Challenge Workbook 7 Answers

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

Unit 1 Plants and humans as organisms

1.1 Comparing plant structures

1 Look for:

- answers written in the student's own words, not simply copied from another source
- clear, simple expression of ideas
- function of leaves given as making food, using sunlight
- function of flowers given as reproduction, involving the production of seeds
- function of roots given as anchoring the plant to the ground, and providing water and minerals
- function of stems given as holding the leaves and flowers above the ground.

2 Look for:

- a comparison table drawn neatly with a ruler and a pencil
- at least two columns, headed **Plant A** and **Plant B**
- an optional initial column, with a heading such as **Feature**
- comparative points arranged opposite one another, with ruled lines separating each pair of points
- differences expressed simply and clearly, stating the part being compared and a clear description
- differences that relate to one another – e.g. statements about flower shape for both plants, rather than a statement about leaf shape for one and position of leaves for the other
- at least ten differences given.

1.2 Choosing a question about bones to investigate

1 Are thick bones stronger than thin bones? ✔

Do hollow bones break more easily than solid bones? ✔

2 **a** There should be a clear statement of either the thickness of the straw, or whether the straw is hollow or solid (depending on the chosen question).

b The force needed to bend the straw.

c Look for at least two correct answers. They should be things that would actually affect the results if they were altered, for example: the length of the straw; the position of the hook on the straw; the angle at which the forcemeter is pulled; the material from which the straw is made.

d The description should state clearly what the student would do, in a suitable sequence.

A good measure of success is whether someone else could follow these instructions without having to ask for further guidance.

e The results chart should be drawn with a ruler and a pencil. The first column (or row) should be headed with the variable that will be changed (either the thickness of the straw, or whether the straw is hollow or solid). If thickness has been chosen, there should be a suitable unit for this, e.g. mm. The second column (or row) should be headed with: **Force needed to bend the straw in newtons**.

Some students may decide to make repeat measurements, in which case they will need to include columns (or rows) for each of the force measurements, and another column (or row) for the calculated mean.

f Accept any prediction that relates to the stated question. It does not have to be a 'correct' prediction. For example, for the first question, any of these predictions would be appropriate:

Thick bones are stronger than thin bones.

Thick bones are not stronger than thin bones.

Thin bones are stronger than thick bones.

There is no difference in the strength of thick bones and thin bones.

1.3 Planning an experiment about muscles

1 This task is much less structured than that in Challenge 1.2. Students are advised to follow the structure given in Challenge 1.2 to guide them. For some students, you might like to give them a 'help sheet' with a series of structured questions on it, if you feel that the challenge posed here is a little too great.

Look for:

- a clear statement of what will be changed – whether or not the person has been jumping or whether they have been sitting down
- a clear statement of what will be measured – the number of lifts that can be done in a minute, for several consecutive minutes
- a clear statement about what will be kept the same – including the position of the arm; the weight that is lifted; the distance that the weight is lifted
- instructions that could be followed by someone else to carry out the experiment, with no further guidance needed

- a results chart drawn with ruler and pencil, columns clearly and fully headed; for example:

Time in minutes	Number of lifts in one minute	
	After jumping	After sitting
1		
2		
3		
4		
5		

- a prediction of what they would expect to find. Accept any prediction that is relevant.

  It would be excellent if students were given the opportunity to carry out their experiment after they have planned it. They will almost always find things that they want to change once they begin actually doing the experiment. This is to be encouraged.

  It is quite likely that their results will not match their prediction. For example, students may predict that the biceps will tire more quickly after jumping, and then find out that it makes no difference whether they have been jumping or sitting. If this happens, take the opportunity to make clear that this is good science, not a 'failed' experiment. The purpose of an experiment is to find out whether or not a prediction is correct, not to confirm a prediction. Evidence that suggests that a prediction (or hypothesis) is incorrect is just as important and useful as evidence that suggests it is correct.

Unit 2 Cells and organisms

2.1 Analysing data about mould on bread

1 The best way would be to use a piece of mesh, or some transparent paper marked off in squares of known size, e.g. with 2 mm sides. They could place the mesh or paper over the mould, and count how many squares the mould covers.

2 A circle should be drawn around the number 5, bread sample 2 in dish 4.

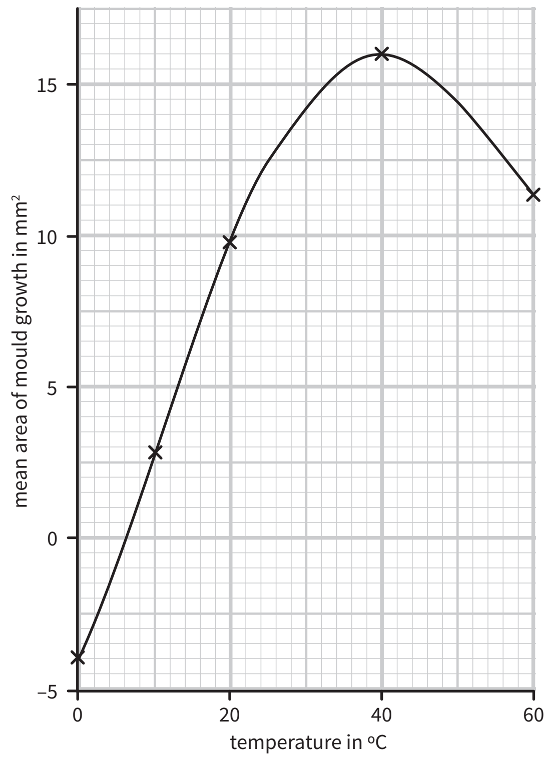
3 16 mm^2 but, strictly, this should be written as 16.0 mm^2, to match the number of decimal places given for the other means.

4 11.7 mm^2

5 There could be variables that the boys were not able to control, for example:

- despite their best efforts, there may have been more moisture on some pieces of bread than others
- more mould spores might have landed on one piece of bread than on another
- there might have been small variations in the nutrient levels in different pieces of bread, even if they came from the same slice
- it is really difficult to estimate the area that the mould covers, because the patches are irregular, so the boys' measurements may not have been exactly correct.

6



7 The conclusion should relate to the aim of the experiment, which was to investigate how temperature affects the growth of mould on moist bread. Suitable conclusions could be:

- Mould grows best on bread at 40 °C.
- As temperature increases, the growth of mould increases, until the temperature is higher than 40 °C.
- Mould generally grows better at higher temperatures than at lower temperatures, but it does not grow well at temperatures above 40 °C.

8 Look for:

- an answer that relates to these particular results, i.e. to mould growing on moist bread at different temperatures, rather than a general answer
- an explanation – that is, the answer explains **why** the results are as shown in the table or graph, rather than simply describing the results
- a logical explanation, which is easy to follow sequentially, step by step
- an explanation that uses all of the information provided, and that relates to the full pattern of results across the whole range of temperatures
- an answer written in the student's own words, with almost nothing copied word-for-word from the information provided.

2.2 Stinging cells in *Hydra*

1 **a** tissue

b tissue

c cell

d organ

2 No, *Hydra* does not have a digestive system. A system is made up of many different organs, and *Hydra* just has a cavity inside which food is digested.

3 Nucleus, cytoplasm, cell membrane.

4 It does not have a cell wall. This is the only genuinely distinguishing feature. The lack of a large vacuole or lack of chloroplasts does not definitely mean it is not a plant cell, as there are many examples of plant cells that lack these features.

5 Look for an explanation that relates the **structures** inside the sting cell, and its **behaviour**, to its **function** of trapping (and possibly killing) prey. The answer must not copy the sentences in the text preceding the diagrams. Students should use the information from here, but present it in their own words.

Unit 3 Living things in their environment

3.1 Hydrothermal vents

1 There is no light, so they cannot photosynthesise. (Note that the question asks for an explanation, so it is not enough just to say that there is no light.) It is too hot, so any plants would be killed.

2 There is no light, so there would be no use for eyes.

3 Accept any four-organism food chain that matches the descriptions, for example:

bacteria ➔ zooplankton ➔ sea anemones ➔ octopuses

Check that each arrow is pointing in the direction of energy flow.

4 Bacteria.

5 From the chemicals in the water coming out at the vent.

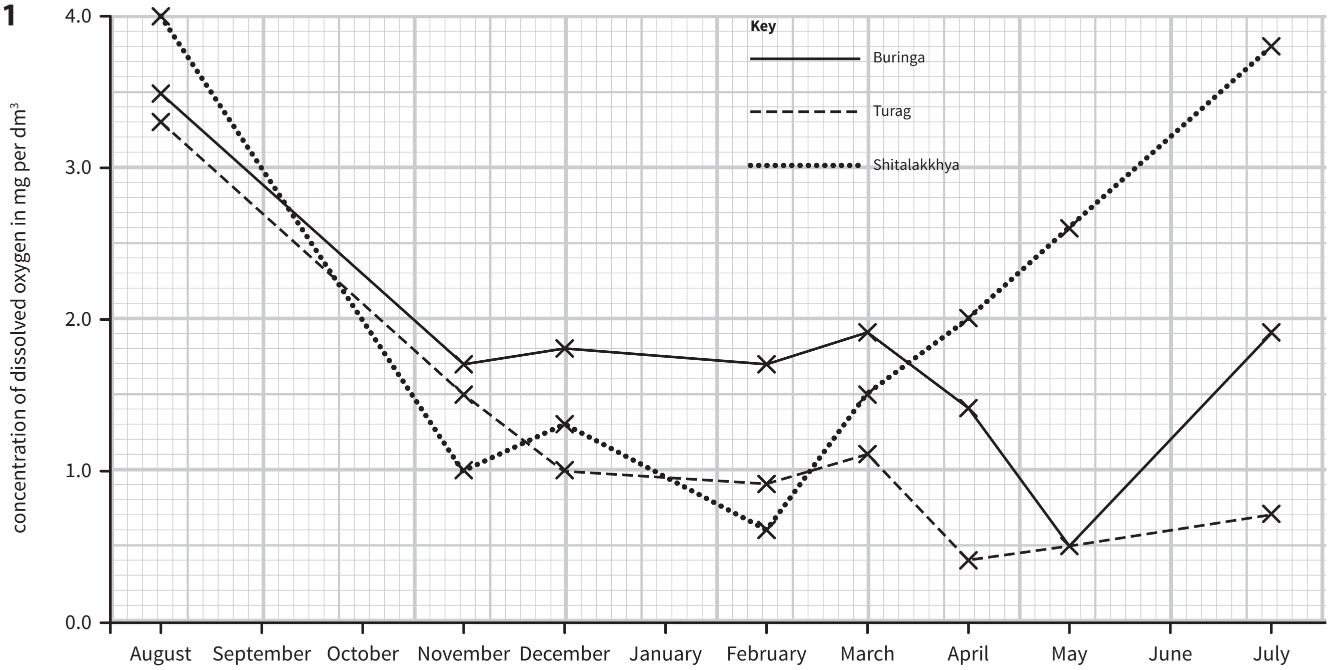
6 All of the organisms in the food chain, apart from the bacteria, should be listed.

7 Energy is passed from one organism to another in food, as they eat one another.

8 The energy at the start of a food chain on land is from light. The energy at the start of this food chain is in the chemicals in the water.

3.2 Water pollution in Bangladesh

1



2 River Turag, 0.4 mg per dm^3

3 August.

4 May. This is when its concentration of dissolved oxygen was lowest. Low oxygen results from high pollution, because bacterial populations increase as they feed on the pollutants. The bacteria use up oxygen as they respire.

5 December to April.

6 This is a difficult question. Students need to be able to:

- see the link between the patterns shown in the two graphs, such that they appreciate that the times of year when the water flow is least match the times of year when pollution levels are at their highest (i.e. oxygen levels are at their lowest)
- assume that the quantity of pollutants getting into the river is likely to be about the same throughout the year
- appreciate that the same quantity of pollutant added to a larger volume of water will result in a lower concentration.

Thinking through so many linked steps is a high-level skill, and one that many Stage 7 students will not be able to achieve without some guidance. You could discuss this with them, or ask them to discuss it in groups, before asking them to write their answers. The final idea, relating volume and concentration, is particularly difficult. You might like to help with this by demonstrating adding some fruit drink to a glass, and then adding different volumes of water to it, and asking what effect this has on the concentration of the fruit drink.

3.3 Conserving snow leopards

This is a very challenging task, which can probably only be tackled successfully by students with fairly strong English language skills.

They will need to be able to pick out individual pieces of information from the text, map and charts, and then put these together in their own words.

It could be very valuable to work through all of the information either as a whole class, or as group discussions, before asking individuals or groups to complete the task.

It is suggested that you do not ask students to search for extra information on the internet or in books, but restrict them to the information provided here.

Look for:

- good use of a wide range of information from that which is provided – but not necessarily all of it
- a logical sequence to the written account, which is easy to follow
- accurate use of the information provided, based on the evidence; if students are making suggestions, predictions or guesses that go beyond the evidence, they should state this clearly
- an individual account that does not copy sentences from the text provided
- an ability to pull together some of the evidence from different sources.

Try **not** to judge grammar and spelling too harshly. It is the ability to analyse and present information that is being practised here.

Similarly, do **not** judge the answer on its length. A well-focused, information-packed and carefully constructed short answer is far better than a long one that does not meet these criteria.

Unit 4 Variation and classification

4.1 A new frog species

This is a very open-ended task, and many students will benefit from discussion about the issues involved, before attempting to construct their answer. This could be done as a class discussion, or you could ask students to discuss in pairs or small groups. They could then either write their answers individually, or work together to construct an answer.

Some students may simply state that the researchers should find out whether this frog can breed with frogs in other species. You could explain the great difficulties in determining this, and that usually decisions about species are made by making comparisons between the characteristics of the organisms.

Look for these features in the students' answers:

- an appreciation of the importance of using several specimens to study, because of variation within a species; but that studying too many of the little frogs might endanger the species, especially if these are not returned to their natural habitat
- a clear, simple description or list of what evidence the scientists should collect. This could include information about observable features (e.g. coloration), measurements of body parts, behaviour and perhaps a study of its genes – and that these should be compared with the same features in other similar frog species. Some students might also suggest studying the tadpoles, to see if they differ in any way from the tadpoles of the other species.

- reference to the ability of this frog to breed with known species of frog to produce fertile offspring
- suggestions about how the scientists could use their information to decide whether the frog belongs to a new species.

Some students may also be able to add information that they find on the internet. For this, it is very important to make sure that they have written in their own words, and not copied sentences directly from their sources.

4.2 Variation in pea pods

1 Number of peas, length, width.

2 Number of peas: 9, 9, 9, 11, 8, 7, 10, 6, 13, 7, 9, 12, 9, 10, 9, 9, 7, 11, 9, 8

Length of pods: The lengths that learners measure will vary, depending on the exact parts of the pods that they use as the start and end of the line that they measure. Representative values are: 32, 29, 42, 42, 27, 28, 29, 34, 41, 42, 42, 42, 34, 34, 34, 34, 33, 34, 42, 39 (all in mm)

3 There are different possibilities for the choices of categories into which to group the results, so accept other groupings.

Number of peas:

Number of peas	6 to 7	8 to 9	10 to 11	12 to 13
Tally	||||	~~||||~~ ~~||||~~	||||	||
Number of pods	4	10	4	2

Length of pod:

Length in mm	25 to 29	30 to 34	35 to 39	40 to 44
Tally	||||	~~||||~~ |||	|	~~||||~~ ||
Number of pods	4	8	1	7

4 The frequency diagrams that learners draw will depend on the feature they have chosen, and the way that they have grouped the data.

Look for:

- the chosen feature on the x-axis, with a clearly labelled scale including units
- the number of pods on the y-axis, with a scale with equal intervals
- at least half of the graph grid used, preferably more
- bars carefully and neatly drawn, touching each other

4.3 Researching a group of invertebrates

1 Assess students' work individually.

This task gives students experience of using the internet and books to find information, and then selecting small parts of that information to write their own account of a group of invertebrates. Five groups are given as suggestions, but students should be free to research any invertebrate group of their own choice.

There are several challenges involved in this task. They include:

- finding sources of information, using suitable search terms on the internet, or finding relevant books in a library
- sifting out good sources from those that are less useful and possibly less reliable
- selecting the most useful and interesting pieces of information from the chosen secondary sources
- summarising this information in their own words, or with annotated diagrams
- presenting the information in an interesting way.

This is another task where group work could be valuable, enabling students to share out tasks and pool resources. Discussion between the members of the group will help them to focus on the different aspects of the task, and to develop their skills to a higher level.

You could ask each group to present their findings to the rest of the class.

Unit 5 States of matter

5.1 Properties of solids, liquids and gases

Look for answers that show an understanding that the individual pieces of flour do not change shape or volume, but the air between the pieces does.

1 A: liquid or gas

B: liquid or gas

2 A This shows the flour being poured. The flour behaves in this way because it is a powder. That is, the solid pieces of flour are small and they have an irregular shape so that there is space for air between them. This means that the powder behaves like a liquid and can be poured because the individual pieces can slide past one another.

B This shows the flour takes the shape of these different containers because the individual pieces of flour are very small and have air between them. They cannot, as a group, hold themselves in a fixed shape, but each individual piece is a fixed shape.

C This shows what happens when the container is shaken or tapped on the table. This causes the air between the small pieces of flour to rise to the top and so the flour takes up less space in the container. The pieces of flour do not take up less space, but the air between them is moved to the space above the pieces of flour.

5.2 Investigating fizzy drinks

1 Give credit to any prediction chosen if it has a **logical** explanation and / or some practical example to back it up.

Most students will be able to recognise the fact that something is escaping. This means something is lost, so that must have mass; thus the mass of the flat drink will be smaller than that of the fizzy drink. Some will recognise that gas does not have much mass and thus may choose the ‘mass will stay the same’ option, especially if they recognise how accurate a balance they would need.

Those who choose the 'it will get heavier' option may find it more difficult to give a logical explanation.

2 Look for any method that takes account of fair testing, reliability and logic. The main steps should be as follows:

- Place a can or bottle of fizzy drink on the balance. Some comment as to the accuracy of the balance should be made (in grams to at least two decimal places).
- Find mass.
- Open can / bottle. (Mass measured with top on.)
- Measure mass every minute for ten minutes.
- Repeat to ensure the reliability of results. The same size of bottle and brand of drink should be used.

It is acceptable to use a measured volume of the fizzy drink in a beaker and then find the mass every minute. Some comment should be made that the first reading would need to be done quickly, so that on repeating, you use fizzy drink with the same amount of fizz.

3 Suggested table:

Time in minutes	Mass in grams	Mass in grams	Mass in grams	Mean mass in grams
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Give credit even if students do not have additional columns for collecting repeated results and calculating the mean.

5.3 Investigating hot liquids

1 Look for any logical method, which takes account of making this a fair test and repeating it for reliability.

One method would be:

- Place some of the oil in a beaker and allow it to come to temperature.
- Use the thermometer to get an accurate temperature. Some mention of this being difficult to do would show a high level of understanding.
- Pour the oil through the funnel and measure the time for a measured volume, such as 50 cm^3, to come through.
- Clean up the funnel etc. and repeat at another temperature.

If students mention the fact that the temperature of the oil will change during the test, this again shows a high level of understanding.

Some mention of reliable results and repeating each temperature is needed.

2 They should have used the **same equipment**, the **same method** and, for the method above, measured the time for the **same volume** of oil to move through the funnel.

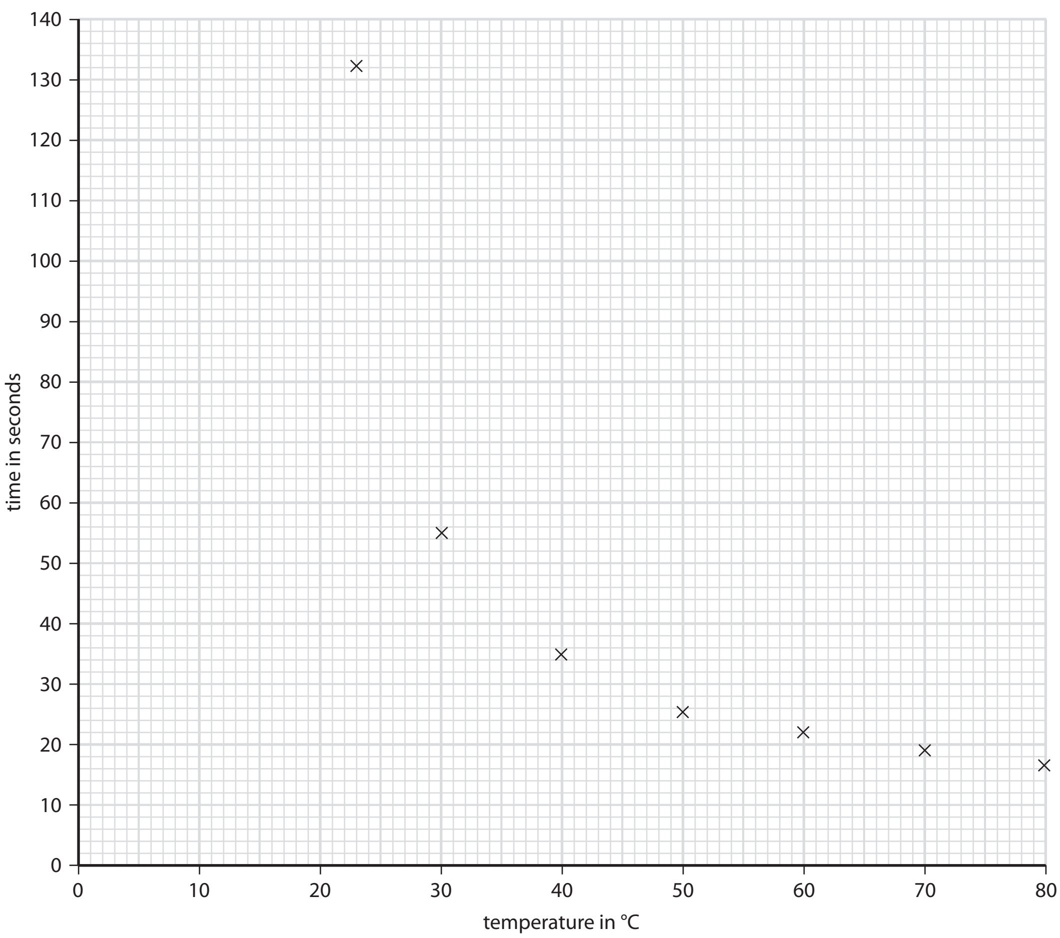
3 This could be because they made a mistake, but it is more likely to be because this was the temperature of the room and thus the oil.

4

Oil temperature in °C	Time for oil to run through funnel in seconds			
	Amal's results	Anna's results	Sam's results	Mean
23	137	132	128	**132.3**
30	55	57	54	**55.3**
40	33	36	35	**34.7**
50	27	25	24	**25.3**
60	22	21	23	**22.0**
70	18	20	19	**19.0**
80	18	18	19	**18.3**

Mean values must be to one decimal place.

5



6 The simple statement 'the hotter the oil, the runnier it is' should be made. But it would be excellent if students note that the oil does not get runnier at the same rate. There is a very big change in how runny the oil is between 23 °C and 30 °C. The oil goes through in less than half the time, with a change of only 7 °C. It takes a rise of almost 20 °C for the time to reduce by about half again. There is very little time change between 50 °C and 80 °C.

5.4 Identifying anomalous results

1 Nor's readings at 3 minutes and 9 minutes do not seem to follow the pattern. The result at 3 minutes is the same as that at 2 minutes. This is unlikely, unless she stopped heating the water. The temperature at 9 minutes is lower than the reading at 8 minutes and is the same as the reading at 7 minutes. This is very unlikely.

2 She should not use these readings in plotting the graph. She should repeat this investigation.

3 Amal has made a mistake in recording his results, because the table shows he started his investigation at 1 minute instead of at 0 minute. He has taken the temperature of the water before heating it and recorded it in the table as if he had heated the water for 1 minute (or possibly he has failed to take the temperature at the start before heating, but this is unlikely because he started with the same water as Nor, at 20 °C).

4 The axes are round the wrong way: time should be along the *x*-axis and temperature on the *y*-axis. On the temperature scale, the reading for 52 °C has been left out.

5 The points at 0 minutes, 4 minutes and 6 minutes have been plotted incorrectly. Students should have circled these points.

Unit 6 Material properties

6.1 Properties of metals and non-metals.

1 **a** ductile – can be drawn out into strands or wires

b brittle – breaks with a snap

c malleable – can be easily hammered into shape

2 Give credit for mentioning the differences in the properties of metals and non-metals, such as 'a metal is shiny whereas a non-metal is dull' or similar. Students should not give a list of properties without metal/non-metal comparison.

For example:

Observation or investigation	Metals	Non-metals
Observe the state of the item – if it is a solid, liquid or gas.	(most are) solid at room temperature	may be solid, liquid or gas at room temperature, but many are gases
Observe the surface – is it shiny or dull?	are shiny	(when solid) are dull
Observe what happens if you drop the item.	do not shatter	(when solid) are brittle and may shatter
Place a drop of wax and let it cool on one end of the item. Heat the other end of the item. The wax on those that conduct heat energy well will melt very quickly.	conduct heat energy well	do not conduct heat energy well
Set up a circuit with a switch and a lamp. Use the item as part of the circuit. If the light comes on, the item conducts electricity.	conduct electricity	(when solid) (most) do not conduct electricity
Strike the item and listen to the sound.	make a ringing sound when hit	(when solid) do not make a ringing sound when hit

Any students who mention that carbon is a non-metal but able to conduct electricity or that mercury is a metal that is liquid at room temperature show a high level of knowledge and understanding that these are not typical properties.

The relative malleability and ductility of metals would be difficult to investigate, but might be mentioned.

6.2 Identifying metals and non-metals

1 Give credit for identifying any properties that indicate metal or non-metal, and for any use. If students are able to link the use to the properties, this shows a good use of their knowledge.

Substance A is a metal.

Reasons: because it conducts electricity.

It is mercury.

Use: It has been used in thermometers because it is a liquid at room temperature and it expands a lot with a small increase in temperature. Students may also mention use in barometers, dental amalgam and as liquid contact switches in some electrical circuits. Due to its toxicity, mercury is no longer used in thermometers and barometers.

Substance B is a non-metal.

Reasons: because it is dull and brittle and only one form (dull brittle) conducts electricity. The shiny form does not conduct electricity.

It is carbon.

Use: In the dull, soft form it is used in pencils for drawing – because it is so soft the carbon wears away as it leaves marks on the paper. It is also used in electrical motors as brushes. The hard shiny form is diamond. It is used in jewellery because it is shiny, rare and expensive. Diamond is also used in drills to cut through other substances because it is so hard.

Substance C is a non-metal.

Reasons: because it is a gas at room temperature and it does not conduct electricity.

It is oxygen.

Use: Oxygen is used in respiration of most living things. It is also very reactive and is used in burning.

Substance D is a non-metal.

Reasons: because it is a gas at room temperature and it does not conduct electricity.

It is helium.

Use: as it is very unreactive, but very light, it is used in airships and in balloons.

Substance E is a metal.

Reasons: because it conducts heat and electricity well.

It is copper.

Use: for electrical wiring because it is ductile and conducts electricity well. It is used for cooking pans because it conducts heat very well.

Substance F is a non-metal.

Reasons: because it does not conduct electricity and it is brittle.

It is sulfur.

Use: to harden rubber.

6.3 Choosing materials for a car

1 Material 1: it is heavy **or** expensive **or** it dents easily.

Material 2: it is only available from a few specialist manufacturers and has to travel a long distance **or** it buckles and deforms if exposed to high temperatures **or** material shatters on high impact.

Material 3: it is very expensive **or** workforce will need more training in order to use this material.

2 Material 1: it is available from many local sources **or** it is easy to use **or** there is no problem when it is exposed to the heat of the engine **or** it is easy to repair.

Material 2: it is cheap or very light **or** this is a new technology but is very easy to work with **or** resistant to minor dents, material "bounces back" **or** sections of bodywork can be easily replaced.

Material 3: it is light **or** available from many local sources **or** resistant to heat or strong material, dents only on high impact.

3 Students should present a reasoned and logical report. It is not necessary for them to come to a conclusion, but they need to mention the things that could make a material a good or bad choice. They need to show some evidence of thinking this through.

The report should ideally include:

- The advantages and disadvantages of each material.
- A discussion about compromise, as no one material is perfect, and which features are essential.
- A discussion about using some of the material for different parts of the car, perhaps not for the engine compartment, but for the wings or doors.
- A discussion about what further information would be needed. For example: At what temperature does material 2 buckle and deform? How much more expensive is material 3?

Unit 7 Material changes

7.1 Key words for acids and alkalis.

Word	Meaning
acid	a substance with a pH of less than 7
neutralisation	**changing an acid or an alkali into a solution at pH 7**
corrosive	able to dissolve or eat away other materials
alkali	**a substance with a pH of more than 7**
indicator	**a substance that changes to a different colour in acid and alkali**
Universal Indicator	a mixture of different indicators that gives a range of colours in solutions of different pH
irritant	**a substance that will cause itching or sores to your body**
hazard symbol	information found on bottles of chemicals and warn you of any dangers
pH scale	**a scale from 1 to 14 that measures acidity and alkalinity**

7.2 Neutralising acid

1 For example:

I put on my safety goggles to protect my eyes in case of spills or splashes.

I collected the chemicals **from the teacher. I used a beaker to take a small amount of acid** back to my workspace.

I used **0.5 mol / dm^3** hydrochloric acid and **carefully filled a burette**. **I made sure that the burette was secure in the clamp stand and that the tap was closed, so that no acid was spilt**.

I collected some sodium hydroxide from the teacher in a beaker. **I measured 25 cm^3** (accept a measured amount of any suitable volume) of the sodium hydroxide, **using a measuring cylinder, and put it into a conical flask**.

I added **a few drops of Universal Indicator** solution to the sodium hydroxide in the flask. The solution turned blue because sodium hydroxide is an alkali. I **placed the conical flask under the burette**.

I slowly added acid from the burette to the conical flask. I gently shook the flask each time I added acid. I was careful to look at the colour of the solution. When the solution was green, I knew I had added enough acid to neutralise the sodium hydroxide.

Students should be able to write this using the method you used in class. The important points are:

- the acid should be in the burette
- the sodium hydroxide should be measured using a measuring cylinder or a pipette
- the safety measures and the reasons for them.

7.3 Transporting acid

1 The acid is corrosive – it can dissolve away other materials. So it can destroy skin. Credit any mention of specific materials that the acid could destroy. Students should mention risks to humans and other animals in the area.

2 Look for any response that indicates that the tyres, metalwork and structures on the underside of the car may be damaged or destroyed by the acid. This could cause brakes to fail, causing a further accident.

3 There should be an information label on the tanker that shows what the tanker is carrying. Some students may suggest they phone the company or ask the driver.

4 They need to dilute it as the acid is so strong, so they may spray it with water. They may attempt to neutralise it by using an alkali. Students may suggest stopping the acid running onto vegetation and other wildlife.

5 Students may suggest testing with an indicator to see that the acid has been neutralised or diluted so much it is harmless.

6 Students should mention face masks or goggles to protect eyes. They should also mention protective clothing to prevent acid burns to the skin. This should include gloves, suitable footwear and overalls. They may mention breathing apparatus.

7 The report should show evidence of the use of answers 1–6 above and the following:

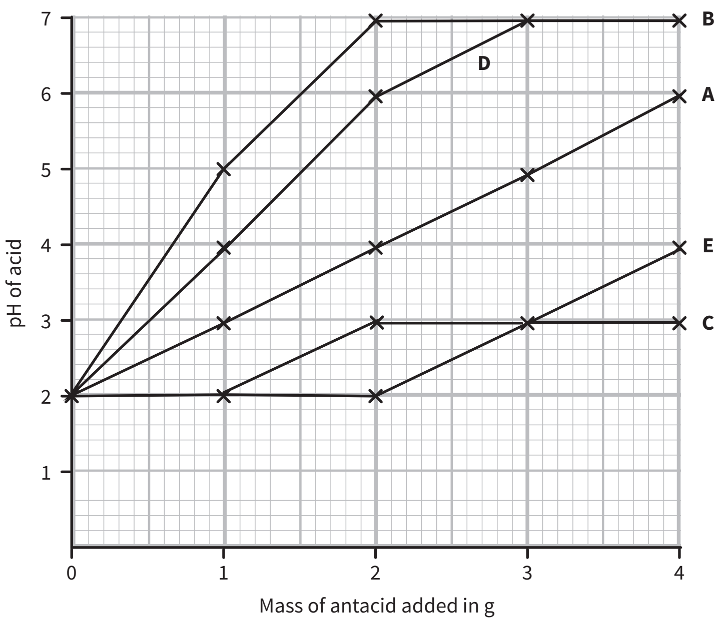
- an understanding of neutralisation
- information from research about the regulations for tanker lorries transporting dangerous loads.

Students should show logical thinking and ability to order information into continuous text.

7.4 Investigating antacids

1 Antacid powder	pH after 0 g	pH after 1 g	pH after 2 g	pH after 3 g	pH after 4 g
A	2	3	4	5	6
B	2	5	7	7	7
C	2	2	2	3	3
D	2	4	6	7	7
E	2	2	3	3	4

2



3 They kept the **volume of acid** and the **type of acid** the same to make this a fair test.

4 B and D

5 B

6 C

7 pH 7

8 3.5 g

9 D because it reaches pH 7 but it does not neutralise the acid too fast so may not produce a lot of gas quickly. (Accept B if it has some comment about the gas being produced quickly.)

Unit 8 The Earth

8.1 Comparing rocks

1 Students will have to revisit work already done, including using the coursebook and other sources.

Credit any correct comparisons. Those given here are from the coursebook text.

	Igneous	Sedimentary	Metamorphic
Give two examples of this type of rock.	granite, basalt	limestone, sandstone	marble, quartzite
How is this type of rock formed?	formed from melted material deep in the Earth; beneath the Earth it is molten and it cools when it reaches the surface from volcanoes	formed in the sea from sediment carried there by rivers; the layers press down on each other and are compressed into solid rock	from sedimentary rocks that are forced deep into the Earth by movements of the land, become very hot and are under pressure
What is its structure? (Mention items such as grains, crystals, layers and fossils.)	may contain crystals; the faster the rock cools, the smaller the crystals; no fossils	grains make up these rocks; they are in layers; fossils found in these	no grains
Is this type of rock porous?	no	yes	no
Is this type of rock hard or soft?	very hard	soft	hard
Does this type of rock react with acids?	no	yes	some very slowly
What do we use this type of rock for and why?	buildings and kitchen work surfaces, because it is very hard and resists damage	buildings and statues, because it is easy to work with and carve, and looks attractive	buildings and statues, because it is harder than sedimentary rock, and looks beautiful

8.2 How rocks change

1 Physical weathering (credit weathering).

2 Chemical weathering, such as acid rain reacting with limestone and forming carbon dioxide gas, water and a salt.

Biotic weathering, such as plants growing in the cracks in rocks and causing damage.

3 Gravity.

4 Abrasion.

5 The smallest fragments of rock can be carried by water in both fast-moving streams and slow-flowing ones, and can end up being carried as far as the sea. The heavier the piece of rock, the shorter the distance it will be carried by streams and rivers, unless it breaks into smaller pieces.

6 The further a rock fragment is moved, the more likely it is to rub against other rocks or rock fragments. The more this happens, the rounder and smoother the rock will become. If a rock does not travel far, then it will retain its more jagged shape.

7 Mount Everest will become damaged by physical weathering caused by freezing and thawing (as the climate changes). Climbers may also cause physical damage by using pickaxes and by walking / climbing on the rock. There may be damage caused by acid rain. Plant growth could damage the rock. Streams will carry broken fragments of rock away. This will mean that Mount Everest will get smaller over millions of years.

8 Heat and pressure.

9 It will reach the surface of the Earth and be exposed to the weather, which will start to break the rock down over millions of years.

8.3 The fossil record of the horse

1 Look for a logical approach. Students should describe the **changes** in the features over time, for example:

The horse species *Hyracotherium* that lived about 55 million years ago was very small, about the size of a lamb, and over the years horses have increased in size. For example, the next most recent species *Mesohippus*, which lived about 34 million years ago, was twice the size of *Hydracotherium*. *Equus*, the modern horse, living from about two million years ago, is very much larger.

They should not simply give a description of the horse at each stage.

Students should also mention the changes in features other than size, for example the proportions of the skulls – larger lower jaw relative to upper jaw.

The changes in the legs are the most marked and should be described in detail.

Students should also mention features that have remained much the same, such as the tail.

Unit 9 Forces and motion

9.1 Identifying forces

1 There are three points to make here:

- the weight of the book is acting downward / toward the centre of the Earth
- the contact force from the table is acting upward / in the opposite direction to the weight (of the book)
- the two forces are equal / balanced / cancel out

The answer must make clear which force is related to which object, so 'the weight is of the book' and 'the contact force comes from the table' are two separate points.

The third point is that these two forces are equal and opposite. 'Balanced' is also a good term whereas 'cancel out' is the lowest level acceptable.

2 The four forces that should be identified include:

- pull on the arrow drawn from the girl's right hand horizontally to the left
- push on the bow drawn from the girl's left hand horizontally forward

- weight of the girl drawn from anywhere on the girl vertically downward
- contact force from the ground drawn from the ground below the girl vertically upward.

The sizes of the arrows should be equal for each pair: push-pull; weight-contact.

3 Here, learners must distinguish between mass and weight, so any statement such as a weight of 2 tonnes or a weight of 2000 kg cannot be given credit. Any attempt to convert to newtons must be done correctly, so 20 000 N or 20 kN are acceptable (as are 19 600 N and 19.6 kN if they have used 9.8 instead of 10 in the equation). The explanation should include:

- the bridge cannot support a weight greater than 20 000 N / 20 kN
- this will exceed the contact force that the bridge can provide.

9.2 Friction and air resistance

1 'Useful' includes:

- any examples of grip, e.g. shoes or tyres on the ground, which could be expressed as stopping things sliding
- any useful examples of producing heat, e.g. rubbing hands or rubbing sticks to start a fire
- any examples of braking systems, e.g. on a bike or car.

'Unwanted' includes:

- any examples of slowing down sliding objects, e.g. skis or on a slide
- any examples of slowing down moving parts in machines or engines
- any examples of unwanted heat, e.g. from moving parts in engines
- any examples of slowing moving objects or taking extra effort to move objects when unwanted, e.g. bike or car.

2 Any idea of no friction between train and ground enabling greater speed and / or less effort:

- no friction between train and ground
- less power / effort / energy / fuel needed.

3 Look for ideas of keeping the train moving in the desired direction and being able to slow it down or stop it; also the idea of lateral support or balance, which could be expressed as stopping it from tipping over. So:

- keeping the train going in the correct direction
- keeping the train balanced
- braking.

4 using the forcemeter / from the reading on the forcemeter (because the greater the air resistance, the greater the pulling force)

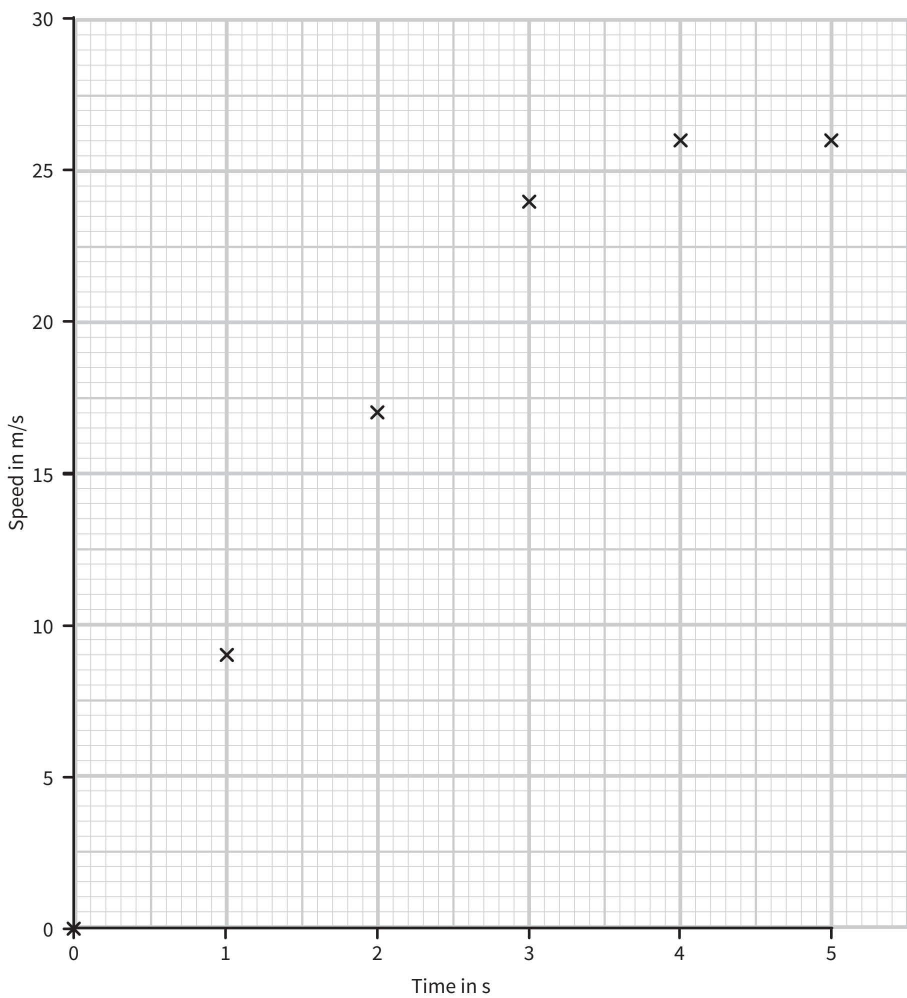
5

Variable	Changed?	Kept the same?	Observed?	No effect?
Type of model car	✔			
Colour of the car				✔
Speed setting of the hairdryer		✔		
Angle of the hairdryer		✔		
Distance from hairdryer to car		✔		
Reading on the newton meter			✔	
Type of surface		✔		

6 Any idea of streamlined shape decreasing air resistance / non-streamlined shape increasing air resistance. But the word 'streamlined' does not have to be used. This could be expressed as pointed at the front, low to the ground, or like a sports car. 'Non-streamlined' could be expressed as flat at the front, big, tall, high off the ground like a van or truck.

9.3 The speed of falling objects

1



Check the following:

- axes are the right way round and labelled with quantity and units as in the table
- there are linear scales with zero shown on both axes
- the graphs is scaled so that points occupy most of the grid in both directions, e.g. 2 cm = 1 s horizontally and 2 cm = 5 m / s vertically
- all points are plotted correctly

2 The answer should describe what is happening to the speed **and** explain why in terms of forces. Do not credit statements that include the term ‘proportional’. The answer should include ideas that:

- at time = 0, speed = 0 (no units are required for zero)
- speed increases with time / object accelerates.due to gravity / weight
- speed increases less quickly / acceleration decreases.

This point is difficult for learners to express without referring to acceleration. It is not correct to say that speed begins to decrease. Look for the idea that the rate of increase of speed is decreasing:

air resistance increases (as speed increases).

Do not encourage statements such as ‘air resistance increases with time’, as while this may appear true from the graph and is not incorrect in this case, air resistance does not directly depend on time.

3 A full answer needs to refer to both air resistance and weight and then recognise that they are balanced:

- air resistance becomes equal to weight / air resistance is equal to weight (at this stage in the fall)
- air resistance and weight cancel each other out / are balanced.

4 Students should have described the basis of a workable test, e.g. drop objects from the same height and time how long it takes to fall. The dependent variable here is the time to fall.

Methods of measurement should be mentioned:

- a method of timing, e.g. stopwatch / light gates / electromagnetic switches / datalogger
- a method of measuring height, e.g. tape measure / metre rules or controlling height, e.g. mark on wall etc.
- a method of measuring mass, e.g. electronic balance.

Variables to be controlled include:

- mass of object
- height of drop (if an example height is given, it should be suitable, e.g. if manual timing then a minimum height of 1.5 m)
- method of releasing the object (so it is not thrown down or given any initial speed).

Students might also mention that it should be done in a draught-free or windless place. Ignore references to atmospheric pressure or temperature as, within reasonable limits such as day-to-day in the same place, these will have no measurable effect.

5 He should repeat the test, at least two more times (we need at least two more results that agree with one of these observations) because we cannot tell which one is wrong / need to confirm which one is correct. Students could give an example of this, e.g. if he did it twice more and got 2.0 and 2.5 then he would know the 3.5 result was wrong etc.

Unit 10 Energy

10.1 Investigating energy stores

1

Object	Battery	Coiled spring	Being moved to a height
Playground swing			✔
Mobile phone	✔		
Roller coaster			✔
Wind-up toy		✔	

2 **a** battery – chemical

b coiled spring – elastic

c being moved to a height – gravitational potential

3 There are three possible approaches to this. In each approach the same variables should be controlled:

- same volume of water
- identical beakers
- identical thermometers (this point is not about accuracy, but about the thermometer affecting the water temperature)
- same starting temperature of water
- same distance from flame to bottom of beaker
- any other procedure such as eliminating draughts / stirring water.

The **first approach** is to carry out both tests at the same time and see which raises the water temperature fastest.

Control variables as above, and:

- set up two tests
- light both candles at the same time / place lit candles under each beaker at the same time
- see which candle causes the water temperature to increase the most in a fixed time interval / suitable stated time, e.g. five minutes
- conclusion: the one that heats the water faster stored more energy.

The **second approach** is to carry out the tests separately and measure the temperature increase after an equal time interval.

Control variables as above, and:

- use first candle to heat water
- measure temperature increase after stated time, e.g. five minutes

- repeat test (with new sample of water to ensure same starting temperature) with second candle
- conclusion: the one that heated the water more in the same time stored more energy.

The **third approach** is to carry out the tests separately and measure the time taken to raise the water temperature by a fixed number of ºC.

Control variables as above, and:

- use first candle to heat water
- measure time taken to raise water temperature by fixed amount, e.g. 10 ºC
- repeat test (with new sample of water to ensure same starting temperature) with second candle
- conclusion: the one that heated the water by the stated amount in the shorter time stored more energy.

(There is a fourth, more complex, approach where the candles could each be burned, the temperature rise recorded, then the loss of mass of candle wax be recorded for each. If described fully and correctly in the same way, this approach should be given full credit.)

10.2 Cooling down

1 thermal

2 Yes, the teacher is correct. The explanation should be related to the behaviour shown on the graph (although the graph may not be mentioned):

- the line (on the graph) is steeper at higher temperature / less steep at lower temperature
- (the graph shows that) a higher (starting) temperature will fall more in a given time than a lower (starting) temperature.

3 when it is the same as the temperature of the room

4 A circle should be drawn around the anomalous point above the curve.

Credit any suggestion that could lead to an anomalous result that is too large, including:

- not stirred (properly)
- thermometer at different position in the beaker / too high / too low.

Do not credit any suggestion that would make the result too low, e.g. sudden draught, or any suggestion that would actually raise the water temperature, e.g. temporary proximity of a heat source, as this would change the results pattern for all times subsequently.

10.3 Different ways of changing energy

1 Chemical reactions have not been covered in the curriculum at this stage, so there will not be detail in students' answers about reactants or products. But they must make it clear which chemicals are running out and which are building up. The main points are:

- the original chemicals in the battery run out
- other (waste) chemicals build up
- reaction stops
- electricity is no longer produced.

2 they hold more (of the original) chemicals; there is more space for other (waste) chemicals

3

kinetic	➔	elastic	➔	electrical	➔	kinetic	➔	sound
(turning handle)		(in a coiled spring)				(vibration of speaker)		

Not all of these energy transfers may be mentioned, but they must be in a logical order.

4 Answer 400 J / 400 joules

Working shown as:

1000 – 600 **or** 1000 – 400 – 200

5 thermal / heat

Parts get hot / transferred to the surroundings / heats the air around it.

Unit 11 The Earth and beyond

11.1 Moons around other planets

1 making observations

2 She should make a drawing / take a photograph. This first point is about the idea of **recording** the visual observation somehow.

Then she should compare their positions on a different night / different time. This second point is the idea of making a **comparison at suitably different time intervals**.

3 They may be behind / in front of the planet. This point is about one or more of the moons being in line with the planet, so being either **obscured behind it, or in transit in front of it** and hence not clearly visible.

Or they may be too close together / too close to the planet. If two of the moons are in line with each other, or appear to be very close to the planet, then the binoculars or human eyesight may **not be able to visually separate them**.

11.2 Discoveries in astronomy

1 Mercury, Venus, Earth, Mars, Jupiter, Saturn

2 They are doing things for the first time / need new technology to do new things.

This point is about the idea that scientists are pioneers and need equipment that is not available as 'off the shelf' products designed to do already established tasks.

3 It was clearly moving (compared to the stars), so must be much closer to Earth.

4 Objects further away appear to move slower.

5 The answer should be approximately double, so in the range of 150–200 years. The concept is that a path that is approximately circular will double in length if the radius is doubled, so if the planet is travelling at roughly the same speed, it will take twice as long to complete the path.

11.3 Probing space

1 9 years.

2 It had to travel a very long distance / very far away.

3 Voyager 2 got very much closer to the planet. Also, it was not looking though the Earth's atmosphere / air / clouds.

4 The power supply (for the camera / transmitter) will run out / the equipment will eventually fail. It will go out of range / the signal will be too weak.

Do not accept that it will collide with something unless this answer is qualified, as the chance of a collision with another object is very small. Do not accept that it will collide with a star, as this would be extremely unlikely and a **very** long way into the future because of the distance away. However, if a collision with an asteroid / comet / dwarf planet in the outer Solar System is specified, it would be acceptable.

5 Advantages of an unmanned probe include the ideas that it:

- is smaller / cheaper
- does not need to carry supplies / food / oxygen / water
- does not have to return (to Earth)
- is safer / does not put lives at risk.

Disadvantages of an unmanned probe include the ideas that:

- repairs are not possible
- it is not possible to use senses / judgement in collecting data
- it is not possible to check results.