Cambridge IGCSE

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

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| CANDIDATE NAME | |
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*9449031324*

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

Paper 3 (Extended) **May/June 2015**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**MODIFIED LANGUAGE**

**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

**[Turn over**

**1** Complete the following table which gives the number of protons, electrons and neutrons in each of the five particles.

| particle | number of protons | number of electrons | number of neutrons |
|---|---|---|---|
| ..... | 19 | 19 | 20 |
| $^{56}_{26}Fe$ | ..... | ..... | ..... |
| ..... | 3 | 2 | 4 |
| $^{70}_{31}Ga^{3+}$ | ..... | ..... | ..... |
| ..... | 34 | 36 | 45 |

[Total: 8]

**2** The table shows the melting points, boiling points and electrical properties of five substances, **A** to **E**.

| substance | melting point / °C | boiling point / °C | electrical conductivity of solid | electrical conductivity of liquid |
|---|---|---|---|---|
| **A** | –7 | 59 | poor | poor |
| **B** | 1083 | 2567 | good | good |
| **C** | 755 | 1387 | poor | good |
| **D** | 43 | 181 | poor | poor |
| **E** | 1607 | 2227 | poor | poor |

Choose a substance from the table above to match each of the following descriptions. A substance may be used once, more than once or not at all. Justify each choice with evidence from the table.

One has been completed as an example.

This substance is covalent and is a solid at room temperature (25 °C). .....**D**.....

evidence *Its melting point is above room temperature. It has a low melting point and it does not conduct as a liquid, so it is covalent*.

**(a)** This substance has a giant covalent structure. .....

evidence .....

..... [3]

**(b)** This substance is a metal. .....

evidence .....

..... [2]

**(c)** This substance is a liquid at room temperature (25 °C). .....

evidence .....

..... [3]

**(d)** This substance is an ionic solid. .....

evidence .....

..... [3]

[Total: 11]

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**[Turn over**

**3** Calcium reacts with nitrogen to form the ionic compound calcium nitride, $Ca_3N_2$.

**(a)** Draw a diagram, based on the correct formula, which shows the charges on the ions and the arrangement of the electrons around the negative ion.

Use o to represent an electron from a calcium atom.
Use x to represent an electron from a nitrogen atom.

[3]

**(b)** In the lattice of calcium nitride, the ratio of calcium ions to nitride ions is 3 : 2.

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

.....

..... [2]

**(ii)** In terms of ionic charges, explain why the ratio of ions is 3 : 2.

.....

..... [2]

**(c)** The reaction between calcium and nitrogen to form calcium nitride is a redox reaction.

In terms of electron transfer, explain why calcium is the reducing agent.

.....

.....

.....

..... [3]

[Total: 10]

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**4** Ammonia is made by the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.

Typical reaction conditions are:

- finely divided iron catalyst,
- temperature 450 °C,
- pressure 200 atmospheres.

**(a)** Explain why the catalyst is used as a very fine powder and larger pieces of iron are not used.

.....

.....

..... [2]

**(b)** Using the above conditions, the equilibrium mixture contains about 15% ammonia.

State two changes to the reaction conditions which would increase the percentage of ammonia at equilibrium.

.....

.....

..... [2]

**(c)** Suggest why the changes you have described in **(b)** are **not** used in practice.

.....

.....

..... [2]

[Total: 6]

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**[Turn over**

**5** Three common methods of preparing salts are shown below.

method **A** adding an excess of an insoluble base or carbonate or metal to a dilute acid and removing excess by filtration

method **B** using a burette and indicator

method **C** mixing two solutions to obtain the salt by precipitation

For each of the following salt preparations, choose a method, **A**, **B** or **C**. Name any additional reagent which is needed and complete the equation.

**(a)** the soluble salt, nickel chloride, from the insoluble compound nickel carbonate

method .....

reagent .....

word equation .....

[3]

**(b)** the insoluble salt, lead(II) bromide, from aqueous lead(II) nitrate

method .....

reagent .....

ionic equation ..... + ..... $\rightarrow$ $PbBr_2$

[3]

**(c)** the soluble salt, lithium sulfate, from the soluble base lithium hydroxide

method .....

reagent .....

equation .....

[4]

[Total: 10]

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**6** The Atacama desert in Chile has deposits of the salt sodium nitrate. Very large amounts of this salt were exported to Europe for use as a fertiliser. After the introduction of the Haber process in 1913, this trade rapidly diminished.

**(a) (i)** Explain why the introduction of the Haber process reduced the demand for sodium nitrate.

.....

..... [2]

**(ii)** Suggest why surface deposits of sodium nitrate only occur in areas with very low rainfall such as desert areas.

..... [1]

**(iii)** The desert has smaller surface deposits of potassium nitrate.

Suggest why potassium nitrate is a better fertiliser than the sodium salt.

..... [1]

**(b)** All nitrates decompose when heated. The extent to which a nitrate decomposes is determined by the metal in the salt.

**(i)** Sodium nitrate decomposes to form sodium nitrite, $NaNO_2$.

Write the equation for decomposition of sodium nitrate.

..... [2]

**(ii)** Sodium nitrite is a reducing agent.

What would be observed if an excess of sodium nitrite solution was added to a solution of acidified potassium manganate(VII)?

..... [2]

**(iii)** Copper(II) nitrate decomposes to form copper(II) oxide, nitrogen dioxide and oxygen.

What is the relationship between the extent of decomposition and the reactivity of the metal in the nitrate?

.....

..... [1]

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**[Turn over**

**(c)** The equation for the decomposition of copper(II) nitrate is given below.

$$2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$$

**(i)** Predict what you would observe when copper(II) nitrate is heated.

.....

.....

..... [3]

**(ii)** Copper(II) nitrate forms a series of hydrates with the formula $Cu(NO_3)_2.xH_2O$.
All these hydrates decompose to form copper(II) oxide.
1 mole of $Cu(NO_3)_2.xH_2O$ forms 1 mole of CuO.

What is meant by 1 mole of a substance?

.....

..... [2]

**(iii)** 7.26 g of a hydrate, $Cu(NO_3)_2.xH_2O$, formed 2.4 g copper(II) oxide.

number of moles of CuO formed = .....

number of moles of $Cu(NO_3)_2.xH_2O$ in 7.26 g = .....

mass of 1 mole of $Cu(NO_3)_2.xH_2O$ = ..... g

mass of 1 mole of $Cu(NO_3)_2$ is 188 g

the value of *x* in this hydrate = .....

[4]

[Total: 18]

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**7** Alcohols can be made by fermentation or from petroleum.

**(a)** Ethanol can be made by the fermentation of glucose.

$$C_6H_{12}O_6(aq) \xrightarrow{\text{yeast}} 2C_2H_5OH(aq) + 2CO_2(g) \quad \text{exothermic reaction}$$

Yeast are living single-cell fungi which ferment glucose by anaerobic respiration. This reaction is catalysed by enzymes from the yeast.

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

.....

.....

..... [3]

**(ii)** *Anaerobic* means in the absence of oxygen.

Name the products formed from respiration in the **presence** of oxygen.

..... [1]

**(iii)** What are enzymes?

..... [1]

**(iv)** Suggest a method of measuring the rate of this reaction.

.....

..... [1]

**(b)** The following observations were noted.

- When a small amount of yeast was added to the aqueous glucose the reaction started and the solution went slightly cloudy.
- The reaction rate increased and the solution became cloudier and warmer.
- After a while, the reaction rate decreased and eventually stopped, leaving a 14% solution of ethanol in water.

**(i)** Why did the reaction rate increase?

..... [1]

**(ii)** Suggest an explanation for the increase in cloudiness of the solution.

..... [1]

**(iii)** Give **two** reasons why the fermentation stopped.

.....

..... [2]

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**[Turn over**

**(c)** One use of ethanol is in alcoholic drinks.

Give **two** other uses of ethanol.

..... [2]

**(d)** Alcohols can be made from petroleum by the following sequence of reactions.

alkanes from petroleum $\rightarrow$ alkene $\rightarrow$ alcohol

Describe the manufacture of ethanol from hexane, $C_6H_{14}$. Include in your description an equation and type of reaction for each step.

.....

.....

.....

..... [5]

[Total: 17]

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**DATA SHEET**
**The Periodic Table of the Elements**

| | Group | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | | | | | | | | | III | IV | V | VI | VII | 0 |
| | | | | | | | | | | | | | | | | 4 **He** Helium 2 |
| | | | | | 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 |
| | 7 **Li** Lithium 3 | 9 **Be** Beryllium 4 | | | | | | | | | 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 |
| | 23 **Na** Sodium 11 | 24 **Mg** Magnesium 12 | | | | | | | | | 70 **Ga** Gallium 31 | 73 **Ge** Germanium 32 | 75 **As** Arsenic 33 | 79 **Se** Selenium 34 | 80 **Br** Bromine 35 | 84 **Kr** Krypton 36 |
| | 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 | 115 **In** Indium 49 | 119 **Sn** Tin 50 | 122 **Sb** Antimony 51 | 128 **Te** Tellurium 52 | 127 **I** Iodine 53 | 131 **Xe** Xenon 54 |
| | 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 | 204 **Tl** Thallium 81 | 207 **Pb** Lead 82 | 209 **Bi** Bismuth 83 | **Po** Polonium 84 | **At** Astatine 85 | **Rn** Radon 86 |
| | 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 | | | | | | |
| | **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 | a = relative atomic mass |
| X | X = atomic symbol |
| b | 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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