UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2973907829

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.

For Examiner's Use

1 The list shows some non-metallic elements.

bromine
carbon
fluorine
krypton
nitrogen
oxygen

(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?

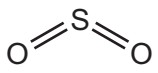
..... and ..... [1]

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

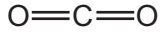
[1]

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

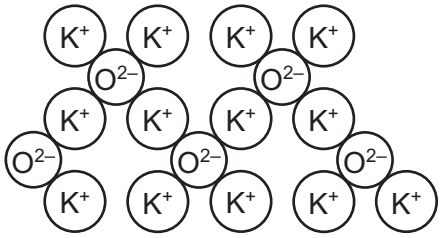
A



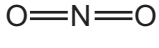
B



C



D



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

..... [1]

For Examiner's Use

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

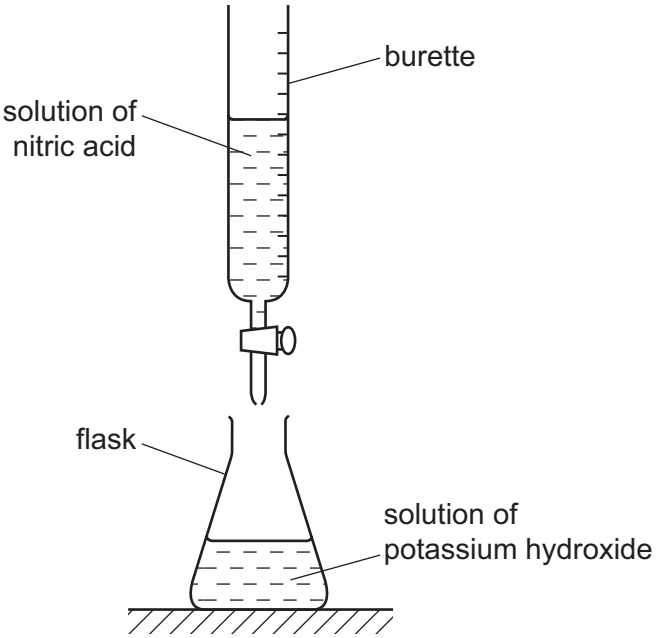
Source .....

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

$KOH + HNO_3 \rightarrow KNO_3 + H_2O$

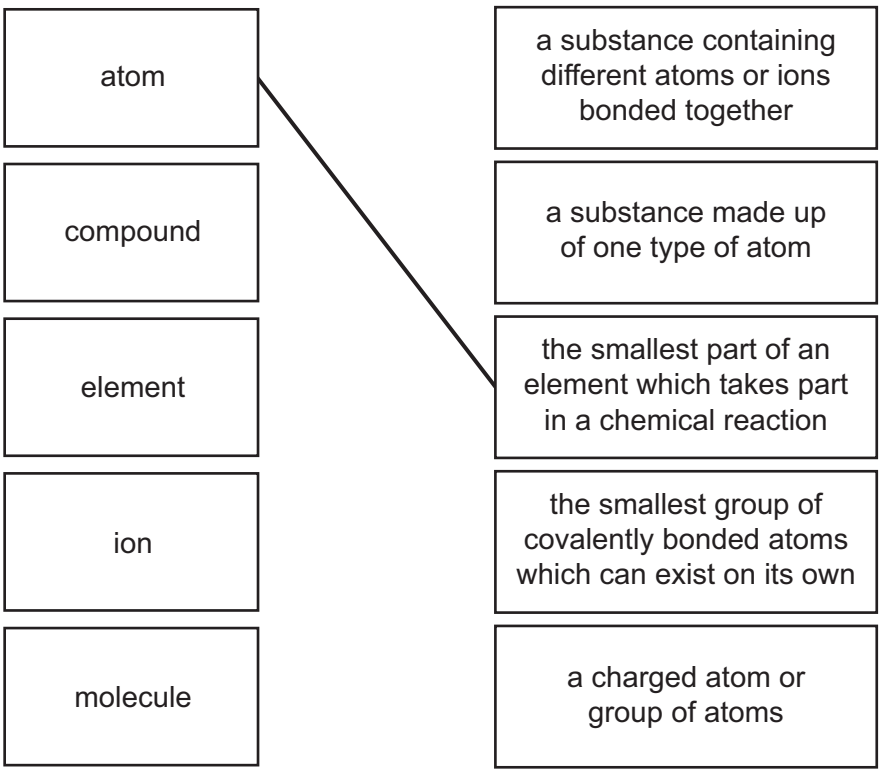
State the name of the salt formed in this reaction.

..... [1]

[Total: 12]

For Examiner's Use

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.



[4]

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

air ☐

graphite ☐

sodium chloride ☐

steel ☐

[1]

For Examiner's Use

(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.

[4]

(ii) State a use for helium.

.....

[1]

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

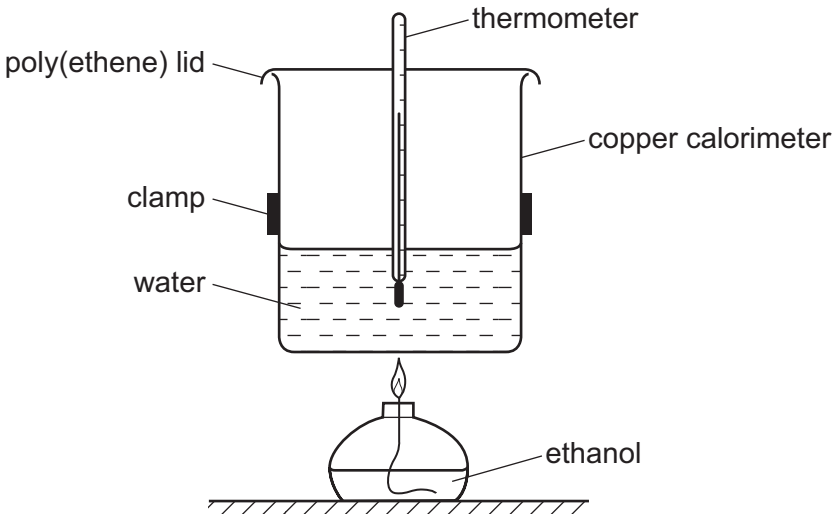
helium is in Period 2 of the Periodic Table	☐
helium is a liquid at room temperature	☐
helium is unreactive	☐
helium has an incomplete outer shell of electrons	☐

[1]

[Total: 11]

For Examiner's Use

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



(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]

For Examiner's Use

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

$C_2H_5OH + 3O_2 \rightarrow$ ..... $CO_2 +$ ..... H_2O [1]

(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.

$$CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + CO_2(g) + H_2O(l)$$

(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]

For Examiner's Use

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

(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.

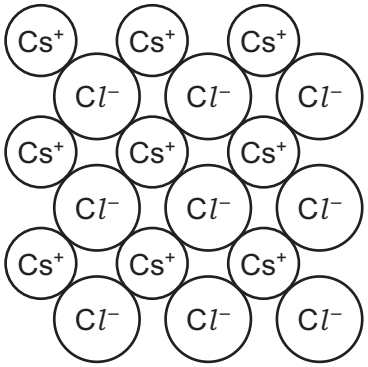
..... [1]

(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 .....

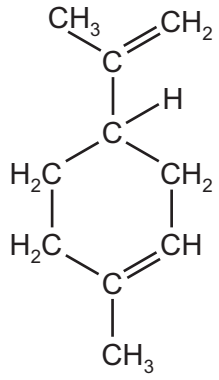
result .....

..... [2]

[Total: 11]

For Examiner's Use

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



(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.

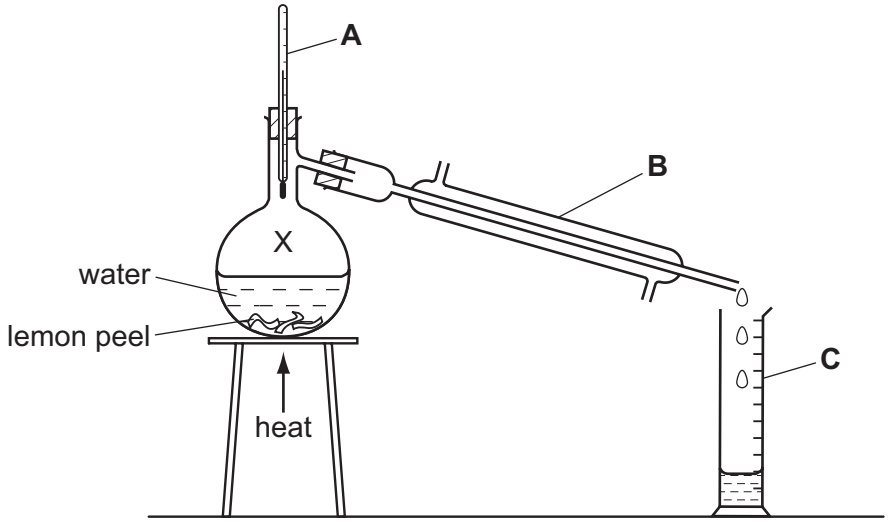
..... [1]

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

..... [2]

For Examiner's Use

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



(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]

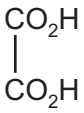
(ii) State an adverse effect of carbon monoxide on health.

..... [1]

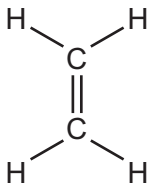
[Turn over

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

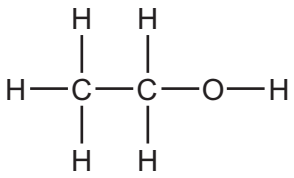
A



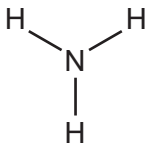
B



C



D



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

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

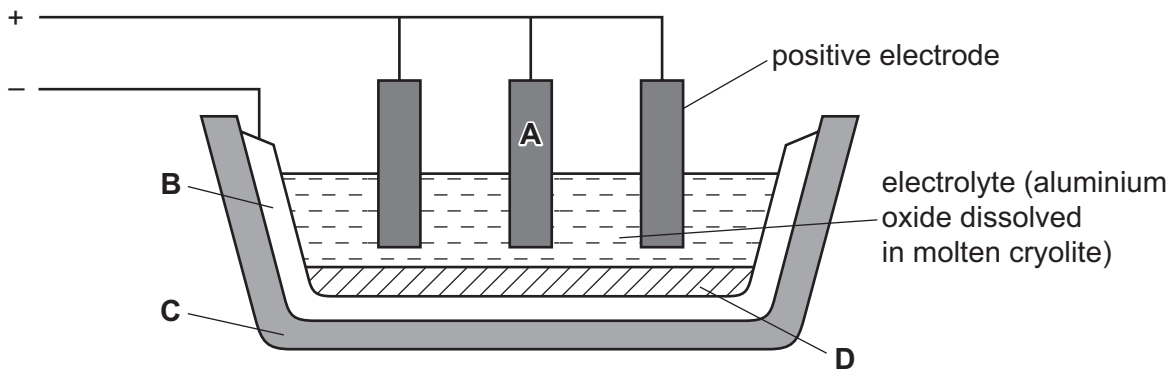
..... [1]

(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.

$$\underset{\text{hydrated aluminium oxide}}{Al_2O_3.3H_2O} \rightarrow Al_2O_3 + 3H_2O$$

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]

[Turn over

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

Al^{3+} + ... e^- → Al [1]

For Examiner's Use

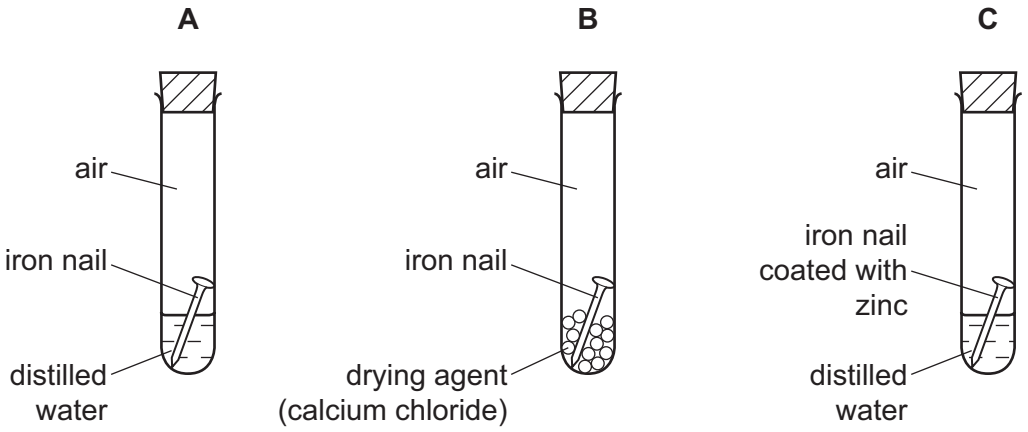
(h) State one use of aluminium.

..... [1]

[Total: 10]

For Examiner's Use

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



(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]

For Examiner's Use

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

$$FeO + H_2 \rightarrow Fe + H_2O$$

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

.....

..... [1]

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

$$FeO + 2HCl \rightarrow FeCl_2 + H_2O$$

Write a word equation for this reaction.

..... [2]

[Total: 10]

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II									III	IV	V	VI	VII	0		
															4 He Helium 2		
					1 H Hydrogen 1												
7 Li Lithium 3	9 Be Beryllium 4									11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	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	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	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	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	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	127 I Iodine 53	131 Xe Xenon 54
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	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

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