Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **0653/41**

Paper 4 (Extended) **October/November 2018**

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 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.

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

CAMBRIDGE International Examinations

[Turn over

1 **(a)** Fig. 1.1 shows a diagram of an alveolus.

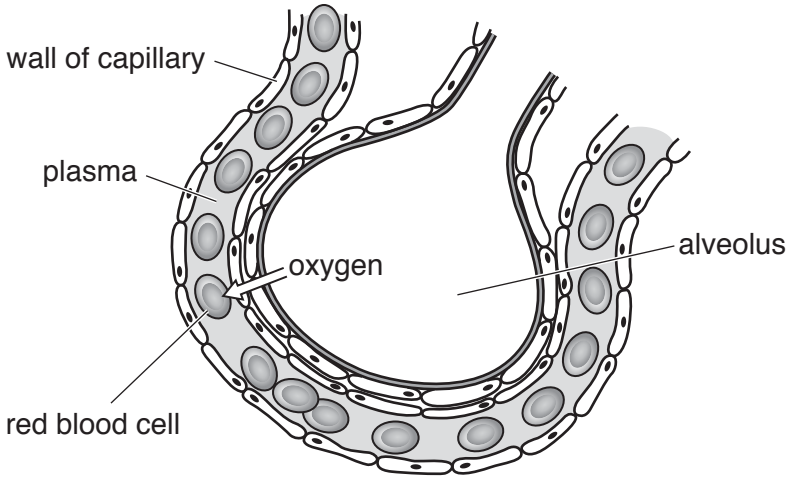

Fig. 1.1

(i) On Fig. 1.1 draw an arrow to show the direction of movement of carbon dioxide at the alveolus during gas exchange. [1]

(ii) Explain why oxygen molecules diffuse from the alveolus into the blood.

.....

.....[1]

(iii) Describe **two** ways in which the structure of the alveolus in Fig. 1.1 makes it suitable for gas exchange.

1. .....

.....

2. .....

.....

[2]

(b) Describe how a growing baby in the uterus of a pregnant woman obtains glucose.

.....

.....

.....[2]

(c) Fig. 1.2 shows apparatus which is used to study the contents of cigarette smoke. A pump draws air through the apparatus.

When the cigarette is lit, the smoke produced travels through the apparatus.

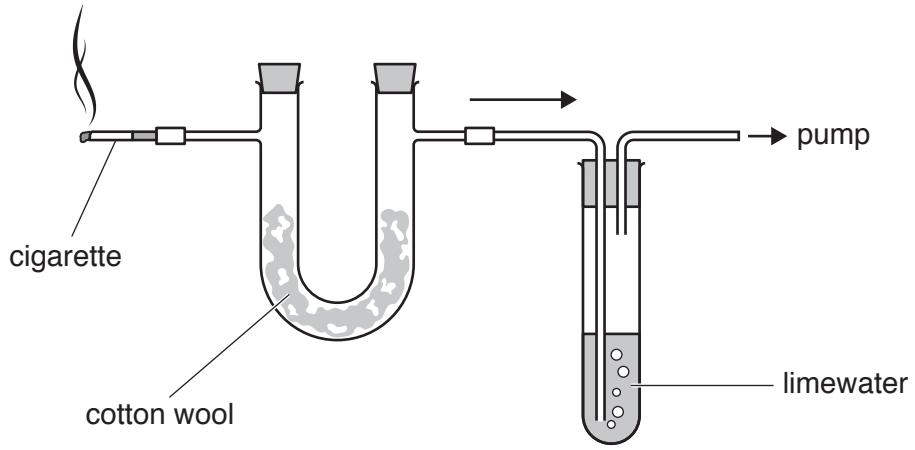

Fig. 1.2

(i) The limewater turns milky.

Explain why this happens.

.....

.....[1]

(ii) Tar from the cigarette is left on the cotton wool.

Describe **one** effect of tar on the gas exchange system.

.....

.....[1]

(iii) Cigarette smoke damages the cilia that line the airway.

Explain why this is harmful.

.....

.....

.....[2]

(iv) The lit cigarette also produces carbon monoxide gas.

Explain why this is a harmful gas when inspired.

.....

.....

.....[2]

2 **(a)** **(i)** Name the type of bonding in a water molecule.

.....[1]

(ii) Describe how electrons are involved in the bonds in a water molecule.

.....

.....[1]

(iii) Draw a dot-and-cross diagram of a water molecule.

Show all of the outer shell electrons.

H O H

[2]

(b) A student dissolves copper chloride in water.

He then passes an electric current through the aqueous copper chloride using the apparatus shown in Fig. 2.1.

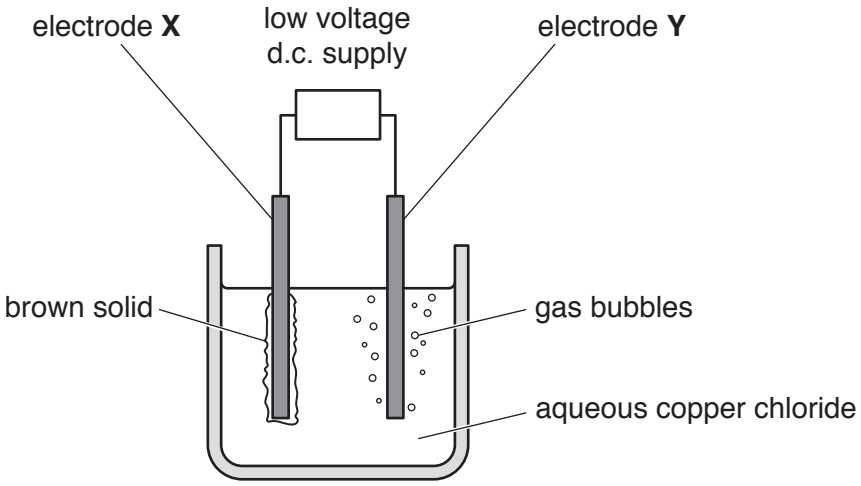

Fig. 2.1

(i) Name electrode **X** and electrode **Y**.

electrode **X** .....

electrode **Y** .....

[2]

(ii) During this process particles move to the electrodes. A brown solid and gas bubbles form at the electrodes.

Identify the particles

1. moving to electrode **X**,

.....

2. moving to electrode **Y**.

.....

[2]

(c) Predict the electrode products when an electric current is passed through molten lead oxide.

product at negative electrode .....

product at positive electrode .....

[2]

3 Fig. 3.1 shows a train made up of a steam engine and a passenger coach.

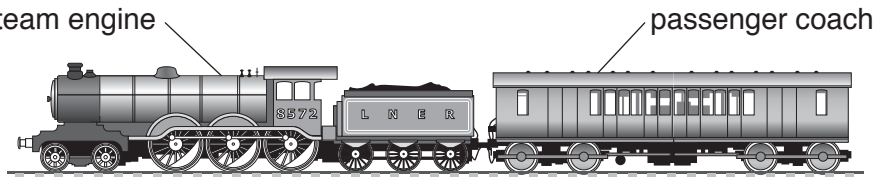

Fig. 3.1

(a) The train is travelling at a constant speed along a level track. Fig. 3.2 shows the four forces **W**, **X**, **Y** and **Z** acting on the train.

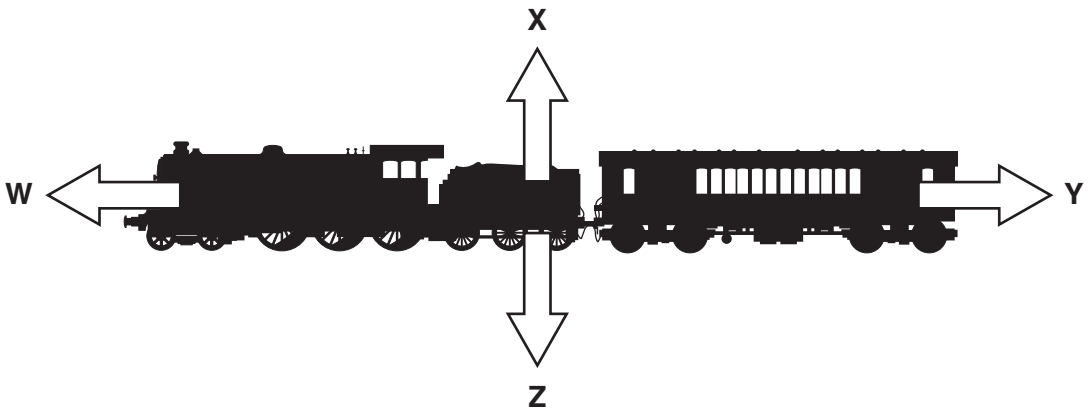

Fig. 3.2

(i) Name force **Z**.

.....[1]

(ii) The force arrows on Fig. 3.2 do not show the sizes of the forces.

State whether or not the driver has made force **W** equal in size to force **Y**.

Explain your answer.

.....

.....[1]

(b) Fig. 3.3 shows a speed–time graph of the train as it travels between two stations.

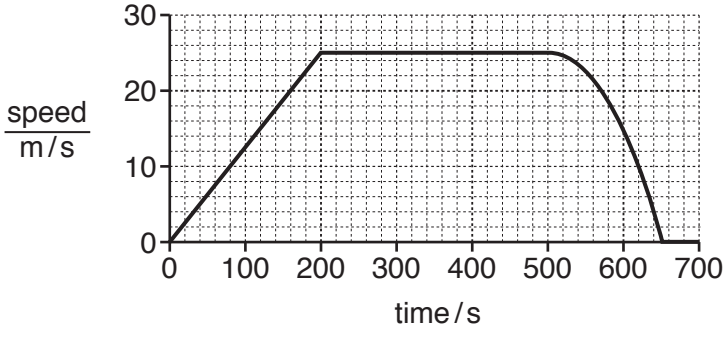

Fig. 3.3

(i) Force **W** in Fig. 3.2 is 200 000 N when the engine is pulling the train at 25 m / s.

Calculate the useful work done by the engine while the train is travelling at 25 m / s in the journey shown in Fig. 3.3.

State the formula you use, show your working and state the unit of your answer.

formula

working

work done = ... unit ..... [3]

(ii) Describe the motion of the train after 500 s until it stops.

.....

.....

.....[2]

(iii) Use Fig. 3.3 to calculate the distance, in km, travelled by the train in the first 200 s of its journey.

Show your working.

distance = ...km [2]

(iv) After 500 s on this journey, the train travels a further 2.8 km until it stops at the next station.

Calculate the total distance in kilometres between the two stations.

Show your working.

total distance = ... km [1]

4 Fig. 4.1 shows an aquatic food web.

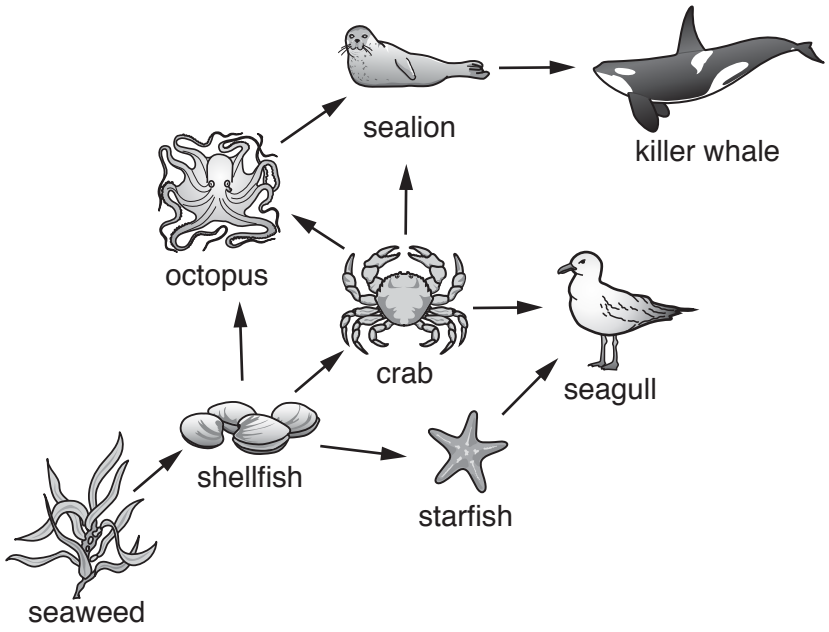

Fig. 4.1

The food web in Fig. 4.1 is made from interconnected food chains.

(a) (i) Write the food chain, contained in Fig. 4.1, which has the greatest number of trophic levels.

[2]

(ii) Suggest why the food chain you have written in **(a)(i)** is unusual.

.....[1]

(b) Chemical energy is lost at each trophic level in a food chain. One reason for this is respiration in the cells of the organisms.

List **two** uses of the energy released by respiration in the bodies of **all** of the organisms shown in Fig. 4.1.

1. .....

2. .....
[2]

(c) Describe **two** other ways in which energy is wasted when the killer whale eats the sealion.

1. .....

.....

2. .....

.....
[2]

5 **(a)** Calcium sulfate is an insoluble salt.

(i) Name two compounds that react together to form calcium sulfate.

1. .....

2. .....
[2]

(ii) Suggest the separation method that is used to separate an insoluble salt from an aqueous reaction mixture.

Explain how this separation method removes the solid from the liquid.

method .....

explanation .....

.....

.....
[2]

(b) Calcium is in Group II in the Periodic Table.

(i) Complete the following sentences using words from the list.

Each word may be used once, more than once or not at all.

good **high** **low** **poor**

Calcium is a ..... electrical conductor.

Calcium has a ..... melting point.
[1]

(ii) State the electronic structure of a calcium atom.

.....[1]

(c) Caesium is below potassium in Group I of the Periodic Table.

Potassium melts at 63 °C and it reacts rapidly with water.

Caesium is a solid at room temperature (25 °C).

(i) Compare the rate of the reaction between caesium and water with the rate of reaction between potassium and water.

.....

.....[1]

(ii) Suggest the melting point of caesium.

..... °C [1]

(d) Describe the reaction, if any, which occurs when copper is mixed with aqueous potassium chloride.

Explain your answer.

reaction .....

explanation .....

.....

[1]

6 Fig. 6.1 shows a liquid-in-glass thermometer at room temperature.

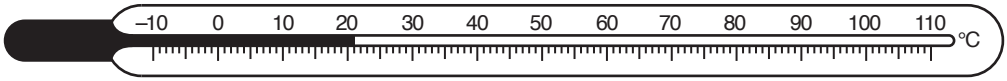

Fig. 6.1

(a) State the property of a liquid that is used in a thermometer when measuring temperature.

.....[1]

(b) Table 6.1 gives a list of the melting points and boiling points of five substances that are used in liquid-in-glass thermometers.

Table 6.1

substance	melting point /°C	boiling point /°C
ethanol	–114	78
gallium	30	2403
glycol	–12	198
mercury	–39	357
water	0	100

(i) Ammonia has a melting point of –78 °C and a boiling point of –33 °C.

Explain why ethanol would be the most suitable for use in a liquid-in-glass thermometer to measure both the melting point and the boiling point of ammonia.

.....

.....[1]

(ii) Explain why a thermometer that uses liquid gallium has to be kept in a warm container, well above room temperature.

.....

.....

.....[2]

(c) An infra-red thermometer measures temperature in a different way. The wavelength of the infra-red radiation emitted by a hot body changes with temperature.

An infra-red thermometer measures the wavelengths of infra-red radiation emitted and converts these to temperature readings.

(i) The wavelength of the infra-red radiation emitted decreases as the temperature of the hot body increases.

Predict what happens to the frequency of the infra-red radiation as the temperature of the hot body increases.

Explain your answer.

prediction .....

explanation .....

.....

[2]

(ii) In the infra-red thermometer, the radiation is focused onto the detector by a thin converging lens.

On Fig. 6.2 complete the ray diagram to show how this happens.

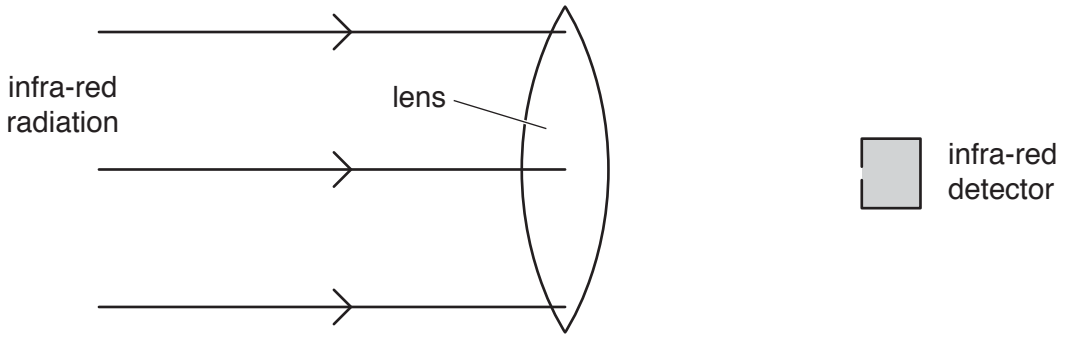

Fig. 6.2

[1]

7 A student is investigating photosynthesis in an aquatic plant.

(a) Complete the balanced symbol equation for photosynthesis.

..... + ...CO_2 ⟶ ..... + ...O_2 [2]

(b) Fig. 7.1 shows the apparatus that the student uses in the investigation.

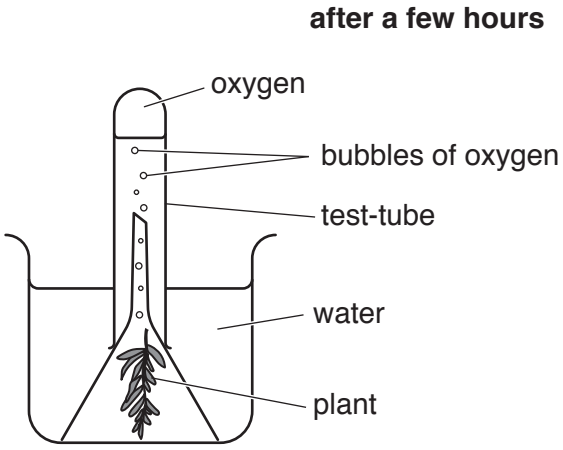

Fig. 7.1

The test-tube is full of water at the start. The apparatus is placed on a laboratory bench and left for a few hours.

Explain why the water in the test-tube moves downwards in the test-tube in Fig. 7.1.

.....

.....[1]

(c) The investigation is repeated in conditions of much greater light intensity.
The apparatus is left for the same length of time as before.

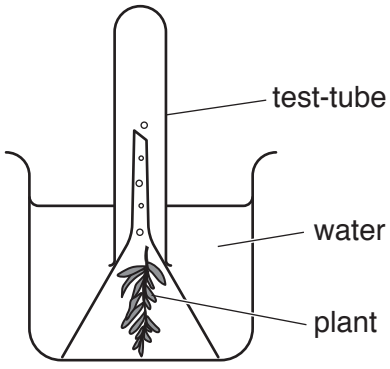

Fig. 7.2

(i) On Fig. 7.2 draw a line to suggest the new level of water in the test-tube. [1]

(ii) Explain your answer to **(c)(i)**.

.....

.....[1]

(d) (i) Explain why acid rain reduces the rate of photosynthesis in plants.

.....

.....[1]

(ii) Describe **two** measures that can be taken to reduce acid rain.

1. .....

2. .....
[2]

8 Useful substances are obtained from petroleum using the processes shown in Fig. 8.1.

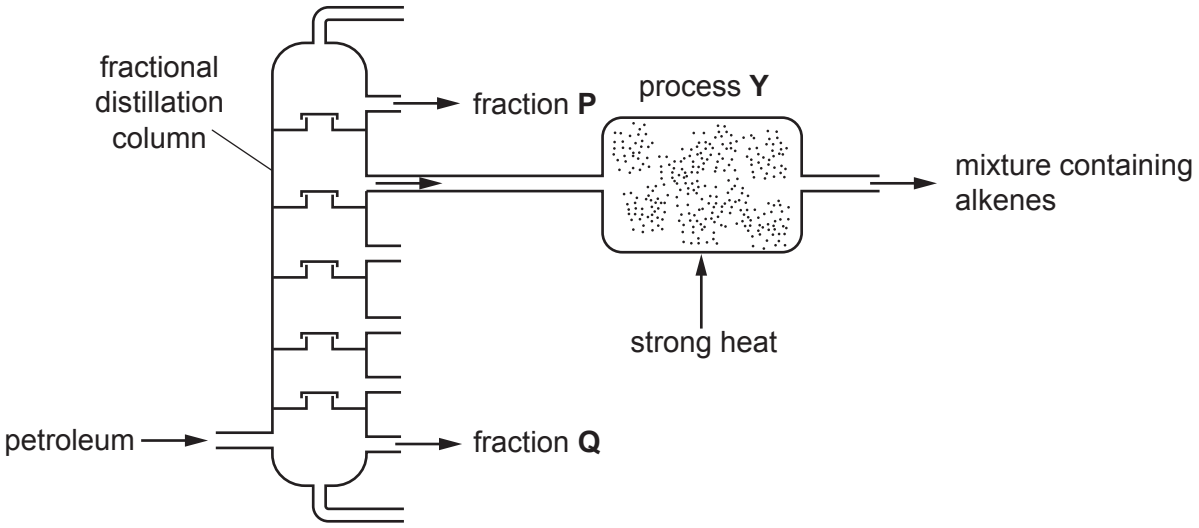

Fig. 8.1

(a) Compare the sizes of the molecules and the strengths of the intermolecular attractive forces between molecules in fraction **P** and in fraction **Q**.

sizes of molecules .....

.....

intermolecular attractive forces .....

.....

[2]

(b) Fraction **P** contains propane, C_3H_8.

Construct the balanced equation for the complete combustion of propane.

.....[2]

(c) Process **Y** produces alkene molecules from large alkane molecules.

(i) State how the molecular structure of alkenes differs from the molecular structure of alkanes.

.....

.....[1]

(ii) Describe a chemical test that is used to distinguish between propane and propene.

State the observation for propane and for propene.

test .....

propane observation .....

.....

propene observation .....

.....

[2]

9 Fig. 9.1 shows a dishwasher (an electric dishwashing machine).

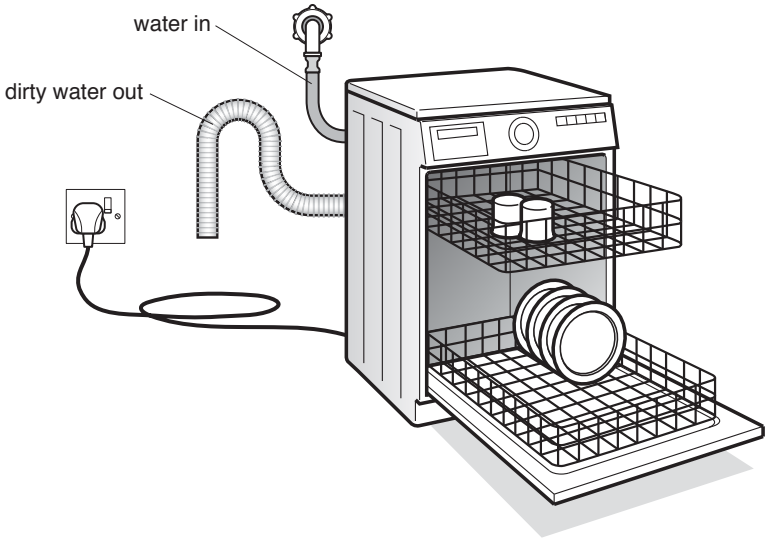

Fig. 9.1

The dishwasher uses electrical energy to

- power a heater to heat the water used,
- power **two** motors, one to wash the dishes, and another to pump water out of the machine,
- light a small lamp to indicate that the heater is switched on.

The circuit symbols for a heater and a motor are:

heater motor

Fig. 9.2 shows part of the circuit diagram for the dishwasher.

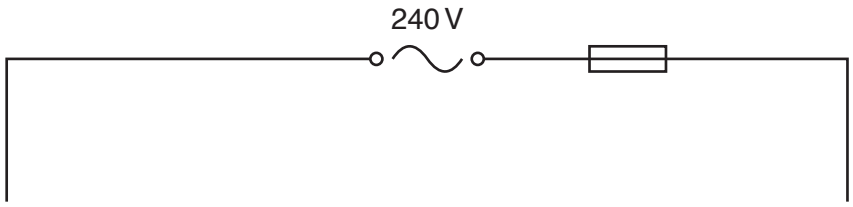

Fig. 9.2

Each of the motors and the heater has a switch in series. The heater and each motor are turned on at different times.

(a) (i) Name the type of circuit connection needed.

.....[1]

(ii) On Fig. 9.2 complete the circuit diagram for the dishwasher. [4]

(b) (i) The heater is rated at 2.4 kW. The power consumption in the indicator lamp can be ignored.

Calculate the current through the heater.

State the formula you use and show your working.

formula

working

current = ... A [2]

(ii) Each motor running at maximum power takes a current of 1.2 A.

Find the maximum current taken from the 240 V mains when the heater and both motors are working at maximum power. The current in the indicator lamp can be ignored.

current = ... A [1]

(iii) Suggest a suitable value for the fuse in the main circuit.

Give a reason for your answer.

value = ... A

reason .....

.....

.....

[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 119	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.).