



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CHEMISTRY

0620/02

Paper 2

October/November 2009

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 need to use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the periodic table is printed on page 20.

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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **17** printed pages and **3** blank pages.



1 The list shows some non-metallic elements.

bromine
carbon
fluorine
krypton
nitrogen
oxygen

For
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Use

(a) Which **two** elements in the list are in the same Group of the Periodic Table?

..... and [1]

(b) Which element in the list has the highest proton number?

..... [1]

(c) Which **two** of these elements make up most of the air?

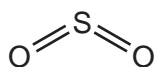
..... and [1]

(d) Bromine and fluorine form a compound with the formula BrF_5 .
Calculate the relative molecular mass of BrF_5 .

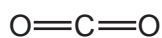
[1]

(e) The diagram shows the structure of some compounds containing oxygen.

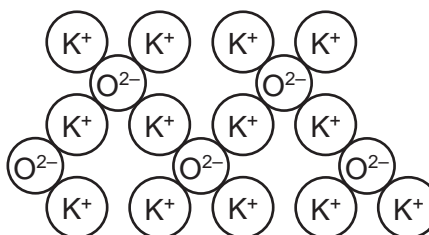
A



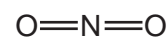
B



C



D



(i) What type of oxide is compound **C**?

..... [1]

- (ii) Compound **A** is an atmospheric pollutant.
Describe the source of compound **A** and state its effect on the environment.

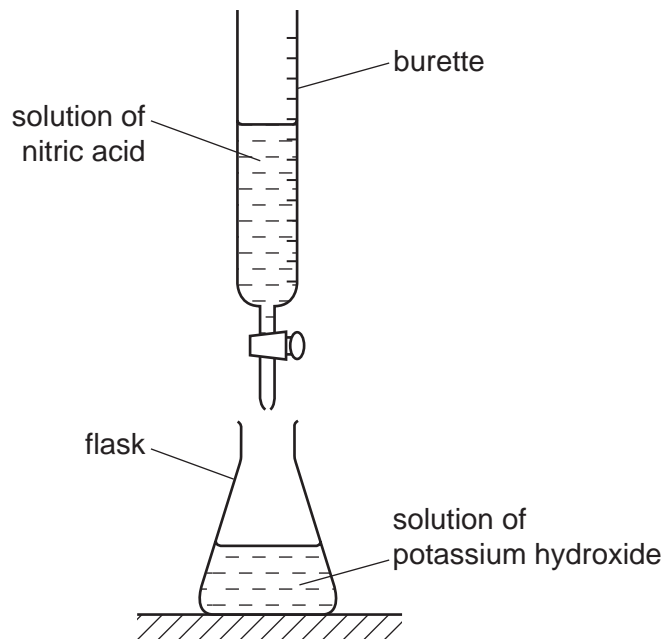
Source

Effect on the environment

..... [2]

- (iii) In the presence of air, compound **D** reacts with water to form nitric acid.

A student used the apparatus below to add an aqueous solution of nitric acid to an aqueous solution of potassium hydroxide. He added the acid until it was in excess.



Describe how the pH of the solution in the flask changes as the nitric acid is added until the acid is in excess.

.....

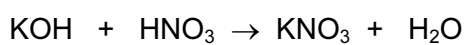
.....

..... [3]

- (iv) Describe how you can measure this pH change.

..... [1]

- (v) The equation for the reaction is



State the name of the salt formed in this reaction.

..... [1]

[Total: 12]

- 2 (a) Link the terms in the boxes on the left with the definitions on the right. The first one has been done for you.

atom	a substance containing different atoms or ions bonded together
compound	a substance made up of one type of atom
element	the smallest part of an element which takes part in a chemical reaction
ion	the smallest group of covalently bonded atoms which can exist on its own
molecule	a charged atom or group of atoms

[4]

- (b) Which **two** of the following are mixtures?
Tick two boxes.

air

graphite

sodium chloride

steel

[1]

- (c) (i) Draw a labelled diagram to show the atomic structure of an atom of helium. In your diagram include the structure of the nucleus.

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[4]

- (ii) State a use for helium.

..... [1]

- (iii) Which one of these statements about helium is correct?

helium is in Period 2 of the Periodic Table

helium is a liquid at room temperature

helium is unreactive

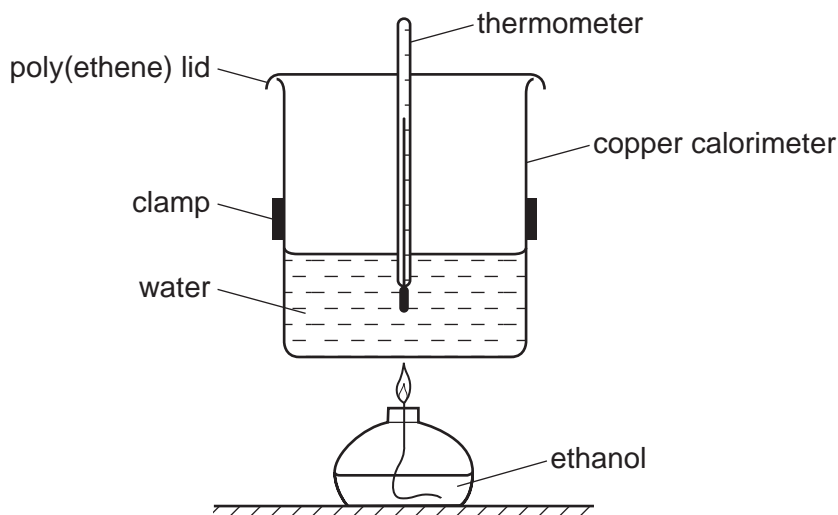
helium has an incomplete outer shell of electrons

[1]

[Total: 11]

- 3 A student used the apparatus shown to calculate the energy released when ethanol burns.

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Use



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

[1]

- (b) The energy released by the burning ethanol raises the temperature of the water in the copper calorimeter.

- (i) Which one of these words best describes the energy change when ethanol burns? Put a ring around the correct answer.

electrolytic **electronic** **endothermic** **exothermic**

[1]

- (ii) When 4.6 g of ethanol is burnt, 5.4 g of water is formed.
Calculate the mass of water formed when 13.8 g of ethanol is burnt.

[1]

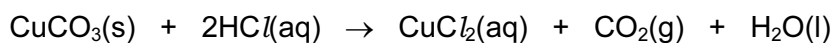
(iii) Complete the equation for the combustion of ethanol.



(c) The calorimeter is made of copper. Copper is a transition metal.
State two properties which distinguish transition metals from Group I metals.

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

(d) When copper is left exposed to the air for some time, a coating of copper carbonate forms on its surface. The equation shows how copper carbonate reacts with hydrochloric acid.



(i) Describe two observations that can be made as this reaction happens.

1.
2. [2]

(ii) State the meaning of the symbol (aq).

..... [1]

(e) The calorimeter lid is made of poly(ethene).
Complete these sentences about poly(ethene) using words from the list.

acids	addition	condensation	ethane	ethene
	monomers		polymer	

Poly(ethene) is a formed by the of ethene molecules.

In this reaction the ethene molecules can be described as

[3]

[Total: 12]

4 Caesium is a metal in Group I of the Periodic Table.

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Use

(a) State two physical properties of caesium.

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

(b) State the number of electrons in the outer shell of a caesium atom.

..... [1]

(c) An isotope of caesium has a mass number of 133.

(i) What do you understand by the term *isotope*?

..... [1]

(ii) Calculate the number of neutrons in this isotope of caesium.

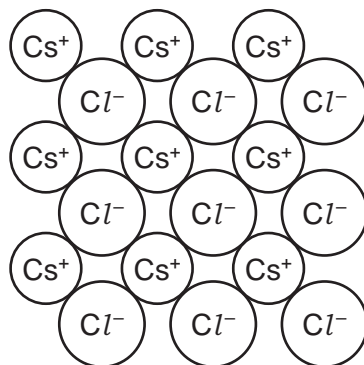
..... [1]

(d) Complete the following table to estimate the boiling point of caesium and predict the reactivity of caesium with water.

Group I metal	density / g/cm ³	boiling point / °C	reactivity with water
sodium	0.97	883	fizzes quickly, disappears gradually and does not burst into flame
potassium	0.86	760	fizzes very quickly, disappears quickly and bursts into flame with a little spitting
rubidium	1.53	686	fizzes extremely quickly, bursts into flame then spits violently and may explode
caesium	1.88		

[2]

(e) The diagram shows the structure of caesium chloride.



Use this diagram to work out the simplest formula for caesium chloride.

..... [1]

(f) Caesium chloride dissolves in water to form a neutral solution.
State the pH of a neutral solution.

..... [1]

(g) Describe a test for chloride ions.

test

result

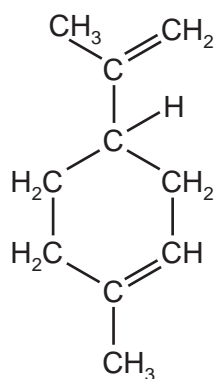
..... [2]

[Total: 11]

For
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- 5 Limonene is a colourless unsaturated hydrocarbon found in lemons. The structure of limonene is shown below.

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Use



- (a) On the formula above, draw a circle around the bonds which make limonene an unsaturated compound. [1]

- (b) Write the molecular formula for a molecule of limonene.

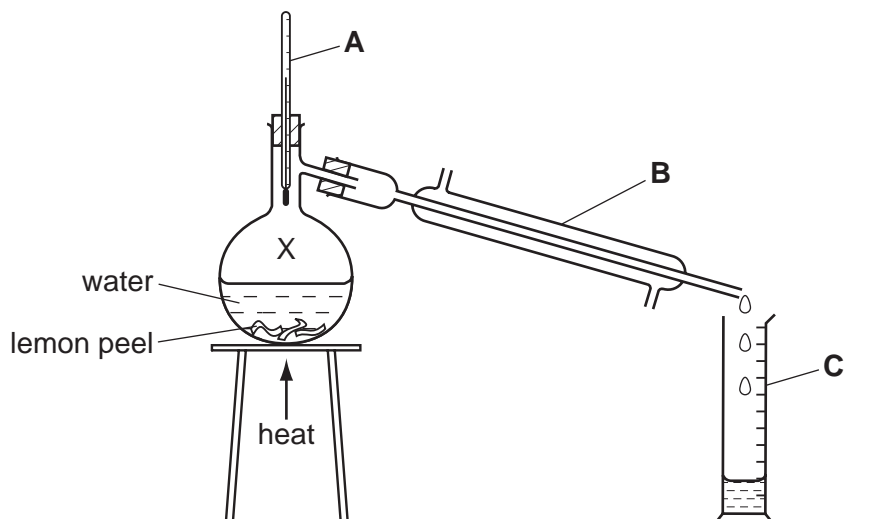
..... [1]

- (c) Describe the colour change which occurs when excess limonene is added to a few drops of bromine water.

..... [2]

(d) Limonene can be extracted from lemon peel by steam distillation.

For
Examiner's
Use



(i) State the name of the pieces of apparatus labelled **A**, **B** and **C**.

A

B

C [3]

(ii) At point X on the diagram, the water is in the form of steam.
Describe the arrangement and the movement of the particles in steam.

arrangement

movement [2]

(e) When limonene undergoes incomplete combustion, carbon monoxide is formed.

(i) What do you understand by the term *incomplete combustion*?

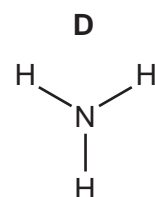
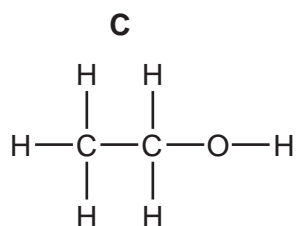
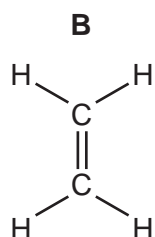
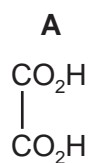
..... [1]

(ii) State an adverse effect of carbon monoxide on health.

..... [1]

(f) The structures of some compounds found in plants are shown below.

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Examiner's
Use



(i) Which one of these compounds is a carboxylic acid? [1]

(ii) Which one of these compounds is produced by the fermentation of glucose?

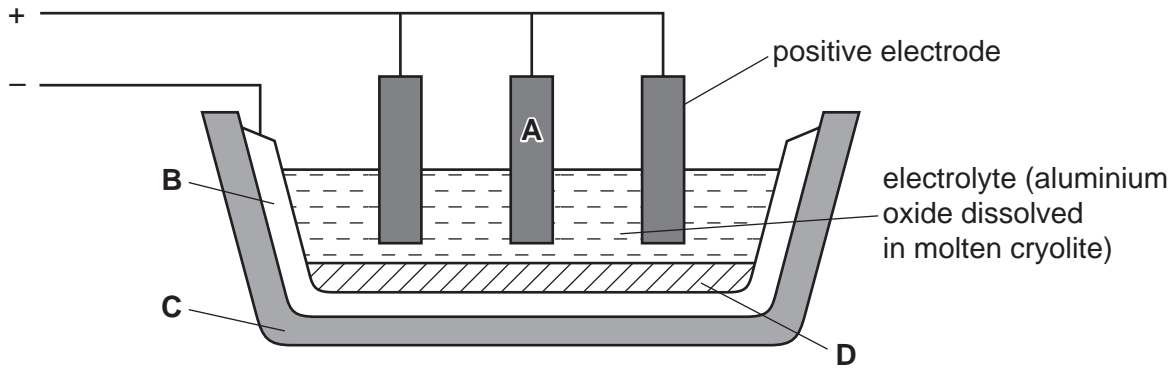
..... [1]

(iii) Which one of these compounds is a hydrocarbon? [1]

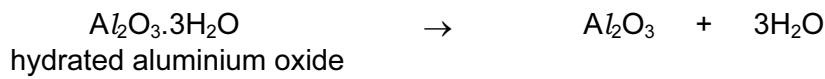
[Total: 14]

6 Aluminium is extracted by the electrolysis of aluminium oxide.

For
Examiner's
Use



(a) Hydrated aluminium oxide is heated to produce pure aluminium oxide.



What type of reaction is this?
Put a ring around the correct answer.

- decompositon neutralisation oxidation reduction**

[1]

(b) Explain why the electrolyte must be molten for electrolysis to occur.

..... [1]

(c) What is the purpose of the cryolite?

..... [1]

(d) Which letter in the diagram, **A**, **B**, **C** or **D**, represents the cathode?

..... [1]

(e) State the name of the products formed at the anode and cathode during this electrolysis.

anode

cathode [2]

(f) Why do the anodes have to be renewed periodically?

.....

..... [2]

(g) Complete the equation for the formation of aluminium from aluminium ions.



(h) State one use of aluminium.

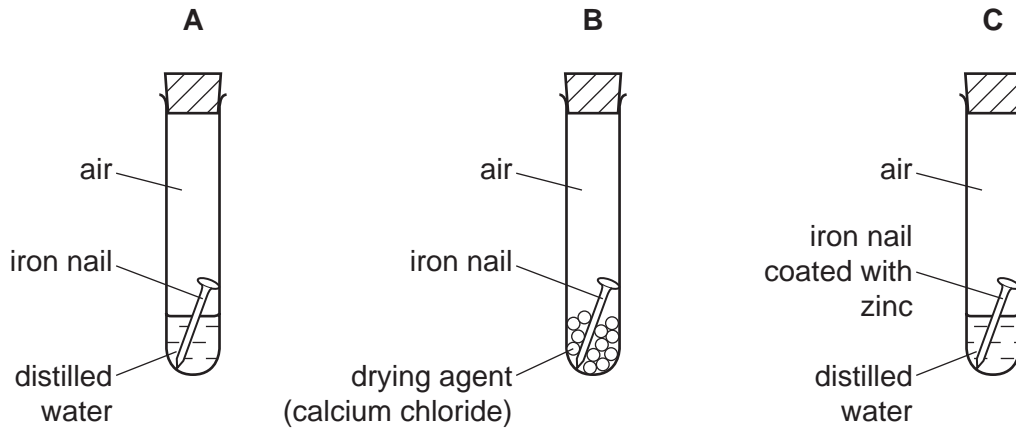
..... [1]

[Total: 10]

*For
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Use*

7 The diagram shows an experiment to investigate the rusting of some iron nails.

For
Examiner's
Use



(a) For each tube **A**, **B** and **C** predict whether the nails will rust. In each case give a reason.

tube **A**: does the nail rust?

reason

tube **B**: does the nail rust?

reason

tube **C**: does the nail rust?

reason

[3]

(b) Iron from the blast furnace contains impurities such as carbon, phosphorus, silicon and sulfur.

Describe how the level of these impurities is decreased when steel is made from impure iron.

.....

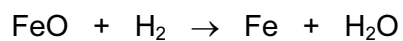
[3]

(c) State a use for stainless steel.

.....

[1]

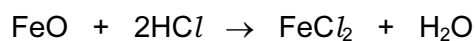
(d) Pure iron can be prepared by the reduction of iron(II) oxide, FeO.



Explain how this equation shows that the iron(II) oxide has been reduced.

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

(e) Iron(II) oxide reacts with acids.



Write a word equation for this reaction.

..... [2]

[Total: 10]

For
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Use

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 Li Lithium 3									
		4 Be Beryllium 4									
		5 B Boron 5									
		6 C Carbon 6									
		7 N Nitrogen 7									
		8 O Oxygen 8									
		9 F Fluorine 9									
		10 Ne Neon 10									
		11 Na Sodium 11									
		12 Mg Magnesium 12									
		13 Al Aluminium 13									
		14 Si Silicon 14									
		15 P Phosphorus 15									
		16 S Sulfur 16									
		17 Cl Chlorine 17									
		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									
		58-71 Lanthanoid series									
		† 90-103 Actinoid series									
		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									
		90-103 Actinoid series									
		91 Pa Protactinium 91									
		92 Th Thorium 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									
		104-118 Lanthanoid series									
		105 Lr Lawrencium 105									
		106 Uu Ununhexium 106									
		107 Uuh Ununheptium 107									
		108 Uuq Ununquadium 108									
		109 Uuq Ununquadium 109									
		110 Uuo Ununoctium 110									
		111 Uuq Ununquadium 111									
		112 Uuo Ununoctium 112									
		113 Uuq Ununquadium 113									
		114 Uuo Ununoctium 114									
		115 Uuq Ununquadium 115									
		116 Uuo Ununoctium 116									
		117 Uuq Ununquadium 117									
		118 Uuo Ununoctium 118									

Key

a	X
b	X

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.).

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