



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0654/31

May/June 2023

2 hours

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 120.
- 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 **32** pages. Any blank pages are indicated.

- 1 (a) Fig. 1.1 is a diagram of the alimentary canal and associated organs.

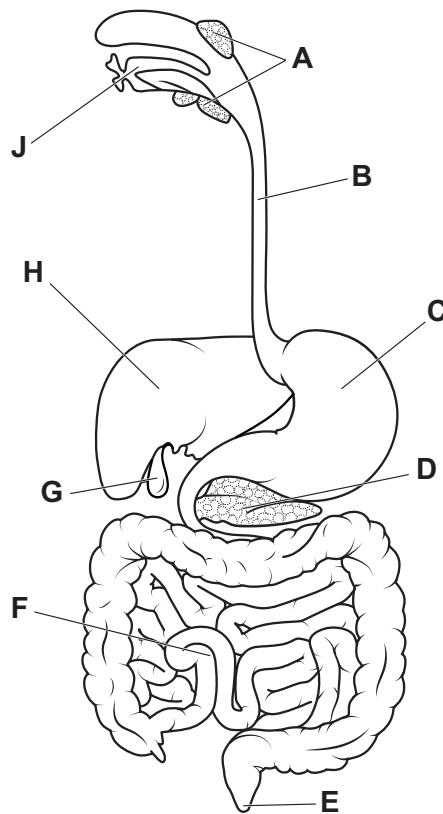


Fig. 1.1

- (i) State the letter in Fig. 1.1 that identifies where:

most absorption occurs

egestion occurs

ingestion occurs

saliva is produced.

[4]

- (ii) State the names of the parts labelled **D** and **H** in Fig. 1.1.

D

H

[2]

- (iii) Complete the sentence to define the term digestion.

Digestion is the of large, insoluble food molecules into small, water-soluble molecules using mechanical and processes.

[2]

(b) The boxes on the left show some nutrients.

The boxes on the right show some principal sources of nutrients.

Draw **one** straight line from each nutrient to its principal source.

nutrient	principal source
carbohydrate	tuna fish
vitamin C	grapefruit
	rice

[2]

(c) Describe the dietary importance of iron.

.....
 [1]

[Total: 11]

- 2 (a) (i) An iron nail rusts when it is exposed to damp air.

Rusting involves the oxidation of iron.

State what is meant by the term oxidation.

.....
 [1]

- (ii) Describe **one** method used to prevent the iron nail from rusting.

Explain how this method prevents the iron nail from rusting.

method

 explanation
 [2]

- (b) Complete the sentence.

Metal ores are a finite resource and therefore, metals need to be [1]

- (c) Iron is a transition element.

Put a tick (✓) in the boxes next to **all** the correct statements about iron.

iron acts as a catalyst	<input type="checkbox"/>
iron forms coloured compounds	<input type="checkbox"/>
iron has a low density	<input type="checkbox"/>
iron has a low melting point	<input type="checkbox"/>
iron is brown in colour	<input type="checkbox"/>

[2]

(d) Steel is an alloy of iron.

(i) Suggest why steel is used for making cars instead of pure iron.

.....
 [1]

(ii) Table 2.1 shows the percentage composition of stainless steel.

Table 2.1

element	percentage by mass in the alloy / %
carbon	1
chromium	18
iron	
manganese	2
molybdenum	2
nickel	12

Calculate the mass of iron contained in 80 kg of stainless steel.

mass of iron = kg [2]

(e) Iron is malleable.

State the meaning of malleable.

.....
 [1]

[Total: 10]

- 3 (a) (i) Fig. 3.1 shows a skier standing on the snow.



Fig. 3.1

When she stands on the snow without her skis, she sinks into the snow.

When she wears her skis, she can stand on the snow without sinking.

Explain these observations.

.....

 [2]

- (ii) The skier makes a sound near a high wall.

The sound travels through the air as a wave.

The skier hears an echo.

State what happens to the sound wave at the high wall to cause an echo to be heard.

..... [1]

- (b) Fig. 3.2 shows the forces acting on the skier on level snow when she is travelling in a snowmobile.

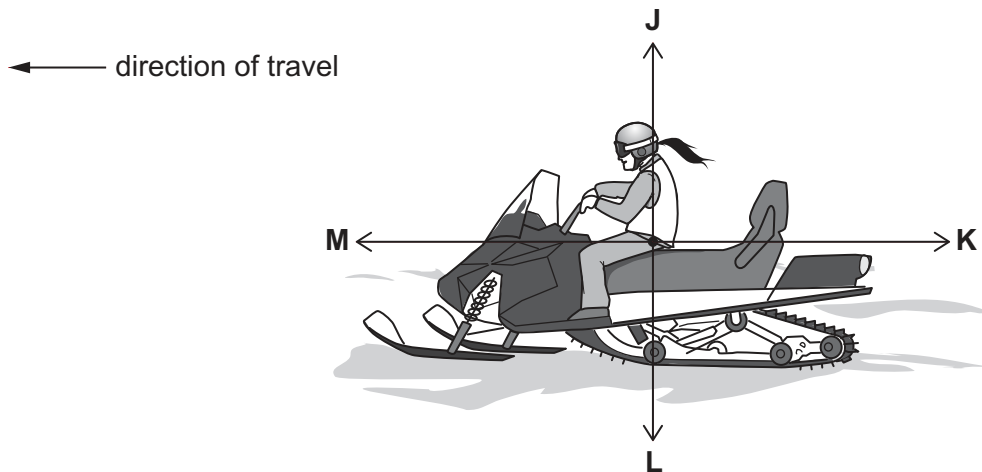


Fig. 3.2

- (i) State which force, **J**, **K**, **L** or **M**, is the weight of the snowmobile and skier.

.....

[1]

- (ii) State which force, **J**, **K**, **L** or **M**, is the friction force acting on the snowmobile.

.....

[1]

(c) Fig. 3.3 shows the speed–time graph for the motion of the skier.

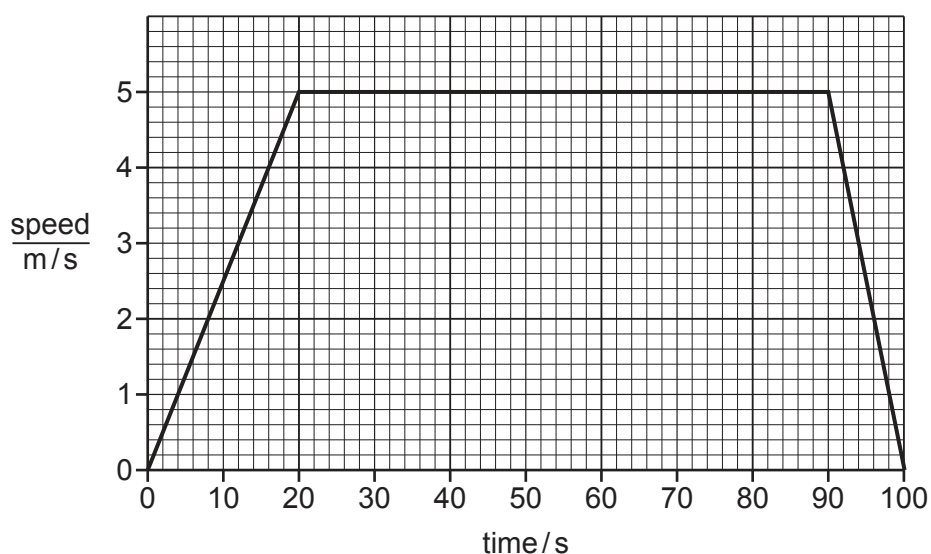


Fig. 3.3

(i) State the maximum speed of the skier.

speed = m/s [1]

(ii) The skier is accelerating during the first 20 s of her journey.

Describe how the graph shows that the skier is accelerating.

.....
 [1]

(iii) Show that the distance travelled by the skier during the first 20 s is 50 m.

[1]

(d) The skier is exposed to ultraviolet radiation from the Sun.

Ultraviolet radiation is a form of ionising radiation.

Describe **one** danger to humans of being exposed to large quantities of ultraviolet radiation.

.....
 [1]

[Total: 9]

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- 4 (a) Fig. 4.1 shows some different sources of pollution of the water in seas.

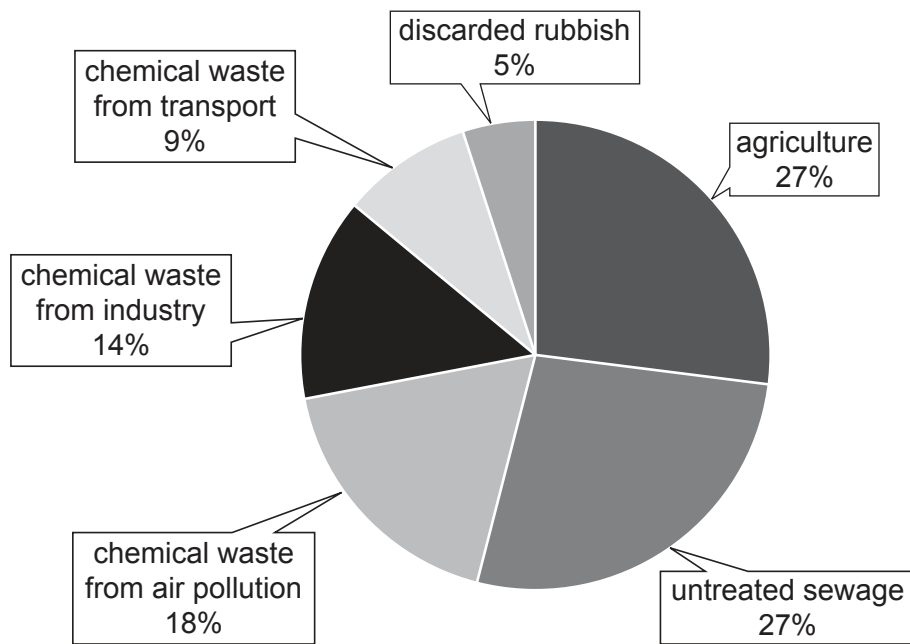


Fig. 4.1

- (i) Complete the sentences using information from Fig. 4.1.

The two biggest sources of pollution are and

The total percentage of pollution caused by chemical waste is %.

The percentage of pollution caused by discarded rubbish is %.

[3]

- (ii) Suggest **one** negative impact of untreated sewage on humans.

.....
 [1]

(b) Polluted water affects the growth of plants.

A scientist measures the height of two pea plants, **A** and **B**, for one month.

Plant **A** is given unpolluted water.

Plant **B** is given polluted water.

Table 4.1 shows the increase in height for each plant.

Table 4.1

plant	type of water	increase in height/cm
A	unpolluted	29
B	polluted	11

(i) Calculate the difference in increase in height between plant **A** and plant **B** from Table 4.1.

..... cm [1]

(ii) Water is needed for germination of seeds.

State two other environmental conditions required for germination.

1

2 [2]

[Total: 7]

- 5 (a) Substances are separated from mixtures of substances using different methods.

Draw **one** straight line from each substance to the correct method of separating it from the mixture.

One line has been drawn for you.

substance separated from the mixture

method of separation

blue dye from black ink	chromatography
gas oil from petroleum	crystallisation
salt from salt water	distillation
sand from sand and water	filtration
water from salt water	fractional distillation

[3]

- (b) One reason for separating mixtures is to purify substances.

Explain the importance of purity in the manufacture of substances used in food additives.

.....
 [1]

- (c) The element lead is obtained from the compound lead(II) bromide by electrolysis.

- (i) Describe the difference between an element and a compound.

.....

 [1]

- (ii) Complete the sentences to describe the electrolysis of lead(II) bromide.

Electrolysis is the breakdown of molten lead(II) bromide

by the passage of

The gas released at the positive electrode is and

..... is formed at the negative electrode.

The negative electrode is called the

[3]

(d) A student reacts dilute hydrochloric acid with four metals.

The student's observations are shown in Table 5.1.


Table 5.1

metal	observation
calcium	reacts very quickly
copper	does not react
lead	reacts very slowly
magnesium	reacts quickly

Place the four metals in order of their reactivity from the most reactive to the least reactive.

..... most reactive

 least reactive



[2]

[Total: 10]

- 6 (a) (i) Complete the sentences to describe the energy changes that occur during the generation of electricity in a nuclear power station.

Nuclear fission releases energy which heats up water in a boiler.

When the turbine and generator are turning, they have energy.

The generator produces energy.

[3]

- (ii) Nuclear fission occurs in the nuclear power station.

State what happens to the nucleus of an atom during nuclear fission.

..... [1]

- (b) The radioactive decay of plutonium-239 produces an isotope of uranium, uranium-235.



- (i) State the charge on an α -particle.

..... [1]

- (ii) Describe how the numbers of protons and neutrons change in the nucleus of a plutonium-239 atom when it emits an α -particle.

protons

neutrons

[2]

- (iii) The half-life of plutonium-239 is 24 000 years.

A sample of nuclear fuel contains 6.0 g of plutonium-239.

Calculate the mass of plutonium-239 remaining after 72 000 years.

mass = g [3]

[Total: 10]

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- 7 (a) Fig. 7.1 is a drawing of a cross-section of a leaf.

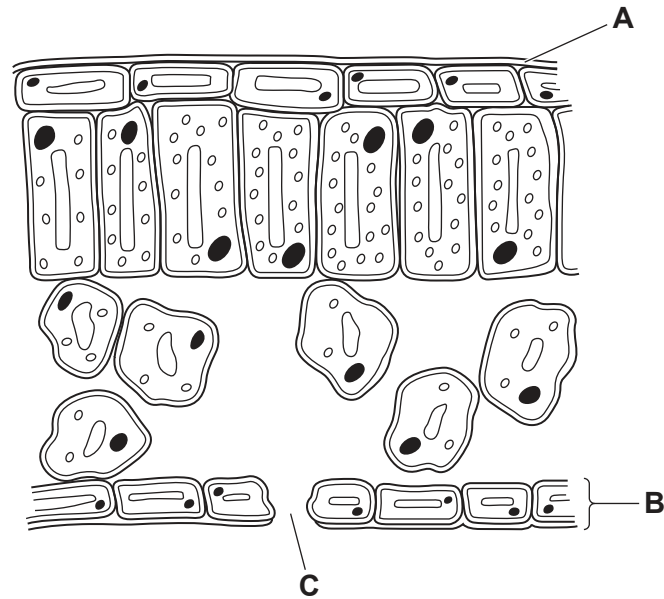


Fig. 7.1

State the names of the parts labelled **A**, **B** and **C** in Fig. 7.1.

- A**
- B**
- C**

[3]

- (b) Fig. 7.2 is a cell from the palisade mesophyll layer of the leaf.

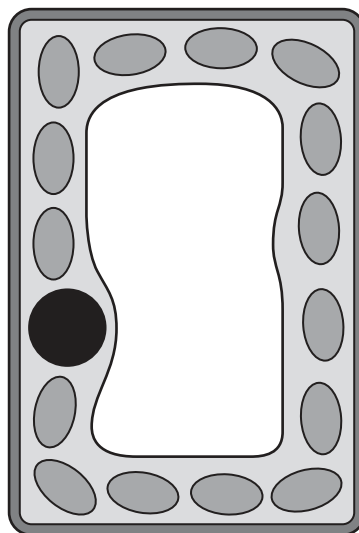


Fig. 7.2

On Fig. 7.2:

- Identify the part where photosynthesis takes place with a label line and the correct name.
- Identify the part that contains the genetic material with a label line and the letter **X**.

[3]

(c) Describe the process of photosynthesis.

.....

.....

.....

.....

..... [3]

(d) Plants need nitrate ions to make an important substance.

Circle the name of this substance.

amino acid

fatty acid

starch

glycogen

glycerol

[1]

(e) State the name of the cell that absorbs mineral ions in a plant.

..... [1]

(f) State the name of the vessels that transport mineral ions in the stem.

..... [1]

[Total: 12]

- 8 (a) (i) Complete the dot-and-cross diagram in Fig. 8.1 to show the bonding in a molecule of methane, CH_4 .

Show only the outer-shell electrons.

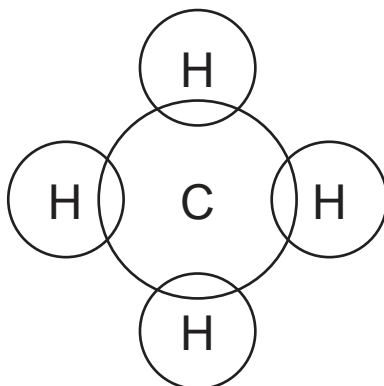


Fig. 8.1

[2]

- (ii) State the name of the type of chemical bonding present in a molecule of methane.

Explain your answer.

type of chemical bonding

explanation

.....

[2]

- (b) Complete the word equation for the complete combustion of methane.

methane + \rightarrow + [2]

- (c) (i) State the name of the pollutant gas produced during the **incomplete** combustion of methane.

..... [1]

- (ii) State **one** adverse effect of the gas you have named in (c)(i) on the health of humans.

..... [1]

[Total: 8]

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9 Fig. 9.1 shows a washing machine.

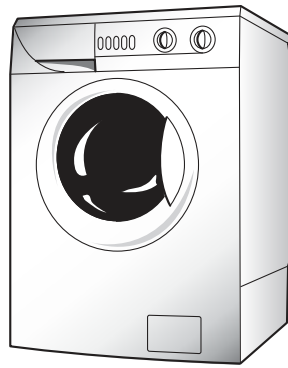



Fig. 9.1

(a) (i) The washing machine uses:

- a heater to heat the water
- a motor to pump the hot water through the machine.

The motor and the heater are connected in a parallel circuit.

The motor and the heater are each operated by separate switches.

The circuit symbol for a heater is 


The circuit symbol for a motor is 

Fig. 9.2 shows an incomplete circuit diagram for the washing machine.

Complete the circuit diagram on Fig. 9.2.

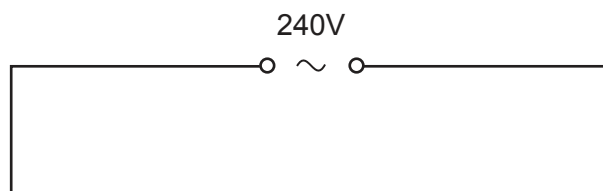


Fig. 9.2

[3]

- (ii) The resistance of the heater is $20\ \Omega$.

The resistance of the motor is $80\ \Omega$.

Identify from the list the most likely value for the combined resistance of the heater and motor connected in parallel.

Explain your answer.

$16\ \Omega$ $20\ \Omega$ $50\ \Omega$ $80\ \Omega$ $100\ \Omega$

combined resistance = Ω

explanation
 [2]

- (iii) The current in the wires of the electrical circuit is a flow of charged particles.

State the name of the particles that flow in the wires of the electrical circuit.

..... [1]

- (iv) The current-carrying coil in the motor experiences a turning effect.

This turning effect can be increased by increasing the number of turns on the coil.

State two other ways to **increase** this turning effect.

1
 2 [2]

- (b) Inside the washing machine, some of the water evaporates.

During evaporation, water changes state from a liquid to a gas.

- (i) Complete the diagrams in Fig. 9.3 to show the arrangement and separation of molecules in a liquid and in a gas.

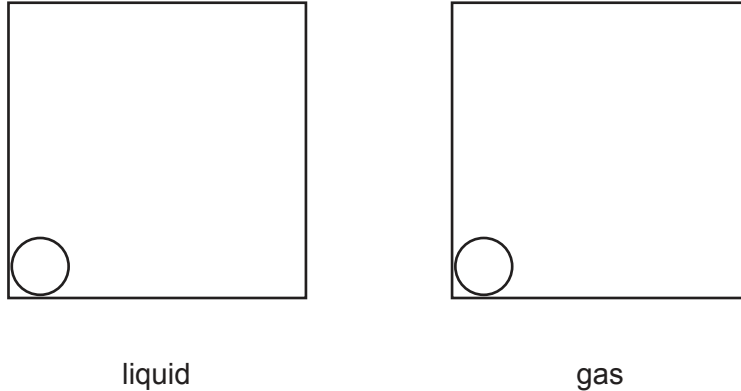


Fig. 9.3

[2]

- (ii) During evaporation, the water does not boil.

State the boiling point of water.

..... °C [1]

[Total: 11]

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- 10 (a) A person touches a hot pan and instantly removes their hand.

This is a reflex action.

The reflex arc is shown in Fig. 10.1.

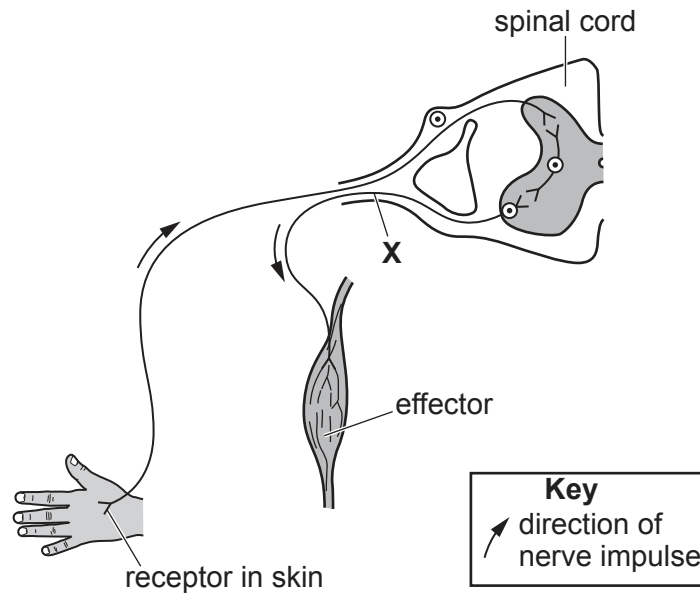


Fig. 10.1

- (i) State the names of the stimulus and the effector in this reflex arc.

stimulus

effector

[2]

- (ii) State the name of the neurone labelled X in Fig. 10.1.

..... [1]

- (iii) The spinal cord is one part of the central nervous system.

State the name of the other part of the central nervous system.

..... [1]

- (b) Neurones are the longest cells in the body.

One neurone measures 1.5 m in length.

One plant cell measures 0.1 mm in length.

Calculate how many times longer the neurone is than the plant cell.

..... [2]

- (c) Hormones and nerve impulses both carry information around the body.

Identify if each statement is about **hormones** or **nerve impulses**.

They are carried in the blood.

They are produced by glands.

They are electrical signals.

[2]

- (d) Adrenaline is a hormone released in 'fight or flight' situations.

Describe two effects of adrenaline on the body.

1

2

[2]

[Total: 10]

- 11 (a) Limestone is insoluble in water.

Limestone is mixed with water and poured through filter paper.

- (i) Explain how filter paper separates limestone from water.

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

- (ii) The filtrate is tested to find its pH number.

One way of finding the pH number is to use a pH meter.

Describe **one** other way to find the pH number of the filtrate.

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

- (b) Limestone is sometimes added to soil to reduce soil acidity.

Limestone is mainly calcium carbonate which reacts with acid.

- (i) This soil treatment adds carbon dioxide to the atmosphere.

State **one** other reason why the amount of carbon dioxide in the atmosphere is increasing.

..... [1]

- (ii) Describe how an increase in carbon dioxide in the atmosphere affects the environment.

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

- (c) A student investigates the rate of reaction between excess dilute hydrochloric acid and a piece of limestone.

Fig. 11.1 shows the apparatus used.

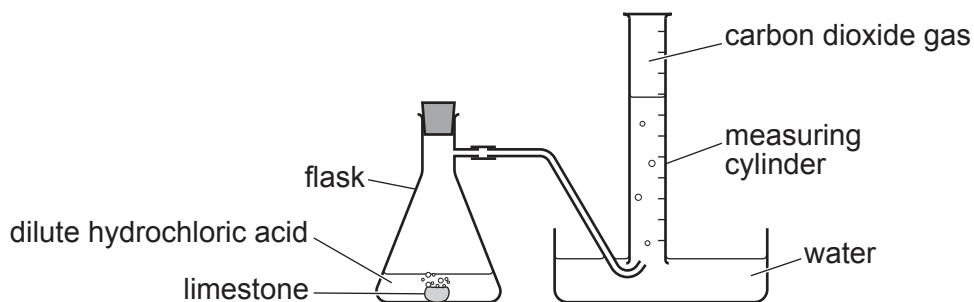


Fig. 11.1

The student measures the volume of carbon dioxide in the measuring cylinder every 20 seconds for 280 seconds.

A graph of the student's results is shown in Fig. 11.2.

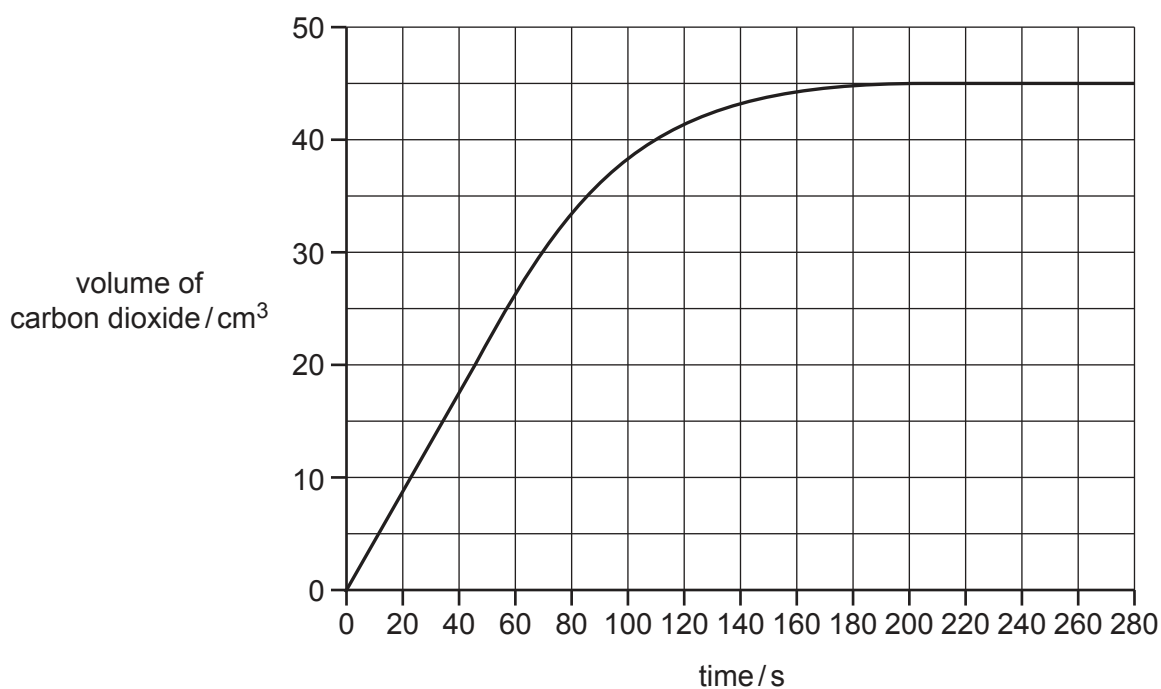


Fig. 11.2

- (i) Use Fig. 11.2 to find the total volume of carbon dioxide released.

volume = cm³ [1]

- (ii) Use Fig. 11.2 to find the time when the reaction finished.

time = s [1]

- (iii) The student repeats the experiment at a **higher** temperature.

On Fig. 11.2, sketch a line to show the results.

[2]

- (iv) Increasing the temperature increases the rate of reaction.

State two other ways the student can increase the rate of the reaction.

1

2

[2]

[Total: 12]

- 12 (a)** The mass of the Sun is $1.97 \times 10^{30} \text{ kg}$.

The average density of the Sun is 1410 kg/m^3 .

Calculate the volume of the Sun.

volume = m^3 [2]

- (b)** The Sun is made of very hot gas.

- (i)** Suggest the main method of thermal energy transfer from the inside of the Sun to the surface of the Sun.

..... [1]

- (ii)** State the main method of energy transfer that occurs when infrared waves travel from the Sun to the Earth through space.

..... [1]

- (iii)** Sound energy is produced by the Sun.

Explain why we are unable to hear this sound on Earth.

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

- (c) (i)** Fig. 12.1 shows an incomplete electromagnetic spectrum.

Write infrared radiation in its correct place.

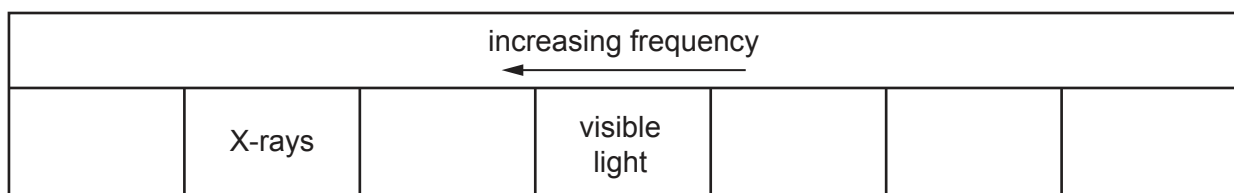


Fig. 12.1

[1]

- (ii)** State the electromagnetic radiation which has the highest frequency.

..... [1]

- (iii)** Explain why it takes the same time for infrared and visible light to travel from the Sun to the Earth.

..... [1]

(d) Fig. 12.2 shows a sound wave.

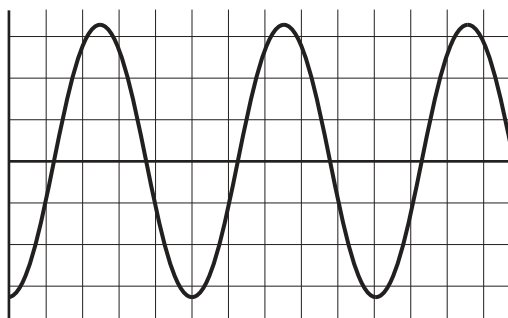


Fig. 12.2

- (i) On Fig. 12.2, label the amplitude of the wave with a double-headed arrow (\leftrightarrow) or (\updownarrow) and the letter **A**. [1]
- (ii) On Fig. 12.2, label the wavelength of one wave with a double-headed arrow (\leftrightarrow) or (\updownarrow) and the letter **W**. [1]

[Total: 10]

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The Periodic Table of Elements

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87 Fr francium —	88 Ra radium —													112 Cn copernicium —	114 Fl flerovium —	116 Lv livermorium —	118 Og oganeson —	119 Ts tennessine —	120 Uue unbinilium —		121 Uuh ununilium —	122 Uut untrium —	123 Uuq unquadium —	124 Uup unpentium —	125 Uub unhexium —	126 Uuq unseptium —	127 Uuh unhennium —	128 Uuo unoctium —	129 Uus ununium —	130 Uuq unquadrium —	131 Uuh unhennium —	132 Uuo unoctium —	133 Uus ununium —	134 Uuq unquadrium —	135 Uuh unhennium —	136 Uuo unoctium —	137 Uus ununium —	138 Uuq unquadrium —	139 Uuh unhennium —	140 Uuo unoctium —	141 Uus ununium —	142 Uuq unquadrium —	143 Uuh unhennium —	144 Uuo unoctium —	145 Uus ununium —	146 Uuq unquadrium —	147 Uuh unhennium —	148 Uuo unoctium —	149 Uus ununium —	150 Uuq unquadrium —	151 Uuh unhennium —	152 Uuo unoctium —	153 Uus ununium —	154 Uuq unquadrium —	155 Uuh unhennium —	156 Uuo unoctium —	157 Uus ununium —	158 Uuq unquadrium —	159 Uuh unhennium —	160 Uuo unoctium —	161 Uus ununium —	162 Uuq unquadrium —	163 Uuh unhennium —	164 Uuo unoctium —	165 Uus ununium —	166 Uuq unquadrium —	167 Uuh unhennium —	168 Uuo unoctium —	169 Uus ununium —	170 Uuq unquadrium —	171 Uuh unhennium —	172 Uuo unoctium —	173 Uus ununium —	174 Uuq unquadrium —	175 Uuh unhennium —	176 Uuo unoctium —	177 Uus ununium —	178 Uuq unquadrium —	179 Uuh unhennium —	180 Uuo unoctium —	181 Uus ununium —	182 Uuq unquadrium —	183 Uuh unhennium —	184 Uuo unoctium —	185 Uus ununium —	186 Uuq unquadrium —	187 Uuh unhennium —	188 Uuo unoctium —	189 Uus ununium —	190 Uuq unquadrium —	191 Uuh unhennium —	192 Uuo unoctium —	193 Uus ununium —	194 Uuq unquadrium —	195 Uuh unhennium —	196 Uuo unoctium —	197 Uus ununium —	198 Uuq unquadrium —	199 Uuh unhennium —	200 Uuo unoctium —	201 Uus ununium —	202 Uuq unquadrium —	203 Uuh unhennium —	204 Uuo unoctium —	205 Uus ununium —	206 Uuq unquadrium —	207 Uuh unhennium —	208 Uuo unoctium —	209 Uus ununium —	210 Uuq unquadrium —	211 Uuh unhennium —	212 Uuo unoctium —	213 Uus ununium —	214 Uuq unquadrium —	215 Uuh unhennium —	216 Uuo unoctium —	217 Uus ununium —	218 Uuq unquadrium —	219 Uuh unhennium —	220 Uuo unoctium —	221 Uus ununium —	222 Uuq unquadrium —	223 Uuh unhennium —	224 Uuo unoctium —	225 Uus ununium —	226 Uuq unquadrium —	227 Uuh unhennium —	228 Uuo unoctium —	229 Uus ununium —	230 Uuq unquadrium —	231 Uuh unhennium —	232 Uuo unoctium —	233 Uus ununium —	234 Uuq unquadrium —	235 Uuh unhennium —	236 Uuo unoctium —	237 Uus ununium —	238 Uuq unquadrium —	239 Uuh unhennium —	240 Uuo unoctium —	241 Uus ununium —	242 Uuq unquadrium —	243 Uuh unhennium —	244 Uuo unoctium —	245 Uus ununium —	246 Uuq unquadrium —	247 Uuh unhennium —	248 Uuo unoctium —	249 Uus ununium —	250 Uuq unquadrium —	251 Uuh unhennium —	252 Uuo unoctium —	253 Uus ununium —	254 Uuq unquadrium —	255 Uuh unhennium —	256 Uuo unoctium —	257 Uus ununium —	258 Uuq unquadrium —	259 Uuh unhennium —	260 Uuo unoctium —	261 Uus ununium —	262 Uuq unquadrium —	263 Uuh unhennium —	264 Uuo unoctium —	265 Uus ununium —	266 Uuq unquadrium —	267 Uuh unhennium —	268 Uuo unoctium —	269 Uus ununium —	270 Uuq unquadrium —	271 Uuh unhennium —	272 Uuo unoctium —	273 Uus ununium —	274 Uuq unquadrium —	275 Uuh unhennium —	276 Uuo unoctium —	277 Uus ununium —	278 Uuq unquadrium —	279 Uuh unhennium —	280 Uuo unoctium —	281 Uus ununium —	282 Uuq unquadrium —	283 Uuh unhennium —	284 Uuo unoctium —	285 Uus ununium —	286 Uuq unquadrium —	287 Uuh unhennium —	288 Uuo unoctium —	289 Uus ununium —	290 Uuq unquadrium —	291 Uuh unhennium —	292 Uuo unoctium —	293 Uus ununium —	294 Uuq unquadrium —	295 Uuh unhennium —	296 Uuo unoctium —	297 Uus ununium —	298 Uuq unquadrium —	299 Uuh unhennium —	300 Uuo unoctium —	301 Uus ununium —	302 Uuq unquadrium —	303 Uuh unhennium —	304 Uuo unoctium —	305 Uus ununium —	306 Uuq unquadrium —	307 Uuh unhennium —	308 Uuo unoctium —	309 Uus ununium —	310 Uuq unquadrium —	311 Uuh unhennium —	312 Uuo unoctium —	313 Uus ununium —	314 Uuq unquadrium —	315 Uuh unhennium —	316 Uuo unoctium —	317 Uus ununium —	318 Uuq unquadrium —	319 Uuh unhennium —	320 Uuo unoctium —	321 Uus ununium —	322 Uuq unquadrium —	323 Uuh unhennium —	324 Uuo unoctium —	325 Uus ununium —	326 Uuq unquadrium —	327 Uuh unhennium —	328 Uuo unoctium —	329 Uus ununium —	330 Uuq unquadrium —	331 Uuh unhennium —	332 Uuo unoctium —	333 Uus ununium —	334 Uuq unquadrium —	335 Uuh unhennium —	336 Uuo unoctium —	337 Uus ununium —	338 Uuq unquadrium —	339 Uuh unhennium —	340 Uuo unoctium —	341 Uus ununium —	342 Uuq unquadrium —	343 Uuh unhennium —	344 Uuo unoctium —	345 Uus ununium —	346 Uuq unquadrium —	347 Uuh unhennium —	348 Uuo unoctium —	349 Uus ununium —	350 Uuq unquadrium —	351 Uuh unhennium —	352 Uuo unoctium —	353 Uus ununium —	354 Uuq unquadrium —	355 Uuh unhennium —	356 Uuo unoctium —	357 Uus ununium —	358 Uuq unquadrium —	359 Uuh unhennium —	360 Uuo unoctium —	361 Uus ununium —	362 Uuq unquadrium —	363 Uuh unhennium —	364 Uuo unoctium —	365 Uus ununium —	366 Uuq unquadrium —	367 Uuh unhennium —	368 Uuo unoctium —	369 Uus ununium —	370 Uuq unquadrium —	371 Uuh unhennium —	372 Uuo unoctium —	373 Uus ununium —	374 Uuq unquadrium —	375 Uuh unhennium —	376 Uuo unoctium —	377 Uus ununium —	378 Uuq unquadrium —	379 Uuh unhennium —	380 Uuo unoctium —	381 Uus ununium —	382 Uuq unquadrium —	383 Uuh unhennium —	384 Uuo unoctium —	385 Uus ununium —	386 Uuq unquadrium —	387 Uuh unhennium —	388 Uuo unoctium —	389 Uus ununium —	390 Uuq unquadrium —	391 Uuh unhennium —	392 Uuo unoctium —	393 Uus ununium —	394 Uuq unquadrium —	395 Uuh unhennium —	396 Uuo unoctium —	397 Uus ununium —	398 Uuq unquadrium —	399 Uuh unhennium —	400 Uuo unoctium —	401 Uus ununium —	402 Uuq unquadrium —	403 Uuh unhennium —	404 Uuo unoctium —	405 Uus ununium —	406 Uuq unquadrium —	407 Uuh unhennium —	408 Uuo unoctium —	409 Uus ununium —	410 Uuq unquadrium —	411 Uuh unhennium —	412 Uuo unoctium —	413 Uus ununium —	414 Uuq unquadrium —	415 Uuh unhennium —	416 Uuo unoctium —	417 Uus ununium —	418 Uuq unquadrium —	419 Uuh unhennium —	420 Uuo unoctium —	421 Uus ununium —	422 Uuq unquadrium —	423 Uuh unhennium —	424 Uuo unoctium —	425 Uus ununium —	426 Uuq unquadrium —	427 Uuh unhennium —	428 Uuo unoctium —	429 Uus ununium —	430 Uuq unquadrium —	431 Uuh unhennium —	432 Uuo unoctium —	433 Uus ununium —	434 Uuq unquadrium —	435 Uuh unhennium —	436 Uuo unoctium —	437 Uus ununium —	438 Uuq unquadrium —	439 Uuh unhennium —	440 Uuo unoctium —	441 Uus ununium —	442 Uuq unquadrium —	443 Uuh unhennium —	444 Uuo unoctium —	445 Uus ununium —	446 Uuq unquadrium —	447 Uuh unhennium —	448 Uuo unoctium —	449 Uus ununium —	450 Uuq unquadrium —	451 Uuh unhennium —	452 Uuo unoctium —	453 Uus ununium —	454 Uuq unquadrium —	455 Uuh unhennium —	456 Uuo unoctium —	457 Uus ununium —	458 Uuq unquadrium —	459 Uuh unhennium —	460 Uuo unoctium —	461 Uus ununium —	462 Uuq unquadrium —	463 Uuh unhennium —	464 Uuo unoctium —	465 Uus ununium —	466 Uuq unquadrium —	467 Uuh unhennium —	468 Uuo unoctium —	469 Uus ununium —	470 Uuq unquadrium —	471 Uuh unhennium —	472 Uuo unoctium —	473 Uus ununium —	474 Uuq unquadrium —	475 Uuh unhennium —	476 Uuo unoctium —	477 Uus ununium —	478 Uuq unquadrium —	479 Uuh unhennium —	480 Uuo unoctium —	481 Uus ununium —	482 Uuq unquadrium —	483 Uuh unhennium —	484 Uuo unoctium —	485 Uus ununium —	486 Uuq unquadrium —	487 Uuh unhennium —	488 Uuo unoctium —	489 Uus ununium —	490 Uuq unquadrium —	491 Uuh unhennium —	492 Uuo unoctium —	493 Uus ununium —	494 Uuq unquadrium —	495 Uuh unhennium —	496 Uuo unoctium —	497 Uus ununium —	498 Uuq unquadrium —	499 Uuh unhennium —	500 Uuo unoctium —	501 Uus ununium —	502 Uuq unquadrium —	503 Uuh unhennium —	504 Uuo unoctium —	505 Uus ununium —	506 Uuq unquadrium —	507 Uuh unhennium —	508 Uuo unoctium —	509 Uus ununium —	510 Uuq unquadrium —	511 Uuh unhennium —	512 Uuo unoctium —	513 Uus ununium —	514 Uuq unquadrium —	515 Uuh unhennium —	516 Uuo unoctium —	517 Uus ununium —	518 Uuq unquadrium —	519 Uuh unhennium —	520 Uuo unoctium —	521 Uus ununium —	522 Uuq unquadrium —	523 Uuh unhennium —	524 Uuo unoctium —	525 Uus ununium —	526 Uuq unquadrium —	527 Uuh unhennium —	528 Uuo unoctium —	529 Uus ununium —	530 Uuq unquadrium —	531 Uuh unhennium —	532 Uuo unoctium —	533 Uus ununium —	534 Uuq unquadrium —	535 Uuh unhennium —	536 Uuo unoctium —	537 Uus ununium —	538 Uuq unquadrium —	539 Uuh unhennium —	540 Uuo unoctium —	541 Uus ununium —	542 Uuq unquadrium —	543 Uuh unhennium —	544 Uuo unoctium —	545 Uus ununium —	546 Uuq unquadrium —	547 Uuh unhennium —	548 Uuo unoctium —	549 Uus ununium —	550 Uuq unquadrium —	551 Uuh unhennium —	552 Uuo unoctium —	553 Uus ununium —	554 Uuq unquadrium —	555 Uuh unhennium —	556 Uuo unoctium —	557 Uus ununium —	558 Uuq unquadrium —	559 Uuh unhennium —	560 Uuo unoctium —	561 Uus ununium —	562 Uuq unquadrium —	563 Uuh unhennium —	564 Uuo unoctium —	565 Uus ununium —	566 Uuq unquadrium —	567 Uuh unhennium —	568 Uuo unoctium —	569 Uus ununium —	570 Uuq unquadrium —	571 Uuh unhennium —	572 Uuo unoctium —	573 Uus ununium —	574 Uuq unquadrium —	575 Uuh unhennium —	576 Uuo unoctium —	577 Uus ununium —	578 Uuq unquadrium —	579 Uuh unhennium —	580 Uuo unoctium —	581 Uus ununium —	582 Uuq unquadrium —	583 Uuh unhennium —	584 Uuo unoctium —	585 Uus ununium —	586 Uuq unquadrium —	587 Uuh unhennium —	588 Uuo unoctium —	589 Uus ununium —	590 Uuq unquadrium —	591 Uuh unhennium —	592 Uuo unoctium —	593 Uus ununium —	594 Uuq unquadrium —	595 Uuh unhennium —	596 Uuo unoctium —	597 Uus ununium —	598 Uuq unquadrium —	599 Uuh unhennium —	600 Uuo unoctium —	601 Uus ununium —	602 Uuq unquadrium —	603 Uuh unhennium —	604 Uuo unoctium —	605 Uus ununium —	606 Uuq unquadrium —	607 Uuh unhennium —	608 Uuo unoctium —	609 Uus ununium —	610 Uuq unquadrium —	611 Uuh unhennium —	612 Uuo unoctium —	613 Uus ununium —	614 Uuq unquadrium —	615 Uuh unhennium —	616 Uuo unoctium —	617 Uus ununium —	618 Uuq unquadrium —	619 Uuh unhennium —	620 Uuo unoctium —	621 Uus ununium —	622 Uuq unquadrium —	623 Uuh unhennium —	624 Uuo unoctium —	625 Uus ununium —	626 Uuq unquadrium —	627 Uuh unhennium —	628 Uuo unoctium —	629 Uus ununium —	630 Uuq unquadrium —	631 Uuh unhennium —	632 Uuo unoctium —	633 Uus ununium —	634 Uuq unquadrium —	635 Uuh unhennium —	636 Uuo unoctium —	637 Uus ununium —	638 Uuq unquadrium —	639 Uuh unhennium —	640 Uuo unoctium —	641 Uus ununium —	642 Uuq unquadrium —	643 Uuh unhennium —	644 Uuo unoctium —	645 Uus ununium —	646 Uuq unquadrium —	647 Uuh unhennium —	648 Uuo unoctium —	649 Uus ununium —	650 Uuq unquadrium —	651 Uuh unhennium —	652 Uuo unoctium —	653 Uus ununium —	654 Uuq unquadrium —	655 Uuh unhennium —	656 Uuo unoctium —	657 Uus ununium —	658 Uuq unquadrium —	659 Uuh unhennium —	660 Uuo unoctium —	661 Uus ununium —	662 Uuq unquadrium —	663 Uuh unhennium —	664 Uuo unoctium —	665 Uus ununium —	666 Uuq unquadrium —	667 Uuh unhennium —	668 Uuo unoctium —	669 Uus ununium —	670 Uuq unquadrium —	671 Uuh unhennium —