Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

8571968374

COMBINED SCIENCE **0653/31**

Paper 3 Theory (Core) **May/June 2020**

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. Blank pages are indicated.

DC (DH/FC) 192153/4

1 **(a)** Fig. 1.1 shows the structure of a human heart.

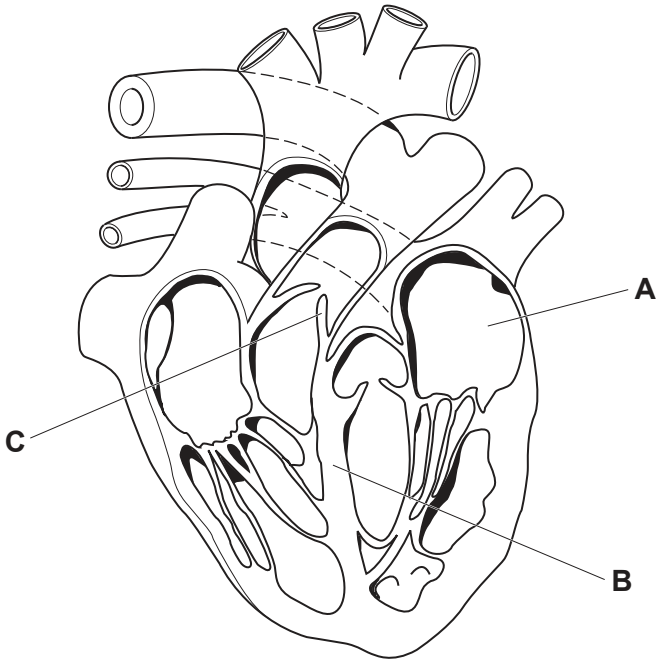

Fig. 1.1

(i) Identify parts **A** and **B** shown in Fig. 1.1.

A .....

B .....
[2]

(ii) Identify part **C** shown in Fig. 1.1.

..... [1]

(iii) Describe the importance of part **C** to the flow of blood through the heart.

.....

..... [1]

(b) Complete Table 1.1 to show the function of different components of blood.

Table 1.1

components of blood	function
	produces antibodies
	transport hormones
platelets	

[3]

(c) Blood transports carbon dioxide around the body.

(i) Name the process in the body that produces carbon dioxide.

..... [1]

(ii) Carbon dioxide moves from the cells into the blood.

Complete the sentences to describe how carbon dioxide **moves out** of a cell into the blood.

The concentration of carbon dioxide is ..... inside the cell than in the blood.

This causes carbon dioxide to move out of the cell by ..... . [2]

[Total: 10]

2 **(a)** A teacher uses the apparatus shown in Fig. 2.1.

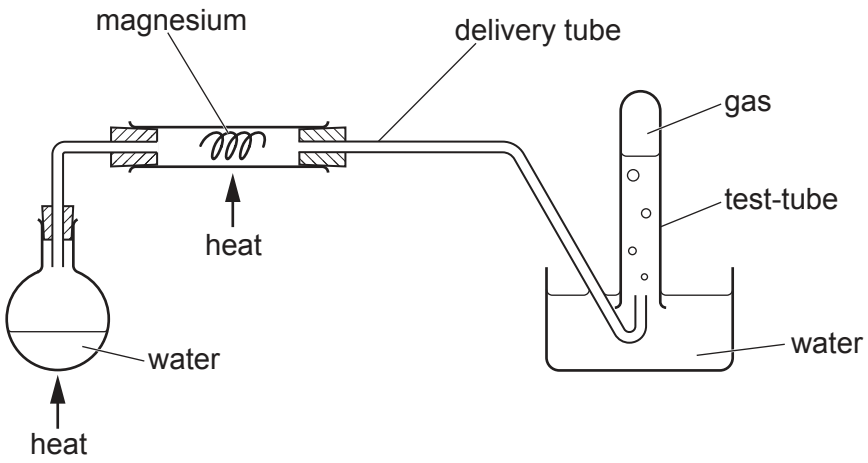

Fig. 2.1

The teacher heats the water to make steam.

The steam passes over heated magnesium.

The magnesium burns brightly. A white solid and a gas form.

The gas is collected in a test-tube. The teacher tests the gas using a lighted splint. It burns with a squeaky pop.

(i) Identify **one** chemical change and **one** physical change in the teacher's experiment.

chemical change .....

physical change .....

[2]

(ii) Give the chemical names for the white solid and the gas that form.

white solid .....

gas .....

[2]

(b) An atom of sodium can be represented by the symbol shown.

$$^{23}_{11}Na$$

Deduce the number of protons and the number of neutrons in this atom.

protons .....

neutrons .....

[2]

(c) The electronic structure of a sodium atom is shown in Fig. 2.2.

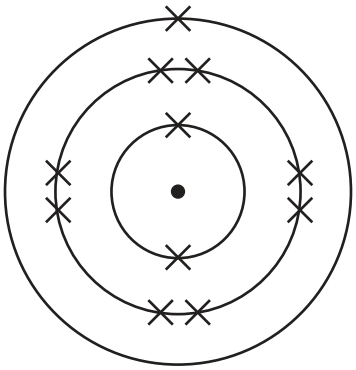

Fig. 2.2

Sodium reacts with chlorine to make sodium chloride.

Sodium chloride contains sodium ions, Na^+, and chloride ions, Cl^-.

(i) State the change to the electronic structure of sodium atoms when sodium reacts with chlorine.

..... [1]

(ii) State which feature of the electronic structure of the sodium ion, Na^+, makes the ion stable.

.....

..... [1]

[Total: 8]

3 Fig. 3.1 shows a rocket about to transport a large mirror into orbit around the Earth.

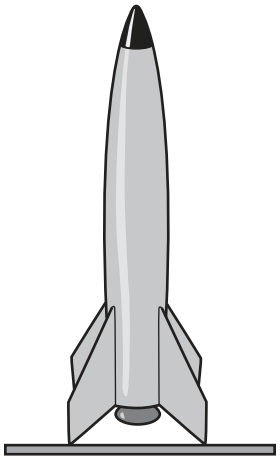

Fig. 3.1

(a) The total mass of the rocket is 750 000 kg.

(i) The Earth's gravitational field strength is 10 N / kg.

Calculate the weight of the rocket.

weight = ... N [1]

(ii) When the rocket is launched, the force exerted on the rocket is 12 000 000 N vertically upwards.

Calculate the resultant force on the rocket.

State the direction of the resultant force.

resultant force = ... N

direction is .....
[2]

(iii) Describe the motion of the rocket as it leaves the Earth.

..... [1]

(b) The rocket is powered by a fuel. The fuel is a store of chemical potential energy.

As the rocket moves upwards, large flames can be seen coming out of the back of the rocket.

The ground crew wear ear protection for their hearing as the rocket rises off the ground.

Use this information to identify **three** forms of energy resulting from the launch of the rocket.

1. ..... energy

2. ..... energy

3. ..... energy
[3]

(c) In space, the rocket places a large mirror in orbit so that it reflects sunlight down to a solar panel on Earth.

Fig. 3.2 shows how the mirror is placed to reflect sunlight to a solar panel on Earth at night.

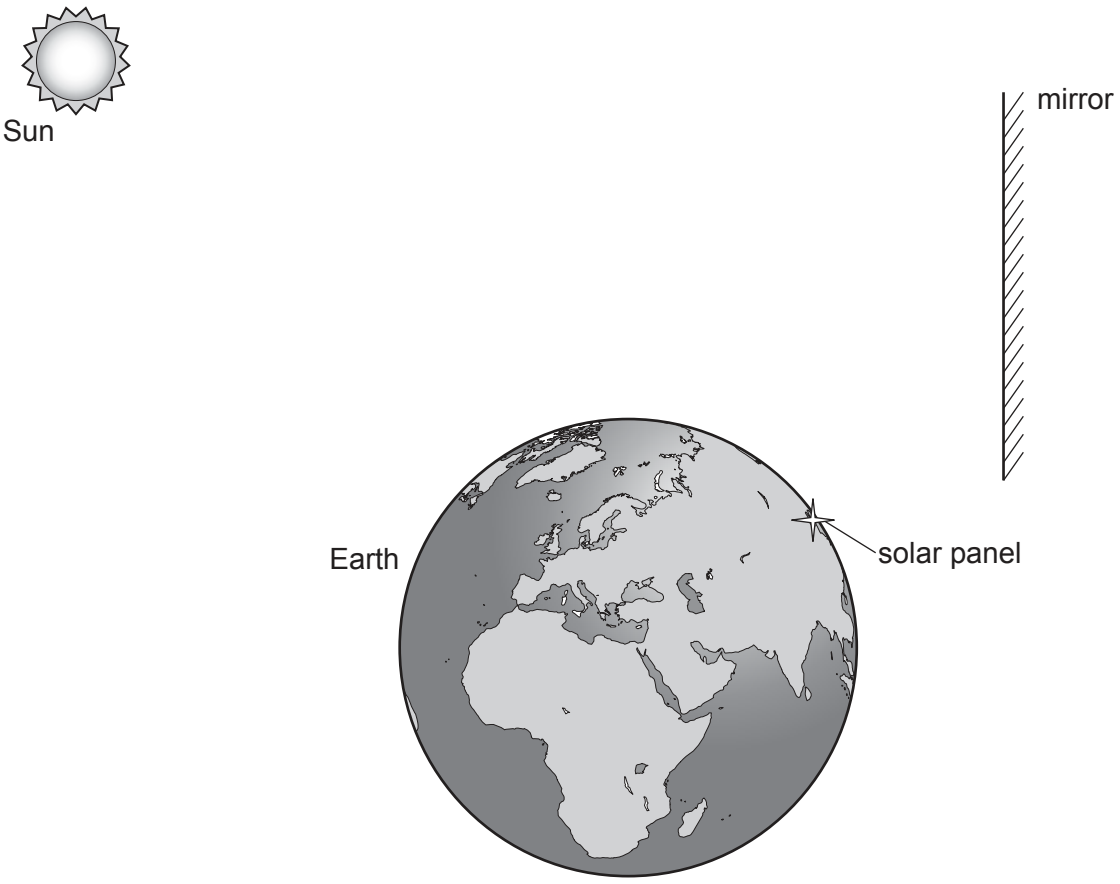

Fig. 3.2 (not to scale)

On Fig. 3.2, draw a ray to show how the mirror can reflect sunlight to the solar panel. [2]

[Total: 9]

4 **(a)** Fig. 4.1 is a graph showing the vitamin C content in 100 g of different foods.

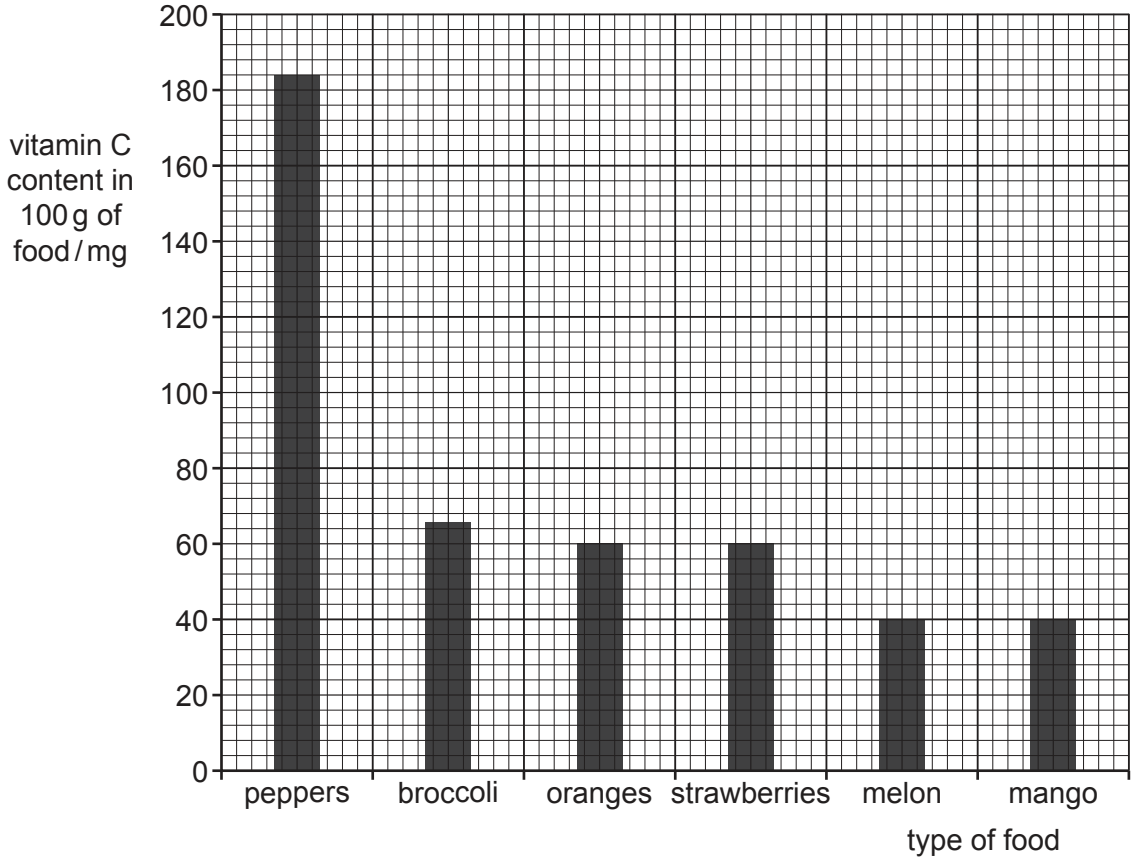

Fig. 4.1

(i) Name **two** foods from Fig. 4.1 that contain exactly 60 mg of vitamin C in 100 g of the food.

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

(ii) Calculate the mass of mango needed to provide 80 mg of vitamin C.

mass = ... g [2]

(b) Fig. 4.2 shows the names and functions of some parts of the human alimentary canal.

Draw **one** line from the name of each part to its correct function.

name	function
anus	absorption
liver	ingestion
mouth	produces bile
small intestine	egestion

Fig. 4.2

[3]

(c) (i) Proteins and carbohydrates are made up of chemical elements.

List the chemical elements found in **both** proteins and carbohydrates.

..... [1]

(ii) Proteins are digested by the enzyme pepsin.

Pepsin works best in the stomach.

The pH of the stomach is pH 2.

Complete Fig. 4.3 by sketching a curve to show how the activity of the enzyme pepsin changes with pH.

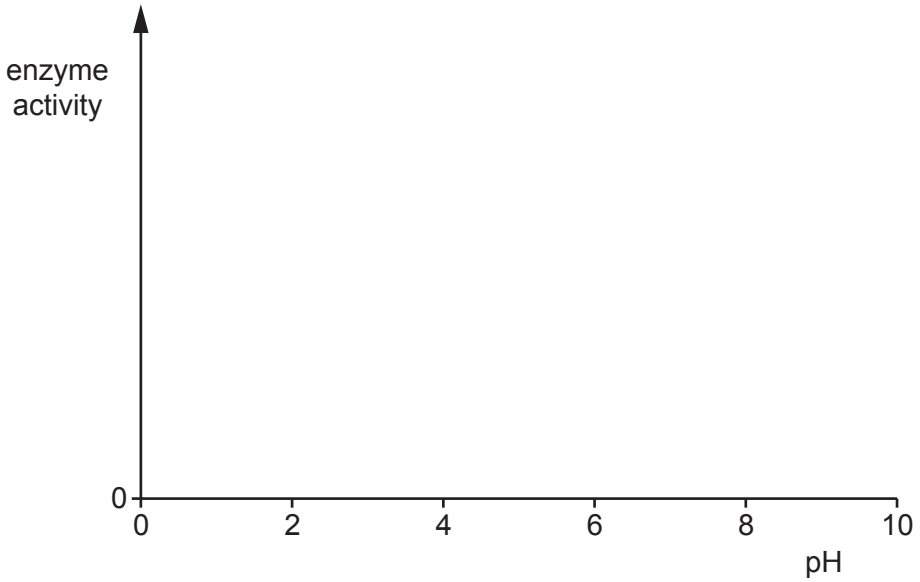

Fig. 4.3

[2]

(iii) Proteins are made from small molecules that have reacted together.

Name these small molecules.

..... [1]

[Total: 10]

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5 **(a)** Petroleum is separated using the process shown in Fig. 5.1.

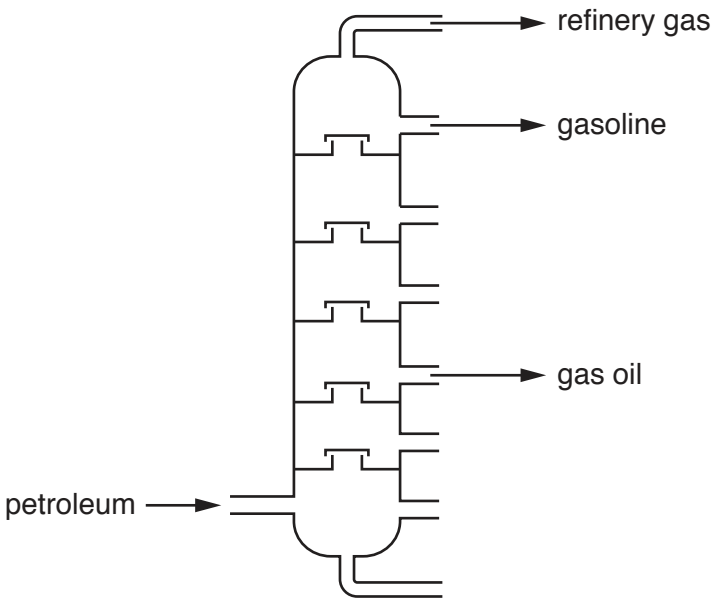

Fig. 5.1

(i) Name the process shown in Fig. 5.1.

..... [1]

(ii) Refinery gas and gas oil can be used as fuels.

State **one** use for each of these fuels.

refinery gas .....

gas oil .....
[2]

(iii) Identify the greenhouse gas that forms during the complete combustion of gasoline.

..... [1]

(b) Petroleum is a mixture of hydrocarbon molecules called alkanes.

(i) Explain what is meant by *hydrocarbon*.

.....

..... [2]

(ii) State the name of a process used to produce alkenes.

..... [1]

(iii) Describe the difference between the bonding in alkanes and in alkenes.

.....

..... [1]

(iv) Many ethene molecules combine to form poly(ethene).

State the type of addition reaction that occurs.

..... [1]

[Total: 9]

6 Fig. 6.1 shows a bucket of crushed ice used to cool drinks.

A thermometer is placed in the ice to check the temperature, and a glass bottle containing a drink is placed in the ice to cool.

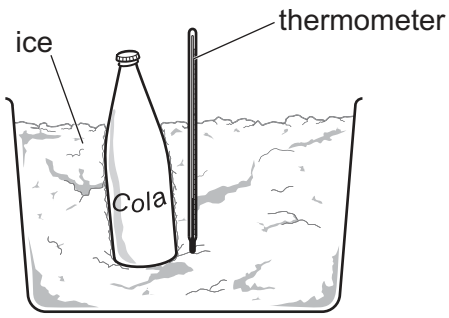

Fig. 6.1

The temperature of the ice when it is put in the bucket is –15 °C.

The temperature of the drink before it is placed in the ice is 20 °C.

(a) Calculate the temperature difference between the ice and the drink at the start.

temperature difference = ... °C [1]

(b) After 5 minutes the contents of the bucket are stirred and the temperature of the ice is taken again. The thermometer reading is –10 °C.

State the names of **two** ways in which thermal energy has been transferred from the drink inside the bottle to the ice.

1. .....

2. .....
[2]

(c) Fig. 6.2 shows a graph of how the temperature of the ice in the bucket changes over 30 minutes as the drink is cooled.

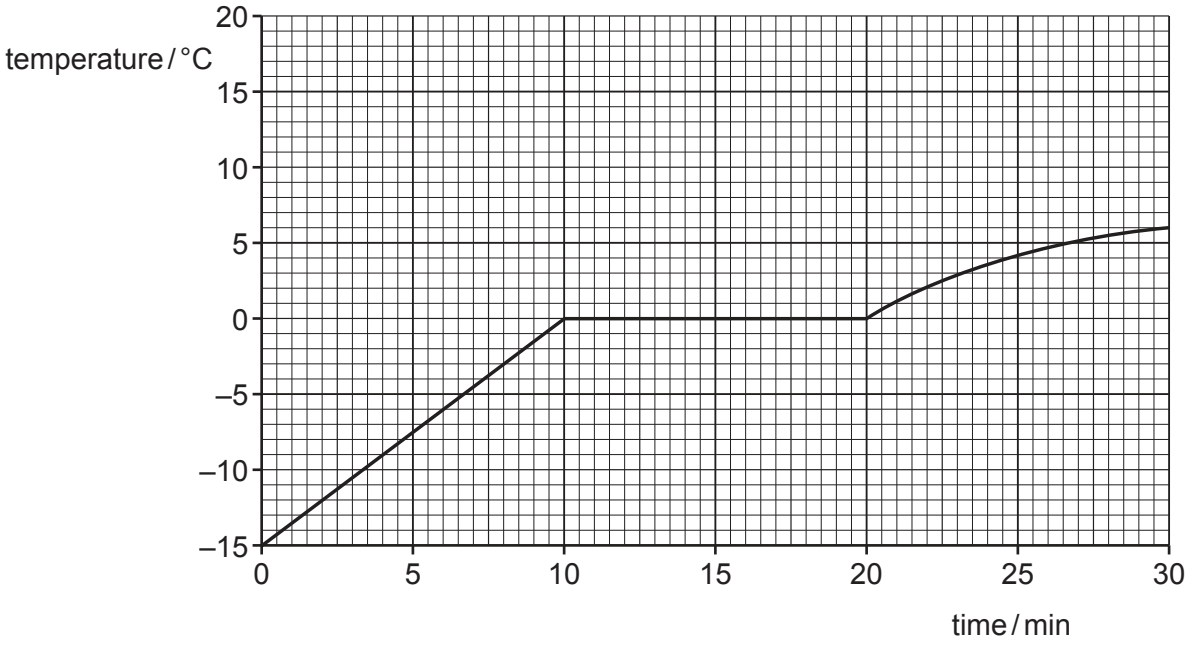

Fig. 6.2

(i) State what is happening to the ice in the bucket between 10 and 20 minutes.

..... [1]

(ii) On Fig. 6.2, sketch a graph to show how the temperature of the drink in the bottle changes over the 30 minutes it is cooling in the ice bucket. [2]

(d) At the start, the total mass of the bucket, ice and bottle of drink is 2.25 kg.

(i) Predict the total mass of the bucket, ice and bottle of drink after 30 minutes.

Give a reason for your answer.

total mass = ... kg

reason .....

..... [1]

(ii) The ice placed in the bucket is made from a block of mass 400 g.

The volume of the block of ice is 436 cm^3.

Calculate the density of the ice.

density = ... g/cm^3 [2]

[Total: 9]

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

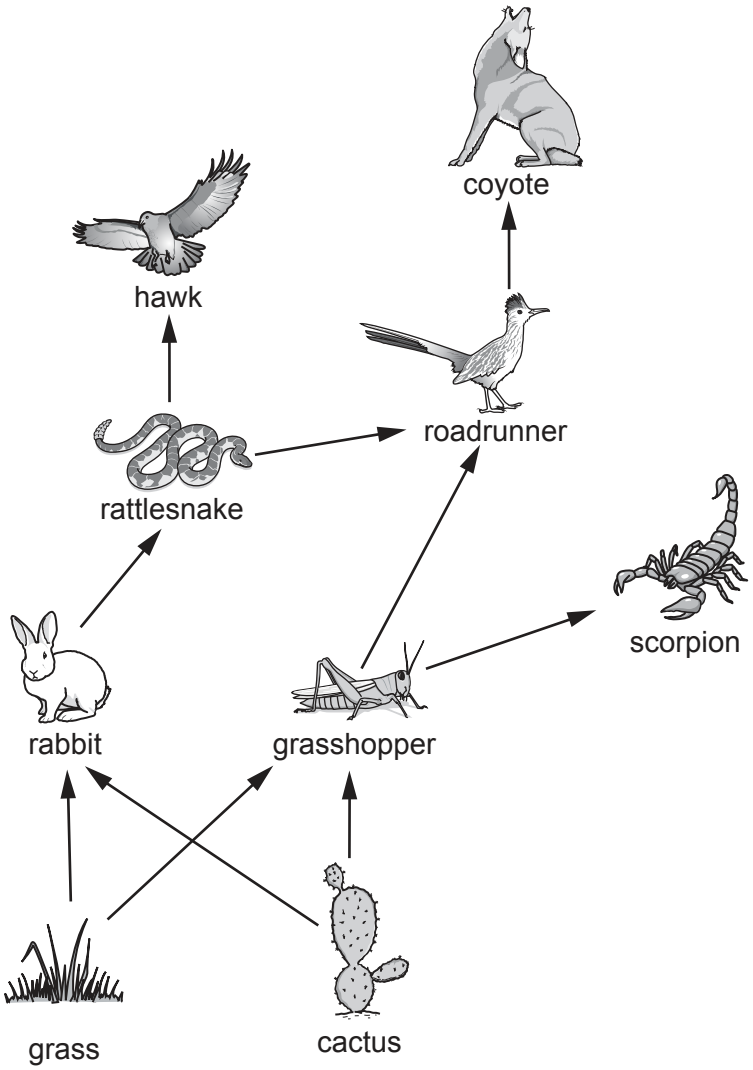

Fig. 7.1

(i) The food web is **not** complete.

Scorpions are eaten by roadrunners.

Use this information to complete the food web in Fig. 7.1 by drawing **one** arrow. [1]

(ii) Identify **one** tertiary consumer from the food web in Fig. 7.1.

..... [1]

(iii) One year the number of rattlesnakes decreases.

This leads to a decrease in the number of grasshoppers.

Explain why using the information in Fig. 7.1.

.....

.....

.....

..... [2]

(b) Fig. 7.2 is a diagram of a cactus growing in a desert.

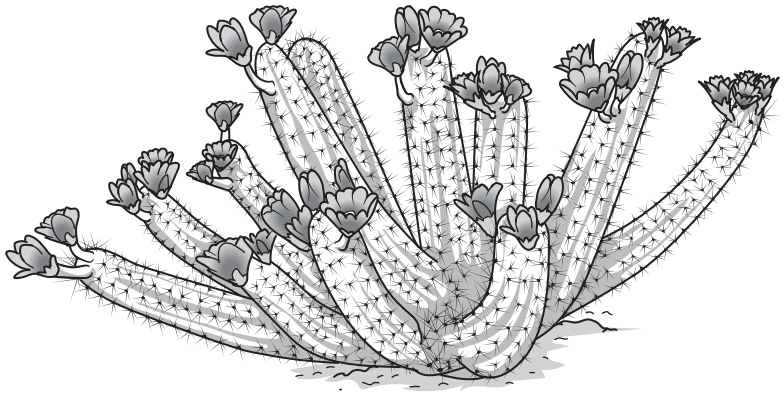

Fig. 7.2

The cactus is a flowering plant.

A bird feeds on the nectar produced by the flowers. As it feeds, pollen sticks to the bird and can be moved from one flower to another.

Complete the sentences using words from the list.

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

agent **anther** **catalyst** **ovule**

petals **sepals** **stigma**

The cactus flower is pollinated when pollen is transferred to the ..... .

The bird is the ..... of pollination.

The flower has nectar and coloured ..... to attract the bird. [3]

[Total: 7]

8 Period 4 of the Periodic Table is shown in Fig. 8.1. It contains the elements from potassium, K, to krypton, Kr.

Group																	
I	II											III	IV	V	VI	VII	VIII
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	**Ca**	**Sc**	**Ti**	**V**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**	**Ga**	**Ge**	**As**	**Se**	**Br**	**Kr**
potassium	calcium	scandium	titanium	vanadium	chromium	manganese	iron	cobalt	nickel	copper	zinc	gallium	germanium	arsenic	selenium	bromine	krypton
39	40	45	48	51	52	55	56	59	59	64	65	70	73	75	79	80	84

Key

atomic number
atomic symbol
name
relative atomic mass

Fig. 8.1

(a) State the trend in the metallic character of the elements from potassium to krypton.

..... to ..... [1]

(b) Iron is in a collection of elements between calcium, Ca, and gallium, Ga, in period 4.

These elements have high densities and form coloured compounds.

(i) State the name of this collection of elements.

..... [1]

(ii) Describe **one** other property shown by these elements.

..... [1]

(c) Chlorine is a gas in Group VII.

It is made by passing electricity through an aqueous salt.

(i) Name the process which uses electricity to break down an aqueous salt.

..... [1]

(ii) Suggest **one** aqueous salt that is used to make chlorine in this process.

..... [1]

(iii) Describe a chemical test for chlorine and the positive result for this test.

test .....

result .....
[2]

(iv) State the name of the collection of elements in Group VII.

..... [1]

(d) Krypton is a gas in Group VIII (Group 0) in the Periodic Table.

Complete the sentence about this group.

The Group VIII (Group 0) gases are known as the ..... gases. [1]

[Total: 9]

9 Fig. 9.1 shows a mobile (cell) phone and a loudspeaker.

The mobile phone transmits a signal to the loudspeaker.

The loudspeaker converts the signal into sound.

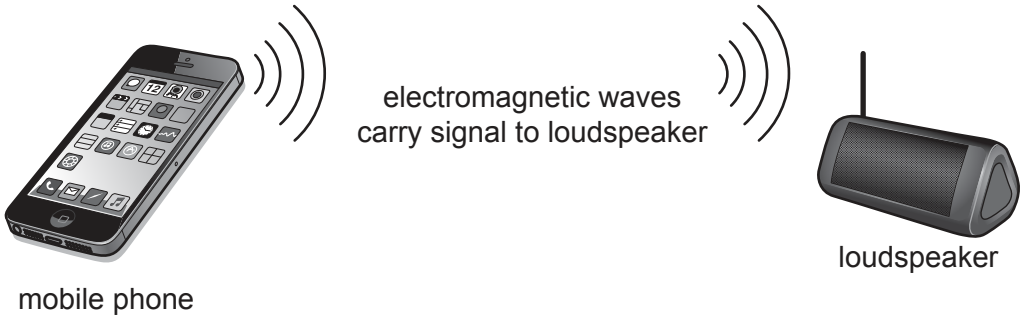

Fig. 9.1

(a) Electromagnetic waves of frequency 2.4×10^9 Hz are used to carry the signal from the mobile phone to the loudspeaker.

(i) Fig. 9.2 shows the approximate ranges of frequency for each type of electromagnetic wave.

more than 10^{19} Hz	10^{19} to 10^{17} Hz	10^{17} to 10^{15} Hz	10^{15} to 10^{14} Hz	10^{14} to 10^{11} Hz	10^{11} to 10^{9} Hz	less than 10^{9} Hz
gamma radiation	X-rays	ultraviolet	visible light	infrared	microwaves	radio waves

Fig. 9.2

Use the information in Fig. 9.2 to identify the type of electromagnetic wave used to carry the signal to the loudspeaker.

..... [1]

(ii) The loudspeaker can be switched on and off using a remote controller.

State the type of electromagnetic wave transmitted by a remote controller.

..... [1]

(b) The loudspeaker is operated by an alternating current (a.c.) supply.

A lamp is connected in parallel with the loudspeaker.

A switch is used to switch on both the lamp and the loudspeaker.

(i) On Fig. 9.3, complete the circuit diagram to show how the loudspeaker, lamp and switch are connected.

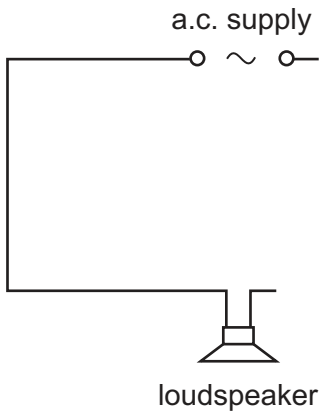

Fig. 9.3

[3]

(ii) The loudspeaker requires a current of 0.80 A.

The power supply provides a voltage of 20 V across the loudspeaker.

Calculate the resistance of the loudspeaker.

Give the unit of your answer.

resistance = ... unit ..... [3]

(c) The alternating current supply has a frequency of 50 Hz.

When the speaker is switched on, but no signal is being received, sound waves of frequency 50 Hz are emitted from the loudspeaker.

Suggest whether a person near the loudspeaker will hear these sound waves.

Give a reason for your answer.

.....

.....

..... [1]

[Total: 9]

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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.).