



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
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CHEMISTRY

0620/21

Paper 2

May/June 2015

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 in the spaces at the top of this page.

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.

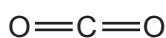
The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **16** printed pages.

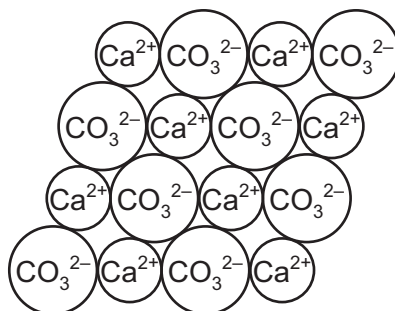


1 The structures of six substances containing carbon are shown below.

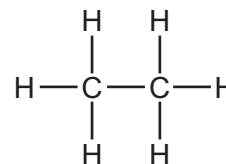
A



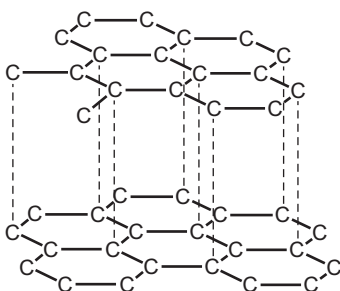
B



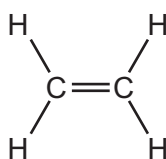
C



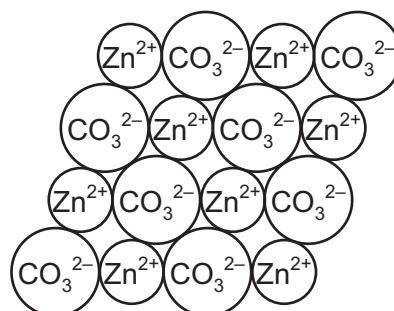
D



E



F



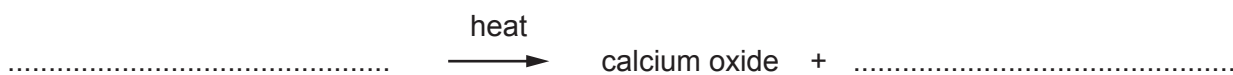
Answer the following questions about these substances.

Each substance may be used once, more than once or not at all.

(a) Which substance, **A**, **B**, **C**, **D**, **E** or **F**,

- (i) is an element, [1]
- (ii) is a saturated hydrocarbon, [1]
- (iii) is added to the blast furnace to help in the extraction of iron, [1]
- (iv) has a giant covalent structure, [1]
- (v) is a product of respiration, [1]
- (vi) contains a metal ion with 20 protons? [1]

(b) Complete the word equation for the thermal decomposition of substance **B**.



[2]

(c) Describe a test for substance **A**.

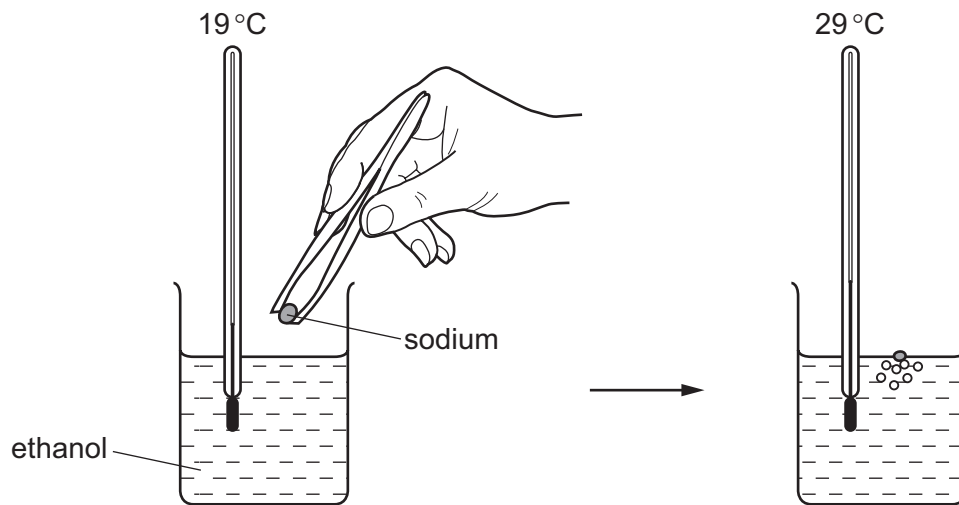
test

result

[2]

[Total: 10]

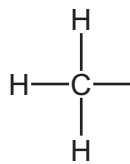
- 2 A small piece of sodium is added to some ethanol. The temperature was measured before and after the sodium was added.



- (a) Explain how this experiment shows that the reaction is exothermic.

..... [1]

- (b) Complete the structure of ethanol to show all atoms and bonds.



[1]

(c) Ethanol can be made by the reaction of steam with ethene.

(i) Write the word equation for this reaction.

..... [1]

(ii) What conditions are needed for this reaction?
Tick **two** boxes.

enzyme catalyst

high temperature (300 °C)

low temperature (10 °C)

phosphoric acid catalyst

presence of light

[2]

(iii) What will be observed when ethene is bubbled through aqueous bromine?

..... [1]

(d) Ethanol can also be made by fermentation.

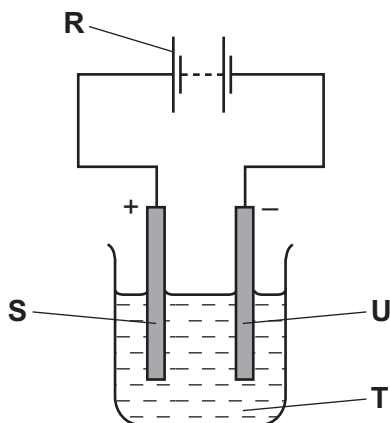
The fermentation mixture contains solids as well as an aqueous solution of ethanol.

Suggest how the ethanol can be purified from this fermentation mixture.

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

[Total: 9]

- 3 The diagram shows the apparatus used for the electrolysis of molten sodium bromide.



- (a) (i) What does the term *electrolysis* mean?

.....
 [1]

- (ii) Which letter, **R**, **S**, **T** or **U**, in the diagram above represents the cathode?

..... [1]

- (b) Complete the word equation for the electrolysis of molten sodium bromide.

sodium bromide → + [2]

- (c) A solution of sodium bromide in water is neutral.

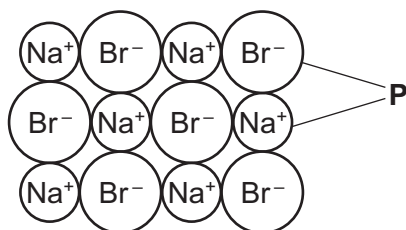
Which **one** of the following pH values is neutral?

Put a ring around the correct answer.

pH 0 pH 6 pH 7 pH 10 pH 14

[1]

- (d) The diagram below shows the arrangement of the particles in sodium bromide at room temperature.



- (i) Give the name of the type of particles, **P**, present in sodium bromide.

..... [1]

- (ii) What is the state of sodium bromide at room temperature?
Use the information in the diagram to explain your answer.

.....

 [2]

- (e) Sodium bromide can be made by heating sodium in bromine vapour.

Complete the balanced symbol equation for this reaction.



[2]

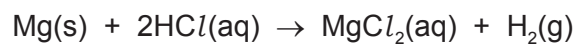
- (f) Bromine has two naturally-occurring isotopes.

What is the meaning of the term *isotope*?

.....
 [1]

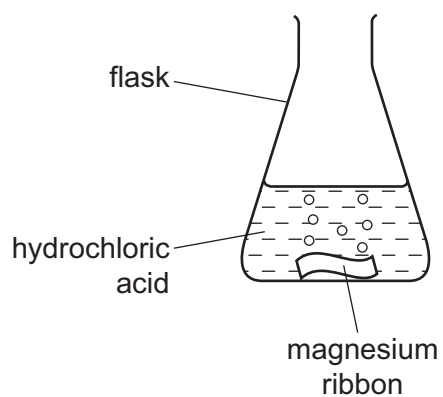
[Total: 11]

- 4 A student investigated the reaction of magnesium with dilute hydrochloric acid.



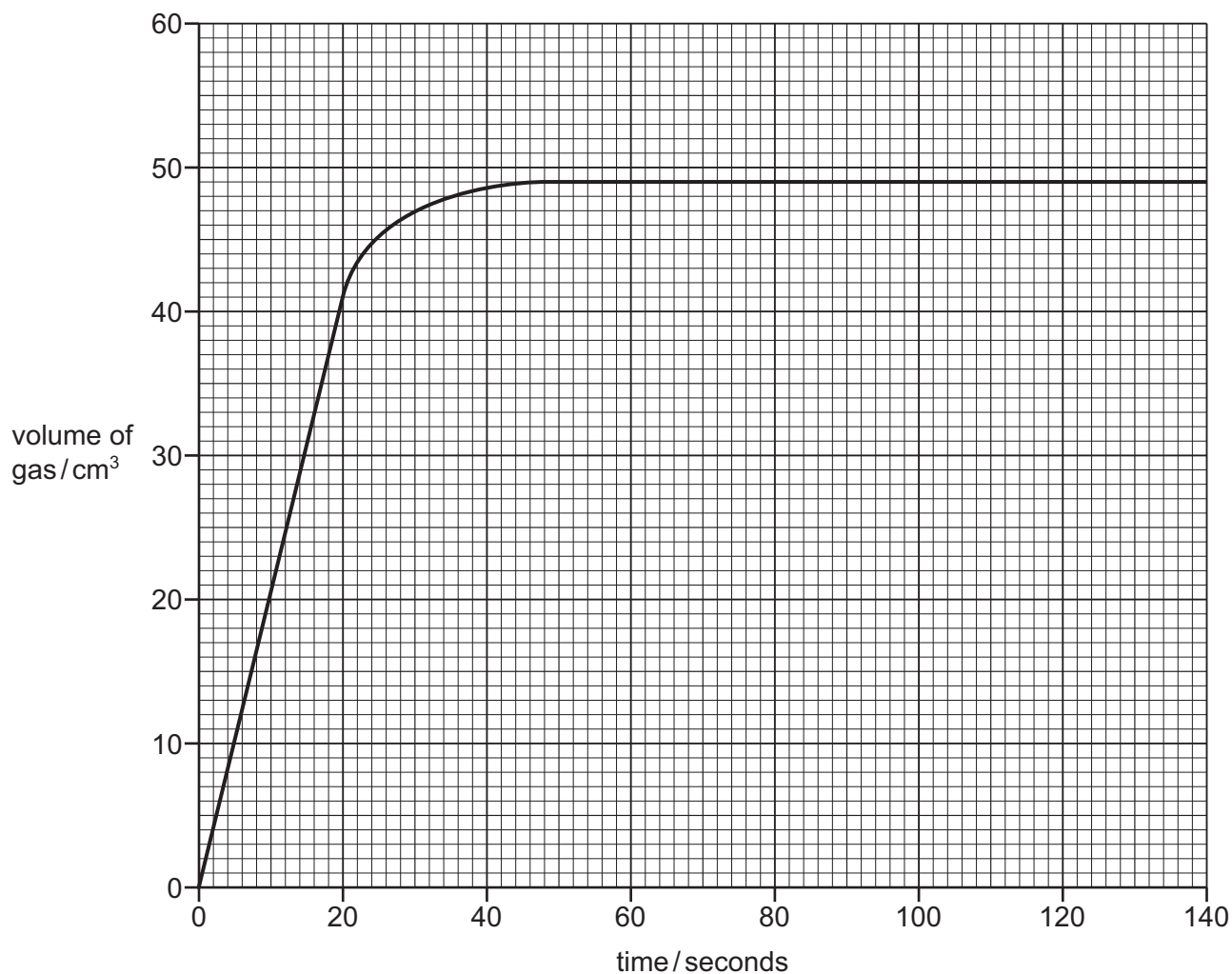
She measured the volume of gas given off at various times during the reaction.

- (a) Complete the diagram of the apparatus she would use to measure the volume of the gas given off.
Label the apparatus.



[3]

- (b) The student carried out the reaction at 25 °C using magnesium ribbon. Her results are shown below.



- (i) How long does it take for the reaction to stop?

..... seconds [1]

- (ii) What is the volume of hydrogen made after 20 seconds?

..... cm³ [1]

- (iii) On the grid above, draw a line to show how the volume of gas changes when the experiment is carried out at 15 °C and all other conditions remain the same. [2]

- (iv) The student repeated the experiment using magnesium powder. All other conditions remain the same.

How does the rate of reaction with magnesium powder compare with the rate of reaction with magnesium ribbon?

..... [1]

(c) (i) Draw a diagram to show the electron arrangement in a molecule of hydrogen.

[1]

(ii) What type of bonding is present in a hydrogen molecule?

..... [1]

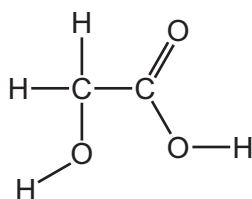
(d) Magnesium chloride is a salt.
Magnesium sulfate is also a salt.

Give the name of two **compounds** which react together to form magnesium sulfate.

..... and [2]

[Total: 12]

5 The structure of glycolic acid is shown below.



(a) On the structure above, put a ring around the carboxylic acid functional group. [1]

(b) Glycolic acid is prepared by heating a mixture of methanal, carbon monoxide and water with a sulfuric acid catalyst.

(i) The formula of methanal is HCHO.

Calculate the relative molecular mass of methanal.

[1]

(ii) What is the function of the catalyst?

..... [1]

(iii) State **one** adverse effect of carbon monoxide on humans.

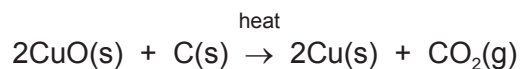
..... [1]

(c) Glycolic acid can also be prepared by the reduction of oxalic acid.

(i) What does the term *reduction* mean?

..... [1]

(ii) Give the name of the reducing agent in the following reaction.



name of reducing agent [1]

- (d) Glycolic acid is found in unripe grapes.
Grape skins contain a number of different coloured pigments.

Describe how you could obtain a solution of these pigments from grape skins.

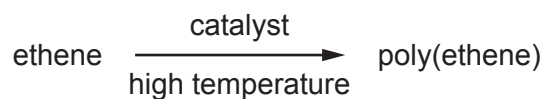
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.....

.....

..... [3]

- (e) Glycolic acid can undergo polymerisation.
Ethene can also undergo polymerisation.
The equation for the polymerisation of ethene is shown below.



Give the name of the monomer in this equation.

..... [1]

- (f) Long chain alkanes can be cracked to produce shorter chain alkanes and alkenes.

- (i) What conditions are needed for cracking?

.....

..... [2]

- (ii) Complete the equation for the cracking of hexadecane, $C_{16}H_{34}$, to form octane, C_8H_{18} , and ethene only.



[Total: 13]

6 The table shows some physical properties of the metals, **A**, **B**, **C** and **D**.

metal	electrical conductivity	density in g/cm ³	boiling point /°C	hardness
A	fairly good	8.64	765	hard
B	good	0.97	883	soft
C	good	7.14	907	hard
D	good	0.86	760	soft

(a) (i) Which **two** metals in the table are Group I metals?
Give a reason for your answer.

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

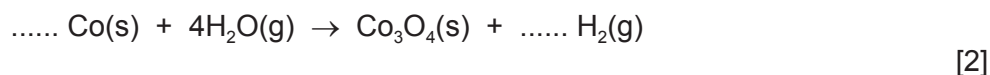
(ii) None of the metals **A**, **B**, **C** or **D** are transition elements.

Give **two** properties of transition elements or their compounds that make them different from metals **A**, **B**, **C** and **D**.

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

(iii) Cobalt is a transition element.
When it is heated very strongly in steam, hydrogen is given off.

Complete the symbol equation for this reaction.



(iv) Iron is also a transition element.

Describe how iron is converted to steel.
In your answer, refer to basic oxides and oxygen.

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

(b) When lithium reacts with water it moves about on the surface of the water, bubbles are seen and the lithium disappears slowly.

Predict how the reaction of potassium with water compares with the reaction of lithium with water.

In your answer, include

- any differences in observations,
- the names of the products formed when lithium and potassium react with water.

.....

.....

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.....

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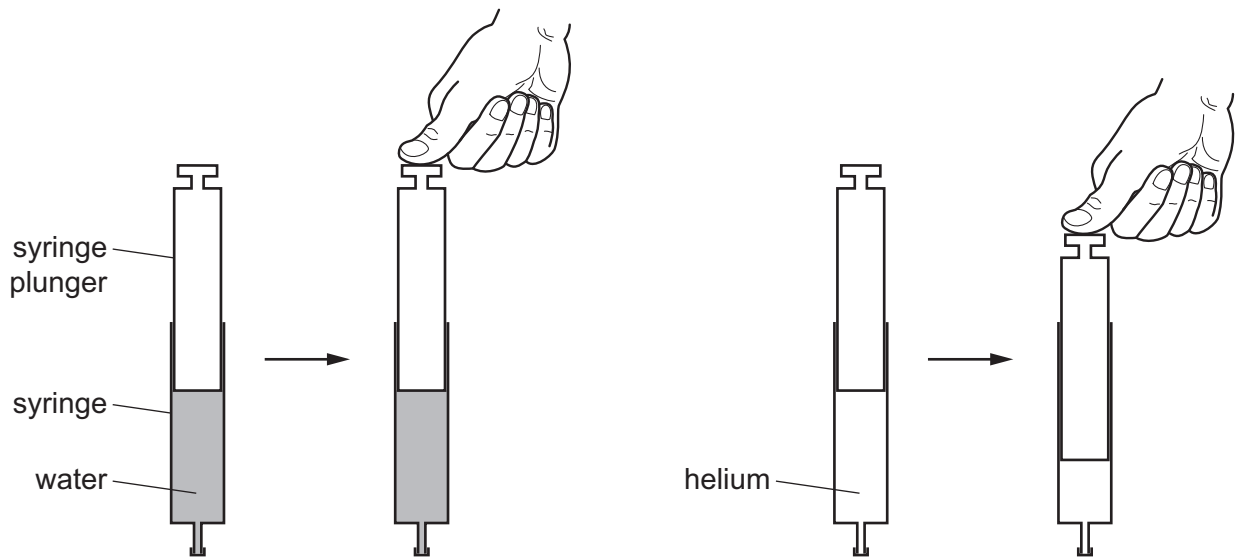
.....

.....

..... [5]

[Total: 14]

- 7 (a) A student took two identical syringes. He filled one with water and the other with helium gas and sealed the end of both syringes. He then pushed the syringe plungers with equal force. The diagram shows what happened.



Describe and explain these results using ideas about particles in liquids and gases.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) The table shows some properties of the Group 0 elements helium, neon, argon and krypton.

element	electron arrangement	density of the liquefied gas in g/cm ³	melting point /°C	boiling point /°C
helium	2	0.15	-272	-269
neon		1.20	-248	-245
argon	2,8,8	1.40	-189	-186
krypton	2,8,18,8	2.15	-157	-152

(i) Describe how the density of the liquefied noble gases changes down Group 0.

..... [1]

(ii) Deduce the electron arrangement of neon.

..... [1]

(iii) What is the state of argon at -188°C?

..... [1]

(iv) Which element in the table has the highest melting point?

..... [1]

(c) The table below shows the number of electrons, protons and neutrons in some isotopes of helium, argon and neon.

Complete the table.

element	number of electrons	number of protons	number of neutrons
${}^3_2\text{He}$	2	2
${}^{38}_{18}\text{Ar}$	18	20
.....	10	10	11

[3]

[Total: 11]

DATA SHEET
The Periodic Table of the Elements

Group		I	II	III	IV	V	VI	VII	0	
		1 H Hydrogen 1								
		2 He Helium 2								
3	4	7 Li Lithium	9 Be Beryllium							10 Ne Neon
11	12	23 Na Sodium	24 Mg Magnesium	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	18 Ar Argon	
19	20	39 K Potassium	40 Ca Calcium	13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	36 Kr Krypton	
37	38	87 Rb Rubidium	88 Sr Strontium	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	54 Xe Xenon	
55	56	137 Cs Caesium	138 Ba Barium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	86 Rn Radon	
87	88	226 Fr Francium	227 Ra Radium	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine		
		89 Ac Actinium †								
		90-103 Lanthanoid series								
		94-103 Actinoid series								
		<div style="display: flex; justify-content: space-between; align-items: center;"> a X b </div>								
		† 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.).