



CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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0653/31

October/November 2021

1 hour 15 minutes

No additional materials are needed.

- 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.

- 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) Fig. 1.1 is a diagram of the circulatory system in humans.

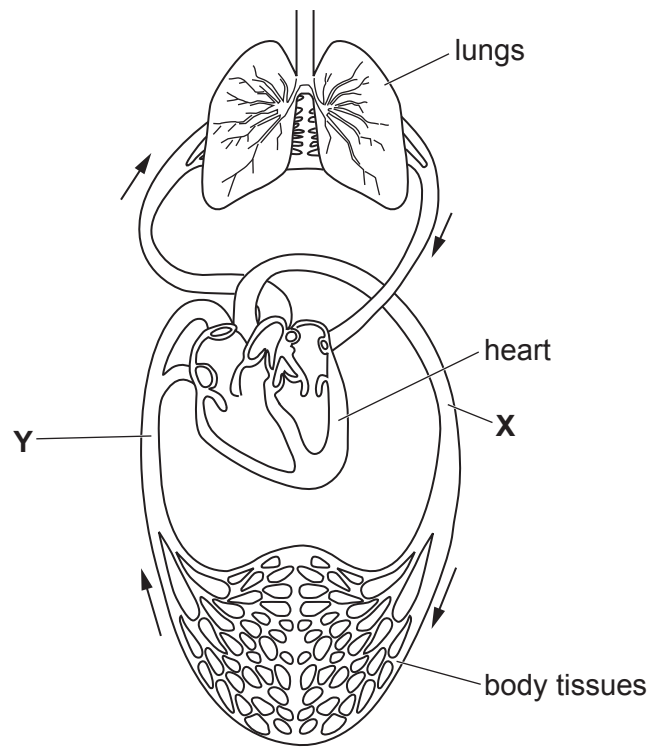


Fig. 1.1

- (i) The arrows show the direction of blood flow through the blood vessels.

Blood vessels **X** and **Y** are two of the main blood vessels attached to the heart.

Identify blood vessels **X** and **Y** shown in Fig. 1.1.

X

Y

[2]

- (ii) State the function of the heart.

..... [1]

- (iii) Circle the name of the tube that connects the lungs to the nose and mouth.

alveoli

bronchi

bronchiole

larynx

trachea

[1]

(b) Complete these sentences about the blood.

Choose words from the list.

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

chlorophyll

glucose

haemoglobin

nitrogen

oxygen

phagocytosis

egestion

There are two types of blood cells, red blood cells and white blood cells.

Red blood cells transport the gas, ...

The gas binds to a chemical in red blood cells called

White blood cells produce antibodies.

White blood cells are also involved in the process of

[3]

(c) Fig. 1.2 shows the pulse rate of a person doing different activities.

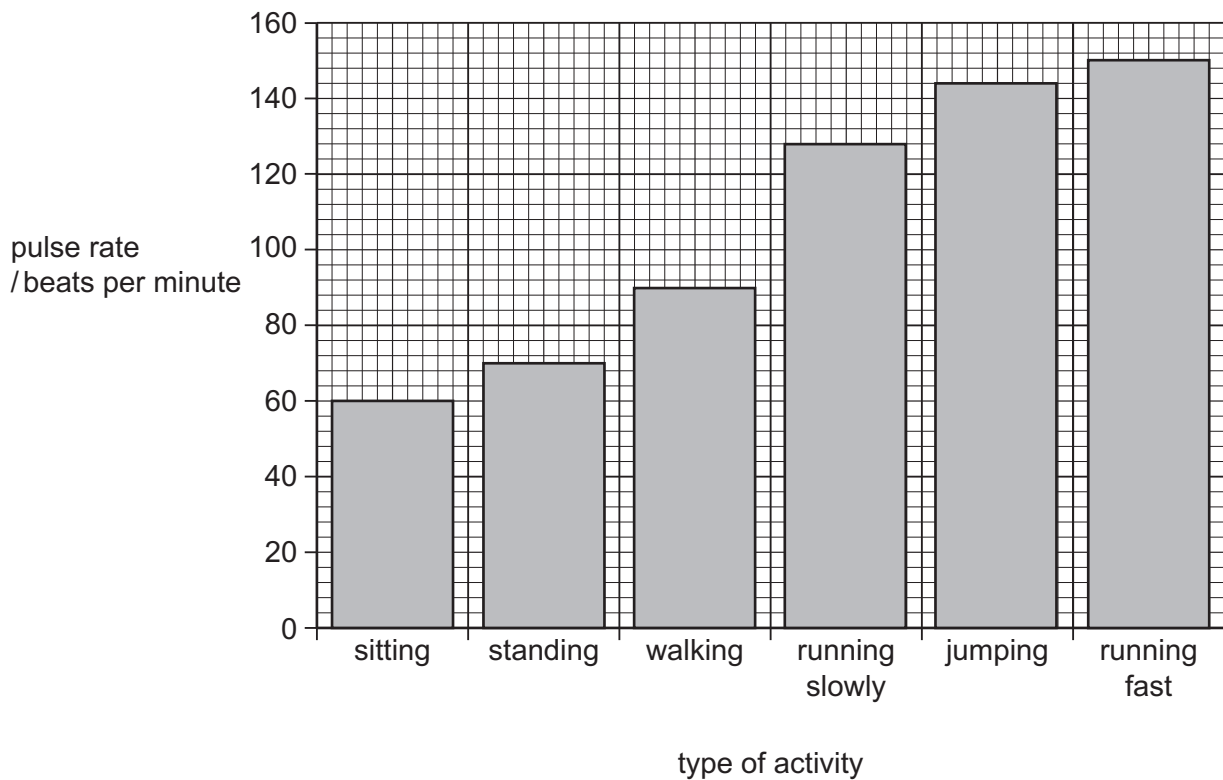


Fig. 1.2

- (i) Place a tick (✓) in **one** box to show the activity that results in a pulse rate of between 120 and 140 beats per minute.

jumping	☐	sitting	☐
running fast	☐	standing	☐
running slowly	☐	walking	☐

[1]

- (ii) Calculate the difference in pulse rate between sitting and running fast.

pulse rate sitting = ... beats per minute

pulse rate running fast = ... beats per minute

difference in pulse rate = ... beats per minute

[2]

- (iii) Describe how the person's **breathing** is different when walking compared to jumping.

.....

.....

[2]

[Total: 12]

- 2 (a) The order of reactivity for some metals is shown in Fig. 2.1.

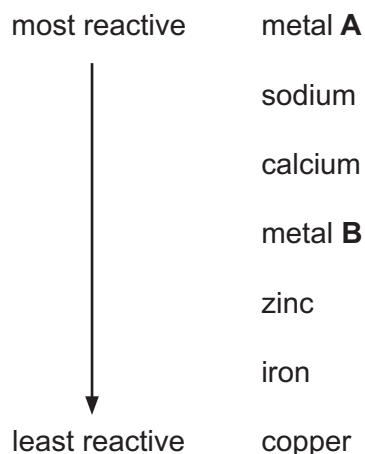


Fig. 2.1

- (i) Suggest the identities of metals A and B.

A

B

[1]

- (ii) State **two** observations for the reaction of sodium with water.

1

2

[2]

- (b) Sodium is in Group I of the Periodic Table.

Iron is a transition element.

Describe **two** physical properties of iron that show that it is different from sodium.

1

2

[2]

- (c) Brass is an alloy of zinc and one other metal.

State the name of this other metal.

..... [1]

- (d) Recycling metals uses less energy and costs less money than extracting the metals from their ores.

State **one** other reason why metals need to be recycled.

.....

..... [1]

(e) Sodium and chlorine react together in an exothermic reaction to form sodium chloride.

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

.....
 [1]

(ii) Fig. 2.2 shows the electronic structures of a sodium **ion**, Na^+ , and a chloride **ion**, Cl^- , in sodium chloride.

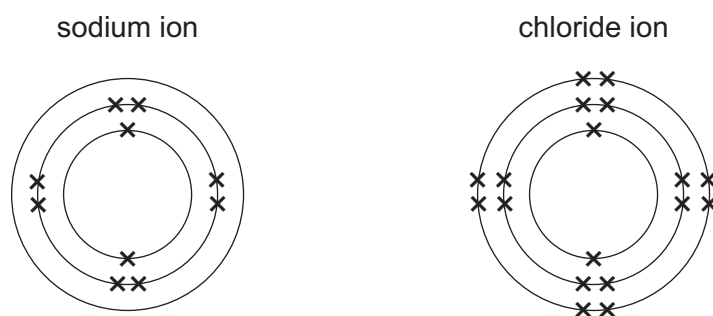


Fig. 2.2

Complete Fig. 2.3 to show the electronic structures of a sodium **atom**, Na , and a chlorine **atom**, Cl .

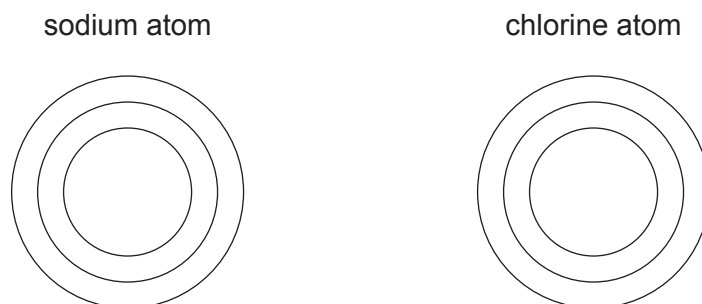


Fig. 2.3

[2]

[Total: 10]

3 (a) Fig. 3.1 shows a wave.

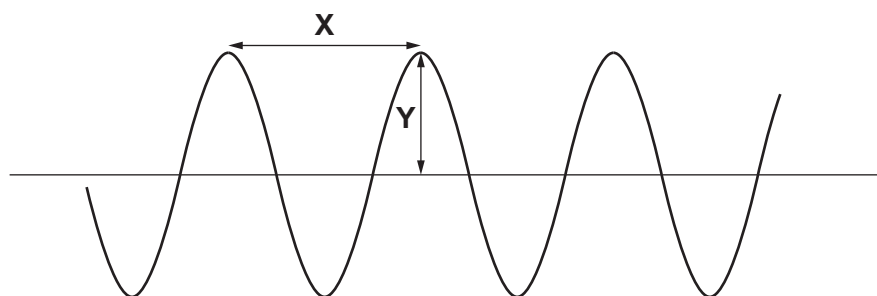


Fig. 3.1

Use Fig. 3.1 to complete the two sentences about the wave.

- **X** shows the of the wave.
- **Y** shows the of the wave.

[2]

(b) Table 3.1 shows the frequency ranges of sounds emitted by different species of whale.

Table 3.1

species	frequency range / Hz
beluga whale	40–60 000
blue whale	10–39
dwarf minke whale	50–9 400
fin whale	16–40

State which species of whale emits sounds that are **all** heard by a healthy human ear.

Give a reason for your answer.

species of whale

reason

.....

[2]

(c) A whale is swimming at a constant speed.

(i) State the size of the resultant force on the whale.

Give a reason for your answer.

resultant force = ... N

reason

.....

[1]

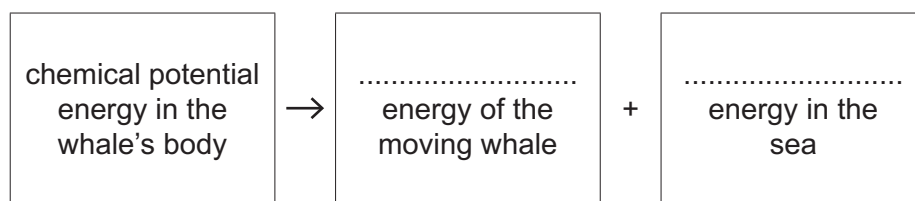
(ii) The whale swims at a constant speed of 6.1 m/s for 15 minutes.

Calculate the distance the whale travels in this time.

distance = ... m [3]

(iii) Energy is transferred while the whale is swimming.

Complete the boxes to show the energy transfers that take place.



[2]

[Total: 10]

- 4 (a) Table 4.1 shows the names and functions of some organs associated with the alimentary canal.

Complete Table 4.1.

Table 4.1

organ	function
pancreas	produces enzymes used in the intestine for digestion
.....	produces bile which is stored in the gall bladder
salivary gland	makes saliva and releases it into the for digestion

[3]

- (b) Enzymes in saliva break down large starch molecules into smaller glucose molecules.

- (i) Glucose is a reducing sugar.

State the name of the test solution used to identify the presence of a reducing sugar in food.

..... [1]

- (ii) Circle the name of **one** other large molecule made from glucose molecules.

amino acids fatty acids glycerol glycogen

[1]

- (c) Food labels show the quantities of nutrients found in the food.

Fig. 4.2 shows a food label from a box of burgers.

Each grilled burger (94 g) contains

Energy	Fat	Saturated fat	Sugars	Salt
898 kJ	12 g	5.8 g	0.7 g	0.6 g

Fig. 4.2

- (i) A person eats **two** burgers.

Calculate the mass of salt the person eats.

..... g [1]

- (ii) The label does **not** show a value for fibre.

State the importance of eating fibre in a balanced diet.

.....
 [1]

[Total: 7]

- 5 (a) The boxes on the left of Fig. 5.1 show some separation and collection methods.

The boxes on the right of Fig. 5.1 show some substances and the mixtures they come from.

Complete Fig. 5.1 to show the method used to separate and collect each substance from its mixture.

Draw one line from each box on the left to one box on the right.

Distillation of water from salty water has been done as an example for you.

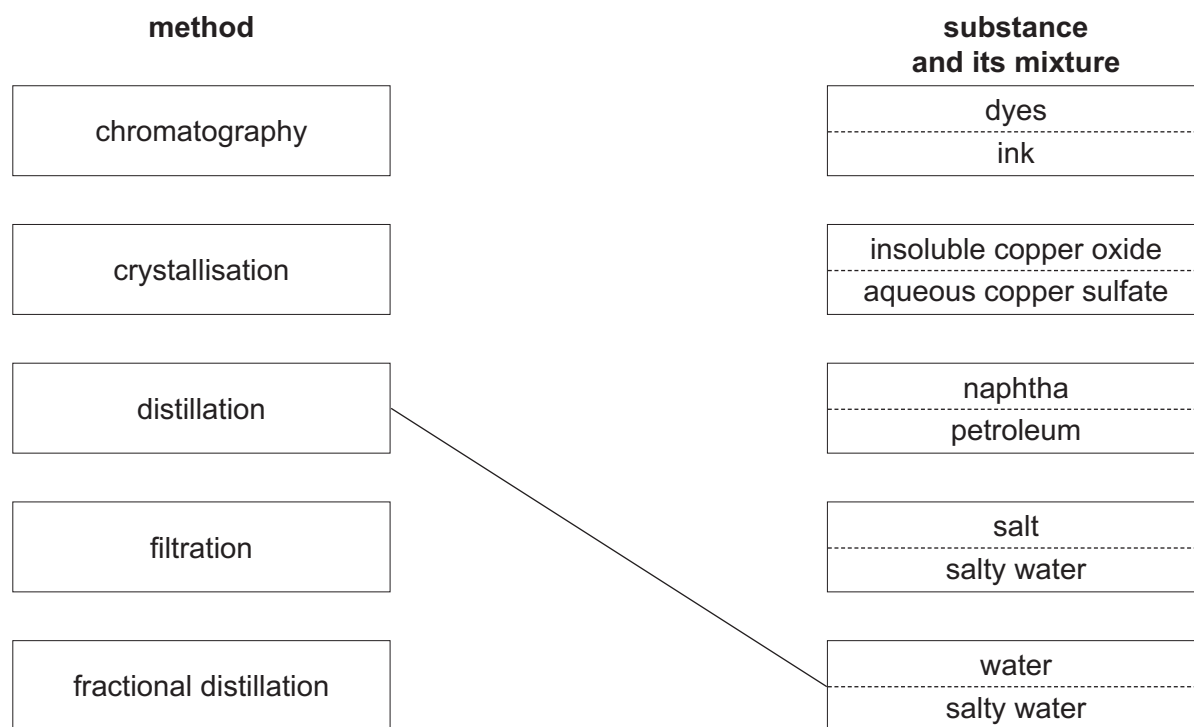


Fig. 5.1

[2]

- (b) Evaporation is also used to separate some mixtures.

During evaporation, a liquid becomes a gas.

- (i) Explain why evaporation is a physical change and **not** a chemical change.

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

- (ii) Describe how the structure of a gas is different to the structure of a liquid in terms of particle arrangement and particle motion.

particle arrangement
.....
particle motion
..... [2]

- (c) Copper sulfate and water are made when copper oxide reacts with an acid.

State the name of this acid.

..... [1]

- (d) State **one** use for naphtha.

..... [1]

[Total: 7]

- 6 Fig. 6.1 shows a gas flame being used to heat a metal kettle of water until the water boils.

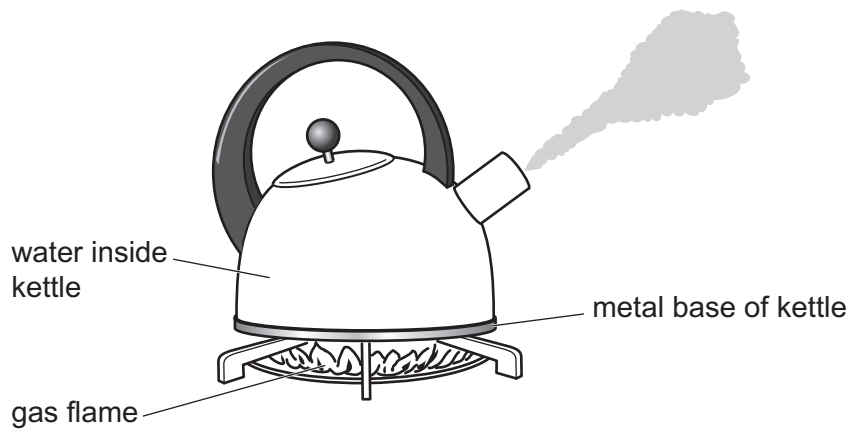


Fig. 6.1

- (a) (i) State the boiling point of water in degrees Celsius.

..... °C [1]

- (ii) Identify the main method of thermal energy transfer:

- through the metal base of the kettle
- through the water in the kettle

[2]

- (b) Natural gas is a non-renewable source of energy.

State two **renewable** sources of energy.

1

2

[2]

- (c) Fig. 6.2 shows a student standing in front of a plane mirror. The student is pouring water from the kettle into a cup.

There is an image of the student in the plane mirror.

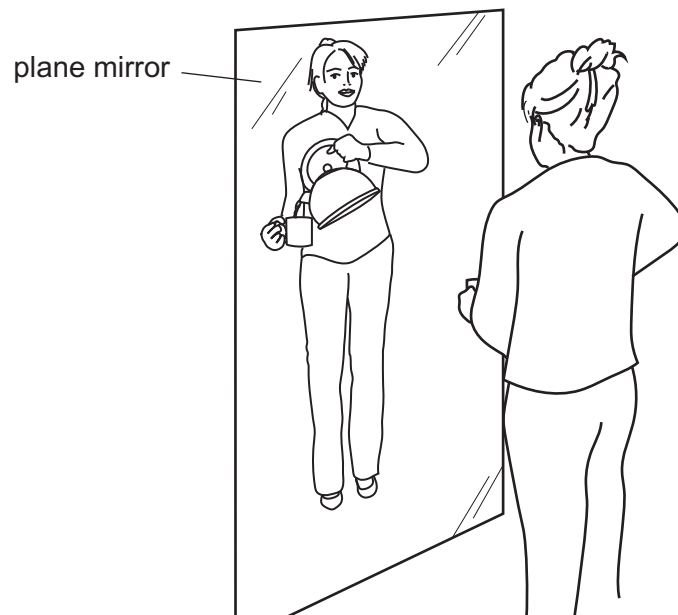


Fig. 6.2

The image of the student in the mirror is *laterally inverted*.

This lateral inversion is a *characteristic* of the image.

- (i) Describe how Fig. 6.2 shows that the image of the student is *laterally inverted*.

.....

.....

..... [2]

- (ii) State **one** other *characteristic* of the image in the mirror.

..... [1]

[Total: 8]

- 7 (a) Fig. 7.1 shows the life cycle of a plant.

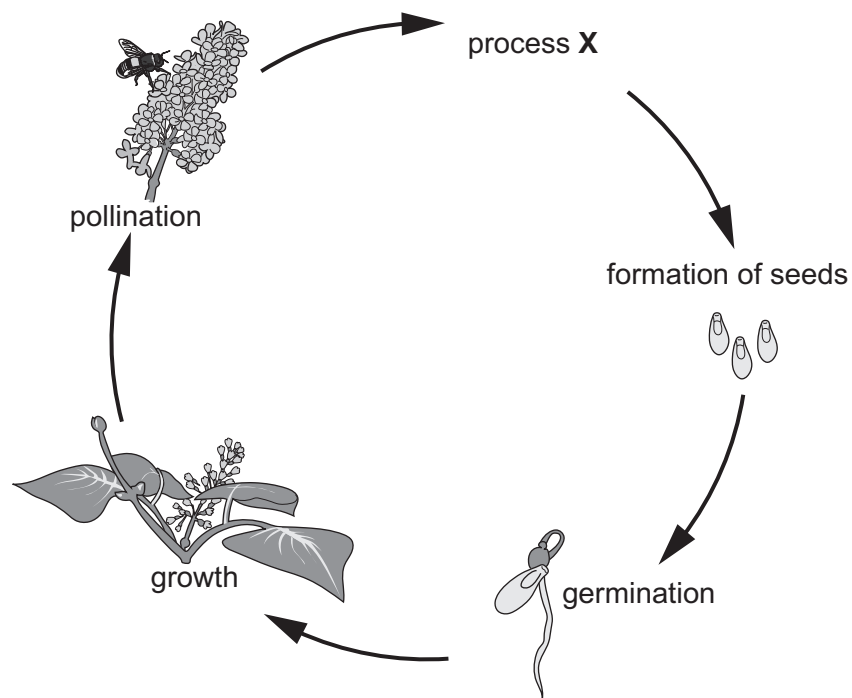


Fig. 7.1

- (i) Identify process X in Fig. 7.1.

..... [1]

- (ii) Explain why plants need amino acids for growth.

.....
.....
..... [2]

(b) Fig. 7.2 shows some of the parts of an insect-pollinated flower.

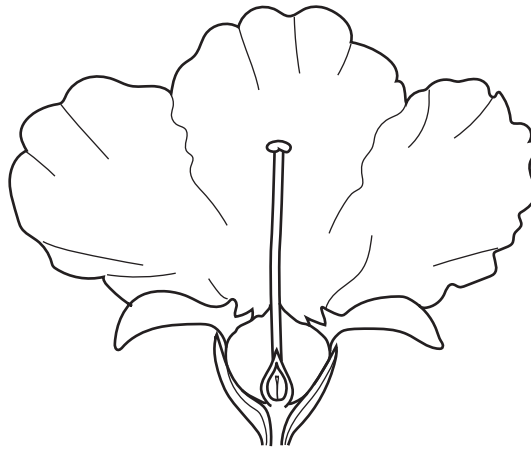


Fig. 7.2

(i) On Fig. 7.2, draw a label line and the letter **P** to show where pollination occurs. [1]

(ii) The male parts of the flower are **not** visible in Fig. 7.2.

State the name of **one** male part of the flower **not** visible in Fig. 7.2.

..... [1]

(c) Plants can also reproduce asexually.

Complete these sentences to define the term asexual reproduction.

Asexual reproduction is a process resulting in the production of

identical offspring from parent.

[2]

(d) The roots of a plant grow down into the ground in response to gravity.

State the name of this response.

..... [1]

[Total: 8]

8 Methane, CH_4 , is a hydrocarbon.

(a) State what is meant by *hydrocarbon*.

.....
..... [2]

(b) Methane is an alkane. An alkane contains only single covalent bonds.

Fig. 8.1 is a dot-and-cross diagram of a molecule of methane, CH_4 . Only the outer shell electrons are shown.

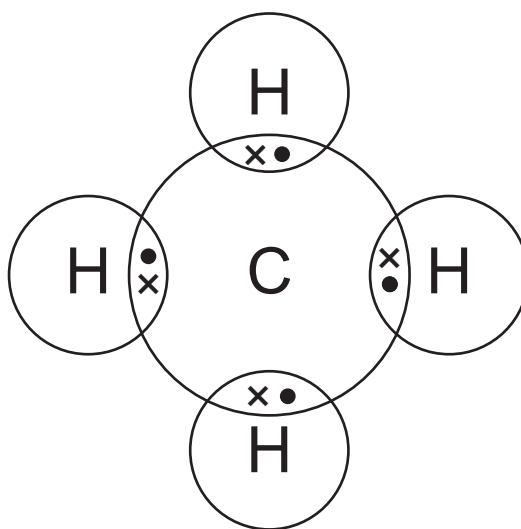


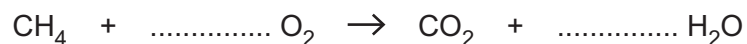
Fig. 8.1

Use Fig. 8.1 to describe what is meant by *single covalent bonds*.

.....
.....
..... [2]

(c) The complete combustion of methane produces carbon dioxide and water.

(i) Balance the equation for the complete combustion of methane.



[2]

(ii) State and explain whether the carbon in methane is oxidised or reduced in this reaction.

carbon

explanation

.....

[1]

(iii) Explain why argon, a noble gas, does not react with oxygen.

Use ideas about electronic structure in your answer.

.....

..... [1]

(d) Describe how the bonding in alkenes is different from the bonding in alkanes.

.....

..... [1]

[Total: 9]

- 9 Fig. 9.1 shows three identical resistors, **E**, **F** and **G**, connected to a battery and an ammeter.

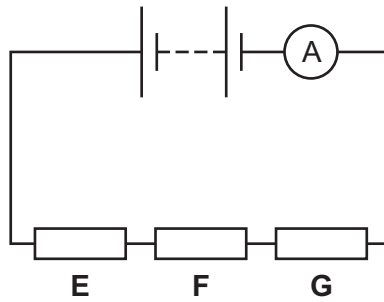


Fig. 9.1

- (a) The resistors each have a resistance of $10\ \Omega$.

- (i) Calculate the combined resistance of resistors **E**, **F** and **G** in this circuit.

resistance = ... Ω [1]

- (ii) The ammeter reading is 0.12 A .

Calculate the potential difference across the three resistors.

State the unit of your answer.

potential difference = ... unit [3]

- (b) State the name of the circuit component with the electrical symbol shown.



..... [1]

- (c) Fig. 9.2 shows resistors **E**, **F** and **G** in a different circuit with three ammeters, **A₁**, **A₂**, and **A₃**, and a switch, **S**.

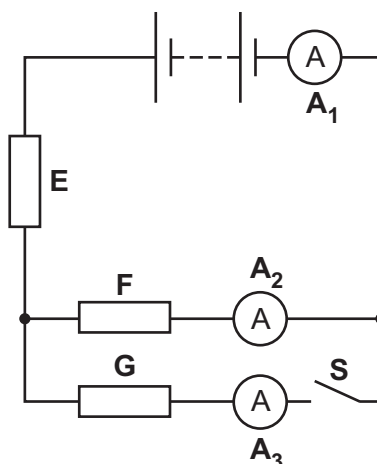


Fig. 9.2

- (i) State the type of circuit arrangement for resistors **F** and **G**.

..... [1]

- (ii) Switch **S** is closed.

State which ammeter, **A₁**, **A₂** or **A₃**, shows the highest reading.

Give a reason for your answer.

ammeter

reason

..... [1]

- (iii) Switch **S** is opened.

Describe how the reading on ammeter **A₂** compares with the reading on ammeter **A₁**.

Give a reason for your answer.

description

reason

..... [2]

[Total: 9]

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
1 H hydrogen 1 atomic number atomic symbol name relative atomic mass																	
3 Li lithium 7	4 Be beryllium 9																
11 Na sodium 23	12 Mg magnesium 24																
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 —
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 —	118 Og oganeson —	119 Ts tennessine —	120 Nh nihonium —

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
	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 dm³ at room temperature and pressure (r.t.p.).



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- 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.

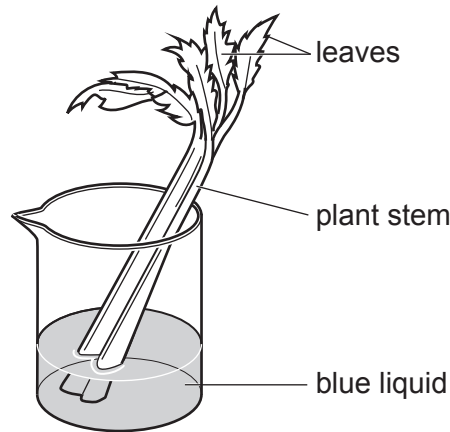


Fig. 1.1

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.

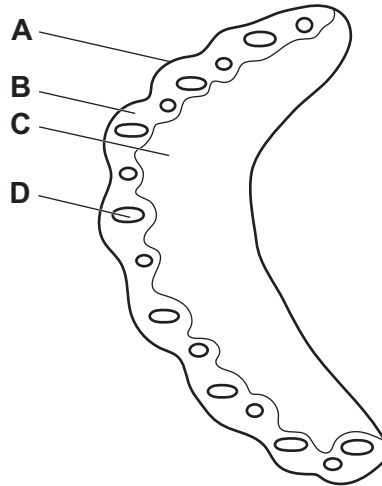


Fig. 1.2

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

oil

protein

starch

smaller molecules

amino acids

fatty acids and glycerol

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.

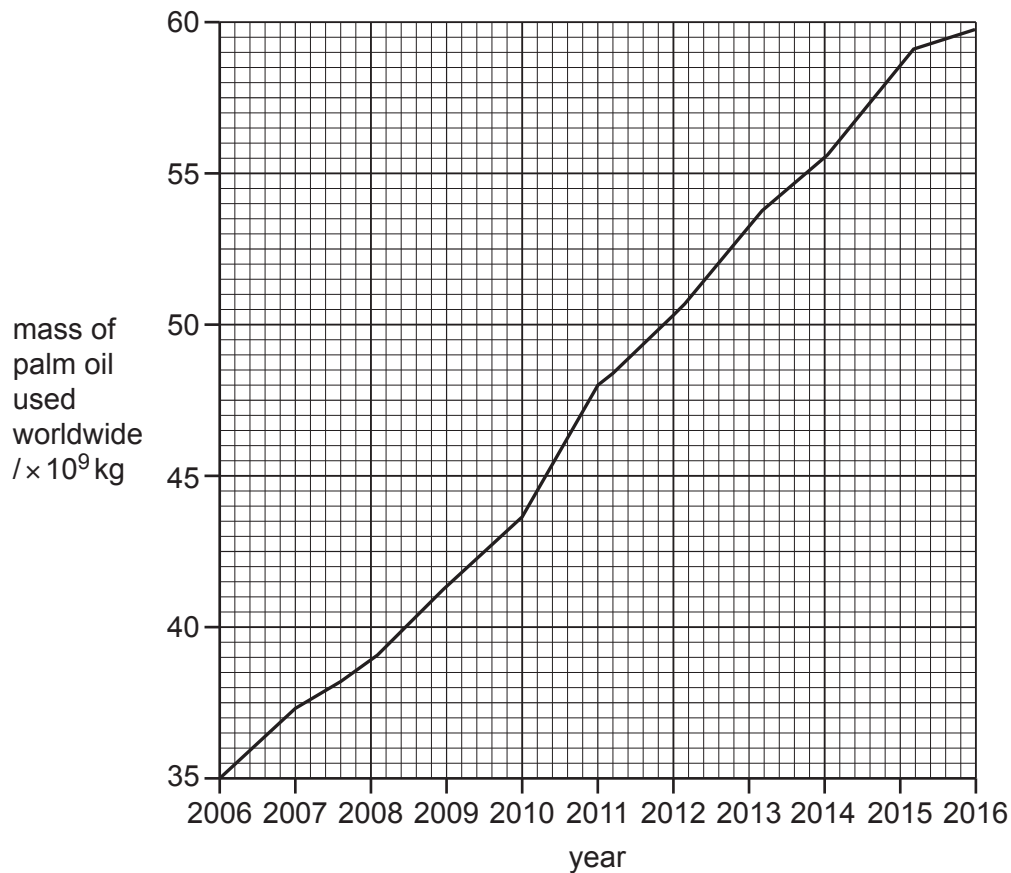


Fig. 1.3

- (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.

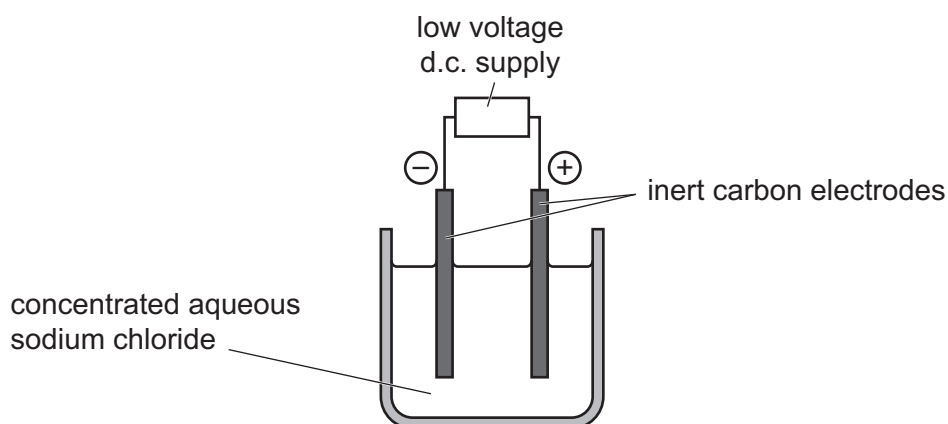


Fig. 2.1

(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.

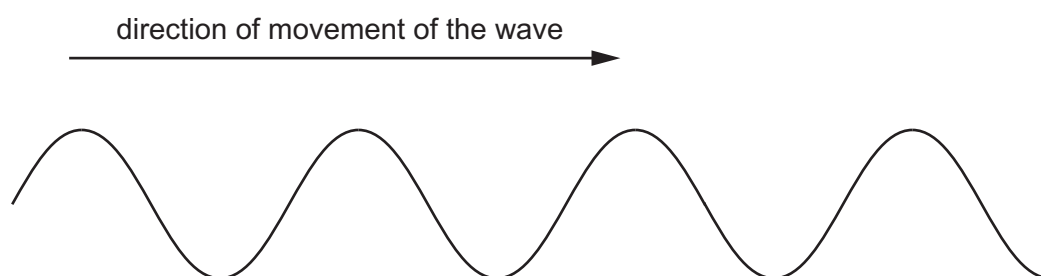


Fig. 3.2

- (i) On Fig. 3.2, draw a double-headed arrow ($\leftrightarrow$ or $\updownarrow$) 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.

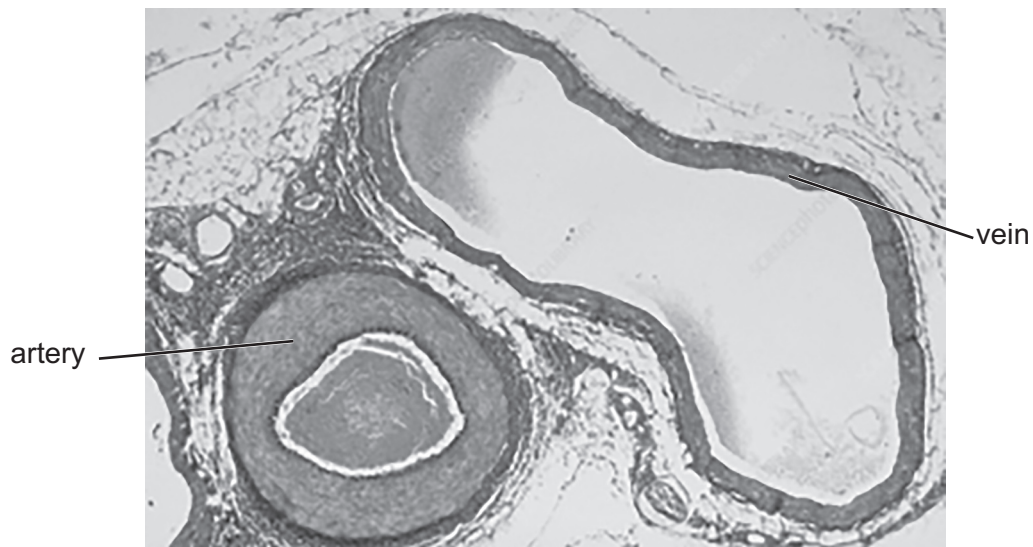


Fig. 4.1

- (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.

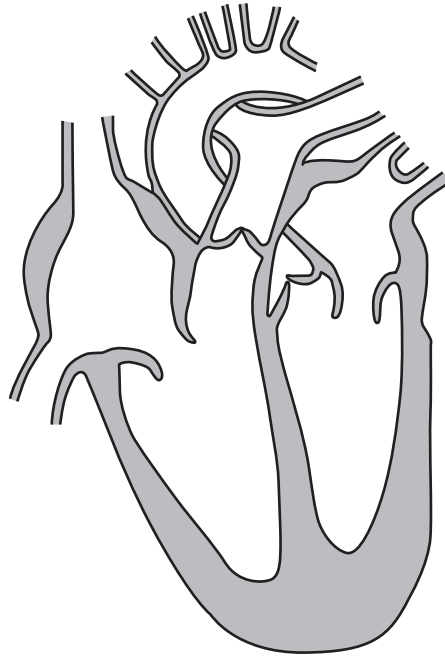


Fig. 4.2

- (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]

..... [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]

..... [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.

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(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.

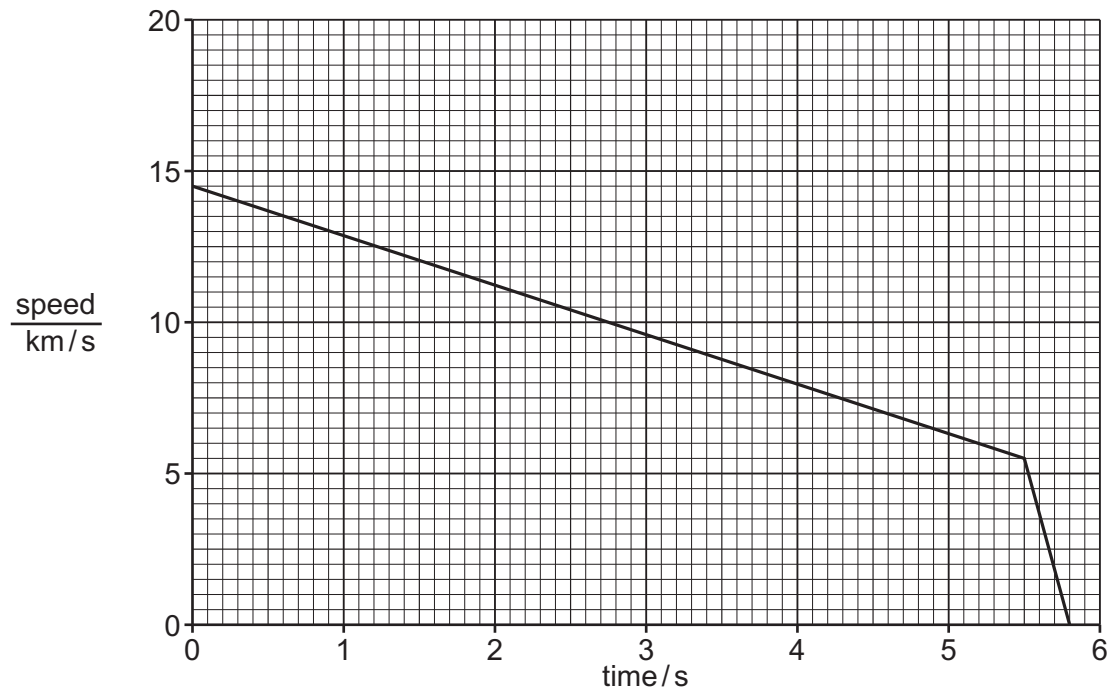


Fig. 6.1

- (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.

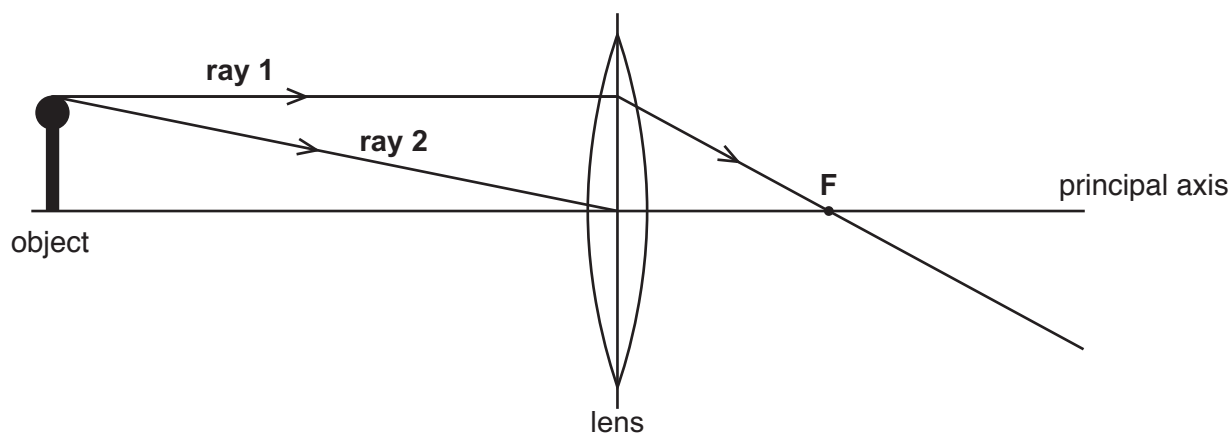


Fig. 6.2

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.

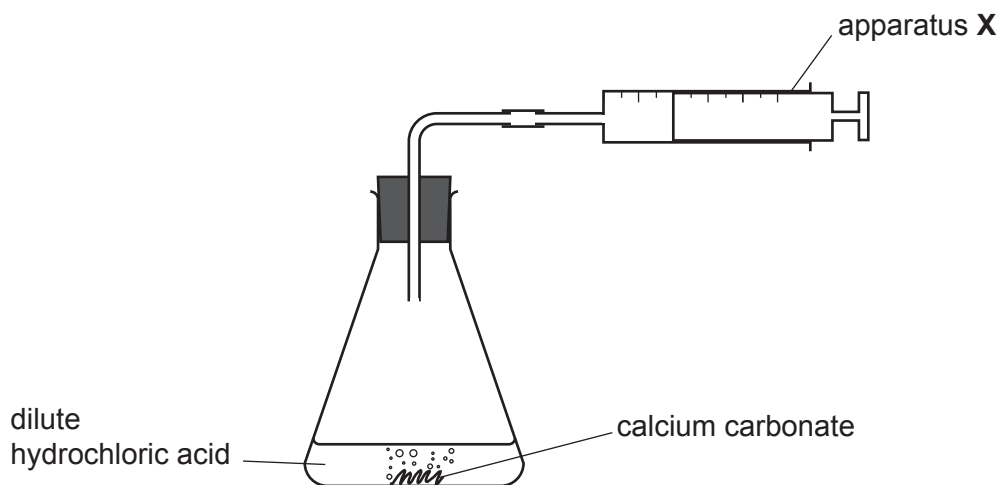


Fig. 8.1

- (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.



[2]

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

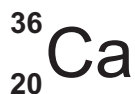
- (i) Suggest **one** change that the student makes to the **calcium carbonate** to increase the rate of the reaction.

..... [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.



- (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.

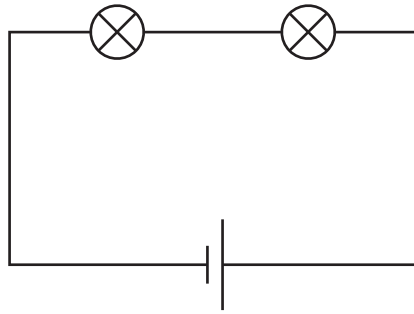


Fig. 9.1

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

..... [1]

- (ii) The resistance of one lamp is $5.5\ \Omega$.

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.

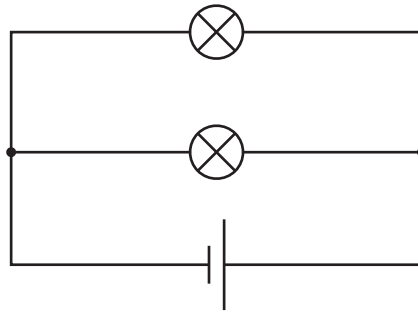


Fig. 9.2

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

.....
 [1]

(c) Fig. 9.3 shows an incomplete circuit.

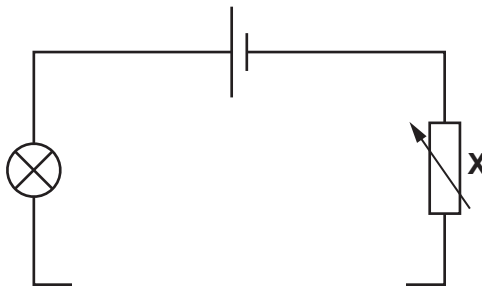


Fig. 9.3

(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	Key										III	IV	V	VI	VII	VIII	
		atomic number atomic symbol name relative atomic mass																
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		2 He helium 4
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 dm³ at room temperature and pressure (r.t.p.).



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0653/33

October/November 2021

1 hour 15 minutes

No additional materials are needed.

- 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.

- 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.

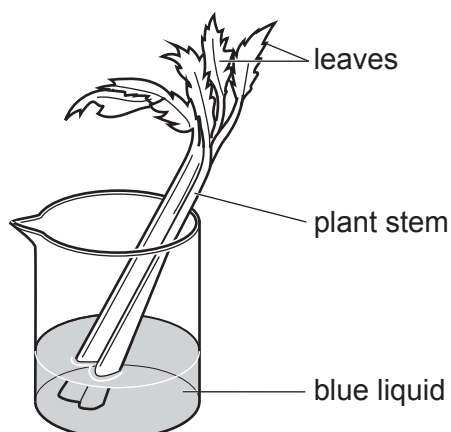


Fig. 1.1

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.

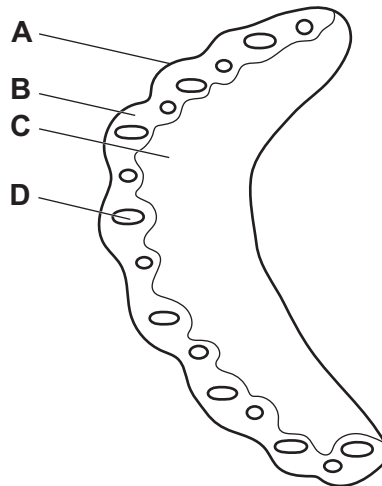


Fig. 1.2

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

oil

protein

starch

smaller molecules

amino acids

fatty acids and glycerol

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.

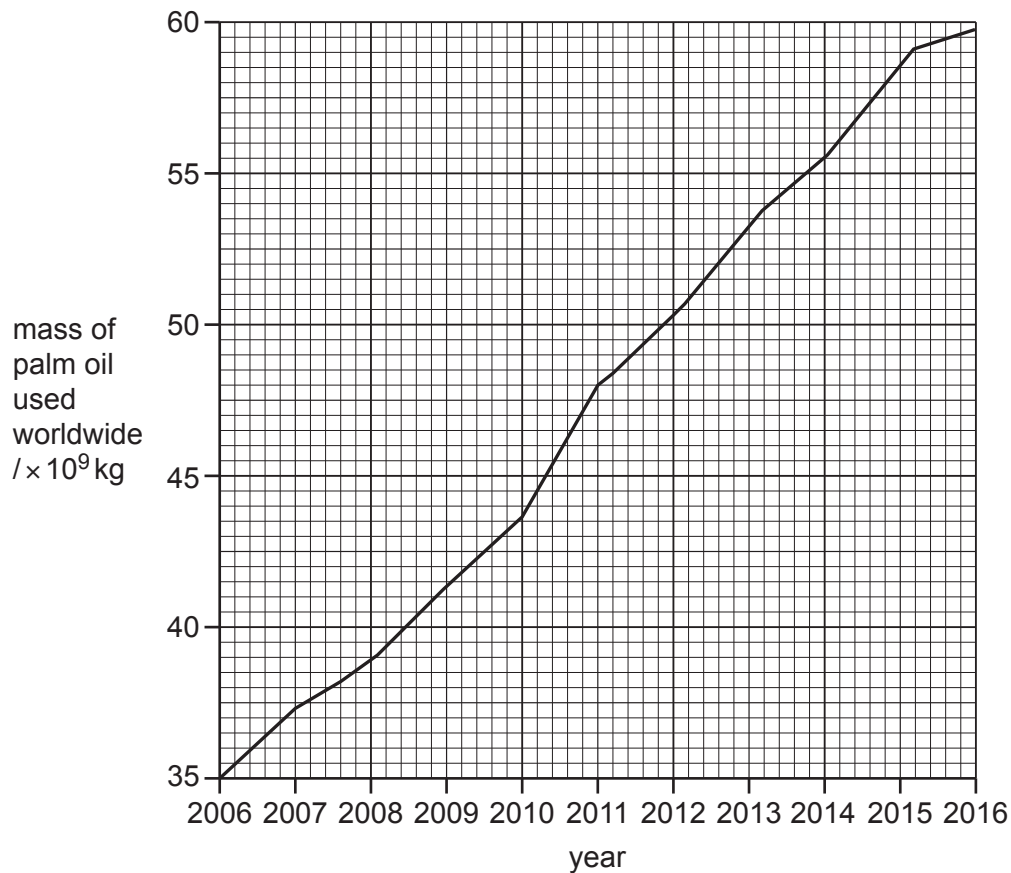


Fig. 1.3

- (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.

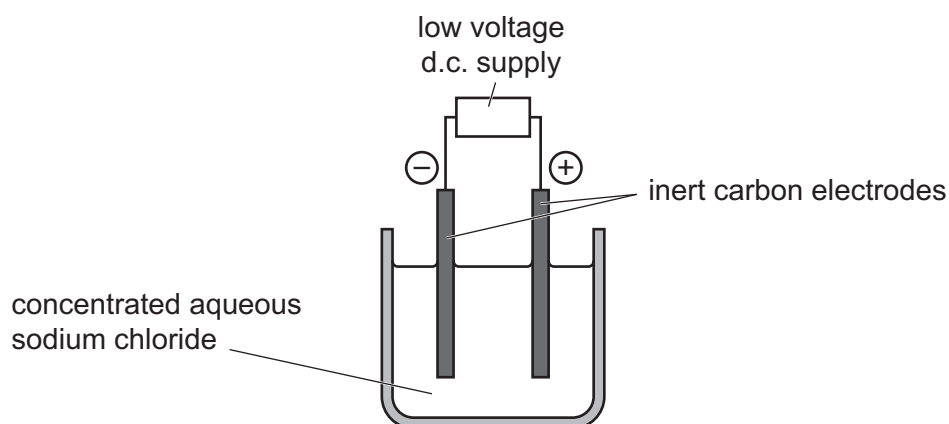


Fig. 2.1

(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.

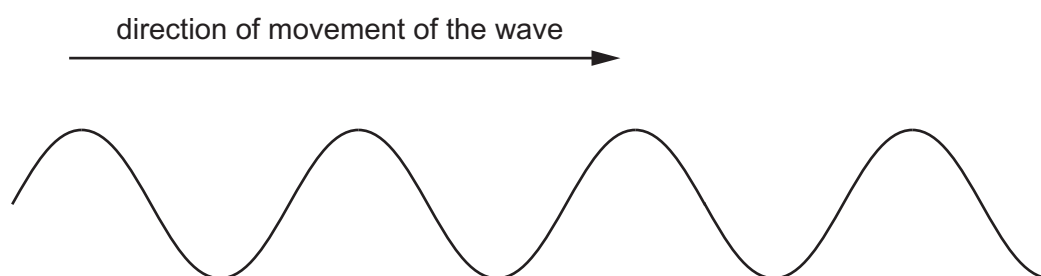


Fig. 3.2

- (i) On Fig. 3.2, draw a double-headed arrow ($\leftrightarrow$ or $\updownarrow$) 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.

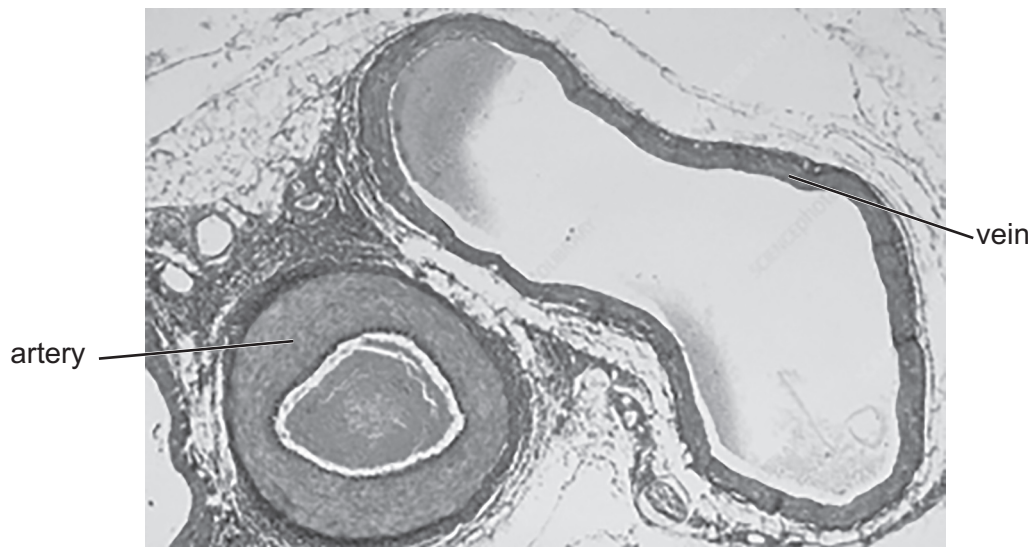


Fig. 4.1

- (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.

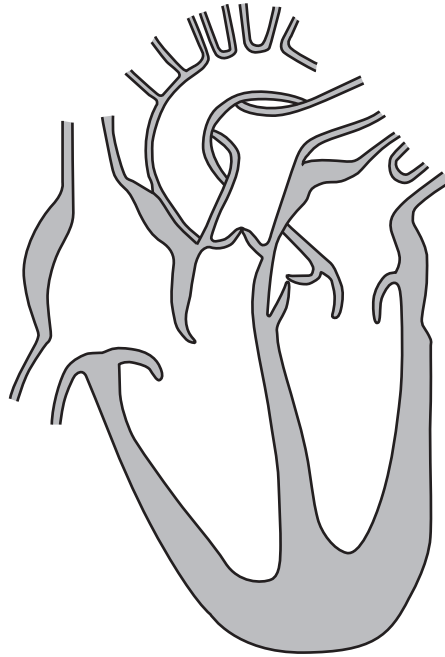


Fig. 4.2

- (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]

..... [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]

..... [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]

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

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Describe the difference between an element and a compound.

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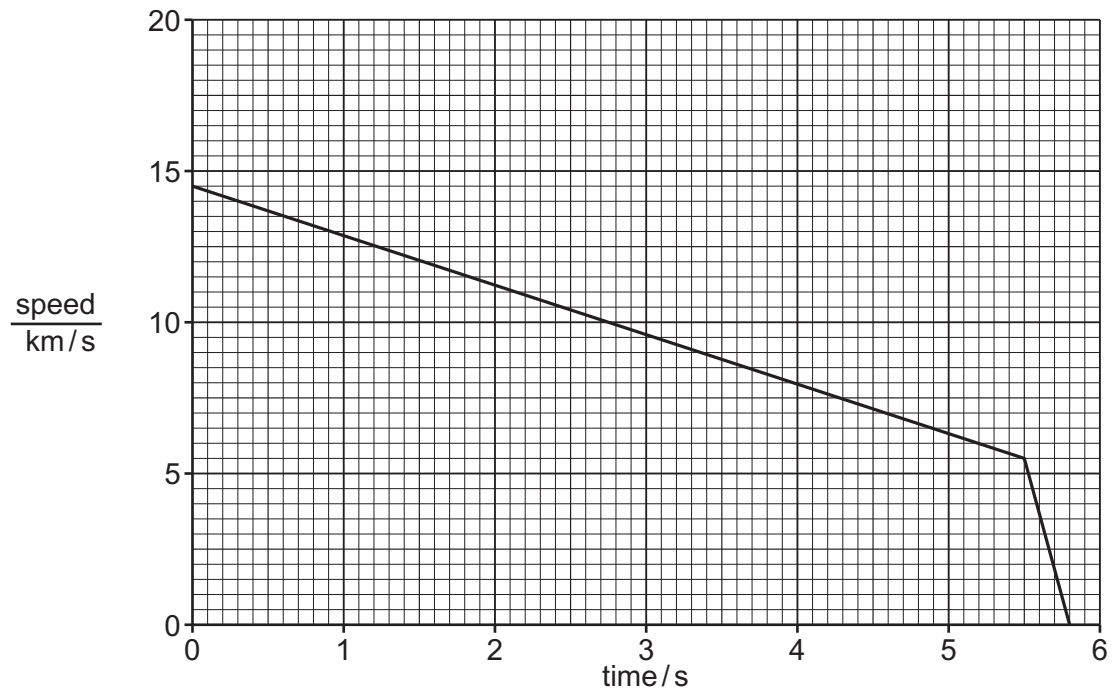


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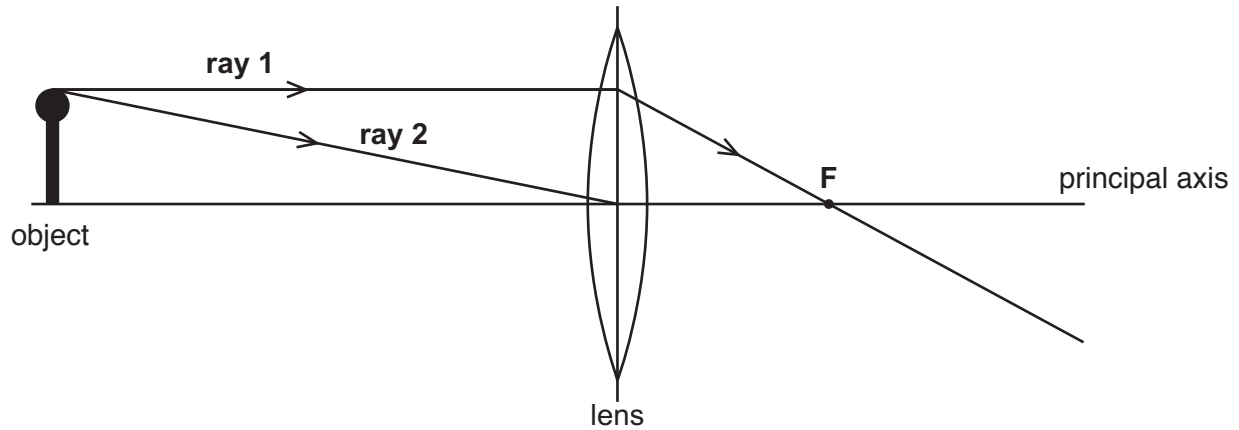


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- (iii) Giraffes are herbivores.

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.

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

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.....

cell wall

.....

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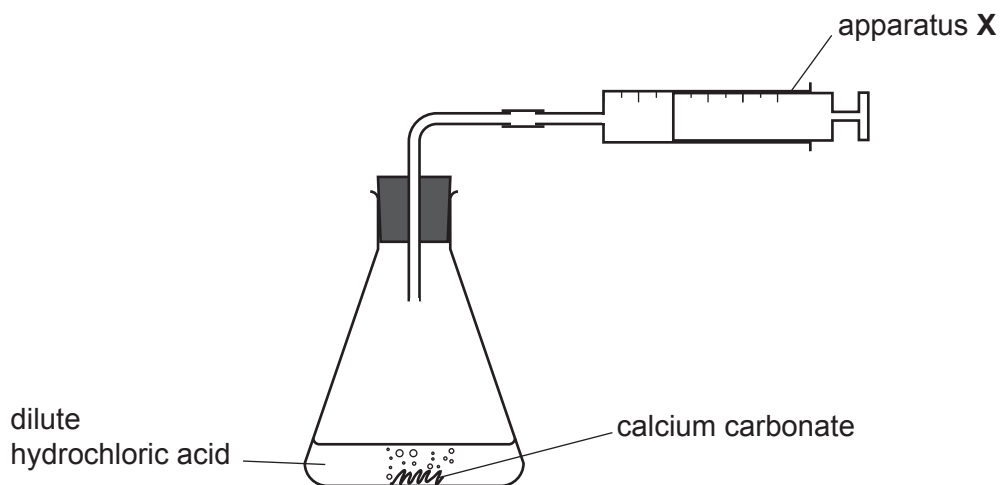


Fig. 8.1

- (a) State the name of apparatus X.

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- (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.

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- (c) Complete the word equation for this reaction.



[2]

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

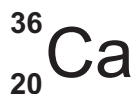
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..... [1]

- (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.



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

..... [1]

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

..... [1]

[Total: 8]

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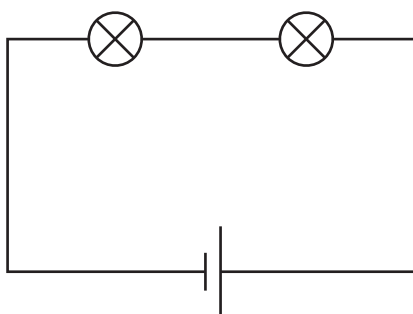


Fig. 9.1

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

..... [1]

- (ii) The resistance of one lamp is $5.5\ \Omega$.

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.

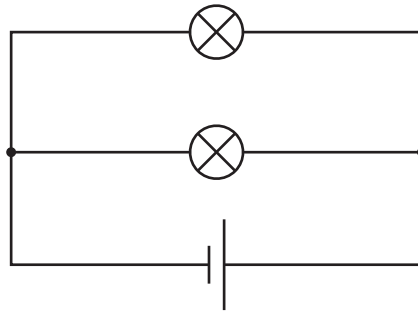


Fig. 9.2

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

.....
 [1]

(c) Fig. 9.3 shows an incomplete circuit.

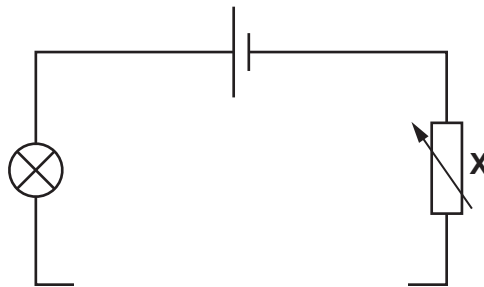


Fig. 9.3

(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	1 H hydrogen 1										III	IV	V	VI	VII	VIII
3 Li lithium 7	4 Be beryllium 9	Key atomic number atomic symbol name relative atomic mass										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 dm³ at room temperature and pressure (r.t.p.).