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.

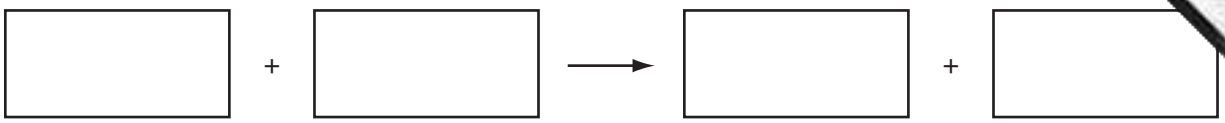
Answer **all** questions.
A copy of the Periodic Table is printed on page 28.

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.

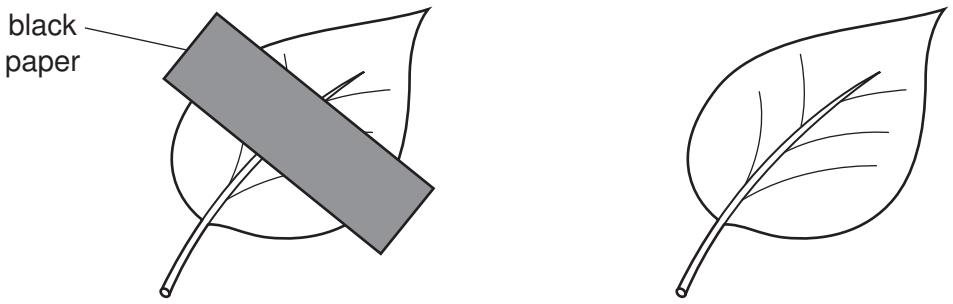
He then removed the leaf from the plant and tested it for starch, after removing the black paper.

(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.



before testing after testing

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]

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

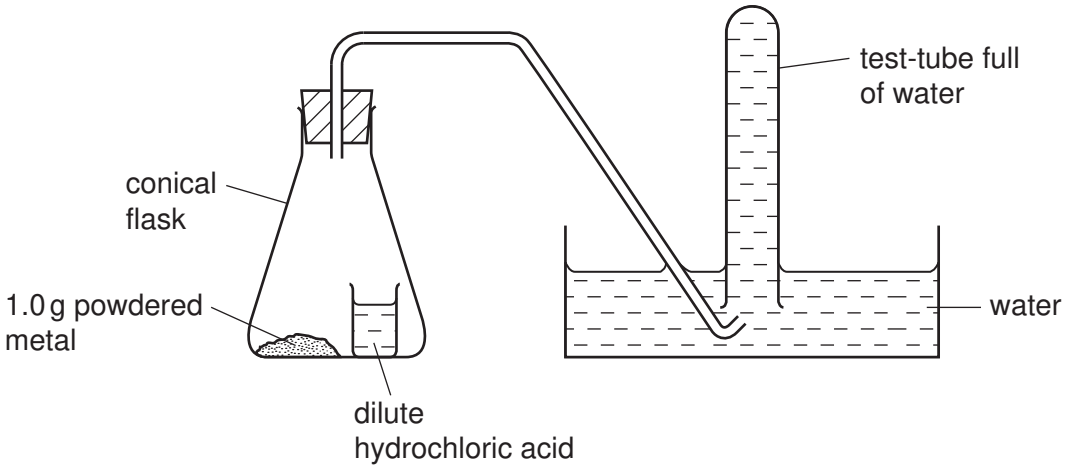


Fig. 2.1

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]

(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 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]

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.

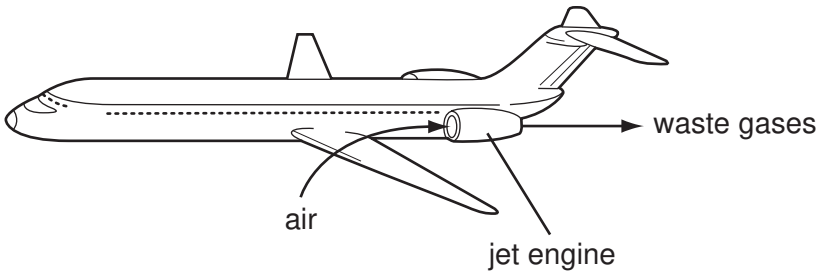
(i) Name **one** other form of electromagnetic radiation.

..... [1]

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

..... [1]

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

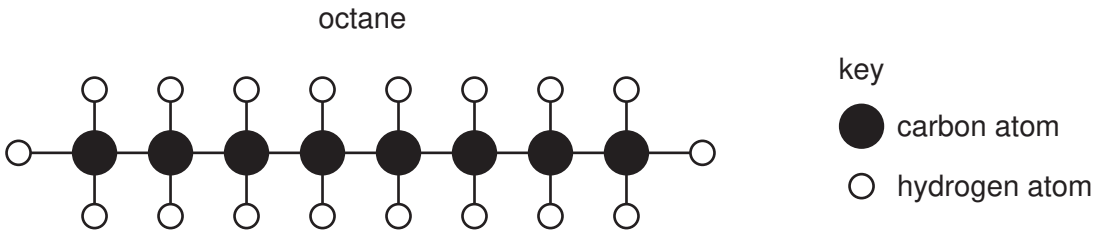


Fig. 4.1

(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]

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

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 w… the list.

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]

BLANK PAGE

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 be

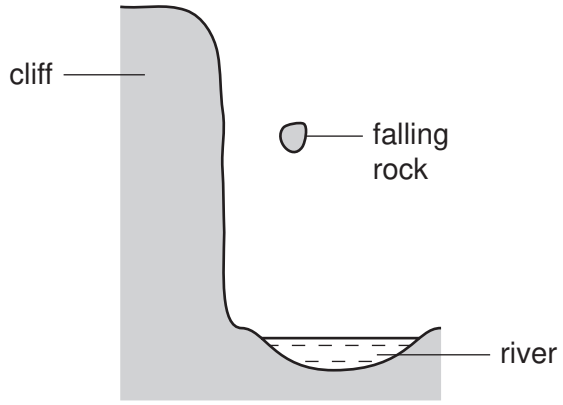


Fig. 6.1

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

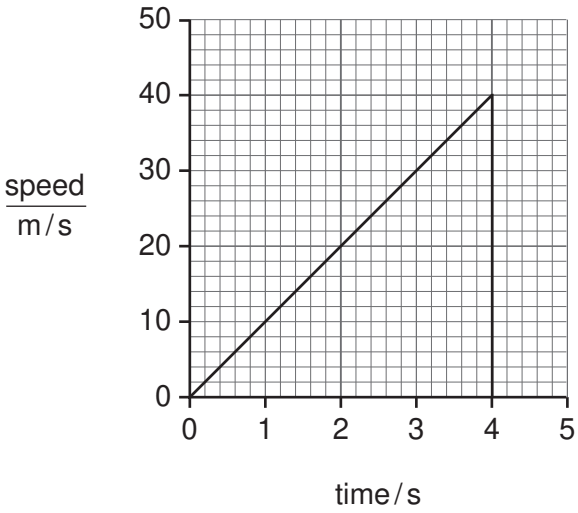


Fig. 6.2

(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]

(b) An observer on the top of the cliff measured the time between when he saw the
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]

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

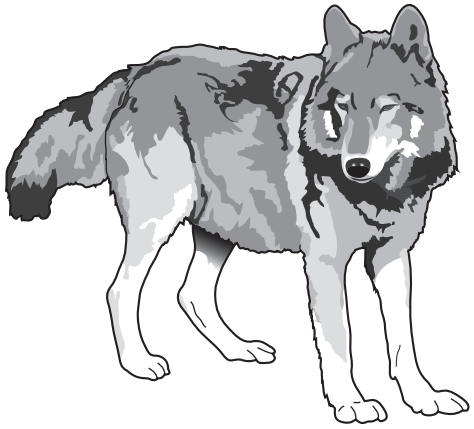


Fig. 7.1

(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]

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

(d) People used to shoot gray wolves. In 1978, a conservation programme for gray 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.

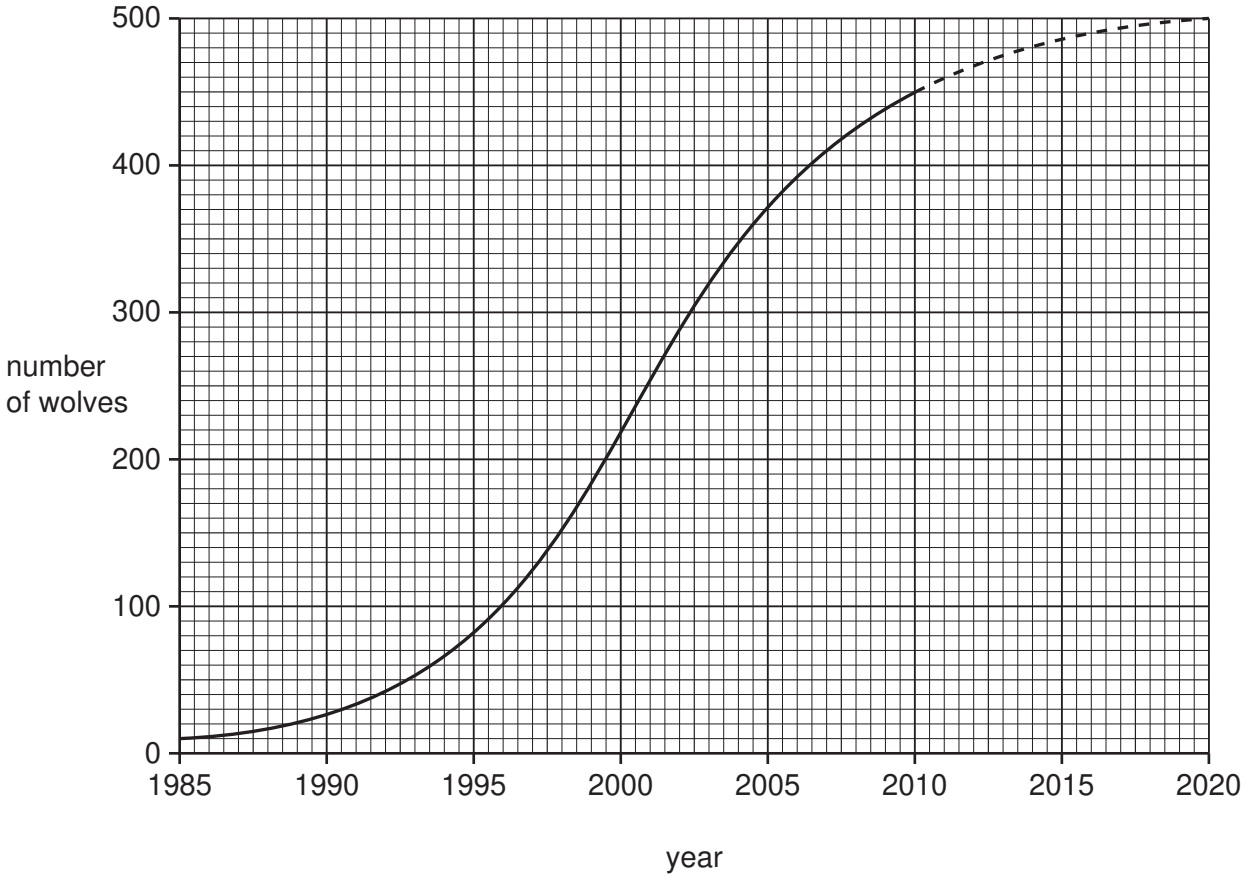


Fig. 7.2

(i) Suggest why the population of gray wolves in Wisconsin is not expe increase beyond about 500 individuals, even if they are no longer kille 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]

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

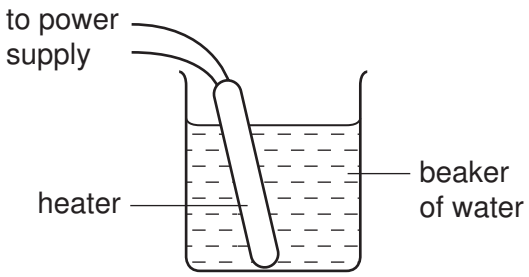


Fig. 8.1

(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]

(c) The electrical energy for the heater has been generated by burning a fossil fu
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]

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.

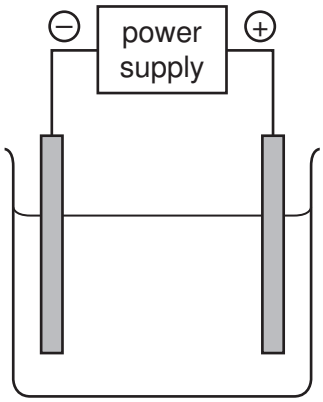


Fig. 9.1

(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]

10 **(a)** A student investigated the relationship between the potential difference across a
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.

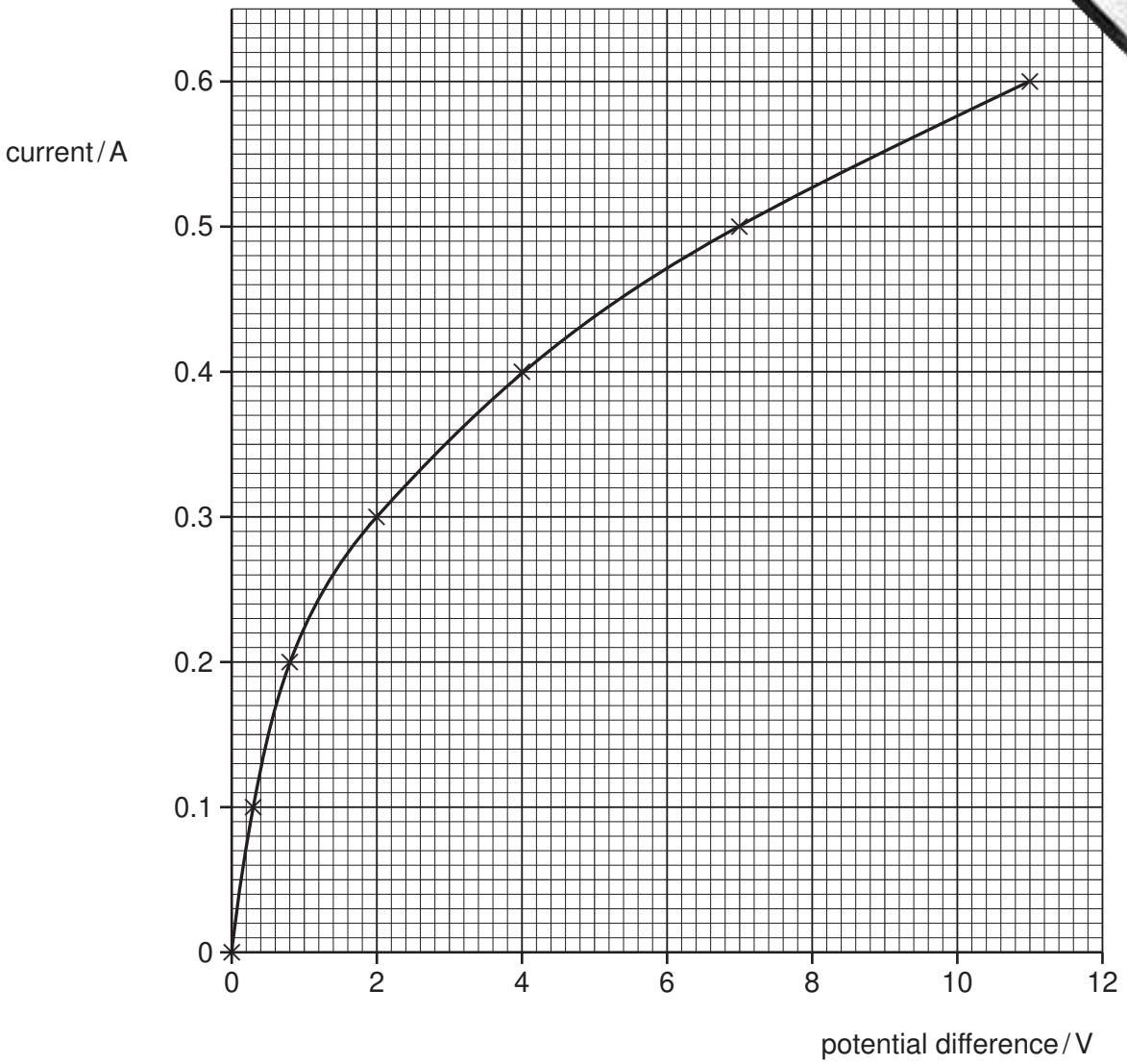


Fig. 10.1

(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]

BLANK PAGE

BLANK PAGE

BLANK PAGE

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 = 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.).