



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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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	
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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.

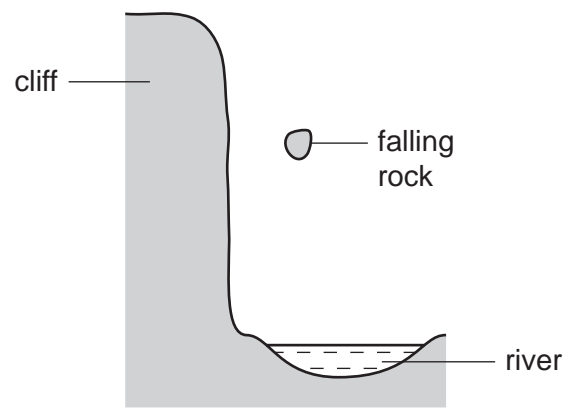


Fig. 1.1

(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.

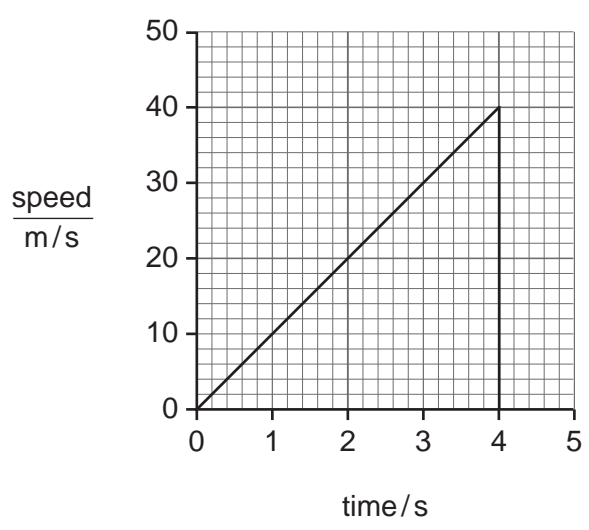


Fig. 1.2

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.

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

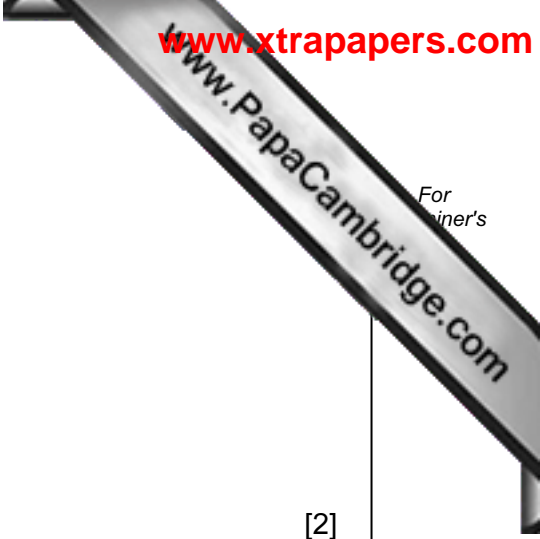
(d) The rock contains radioactive substances emitting high levels of ionising radiation.

(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]



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.

.....

.....

..... [2]

(b) People used to shoot gray wolves, because the wolves kill sheep on farms and 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.

.....

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.....

[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 ₂ O

(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 O²⁻.

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.

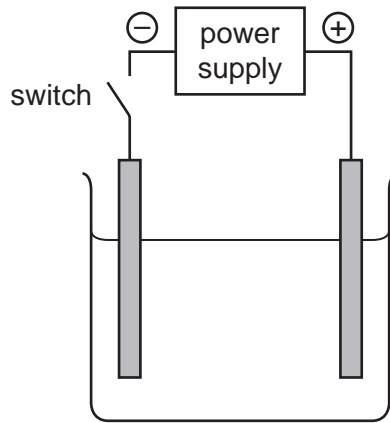


Fig. 3.1

(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.

.....

.....

.....

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.....

.....

..... [4]

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

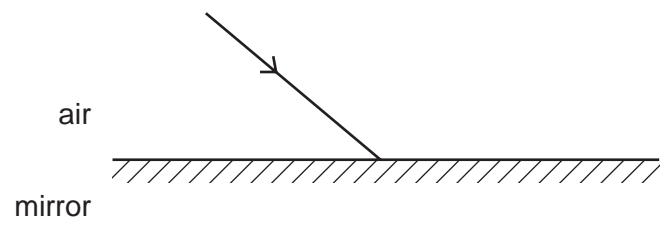


Fig. 4.1

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.

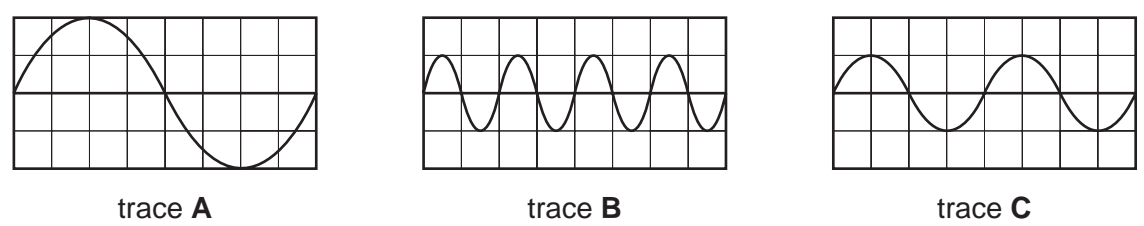
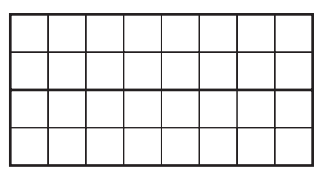


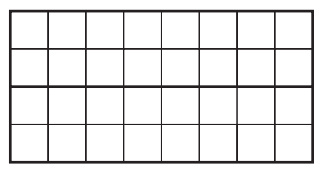
Fig. 4.2

(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.

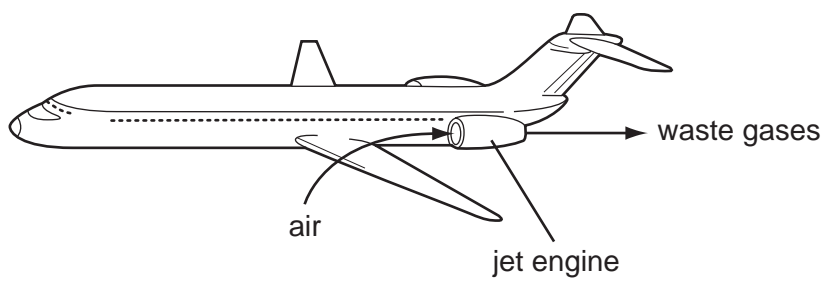


[1]

(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.



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

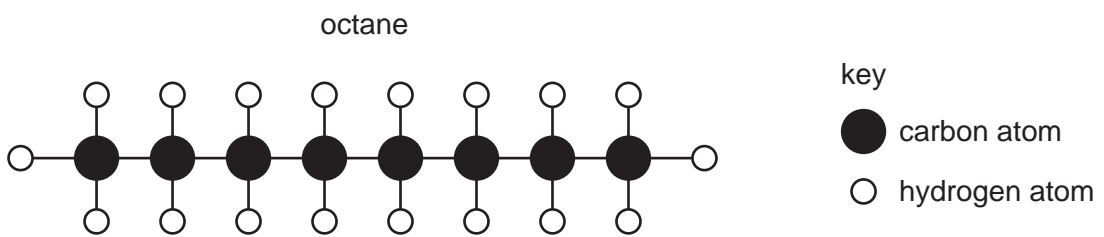


Fig. 5.1

(i) State the chemical formula of octane.
 [1]

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

octane

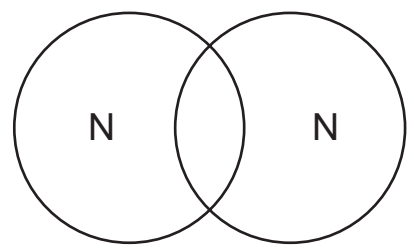
 + → +

[2]

(b) Air contains the element nitrogen, N₂.

(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.

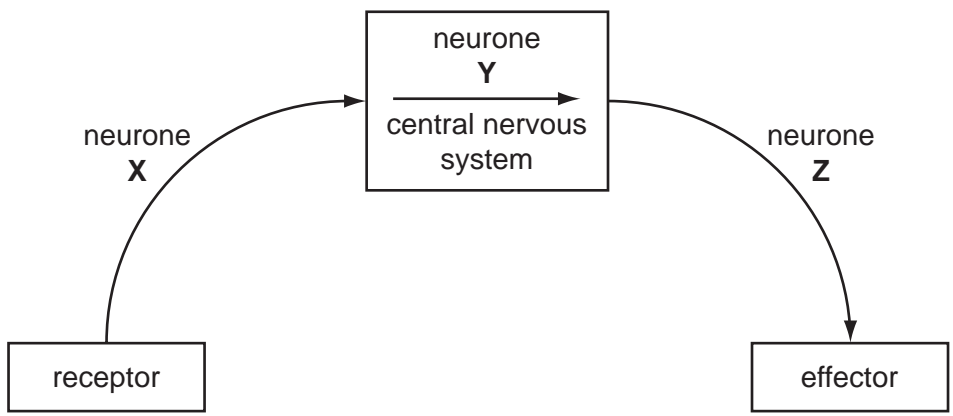


Fig. 6.1

(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.

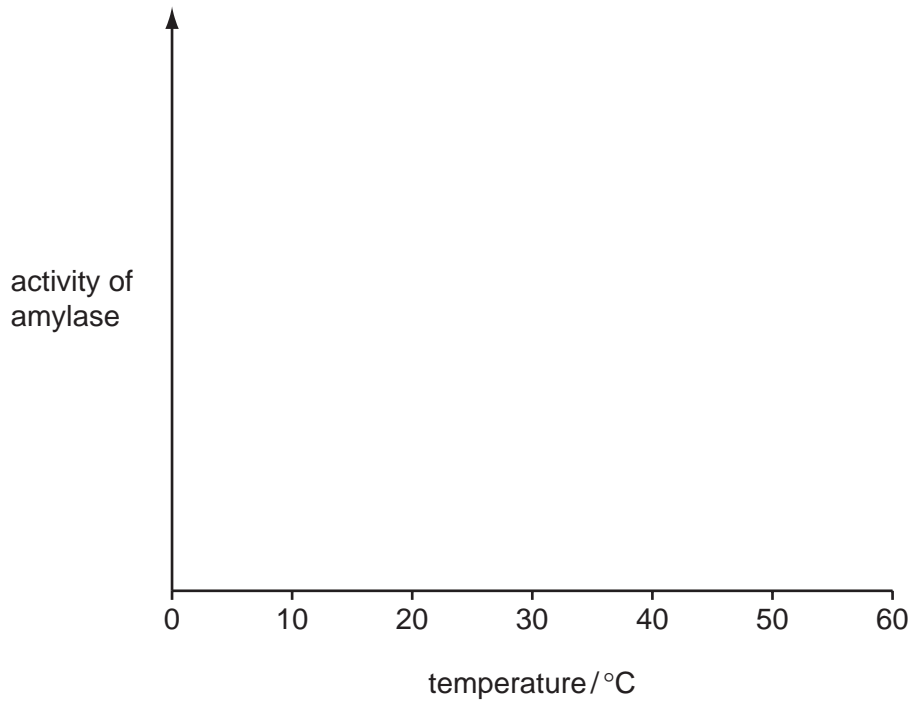
(i) Describe the role of amylase in the digestion of food.

-
-
- [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**.

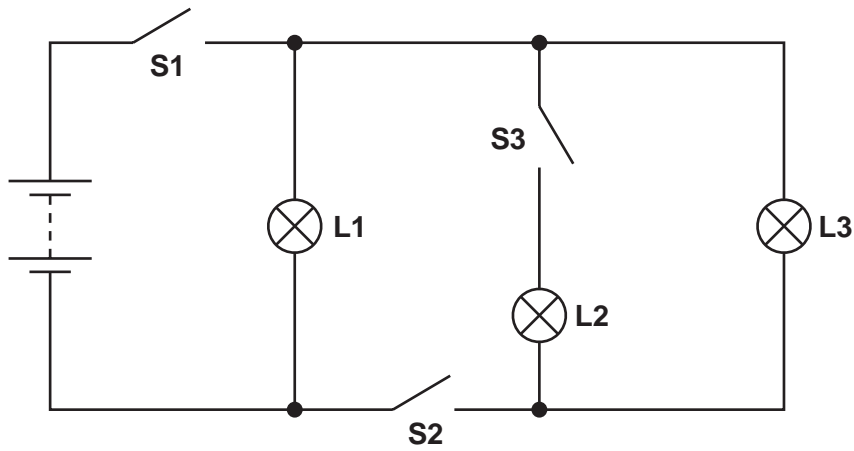


Fig. 7.1

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.

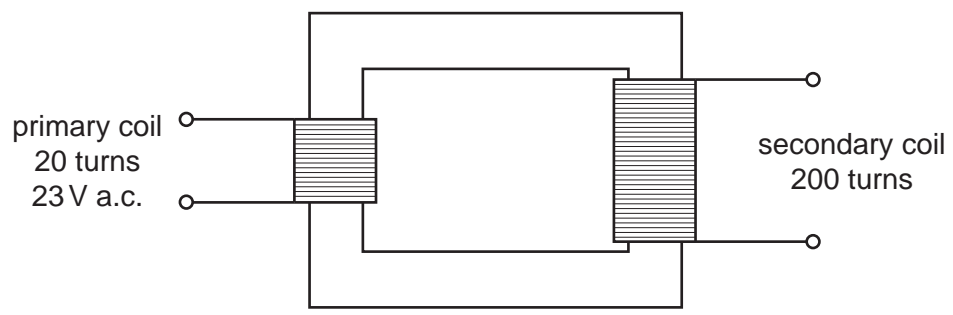


Fig. 7.2

(i) Name the device.

..... [1]

(ii) Calculate the output voltage.

State the formula that you use and show your working.

formula used

working

..... [2]

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.

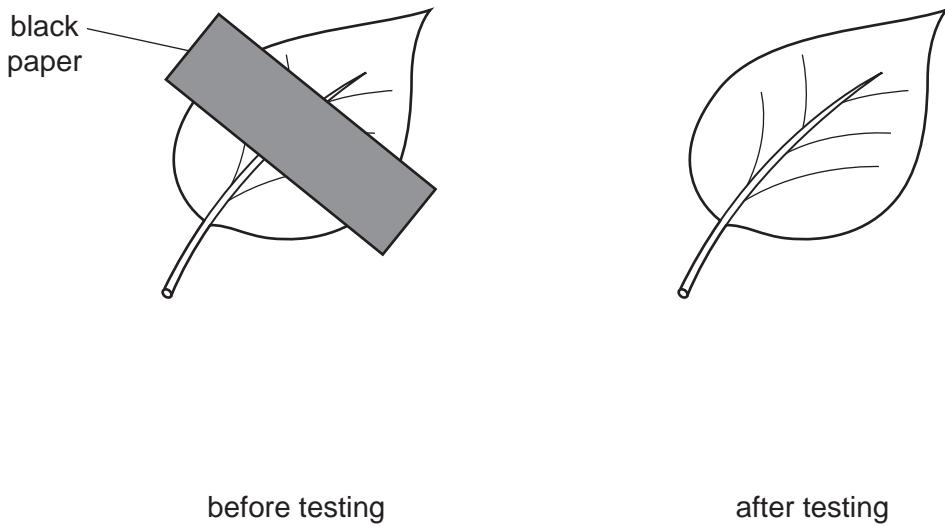


Fig. 8.1

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.

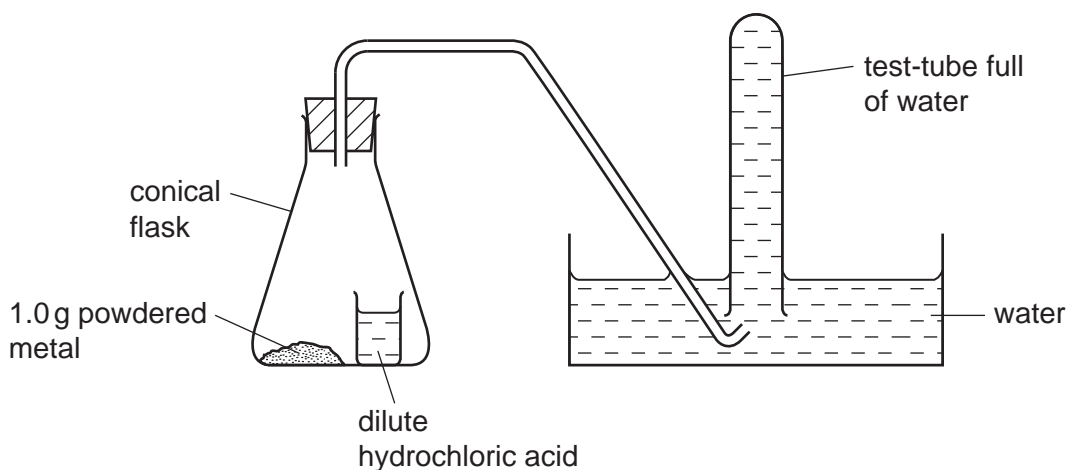


Fig. 9.1

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 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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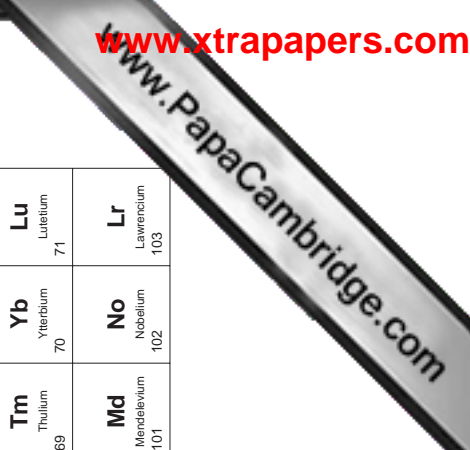
.....

..... [3]

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

Construct a balanced symbolic equation for this reaction.

..... [2]



DATA SHEET

The Periodic Table of the Elements

Group			I	II	III	IV	V	VI	VII	0			
			1 H Hydrogen 1								2 He Helium 2		
7 Li Lithium 3	9 Be Beryllium 4												
23 Na Sodium 11	24 Mg Magnesium 12												
39 K Potassium 19	40 Ca Calcium 20	51 V Vanadium 23	48 Ti Titanium 22	45 Sc Scandium 21	56 Fe Iron 26	59 Co Cobalt 27	64 Cu Copper 29	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	84 Kr Krypton 36		
85 Rb Rubidium 37	88 Sr Strontium 38	93 Nb Niobium 41	91 Zr Zirconium 40	89 Y Yttrium 39	101 Ru Ruthenium 44	103 Rh Rhodium 45	108 Ag Silver 47	115 In Indium 49	122 Sb Antimony 51	128 Te Tellurium 52	131 Xe Xenon 54		
133 Cs Caesium 55	137 Ba Barium 56	181 Ta Tantalum 73	178 Hf Hafnium 72	139 La Lanthanum 57	190 Os Osmium 76	192 Ir Iridium 77	197 Au Gold 79	204 Tl Thallium 81	209 Pb Lead 82	210 Po Polonium 84	210 Rn Radon 86		
226 Ra Radium 88	227 Ac Actinium 89	† 58-71 Lanthanoid series † 90-103 Actinoid series											
		140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	146 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	162 Dy Dysprosium 66	165 Ho Holmium 67	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
		232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	234 Np Neptunium 93	244 Pu Plutonium 94	247 Am Americium 95	253 Cm Curium 96	259 Bk Berkelium 97	264 Cf Californium 98	269 Es Einsteinium 99	271 Fm Fermium 100	277 Lr Lawrencium 103
Key		a	X	b	a = relative atomic mass	X = atomic symbol	b = proton (atomic) number						

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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