Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

9148023898

COMBINED SCIENCE **0653/33**

Paper 3 Theory (Core) **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 **24** pages. Any blank pages are indicated.

1 **(a)** A blue dye is dissolved in water to make a blue liquid.

Fig. 1.1 shows a cut plant stem in a beaker of the blue liquid.

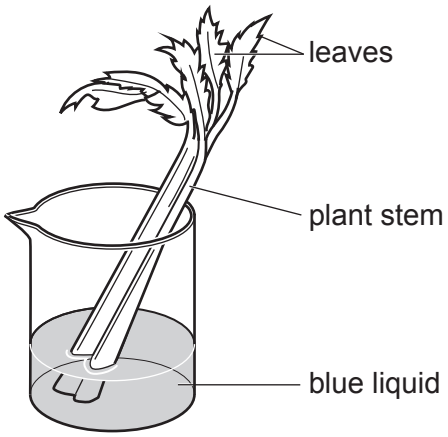

Fig. 1.1

The plant stem is left in the blue liquid for 24 hours.

(i) Complete the sentences to explain why the leaves turn blue.

Choose words from the list.

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

cortex	**mesophyll**	**phloem**
root hair	**stomata**	**xylem**

The blue liquid moves up the plant stem in vessels called

..... .

In the leaves, the blue liquid moves out of the vessels into

..... cells.

Water in the blue liquid then diffuses out of the ..... into the air.

[3]

(ii) Fig. 1.2 shows the cross-section of the plant stem from Fig. 1.1.

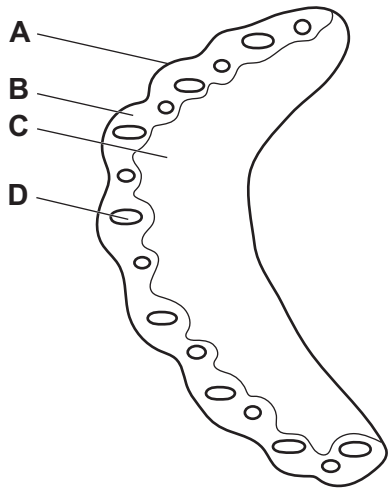

Fig. 1.2

The blue liquid only stains the transport vessels in the stem blue.

Identify the letter in Fig. 1.2 that shows these transport vessels.

..... [1]

(b) Plants make their own food. They make large molecules from smaller molecules.

(i) The boxes on the left show some large molecules.

The boxes on the right show the smaller molecules the large molecules are made from.

Draw one straight line from each large molecule to the smaller molecules it is made from.

large molecules	**smaller molecules**
oil	amino acids
protein	fatty acids and glycerol
starch	glucose

[2]

(ii) Oils are stored in the seeds of a plant.

A test is used to find the presence of oil in seeds.

State the name of this test.

..... [1]

(c) Oil from palm trees has many uses.

Fig. 1.3 shows the mass of palm oil used worldwide between 2006 and 2016.

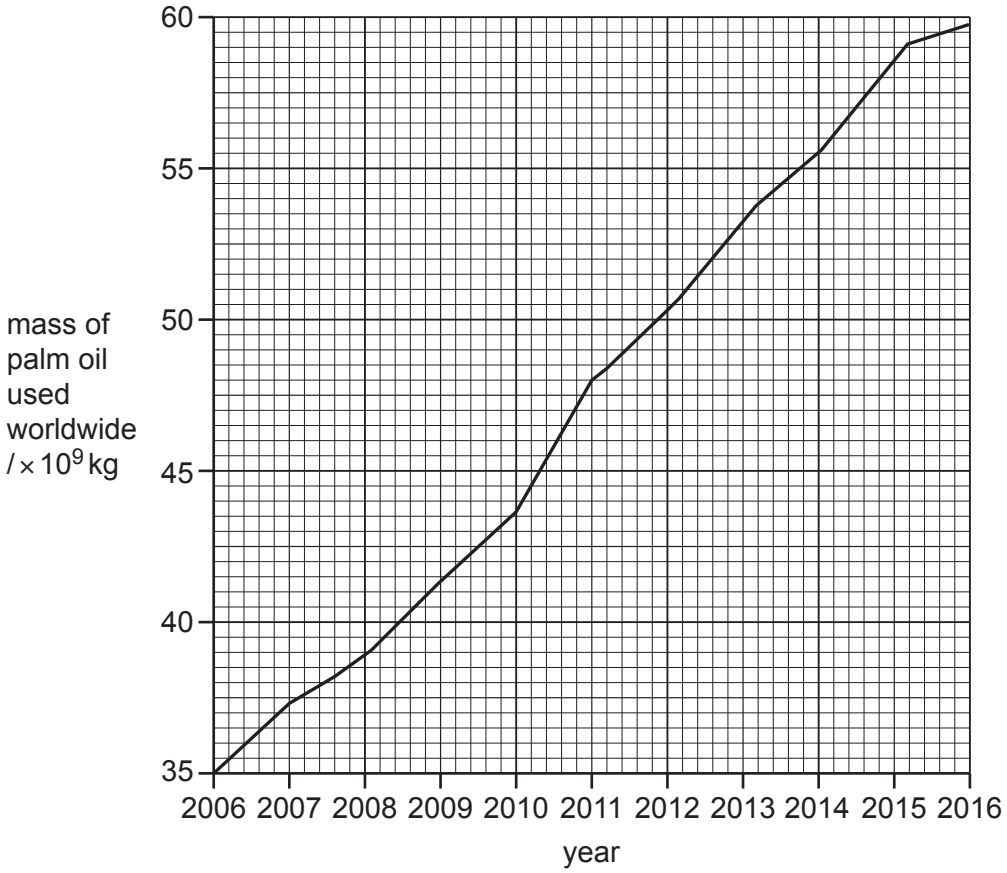

Fig. 1.3

(i) Use Fig. 1.3 to determine the mass of palm oil used worldwide in 2011.

..... $\times 10^9$ kg [1]

(ii) Areas of rainforest are removed to plant palm trees for oil.

Describe how deforestation affects the animals living in the rainforest.

.....

.....

..... [2]

[Total: 10]

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2 **(a)** A student separates some insoluble solid material from concentrated aqueous sodium chloride.

(i) State the name of the separation method that the student uses.

..... [1]

(ii) Identify the solute and the solvent in concentrated aqueous sodium chloride.

solute .....

solvent .....
[1]

(iii) State what is meant by *concentrated*.

Use ideas about particles in your answer.

.....

..... [1]

(b) The student passes an electric current through concentrated aqueous sodium chloride, as shown in Fig. 2.1.

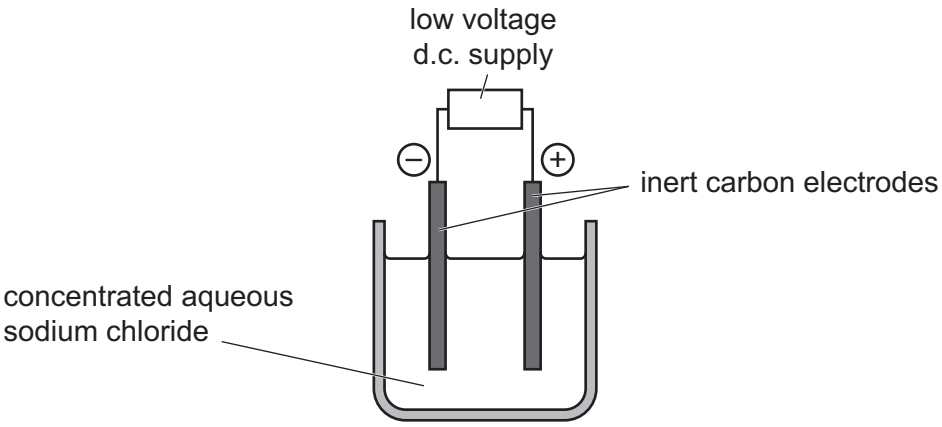

Fig. 2.1

(i) State the name of this process.

..... [1]

(ii) State the name of the positive electrode.

..... [1]

(iii) Identify the product that forms at the negative electrode.

..... [1]

(c) Sodium is a metal, and chlorine is a diatomic non-metal.

When sodium and chlorine are heated together, sodium chloride is formed.

(i) State what is meant by *diatomic*.

.....

..... [1]

(ii) State the type of chemical bonding present in sodium chloride.

..... [1]

(iii) Describe a chemical test for the presence of chloride ions in aqueous sodium chloride.

State the observation for a positive result.

test .....

.....

observation .....

.....

[2]

[Total: 10]

3 **(a)** Fig. 3.1 shows the seven regions of the electromagnetic spectrum.

gamma rays	X-rays	ultraviolet	visible light	infrared	microwaves	radio waves

Fig. 3.1

(i) State the region of the electromagnetic spectrum that is used for satellite television.

..... [1]

(ii) State the region of the electromagnetic spectrum that causes sunburn.

..... [1]

(b) Fig. 3.2 shows a wave.

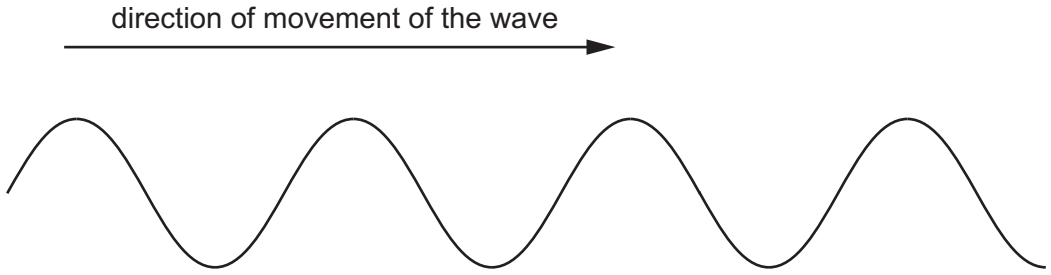

Fig. 3.2

(i) On Fig. 3.2, draw a double-headed arrow (↔ or ↕) to show one wavelength. [1]

(ii) It takes 40 seconds for 100 wavelengths to pass a point.

Calculate the frequency of the wave.

frequency = ... Hz [2]

(c) Fig. 3.3 shows a student standing at a distance from a cliff.

Fig. 3.3 (not to scale)

The student makes a loud sound.

After 3.6 seconds, the student hears the echo of the sound reflected back from the cliff.

The speed of sound in air is 330 m / s.

Calculate the distance of the student from the cliff.

distance = ... m [3]

[Total: 8]

4 **(a)** A biology teacher measures the pulse rate of five students **A**–**E** before and after exercise.

Table 4.1 shows the results.

Table 4.1

student	pulse rate before exercise / beats per minute	pulse rate after exercise / beats per minute	change in pulse rate / beats per minute
A	65	90	25
B	75	102	27
C	78	104	26
D	69	101	32
E	81	109	

(i) Calculate the change in pulse rate for student **E**.

..... beats per minute [1]

(ii) Identify the student with the greatest change in pulse rate.

..... [1]

(b) Fig. 4.1 shows a cross-section through an artery and a vein as seen using a light microscope.

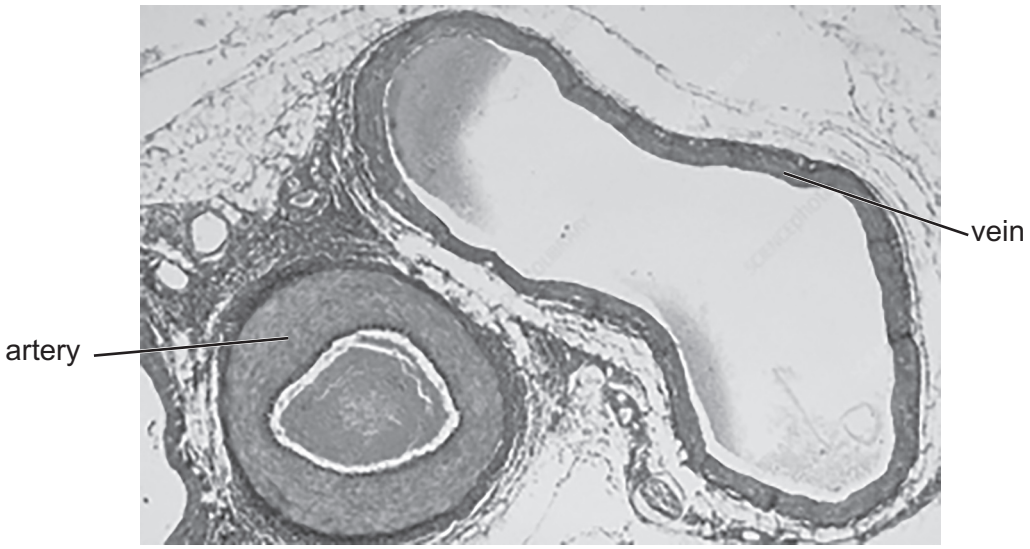

Fig. 4.1

(i) Describe **two** differences between the structure of the artery and the structure of the vein seen in Fig. 4.1.

1 .....

.....

2 .....

.....
[2]

(ii) State the role of haemoglobin in the blood.

..... [1]

(c) The heart is used to pump blood around the body.

Fig. 4.2 shows a cross-section of the human heart.

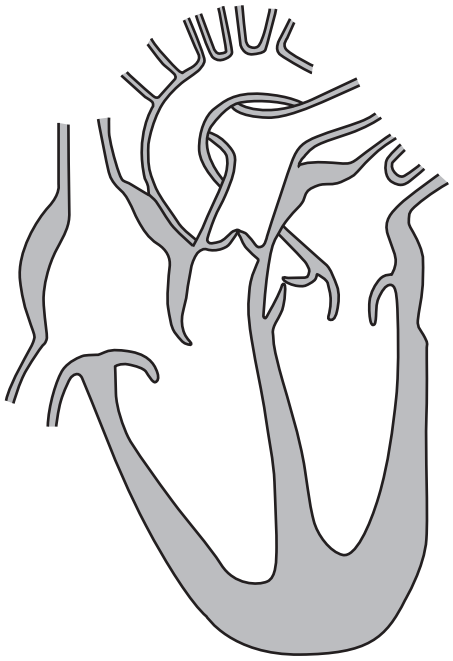

Fig. 4.2

(i) On Fig. 4.2, draw a label line and the letter **S** to show the position of the septum. [1]

(ii) State the name of the blood vessel that transports blood from the heart to the lungs.

..... [1]

(d) The blood transports hormones around the body.

One hormone is released in response to a 'fight or flight' situation.

(i) State the name of this hormone.

..... [1]

(ii) One effect of this hormone is to increase the pulse rate.

Describe **one** other effect of this hormone on the body.

..... [1]

[Total: 9]

5 The Periodic Table lists all of the known elements.

(a) State the name of the element used to kill bacteria in water supplies.

..... [1]

(b) Iron is mixed with other elements to change its properties.

State the name of the type of mixture that contains a metal and other elements.

..... [1]

(c) Table 5.1 shows the chemical and physical properties of four elements in the Periodic Table.

Complete Table 5.1 by choosing four elements from the list.

argon **carbon** **hydrogen**

iron **magnesium** **nitrogen** **oxygen**

Table 5.1

element	properties
.....	• boils at –252.9 °C • present in molecules of methane
.....	• boils at –185.8 °C • is unreactive (and so is used in lamps)
.....	• boils at –182.95 °C • required for the rusting of iron
.....	• melts at 650 °C • reacts slowly with cold water • reacts rapidly with steam forming a white solid

[4]

(d) Methane is a compound.

Describe the difference between an element and a compound.

Use ideas about types of atom in your answer.

element .....

.....

compound .....

.....

[2]

[Total: 8]

6 A meteorite is a rock from space that travels through the Earth's atmosphere and hits the surface of the Earth.

(a) A meteorite is moving in space towards the Earth.

State the type of energy that the meteorite has due to its motion.

..... [1]

(b) The meteorite slows down as it travels through the Earth's atmosphere.

State the name of the force that slows the meteorite down.

..... [1]

(c) The volume of the meteorite is $1.2\,m^3$.

The density of the meteorite is $3700\,kg/m^3$.

Calculate the mass of the meteorite.

mass = ... kg [2]

(d) Fig. 6.1 shows a speed–time graph for the meteorite as it travels through the Earth's atmosphere and then hits the surface of the Earth.

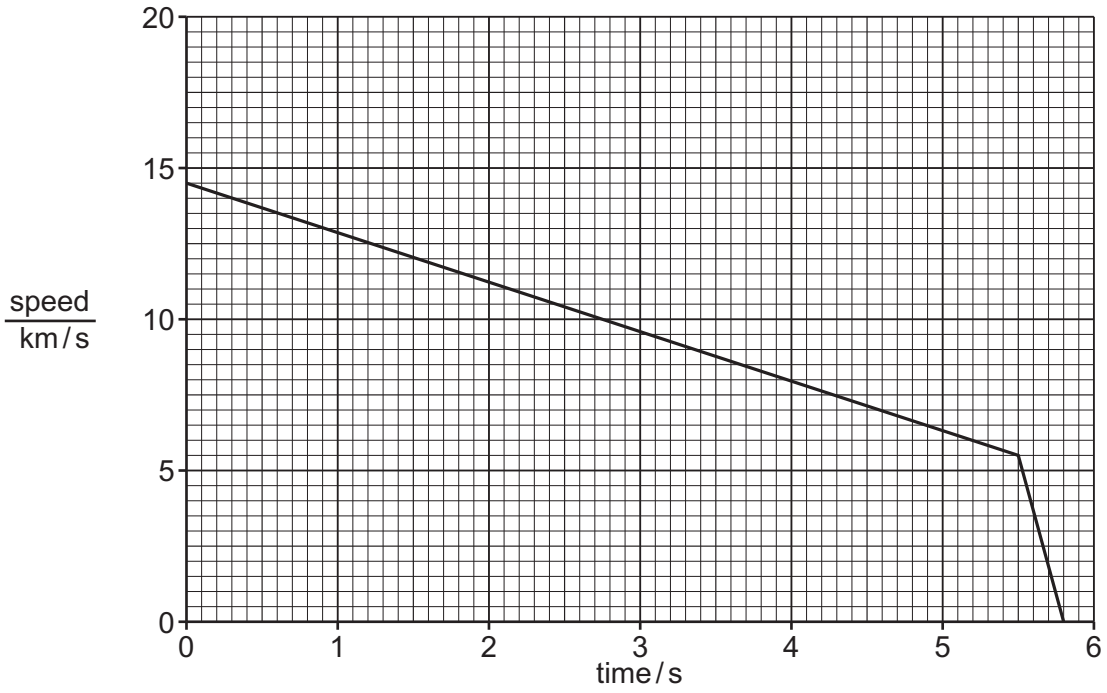

Fig. 6.1

(i) Use Fig. 6.1 to identify the time at which the meteorite hits the surface of the Earth.

Give a reason for your answer.

time ..... s

reason .....

[1]

(ii) Compare the deceleration of the meteorite between 0 s and 5.5 s with the deceleration of the meteorite between 5.5 s and 5.8 s.

Explain your answer.

.....

..... [2]

(e) Lenses are often used in telescopes to help astronomers observe objects in space.

Fig. 6.2 shows an incomplete ray diagram for two rays of light from an object entering a thin converging lens.

F is the principal focus of the lens.

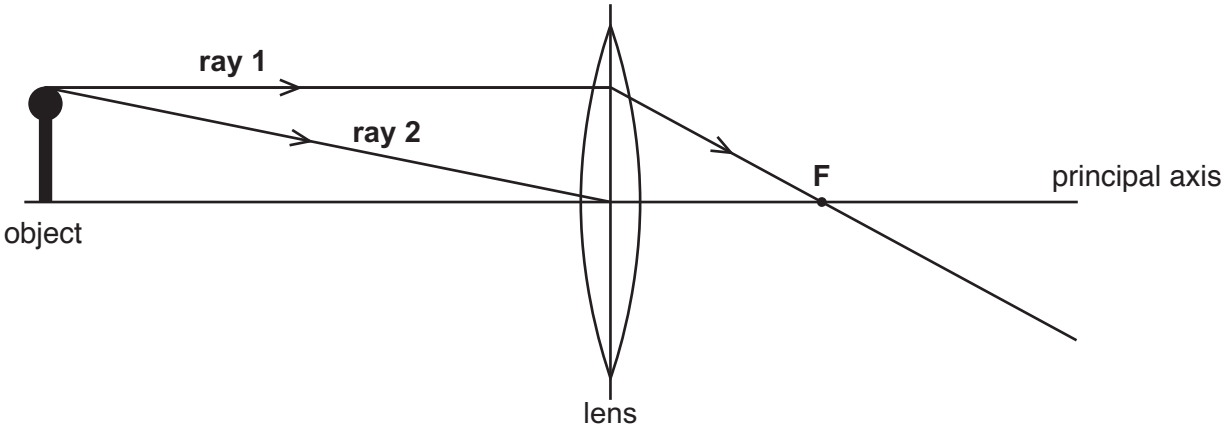

Fig. 6.2

Complete Fig. 6.2 to show:

- the path of **ray 2** leaving the lens
- the image. [2]

[Total: 9]

7 **(a)** Fig. 7.1 contains information about some organisms.

- giraffes eat trees
- lions hunt and eat giraffes
- when lions die, vultures feed on parts of their dead bodies
- the parts of the lion not eaten then decompose

Fig. 7.1

(i) Construct the food chain for the organisms in Fig. 7.1.

..... [2]

(ii) Identify the **secondary** consumer from Fig. 7.1.

..... [1]

(iii) Giraffes are herbivores.

State what is meant by *herbivore*.

.....

..... [2]

(iv) Decomposition of the lion's body returns carbon to the atmosphere as part of the carbon cycle.

State the part of the carbon cycle that **removes** carbon from the atmosphere.

..... [1]

(b) Living organisms are made up of cells. Cells contain different structures.

State the functions of the cell membrane and the cell wall.

cell membrane .....

.....

cell wall .....

.....

[2]

[Total: 8]

8 A student investigates the rate of the reaction between lumps of calcium carbonate and dilute hydrochloric acid.

The student uses the pieces of apparatus shown in Fig. 8.1.

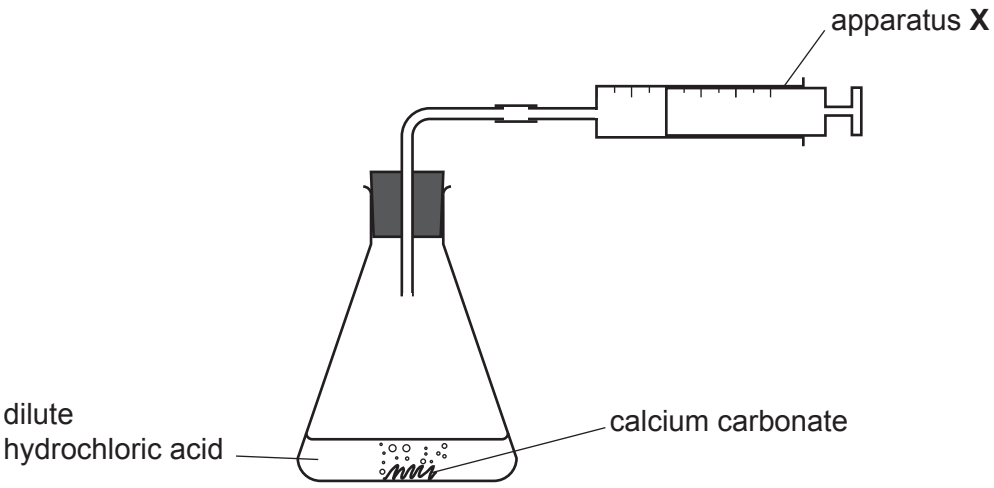

Fig. 8.1

(a) State the name of apparatus **X**.

..... [1]

(b) Suggest **one** piece of apparatus that is **not** shown in Fig. 8.1 which the student needs to investigate the rate of this reaction.

..... [1]

(c) Complete the word equation for this reaction.

calcium carbonate	+	hydrochloric acid	→		+		+	

[2]

(d) The student repeats the experiment using the same mass of calcium carbonate and the same volume of dilute hydrochloric acid.

(i) Suggest **one** change that the student makes to the **calcium carbonate** to increase the rate of the reaction.

..... [1]

(ii) Suggest **one** change that the student makes to the **hydrochloric acid** to increase the rate of the reaction.

..... [1]

(e) A type of calcium atom has the symbol shown.

$$^{36}_{20}Ca$$

(i) Deduce the number of neutrons in this atom.

..... [1]

(ii) Deduce the number of electrons in one Ca^{2+} ion.

..... [1]

[Total: 8]

9 Fig. 9.1 shows two identical lamps connected to a 1.5 V cell.

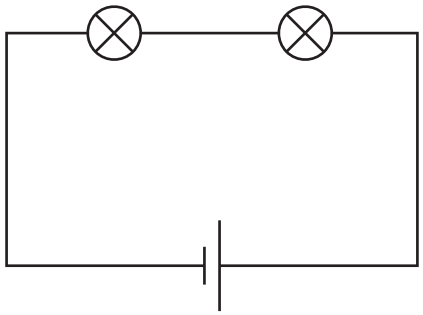

Fig. 9.1

(a) (i) State the type of circuit arrangement of the lamps in Fig. 9.1.

..... [1]

(ii) The resistance of one lamp is 5.5 Ω.

Calculate the current in the circuit.

State the unit of your answer.

current = ... unit ..... [4]

(iii) One of the lamps in Fig. 9.1 breaks.

State what happens to the other lamp.

Give a reason for your answer.

.....

..... [1]

(b) Fig. 9.2 shows a different circuit containing the same lamps and 1.5 V cell.

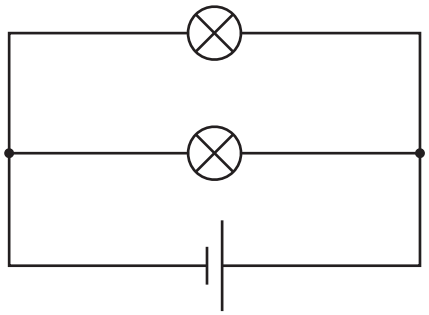

Fig. 9.2

State **one** advantage of the arrangement of lamps shown in Fig. 9.2.

.....

..... [1]

(c) Fig. 9.3 shows an incomplete circuit.

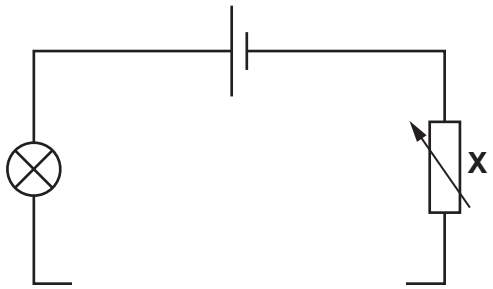

Fig. 9.3

(i) State the name of the component labelled **X** on Fig. 9.3.

..... [1]

(ii) A student wants to measure the current in the circuit.

On Fig. 9.3:

- add the symbol for an instrument to measure the current
- complete the circuit.

[2]

[Total: 10]

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The Periodic Table of Elements

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 –		

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.).