UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

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.

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

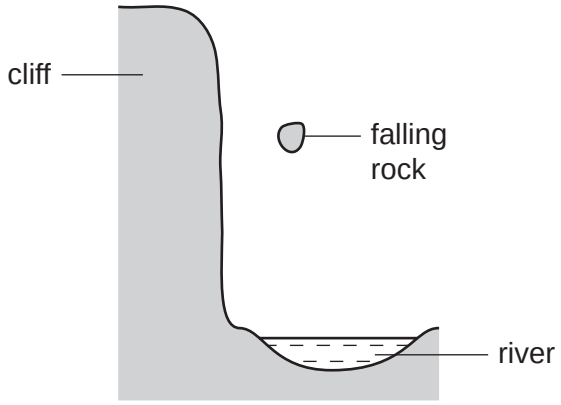


Fig. 1.1

(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.

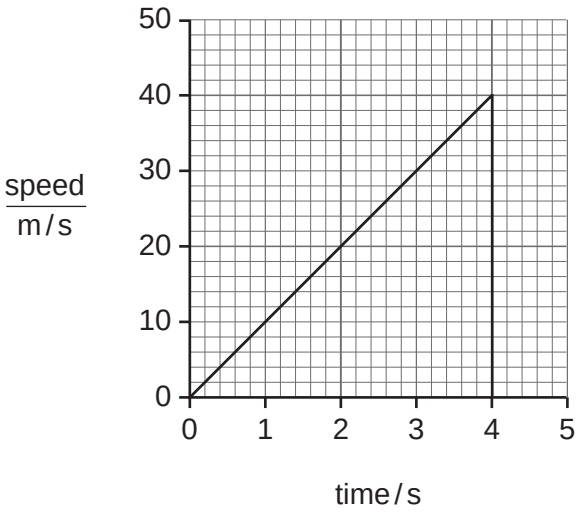


Fig. 1.2

Calculate the height of the cliff.

Show your working.

..... [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.

.....

.....

.....

.....

..... [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]

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, beave 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.

.....

.....

..... [2]

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

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.

.....

.....

.....

.....

.....

.....

..... [3]

3 **(a)** Copper metal reacts with oxygen gas to form copper oxide. Table 3.1 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.

.....

.....

[2]

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

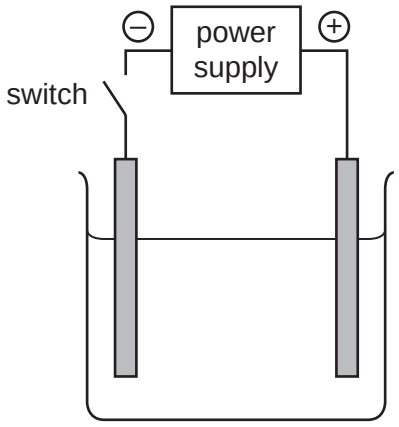


Fig. 3.1

(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.

.....

.....

.....

.....

.....

..... [4]

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

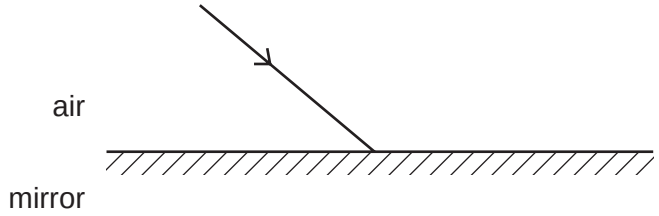


Fig. 4.1

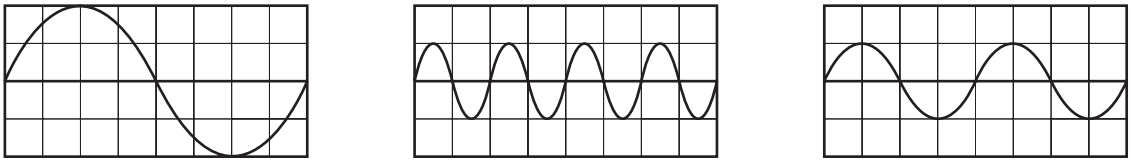
On Fig. 4.1

(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]

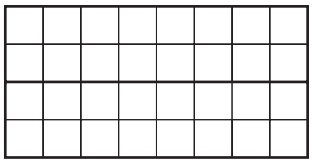
(b) Fig. 4.2 shows the wave traces made by three sounds.



trace **A** trace **B** trace **C**

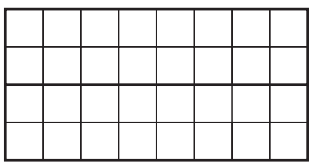
Fig. 4.2

(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**.

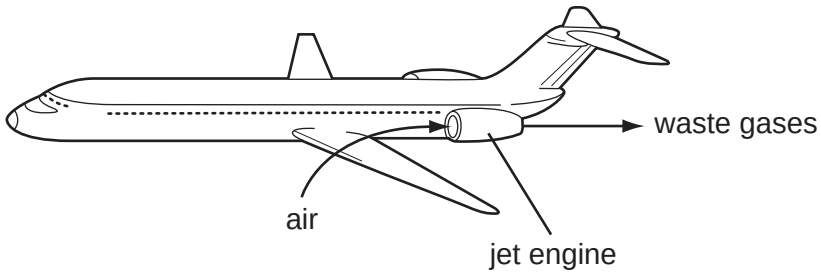


[1]

(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 re
a large amount of energy and produces a mixture of waste gases. These waste gases
out through the back of the jet engine into the atmosphere.



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

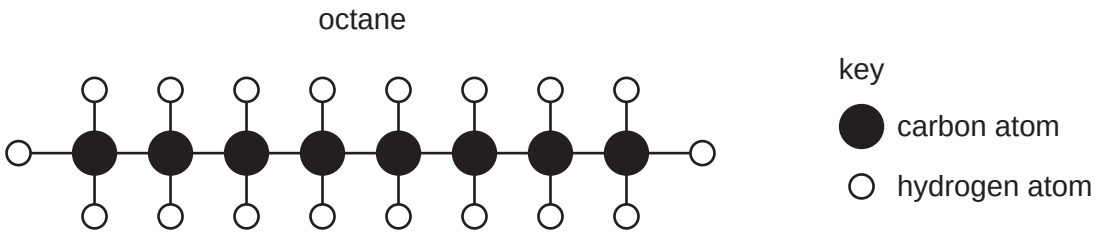


Fig. 5.1

(i) State the chemical formula of octane.

..... [1]

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

octane	+		→		+	

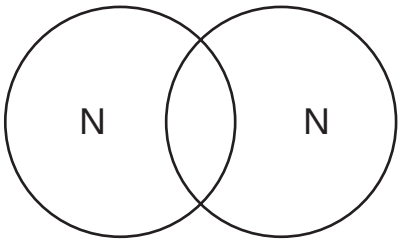
[2]

(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.

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.

.....

.....

.....

.....

..... [2]

6 Fig. 6.1 shows a generalised reflex arc.

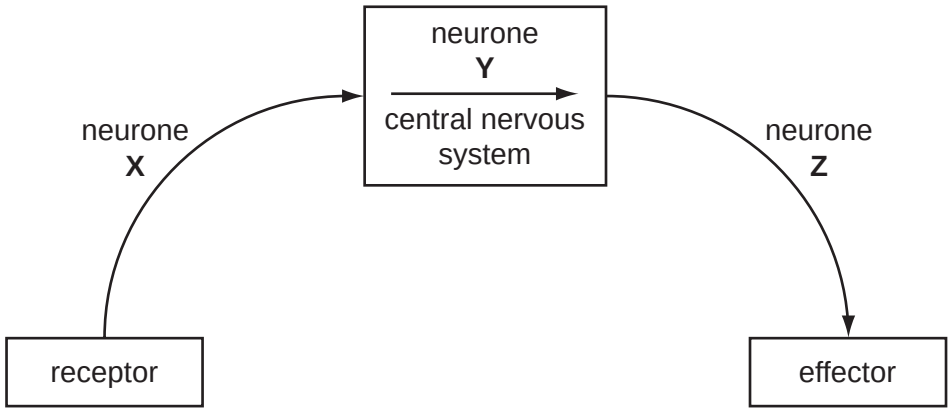


Fig. 6.1

(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]

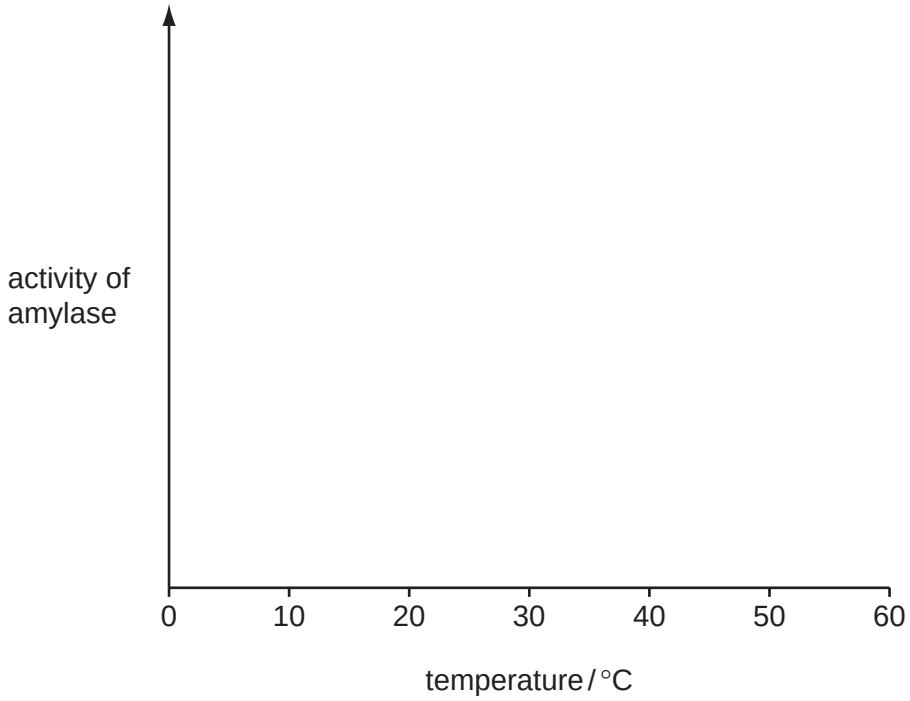
(ii) Explain why it is necessary for most types of food that we eat to be digested.

.....

.....

..... [2]

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



[2]

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**.

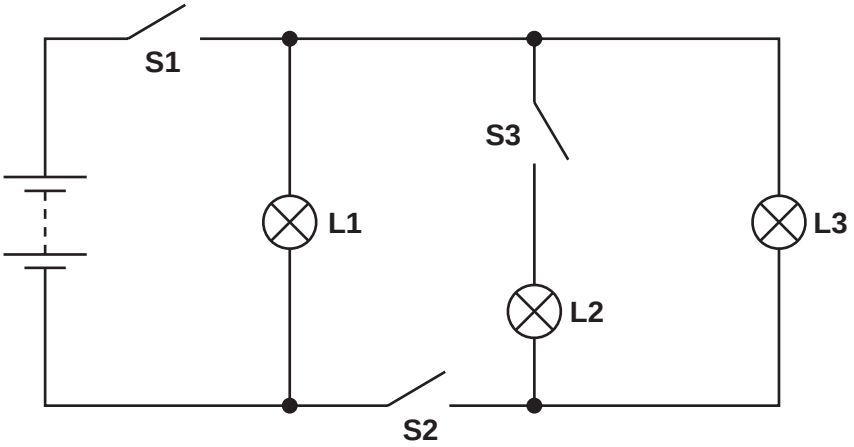


Fig. 7.1

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.

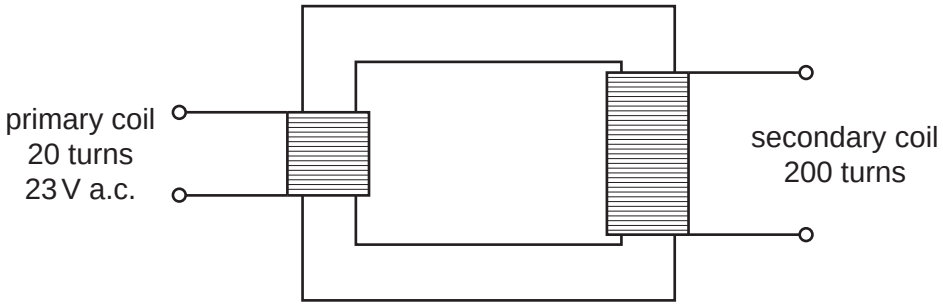


Fig. 7.2

(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.

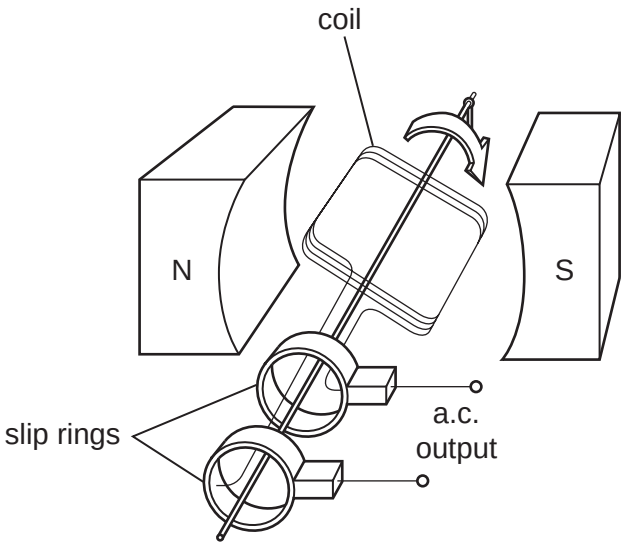


Fig. 7.3

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.

.....

.....

.....

.....

.....

.....

.....

..... [4]

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

.....

.....

..... [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.

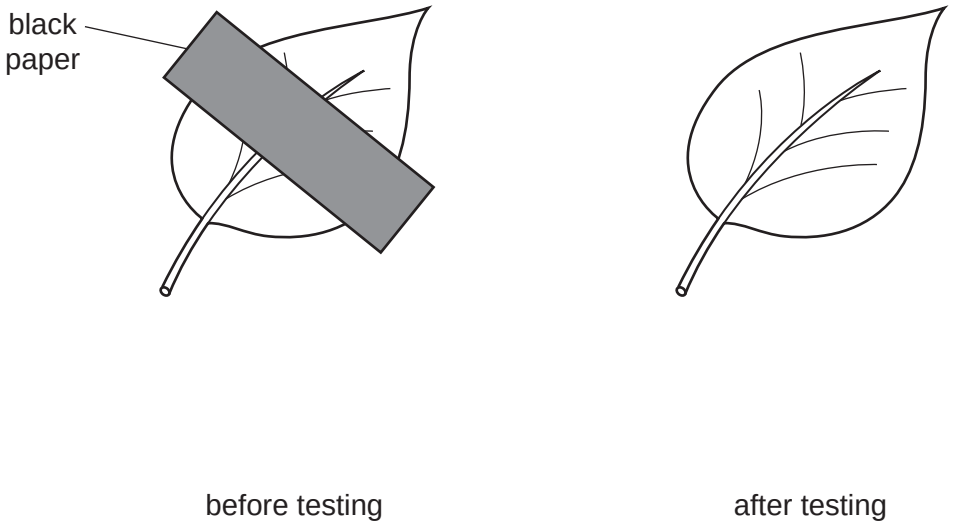


Fig. 8.1

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.

.....

.....

.....

..... [3]

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

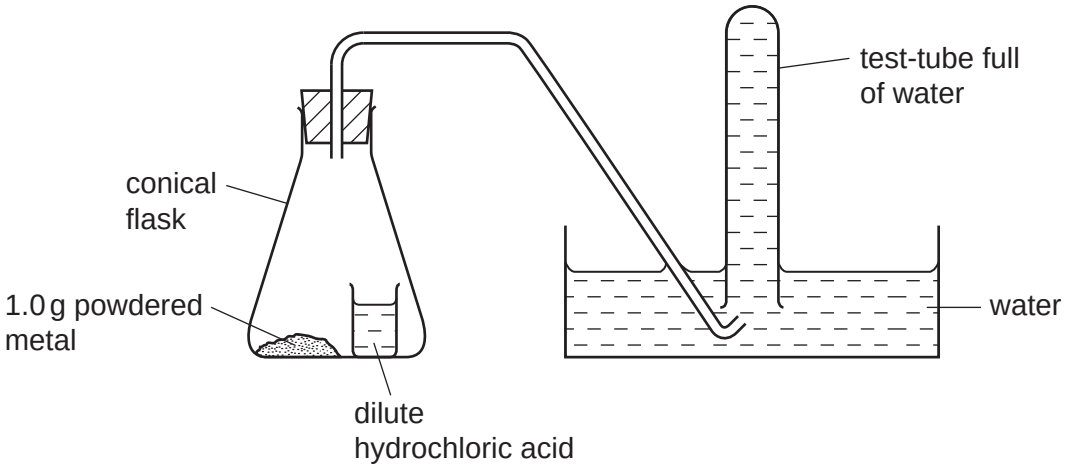


Fig. 9.1

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 re 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.

.....

.....

.....

..... [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]

BLANK PAGE

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.).