



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

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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.



- 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 |
| ${}_{26}^{56}\text{Fe}$ | | | |
| | 3 | 2 | 4 |
| ${}_{31}^{70}\text{Ga}^{3+}$ | | | |
| | 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]

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]

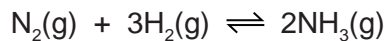
(c) The reaction between calcium and nitrogen to form calcium nitride is a redox reaction.

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

.....
.....
.....
..... [3]

[Total: 10]

4 Ammonia is made by the Haber process.



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]

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]

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]

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



(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 $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$.
 All these hydrates decompose to form copper(II) oxide.
 1 mole of $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$ forms 1 mole of CuO.

What is meant by 1 mole of a substance?

.....
 [2]

(iii) 7.26 g of a hydrate, $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$, formed 2.4 g copper(II) oxide.

number of moles of CuO formed =

number of moles of $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$ in 7.26 g =

mass of 1 mole of $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$ = g

mass of 1 mole of $\text{Cu}(\text{NO}_3)_2$ is 188 g

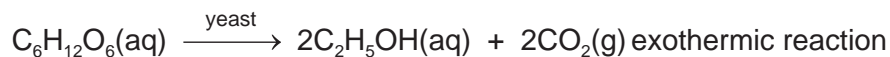
the value of x in this hydrate =

[4]

[Total: 18]

7 Alcohols can be made by fermentation or from petroleum.

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



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.

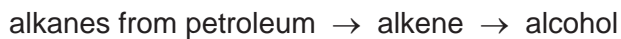
.....
 [2]

(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.



Describe the manufacture of ethanol from hexane, C₆H₁₄. 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 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 | 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 | 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 | 214 At Astatine 85 | 216 Rn Radon 86 | 226 Ra Radium 88 | 227 Ac Actinium 89 | 232 Th Thorium 90 | 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 | 140 Ce Cerium 58 | 141 Pr Praseodymium 59 | 144 Nd Neodymium 60 | 146 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 |

*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.).