Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

1329341844

COMBINED SCIENCE **0653/41**

Paper 4 Theory (Extended) **October/November 2021**

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)** The boxes on the left show the names of different types of cell.

The boxes on the right show the functions of these cells.

Draw one straight line from each cell to its function.

cell	function
ciliated cell	movement of mucus
palisade mesophyll cell	photosynthesis
sperm cell	reproduction

[2]

(b) Fig. 1.1 is a photomicrograph of some cells in a plant root.

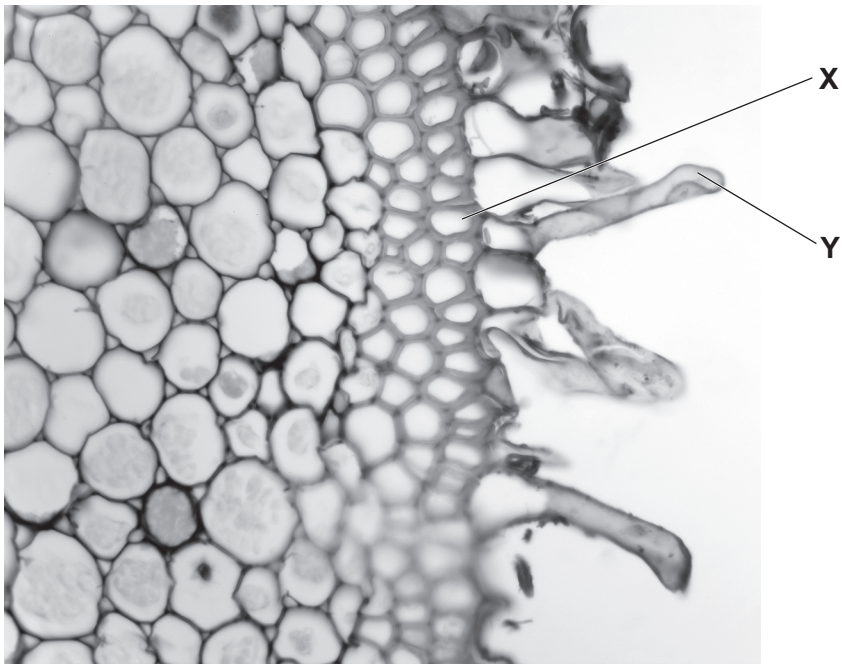

Fig. 1.1

(i) State the name of **one** structure shown in Fig. 1.1 that identifies cell **X** as a plant cell.

..... [1]

(ii) Identify the type of plant cell labelled **Y** in Fig. 1.1.

..... [1]

(iii) The liquid inside cell **X** has a higher concentration of salts than the liquid inside cell **Y**.

Explain why water moves from cell **Y** to cell **X**.

Use ideas about water potential in your answer.

.....

.....

.....

.....

.....

..... [3]

(c) Describe how water is lost from the leaves of a plant by transpiration.

.....

.....

..... [2]

(d) The roots of a plant absorb magnesium ions.

Explain the effect of a deficiency of magnesium on the **colour** of plant leaves.

.....

.....

..... [2]

[Total: 11]

2 Fig. 2.1 shows the energy and state changes for water when it is heated from –10 °C to 120 °C.

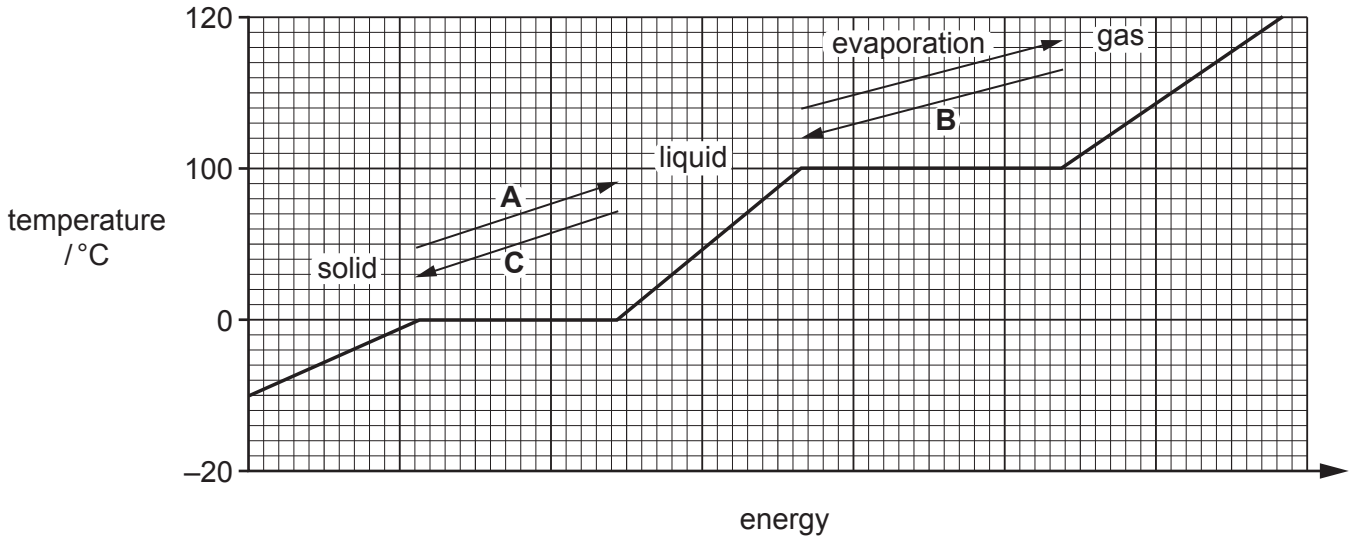

Fig. 2.1

(a) State the names of processes **A**, **B** and **C**.

A .....

B .....

C .....

[3]

(b) Describe the differences between the energy, the arrangement and the movement of the particles in the water at –10 °C and at 120 °C.

energy .....

.....

arrangement .....

.....

movement .....

.....

[3]

(c) The melting point of sodium chloride is 800°C.

The boiling point of sodium chloride is 1465°C.

Explain why the melting point and boiling point of sodium chloride are higher than those shown for water in Fig. 2.1.

Use ideas about bonds in your answer.

.....

.....

.....

..... [3]

[Total: 9]

3 A dog accelerates from rest to a maximum constant speed.

(a) Complete the boxes to show the energy changes for the dog as it is running.

..... energy in the muscles of the dog's body	→	kinetic energy of the moving dog	+	..... energy lost to the environment

[2]

(b) Fig. 3.1 shows a speed-time graph for the dog.

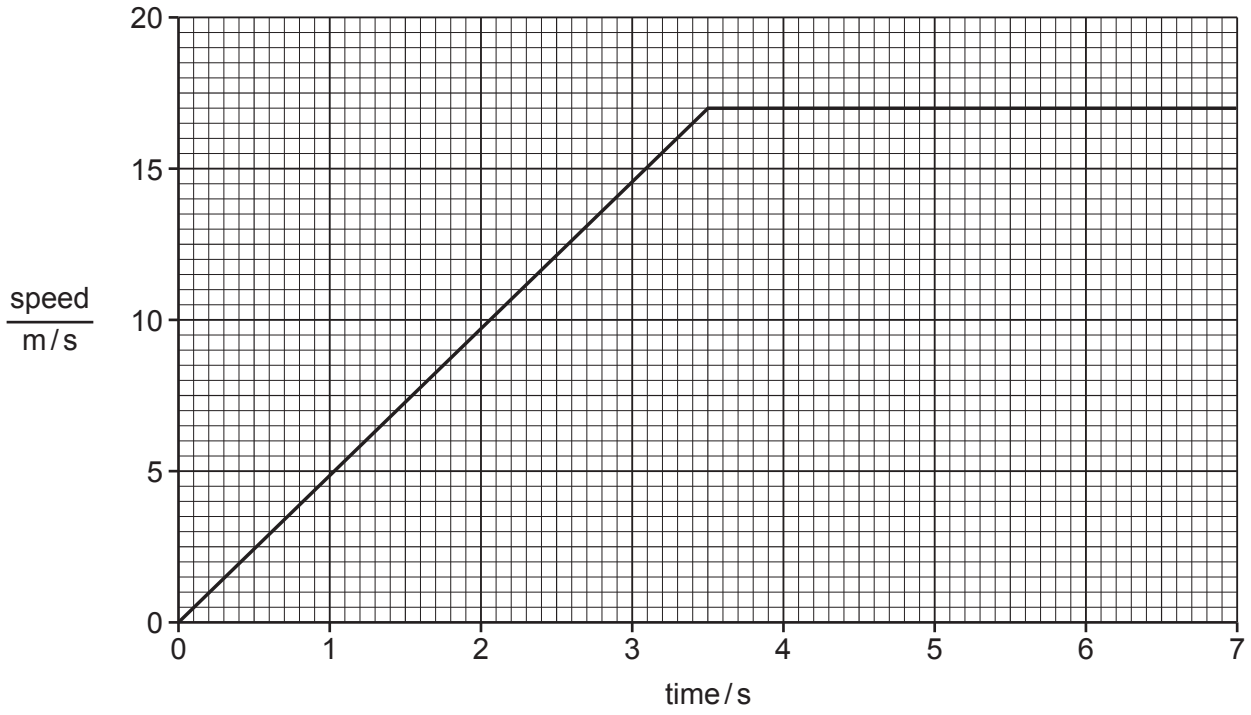

Fig. 3.1

(i) Use Fig. 3.1 to calculate the acceleration of the dog.

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

(ii) Use Fig. 3.1 to calculate the distance travelled by the dog while accelerating.

distance = ... m [2]

(iii) The dog has a mass of 32 kg.

Use Fig. 3.1 to calculate the kinetic energy of the dog at maximum constant speed.

kinetic energy = ... J [2]

(iv) Use your answer to **(b)(iii)** to calculate the power of the dog as it accelerates from rest to maximum constant speed.

State the unit of your answer.

power = ... unit ..... [3]

[Total: 11]

4 **(a)** Complete the sentence to define an ecosystem.

An ecosystem is a unit containing all the organisms and their ..... ,

interacting together, in a given ..... . [2]

(b) Fig. 4.1 shows a food web from the Arctic ecosystem.

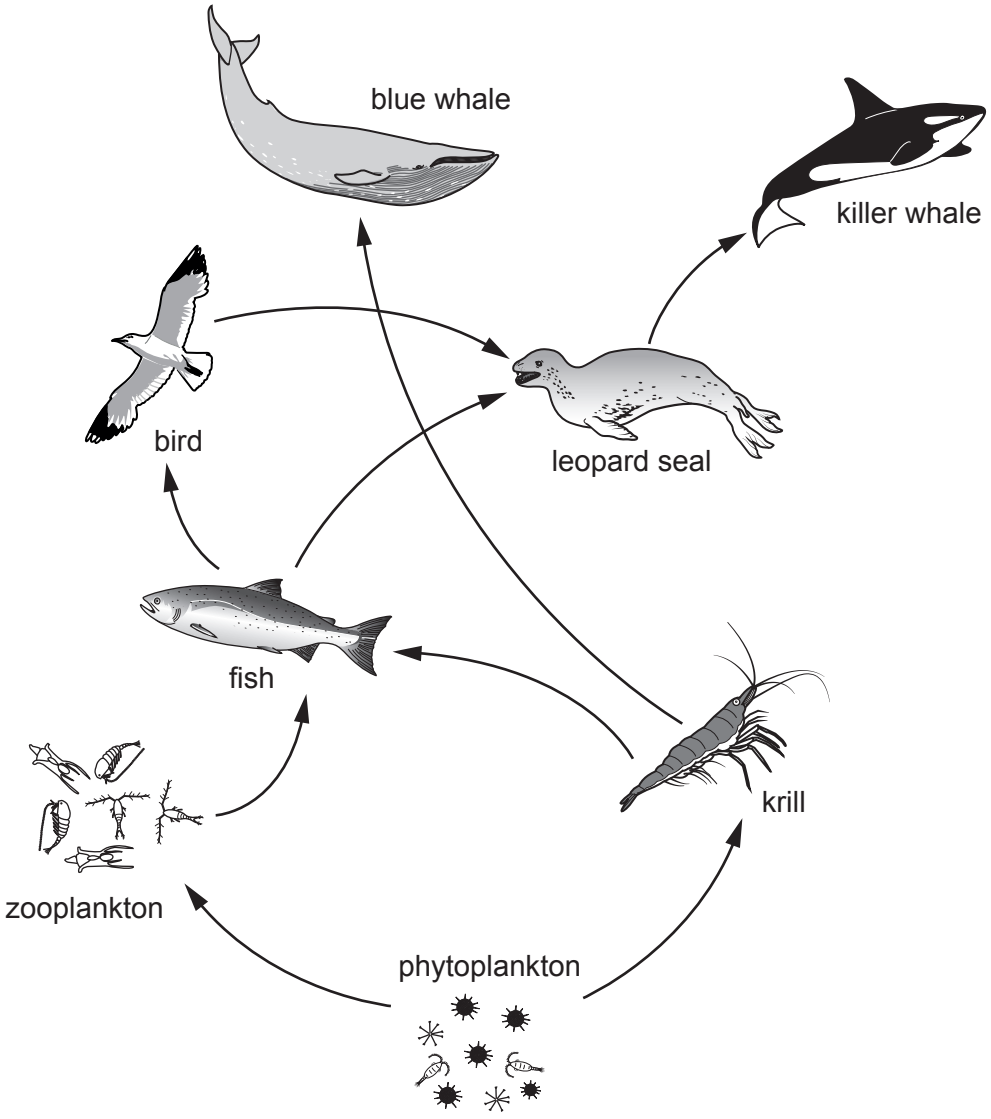

Fig. 4.1

(i) Use Fig. 4.1 to identify **one** organism in the food web that is on the third trophic level.

..... [1]

(ii) Describe how energy is transferred from the zooplankton to the bird.

.....

..... [2]

(c) Fig. 4.2 is a diagram showing stages in the process of eutrophication.

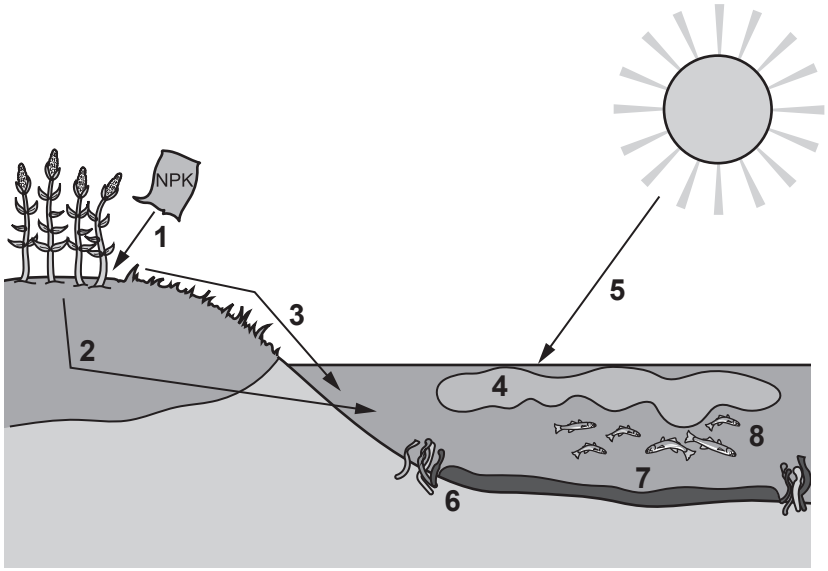

Fig. 4.2

Table 4.1 describes these stages in the process of eutrophication.

Use the information in Fig. 4.2. to complete Table 4.1.

Table 4.1

stage in Fig. 4.2	description of stage
1	Fertiliser is added to the soil.
2	Nitrate ions from the fertiliser leach from the soil into the water in the lake.
3	Fertiliser runs off the land into the water in the lake.
4	Increased availability of nitrate ions causes ....
5	Light is blocked from reaching the plants on the bottom of the lake.
6	Plants on the bottom of the lake die.
7	Increased aerobic respiration by ..... .
8	Death of fish due to ..... .

[3]

[Total: 8]

5 **(a)** Table 5.1 shows some names and some formulae of four metal oxides.

Complete Table 5.1.

Table 5.1

name	formula
iron(II) oxide	FeO
	Fe_2O_3
copper(II) oxide	
lead(II) oxide	PbO

[2]

(b) Lead can be extracted from lead(II) oxide by heating with carbon.

The equation for this reaction is shown.

$$2PbO + C \rightarrow 2Pb + CO_2$$

State the name of the reducing agent in this reaction.

Explain your answer.

reducing agent .....

explanation .....

.....

[2]

(c) When lead is heated with copper(II) oxide, copper metal forms.

When lead is heated with iron(II) oxide, there is no reaction.

(i) Use this information to deduce the order of reactivity of these three metals.

Explain your answer.

most reactive .....

.....

least reactive .....

explanation .....

.....

[2]

(ii) Zinc is heated with iron(II) oxide.

State whether a reaction occurs.

Give a reason for your answer.

.....

..... [1]

(d) A piece of lead is placed into aqueous copper nitrate and a reaction occurs.

Before the reaction, the lead has a silver colour and the aqueous copper nitrate is blue.

State **two** observations that are seen during this reaction.

1 .....

.....

2 .....

.....

[2]

[Total: 9]

6 **(a)** Fig. 6.1 shows the compressions and rarefactions of a sound wave in air.

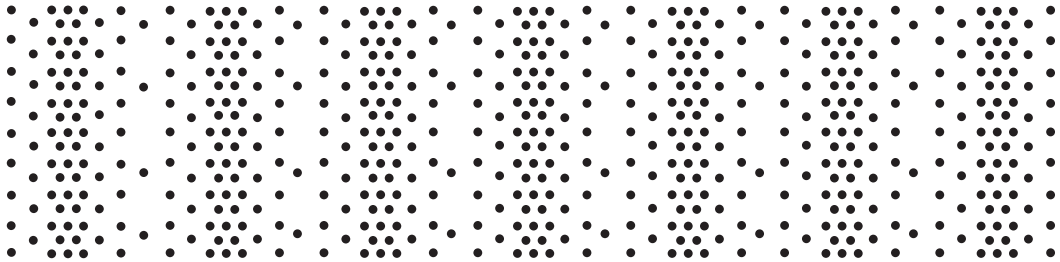

Fig. 6.1

(i) On Fig. 6.1, draw a double-headed arrow (↔) to show one wavelength. [1]

(ii) Compare the separation of the particles in the air in compressions and in rarefactions.

.....

..... [1]

(b) Table 6.1 shows the frequency range of sounds that different animals can hear.

Table 6.1

animal	frequency range / Hz
bat	10 000 – 39 000
canary bird	250 – 8 000
dog	64 – 44 000
elephant	17 – 10 000
horse	14 – 25 000

(i) Identify **two** animals in Table 6.1 that can hear sounds above the normal range of human hearing.

..... [1]

(ii) Humans emit sounds between 85 Hz and 255 Hz when talking.

Identify which animals in Table 6.1 **cannot** hear **all** the sounds of humans talking.

..... [1]

(c) An elephant emits a sound at a frequency of 170 Hz. A second elephant hears the sound.

There is a distance of 60 wavelengths between the two elephants.

Calculate the distance in metres.

The speed of sound in air is 340 m / s.

distance = ... m [3]

(d) Fig. 6.2 shows a drawing of an elephant.

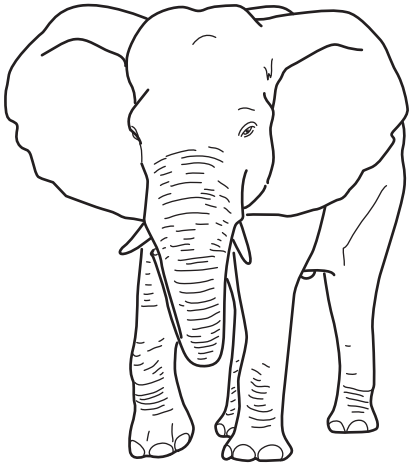

Fig. 6.2

Elephants use their ears to transfer thermal energy to the environment. This helps to control their body temperature.

Suggest how an elephant's ears are adapted to transfer thermal energy to the environment.

Use ideas about conduction, convection or radiation in your answer.

.....

.....

.....

[2]

[Total: 9]

7 **(a)** Fig. 7.1 is a diagram of the gas exchange system in humans.

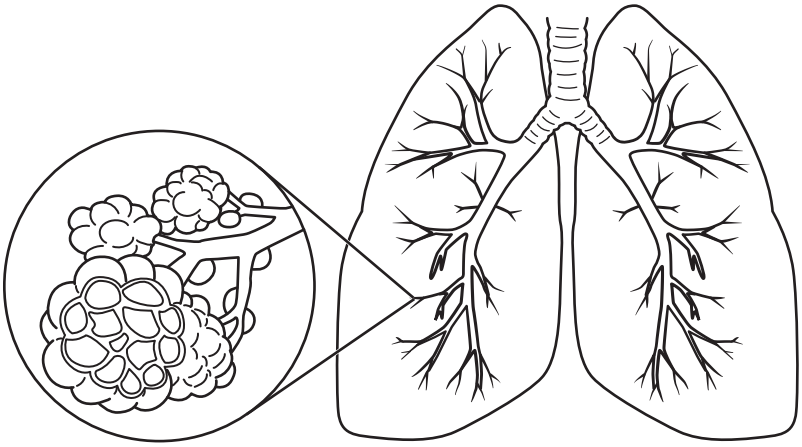

Fig. 7.1

(i) On Fig. 7.1 draw a label line and the letter **B** to identify a bronchus. [1]

(ii) State **two** features of the alveoli that make them an efficient gas exchange surface.

1 .....

.....

2 .....

.....

[2]

(b) The pulse rate and breathing rate of two people are measured before and after activity.

Fig. 7.2 shows a bar chart of the results.

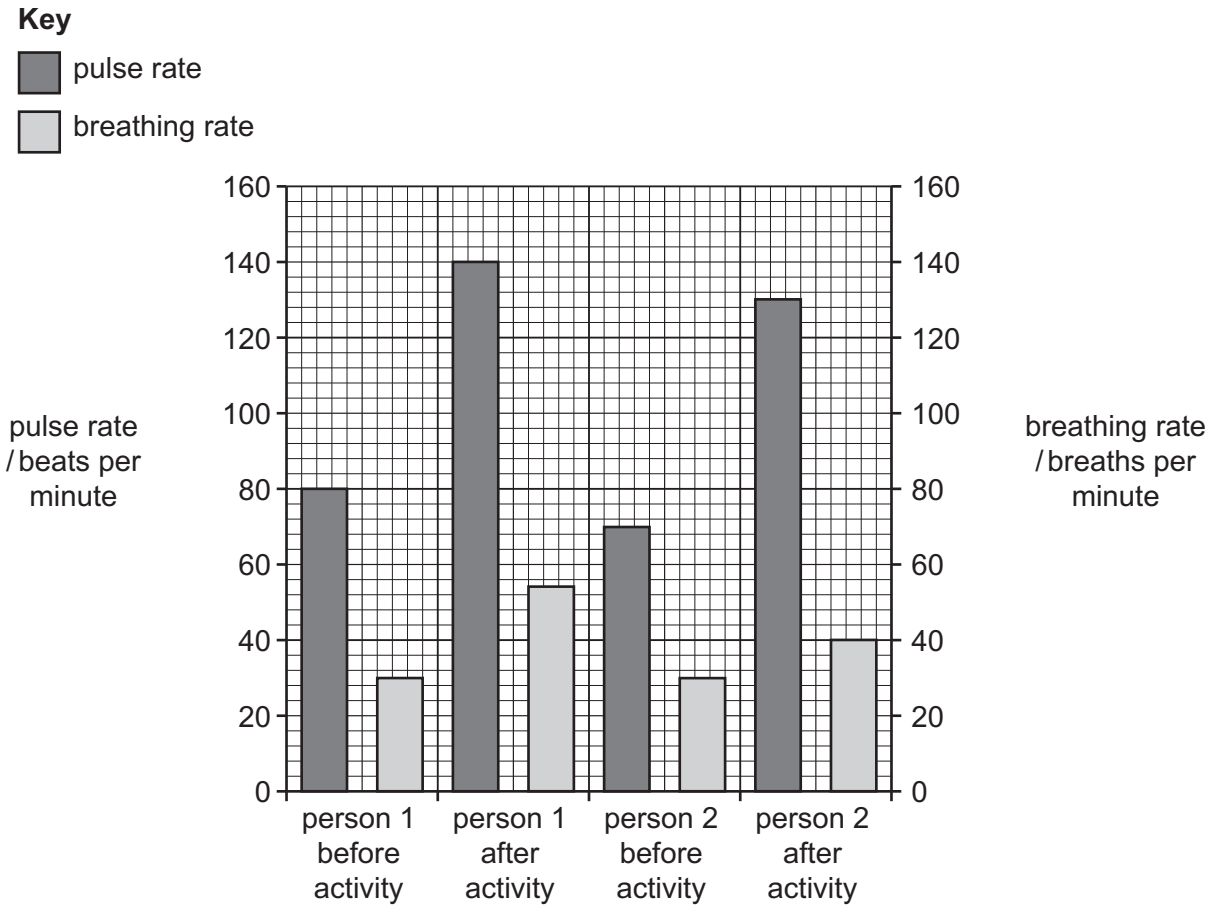

Fig. 7.2

(i) Compare the increase in breathing rates of the two people.

.....

..... [1]

(ii) Table 7.1 shows the pulse rate data and percentage increase in pulse rate for person 1.

Complete Table 7.1 to show the pulse rate data and percentage increase in pulse rate for person 2.

Table 7.1

person	pulse rate before activity / beats per minute	pulse rate after activity / beats per minute	change in pulse rate / beats per minute	percentage increase in pulse rate
1	80	140	60	75
2				

[2]

(c) One reason why breathing rate increases during activity is the need for more oxygen.

Explain **one** other reason why breathing rate increases during activity.

.....

.....

.....

..... [2]

[Total: 8]

8 A scientist uses three processes to treat a sample of sea water to make it safe to drink and store.

(a) The sample of sea water contains some solid plastic waste.

The scientist uses a filter to remove the solid plastic waste from the sea water.

Explain how this filter works.

.....

.....

..... [2]

(b) The sea water contains large amounts of dissolved salt.

After filtering, the scientist uses a separation method to obtain pure water from the sea water.

State the name of this separation method and explain how this method works.

separation method .....

explanation .....

.....

.....
[4]

(c) Next, the scientist adds a chemical to the pure water to make it safe to drink and store.

State the name of this chemical and explain how it makes the pure water safe to drink and store.

chemical .....

explanation .....

.....
[2]

[Total: 8]

9 A student connects a heater and four identical lamps to a battery.

Fig. 9.1 shows the circuit.

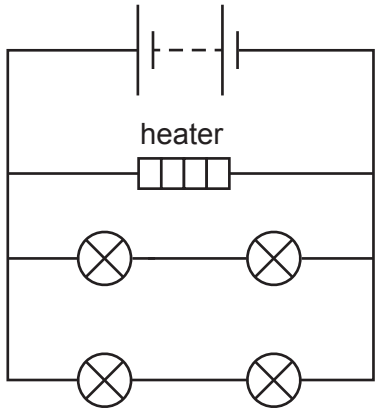

Fig. 9.1

(a) There is a current of 8.5A in the heater.

There is a current of 1.5A in each lamp.

Calculate the total current in the battery.

total current = ... A [2]

(b) State the name of the instrument used to measure current.

..... [1]

(c) A student has two switches, **S1** and **S2**, and a fuse.

The student changes the circuit so that:

- switch **S1** controls the heater but does **not** control the lamps
- switch **S2** controls all four lamps but does **not** control the heater
- the fuse protects the whole circuit.

On Fig. 9.2, complete the circuit diagram to show how the student connects the circuit.

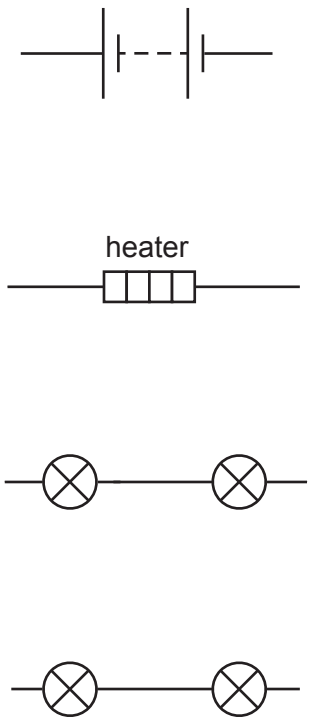

Fig. 9.2

[4]

[Total: 7]

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.).