



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

CHEMISTRY

0620/42

Paper 4 Theory (Extended)

May/June 2016

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 **12** printed pages.



2

- 1 (a)** For each of the following, give the name of an element from Period 2 (lithium to neon), which matches the description.
Elements may be used once, more than once or not at all.

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

..... [1]

(ii) an element which forms an oxide that is a reactant in photosynthesis

..... [1]

(iii) an element that is a product of photosynthesis

..... [1]

(iv) an element that makes up approximately 78% by volume of the air

..... [1]

(v) an element which has atoms with a full outer shell of electrons

..... [1]

(vi) an element which exists as both diamond and graphite

..... [1]

(vii) an element that reacts vigorously with cold water

..... [1]

(viii) a soft metallic element which is stored in oil

..... [1]

(b) Give the formula of a compound that contains

(i) only boron and oxygen, [1]

(ii) only lithium and nitrogen. [1]

[Total: 10]

3**2 (a) (i)** Define the term *atomic number*.

..... [1]

(ii) Define the term *nucleon number*.

.....

..... [2]

(b) The table shows the number of protons, neutrons and electrons in some atoms or ions.

Complete the table. The first line is given as an example.

particle	number of protons	number of electrons	number of neutrons	symbol or formula
A	6	6	6	$^{12}_6\text{C}$
B	12	12	12	
C	8			$^{16}_8\text{O}^{2-}$
D	11	10	13	

[6]

[Total: 9]

4

3 Gallium is a metallic element in Group III. It has similar properties to aluminium.

- (a) (i)** Describe the structure and bonding in a metallic element.
You should include a labelled diagram in your answer.

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

- (ii)** Explain why metallic elements such as gallium are good conductors of electricity.

..... [1]

- (b)** Give the formula of

gallium(III) chloride,

gallium(III) sulfate. [2]

- (c)** Gallium(III) oxide, Ga_2O_3 , is amphoteric.

- (i)** Write the chemical equation for the reaction between gallium(III) oxide and dilute nitric acid to form a salt and water only.

..... [2]

- (ii)** The reaction between gallium(III) oxide and sodium hydroxide solution forms only water and a salt containing the negative ion $\text{Ga}_2\text{O}_4^{2-}$.

Write the chemical equation for this reaction.

..... [2]

- (d)** Alloys of gallium and other elements are often more useful than the metallic element itself.

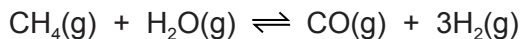
Suggest **two** reasons why alloys of gallium are more useful than the metallic element.

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

[Total: 12]

5

- 4 Hydrogen can be manufactured from methane by steam reforming.



The reaction is carried out using a nickel catalyst at temperatures between 700 °C and 1100 °C and using a pressure of one atmosphere.

The forward reaction is endothermic.

- (a) What is meant by the term *catalyst*?

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

- (b) Suggest **two** reasons why a temperature lower than 700 °C is not used.

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

- (c) Suggest **one** advantage of using a pressure greater than one atmosphere.

..... [1]

- (d) Suggest **one** disadvantage of using a pressure greater than one atmosphere.

..... [1]

- (e) Hydrogen can also be manufactured by electrolysis. The electrolyte is concentrated aqueous sodium chloride. The electrodes are inert.

The products of electrolysis are hydrogen, chlorine and sodium hydroxide.

- (i) Define the term *electrolysis*.

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

- (ii) Name a substance that can be used as the inert electrodes.

..... [1]

- (iii) Write an ionic half-equation for the reaction in which hydrogen is produced.

..... [1]

- (iv) Where is hydrogen produced in the electrolytic cell?

..... [1]

6

(v) Describe a test for chlorine.

test

result

[2]

(f) The electrolysis of concentrated aqueous sodium chloride can be represented by the following word equation.

sodium chloride + water → sodium hydroxide + hydrogen + chlorine

Construct a chemical equation to represent this reaction. Do not include state symbols.

..... [2]

(g) State one use of

chlorine,

sodium hydroxide,

hydrogen.

[3]

[Total: 18]

7

5 (a) Hydrocarbons are compounds which contain hydrogen and carbon only.

- 10 cm³ of a gaseous hydrocarbon, C_xH_y, are burned in 100 cm³ of oxygen, which is an excess of oxygen.
- After cooling to room temperature and pressure, there is 25 cm³ of unreacted oxygen, 50 cm³ of carbon dioxide and some liquid water.

All volumes are measured under the same conditions of temperature and pressure.

(i) What is meant by an excess of oxygen?

..... [1]

(ii) What was the volume of oxygen that reacted with the hydrocarbon?

..... [1]

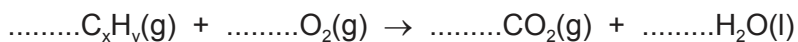
(iii) Complete the table below to express the smallest whole number ratio of

volume of hydrocarbon reacted : volume of oxygen reacted : volume of carbon dioxide produced

	volume of hydrocarbon reacted	volume of oxygen reacted	volume of carbon dioxide produced
smallest whole number ratio of volumes			

[1]

(iv) Use your answer to (a)(iii) to find the mole ratio in the equation below. Complete the equation and deduce the formula of the hydrocarbon.



formula of hydrocarbon = [2]

- (b)** Cracking is used to convert long chain alkanes into shorter chain alkanes and alkenes. Alkenes are unsaturated compounds.

Decane, $C_{10}H_{22}$, can be cracked to give propene and one other product.

- (i)** Complete the chemical equation.



- (ii)** What is meant by the term *unsaturated*?

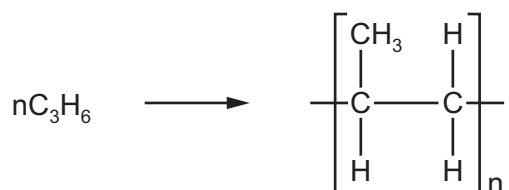
..... [1]

- (iii)** Describe a test to show that propene is an unsaturated compound.

test

result [2]

- (c)** Propene can be polymerised. The only product is polypropene. The equation for the polymerisation is:



- (i)** Name the type of polymerisation that occurs.

..... [1]

- (ii)** Deduce the maximum mass of polypropene that could be produced from 1 kg of propene.

..... kg [1]

- (iii)** Give the empirical formula of

propene,

polypropene. [2]

[Total: 13]

6 Zinc is extracted from an ore called zinc blende, which consists mainly of zinc sulfide, ZnS .

(a) (i) The zinc sulfide in the ore is first converted into zinc oxide.

Describe how zinc oxide is made from zinc sulfide.

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

(ii) Write a chemical equation for the reaction in **(a)(i)**.

..... [2]

(b) Zinc oxide is converted into zinc. Zinc oxide and coke are fed into a furnace. Hot air is blown into the bottom of the furnace.

Zinc has a melting point of 420°C and a boiling point of 907°C . The temperature inside the furnace is over 1000°C .

(i) Explain how zinc oxide is converted into zinc. Your answer should include details of how the heat is produced and equations for all the reactions you describe.

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

(ii) Explain why the zinc produced inside the furnace is a gas.

..... [1]

(iii) State the name of the physical change for conversion of gaseous zinc into molten zinc.

..... [1]

10

- (c) Rusting of steel can be prevented by coating the steel with a layer of zinc.

Explain, in terms of electron transfer, why steel does **not** rust even if the layer of zinc is scratched so that the steel is exposed to air and water.

.....

.....

.....

.....

..... [4]

- (d) When a sample of steel is added to dilute hydrochloric acid, an aqueous solution of iron(II) chloride, FeCl_2 , is formed.

When a sample of rust is added to dilute hydrochloric acid, an aqueous solution of iron(III) chloride, FeCl_3 , is formed.

- (i) Aqueous sodium hydroxide is added to the solutions of iron(II) chloride and iron(III) chloride.

Complete the table below, showing the observations you would expect to make.

	iron(II) chloride solution	iron(III) chloride solution
aqueous sodium hydroxide		

[2]

Solutions of iron(II) chloride and iron(III) chloride were added to solutions of potassium iodide and acidified potassium manganate(VII). The results are shown in the table.

	iron(II) chloride solution	iron(III) chloride solution
potassium iodide solution	no change	solution turns from colourless to brown
acidified potassium manganate(VII) solution	solution turns from purple to colourless	no change

- (ii) What **types** of substance cause potassium iodide solution to turn from colourless to brown?

..... [1]

- (iii) What **types** of substance cause acidified potassium manganate(VII) solution to turn from purple to colourless?

..... [1]

- (iv) Which **ion** in iron(III) chloride solution causes potassium iodide solution to turn from colourless to brown?

..... [1]

- (v) Which **ion** in iron(II) chloride solution causes acidified potassium manganate(VII) solution to turn from purple to colourless?

..... [1]

[Total: 18]

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.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

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.

Group

Group

lanthanoids

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