Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

2404754677

COMBINED SCIENCE **0653/42**

Paper 4 Theory (Extended) **May/June 2022**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **20** pages.

1 **(a)** Fig. 1.1 shows a healthy human heart and a damaged human heart.

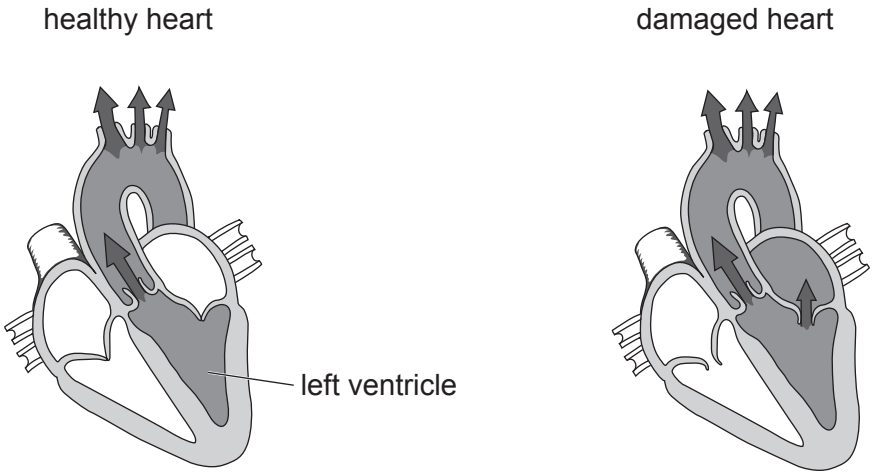


Fig. 1.1

(i) Draw a label line and the letter **A** to show the position of the aorta on the healthy heart in Fig. 1.1. [1]

(ii) The arrows on each heart show the direction of blood flow in the left side of the heart when the ventricles contract.

Identify **one** piece of evidence in Fig. 1.1 that shows the damaged heart has a faulty valve.

.....

..... [1]

(iii) Coronary heart disease damages the heart.
Diet is one risk factor of coronary heart disease.

State **two other** risk factors of coronary heart disease.

1 .....

2 .....
[2]

(b) Fig. 1.2 is a graph showing the effect of physical activity on heart rate.

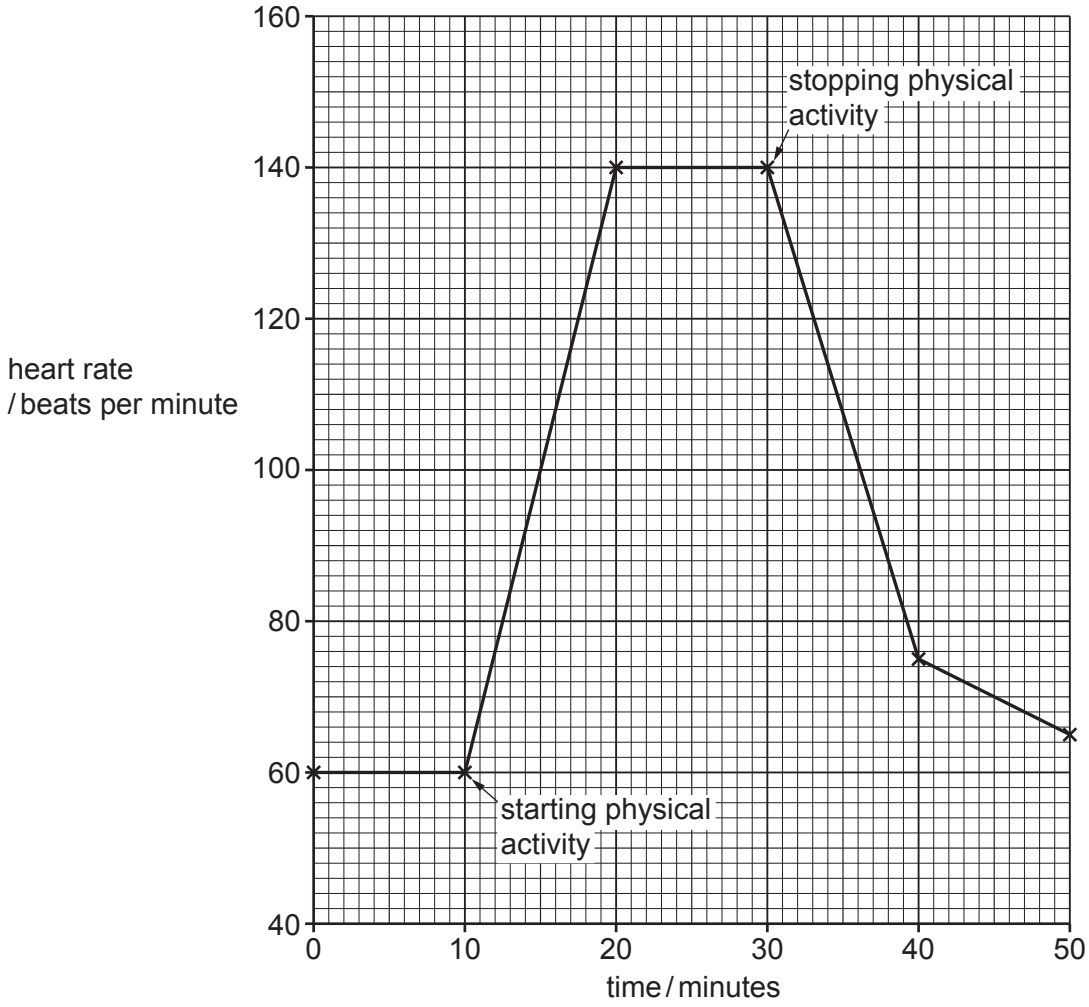


Fig. 1.2

(i) Calculate the percentage increase in heart rate between starting and stopping physical activity.
Give your answer to the nearest whole number.

.....% [3]

(ii) Explain the change in heart rate between **30 and 40 minutes** in Fig. 1.2.

.....

.....

.....

.....

..... [3]

[Total: 10]

2 A student investigates a solid, a liquid and a gas.

(a) Three syringes contain 25 cm^3 of either the solid, the liquid or the gas at room temperature and pressure, as shown in Fig. 2.1.

The end of each syringe is sealed.

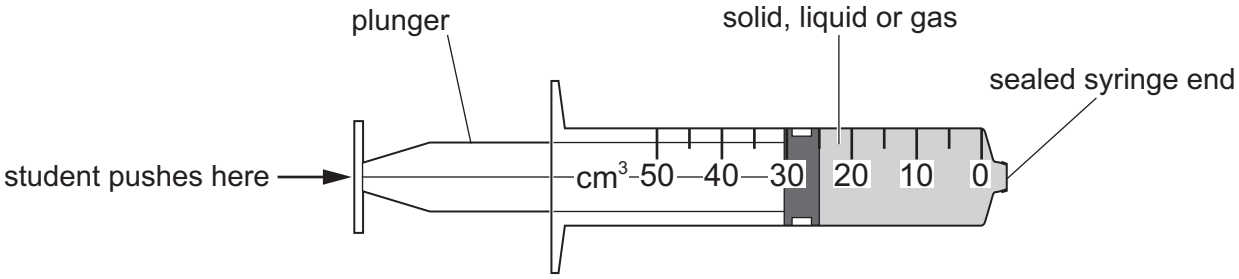


Fig. 2.1

(i) The student pushes on the plunger of each syringe to increase the pressure.

The results are shown in Table 2.1.

Table 2.1

contents of syringe	volume at the start / cm^3	volume when pressure is increased / cm^3
solid	25	25
liquid	25	25
gas	25	21

Explain the results for each syringe when the pressure is increased.

Use ideas about particles in your answer.

.....

.....

.....

.....

..... [3]

(ii) In a separate experiment, the student gently increases the temperature of the syringe that contains the gas, without pushing on the plunger.

The volume of the gas changes from 25 cm^3 to 30 cm^3.

Explain why the volume changes.

Use ideas about particles in your answer.

.....

.....

.....

..... [2]

(b) The student heats a solid **X** and a liquid **Y** separately in two test-tubes and records the state of each after each 5 °C rise in temperature.

Table 2.2 shows the results.

Table 2.2

temperature / °C	state of **X**	state of **Y**
20	solid	liquid
25	solid	liquid
30	solid	liquid
35	solid	liquid
40	liquid	liquid
45	liquid	liquid

(i) Use Table 2.2 to estimate the melting point of **X**.

..... °C [1]

(ii) State **one** conclusion that can be made about the boiling point of **Y**.

.....

..... [1]

(c) The solid **X** used in the experiment can burn.

Explain why burning is a chemical change and melting is **not** a chemical change.

.....

.....

..... [1]

[Total: 8]

[Turn over

3 Fig. 3.1 shows the forces acting as a student rides forwards on a moving scooter.

The scooter has an electric motor.

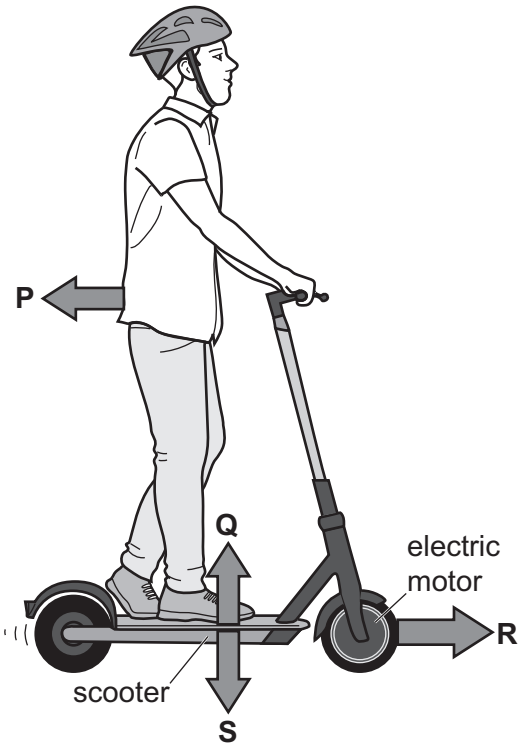


Fig. 3.1

(a) When the student is standing with both feet on the scooter, force **Q** is 340 N.

State the magnitude of force **S**.

Explain your answer.

force **S** = ... N

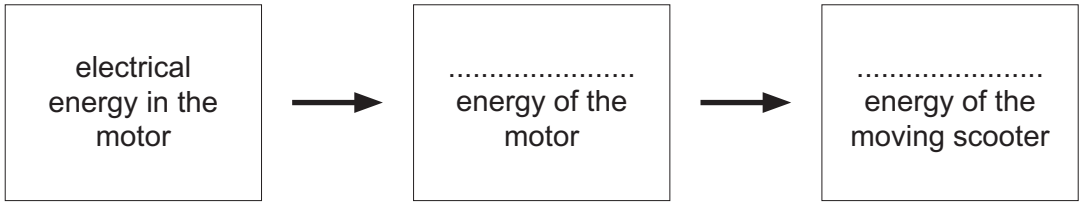
explanation .....

.....

[1]

(b) The electric motor pushes the scooter forward with a constant force of 225 N for a distance of 0.30 m.

(i) Complete the boxes to show the useful energy transfers taking place.



[2]

(ii) Calculate the work done on the scooter by the electric motor.

work done = ... J [2]

(iii) The 225 N force is applied for 1.2 s.

Use your answer to **(b)(ii)** to calculate the useful power supplied to the scooter.

power = ... W [2]

[Total: 7]

[Turn over

4 **(a)** Fig. 4.1 is a diagram of a wind-pollinated flower.

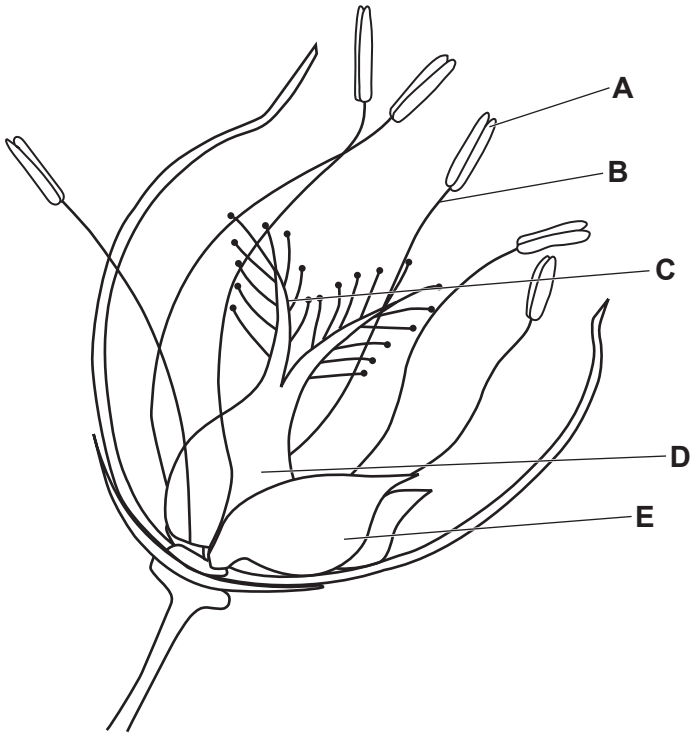


Fig. 4.1

Table 4.1 shows some of the labelled parts in Fig. 4.1 and their function.

Complete Table 4.1.

Table 4.1

letter	name of part	function
A	.....	.....
D	.....	produce ovules
.....	stigma	.....

[3]

(b) State **one** similarity and **one** difference between fertilisation in plants and fertilisation in humans.

similarity .....

.....

difference .....

.....

[2]

(c) After fertilisation in humans, a placenta develops inside the female uterus.

Describe how the placenta protects the fetus **and** allows it to grow.

.....

.....

.....

.....

..... [3]

[Total: 8]

5 Fig. 5.1 shows a key made from the alloy brass.

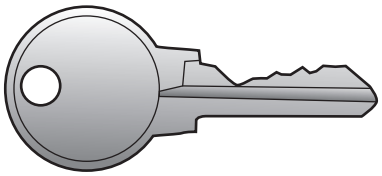


Fig. 5.1

(a) Suggest **two** reasons why brass is more suitable for making keys than pure copper.

1 .....

2 .....
[2]

(b) Brass contains copper atoms and zinc atoms, as shown in Fig. 5.2.

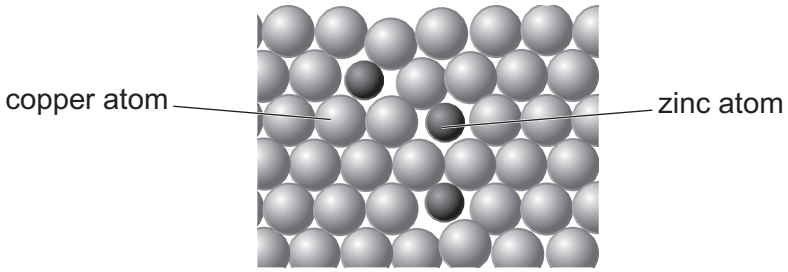


Fig. 5.2

Table 5.1 shows some information about brass.

Table 5.1

	percentage of element in brass	relative size of atom
copper	56	1.0
zinc	37	1.1

Fig. 5.2 is **not** an accurate representation of brass because brass contains more than two elements.

(i) Describe how the information in Table 5.1 shows that there are more than two elements in brass.

.....

..... [1]

(ii) State **two other** reasons why Fig. 5.2 is **not** an accurate representation of the atoms in brass.

Use Table 5.1 to help you.

1 .....

2 .....

[2]

(c) A student investigates the reactivity of copper and zinc.

The student places a zinc rod into a solution containing aqueous copper ions and leaves it for 5 minutes, as shown in Fig. 5.3.

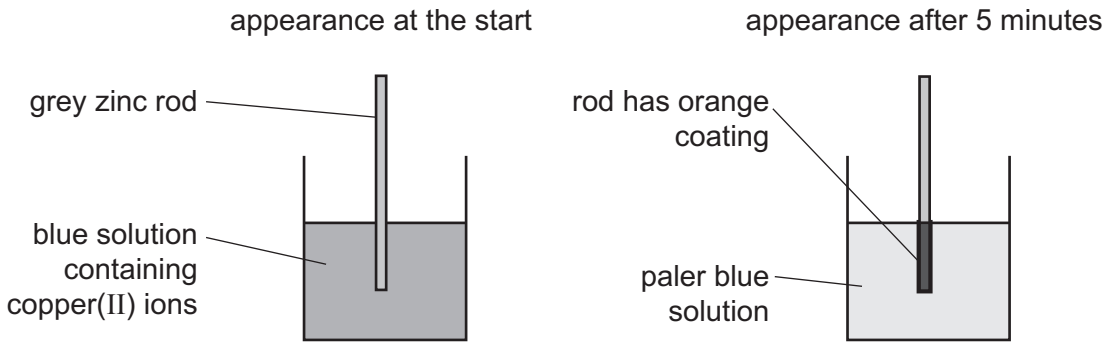


Fig. 5.3

(i) State why the zinc rod has an orange coating after 5 minutes.

.....

..... [1]

(ii) State why the colour of the solution changes.

.....

..... [1]

(iii) In another experiment, a copper rod is placed into an aqueous solution of zinc ions.

Describe the appearance of the rod and the solution after 5 minutes.

Explain your answer.

.....

.....

.....

.....

..... [3]

[Total: 10]

6 Ultraviolet radiation and microwaves are part of the electromagnetic spectrum.

(a) Fig. 6.1 shows an incomplete electromagnetic spectrum.

On Fig. 6.1, write ultraviolet and microwaves in the correct places.

increasing frequency ←						
gamma radiation			visible light			radio waves

Fig. 6.1

[2]

(b) State **one** danger of ultraviolet radiation.

..... [1]

(c) State **one** use of microwaves.

..... [1]

(d) Complete the sentences about ultraviolet radiation and microwaves.

Circle the correct word or phrase to complete each sentence.

Ultraviolet radiation and microwaves are **audible / longitudinal / transverse** waves.

The speed of microwaves in a vacuum is **equal to / faster than / slower than** the speed of ultraviolet radiation in a vacuum.

[2]

(e) **(i)** The speed of ultraviolet radiation in a vacuum is 3.0×10^{8} m/s.

An ultraviolet lamp emits ultraviolet radiation of wavelength 3.5×10^{-7} m.

Calculate the frequency of ultraviolet radiation at this wavelength.

Give the unit of your answer.

frequency = ... unit ..... [3]

(ii) Three identical ultraviolet lamps are connected in parallel to a 230 V electricity supply.

Each lamp uses a power of 150 W.

Calculate the total current from the electricity supply.

current = ... A [3]

[Total: 12]

7 **(a)** Fig. 7.1 shows a food chain.

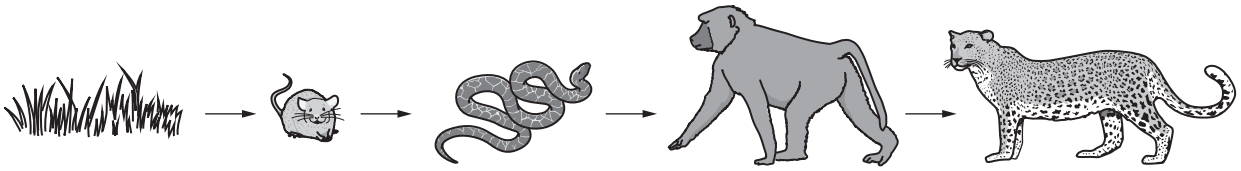


Fig. 7.1

(i) Identify the primary consumer in Fig. 7.1.

..... [1]

(ii) Explain why food chains usually have fewer trophic levels than the food chain in Fig. 7.1.

.....

.....

.....

..... [2]

(b) Grass is a type of plant.

(i) The leaves of a plant have different types of cells with different functions.

State the **main** function of the two types of mesophyll cells.

palisade mesophyll cells .....

spongy mesophyll cells .....
[2]

(ii) Plant growth can be affected by ion deficiencies.

Explain the effects of magnesium ion deficiency on plant growth.

.....

.....

.....

..... [2]

(c) In humans, food is digested in the stomach of the alimentary canal.
Hydrochloric acid is found in the stomach.

State **two** functions of hydrochloric acid in the stomach.

1 .....

2 .....
[2]

[Total: 9]

8 Energy level diagrams for two reactions are shown in Fig. 8.1. The diagrams are drawn to the same scale.

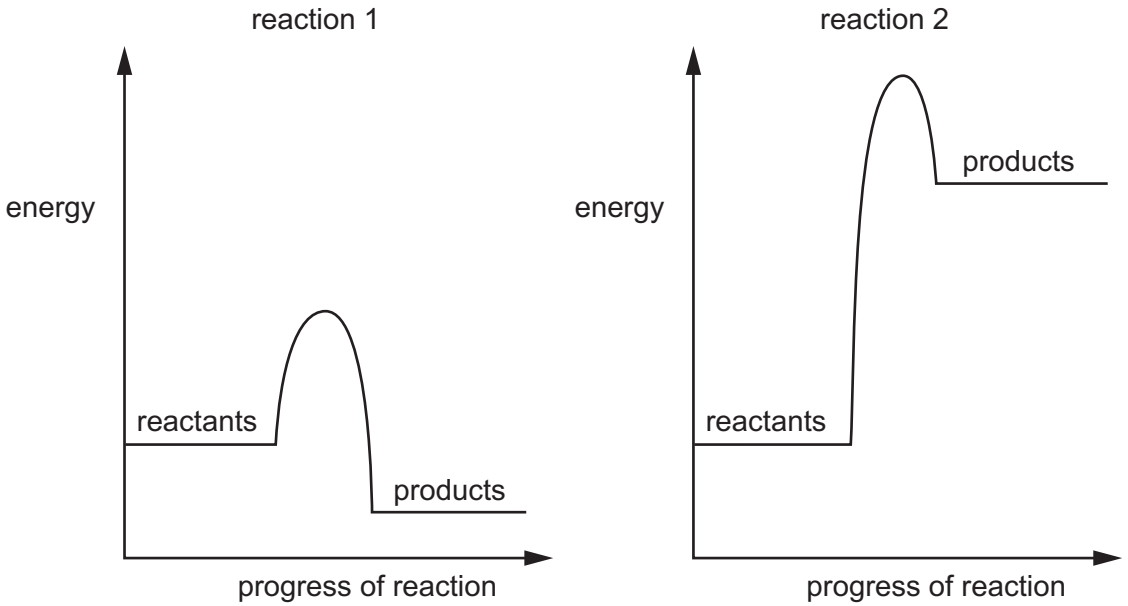


Fig. 8.1

(a) (i) Compare the activation energies for reaction 1 and reaction 2.

Explain your answer.

comparison .....

explanation .....

.....

[1]

(ii) The temperature of reaction 2 is increased.

Use ideas about activation energy to explain why this increases the rate of reaction 2.

.....

..... [1]

(b) One of the reactions represents the combustion of propane.

Identify which reaction, 1 or 2, represents the combustion of propane.

Give a reason for your answer.

reaction .....

reason .....

.....

[1]

(c) Arrows **A** and **B** on Fig. 8.2 represent changes occurring during reaction 1.

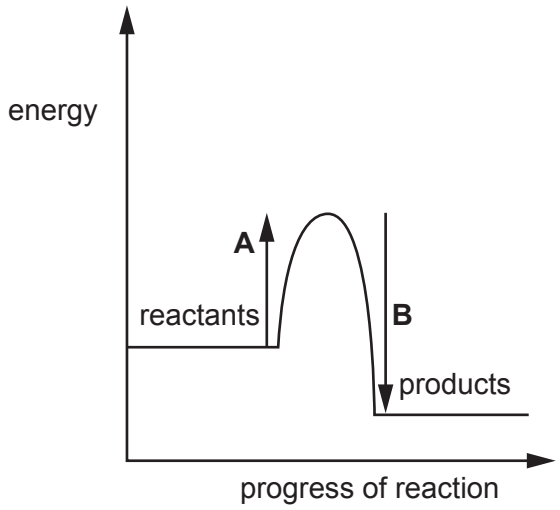


Fig. 8.2

Put ticks (✓) in the boxes to show what these changes represent.

	bonds are being broken	bonds are being formed	energy is being taken in	energy is being given out
arrow **A**				
arrow **B**				

[2]

(d) Equations for the combustion of propane are shown in Fig. 8.3.

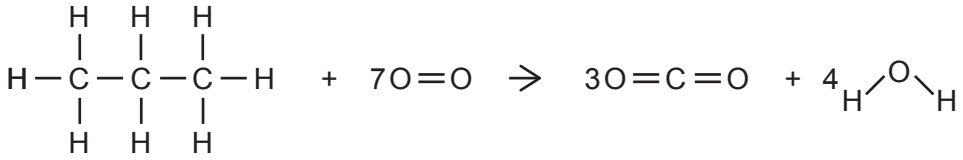


Fig. 8.3

(i) State the number of electrons that are shared between one oxygen atom and one carbon atom in a molecule of carbon dioxide.

..... [1]

(ii) State **two** ways in which the structure of propane shows that it is an alkane.

1 .....

2 .....

[2]

[Total: 8]

9 **(a)** Fig. 9.1 shows a liquid-in-glass thermometer without a scale.

Fig. 9.1

The thermometer measures temperatures between –10 °C and +110 °C.

Table 9.1 gives some information about four liquids, **A**, **B**, **C** and **D**.

Table 9.1

liquid	melting point / °C	boiling point / °C
A	–89	+117
B	–117	+79
C	–39	+367
D	+17	+118

State the letters of the liquids in Table 9.1 that can be used in this thermometer.

..... [1]

(b) Fig. 9.2 shows a circuit used to heat a beaker of water with an electric heater.

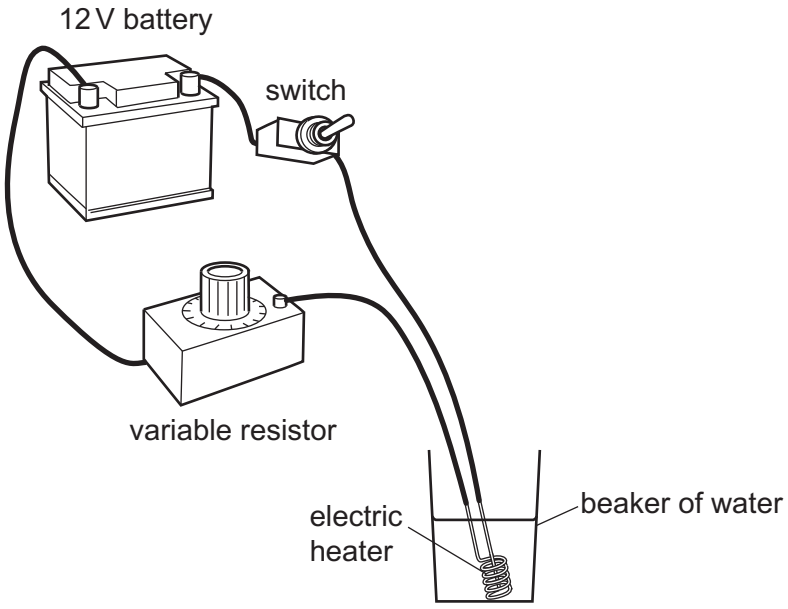


Fig. 9.2

(i) The circuit contains a variable resistor.

Draw the circuit symbol for the variable resistor.

[1]

(ii) The variable resistor is adjusted so that the current is 5.0 A.

Calculate the energy in kilojoules supplied by the 12 V battery when the circuit is switched on for 5 minutes.

energy = ... kJ [3]

(iii) A voltmeter connected across the variable resistor shows a reading of 4.0 V.

Calculate the potential difference across the electric heater.

potential difference = ... V [1]

(iv) Some electrical energy supplied by the battery is **not** transferred to useful thermal energy in the water.

Suggest how electrical energy from the battery is lost **in the circuit**.

.....

..... [2]

[Total: 8]

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 –		

Key

atomic number
atomic symbol
name
relative atomic mass

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.).