 | **Rn** Radon 86 |
| **Fr** Francium 87 | 226 **Ra** Radium 88 | 227 **Ac** Actinium 89 † | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 140 **Ce** Cerium 58 | 141 **Pr** Praseodymium 59 | 144 **Nd** Neodymium 60 | **Pm** Promethium 61 | 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 |
| 232 **Th** Thorium 90 | **Pa** Protactinium 91 | 238 **U** Uranium 92 | **Np** Neptunium 93 | **Pu** Plutonium 94 | **Am** Americium 95 | **Cm** Curium 96 | **Bk** Berkelium 97 | **Cf** Californium 98 | **Es** Einsteinium 99 | **Fm** Fermium 100 | **Md** Mendelevium 101 | **No** Nobelium 102 | **Lr** Lawrencium 103 |

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

Key

| | |
|---|---|
| a **X** b | a = relative atomic mass<br>**X** = atomic symbol<br>b = proton (atomic) number |

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

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