Challenge Workbook 8 Answers

All sample answers to the Cambridge Secondary 1 Checkpoint-style questions have been written by the authors of this work.

Unit 1 Plants

1.1 Turning an idea into a question that can be tested

1 Accept any answer that:

- is in the form of a clearly phrased question or hypothesis
- relates to the effect of either carbon dioxide or colour of light on the rate of photosynthesis of an aquatic plant
- can be tested by experiment.

  For example, for Idea 1, a possible question could be:

  Do aquatic plants photosynthesise faster when they have more carbon dioxide?

  A possible hypothesis could be:

  Water plants give off more bubbles per minute when they are given more carbon dioxide.

2 Look for:

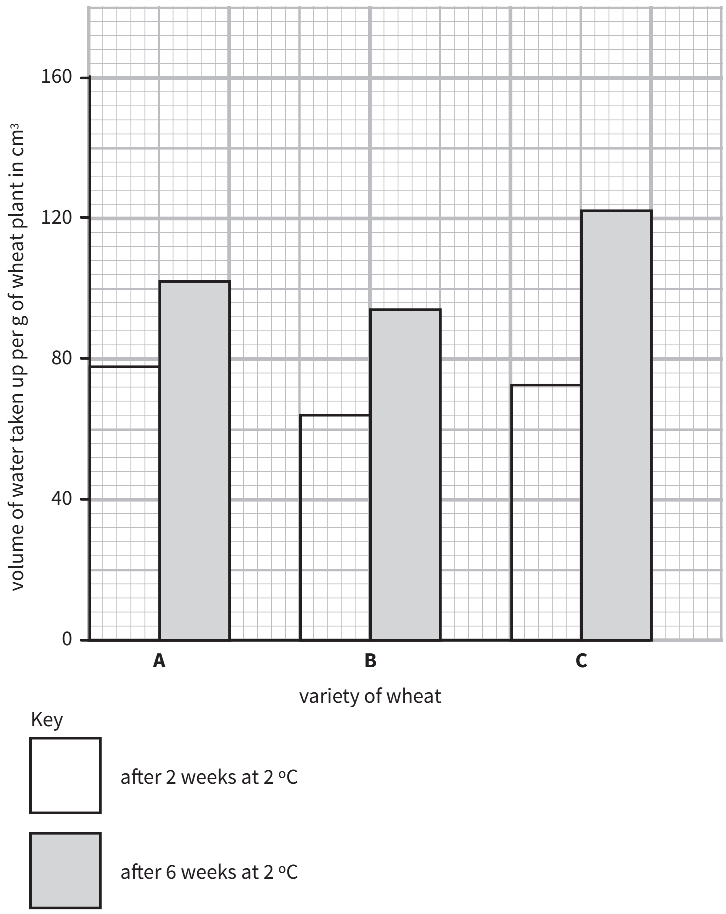
- a clear statement of the independent variable and dependent variable
- at least two other variables that will be controlled
- a clearly explained method, with enough detail that someone else could follow it, including a labelled diagram of the apparatus
- a clear description of how the independent variable will be changed
- a clear description of how and when results will be collected
- a results chart, with headings and units (but no results)
- a prediction based on scientific understanding.

1.2 Interpreting data about water uptake

1 We want to be able to compare the ability of the different varieties to take up water. The quantity of water being taken up will also be affected by the size of the plants, and the plants might be different sizes. Calculating the volume taken up per gram makes it easier to compare the varieties – it controls a variable and makes the comparison fair.

2 A bar chart is the best way to display these data, but you could accept other ways if these are done correctly.

One possibility is shown here.



3 After two weeks, variety A took up the most water, with variety C next and variety B taking up the lowest volume. Students could also calculate the differences between the volumes, for example that variety A took up 6 cm^3 more than variety C.

4 All the plants had taken up a greater volume of water after six weeks. Now, instead of variety A taking up the most, it is variety C.

5 Variety C, because it takes up most water over the longer period. This suggests that it may be able to grow faster than the other varieties in the cold climate of Canada.

Unit 2 Food and digestion

2.1 Investigating how sugar concentration affects the rate of absorption

1 The small intestine.

2 Add Benedict's solution and heat.

3 There are several possible designs of results chart that can be used. For example:

Percentage concentration of sugar	Colour after testing with Benedict's solution		
	After 5 minutes	After 10 minutes	After 15 minutes
0	blue	blue	blue
5	blue	green	brick-red
10	blue	brick-red	brick-red

4 The blue colour after the Benedict's tests shows that there is no sugar present. This is because there was no sugar in the solution.

5 For example:

The greater the concentration of sugar, the more quickly it goes through Visking tubing.

With higher concentrations of sugar, absorption happens faster.

6 This is to do with the rate of diffusion.

The sugar particles are all moving about randomly. The more of them there are, the more likely it is that some will hit the Visking tubing and pass through.

So, after 10 minutes, enough sugar particles had moved into the water from the 10% solution to give a positive result with the Benedict's test. But it took until 15 minutes for enough sugar particles to move into the water from the 5% solution to give a positive result.

2.2 Investigating the effect of amylase on starch

1 The anomalous result is the time of 10 minutes for the temperature of 60 °C.

2 Mean times to one decimal place: 20 °C: 5.3 minutes

40 °C: 2.0 minutes

60 °C: 5.0 minutes

3 It contains starch.

4 The amylase had digested the starch. The iodine remained its natural colour, which is brown.

5 So far, the boys can only say that the temperature at which the enzyme works fastest could be anywhere between 20 °C and 60 °C. They could repeat the experiment, using a range of temperatures on either side of 40 °C: e.g. 30 °C, 35 °C, 40 °C, 45 °C, 50 °C. They could then use their results to narrow the temperature range down even more.

Unit 3 The circulatory system

3.1 Comparing human and fish circulatory systems

1 The diagram should show:

- a two-chambered heart with an upper chamber and lower chamber, labelled
- an indication of blood flowing out of the lower chamber to the gills, with at least one arrow

- an indication of blood flowing from the gills to the rest of the body, with at least one arrow
- an indication of blood flowing from the rest of the body to the upper chamber of the heart, with at least one arrow.

2 A fish heart has only two chambers, whereas a human heart has four chambers.

3 **a** lungs

b gills

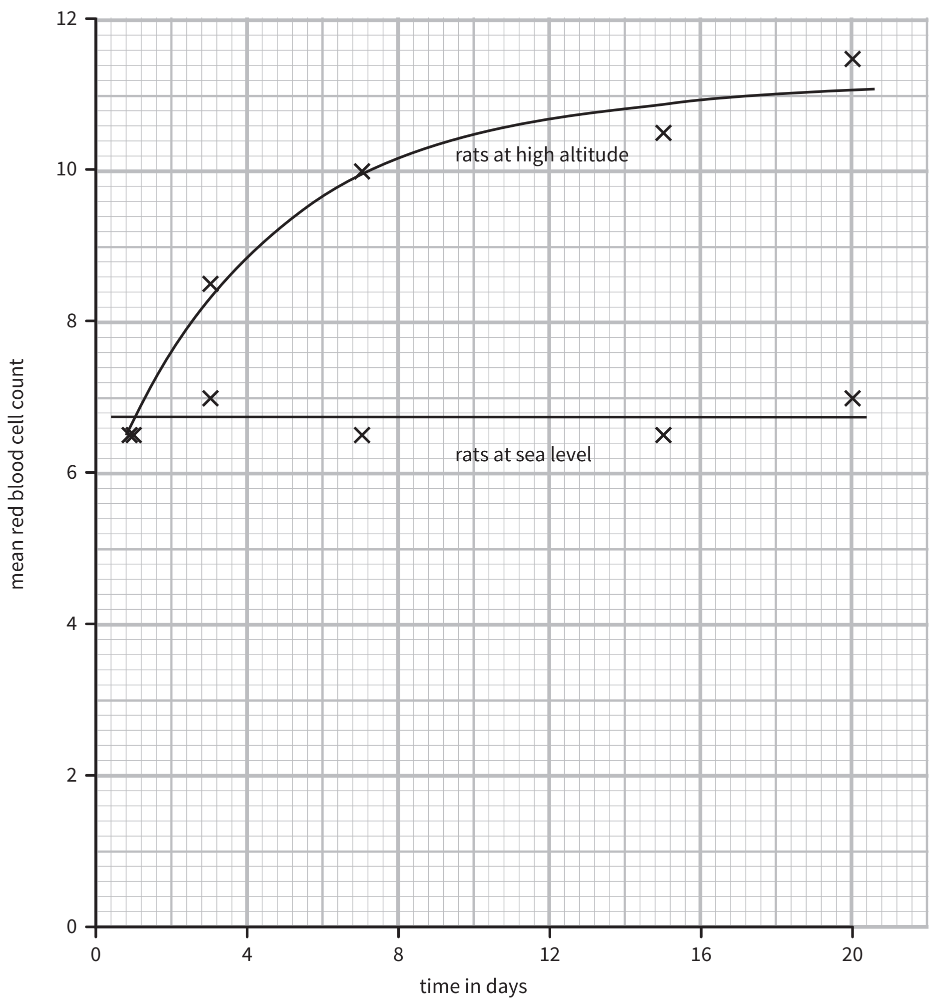
4 Deoxygenated blood, because it has come from the body where it will have given up its oxygen to the body cells.

5 In a fish, blood goes straight from the gills to the rest of the body. In a human, blood goes back to the heart after going to the lungs, and the heart then pumps it around the body.

3.2 Rats at altitude

1 The number of red blood cells might increase. As there is less oxygen in the air, having more red blood cells could help to get enough oxygen to the body cells.

2



3 Whether the rats were at sea level or at altitude.

4 The mean red blood cell count.

5 Two variables should be given. For example: the age of the rats, the food and water provided, how much exercise the rats did.

6 11.5 – 6.5 = 5.0

7 5.0 ÷ 20 = 0.25 per day

8 Their red blood cell count would return to normal, about 6.5 or 7.0. They would no longer need the extra red blood cells, because now they would be surrounded by air with a normal concentration of oxygen.

Unit 4 Respiration

4.1 Lung volume at different ages

1 Look for the idea that there will be a lot of variation in the lung volumes of individual people of the same age. Measuring many samples and calculating a mean takes account of this variation.

2 3.9 dm^3

3 5.0 dm^3 (men) – 3.8 dm^3 (women) = 1.2 dm^3

4 The average volume of air pushed out with one breath of women increases over time until it peaks at the age-group 30–39 then it steadily decreases.

5 An answer of 3.3 dm^3 or 3.4 dm^3 would be acceptable.

6 The line should always be below the original line for women.

It should begin at the 20–29 age range, and end at the 60–69 age range.

It should follow the same pattern as the original line for women.

4.2 Looking at data on giving up smoking

1 Students could choose to display any of these sets of data:

- the percentages of men and women who have given up smoking already, and the percentages of those who are trying to give up smoking
- the reasons for successfully giving up smoking
- the reasons for failing to give up smoking.

2 Look for:

- a neatly drawn chart with ruled columns and rows
- clear headings with units
- correct entries, with no units included in the body of the chart.

3 The chosen method of display should be clearly presented and labelled, so that it is easy to understand.

4 The answer should include some of the following points:

- reference to the fact that people find giving up smoking difficult because nicotine is addictive
- reference to the percentage of people whose reasons for smoking appear to be related to addiction (students should refer directly to the data here, for example, 54% of people say they went back to smoking because they could not manage without cigarettes)
- the idea that e-cigarettes supply users with nicotine, so they will still get the drug to which they are addicted, but can gradually reduce the amount of nicotine in the e-cigarettes until they are ‘smoking’ nicotine-free e-cigarettes.

Unit 5 Reproduction and development

5.1 Growth of girls and boys in India

1 46 cm

2 142 cm

3 142 cm − 46 cm = 96 cm

4 96 cm / 12 years = 8 cm per year

5 Between 0 and 1 years.

6 The line should follow the line already on the graph from 0 to 14 years old.

It should then rise more steeply, ending at a value of 175 cm at 20 years.

5.2 Using apps and smart watches to monitor lifestyle

This is a very open-ended task. Look for:

- some reference to facts – for example, how regular exercise can help to reduce the risk of obesity or heart disease
- clear information about what can be recorded by smart phones or smart watches
- a sensible discussion, in the student’s own words, about how this might help a person to stay healthy; ideally, this should include points both for and against this idea.

You might like to encourage students to give the source of any websites that they have used in their research.

Unit 6 States of matter

6.1 Comparing the diffusion of two dyes

1 **a** the temperature of the water

b the time taken for the dye to diffuse

2 the volume of water used, the volume of dye used, the same range of temperatures

3 The means should be calculated as shown, all written to one decimal place.

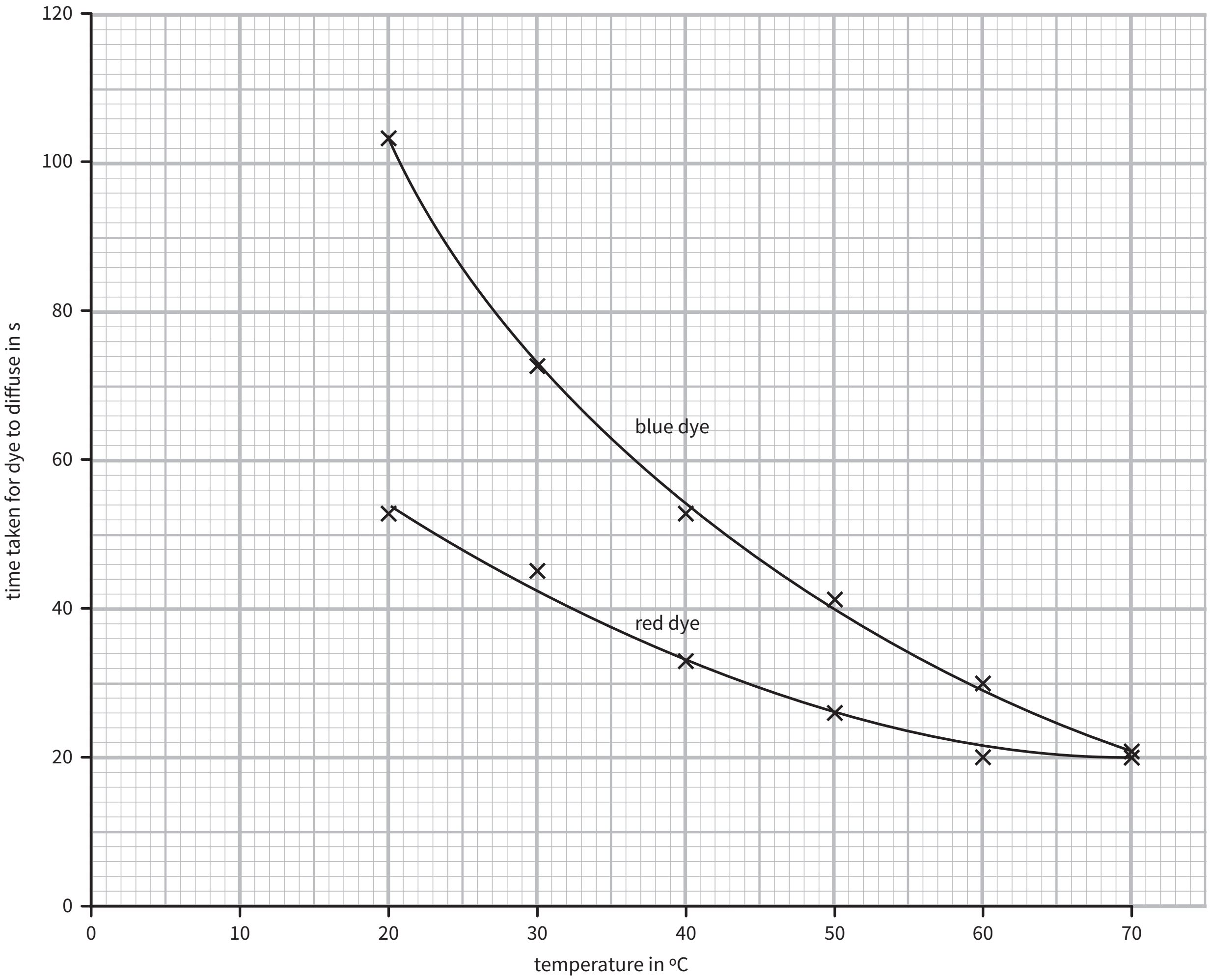
Results for the blue dye

Temperature / °C	Time taken for dye to diffuse completely / s			
	First attempt	Second attempt	Third attempt	Mean
20	108	100	103	**103.7**
30	75	69	73	**72.3**
40	49	55	53	**52.3**
50	39	39	45	**41.0**
60	26	34	30	**30.0**
70	18	24	19	**20.3**

Results for the red dye

Temperature / °C	Time taken for dye to diffuse completely / s			
	First attempt	Second attempt	Third attempt	Mean
20	50	53	56	**53.0**
30	42	44	48	**44.7**
40	35	34	30	**33.0**
50	25	41	27	**26.0**
60	21	19	20	**20.0**
70	20	18	22	**20.0**

The graphs should be plotted on the same axes and appropriately labelled.



Credit:

- the axes the correct way round; temperature on the *x*-axis, time on the *y*-axis
- the use of a suitable scale
- graph drawn neatly with a pencil and ruler
- points plotted accurately
- points joined appropriately
- data for different dyes labelled.

4 The results for the blue dye show that the hotter the water, the faster the dye diffuses.

A change in temperature at the higher end of the temperature range makes less difference than at the lower end of the temperature range.

(Between 20 °C and 30 °C the diffusion time decreases from 103.7 s to 72.3 s, a drop of 31.4 s; between 30 °C and 40 °C the drop in time is 20 s; between 40 °C and 50 °C the drop is 11.3 s; between 50 °C and 60 °C it is 11 s; between 60 °C and 70 °C it is 10.3 s.)

5 The results for the red dye also show that the hotter the water, the faster the dye diffuses.

Again, it seems that a change in temperature at the higher end of the temperature range makes less difference than at the lower end of the temperature range.

(Between 20 °C and 30 °C the drop in diffusion time is 8.3 s; between 30 °C and 40 °C the drop is 11.7 s; between 40 °C and 50 °C the drop is 7 s; between 50 °C and 60 °C the drop is 6 s; there is no drop in time between 60 °C and 70 °C.)

6 The blue dye and the red dye both diffuse faster as the temperature increases. A change in temperature at the lower end of the temperature range used has more effect on the time taken for diffusion than a change at the higher end, for both dyes. However, the red dye diffuses much more quickly than the blue dye. And a change in temperature of 10 °C has less effect on the red dye than the blue dye. There is no change in the time taken for the red dye when the temperature increases from 60 °C to 70 °C whereas the time change for the blue dye is 9.7 s.

6.2 Explaining Brownian motion

1 They could not prove it because they did not have powerful microscopes to enable them to view particles. Credit answers that mention the particle theory and the fact that the Greeks had not thought about this idea so they were not thinking of ways in which they could confirm this idea.

2 His first idea was that the pollen grains were actively swimming.

3 When he looked at dust particles in water he saw that they moved in the same way as the pollen grains. He knew that the dust particles were not living so could not be swimming, so that was not the explanation of why the pollen grains were moving.

4 The important point is that the many, tiny particles of water move about randomly, all the time. Collisions with a pollen grain may knock the pollen grain in one direction, but another time the bombardment by water particles is likely to knock it in another direction. The movement will be in random directions and cannot be predicted. There are so many particles of water that the pollen grains are likely to be hit often and in all different directions.

5 Brown would have seen the pollen grains moving about more quickly if he had used warmer water. This is because the water particles move more quickly so are likely to collide with the pollen grains more frequently and harder.

6 This answer needs to show some reasoning. The argument is more important than any facts. If there were as many pollen grains as water particles, there would not be enough bombardment by water particles to have any effect on the pollen grains. The water particles are very much smaller than the pollen grains. So you would not see the pollen grains moving about.

6.3 Pressure in bottled gas

1 Gas pressure is caused by the particles of the gas colliding with the walls of the container that the gas is in. The smaller the space, the more often the particles collide with the walls, so the higher the pressure.

2 The air will come rushing out, because the particles will rapidly diffuse from the area of high pressure to the one of lower pressure.

3 The cooking gas is stored under high pressure (so that it takes up a smaller space and is easier to transport). The pressure is very high, so the walls of the bottle must be very strong so that the pressure does not cause the bottle to break.

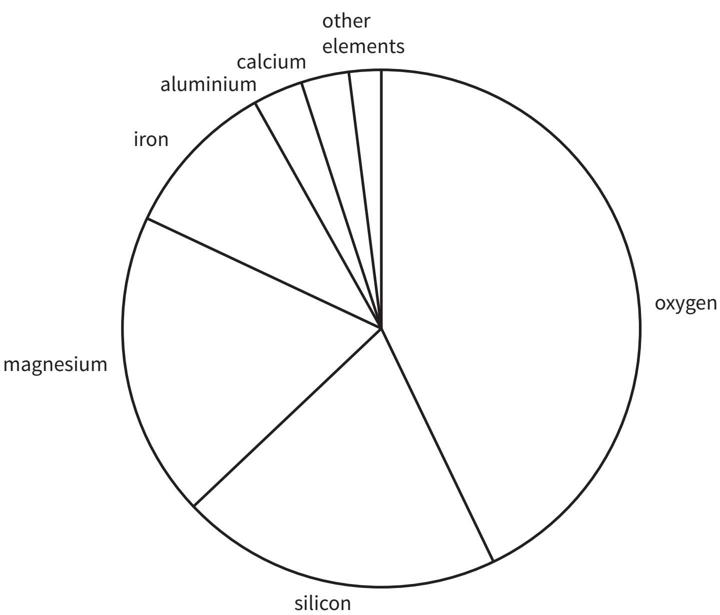
4 The gas inside is under so much pressure that the particles of the gas are squeezed closer together so that they are touching one another but can slide past one another. The cooking gas has been liquefied by pressure – it exists as a liquid.

5 When the temperature increases, some of the heat energy is transferred to the particles of liquid in the container. The particles move about more quickly.

6 If the temperature continues to increase, the particles continue to move more and more quickly. Their increased energy means they can escape the weak forces holding them together as liquid. But there is very little space in the bottle for them to move away (evaporate) and the pressure builds up. If enough pressure builds up the bottle will break open. This can happen violently – the bottle explodes and the gas may catch fire.

Unit 7 Elements and compounds

7.1 Elements in the Moon's crust



There should be evidence of the student doing some calculations in order to create the correct segment size, and of the use of a protractor and ruler.

7.2 Building the Periodic Table

1 He arranged the elements as triads or groups of three according to their properties, and he placed the ones with the lightest atoms at the top and the heaviest at the bottom of the triad.

2 John Newlands then used Doberenier's ideas about similar properties and arranging the elements in order of their atomic mass.

3 The pattern disappeared because there were many as yet undiscovered elements that would have taken up spaces, which would then keep the pattern.

4 Mendeleev modified Newlands' table by leaving gaps for the elements that had not been discovered and made sure that the pattern of the similarities in the properties of the elements was kept. He also swapped a few elements, so they were no longer in order of atomic mass, to fit in with the pattern.

5 Mendeleev's table did not contain helium, argon or neon because they had not been discovered when he was devising his table.

6 fluorine

7 118. If students mention the number of 'natural' and the number of 'synthetic (man-made)' elements here, this would show a great deal of background reading/knowledge.

8 Accept any correct three. Some students will want to list many more than three, especially ones with very strange sounding names. For example: technetium, promethium, polonium, astatine, francium, neptunium, plutonium, americium, berkelium, bohrium, californium, copernicium, curium, darmstadtium, dubnium, einsteinium, fermium, flerovium, hassium, lawrencium, livermorium, meitnerium, mendelevium, nobelium, roentgenium, rutherfordium, seaborgium, ununoctium, ununpentium, ununseptium, ununtrium.

7.3 Formula quiz

1 HCl:

hydrochloric acid

1 atom of hydrogen (H) and 1 atom of chlorine (Cl)

H_2SO_4:

sulfuric acid

2 atoms of hydrogen (H), 1 atom of sulfur (S), 4 atoms of oxygen (O)

HNO_3:

nitric acid

1 atom of hydrogen (H), 1 atom of nitrogen (N), 3 atoms of oxygen (O)

2 hydrogen (H)

3 **a** Na_2CO_3

b $CaCl_2$

c $CaCO_3$

d O_2

e Cl_2

f K_2CO_3

4 It is made of 12 atoms of carbon (C), 22 atoms of hydrogen (H) and 11 atoms of oxygen (O).

5 2 molecules of maltose

6 **a** magnesium hydroxide

b 2

c 2

7 calcium hydroxide $Ca(OH)_2$

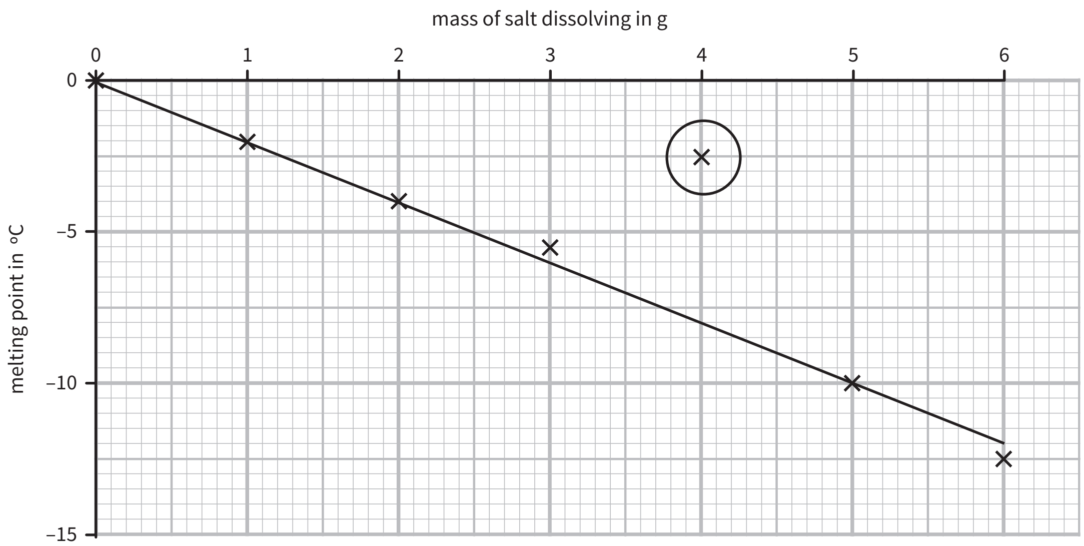
Unit 8 Mixtures

8.1 A frozen mixture of salt and water

1 the volume of water used to dissolve the salt in, the temperature the mixture is frozen at, the size of the pieces of ice when crushed

2 The students may have difficulty with the axes here. The mass of salt used should be on the *x*-axis and the temperature on the *y*-axis. However the temperatures are all at or below zero so the axes should be as shown below.

Credit plotting the points correctly.



3 The plotted point at 4 g salt, melting point –2.5 °C, does not fit the pattern and should be ringed.

4 Credit any reasonable attempt at drawing a line of best fit. The anomalous result (ringed) **must** be ignored.

5 The more salt that is added to the water, the lower the melting point.

6 Credit any reasonable suggestions such as: wrong labels on frozen mixture, mixture made up incorrectly, misreading the mass of salt on top pan balance, misreading the thermometer, ice pieces of different sizes.

7 If the road surface is covered with ice, there is much more chance that vehicles will not be able to stop without skidding and there will be more accidents.

If salt is added to the road surface, in periods when the temperature is likely to fall below zero, any water present on the road surface will not start to freeze at 0 °C. The temperature will have to be several degrees lower than this, depending on how much salt is added, for the surface water to freeze.

8.2 Extracting salt

1 water

2 The main solute is sodium chloride. Other salts are also present, so credit any mention of this.

3 The large shallow ponds have a large area of water exposed to the Sun; this means that the water will evaporate quickly. If the seawater were in deep pools, it would take much longer for the salt to be exposed.

4 If this were attempted in colder countries, it would take far too long for the water to evaporate.

5 The dangers are that cutters and explosives may have to be used and the ground may collapse. The method that involves pumping in water may result in a large area of rock salt being dissolved and the ground collapsing.

6 With solution mining, the salt is pumped up from the ground and does not have to be carried up.

7 Water must be added to the rock salt; the salt will dissolve. This must then be filtered to remove the pieces of rock, which do not dissolve in the water. The salt solution is then heated to remove the water by evaporation.

8.3 Comparing the solubility of two salts

1 the type of salt

2 how much of the salt dissolves

3 the volume of water used and the temperature of the water

4 The account should cover all the points here and it should be possible to follow the plan to complete the investigation.

- Measure a fixed amount of water into two test tubes or beakers.
- Check the temperature is the same.
- Add salt X to one of the test tubes or beakers until no more can be dissolved. Mention measuring the amount of salt added (either count the number of spatulas added or use the top pan balance to measure the mass).
- Repeat using salt Y.

If students have drawn a diagram, credit use of appropriate apparatus such as beaker with thermometer, water at the same level, spatula of salt being added. The diagram should be drawn in pencil, using a ruler where appropriate, and should be fully labelled.

5 80 °C

6 salt Y

7 The solubility of salt X (the solid line) at 0 °C is about 55 g/100 g water. The solubility rises slowly as the temperature increases to about 70 °C, then the graph levels off. This shows that a temperature over about 70 °C makes no difference to the amount of salt X that can dissolve.

8 Salt Y (the dotted line) has a solubility of about 30 g/100 g water at 0 °C. The solubility of salt Y then rises steadily, at the same rate.

Unit 9 Material changes

9.1 Writing word equations

1 zinc + nitric acid ➔ zinc nitrate + hydrogen

2 calcium carbonate + hydrochloric acid ➔ calcium chloride + water + carbon dioxide

The word equation must be written like this, all on one line.

3 The compound is a carbonate.

4 zinc + sulfuric acid ➔ zinc sulfate + hydrogen

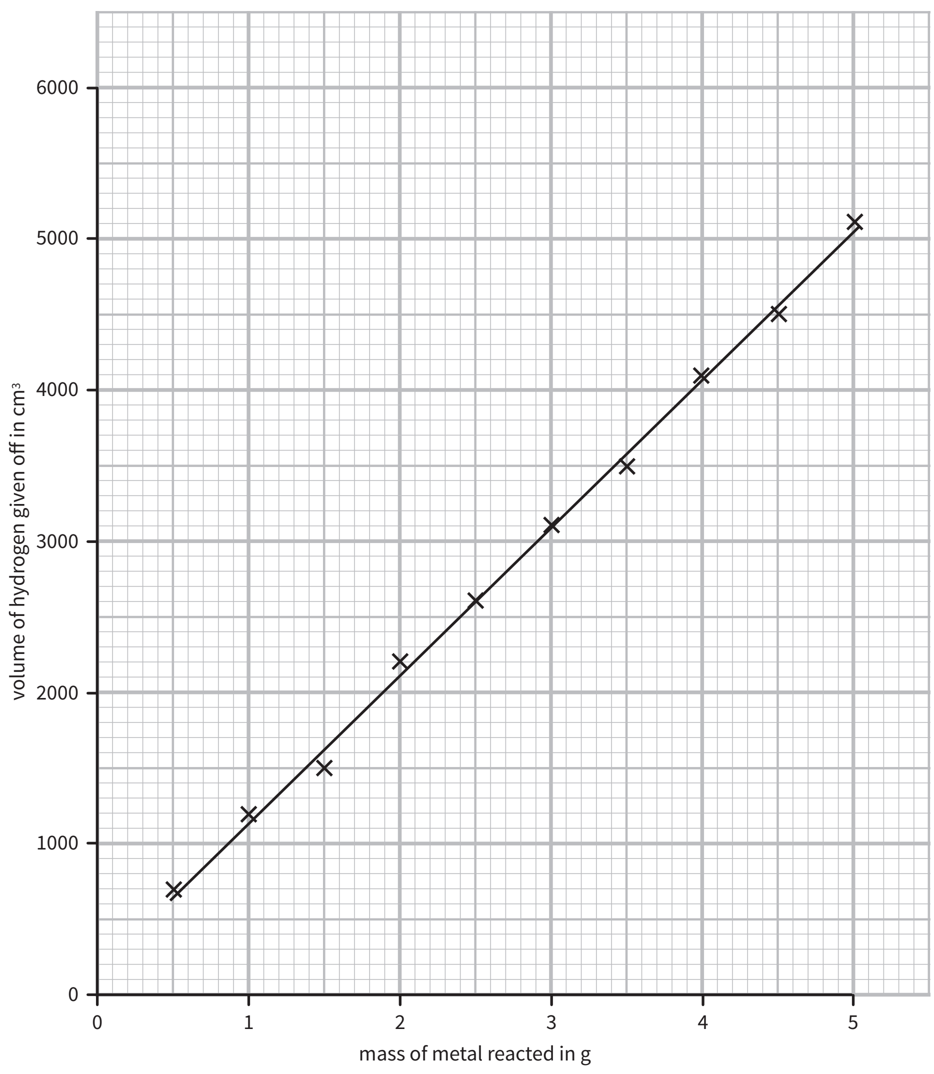
5 hydrogen + oxygen ➔ water

6 hydrogen, sulfur and oxygen

7 copper, carbon and oxygen

9.2 Is more gas produced when more metal is used?

1 Credit use of appropriate scales. Axes round the correct way and accurately labelled. Points plotted accurately and a good attempt at a line of best fit drawn.



2 The more metal used, the more gas is produced. The rate of reaction increases at a steady rate. The line on the graph continues at the same gradient.

3 There may be a problem when you have to change the cylinders. Some gas may be lost if you do not manage to do this quickly.

4 zinc sulfate and hydrogen

5 magnesium chloride and hydrogen

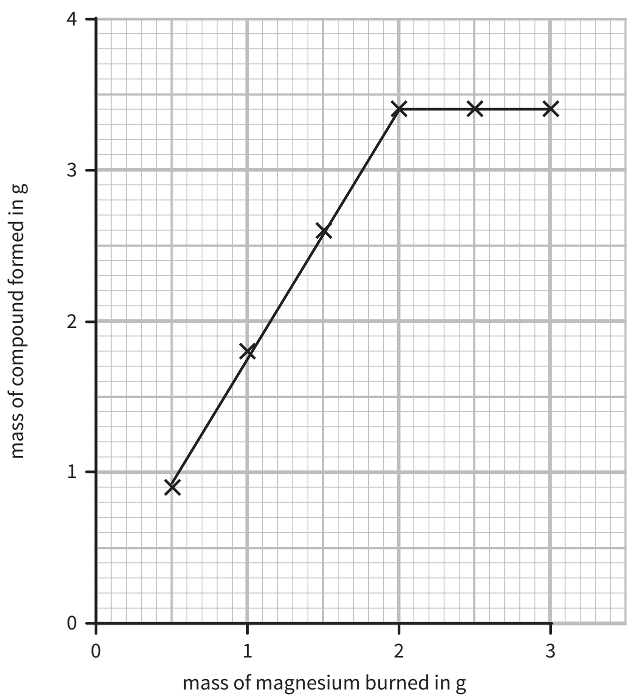
9.3 Investigating burning magnesium

1 the volume of the gas used, the time taken to transfer the deflagrating spoon, the time taken to light the magnesium

2 magnesium + oxygen ➔ magnesium oxide

3 Credit:

- axes the correct way round and correctly labelled, including units
- suitable choice of scale
- points plotted accurately and joined appropriately.



4 The greater the mass of the magnesium burned, the greater the mass of product formed. However this is only true of masses of magnesium up to 2.0 g; above this the mass of product does not change.

5 The mass of the product formed stays the same at these masses because the magnesium has used all the (limited supply of) oxygen available. Some of the magnesium may not have been burnt.

6 **a** There are a number of movements of things into and out of the gas jar, and so chances to spill magnesium or the product. Also there is a good chance that some oxygen will be lost from the gas jar, as the deflagrating spoon is transferred. The lighting of the magnesium would need to be done quickly. If some of the magnesium had not burned it would need to be separated from the product.

b The burning magnesium should not be looked at directly. The deflagrating spoon will get hot so will need to cool down before the mass of the product can be measured.

Unit 10 Measuring motion

10.1 Units of speed

1 60×60

$= 3600$ s

2 1000 m

3 50×1000

$= 50\,000$ m

4 $50\,000 \div 3600$ (allow answer from question 3 ÷ 3600)

$= 13.8888$ or 13.9

rounded to 14 m/s

5 **a** $\frac{36 \times 1000}{3600}$

$= 10$ m/s

b $\frac{300 \times 1000}{3600}$

$= 83.333$ or 83.3

rounded to 83 m/s

c $\frac{5 \times 1000}{3600}$

$= 1.3888$ or 1.39

rounded to 1.4 m/s

10.2 Measuring Speed

1 Either working shown to determine the speed in m/s then ÷ 2 (or × 0.5) to get distance travelled in 0.5 seconds:

$\frac{40 \times 1000}{3600}$

$= 11.11$

$\div 2$

$= 5.555$ or 5.56

rounded to 5.6 m

Or working shown to determine how many km travelled in 0.5 s then × 1000 to convert to metres:

40 ÷ 3600

= 0.01111

÷ 2

= 0.005555

× 1000

= 5.555 or 5.56

rounded to 5.6 m

2 The answer should convey the idea that the speed could change over that distance / speed could increase / speed could decrease.

3 1 ÷ 40

= 0.025 (hours to travel 1 km)

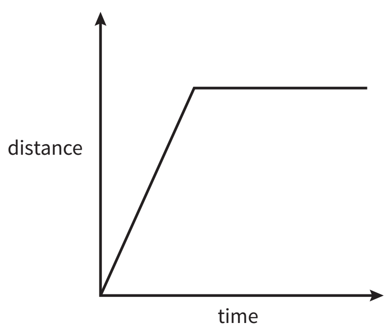
0.025 × 3600

= 90 s

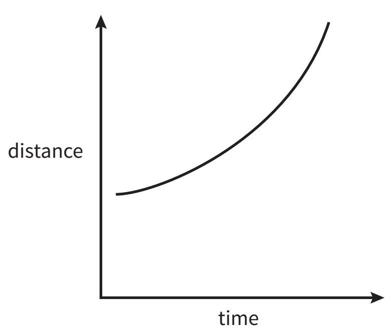
4 Answer should convey the idea that speed is checked over a longer distance in system B, whereas system A just checks speed at one point on the road; cars could slow for the camera in system A then speed up again.

10.3 Showing speed in graphs

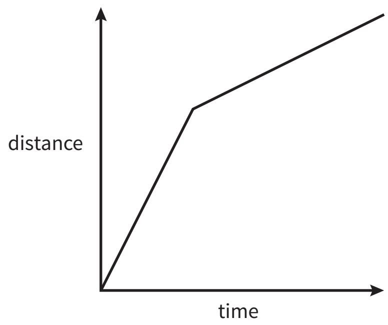
1



The graph must start with a constant slope and finish with a plateau. The line can suddenly change gradient as shown or curve to a plateau.

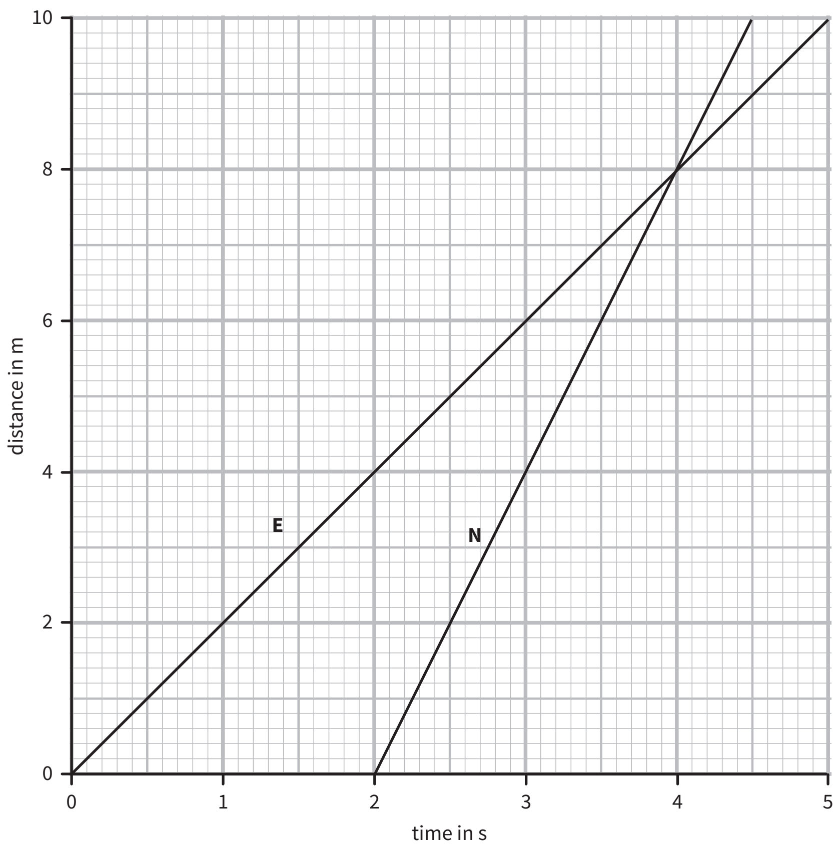


Any line with increasing gradient, but must not become vertical.



Any line that has a steep gradient straight line then a less steep gradient straight line. The gradient can change suddenly as shown or can curve between the two straight parts of the line.

2 and **3**



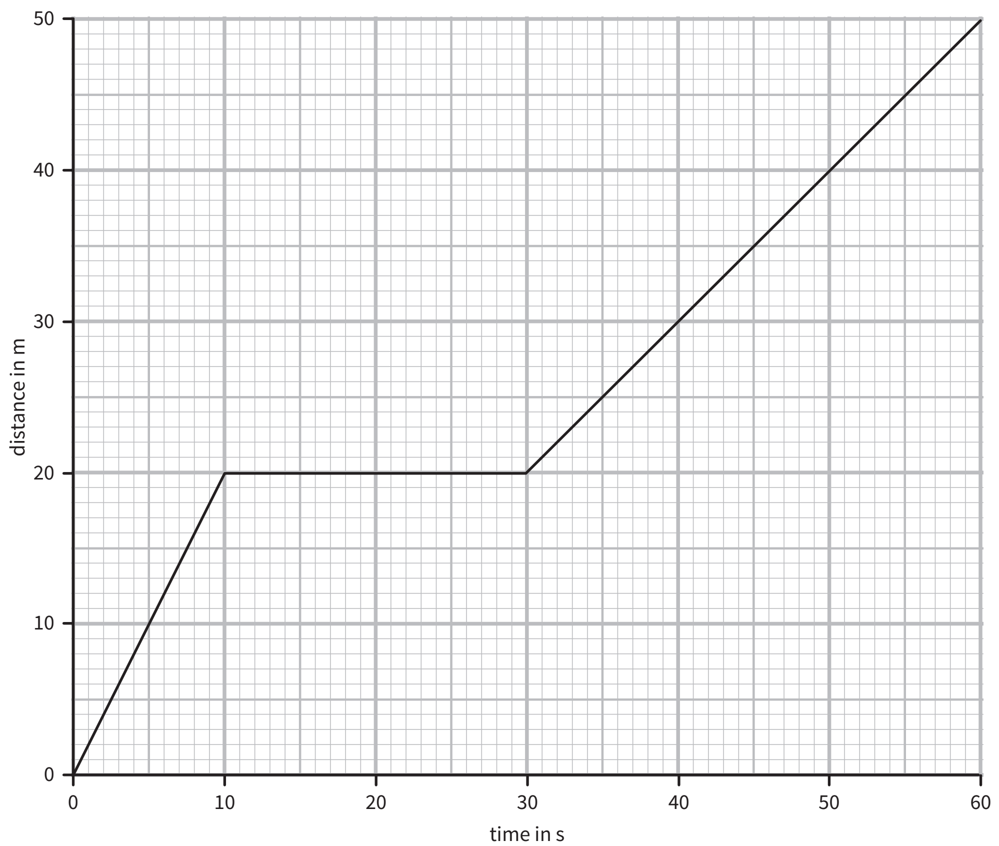
4 The lines on the graph, if correctly drawn, should cross at coordinate (4, 8). A line should be drawn vertically down from where the lines cross to the x-axis.

Answer given as 4 seconds. (Accept the x value where the lines cross even if drawn incorrectly.)

5 A line drawn horizontally from where the lines cross to the y-axis.

Answer given as 8 metres. (Accept the y value where the lines cross even if drawn incorrectly.)

6



(For some credit, accept any positive gradient followed by a horizontal line followed by another positive gradient.)

7 1 m/s (Accept any value derived correctly from their graph, i.e. distance of last section ÷ time taken for last section.)

Unit 11 Sound

11.1 Sound measurements

1 The answer should convey the idea that light travels faster than sound / sound travels slower than light. The answer must be comparative and mention both sound and light. (Ignore figures given for speeds unless that for sound is larger than that for light.)

2 If he changed the distance (between himself and the fireworks), it would affect the time; it would not be a fair test.

3 The calculation must not include the fourth result, 2.3, which is anomalous.

Working shown as $\frac{1.6 + 1.7 + 1.5 + 1.7}{4}$ or equivalent.

Answer given as 1.6

and unit given as s or seconds. (Allow sec or secs.)

4 The calculation should use the result from question 3, even if incorrect.

340 ÷ 1.6 (accept division by 1.63 or 1.625)

= 213 (accept 209 if 1.63 or 1.625 used) or other result from correctly dividing 340 by their answer to question 3

and unit given as m or metres (accept km if converted correctly, e.g. 0.213km).

5 The answer should suggest that this movement would not have any (significant) effect / any effect would not be noticeable / the time may change very slightly / would not change within the precision of his measurements (*accept accuracy* in place of *precision*).

The explanation is that the change in distance is not significant / distance change is very small / small proportion of the total distance.

Give credit for a calculated time value using the distance answer from question 4 with 0.5 subtracted from it, without a written explanation.

6 The speed would decrease with altitude / speed would increase closer to sea level, because sound waves use vibration of particles (to travel), and particles closer together allow faster movement of the wave / reverse argument.

7 $3500 \div 2.36 = 1483$

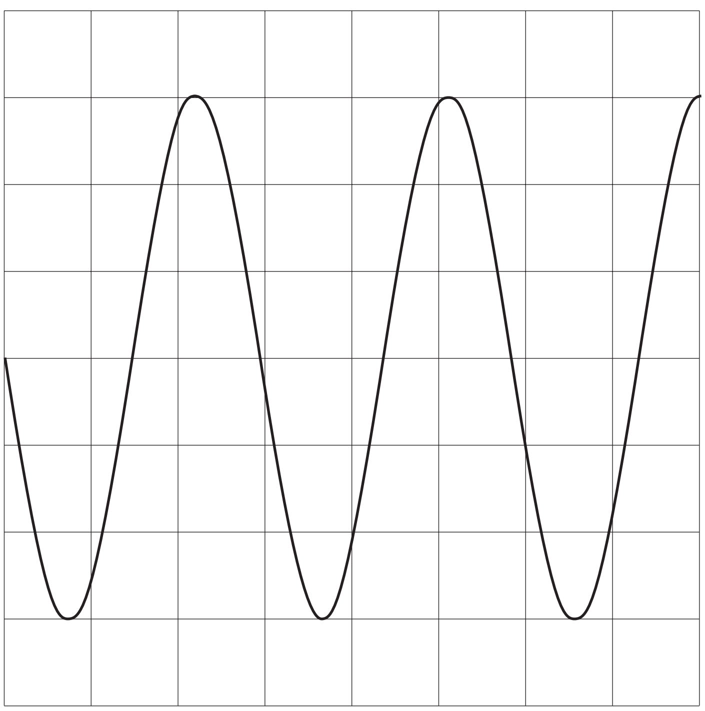
and unit given as m/s

8 The answer should convey the idea that it is different because it is a different substance / different medium / the speed of sound (or any wave) is affected by what it is passing through; and the idea that it is faster in water because sound travels faster in more dense substances / faster in liquid than gas / faster in substances where the particles are closer together.

11.2 Drawing sound waves

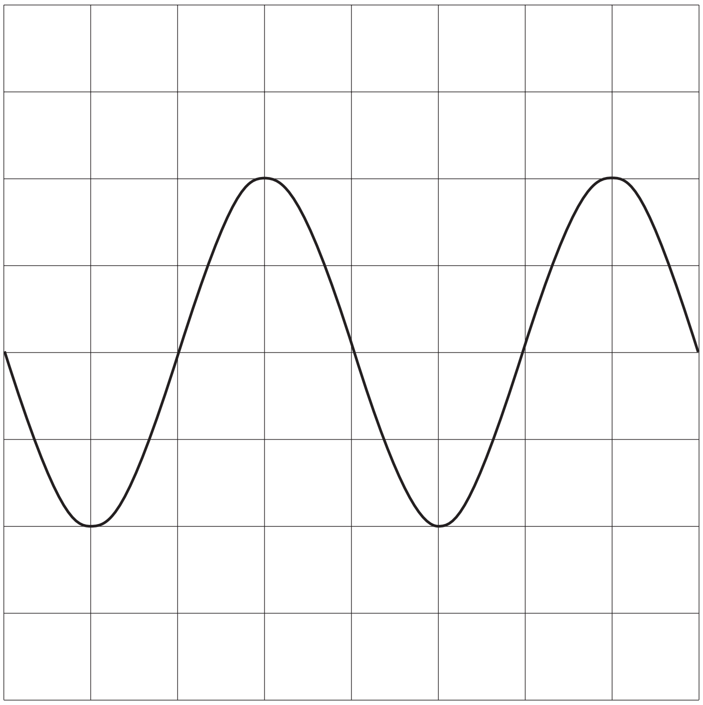
1 B

2



The waves should be drawn to (approximately) the same height as in the original; the waves should be drawn closer together. (Allow an inconsistent wavelength in drawing, as long as wavelength is always smaller than original)

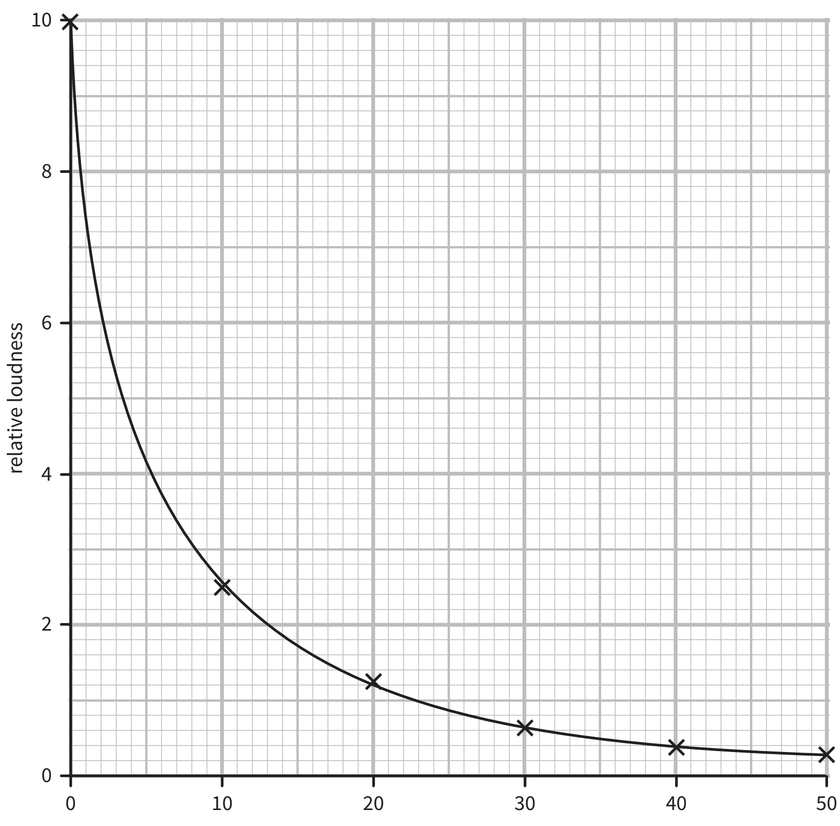
3



The waves should be drawn to (approximately) the same wavelength as original (allow some variation in wavelength, as long as there are two complete waves across the grid as in original); the waves should have smaller amplitude than original, both above and below the central line (allow some variation in amplitude, as long as it is always smaller than original).

4 The answer should convey the idea that sound waves spread out / lose energy / vibrations become less intense with increasing distance from the source.

5



Axes must be the correct way round and correctly labelled, with unit for distance (accept 'distance in cm' or 'distance (cm)'.

The scales should be linear, with a zero at the start of each axis, and such that the whole grid is used in both directions.

All points plotted to within ±½ small square; points can be a small × or a dot in a circle but do not accept large dots 1 mm diameter or greater.

An appropriate smooth, unbroken, best-fit curve should be drawn through the points.

6 (Relative) loudness decreases with increasing distance / negative correlation between loudness and distance (do not accept 'negative correlation' if unqualified).

Plus the idea that loudness decreases (with increasing distance) more rapidly at short distances / less rapidly at longer distances.

Do not accept any reference to inverse proportion.

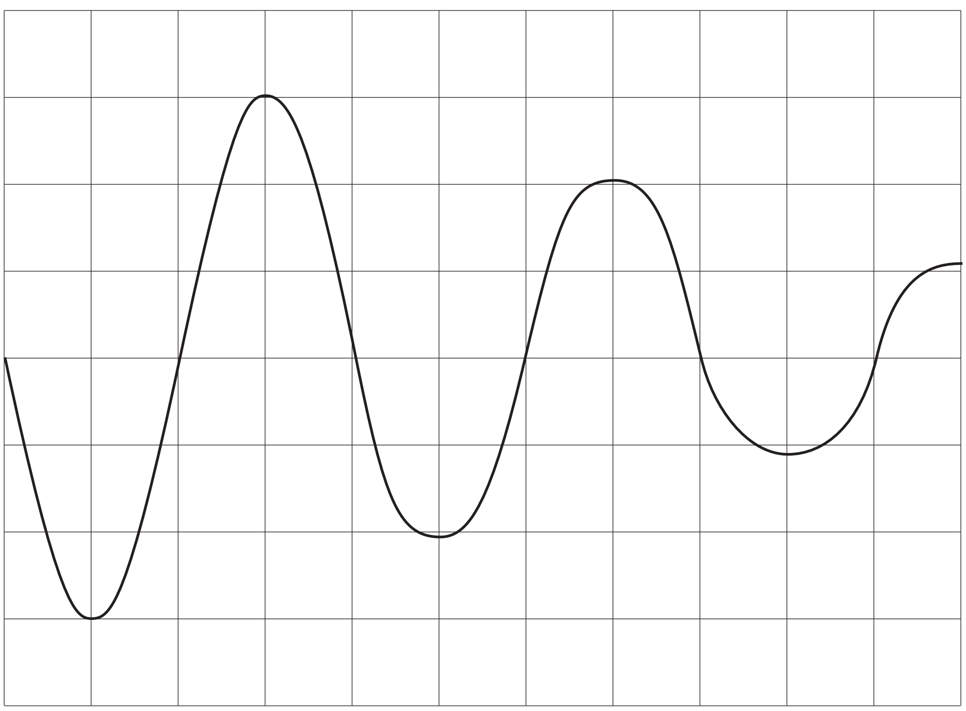
7 The independent variable goes on the horizontal/*x*-axis and the dependent variable goes on the vertical/*y*-axis.

(Accept descriptions of these variables e.g. the distance is being changed and the (relative) loudness is being measured / the relative loudness will depend on the distance, etc.)

8 Any two from:

- pitch / frequency (of the sound source)
- loudness of the sound produced by the speaker / volume setting of the speaker (it must be clear it is the loudness of the sound source that is to be kept constant, as loudness detected is the dependent variable)
- background noise (ideally eliminated)
- setting on the oscilloscope
- use the same microphone
- use the same speaker.

9

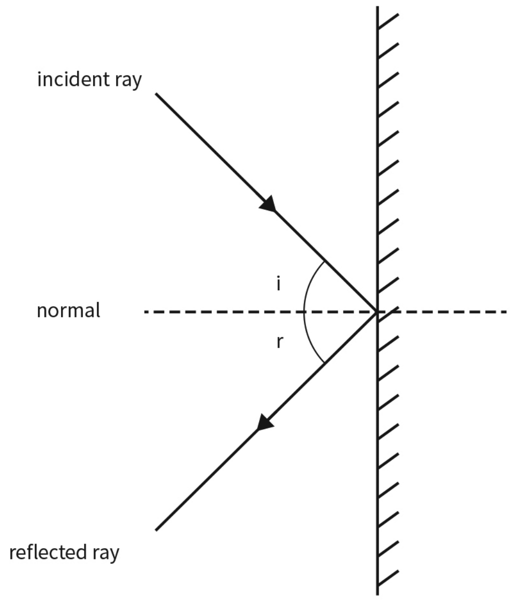


The wave should have (steadily) decreasing amplitude but (approximately) constant wavelength.

Unit 12 Light

12.1 Reflections from mirrors

1



(With or without angle arcs drawn)

2 Angle of incidence 20º or angle of reflection 24º identified

3 The angle of incidence is not equal to the angle of reflection / it does not obey the law of reflection. (Ignore any reference to not fitting a pattern in the results.)

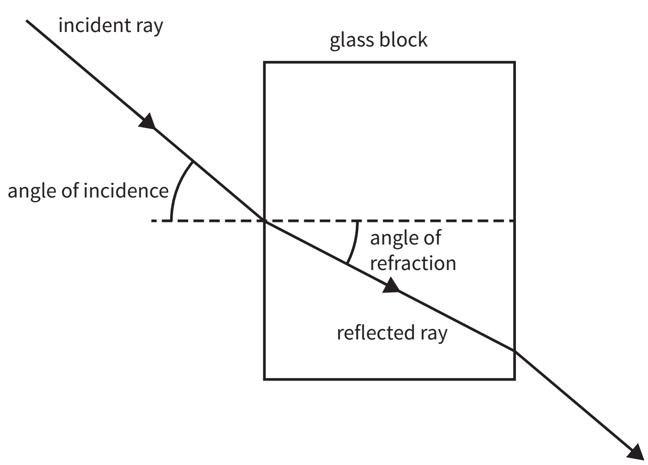
4 The idea is that the reflected ray will travel back along the same path as the incident ray / the reflected and incident rays will overlap. (Do not accept ‘it will come straight back’ without further qualification.)

5 It increases/gets bigger (by 10º).

6 10º

12.2 Refraction by glass and water

1

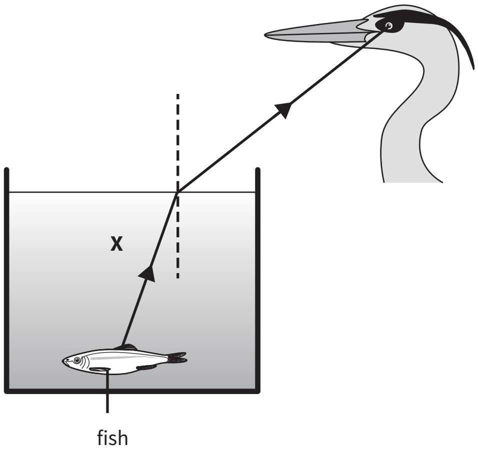


The emergent light ray must touch the glass block and the refracted ray, must be bent down from refracted ray, and ideally be approximately parallel to the incident ray. It should have an arrowhead pointing away from the block. (Ignore any other lines, angles or constructions.)

2 The idea is that the position of the incident ray is marked (on the paper); the position of the emerging ray is marked (with glass block in place); the glass block is removed and the lines are joined. A ruler should be used. Accept description of the use of optical pins.

3 The angle of refraction increases as the angle of incidence increases. The increase is not linear / they are not proportional (to each other). The angle of incidence is always bigger than the angle of refraction.

4



The X can be anywhere in line with the emergent ray (this is not an apparent depth construction)

5 The heron cannot see the fish clearly. The position of the fish appears to move / the angle of incidence / position of refracted ray continually change. Also, changing reflections from the water surface will be distracting.

6 There is no refraction of light rays from the fish to the bird / light rays continue straight at water surface / angle of incidence and angle of refraction are zero. The fish appears in its actual position / these birds do not need to compensate for the refracted angle. Accept a light ray drawn vertically upwards from the fish to the bird as long as it crosses the water surface with an angle of incidence of approximately 90°

12.3 Using coloured filters

1 **a** (mainly) red

b (mainly) green

c (mainly) blue

d (mainly) yellow

2 **a** blue

b nothing / no light / black (do not accept 'dark')

3 **a** red

b nothing / no light / black (do not accept 'dark')

4 **a** green

b green

c black

d black

5 **a** Only red is seen on the screen.

b Nothing is seen on the screen.

Unit 13 Magnetism

13.1 Investigating materials

1 **a** magnetic — is attracted to a magnet / sticks to a magnet

b magnetised — has been made into a magnet / has become a magnet

2 Three materials to be described separately, in any order. Each must be tested with the bar magnet. Ignore any reference to testing with the magnetised block or any other type of test.

The aluminium will not stick to the (bar) magnet / will not be attracted to the (bar) magnet.

The iron block that is *not* magnetised will be attracted to the (bar) magnet equally on all sides.

The iron block that is magnetised will be attracted to the (bar) magnet on one side and repelled on the other; or attracted to the (bar) magnet more strongly on <u>one side</u> than the other iron block; or attracted to the (bar) magnet more strongly on one side than the other.

3 Website 1 – ideas that:

- (possibly) not reliable
- anyone can post
- may not be moderated / checked / edited
- information could be incorrect / useful if correct
- information could be useful if written in terms she can understand.

Website 2 – ideas that:

- reliable
- written by professional people / teachers / information will be correct
- information should be understandable / at the right level for her (and so useful).

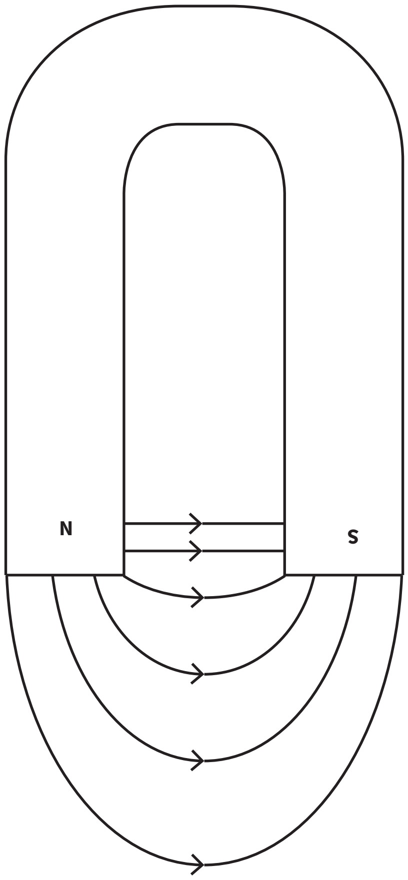
Website 3 – ideas that:

- reliable
- written by teachers / lecturers / experts / scientists / information will be correct
- information probably too advanced (and so less useful).

4 The small (paper clips); because they will be better for detecting small differences / he may miss small differences with the big ones. Accept examples, such as: two magnets may only lift the same number of big paper clips, but there may be a difference in the number of small ones they lift.

13.2 Investigating magnetic fields

1



Field lines drawn between N and S poles; horizontal and parallel between the sides of the poles; curved, connecting the ends of the poles; arrows on at least two field lines pointing from N to S; lines should not touch or cross each other. (Ignore lines extending outward from poles and not continuing.)

2 Magnetic field lines drawn around both magnets that are not touching each other, nor crossing; arrows on at least one of the field lines of each magnet, pointing N ➔ S; more densely packed field lines around the stronger magnet. (Field lines from middle of poles do not all have to be continued to the opposite pole; field lines should touch the poles, but can come out from the sides of the poles; ignore the distances to which the field lines are drawn in both cases.)

3 **a** number of paper clips supported / strength of the magnetic field

b the material (to be investigated) / list of all five materials

4 Any two from: (size of) paper clips; thickness of material. Also allow orientation of the magnet; distance from other magnetic materials / distance from metal clamp stand.

5 use smaller paper clips / lighter pieces of magnetic material (accept examples such as staples, pins etc. but not iron filings unless the suggestion is to weigh them); and the idea that paper clips in the first trial may be too big to detect small differences.