UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

2507801115

CO-ORDINATED SCIENCES **0654/21**

Paper 2 (Core) **October/November 2010**

2 hours

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.

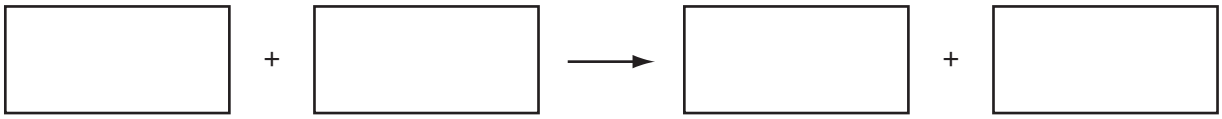
Answer **all** questions.
A copy of the Periodic Table is printed on page 28.

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	
10	
Total	

This document consists of **24** printed pages and **4** blank pages.

1 **(a)** State the word equation for photosynthesis.



[2]

(b) **(i)** Explain why plants need light for photosynthesis.

.....

.....

..... [2]

(ii) State **two** ways in which a plant leaf is adapted to obtain and use light for photosynthesis.

1 .....

.....

2 .....

..... [2]

(c) 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.

(i) Use the letters given to list the correct sequence of the steps he took.

A	Add iodine solution to the leaf.
B	Place the leaf in boiling water.
C	Dip the leaf into water to soften it.
D	Place the leaf in hot ethanol.
E	Spread the leaf on a white tile.

..... [3]

(ii) Fig. 1.1 shows the leaf before and after he did the starch test.

For Examiner's Use

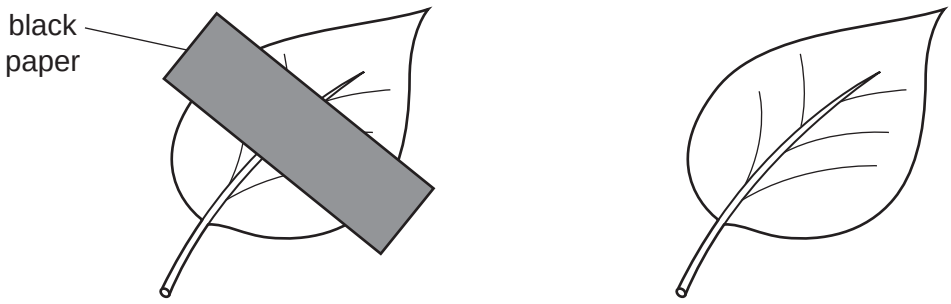


Fig. 1.1

Complete the diagram of the leaf after testing in Fig. 1.1. Do **not** colour the diagram.

Use labels to show which parts would look orange-brown and which parts would look blue-black. [2]

For Examiner's Use

2 Fig. 2.1 shows the apparatus a student used to study the rate of reaction between some powdered metal and dilute hydrochloric acid.

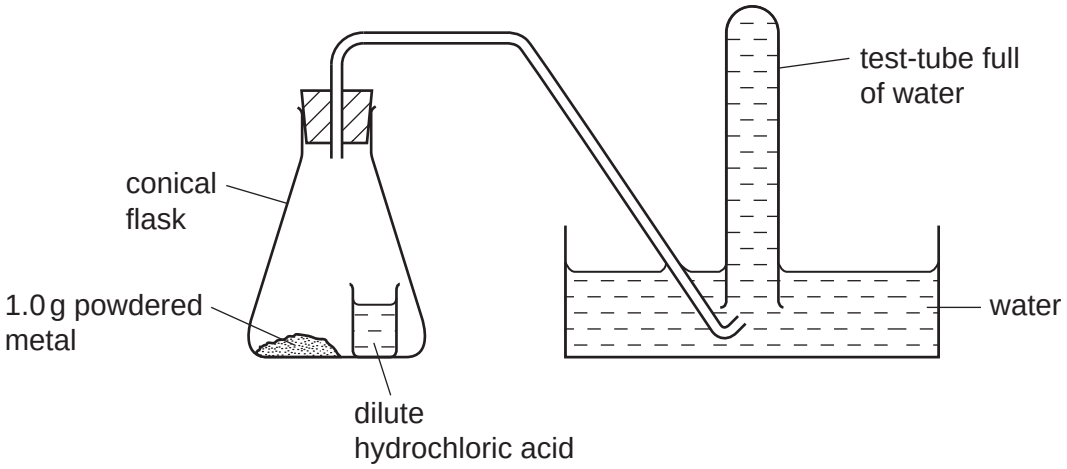


Fig. 2.1

When the student tilted the conical flask, the acid mixed with the powdered metal. If a reaction occurred, any gas which was produced collected in the test-tube, pushing the water out. The student measured the time taken for the test-tube to fill with gas.

The student used the apparatus and method described above 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 2.1.

Table 2.1

metal	mass of metal / g	time for gas to fill the test-tube / seconds
X	1.0	150
Y	1.0	45
Z	1.0	no gas was produced

(a) (i) Name the gas produced when metals **X** and **Y** reacted with dilute hydrochloric acid.

..... [1]

(ii) Describe the test you would carry out to identify this gas.

.....

..... [1]

For Examiner's Use

(iii) Suggest and explain which metal, **X**, **Y** or **Z**, could have been copper.

metal .....

explanation .....

..... [1]

(iv) The student repeated the experiment with metal **X** but this time she used a single piece of metal weighing 1.0 g.

State and explain how the rate of reaction would differ from the experiment in which 1.0 g of powdered metal was used.

.....

.....

..... [2]

(b) In another experiment, the student added powdered zinc to dilute sulfuric acid. When the bubbling stopped, there was still some powdered zinc left at the bottom of the solution.

(i) Explain why the bubbling eventually stopped even though some zinc powder remained.

.....

..... [1]

(ii) Name the salt which was left in the solution at the end of the reaction.

..... [1]

(c) In areas where pollution is very low, rain falls through air which contains the gases nitrogen, oxygen and carbon dioxide.
Chemical weathering may occur when rainwater flows over rocks.

(i) Explain why rainwater which falls through unpolluted air has a pH which is slightly less than 7.

.....

.....

..... [2]

(ii) Describe **one** advantage to plants of the chemical weathering of rocks.

.....

.....

..... [2]

For Examiner's Use

3 **(a)** Complete the sentences by choosing words from the list. Each word may be used once, more than once or not at all.

expansion	**gas**	**heat**	**liquid**
longitudinal	**movement**	**quickly**	
slowly	**transverse**	**vacuum**	**wave**

Sound is a ..... wave. Sound travels through a material by the ..... of its particles.

In a solid the particles are close together, so sound travels more ..... than it does in a gas. Sound cannot travel through a ..... because there are no particles present. [4]

(b) Fig. 3.1 shows a mobile phone (cell phone).
Energy is stored inside the mobile phone in a battery.

mobile phone
containing a battery

Fig. 3.1

State the energy change that takes place when the battery is being charged.

..... energy into ..... energy [1]

(c) Radio waves and visible light are forms of electromagnetic radiation.

(i) Name **one** other form of electromagnetic radiation.

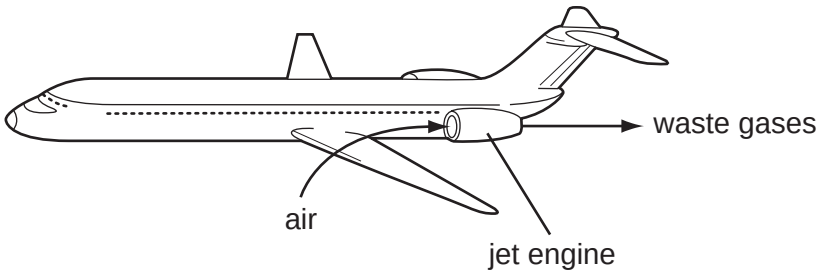
..... [1]

(ii) Give **one** use for the form of electromagnetic radiation you have named in **(i)**.

..... [1]

For Examiner's Use

4 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. 4.1 shows a molecule of octane, which is a typical hydrocarbon molecule in jet fuel.

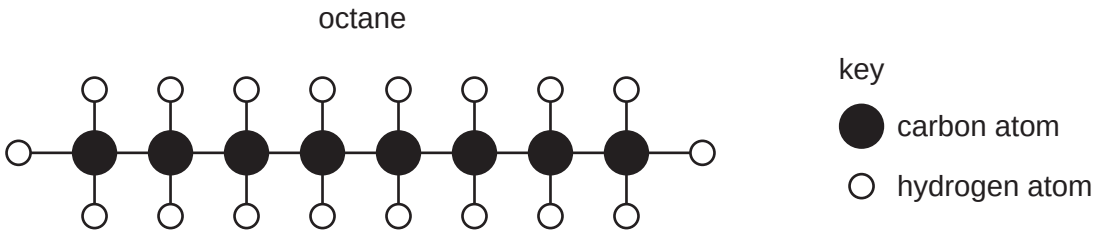


Fig. 4.1

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

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

octane	+		→		+	

[2]

(iii) Explain why the mixture of gases coming from the rear of the jet engine contains a large amount of nitrogen.

.....

.....

..... [2]

(iv) Explain why the metallic parts of the jet engine become hot when it is working.

.....

..... [1]

For Examiner's Use

(b) (i) A carbon atom has a proton (atomic) number 6 and a nucleon (mass) number 12.

State the number of neutrons and electrons in this carbon atom.

number of neutrons .....

number of electrons ..... [2]

(ii) State the chemical symbol of another element which is in the same **group** in the Periodic Table as carbon.

..... [1]

(c) Table 4.1 shows information about some metallic materials.

Table 4.1

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

(i) Describe briefly how aluminium and an alloy of aluminium differ in composition.

.....

..... [1]

(ii) Duralumin is used in the manufacture of aircraft.

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

.....

.....

.....

.....

..... [2]

5 **(a)** Complete the sentences about the human nervous system, using some of the words in the list.

For Examiner's Use

biceps **brain** **detectors** **effectors**

nerves **receptors**

Specialised cells in the human nervous system detect external stimuli. These cells are called ...... They convert the stimulus into electrical impulses in ....., which carry the impulse to the central nervous system.

The central nervous system then sends impulses to parts of the body that respond to the stimulus, such as muscles or glands. These parts are called ..... [3]

(b) When we smell food, the salivary glands respond by secreting saliva.

(i) Saliva contains the enzyme amylase. Describe the function of amylase.

.....

.....

..... [2]

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

.....

.....

..... [2]

(iii) Describe how food is moved through the alimentary canal, after we have swallowed it.

.....

.....

..... [2]

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Please turn over for Question 6.

6 Fig. 6.1 shows a rock of mass 2 kg that is falling from the top of a cliff into the river below.

For Examiner's Use

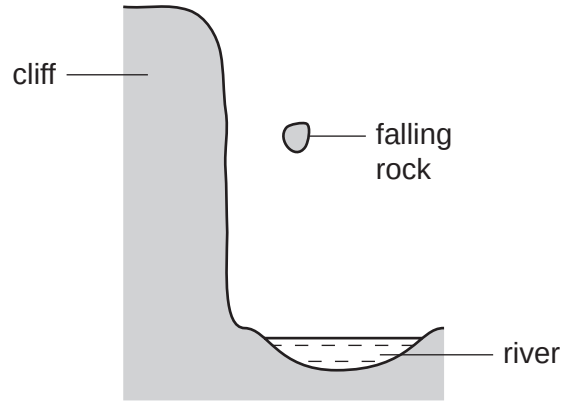

Fig. 6.1

(a) Fig. 6.2 is the speed-time graph for the motion of the rock.

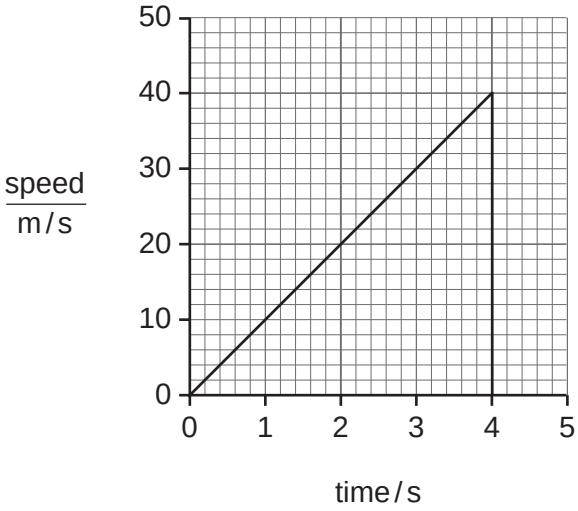

Fig. 6.2

(i) State the maximum speed of the rock. ..... m/s [1]

(ii) Use your answer to **(i)** to calculate the kinetic energy of the rock as it hits the water.

State the formula that you use and show your working.

formula used

working

..... J [2]

For Examiner's Use

(b) An observer on the top of the cliff measured the time between when he saw the rock hit the water and when he heard the sound of the splash. This time was 0.25 s.
The speed of sound in air is 330 m / s.

Calculate the height of the cliff.

State the formula that you use and show your working.

formula used

working

..... m [2]

(c) The rock has a mass of 2000 g and a volume of 700 cm^3.

Calculate the density of the rock.

State the formula that you use and show your working.

State the units of your answer.

formula used

working

..... [3]

(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]

For Examiner's Use

7 The gray wolf, *Canis lupus*, is a predator that lives in North America. Fig. 7.1 shows a gray wolf.

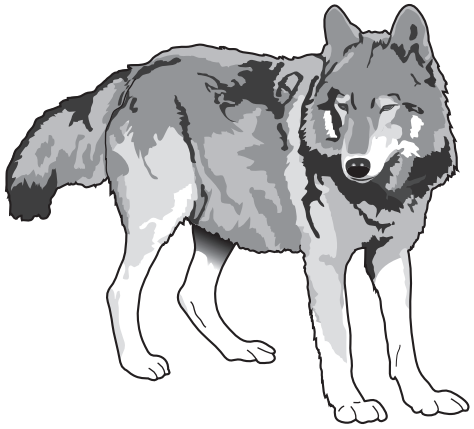

Fig. 7.1

(a) State **one** feature, visible on Fig. 7.1, which shows that the gray wolf is a mammal.

.....

[1]

(b) The binomial for the gray wolf is *Canis lupus*. Another dog-like animal that lives in North America is the coyote, *Canis latrans*.

What do these binomials tell us about the relationship between gray wolf and the coyote?

.....

.....

.....

[2]

For Examiner's Use

(c) In Wisconsin, Canada, the wolves' diet consists mainly of white-tailed deer, beavers, 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]

For Examiner's Use

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

The main causes of death of wolves are disease, starvation and accidents such as collisions with vehicles.

Fig. 7.2 shows the size of the gray wolf population in Wisconsin between 1986 and 2010. It also shows the predicted wolf population if the conservation programme is successful.

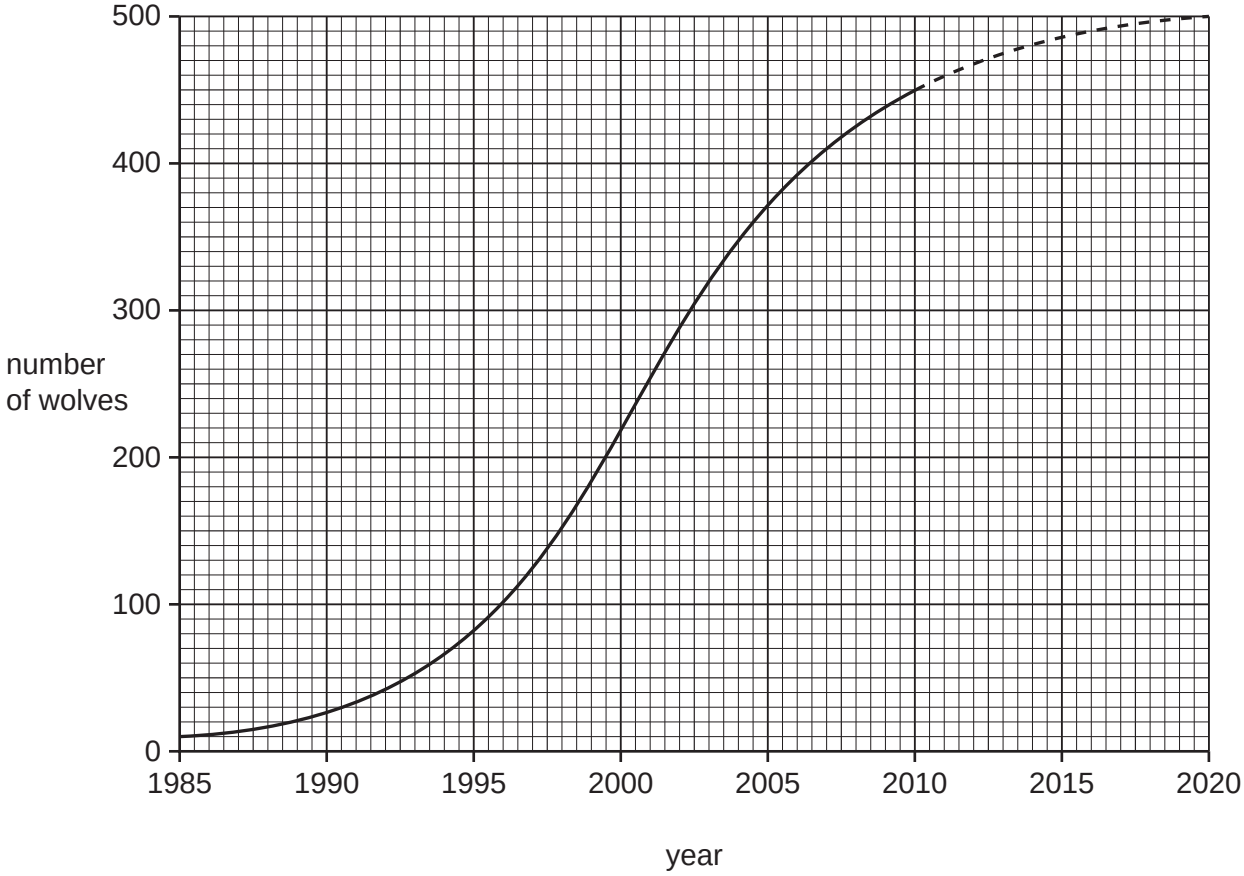

Fig. 7.2

For Examiner's Use

(i) Suggest why the population of gray wolves in Wisconsin is not expected to increase beyond about 500 individuals, even if they are no longer killed by humans.

.....

.....

..... [2]

(ii) Some people in Wisconsin are opposed to the wolf conservation programme. Explain why it is important to conserve species such as the gray wolf.

.....

.....

..... [2]

For Examiner's Use

8 Fig. 8.1 shows an electric heater being used to heat up 0.5 kg of water in a beaker.

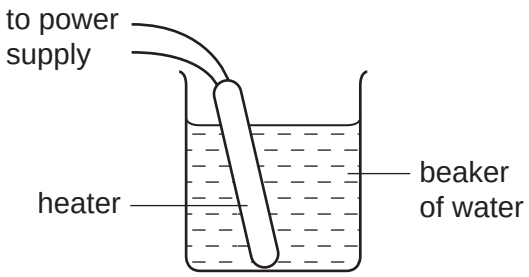

Fig. 8.1

(a) What is the main process by which energy is transferred through the water?

..... [1]

(b) The specific heat capacity of the water is 4200 J / kg °C.

(i) Explain what is meant by the term *specific heat capacity*.

.....

..... [1]

(ii) The electrical energy supplied to the heater in 10 minutes was 70 000 J.

Calculate the power supplied to the heater.

State the formula that you use and show your working.

formula used

working

..... W [2]

For Examiner's Use

(c) The electrical energy for the heater has been generated by burning a fossil fuel in a power station.

(i) Name **one** suitable fossil fuel. ..... [1]

(ii) Describe **one** problem with the burning of fossil fuels to generate electricity.

.....

..... [1]

(iii) State **one** alternative energy resource to fossil fuels, which could have been used to generate the electricity.

..... [1]

For Examiner's Use

9 **(a)** Copper metal reacts with oxygen gas to form copper oxide.

State why this reaction is an example of oxidation.

.....

..... [1]

(b) Table 9.1 shows information about two different types of copper oxide.

Table 9.1

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

(i) Describe briefly the difference in chemical composition of these two types of copper oxide.

.....

.....

..... [2]

(ii) Copper is a transition metal.

State **one** property, shown in Table 9.1, which is typical of transition metals.

..... [1]

(c) Fig. 9.1 shows apparatus used in the electrolysis of copper chloride solution.

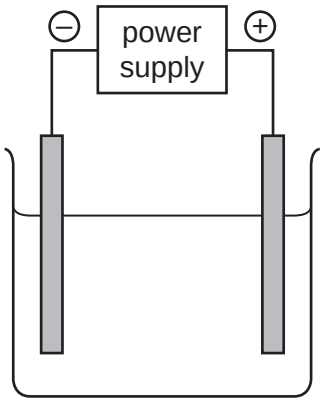

Fig. 9.1

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

(ii) Copper chloride solution is a mixture of copper ions and chloride ions in water.

State briefly **one** difference between a chlorine *atom* and a chloride *ion*.

.....

..... [1]

(iii) When the electrolysis reaction in Fig. 9.1 is occurring, bubbles of gas appear at the surface of the anode.

Describe a safe test and its result to confirm that this gas is chlorine.

.....

.....

..... [2]

(iv) Name the substance which forms at the cathode.

..... [1]

[Turn over

For Examiner's Use

10 (a) A student investigated the relationship between the potential difference across a lamp and the current passing through it.

She used the following apparatus:
ammeter
connecting wires
lamp
power supply
voltmeter

(i) Draw a suitable circuit diagram for this investigation.

[4]

The graph in Fig. 10.1 shows her results.

For Examiner's Use

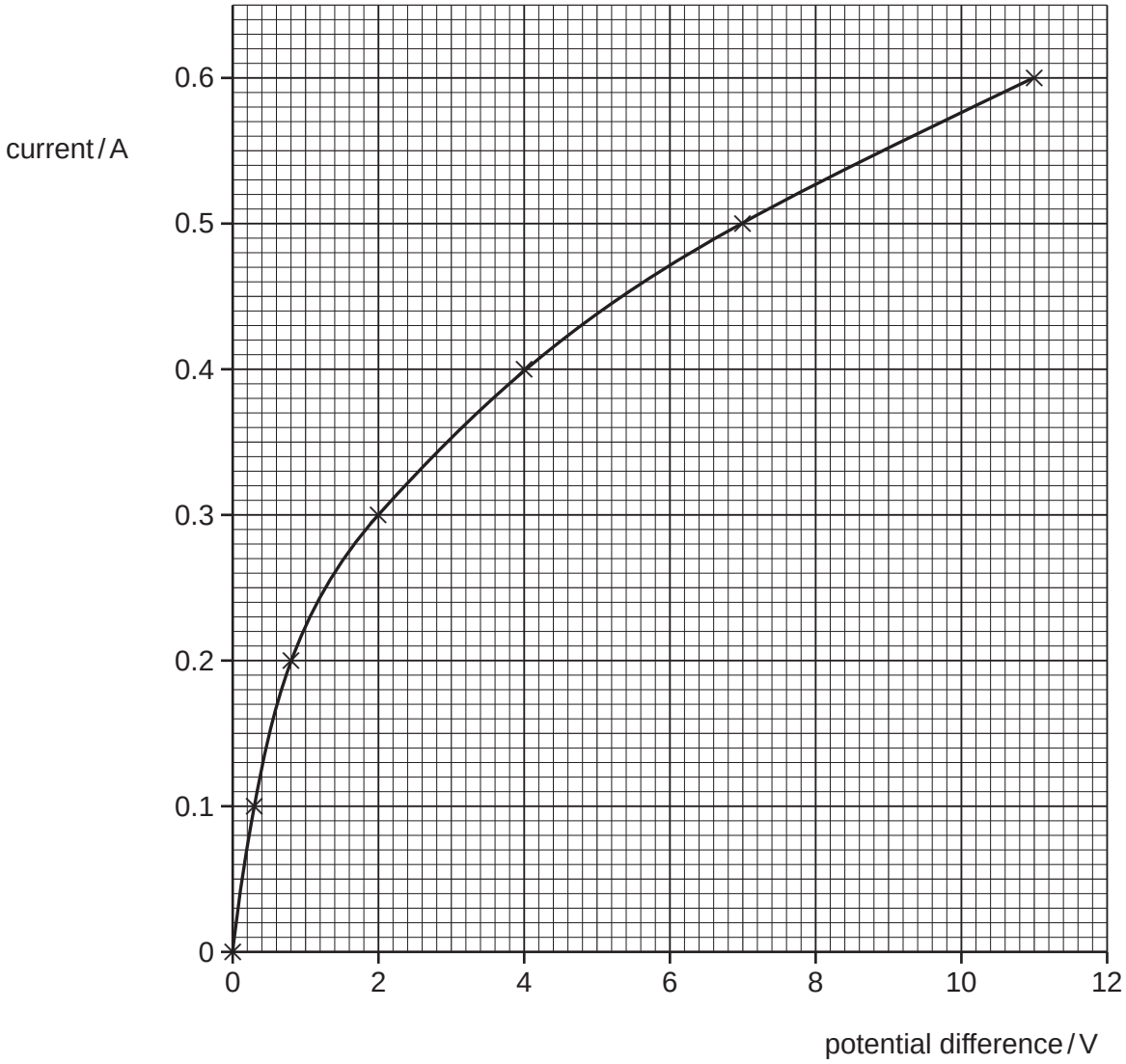

Fig. 10.1

(ii) What is the current when the potential difference is 6 V?

..... A [1]

(iii) Calculate the resistance of the lamp when the potential difference is 6 V.

State the formula that you use and show your working.

formula used

working

..... ohms [2]

(b) A student was given two bar magnets and a bar of soft iron. She carried out the following experiments.

(i) She brought the magnets close together with opposite poles facing.

State what she observed.

.....

..... [1]

(ii) She brought the magnets close together with like poles facing.

State what she observed.

.....

..... [1]

(iii) She brought the soft iron bar towards one of the magnets.

State what she observed.

.....

..... [1]

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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 †															

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

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

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 dm^3 at room temperature and pressure (r.t.p.).