UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

* 0 4 9 7 2 8 9 2 1 9 *

COMBINED SCIENCE **0653/31**

Paper 3 (Extended) **October/November 2010**

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 a soft pencil for any diagrams, graphs, tables 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	
8	
9	
Total	

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

For Examiner's Use

1 Fig. 1.1 shows a rock that is falling from the top of a cliff into the river below.

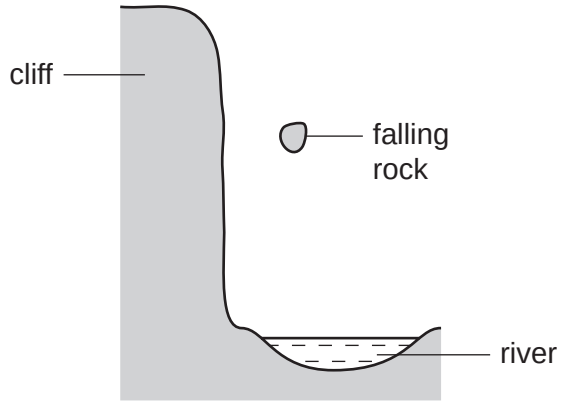

Fig. 1.1

(a) The rock accelerates downwards at $10\,m/s^2$. The mass of the rock is 4 kg.

Calculate the force pulling the rock downwards.

State the formula that you use and show your working.

formula used

working

..... [2]

(b) Fig. 1.2 is speed-time graph for the motion of the rock. This graph ignores the effects of air resistance on the rock.

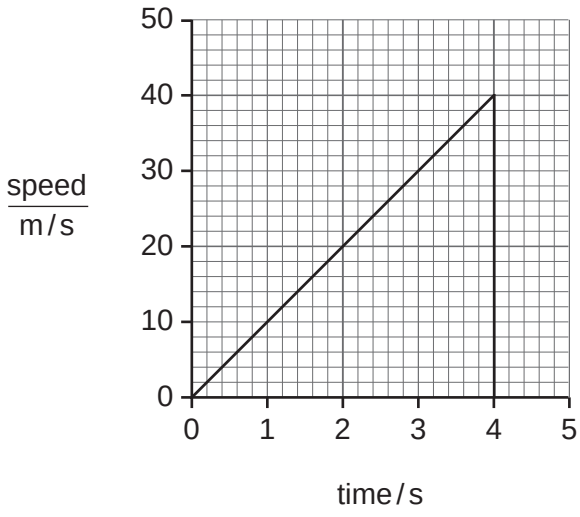

Fig. 1.2

Calculate the height of the cliff.

Show your working.

For Examiner's Use

..... [2]

(c) The rock has an irregular shape.

Describe how you could find the density of an irregularly shaped object such as a rock. You should state the apparatus you would use and the measurements you would need to make.

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..... [4]

(d) The rock contains radioactive substances emitting high levels of ionising radiation.

(i) State how the radioactivity could be detected.

..... [1]

(ii) Explain why it would be dangerous for a person to handle this rock without proper protection.

.....

..... [1]

[Turn over

For Examiner's Use

2 The gray wolf is a predator that lives in North America.

(a) In Wisconsin, Canada, the wolves' diet consists mainly of white-tailed deer, beaver, and snowshoe hares. These all eat plants.

(i) Construct a food web including all the organisms mentioned above.

[3]

(ii) State what the arrows in your food web represent.

..... [1]

(iii) With reference to your answers to **(i)** and **(ii)**, suggest why wolves are rarer than white-tailed deer.

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..... [2]

(b) People used to shoot gray wolves, because the wolves kill sheep on farms and deer that people like to hunt.

For Examiner's Use

In 1978, a conservation programme for gray wolves began in Wisconsin and people were no longer allowed to shoot them.

Some people in Wisconsin are opposed to the wolf conservation programme.

Discuss the arguments for and against conserving the gray wolf.

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..... [3]

For Examiner's Use

3 **(a)** Copper metal reacts with oxygen gas to form copper oxide. Table 3.1 shows information about two different types of copper oxide.

Table 3.1

name	colour	chemical formula
copper(II) oxide	black	CuO
copper(I) oxide	red	Cu_2O

(i) Copper is a transition metal.

State **one** property, shown in Table 3.1, which is typical of transition metals.

.....

[1]

(ii) The formula of the oxide ion is O^{2-}.

Use the formula of copper(I) oxide to deduce the charge on the copper ion in this compound.

Show your working.

.....

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[2]

(b) Fig. 3.1 shows apparatus used in the electrolysis of copper chloride solution.

For Examiner's Use

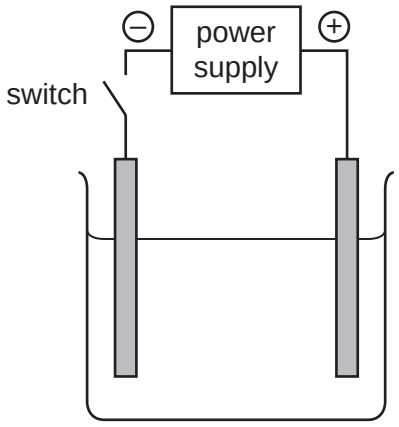

Fig. 3.1

(i) On the diagram, label clearly the **anode** and the **electrolyte**. [2]

(ii) Copper chloride solution contains copper ions and chloride ions.

When the switch in Fig. 3.1 is closed, bubbles of chlorine gas form at the anode and copper metal forms at the cathode.

Explain these observations in terms of ions, electrons and atoms.

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..... [4]

4 **(a)** Fig. 4.1 shows a ray of light hitting a mirror. The angle of incidence is 50°.

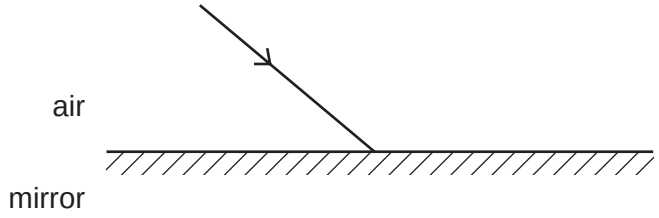


Fig. 4.1

On Fig. 4.1

(i) use a ruler to draw and label the reflected ray, [1]

(ii) use a ruler to draw and label the normal, [1]

(iii) label the angle of incidence. [1]

(b) Fig. 4.2 shows the wave traces made by three sounds.

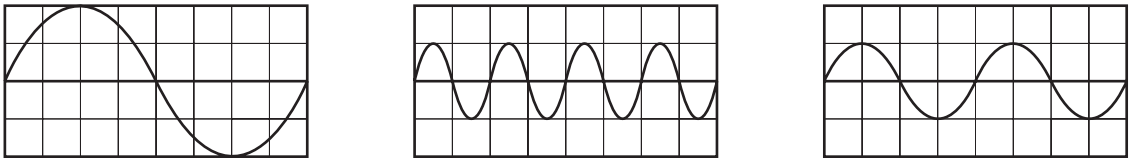
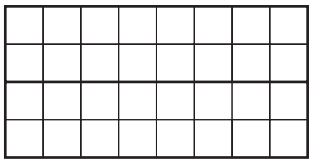


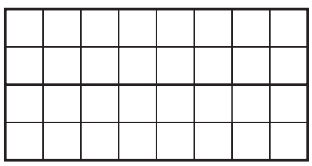
Fig. 4.2

(i) On the grid below, draw the trace of a sound wave which has twice the frequency of trace **A**.



[1]

(ii) On the grid below, draw the trace of a sound wave which has half the amplitude of trace **A**.



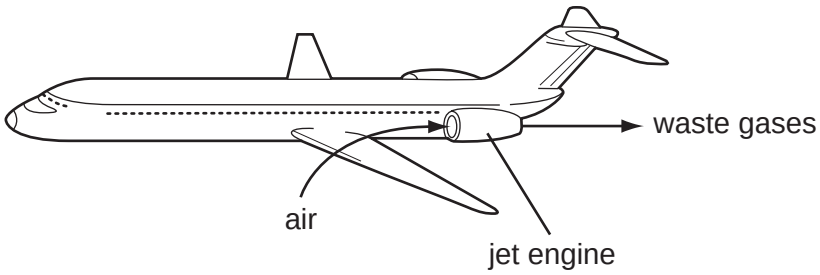
[1]

(iii) Which two traces in Fig. 4.2 show sounds with the same loudness?

..... [1]

5 In jet engines, hydrocarbon molecules from the jet fuel mix with air and burn. This releases a large amount of energy and produces a mixture of waste gases. These waste gases pass out through the back of the jet engine into the atmosphere.

For Examiner's Use



(a) Fig. 5.1 shows a molecule of octane, which is a typical hydrocarbon molecule in jet fuel.

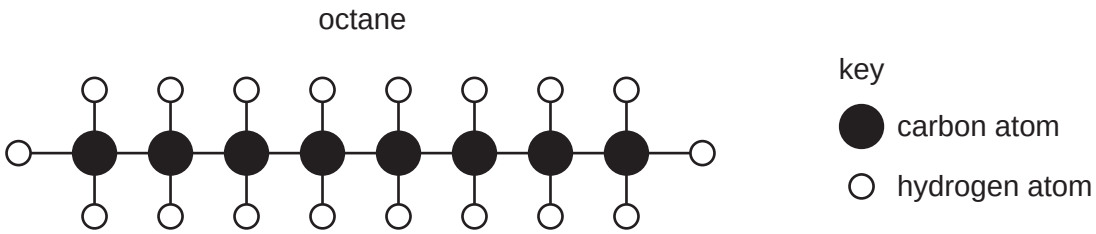


Fig. 5.1

(i) State the chemical formula of octane.

..... [1]

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

octane	+		→		+	

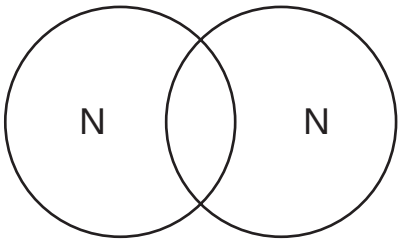
[2]

(b) Air contains the element nitrogen, N_2.

(i) State the number of outer electrons in a single nitrogen atom.

..... [1]

(ii) Complete the bonding diagram below to show how the outer electrons are arranged around the atoms in a nitrogen molecule.



[2]

(c) Table 5.1 shows information about some metallic materials.

For Examiner's Use

Table 5.1

material	strength	density
mild steel	very high	very high
aluminium	low	low
duralumin (an aluminium alloy)	very high	low

Duralumin is used in the manufacture of aircraft.

Explain why the properties of this material make it suitable for this purpose.

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..... [2]

6 Fig. 6.1 shows a generalised reflex arc.

For Examiner's Use

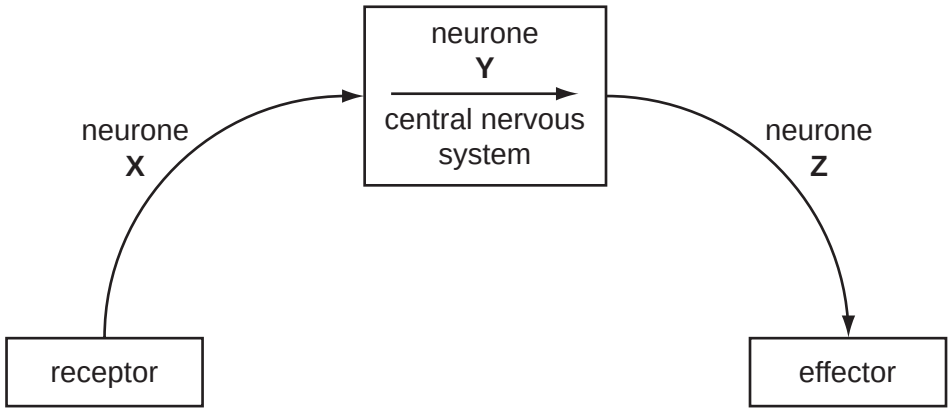

Fig. 6.1

(a) Name the neurones labelled **X**, **Y** and **Z**.

X .....

Y .....

Z ..... [3]

(b) A student hears a sudden, loud bang. Receptors in his ear respond to the sound by generating electrical impulses in neurone **X**. These impulses travel along the reflex arc, eventually reaching an effector.

Suggest what the effector could be in this reflex, and how it would respond.

effector .....

response ..... [2]

(c) Another reflex action involves the secretion of saliva into the mouth, in response to the smell of food. Saliva contains the enzyme amylase.

(i) Describe the role of amylase in the digestion of food.

.....

.....

..... [2]

(ii) Explain why it is necessary for most types of food that we eat to be digested.

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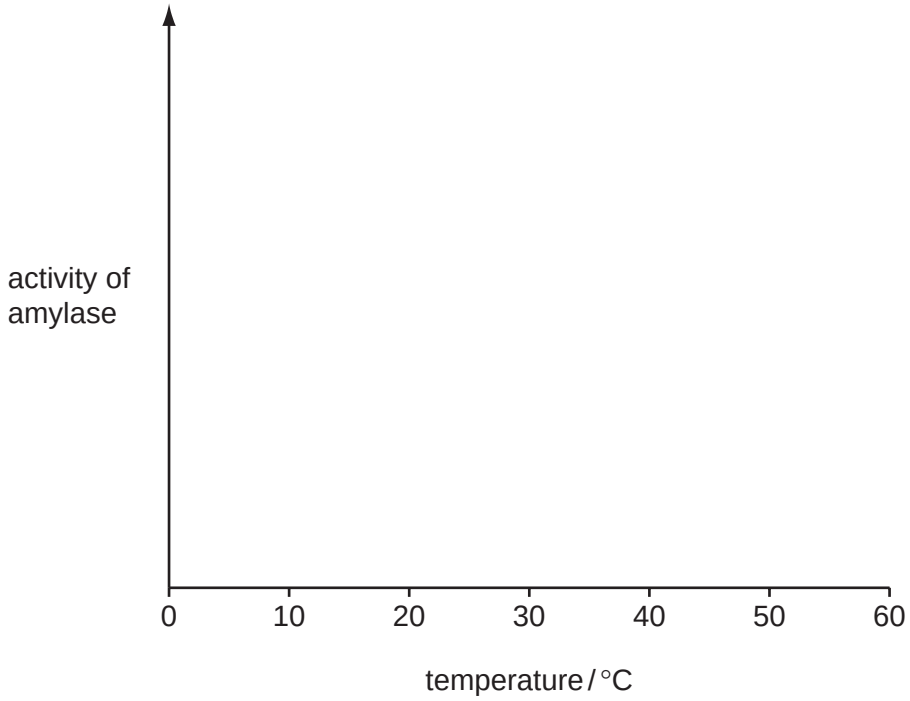
.....

..... [2]

(iii) On the axes below, sketch a curve to show how the activity of amylase from human saliva would vary with temperature.

For Examiner's Use



[2]

For Examiner's Use

7 **(a)** A student set up the electric circuit in Fig. 7.1.

It contains three lamps **L1**, **L2** and **L3**.

It contains three switches **S1**, **S2** and **S3**.

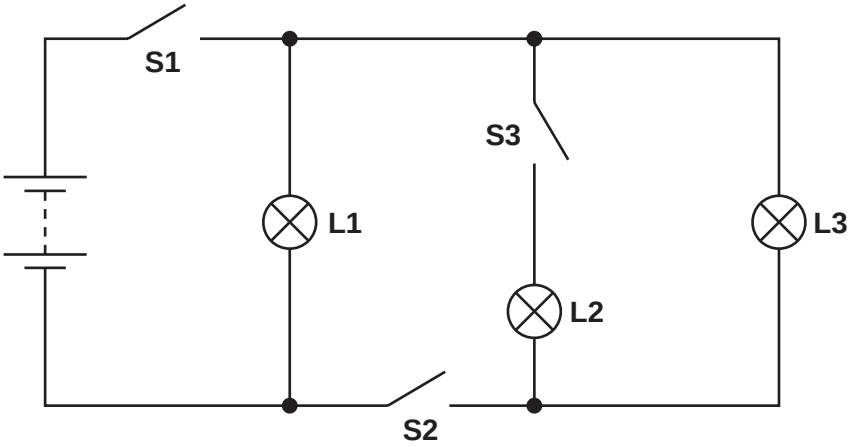


Fig. 7.1

In Table 7.1 write the words **'on'** or **'off'** to show when each lamp is lit or not lit for each set of switch positions.

Table 7.1

switch position			**lamp 'on' or 'off'**		
S1	**S2**	**S3**	**L1**	**L2**	**L3**
closed	closed	closed			
closed	closed	open			
closed	open	open			

[3]

(b) Fig. 7.2 shows an electrical device.

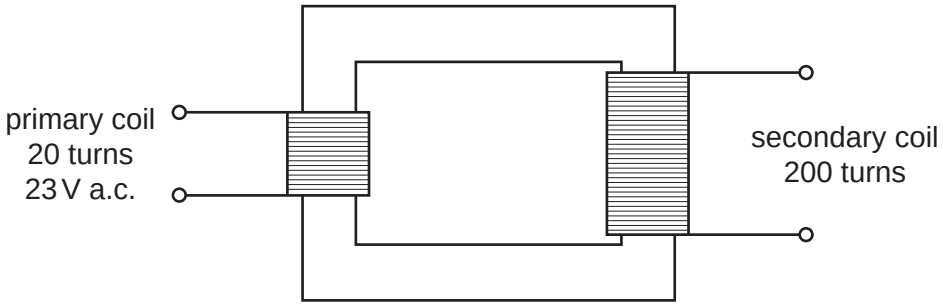


Fig. 7.2

(i) Name the device.

..... [1]

(ii) Calculate the output voltage.

State the formula that you use and show your working.

formula used

working

..... [2]

(c) Fig. 7.3 shows a simple a.c. generator.

For Examiner's Use

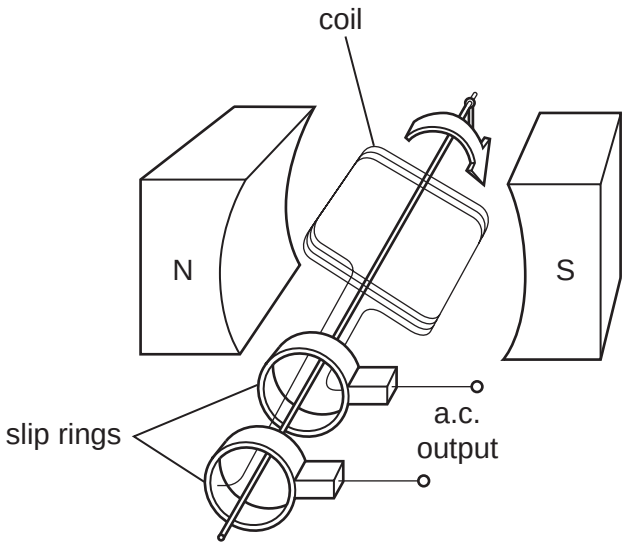


Fig. 7.3

Describe and explain how the generator works. Your answer should refer to

- how a voltage is generated,
- why an alternating voltage is generated,
- why slip rings are used.

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..... [4]

For Examiner's Use

8 **(a)** Explain why plants need light for photosynthesis.

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..... [2]

(b) A student fixed a piece of black paper over a leaf, which was still attached to the plant. He left the plant in the sun for two days.

He then removed the leaf from the plant and tested it for starch, after removing the black paper.

Fig. 8.1 shows the leaf before and after he did the starch test.

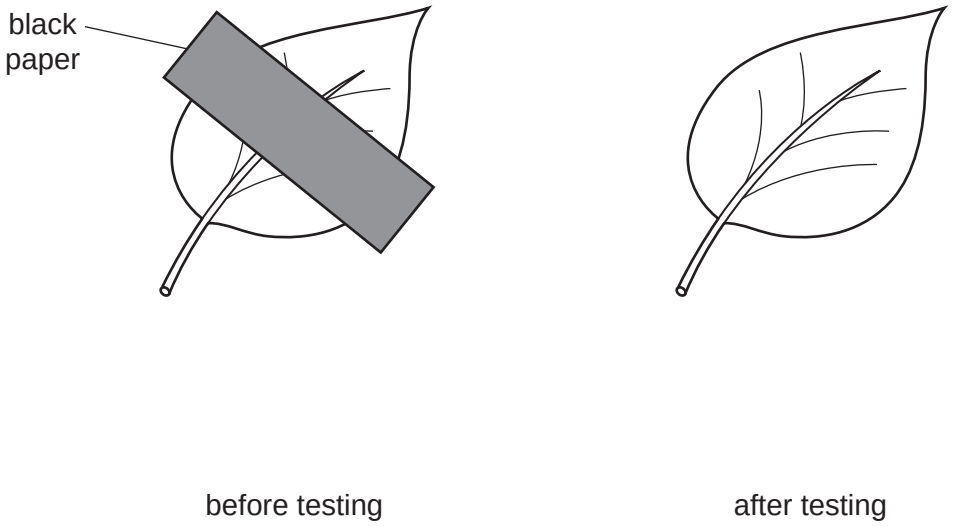

Fig. 8.1

Complete the diagram of the leaf after testing in Fig. 8.1, using labels to show the colours of each part. Do **not** colour the diagram. [2]

(c) In daylight, plant leaves take in carbon dioxide and give out oxygen. In darkness, they take in oxygen and give out carbon dioxide.

Explain why this happens.

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..... [3]

9 Fig. 9.1 shows the apparatus a student used to measure the rate of reaction between some powdered metal and dilute hydrochloric acid.

For Examiner's Use

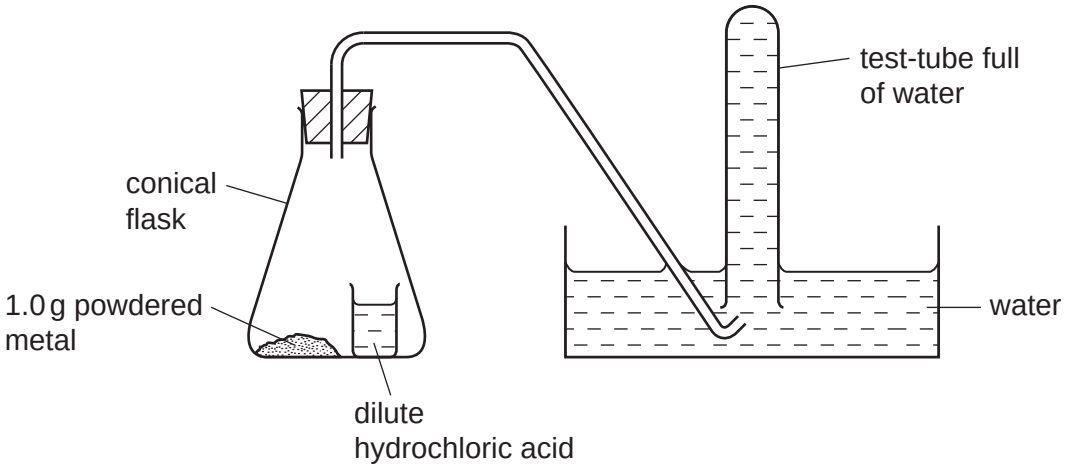

Fig. 9.1

When the student tilted the conical flask, the acid mixed with the powdered metal. Any gas which was produced collected in the test-tube, pushing the water out. The student used a stopwatch to measure the time taken for the test-tube to fill with gas.

(a) (i) Name the gas produced when metals react with dilute acid.

..... [1]

(ii) State the formula of the *ion* that is present in **all** dilute acid solutions.

..... [1]

(b) The student used apparatus like that in Fig. 9.1 to compare the rates of reaction between dilute hydrochloric acid and three powdered metals, **X**, **Y** and **Z**.

The results the student obtained are shown in Table 9.1.

Table 9.1

metal	mass of metal / g	time for gas to fill the test-tube / seconds
X	1.0	154
Y	1.0	28
Z	1.0	76

(i) The student was careful to ensure that the only variable (factor) which differed between the experiments was the type of metal.

State **two** variables, other than the mass and surface area of the metals, that the student must keep the same in each experiment.

1 .....

2 ..... [2]

(ii) Explain how the results show that the rate of reaction was the lowest when metal **X** was used.

.....

..... [1]

(iii) The student repeated the experiment with metal **Y** but this time he used a single piece of metal which had a mass of 1.0 g.

State how the rate of reaction would differ from the experiment in which 1.0 g of powdered metal was used. Explain your answer in terms of the collisions between the surface of the metal and ions in the solution.

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..... [3]

(c) When magnesium reacts with dilute hydrochloric acid, HC*l*, one of the products is magnesium chloride, $MgCl_2$.

Construct a balanced symbolic equation for this reaction.

..... [2]

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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											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 over **X** over b

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.).