Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/31**

Paper 3 (Extended) **May/June 2016**

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 24.

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.

This document consists of **20** printed pages.

CAMBRIDGE International Examinations

[Turn over

1 **(a)** Complete the sentences below using words or phrases from the list.

You may use each word or phrase once, more than once or not at all.

downwards **phloem** **respiration** **root hairs** **transpiration**

upwards **upwards and downwards** **xylem**

In the plant, water travels upwards in the ..... .

Dissolved sugar travels in the ..... and moves

..... . The evaporation of water from the

surfaces of the mesophyll cells is called ..... . [4]

(b) Fig. 1.1 shows a plant cell observed under the microscope.

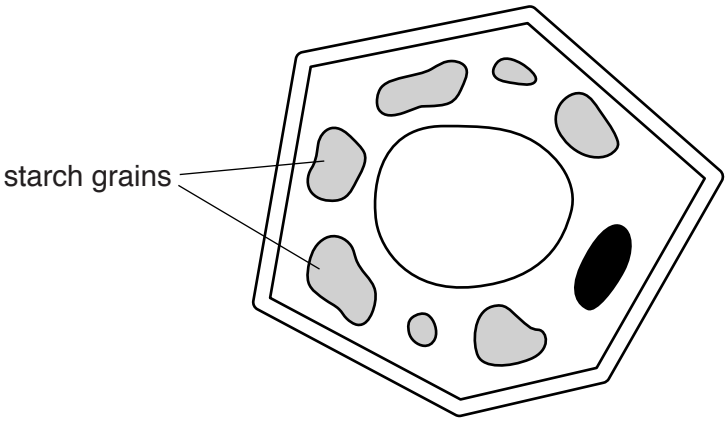


Fig. 1.1

(i) There are many starch grains in this cell.

On Fig. 1.1, name **two** other structures, **1** and **2**, in this cell that are not found in animal cells.

Draw label lines to these structures from the names you have written on the diagram.

Describe the functions of the structures you have labelled.

function of structure **1** .....

.....

.....

function of structure **2** .....

.....

.....[4]

(ii) State **one** piece of evidence from the diagram of the cell in Fig. 1.1 that suggests that the cell is found under the ground.

Explain your answer.

.....

.....

.....[2]

2 A student investigates the speed of reaction between dilute hydrochloric acid and calcium carbonate. The reaction produces carbon dioxide gas.

(a) Fig. 2.1 shows some of the apparatus the student uses.

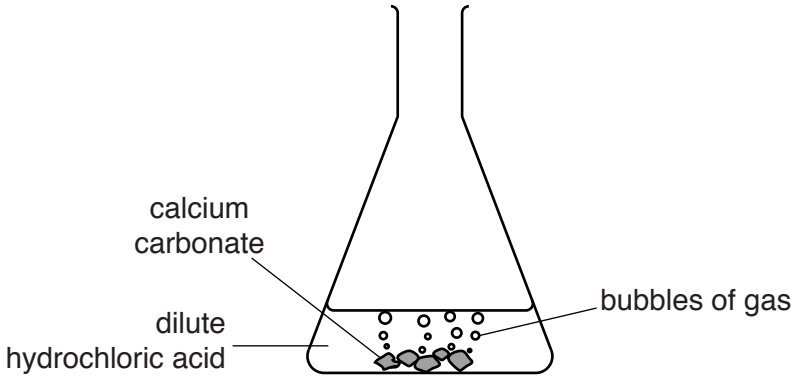


Fig. 2.1

(i) The student wants to measure the volume of gas produced in this reaction every minute for 10 minutes.

Complete Fig. 2.1 to show how the student collects and measures the volume of the gas. [2]

(ii) As the reaction proceeds, the speed of the reaction decreases.

Explain this change in terms of collisions between reacting particles.

.....

.....

.....[2]

(b) Complete the symbol equation for the reaction between hydrochloric acid and calcium carbonate.

..... + ... → $CaCl_2$ + ... + ... [2]

(c) Describe the test for carbon dioxide gas.

test .....

result .....[2]

(d) Suggest the names of an acid and a base that the student can use to make sodium nitrate.

acid .....

base .....[2]

3 Fig. 3.1 shows a television camera that moves on rails alongside an athletics track.

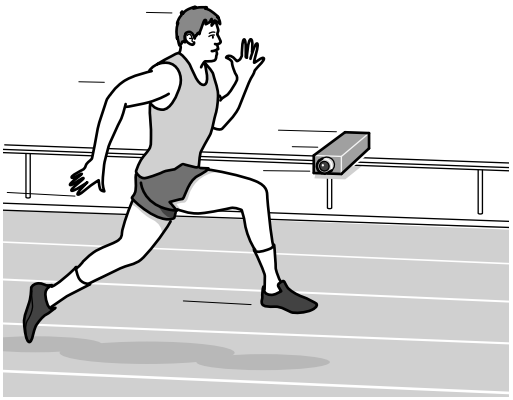


Fig. 3.1

The camera records a race from start to finish. The camera moves alongside the athletes.

The athletes accelerate from the start and quickly reach their maximum speed. They maintain this speed until they cross the finish line.

At the end of the race the athletes and the camera slow to a stop.

(a) Fig. 3.2 shows the speed/time graph for the camera from the start until it stops after the end of the race.

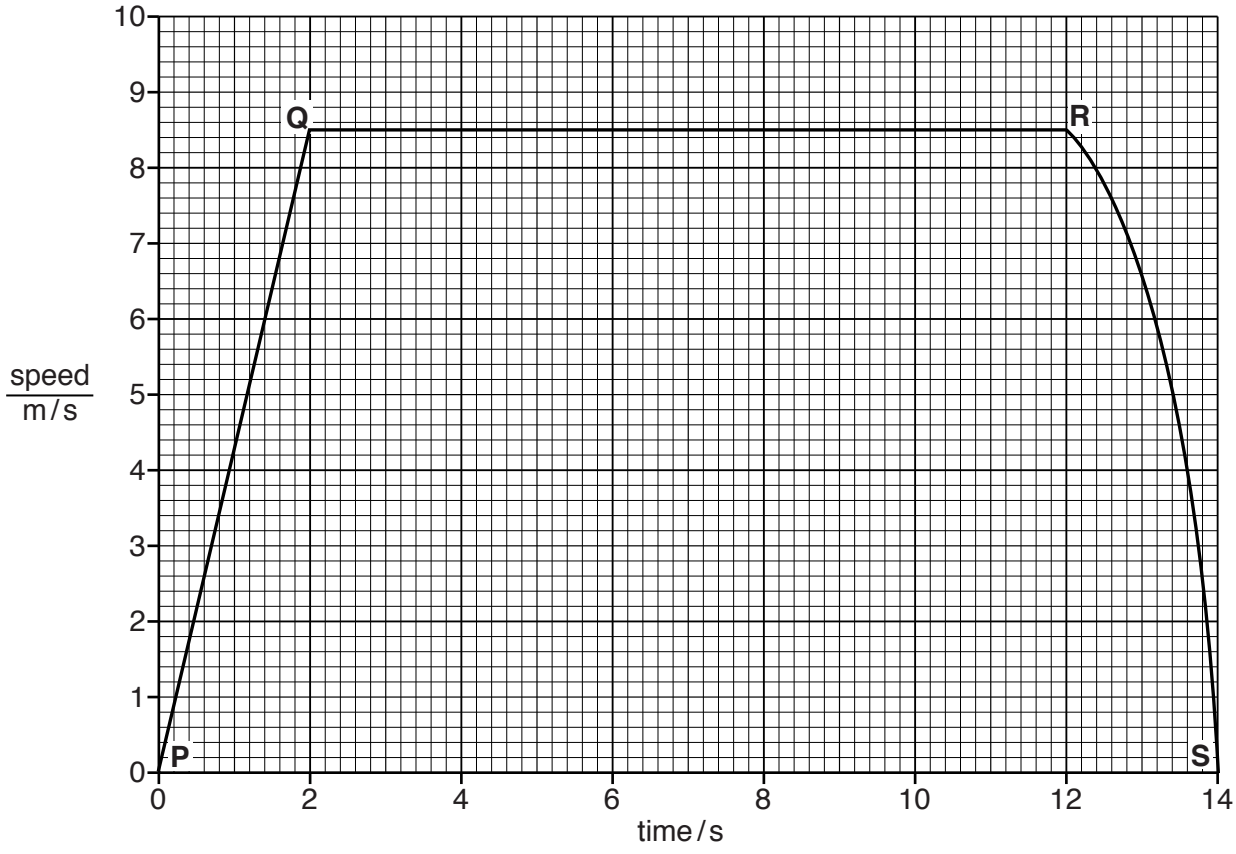


Fig. 3.2

(i) State how you can tell that the acceleration in section **RS** of the graph is not constant.

.....[1]

(ii) The camera has constant acceleration over the section **PQ** on Fig. 3.2.

Use the graph in Fig. 3.2 to calculate this acceleration. Show your working.

working

acceleration = ... m/s^2 [2]

(iii) Use the graph in Fig. 3.2 to calculate the distance travelled by the camera as it followed the sprinters from the start to the finishing time of 12 seconds.

Show your working.

distance = ... m [2]

(b) The camera focuses light rays coming from the athlete onto the light sensor inside the camera.

An important part of the camera is missing from Fig. 3.3.
Complete the ray diagram in Fig. 3.3 by drawing and labelling the missing part in its correct position.

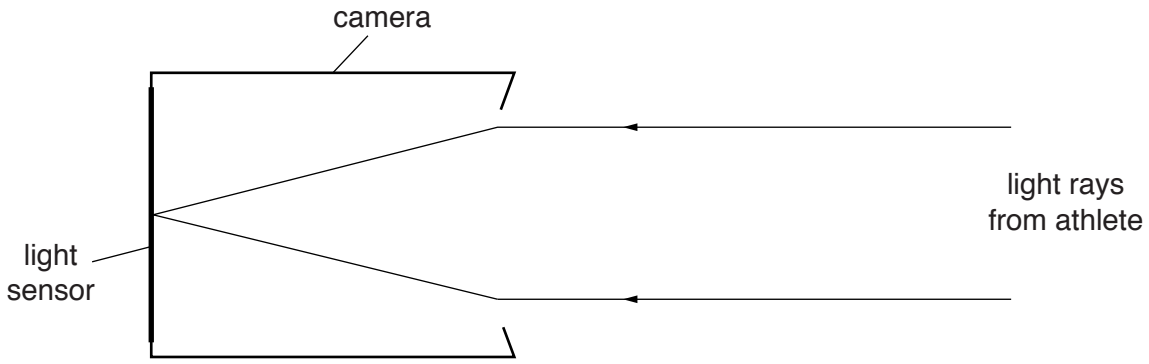


Fig. 3.3

[1]

[Turn over

(c) The camera is moved along the rails by an electric motor powered by a battery.

(i) The camera with motor and battery has a mass of 10 kg.

Calculate the kinetic energy of the camera as it travels at a constant speed of 8.5 m/s.

State the formula you use and show your working.

formula

working

kinetic energy = ... J [2]

(ii) The kinetic energy of the moving camera is much less than the chemical energy supplied by the battery to the electric motor.

Use the principle of the conservation of energy to explain why this happens.

.....

.....

.....[2]

Please turn over for Question 4

4 **(a)** Fig. 4.1 is a diagram of the internal structure of the heart.

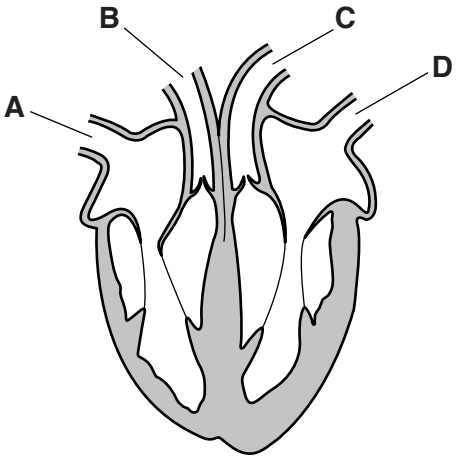


Fig. 4.1

(i) State which of the vessels labelled **A**, **B**, **C** and **D** are arteries.

.....[1]

(ii) State the **name** of the blood vessel with the highest pressure.

.....[1]

(iii) Explain why this blood vessel in **(ii)** needs to have blood at a high pressure.

.....

.....[1]

(b) Fig. 4.2 shows a cross section of an artery.

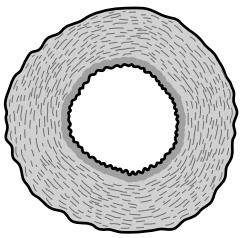


Fig. 4.2

Describe how the structure of this artery adapts it for its function.

.....

.....

.....[2]

(c) Fig. 4.3 shows a longitudinal section of a diseased coronary artery.

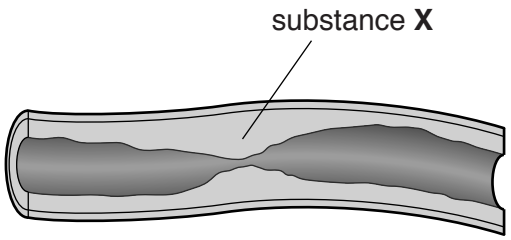


Fig. 4.3

(i) Describe the function of the coronary artery.

.....

.....[1]

(ii) Identify substance **X**.

.....[1]

(iii) State **two** possible lifestyle choices that could increase the rate of formation of substance **X** in the coronary artery.

1. .....

2. .....[2]

[Turn over

5 Fig. 5.1 shows the fractional distillation of petroleum (crude oil).

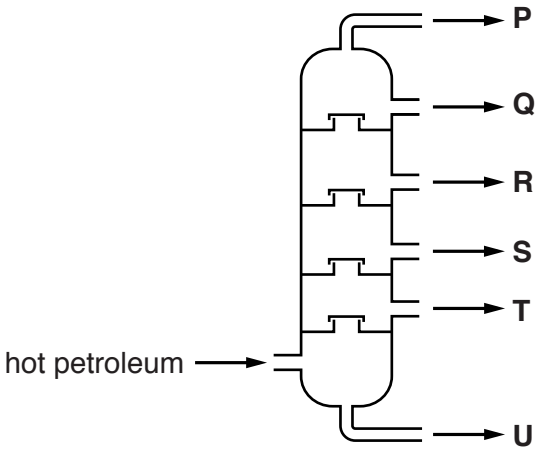


Fig. 5.1

Six fractions, **P**, **Q**, **R**, **S**, **T** and **U**, are produced.

(a) State which fraction

has the greatest intermolecular forces of attraction between molecules,

……

contains only gas molecules.

…… [2]

(b) Fig. 5.2 shows four molecules.

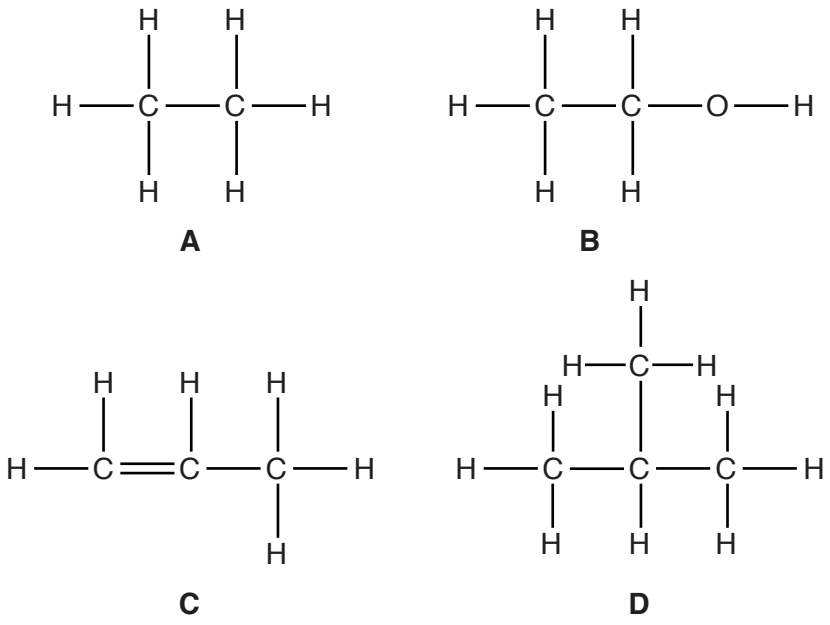


Fig. 5.2

(i) From Fig. 5.2, give the letter of a molecule of an alkane.

……..…… [1]

(ii) From Fig. 5.2, give the letter of a molecule of an alkene. Explain your answer.

.....

.....[2]

(iii) Explain why alkanes and alkenes do not appear in the Periodic Table.

.....[1]

(c) Complete Fig. 5.3 to show the bonding electrons in one molecule of methane, CH_4.

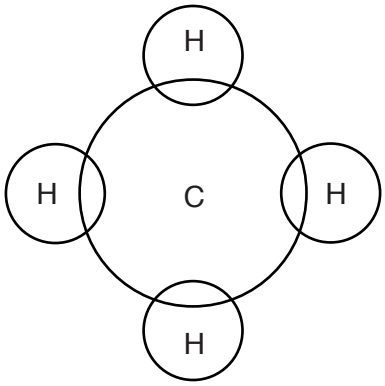


Fig. 5.3

[1]

(d) In the last one hundred years, the proportion of carbon dioxide in the air has increased.

(i) State **one** reason for the increased amount of carbon dioxide.

.....

.....[1]

(ii) State **one** reason why the increase in carbon dioxide may harm the environment.

.....

.....[1]

[Turn over

6 Fig. 6.1 shows a thermometer containing a liquid at 20 °C and at 60 °C.

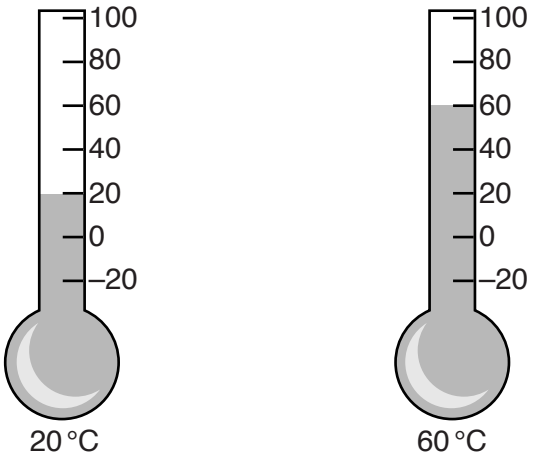


Fig. 6.1

(a) Complete the sentences below by choosing the correct words from the list.

You may use each word once, more than once, or not at all.

density **force** **mass** **power** **work**

When the liquid is heated, the ..... of the liquid remains the same. The volume of the liquid increases on heating, which means that the ..... of the liquid decreases. [2]

(b) Water freezes at 0 °C. Explain why the scale on the thermometer in Fig. 6.1 shows that the liquid in the thermometer cannot be water.

.....

.....

.....[1]

(c) Bright sunlight shines on the thermometer. The temperature reading rises slowly.

(i) In Fig. 6.2 below, write the name of the radiation from the Sun responsible for the temperature rise in the correct position in the electromagnetic spectrum.

	X-rays				microwaves	radio waves

Fig. 6.2

[2]

(ii) A student said he thought the radiation in **(i)** travelled from the Sun faster than sunlight.

Explain why the student is not correct.

.....

.....[1]

(iii) Suggest one way of making the temperature reading rise more quickly when exposed to bright sunshine.

.....

.....[1]

7 Fig. 7.1 shows two simple food chains.

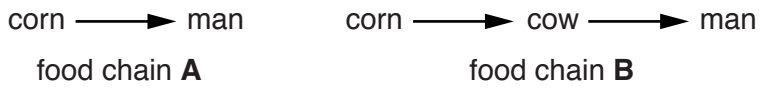


Fig. 7.1

(a) Explain why food chain **A** transfers a greater proportion of the chemical energy in the corn to the man.

Assume that the food chains apply to two identical areas of land.

.....

.....

.....[2]

(b) The farmer tries to improve the efficiency of food chain **B** by keeping the cows in heated buildings.

Suggest how this improves the efficiency of food chain **B**.

.....

.....

.....[2]

(c) When the farmer adds fertiliser to the corn in the field, some of the fertiliser enters a nearby lake.

(i) Suggest what causes the fertiliser to enter the lake.

.....[1]

(ii) Describe and explain how the fertiliser affects

plants near the surface of the water,

.....

.....

plants lower down in the lake.

.....

.....

.....[3]

8 Lithium and sodium are metals in Group I of the Periodic Table of Elements.

(a) (i) The electronic structure of lithium is 2,1.

State the electronic structure of sodium.

.....[1]

(ii) Rubidium is another Group I metal.

It is stored in a liquid.

Suggest a liquid in which rubidium is stored and explain why it is stored in this liquid.

liquid .....

explanation .....

.....[2]

(iii) Predict the **two** products of the electrolysis of molten rubidium chloride.

..... and .....[1]

(b) The reaction between lithium and oxygen is exothermic.

(i) State the change that always occurs in an **exothermic** reaction.

.....[1]

(ii) State the charges on the ions formed in this reaction, and explain how these ions form.

lithium ion .....

oxide ion .....

explanation .....

.....[3]

[Turn over

9 A student investigates the current through a lamp as she varies the potential difference (p.d.) across the lamp.

She designs the circuit in Fig. 9.1 to use in her investigation.

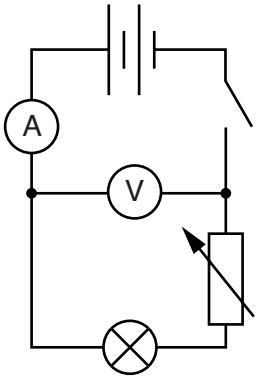
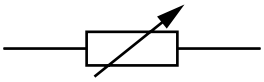


Fig. 9.1

(a) (i) Name the component represented by this symbol



.....[1]

(ii) State and explain why the student includes this component in her circuit.

.....

.....

.....[2]

(b) The student has included all the correct components in the circuit diagram shown in Fig. 9.1, but she has not connected them correctly.

In the space below, draw the diagram for a circuit that will allow the p.d. across the lamp and the current through the lamp to be measured.

[2]

(c) The student used the correct circuit to carry out her experiment.

Fig. 9.2 shows her results plotted as a graph.

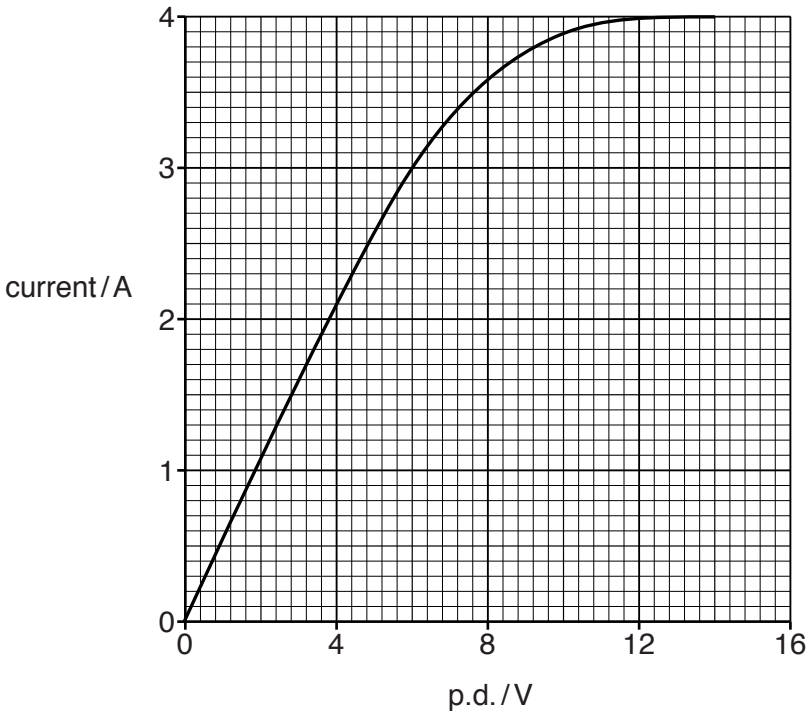


Fig. 9.2

(i) Use the graph in Fig. 9.2 to calculate the resistance of the lamp filament when the p.d. across the filament is 6 V.

State the formula you use and show your working.

formula

working

resistance = ... Ω [2]

(ii) Use the graph to describe how the resistance of the lamp filament changes as the p.d. across the filament increases.

.....

.....

.....[2]

The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 117	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)