



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CHEMISTRY

0620/22

Paper 2

October/November 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.

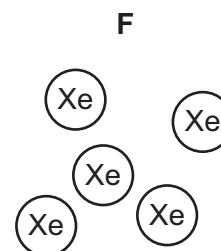
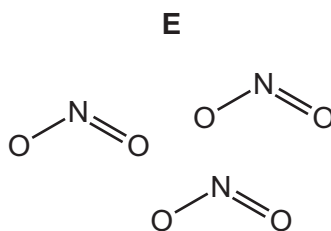
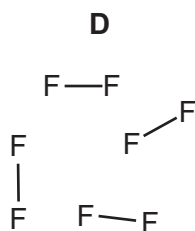
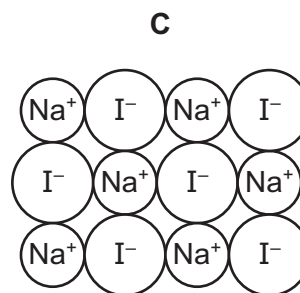
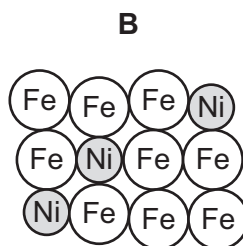
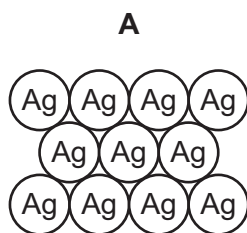
The number of marks is given in brackets [] at the end of each question or part question.

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 **14** printed pages and **2** blank pages.



1 The structures of six substances are shown below.



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 a simple molecular compound, [1]
- (ii) is an alloy, [1]
- (iii) is a compound, whose aqueous solution gives a yellow precipitate on addition of aqueous silver nitrate, [1]
- (iv) is an atmospheric pollutant arising from reactions taking place in car engines, [1]
- (v) is a diatomic molecule, [1]
- (vi) conducts electricity when molten but not when solid? [1]

(b) Substance **A** is an element.

What is meant by the term *element*?

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

(c) Substance **D** oxidises water to oxygen.

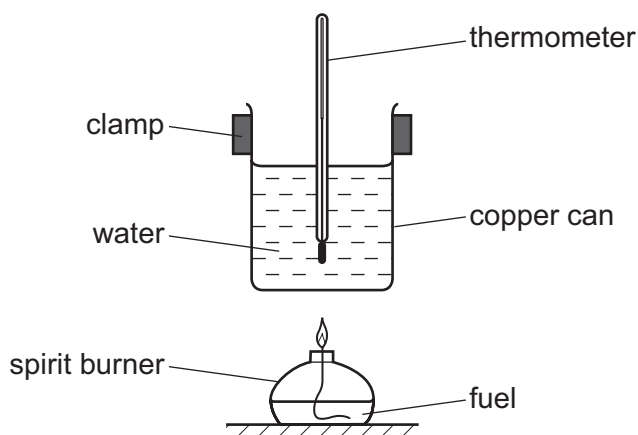
Complete the symbol equation for this reaction.



[2]

[Total: 9]

- 2 A student measured the highest temperature reached when four different fuels were burned. He used the apparatus shown below.



- (a) The same amount of each fuel was burned.

Suggest **two** other things which the student should keep constant to make the experiment a fair test.

1.

2.

[2]

- (b) Is burning an exothermic or an endothermic reaction?
Give a reason for your answer.

..... [1]

- (c) The table below shows the results.

fuel	molecular formula	initial temperature / °C	final temperature / °C
ethanol	C ₂ H ₆ O	23	44
hexane	C ₆ H ₁₄	17	46
pentane	C ₅ H ₁₂	22	48
propanol	C ₃ H ₈ O	21	45

- (i) Which fuel gave the highest temperature change?

..... [1]

- (ii) Which fuel has the highest relative molecular mass?
You are not expected to do any calculations.

..... [1]

(d) Methane is a fuel.

(i) Draw the structure of methane showing all atoms and all bonds.

[1]

(ii) Which **one** of the following fuels is largely methane?
Tick **one** box.

coal	<input type="checkbox"/>
fuel oil	<input type="checkbox"/>
gasoline	<input type="checkbox"/>
natural gas	<input type="checkbox"/>

[1]

(e) Pentane and hexane belong to the same homologous series.

(i) How can you tell this from their names?

..... [1]

(ii) Complete the following sentence about a homologous series using words from the list below.

acidic	alcohol	compounds	density	different
elements	functional	masses	properties	solid

A homologous series is a family of similar with similar
due to the presence of the same group.

[3]

[Total: 11]

- 3 The order of reactivity of zinc, magnesium, calcium and barium is shown below.

zinc → magnesium → calcium → barium

least reactive \longrightarrow most reactive

- (a) Equal-sized pieces of zinc, magnesium, calcium and barium are placed in water. Some observations from these reactions are shown in the table.

- (i) Complete the box for barium.

metal	observations
zinc	no reaction with cold water
magnesium	gives a few bubbles with hot water, does not disappear
calcium	gives off bubbles steadily with cold water, gets smaller slowly
barium	

[2]

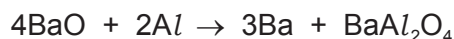
- (ii) Give the name of a metal in the above table which is extracted by heating with carbon.

..... [1]

- (iii) Suggest why barium cannot be extracted using carbon.

..... [1]

- (b) Barium can be extracted by heating barium oxide with aluminium.



How does this equation show that barium oxide gets reduced?

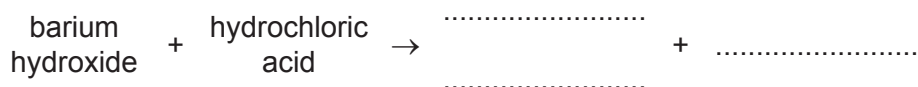
..... [1]

- (c) A solution of barium hydroxide is alkaline.

- (i) Describe how you would show that barium hydroxide solution is alkaline.

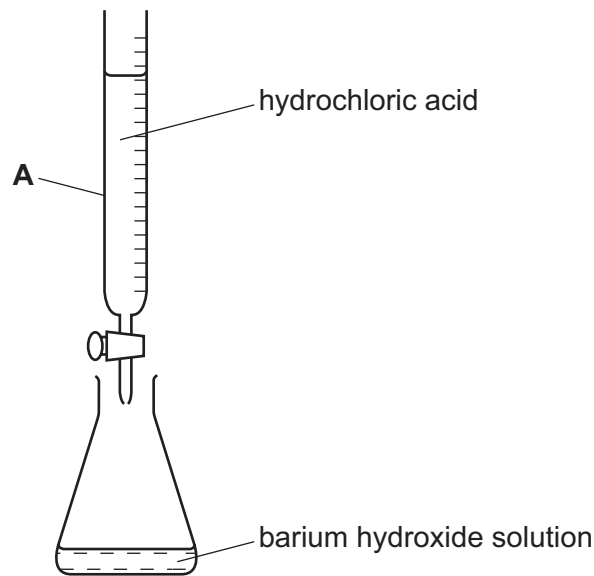
..... [1]

- (ii) Complete the word equation for the reaction of barium hydroxide with hydrochloric acid.



[2]

- (d) A student used the apparatus shown below to calculate the concentration of barium hydroxide solution.



- (i) Give the name of the piece of apparatus labelled **A**.

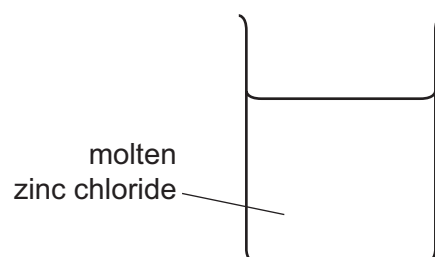
..... [1]

- (ii) The hydrochloric acid is added to the barium hydroxide solution in the flask until the acid is in excess.

Describe how the pH of the solution changes as the acid is added.

.....
 [2]

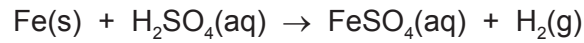
- (e) Complete the diagram below for the electrolysis of molten zinc chloride. Label the electrodes and the power source.



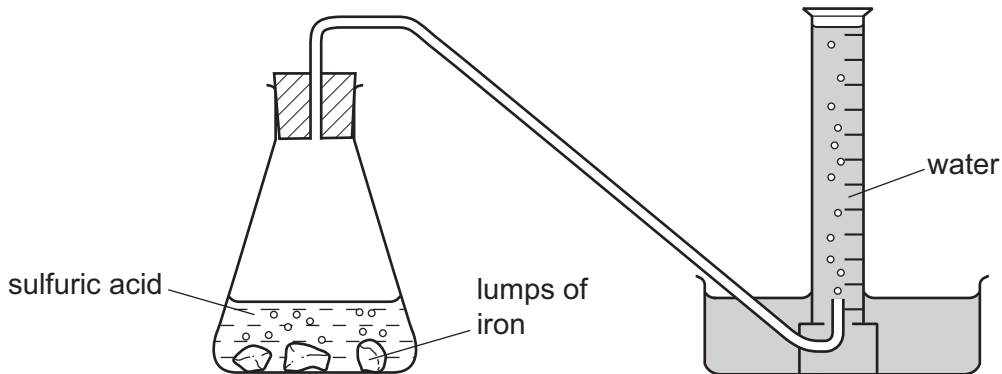
[3]

[Total: 14]

- 4 A student investigated the reaction of lumps of iron with sulfuric acid.



She used the apparatus shown below.



- (a) (i) Describe how this apparatus can be used to investigate the rate of this reaction.

.....

 [3]

- (ii) Describe how the rate of reaction would differ if smaller lumps of iron were used. All other conditions remain the same.

..... [1]

- (b) The student investigated the effect of temperature on the reaction rate.

- (i) State **three** factors which the student should keep the same in each experiment.

1.
 2.
 3. [3]

(ii) The table shows how the rate of reaction changed with temperature.

temperature /°C	rate of reaction in cm ³ /s
20	2.2
30	4.4
40	8.8
50	17.6

Use the information in the table to describe how the rate of reaction changed with temperature.

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

(c) Iron(II) sulfate can be prepared by adding excess iron to sulfuric acid.

Describe how you could obtain pure dry crystals of iron(II) sulfate from the reaction mixture in the conical flask.

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

[Total: 12]

5 A crystal of sulfur melts when heated.

- (a) Explain, using the kinetic particle theory, the differences between the arrangement and motion of the particles in sulfur crystals and liquid sulfur.

.....

.....

.....

.....

..... [4]

(b) Sulfur dioxide is an atmospheric pollutant.

- (i) Describe how sulfur dioxide is formed and how it gets into the atmosphere.

.....

.....

..... [2]

- (ii) What type of oxide is sulfur dioxide?

..... [1]

- (iii) Flue gas desulfurisation removes sulfur dioxide from exhaust gases in factories.

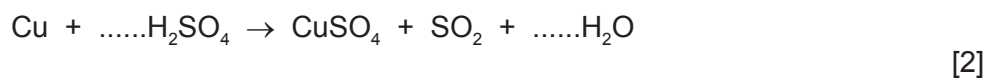
Describe the process of flue gas desulfurisation.

.....

..... [2]

- (iv) Sulfur dioxide is also formed when copper is reduced by hot concentrated sulfuric acid.

Complete the symbol equation for this reaction.



(c) Copper is a metal.

Give **two** physical properties which are characteristic of all metals.

1.
2.
- [2]

- (d) The table below gives some properties of some metals that are used to make electrical cables and wires.

metal	strength	electrical conductivity	melting point /°C	price \$/kg
aluminium	comparatively weak	good	660	1.5
copper	strong	very good	1093	29
steel	strong	fairly good	1535	2.1
silver	fairly strong	very good	962	635

- (i) Suggest why aluminium with a steel core is used for overhead power cables.

.....
 [2]

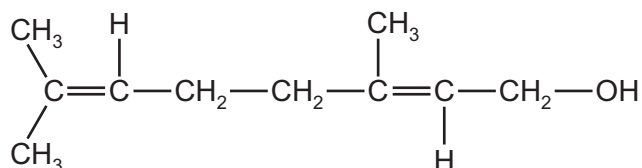
- (ii) Copper is used in electrical wiring in the home rather than silver.

Suggest why.

..... [1]

[Total: 16]

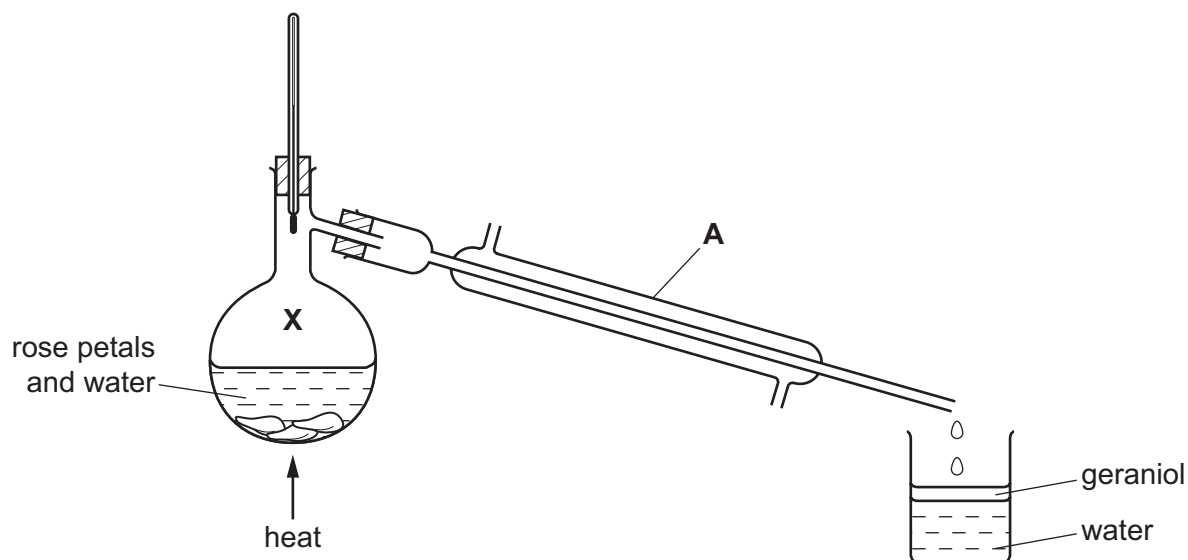
- 6 Geraniol is a chemical found in rose petals.
The structure of geraniol is shown below.



- (a) (i) On the structure above, put a ring around the alcohol functional group. [1]
- (ii) Is geraniol a saturated or an unsaturated compound?
Give a reason for your answer.

..... [1]

- (b) Geraniol can be extracted from rose petals by steam distillation using the apparatus shown below. The geraniol is carried off in small droplets with the steam.



- (i) Give the name of the piece of apparatus labelled A. [1]
-

- (ii) The vapour at point X is a mixture of geraniol and steam.
Give **one** property of a mixture which distinguishes it from a compound.
..... [1]

- (iii) The geraniol and water are collected in the beaker.
What information in the diagram above shows that geraniol is less dense than water?
..... [1]

(c) Geraniol can also be extracted from rose petals by grinding the petals in ethanol.

(i) Draw the structure of ethanol showing all atoms and all bonds.

[1]

(ii) Complete the word equation for the complete combustion of ethanol.

ethanol + oxygen → +

[2]

(d) What is the percentage by volume of oxygen in the air?

..... [1]

[Total: 9]

7 Beryllium is in Group II and Period 2 of the Periodic Table.

(a) Describe the structure of a beryllium atom.
In your answer, refer to

- the type and number of each subatomic particle present,
- the charges on each type of subatomic particle,
- the position of each type of subatomic particle in the atom.

.....

.....

.....

.....

.....

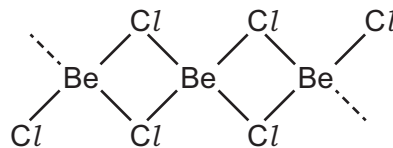
.....

.....

.....

..... [5]

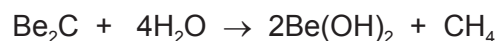
(b) Part of the structure of beryllium chloride is shown below.



Deduce the simplest formula for beryllium chloride.

..... [1]

(c) Beryllium carbide, Be_2C , reacts with water. Beryllium hydroxide and methane are formed.



(i) Calculate the relative formula mass of beryllium hydroxide.

[2]

(ii) Describe **one** adverse effect of methane on the environment.

..... [1]

[Total: 9]

DATA SHEET
The Periodic Table of the Elements

		Group															
I	II	III	IV	V	VI	VII	0										
		1 H Hydrogen 1											4 He Helium 2				
7 Li Lithium 3	9 Be Beryllium 4											20 Ne Neon 10					
23 Na Sodium 11	24 Mg Magnesium 12	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										
39 K Potassium 19	40 Ca Calcium 20	48 Ti Titanium 22	45 Sc Scandium 21	59 Co Cobalt 27	56 Fe Iron 26	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	84 Kr Krypton 36				
85 Rb Rubidium 37	88 Sr Strontium 38	91 Zr Zirconium 40	89 Y Yttrium 39	101 Ru Ruthenium 44	101 Ru Ruthenium 44	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	131 Xe Xenon 54				
133 Cs Caesium 55	137 Ba Barium 56	178 Hf Hafnium 72	139 La Lanthanum 57	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 Rn Radon 86				
226 Ra Radium 88	227 Ac Actinium 89											226 Ra Radium 88					
*58-71 Lanthanoid series													175 Lu Lutetium 71				
†90-103 Actinoid series													103 Lr Lawrencium 103				
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 20px;">a</td> <td style="width: 20px;">X</td> </tr> <tr> <td style="width: 20px;">b</td> <td style="width: 20px;"></td> </tr> </table>													a	X	b		173 Yb Ytterbium 70
a	X																
b																	
<p>a = relative atomic mass X = atomic symbol b = proton (atomic) number</p>													169 Tm Thulium 69				
													167 Er Erbium 68				
													165 Ho Holmium 67				
													162 Dy Dysprosium 66				
													159 Tb Terbium 65				
													157 Gd Gadolinium 64				
													152 Eu Europium 63				
													150 Sm Samarium 62				
													144 Nd Neodymium 60				
													141 Pr Praseodymium 59				
													140 Ce Cerium 58				
													132 Am Americium 95				
													131 U Uranium 92				
													129 Np Neptunium 93				
													128 Pu Plutonium 94				
													127 Pa Protactinium 91				
													123 Th Thorium 90				
													122 Cm Curium 96				
													121 Bk Berkelium 97				
													120 Cf Californium 98				
													119 Es Einsteinium 99				
													118 Fm Fermium 100				
													117 Md Mendelevium 101				
													116 No Nobelium 102				

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