Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0336681138

PHYSICAL SCIENCE **0652/21**

Paper 2 (Core) **October/November 2016**

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 on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
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.

This document consists of **19** printed pages and **1** blank page.

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1 The graph in Fig. 1.1 shows the variation in the speed of a car on a test run.

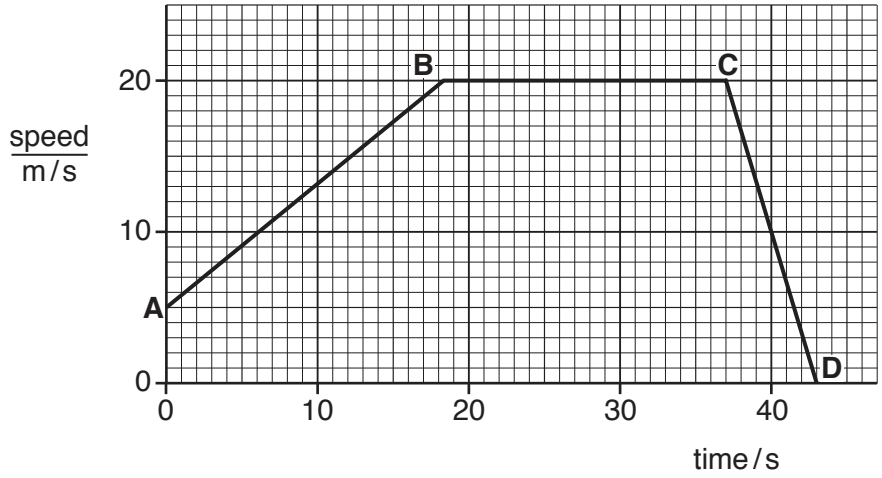

Fig. 1.1

(a) State the section of the graph which shows the car moving

at constant speed, ...

with decreasing speed. .....[2]

(b) On the graph, draw a small cross (**X**) at the point where the speed of the car is zero. [1]

(c) Determine the distance travelled by the car in the last 5 s.

Show your working.

distance = ...m [3]

(d) The acceleration of free fall near the Earth's surface is a constant 9.8 m/s^2.

(i) Explain what is meant by the term *acceleration*.

.....

.....[1]

(ii) Explain what is meant by the term *a constant 9.8 m/s^2*.

.....

.....

.....[2]

2 Table 2.1 gives information about the first four members of the homologous series of alcohols.

Table 2.1

alcohol	molecular formula	boiling point / °C
methanol	CH_3OH	65
ethanol	C_2H_5OH	78
propanol	C_3H_7OH	97
butanol	.....	117

(a) (i) State the difference between the formulae of methanol and ethanol.

.....

.....[1]

(ii) Give one other characteristic of an homologous series.

.....[1]

(iii) Butanol is the fourth member of the alcohol series.

Suggest the molecular formula for butanol.

.....[1]

(b) Draw the structural formula of ethanol.

[1]

(c) Fig. 2.1 shows apparatus used for the fractional distillation of a mixture of water, ethanol and butanol.

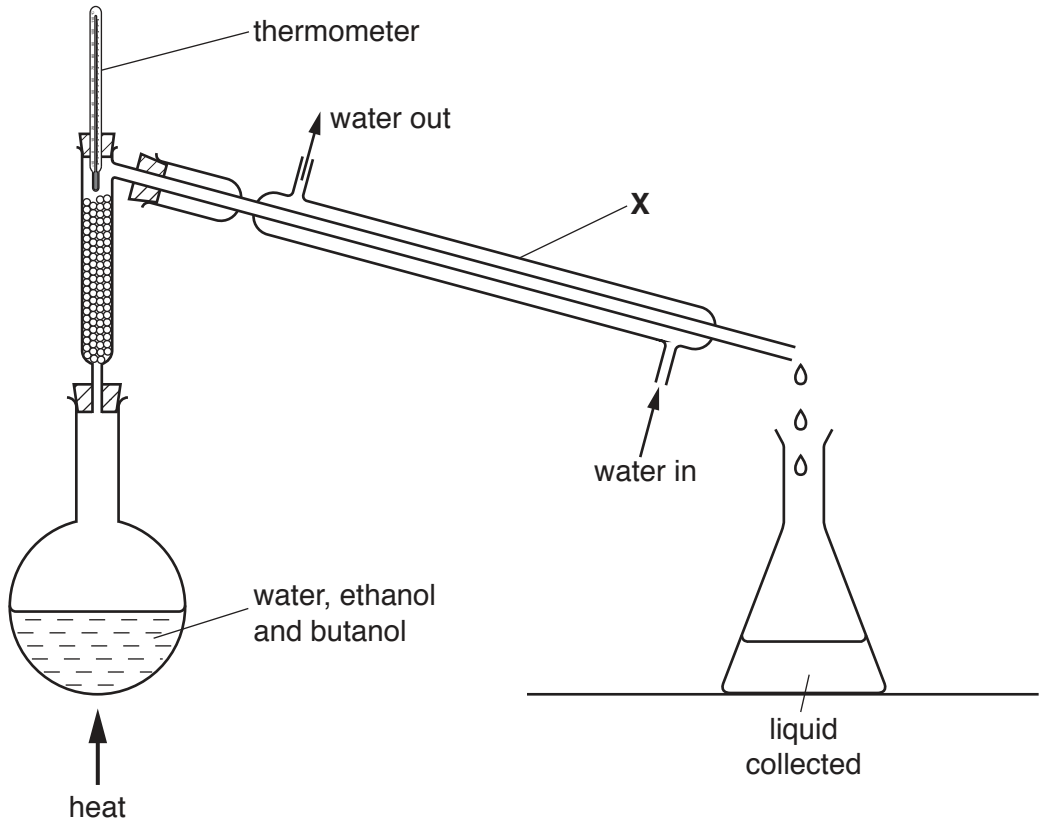

Fig. 2.1

(i) Name the piece of apparatus labelled **X** in the diagram.

.....[1]

(ii) Apparatus **X** has an outer tube and an inner tube. There is a flow of cold water in the space between the outer and inner tube.

State why this cold water flow is needed.

.....

..... [1]

(iii) Name the liquid collected first in this distillation.

Give a reason for your answer.

name of liquid .....

reason .....

.....[2]

(iv) State what happens to the reading on the thermometer when all of the first liquid has been collected.

.....[1]

3 A student finds the centre of mass of a thin sheet of aluminium.

She suspends the aluminium from a fixed rod. She attaches a plumbline to the rod at point **A**, as shown in Fig. 3.1. There is another small hole through the sheet at point **B**.

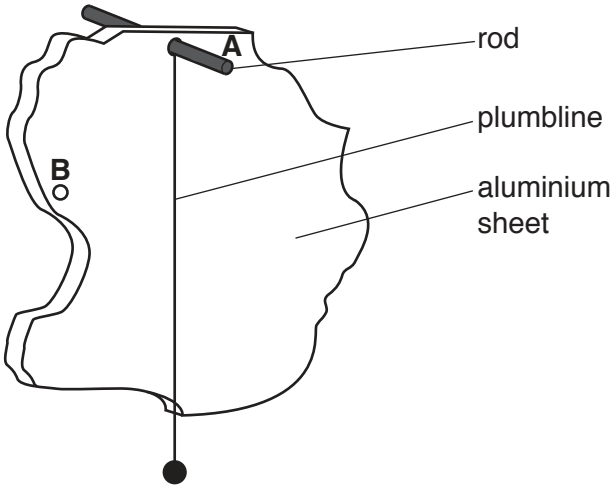

Fig. 3.1

(a) On Fig. 3.1, draw a small cross to show a **possible** position of the centre of mass of the aluminium sheet. [1]

(b) The aluminium sheet is rotated about the rod in a clockwise direction, as shown in Fig. 3.2, and held in this position.

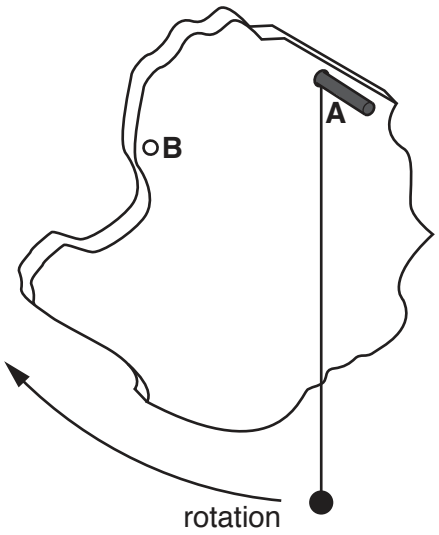

Fig. 3.2

Describe what will happen when the aluminium sheet is released. Give a reason for your answer.

description .....

.....

reason .....

.....[2]

(c) Outline what else the student needs to do to find the exact position of the centre of mass of the aluminium sheet.

.....

.....

.....

.....[3]

4 Fig. 4.1 shows apparatus used to react magnesium with steam.

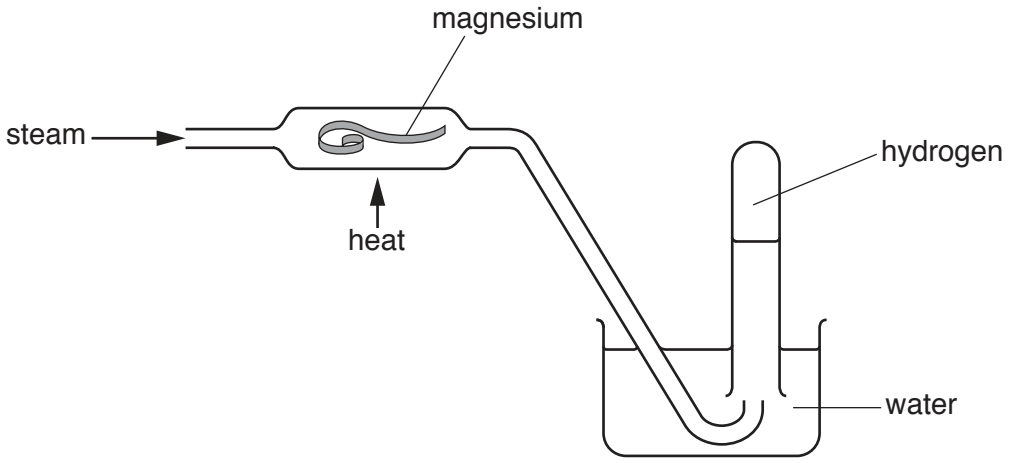

Fig. 4.1

(a) The equation for the reaction of magnesium with steam is shown.

$$Mg + H_2O \rightarrow MgO + H_2$$

Write a word equation for this reaction.

.....[1]

(b) This reaction is exothermic.

(i) State what is meant by the term *exothermic*.

.....

.....[1]

(ii) Suggest why the magnesium needs to be heated before it will react with the steam.

.....

..... [1]

(c) Describe how you could show that the gas collected is hydrogen.

.....

.....

.....[2]

(d) State what you would observe when copper is used instead of magnesium in this experiment.

Give a reason for your answer.

observation with copper .....

.....

reason .....

.....[2]

5 Fig. 5.1 shows a side view of a ripple tank. Some circular waves are moving across the surface of the water.

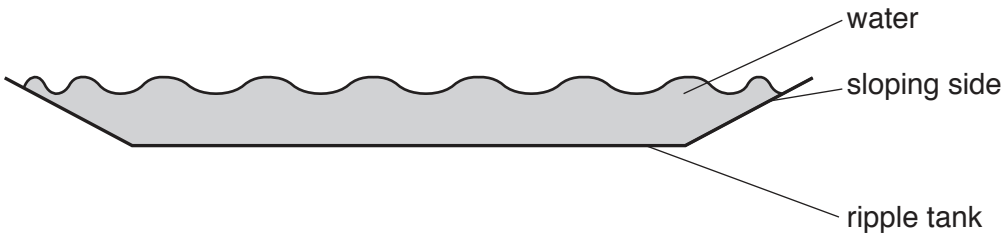

Fig. 5.1

The ripple tank has sloping sides. The depth of water decreases towards the edges of the tank.

Fig. 5.2 shows a view from above of the circular waves spreading out from the middle of the ripple tank shown in Fig. 5.1.

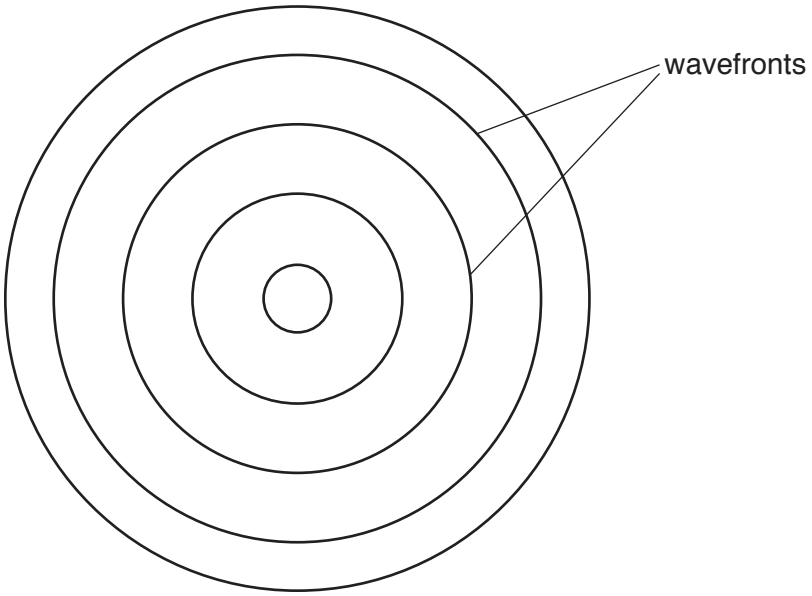

Fig. 5.2

Two of the wavefronts of the waves are labelled.

(a) On Fig. 5.2, use a double-headed arrow (↔) to mark one wavelength of the waves. [1]

(b) Use words from the list to complete the sentences.

amplitude **energy** **frequency** **hertz** **metres**

reflection **refraction** **wavelength**

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

The maximum height of a water wave above the normal water level is called the ..... of the wave.

The number of water waves passing any point each second is called the ..... of the waves. This is measured in ..... .

Water waves slow down when they reach shallower water. This is an example of ..... . [4]

(c) Fig. 5.3 shows straight wavefronts, viewed from above, moving towards a barrier in a flat-bottomed ripple tank.

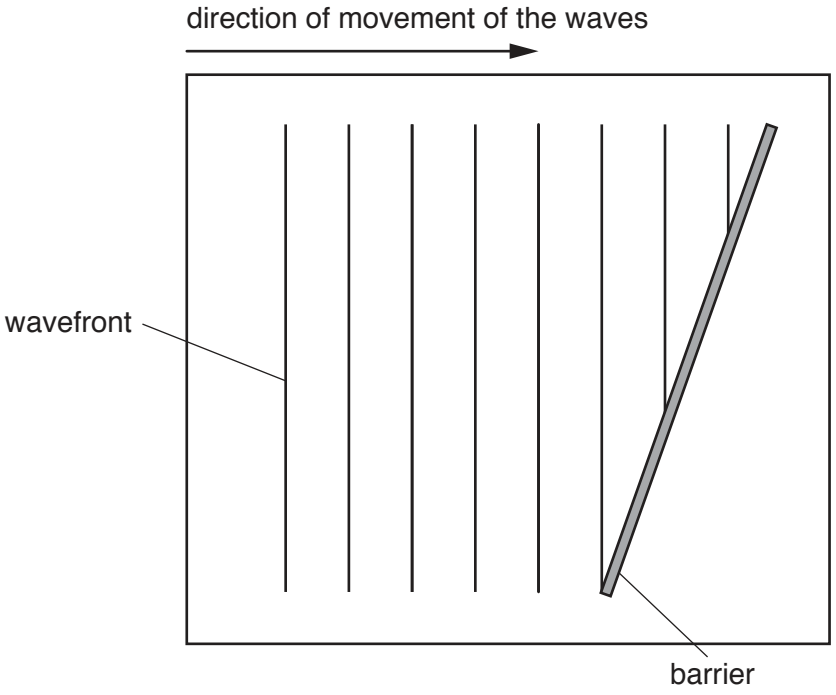

Fig. 5.3

Complete Fig. 5.3 by drawing in **three** wavefronts to show how they appear after they hit the barrier. [3]

6 **(a)** Metals conduct electricity.

(i) State **two** other properties of metals.

1 .....

2 .....[2]

(ii) Name **two** other substances or types of substances which are good conductors of electricity.

1 .....

2 .....[2]

(b) Brass is an alloy of zinc and another metal.

(i) Name this other metal.

.....[1]

(ii) Suggest one physical property of brass which is different from that of zinc.

.....[1]

(c) Zinc reacts with sulfuric acid to make hydrogen and a salt.

(i) State the name of this salt.

.....[1]

(ii) Write a symbol equation for the burning of hydrogen in air to form water.

.....[2]

7 A circuit contains a battery, three resistors in series and an ammeter. Fig. 7.1 shows the circuit diagram.

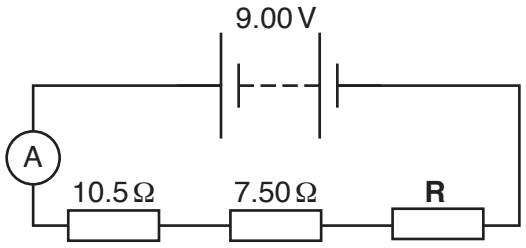

Fig. 7.1

The e.m.f. of the battery is 9.00 V and the reading on the ammeter is 0.400 A.

(a) (i) State the current through resistor **R**.

current = ...A [1]

(ii) Show that the total resistance in the circuit is 22.5 Ω.

[2]

(iii) Calculate the resistance of resistor **R**.
Show your working.

resistance = ...Ω [2]

(b) Fig. 7.2 shows a circuit diagram with the same battery connected across two resistors in parallel.

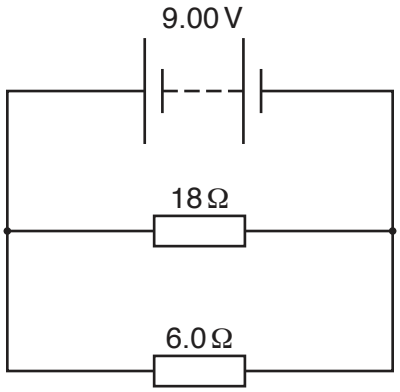

Fig. 7.2

The current through the 18 Ω resistor is 0.5 A and the current through the 6.0 Ω resistor is 1.5 A.

(i) Circle the number below which gives the current through the battery.

0.33 A 0.75 A 1.5 A 2.0 A [1]

(ii) Circle the number below which gives the combined resistance of the two resistors in parallel.

4.5 Ω 6.0 Ω 12 Ω 18 Ω [1]

8 **(a)** Sodium chloride is an ionic compound.

(i) Complete Table 8.1.

Table 8.1

element	number of electrons in an atom	formula of an ion	number of electrons in an ion
sodium	11	.....	.....
chlorine	.....	Cl^-	18

[3]

(ii) Explain why ions of sodium and chlorine are stable.

.....

.....[1]

(iii) Name the **element** with 18 electrons in each atom.

.....[1]

(b) Fig. 8.1 shows the arrangement of electrons in one molecule of hydrogen. The hydrogen atoms are joined by a covalent bond.

Fig. 8.1

(i) Fig. 8.2 is a partly completed diagram to show the electrons in an ammonia (NH_3) molecule.

Each ammonia molecule has 3 covalent bonds.

Complete Fig. 8.2 by adding hydrogen atoms (H) and dots (•) to indicate the arrangement of the electrons in the bonds in the molecule.

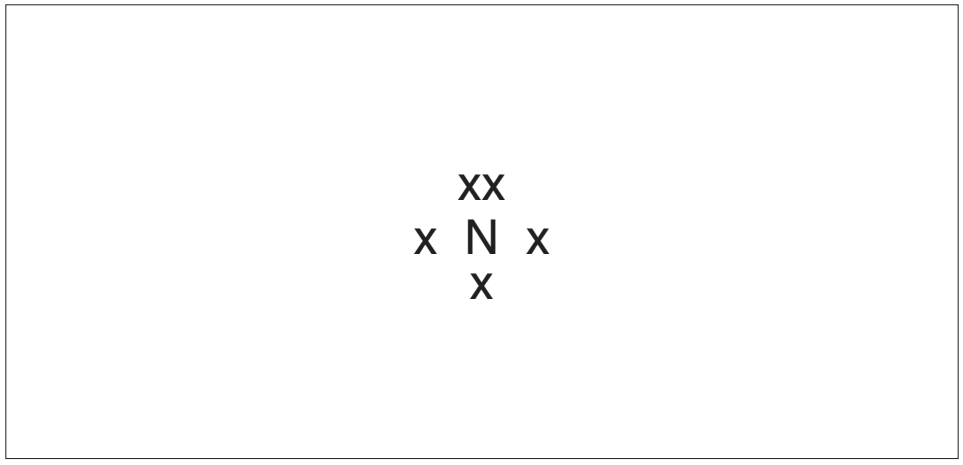

Fig. 8.2

[2]

(ii) Complete this equation.

$$N_2 + \text{.....} H_2 \rightarrow \text{.....} NH_3$$

[1]

(c) State the percentage of clean air that is nitrogen.

.....% [1]

9 Fig. 9.1 shows an electromagnetic door lock.

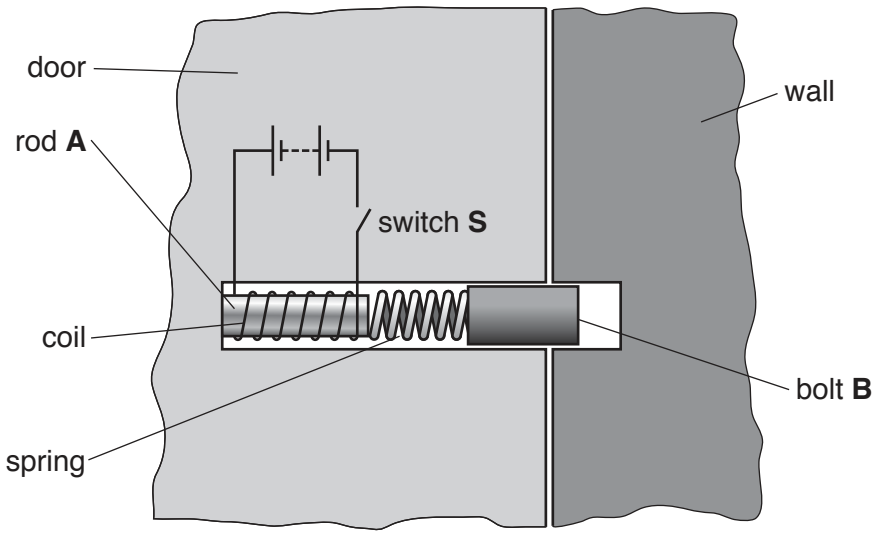

Fig. 9.1

Rod **A** is made of iron and is attached to the door.

Bolt **B** is made from steel and is attached to the spring.

The switch is open and the door is locked.

(a) When switch **S** is closed, the door unlocks.

Explain why the door unlocks by describing what happens in the coil, to rod **A** and to bolt **B** when switch **S** is closed.

in the coil .....

.....

to rod **A** .....

.....

to bolt **B** .....

.....[3]

(b) **(i)** Describe the magnetic property of iron which makes it more suitable than steel for rod **A**.

.....

.....[1]

(ii) Suggest why the spring is needed in the door lock.

.....

.....[1]

10 Fig. 10.1 shows three test-tubes containing solutions of sodium halide salts.
Each solution is colourless.

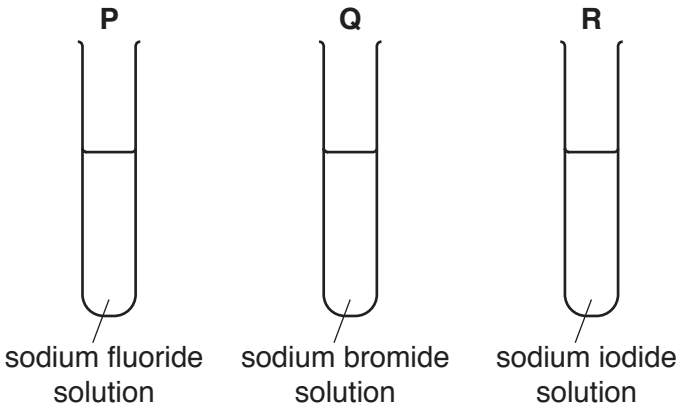

Fig. 10.1

An aqueous solution of chlorine is added to each test-tube.

Table 10.1 shows some of the results.

Table 10.1

test-tube	**P**	**Q**	**R**
action of chlorine solution	.....	turns yellow	turns brown

(a) Name the products of the reactions which produce the colours in test-tubes **Q** and **R**.

test-tube **Q** .....

test-tube **R** .....[2]

(b) Explain how the reactivity of chlorine compares with the reactivities of fluorine, iodine and bromine.

.....

.....

.....

.....[2]

(c) Complete Table 10.1 to suggest what is observed in test-tube **P** when chlorine solution is added. [1]

(d) State why fluorine, chlorine, bromine and iodine are members of Group VII of the Periodic Table and have similar chemical properties.

.....

.....[1]

11 $^{111}_{47}Ag$ is a radioactive isotope of silver.

(a) **(i)** State the number of protons in the nucleus of this isotope.

..... [1]

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

..... [1]

(b) This isotope decays by β-decay.

(i) Complete the equation to show this decay.

$$^{111}_{47}Ag \rightarrow {}^{.....}_{.....}Z + {}^{0}_{-1}\beta$$ [2]

(ii) Use the Periodic Table on page 20 to identify the element **Z**.

.....[1]

The Periodic Table of Elements

Key

atomic number atomic symbol name relative atomic mass

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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