



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CHEMISTRY

0620/32

Paper 3 (Extended)

May/June 2012

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 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.

A copy of the Periodic Table is printed on page 12.

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 | |
|--------------------|--|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| Total | |

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



- 1 The table below includes information about some of the elements in Period 2.

| | | | | |
|------------------|----------------|---------------------------------|---------------------------------|-----------------|
| element | carbon | nitrogen | fluorine | neon |
| symbol | C | N | F | Ne |
| structure | macromolecular | simple molecules N ₂ | simple molecules F ₂ | single atoms Ne |
| boiling point/°C | 4200 | -196 | -188 | -246 |

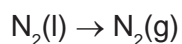
- (a) Why does neon exist as single atoms but fluorine exists as molecules?

.....
 [2]

- (b) What determines the order of the elements in a period?

..... [1]

- (c) When liquid nitrogen boils the following change occurs.



The boiling point of nitrogen is very low even though the bond between the atoms in a nitrogen molecule is very strong. Suggest an explanation.

.....
 [2]

- (d) Draw a diagram showing the arrangement of the outer shell (valency) electrons in a molecule of nitrogen.

[2]

[Total: 7]

3

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Use

- 2 Diamond and graphite are different forms of the same element, carbon. Explain the following in terms of their structure.

(a) Graphite is a soft material which is used as a lubricant.

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

(b) Diamond is a very hard material which is used for drilling and cutting.

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

(c) Graphite is a good conductor of electricity and diamond is a poor conductor.

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

[Total: 6]

- 3 The uses of a substance are determined by its properties.

(a) Plastics are poor conductors of electricity. They are used as insulation for electric cables. Which other **two** properties of plastics make them suitable for this purpose?

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

(b) Chromium is a hard, shiny metal. Suggest **two** reasons why chromium is used to electroplate steel.

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

(c) Why is aluminium used extensively in the manufacture of aeroplanes?

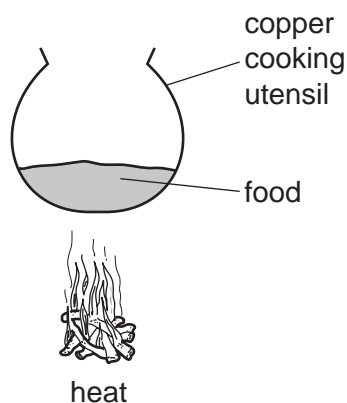


.....
..... [2]

4

(d) Why is copper a suitable material from which to make cooking utensils?

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Use



.....
 [2]

(e) Describe the bonding in a typical metal.

.....

 [2]

[Total: 10]

4 The ore of aluminium is bauxite which is impure aluminium oxide. Alumina, pure aluminium oxide, is obtained from bauxite. Aluminium is formed at the cathode when a molten mixture of alumina and cryolite, Na_3AlF_6 , is electrolysed.

(a) (i) Name **two** products formed at the anode in this electrolysis.

..... [2]

(ii) All the aluminium formed comes from the alumina not the cryolite. Suggest **two** reasons why the electrolyte must contain cryolite.

.....
 [2]

(iii) The major impurity in bauxite is iron(III) oxide. Iron(III) oxide is basic, aluminium oxide is amphoteric. Explain how aqueous sodium hydroxide can be used to separate them.

.....

 [2]

(b) The purification of bauxite uses large amounts of sodium hydroxide.

(i) Describe the chemistry of how sodium hydroxide is made from concentrated aqueous sodium chloride. The description must include at least one ionic equation.

.....

 [5]

(ii) Making sodium hydroxide from sodium chloride produces two other chemicals. Name these two chemicals and state one use of each chemical.

chemical

use

chemical

use [2]

[Total: 13]

5 Islay is an island off the west coast of Scotland. The main industry on the island is making ethanol from barley.

Barley contains the complex carbohydrate, starch. Enzymes catalyse the hydrolysis of starch to a solution of glucose.

(a) (i) Draw the structure of the starch.

Glucose can be represented by HO——OH

[2]

- (ii) Enzymes can catalyse the hydrolysis of starch. Name another catalyst for this reaction.

..... [1]

- (iii) Both starch and glucose are carbohydrates. Name the elements found in all carbohydrates.

.....

..... [1]

- (b) Yeast cells are added to the aqueous glucose. Fermentation produces a solution containing up to 10% of ethanol.

- (i) Complete the word equation for the fermentation of glucose.

glucose → +

[1]

- (ii) Explain why it is necessary to add yeast and suggest why the amount of yeast in the mixture increases.

.....

.....

..... [2]

- (iii) Fermentation is carried out at 35 °C. For many reactions a higher temperature would give a faster reaction. Why is a higher temperature not used in this process?

.....

..... [2]

- (c) The organic waste, the residue of the barley and yeast, is disposed of through a pipeline into the sea. In the future this waste will be converted into biogas by the anaerobic respiration of bacteria. Biogas, which is mainly methane, will supply most of the island's energy.

- (i) Anaerobic means in the absence of oxygen. Suggest an explanation why oxygen must be absent.

..... [1]

- (ii) The obvious advantage of converting the waste into methane is economic. Suggest **two** other advantages.

.....

..... [2]

[Total: 12]

- 6 A length of magnesium ribbon was added to 50 cm³ of sulfuric acid, concentration 1.0 mol/dm³. The time taken for the magnesium to react was measured. The experiment was repeated with the same volume of different acids. In all these experiments, the acid was in excess and the same length of magnesium ribbon was used.

(a)

| experiment | acid | concentration in mol/dm ³ | time/s |
|------------|-------------------|---|--------|
| A | sulfuric acid | 1.0 | 20 |
| B | propanoic acid | 0.5 | 230 |
| C | hydrochloric acid | 1.0 | 40 |
| D | hydrochloric acid | 0.5 | 80 |

- (i) Write these experiments in order of reaction speed. Give the experiment with the fastest speed first.

..... [1]

- (ii) Give reasons for the order you have given in (i).

.....

 [5]

- (b) Suggest **two** changes to experiment C which would increase the speed of the reaction and explain why the speed would increase. The volume of the acid, the concentration of the acid and the mass of magnesium used were kept the same.

change 1

explanation

.....

change 2

explanation

..... [5]

[Total: 11]

7 The alkenes are unsaturated hydrocarbons. They form a homologous series, the members of which have similar chemical properties:

- easily oxidised
- addition reactions
- polymerisation
- combustion.

(a) All the alkenes have the same empirical formula.

(i) State their empirical formula.

..... [1]

(ii) Why is the empirical formula the same for all alkenes?

..... [1]

(b) Alkenes can be oxidised to carboxylic acids by boiling with aqueous potassium manganate(VII).

(i) Pent-2-ene, $\text{CH}_3\text{-CH}_2\text{-CH=CH-CH}_3$, oxidises to $\text{CH}_3\text{-CH}_2\text{-COOH}$ and CH_3COOH . Name these two acids.

$\text{CH}_3\text{-CH}_2\text{-COOH}$

CH_3COOH [2]

(ii) Most alkenes oxidise to two carboxylic acids. Deduce the formula of an alkene which forms only one carboxylic acid.

[1]

(c) Complete the following equations for the addition reactions of propene.

(i) $\text{CH}_3\text{-CH=CH}_2 + \text{Br}_2 \rightarrow$ [1]

(ii) $\text{CH}_3\text{-CH=CH}_2 + \text{H}_2\text{O} \rightarrow$ [1]

(d) Draw the structural formula of poly(propene)

[2]

- (e) 0.01 moles of an alkene needed 2.4 g of oxygen for complete combustion. 2.2 g of carbon dioxide were formed. Determine the following mole ratio.

moles of alkene : moles of O₂ : moles of CO₂

From this ratio determine the formula of the alkene.

..... [3]

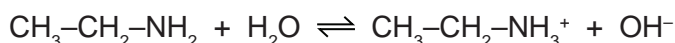
Write an equation for the complete combustion of this alkene.

..... [1]

[Total: 13]

- 8 Ethylamine, CH₃-CH₂-NH₂, is a base which has similar properties to ammonia.

- (a) In aqueous ethylamine, there is the following equilibrium.



Explain why water is behaving as an acid in this reaction.

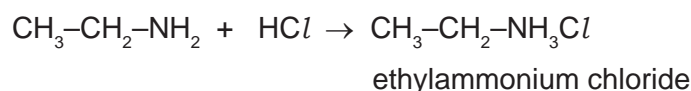
..... [1]

- (b) Given aqueous solutions of ethylamine and sodium hydroxide, describe how you could show that ethylamine is a weak base like ammonia and not a strong base like sodium hydroxide.

.....

 [3]

- (c) Ethylamine, like ammonia, reacts with acids to form salts.



Suggest how you could displace ethylamine from the salt, ethylammonium chloride.

.....
 [2]

10

(d) Explain the chemistry of the following reaction:

*For
Examiner's
Use*

When aqueous ethylamine is added to aqueous iron(III) chloride, a brown precipitate is formed.

.....

..... [2]

[Total: 8]

DATA SHEET
The Periodic Table of the Elements

| | | Group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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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 N Nitrogen 7 | 15 O Oxygen 8 | 16 F Fluorine 9 | 17 Ne Neon 10 | 18 Ar Argon 18 | 19 K Potassium 19 | 20 Ca Calcium 20 | 21 Sc Scandium 21 | 22 Ti Titanium 22 | 23 V Vanadium 23 | 24 Cr Chromium 24 | 25 Mn Manganese 25 | 26 Fe Iron 26 | 27 Co Cobalt 27 | 28 Ni Nickel 28 | 29 Cu Copper 29 | 30 Zn Zinc 30 | 31 Ga Gallium 31 | 32 Ge Germanium 32 | 33 As Arsenic 33 | 34 Se Selenium 34 | 35 Br Bromine 35 | 36 Kr Krypton 36 | 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 | 72 Hf Hafnium 72 | 73 Ta Tantalum 73 | 74 W Tungsten 74 | 75 Re Rhenium 75 | 76 Os Osmium 76 | 77 Ir Iridium 77 | 78 Pt Platinum 78 | 79 Au Gold 79 | 80 Hg Mercury 80 | 81 Tl Thallium 81 | 82 Pb Lead 82 | 83 Bi Bismuth 83 | 84 Po Polonium 84 | 85 At Astatine 85 | 86 Rn Radon 86 | 87 Fr Francium 87 | 88 Ra Radium 88 | 89 Ac Actinium 89 | † | 90 Th Thorium 90 | 91 Pa Protactinium 91 | 92 U Uranium 92 | 93 Np Neptunium 93 | 94 Pu Plutonium 94 | 95 Am Americium 95 | 96 Cm Curium 96 | 97 Bk Berkelium 97 | 98 Cf Californium 98 | 99 Es Einsteinium 99 | 100 Fm Fermium 100 | 101 Md Mendelevium 101 | 102 No Nobelium 102 | 103 Lr Lawrencium 103 | 104 Rf Rutherfordium 104 | 105 Db Dubnium 105 | 106 Sg Seaborgium 106 | 107 Bh Bohrium 107 | 108 Hs Hassium 108 | 109 Mt Meitnerium 109 | 110 Ds Darmstadtium 110 | 111 Rg Roentgenium 111 | 112 Cn Copernicium 112 | 113 Nh Nihonium 113 | 114 Fl Flerovium 114 | 115 Lv Livermorium 115 | 116 Ts Tennessine 116 | 117 Og Oganesson 117 | 118 Uu Ununseptium 118 | 119 Uub Ununseptium 119 | 120 Uuq Ununquadium 120 | 121 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*58-71 Lanthanoid series
†90-103 Actinoid series

Key

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

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

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

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