



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTER  
NUMBER

--	--	--	--	--

CANDIDATE  
NUMBER

--	--	--	--



\* 9 3 2 2 8 6 4 9 5 7 2 \*

**CHEMISTRY (US)**

**0439/23**

Paper 2

**May/June 2012**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Center 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 16.

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	
<b>Total</b>	

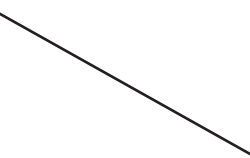
This document consists of **14** printed pages and **2** blank pages.



- 1 (a) Gases can be identified by carrying out particular tests. Some gases and tests to identify them are shown below.

Match the gases on the left with the tests on the right. The first one has been done for you.

sulfur dioxide	turns limewater milky
carbon dioxide	turns potassium dichromate green
chlorine	'pops' with a burning splint
oxygen	relights a glowing splint
hydrogen	bleaches damp litmus paper



[4]

- (b) Chlorine can be prepared by heating hydrochloric acid with manganese(IV) oxide.



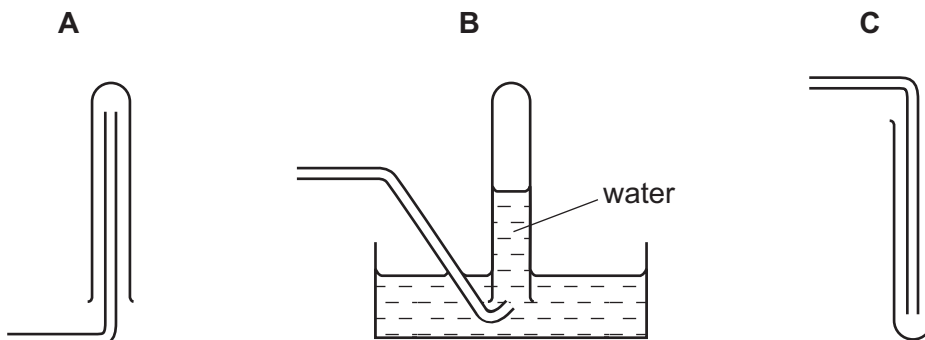
- (i) Write a word equation for this reaction.

[3]

(ii) Chlorine is

- denser than air
- soluble in water.

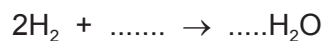
Which **one** of the following diagrams, **A**, **B** or **C**, best describes how chlorine gas is collected?



Answer = ..... [1]

(c) Hydrogen reacts with oxygen to form water.

(i) Complete the equation for this reaction.



[2]

(ii) State **one** use of

hydrogen, .....

water. .... [2]

[Total: 12]

2 Alkalis are soluble bases.

(a) Which **one** of the following is alkaline?  
Put a circle around the correct answer.

- |                                 |                                  |
|---------------------------------|----------------------------------|
| <b>distilled water</b>          | <b>hydrochloric acid</b>         |
| <b>sodium chloride solution</b> | <b>sodium hydroxide solution</b> |

[1]

(b) Suggest a pH value for a solution which is alkaline.

..... [1]

(c) Describe how you would find the pH of a solution.

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

(d) When excess fertilizers are put on the soil, the soil may become acidic.

(i) Why is it important to farmers that the soil does not become too acidic?  
..... [1]

(ii) Calcium carbonate is used to decrease the acidity of the soil. Explain how calcium carbonate decreases soil acidity.  
.....  
..... [2]

[Total: 7]

3 The table below shows some properties of the halogens.

halogen	melting point/°C	boiling point/°C	color
chlorine	-101	-35	
bromine	-7	+59	
iodine	+114	+184	grayish-black

(a) (i) Complete the spaces in the table to show the colors of chlorine and bromine. [2]

(ii) Room temperature is about 20 °C.  
Use the information in the table to explain why

chlorine is a gas at room temperature, .....

.....

bromine is a liquid at room temperature. ....

..... [2]

(iii) Astatine is the halogen below iodine in the Periodic Table.  
Suggest a value for the melting point of astatine.

..... [1]

(b) Chlorine reacts with an aqueous solution of potassium iodide.

(i) Complete the balanced equation for this reaction.



[2]

(ii) State the names of the products of this reaction.

..... [2]

(iii) To which period in the Periodic Table does chlorine belong?

..... [1]

(c) Complete the following sentences about the test for iodide ions using words from the list below.

**hydrochloric**

**nitric**

**potassium**

**precipitate**

**silver**

**solution**

**white**

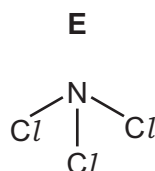
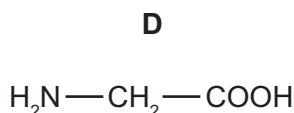
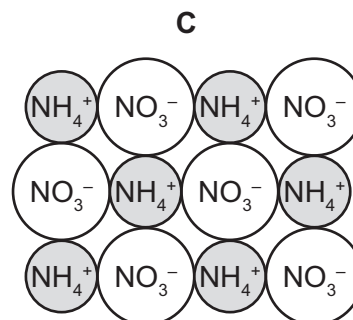
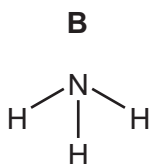
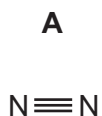
**yellow**

A small volume of solution containing aqueous iodide ions is put into a test-tube. Dilute  
..... acid is added followed by a few drops of ..... nitrate solution.

A ..... colored ..... is formed if iodide ions are present. [4]

[Total: 14]

4 The diagram below shows the structure of some substances containing nitrogen.



- (a) (i) Which one of these substances, **A**, **B**, **C**, **D** or **E**, is an alkaline gas?
- (ii) Which one of these substances is an ionic salt?
- (iii) Which one of these substances contains a carboxylic acid functional group?

[3]

(b) Oxides of nitrogen such as nitrogen dioxide,  $\text{NO}_2$ , are atmospheric pollutants. Give **one** source of nitrogen oxides in the air.

..... [1]

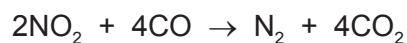
(c) State **one** harmful effect of nitrogen dioxide.

..... [1]

(d) Calculate the relative formula mass of nitrogen dioxide,  $\text{NO}_2$ .

[1]

(e) In the presence of a catalyst, nitrogen dioxide reacts with carbon monoxide.



(i) Which substance gets oxidized during this reaction? Explain your answer.

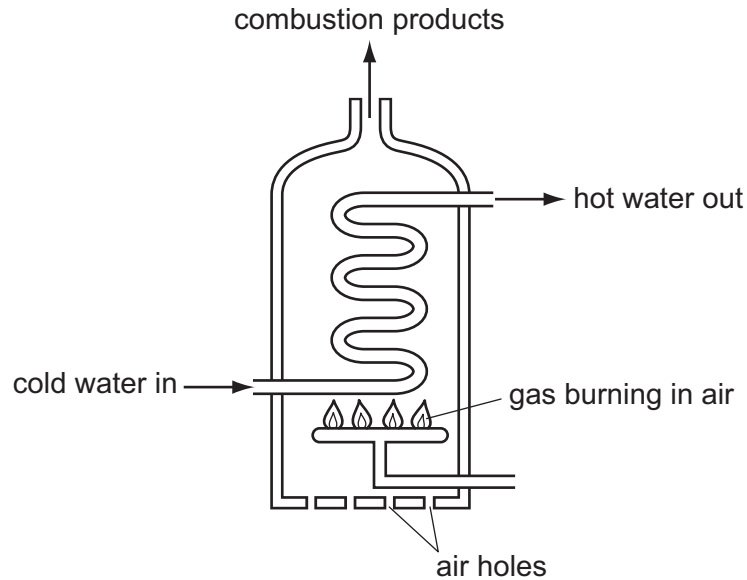
.....

..... [2]

(ii) What is the meaning of the term *catalyst*?

..... [1]

(iii) Carbon monoxide is formed when some of the air holes in a water heater get blocked. The diagram shows a water heater.



Explain why carbon monoxide is formed when some of the air holes in a water heater get blocked.

..... [2]

(iv) Explain why carbon monoxide is dangerous.

..... [1]

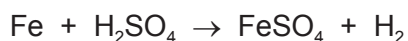
[Total: 12]

5 Iron is a shiny metallic solid. Iron is a transition element.

(a) State **three** other physical properties of a transition element.

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

(b) Iron reacts with sulfuric acid.



(i) Write a word equation for this reaction.

..... [2]

(ii) Describe, with the aid of a diagram, how you could measure the speed of this reaction.

In your answer describe:

- the apparatus you would use
- the measurements you would take.

.....  
.....  
.....  
..... [4]

(c) When iron reacts with sulfur, energy is released.

(i) What is the name given to a reaction which releases energy?

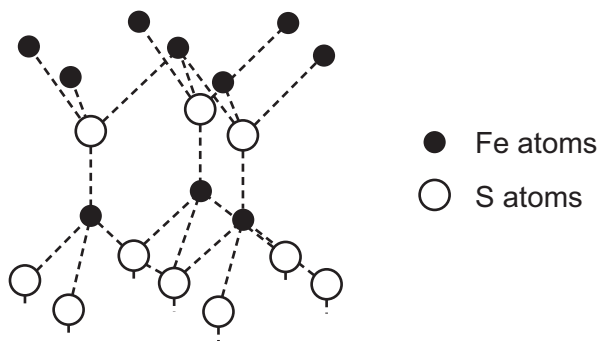
..... [1]



- (ii) The compound formed in this reaction is iron(II) sulfide.  
What do you understand by the term *compound*?

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

- (iii) The diagram below shows the structure of iron(II) sulfide.

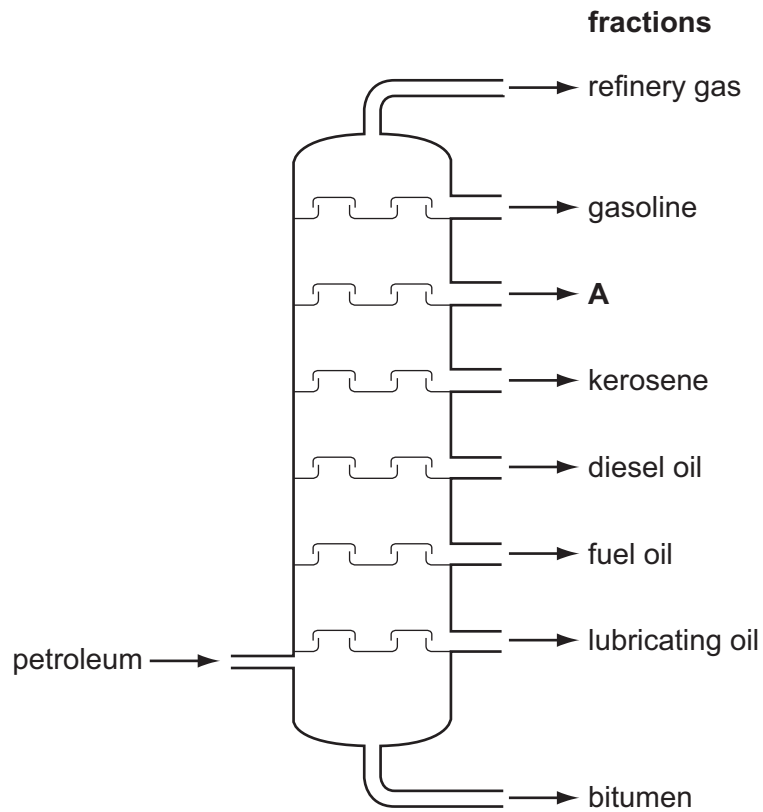


What is the simplest formula for iron(II) sulfide?

..... [1]

[Total: 12]

- 6 The diagram shows a fractionating column used to separate different hydrocarbon fractions in an oil refinery.



- (a) On the diagram, draw an X to show the place in the column where the temperature is the highest. [1]

- (b) State the name of the fraction labelled **A**.  
..... [1]

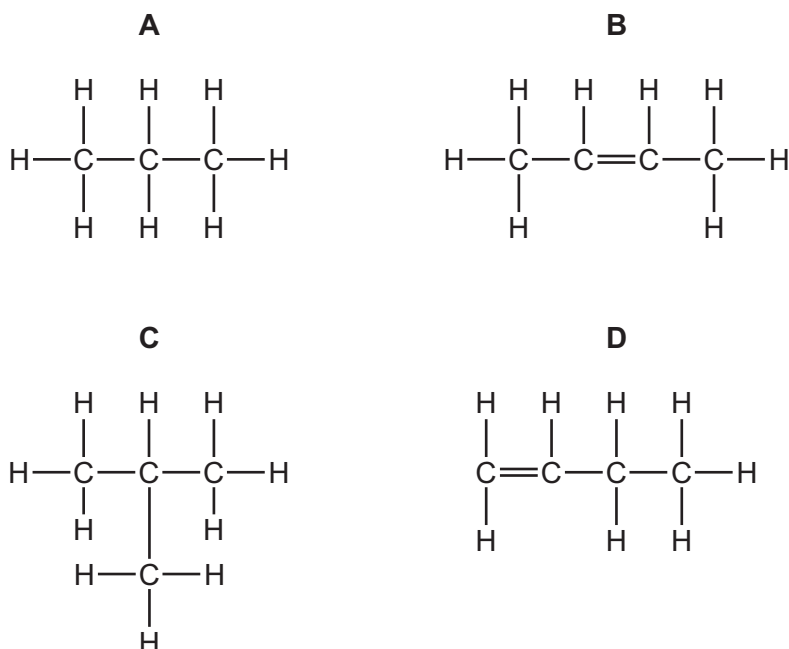
- (c) State a use for  
the kerosene fraction, .....  
the diesel oil fraction. .... [2]

- (d) Complete the following sentences about fractional distillation using words from the list below.

**boiling      condenses      cooled      heated      higher**  
**lower      melting      mixture      pressure      vaporizes**

Petroleum is a ..... of hydrocarbons. This mixture is ..... and the hydrocarbons vaporize. The temperature in the fractionating column is ..... at the top than at the bottom. As the vapors move up the column, each hydrocarbon fraction ..... when the temperature in the column falls below the ..... point of the hydrocarbon fraction. [5]

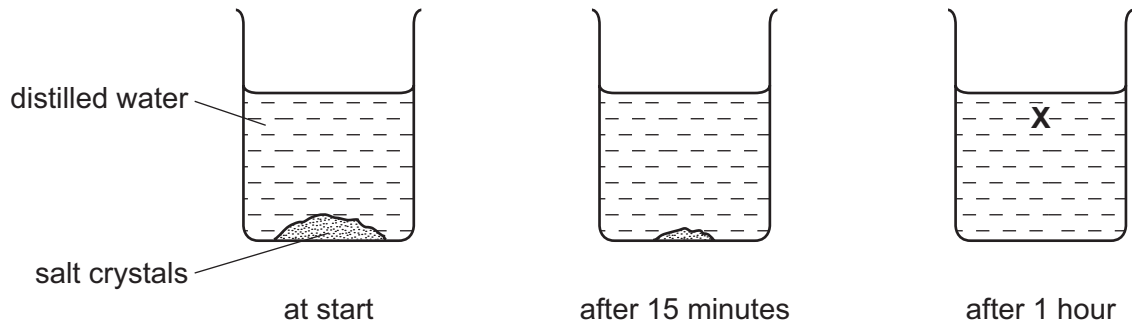
- (e) The structures of four hydrocarbons, **A**, **B**, **C** and **D**, are shown below.



- (i) Which **two** of these structures **A**, **B**, **C** or **D** have the same relative molecular mass?  
..... and ..... [1]
- (ii) Which **two** of these structures **A**, **B**, **C** or **D** will decolorize aqueous bromine?  
..... and ..... [2]

[Total: 12]

- 7 A student placed some crystals of salt at the bottom of a beaker of distilled water. She left the contents of the beaker to stand for one hour. The diagram below shows her observations.



After one hour, all the salt had disappeared but the solution at point **X** tasted salty.

- (a) Use the kinetic particle theory to explain these observations.

.....

.....

.....

.....

.....

.....

[4]

- (b) Salt is sodium chloride,  $\text{NaCl}$ .

- (i) Which one of the following statements about bond formation in sodium chloride is true?

Check **one** box.

A sodium atom shares one electron with a chlorine atom.

A sodium atom loses its outermost electron and a chlorine atom gains an electron.

A sodium atom shares two electrons with a chlorine atom.

A sodium atom gains an electron and a chlorine atom loses its outermost electrons.

[1]

(ii) Explain why solid sodium chloride does not conduct electricity but molten sodium chloride does conduct.

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

(iii) State the name of the product formed at each electrode when a concentrated aqueous solution of sodium chloride is electrolyzed using graphite electrodes.

at the positive electrode .....  
at the negative electrode ..... [2]

(iv) What is the name of the negative electrode?  
Put a circle around the correct answer.

**anion          anode          cation          cathode          electrolyte** [1]

(v) Suggest why graphite is a suitable material for an electrode.

..... [1]

[Total: 11]





**DATA SHEET**  
**The Periodic Table of the Elements**

		Group																																																																																														
I	II	III	IV	V	VI	VII	0																																																																																									
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminum 13	14 <b>N</b> Nitrogen 7	15 <b>O</b> Oxygen 8	16 <b>F</b> Fluorine 9	17 <b>Ne</b> Neon 10	18 <b>Ar</b> Argon 18	19 <b>K</b> Potassium 19	20 <b>Ca</b> Calcium 20	21 <b>Sc</b> Scandium 21	22 <b>Ti</b> Titanium 22	23 <b>V</b> Vanadium 23	24 <b>Cr</b> Chromium 24	25 <b>Mn</b> Manganese 25	26 <b>Fe</b> Iron 26	27 <b>Co</b> Cobalt 27	28 <b>Ni</b> Nickel 28	29 <b>Cu</b> Copper 29	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36	37 <b>Rb</b> Rubidium 37	38 <b>Sr</b> Strontium 38	39 <b>Y</b> Yttrium 39	40 <b>Zr</b> Zirconium 40	41 <b>Nb</b> Niobium 41	42 <b>Mo</b> Molybdenum 42	43 <b>Tc</b> Technetium 43	44 <b>Ru</b> Ruthenium 44	45 <b>Rh</b> Rhodium 45	46 <b>Pd</b> Palladium 46	47 <b>Ag</b> Silver 47	48 <b>Cd</b> Cadmium 48	49 <b>In</b> Indium 49	50 <b>Sn</b> Tin 50	51 <b>Sb</b> Antimony 51	52 <b>Te</b> Tellurium 52	53 <b>I</b> Iodine 53	54 <b>Xe</b> Xenon 54	55 <b>Cs</b> Caesium 55	56 <b>Ba</b> Barium 56	57 <b>La</b> Lanthanum 57	72 <b>Hf</b> Hafnium 72	73 <b>Ta</b> Tantalum 73	74 <b>W</b> Tungsten 74	75 <b>Re</b> Rhenium 75	76 <b>Os</b> Osmium 76	77 <b>Ir</b> Iridium 77	78 <b>Pt</b> Platinum 78	79 <b>Au</b> Gold 79	80 <b>Hg</b> Mercury 80	81 <b>Tl</b> Thallium 81	82 <b>Pb</b> Lead 82	83 <b>Bi</b> Bismuth 83	84 <b>Po</b> Polonium 84	85 <b>At</b> Astatine 85	86 <b>Rn</b> Radon 86	87 <b>Fr</b> Francium 87	88 <b>Ra</b> Radium 88	89 <b>Ac</b> Actinium 89	90 <b>Th</b> Thorium 90	91 <b>Pa</b> Protactinium 91	92 <b>U</b> Uranium 92	93 <b>Np</b> Neptunium 93	94 <b>Pu</b> Plutonium 94	95 <b>Am</b> Americium 95	96 <b>Cm</b> Curium 96	97 <b>Bk</b> Berkelium 97	98 <b>Cf</b> Californium 98	99 <b>Es</b> Einsteinium 99	100 <b>Fm</b> Fermium 100	101 <b>Md</b> Mendelevium 101	102 <b>No</b> Nobelium 102	103 <b>Lr</b> Lawrencium 103	104 <b>Rf</b> Rutherfordium 104	105 <b>Db</b> Dubnium 105	106 <b>Sg</b> Seaborgium 106	107 <b>Bh</b> Bohrium 107	108 <b>Hs</b> Hassium 108	109 <b>Mt</b> Meitnerium 109	110 <b>Ds</b> Darmstadtium 110	111 <b>Rg</b> Roentgenium 111	112 <b>Cn</b> Copernicium 112	113 <b>Nh</b> Nihonium 113	114 <b>Fl</b> Flerovium 114	115 <b>Mc</b> Moscovium 115	116 <b>Lv</b> Livermorium 116	117 <b>Ts</b> Tennessine 117	118 <b>Og</b> Oganesson 118
												140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67	150 <b>Er</b> Erbium 68	151 <b>Tm</b> Thulium 69	152 <b>Yb</b> Ytterbium 70	153 <b>Lu</b> Lutetium 71	154 <b>Hf</b> Hafnium 72	155 <b>Ta</b> Tantalum 73	156 <b>W</b> Tungsten 74	157 <b>Re</b> Rhenium 75	158 <b>Os</b> Osmium 76	159 <b>Ir</b> Iridium 77	160 <b>Pt</b> Platinum 78	161 <b>Au</b> Gold 79	162 <b>Hg</b> Mercury 80	163 <b>Tl</b> Thallium 81	164 <b>Pb</b> Lead 82	165 <b>Bi</b> Bismuth 83	166 <b>Po</b> Polonium 84	167 <b>At</b> Astatine 85	168 <b>Rn</b> Radon 86	169 <b>Fr</b> Francium 87	170 <b>Ra</b> Radium 88	171 <b>Ac</b> Actinium 89	172 <b>Th</b> Thorium 90	173 <b>Pa</b> Protactinium 91	174 <b>U</b> Uranium 92	175 <b>Np</b> Neptunium 93	176 <b>Pu</b> Plutonium 94	177 <b>Am</b> Americium 95	178 <b>Cm</b> Curium 96	179 <b>Bk</b> Berkelium 97	180 <b>Cf</b> Californium 98	181 <b>Es</b> Einsteinium 99	182 <b>Fm</b> Fermium 100	183 <b>Md</b> Mendelevium 101	184 <b>No</b> Nobelium 102	185 <b>Lr</b> Lawrencium 103	186 <b>Rf</b> Rutherfordium 104	187 <b>Db</b> Dubnium 105	188 <b>Sg</b> Seaborgium 106	189 <b>Bh</b> Bohrium 107	190 <b>Hs</b> Hassium 108	191 <b>Mt</b> Meitnerium 109	192 <b>Ds</b> Darmstadtium 110	193 <b>Rg</b> Roentgenium 111	194 <b>Cn</b> Copernicium 112	195 <b>Nh</b> Nihonium 113	196 <b>Fl</b> Flerovium 114	197 <b>Mc</b> Moscovium 115	198 <b>Lv</b> Livermorium 116	199 <b>Ts</b> Tennessine 117	200 <b>Og</b> Oganesson 118																								

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

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

$a$	<b>X</b>
$b$	

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

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.

University of 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.