

CANDIDATE
NAME

CENTRE
NUMBER

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

CANDIDATE
NUMBER

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

* 1 8 4 5 2 9 5 1 3 1 *

CHEMISTRY

0620/32

Paper 3 (Extended)

October/November 2014

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 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.

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 **13** printed pages and **3** blank pages.

1 An important aspect of chemistry is purity and methods of purification.

(a) Give an example of substances used in everyday life which must be pure.

..... [1]

(b) A list of techniques used to separate mixtures is given below.

chromatography crystallisation diffusion dissolving
evaporation filtration fractional distillation simple distillation

(i) From the list, choose the most suitable technique to separate the following.

water from sea-water

helium from a mixture of helium and methane

ethanol from a mixture of ethanol and propanol

iron filings from a mixture of iron filings and water

a mixture of two amino acids, glycine and alanine

[5]

(ii) Describe how you would obtain a pure sample of copper(II) sulfate-5-water crystals from a mixture of copper(II) sulfate-5-water with copper(II) oxide using some of the techniques listed above.

.....

 [4]

[Total: 10]

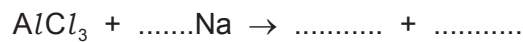
2 Aluminium is obtained by the reduction of aluminium ions to aluminium atoms.

(a) Write an ionic equation for the reduction of an aluminium ion to an aluminium atom.

..... [2]

(b) The original method of extracting aluminium involved the reduction of aluminium chloride using the reactive metal sodium. Aluminium obtained by this method was very expensive due to the high cost of extracting sodium from sodium chloride.

(i) Complete the equation for this reduction.

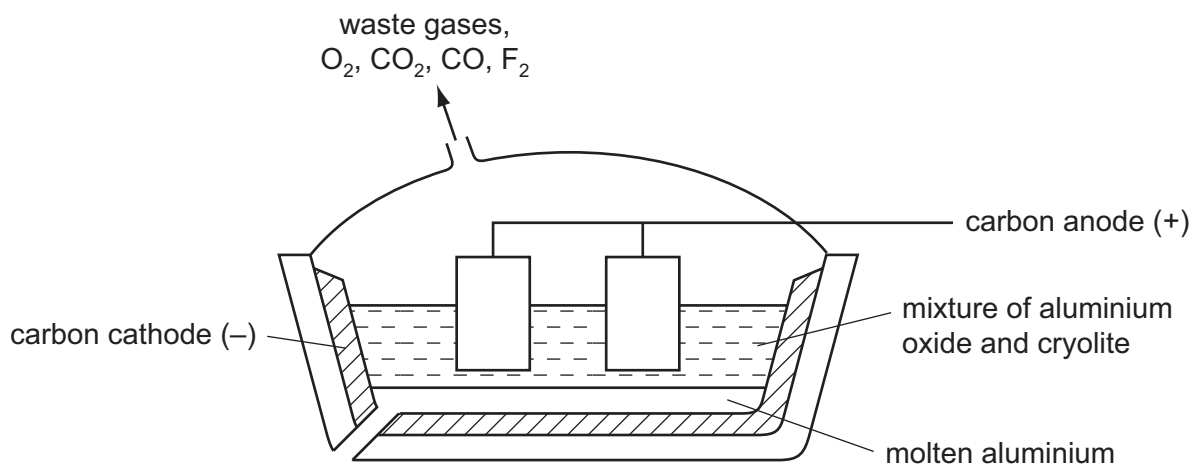


[2]

(ii) How can sodium metal be obtained from sodium chloride?

.....
 [2]

(c) In the modern method, aluminium is obtained by the electrolysis of aluminium oxide (alumina) dissolved in molten cryolite, Na_3AlF_6 .



(i) The major ore of aluminium is impure aluminium oxide. What is the name of this ore?

..... [1]

(ii) This ore is a mixture of aluminium oxide, which is amphoteric, and iron(III) oxide which is basic. Explain how these two oxides can be separated by the addition of aqueous sodium hydroxide.

.....

 [2]

(iii) Give **two** reasons why the electrolyte contains cryolite.

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

(iv) The mixture of gases evolved at the positive electrode includes:

- carbon dioxide
- carbon monoxide
- fluorine
- oxygen

Explain the presence of these gases in the gaseous mixture formed at the positive electrode. Include at least **one** equation in your explanation.

.....
.....
.....
.....
..... [5]

(d) A major use of aluminium is the manufacture of pots and pans. One reason for this is its resistance to corrosion.

(i) Explain why aluminium, a reactive metal, is resistant to corrosion.

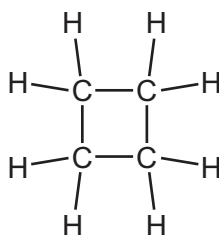
.....
..... [1]

(ii) Suggest **two** other reasons why aluminium is suitable for making pots and pans.

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

[Total: 19]

- 3 (a) A hydrocarbon has the following structural formula.



- (i) State the molecular formula and the empirical formula of this hydrocarbon.

molecular formula

empirical formula

[2]

- (ii) Draw the structural formula of an isomer of the above hydrocarbon.

[1]

- (iii) Explain why these two hydrocarbons are isomers.

.....

..... [2]

- (iv) Are these two hydrocarbons members of the same homologous series?
Give a reason for your choice.

.....

..... [1]

- (b) Alkenes can be made from alkanes by cracking.

- (i) Explain the term *cracking*.

.....

..... [2]

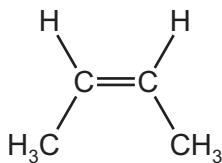
- (ii) One mole of an alkane, when cracked, produced one mole of hexane, C_6H_{14} , and two moles of ethene.

What is the molecular formula of the original alkane?

..... [1]

(c) Alkenes are used in polymerisation reactions and addition reactions.

- (i) Draw the structural formula of the product formed by the addition polymerisation of but-2-ene. Its formula is given below.



[3]

- (ii) Give the name and structural formula of the addition product formed from ethene and bromine.

name

structural formula

[2]

[Total: 14]

4 Zinc is an important metal. Its uses include making alloys and the construction of dry cells (batteries).

(a) Name an alloy which contains zinc. What is the other metal in this alloy?

name of alloy

other metal in alloy

[2]

(b) The main ore of zinc is zinc blende, ZnS.

(i) The ore is heated in the presence of air to form zinc oxide and sulfur dioxide.
Write the equation for this reaction.

..... [2]

(ii) Give a major use of sulfur dioxide.

..... [1]

(c) Zinc can be obtained from zinc oxide in a two step process. Aqueous zinc sulfate is made from zinc oxide and then this solution is electrolysed with inert electrodes. The electrolysis is similar to that of copper(II) sulfate with inert electrodes.

(i) Name the reagent which will react with zinc oxide to form zinc sulfate.

..... [1]

(ii) Complete the following for the electrolysis of aqueous zinc sulfate.

Write the equation for the reaction at the negative electrode.

.....

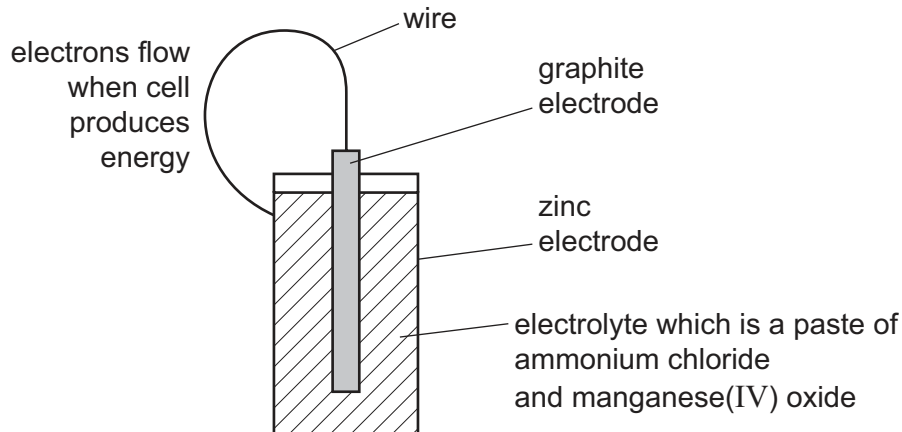
Name the product at the positive electrode.

.....

The electrolyte changes from zinc sulfate to

[3]

- (d) A dry cell (battery) has a central rod, usually made of graphite. This is the positive electrode which is surrounded by the electrolyte, typically a paste of ammonium chloride and manganese(IV) oxide, all of which are in a zinc container which is the negative electrode.



- (i) Draw an arrow on the diagram to indicate the direction of electron flow. [1]

- (ii) Suggest why the electrolyte is a paste.

..... [1]

- (iii) The following changes occur in a dry cell.
For each change, decide if it is oxidation or reduction and give a reason for your choice.

Zn to Zn^{2+}

.....

manganese(IV) oxide to manganese(III) oxide

.....

[2]

[Total: 13]

5 (a) Glucose, sucrose and starch are all carbohydrates. Their formulae are:

glucose, $C_6H_{12}O_6$,
 sucrose, $C_{12}H_{22}O_{11}$,
 starch, $(C_6H_{10}O_5)_n$.

(i) Identify **two** common features in the formulae of these carbohydrates.

.....
 [2]

(ii) Draw the structure of a complex carbohydrate, such as starch. The formula of glucose, can be represented by



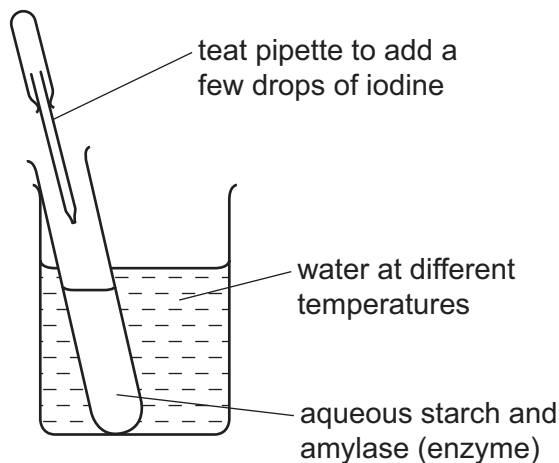
Include **three** glucose units in the structure.

[2]

(b) Starch hydrolyses to glucose in the presence of the enzyme, amylase.
 What is meant by the term *enzyme*?

..... [2]

- (c) The effect of temperature on this reaction can be studied by the experiment shown below. Starch and iodine form a blue-black colour. Glucose and iodine do not form a blue-black colour.



The experiment is set up as in the diagram and the time measured for the mixture to change from blue-black to colourless. The experiment is repeated at different temperatures. Typical results of this experiment are given in the table below.

| experiment | temperature /°C | time for blue-black colour to disappear / min |
|------------|-----------------|---|
| A | 20 | 30 |
| B | 40 | 15 |
| C | 70 | remained blue-black |

- (i) Put the experiments in order of reaction rate – slowest first and fastest last.

..... [2]

- (ii) Explain why the reaction rates in experiments A and B are different.

.....

 [3]

- (iii) Suggest why the colour remains blue-black in experiment C.

..... [1]

[Total: 12]

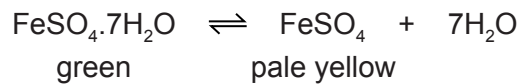
- 6 Sulfuric acid is an important acid, both in the laboratory and in industry. Sulfuric acid is manufactured in the Contact Process. Originally, it was made by heating metal sulfates and by burning a mixture of sulfur and potassium nitrate.

(a) Give a major use of sulfuric acid.

..... [1]

- (b) A group of naturally occurring minerals have the formula of the type $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ where x is 1, 4, 5, 6 or 7. The most common of these minerals is iron(II) sulfate-7-water.

(i) When this mineral is heated gently it dehydrates.

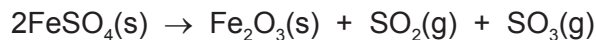


Describe how you could show that this reaction is reversible.

.....

 [2]

(ii) When the iron(II) sulfate is heated strongly, further decomposition occurs.



The gases formed in this reaction react with water and oxygen to form sulfuric acid. Explain how the sulfuric acid is formed.

.....
 [2]

(iii) A mineral of the type $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ contains 37.2% of water. Complete the calculation to determine x.

mass of one mole of H_2O = 18 g

mass of water in 100 g of $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ = 37.2 g

number of moles of H_2O in 100 g of $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ =

mass of FeSO_4 in 100 g of $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ = g

mass of one mole of FeSO_4 = 152 g

number of moles of FeSO_4 in 100 g of $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ =

x =

[4]

(c) When a mixture of sulfur and potassium nitrate is burned and the products are dissolved in water, sulfuric acid is formed.

(i) The sulfuric acid formed by this method is not pure. It contains another acid.
Deduce the identity of this acid.

..... [1]

(ii) The heat causes some of the potassium nitrate to decompose.
Write the equation for the action of heat on potassium nitrate.

..... [2]

[Total: 12]

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 | 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 | 101 Ru Ruthenium 44 | 101 Rh Rhodium 45 | 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 | 212 Po Polonium 84 | 210 At Astatine 85 | 222 Rn Radon 86 |
| 87 Fr Francium | 88 Ra Radium | 89 Ac Actinium | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|-----------------------------------|--|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|-------------------------------------|---------------------------------------|---------------------------------------|-------------------------------------|--|-------------------------------------|---------------------------------------|
| 140 Ce Cerium 58 | 141 Pr Praseodymium 59 | 144 Nd Neodymium 60 | 150 Sm Samarium 62 | 152 Eu Europium 63 | 157 Gd Gadolinium 64 | 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 | 232 Pa Protactinium 91 | 238 U Uranium 92 | 238 Np Neptunium 93 | 238 Pu Plutonium 94 | 238 Am Americium 95 | 238 Cm Curium 96 | 238 Bk Berkelium 97 | 238 Cf Californium 98 | 238 Es Einsteinium 99 | 238 Fm Fermium 100 | 238 Md Mendelevium 101 | 238 No Nobelium 102 | 238 Lr Lawrencium 103 |

| | | |
|---|----------|---|
| a | X | b |
|---|----------|---|

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

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

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

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included the publisher will be pleased to make amends at the earliest possible opportunity.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.