1(a). In some areas of the UK, dogwhelk numbers are decreasing. This reduces biodiversity.

Give **two** benefits of maintaining biodiversity.

1 _____

_____

2 _____

_____

**[2]**

(b). Sea anemones can reproduce asexually.

Give **one** advantage and **one** disadvantage of this method of reproduction.

Advantage _____

_____

Disadvantage _____

_____

**[2]**

(c).

(i) Sea anemones are mainly found in rock pools.

During the summer the water temperature in a rock pool can increase to a level which can be dangerous for a sea anemone.

Put a tick (✓) in the box that best explains why this temperature increase is a problem.

Enzyme catalysed reactions will speed up. ☐

Enzyme catalysed reactions will slow down. ☐

Enzymes will be killed. ☐

Enzymes will become denatured. ☐

**[1]**

(ii) When it rains, the concentration of the sea water in a rock pools decreases.

What effect will this change in concentration have on a sea anemone's cells?

Put a tick (✓) in the box next to the correct answer.

Some cells may burst. ☐

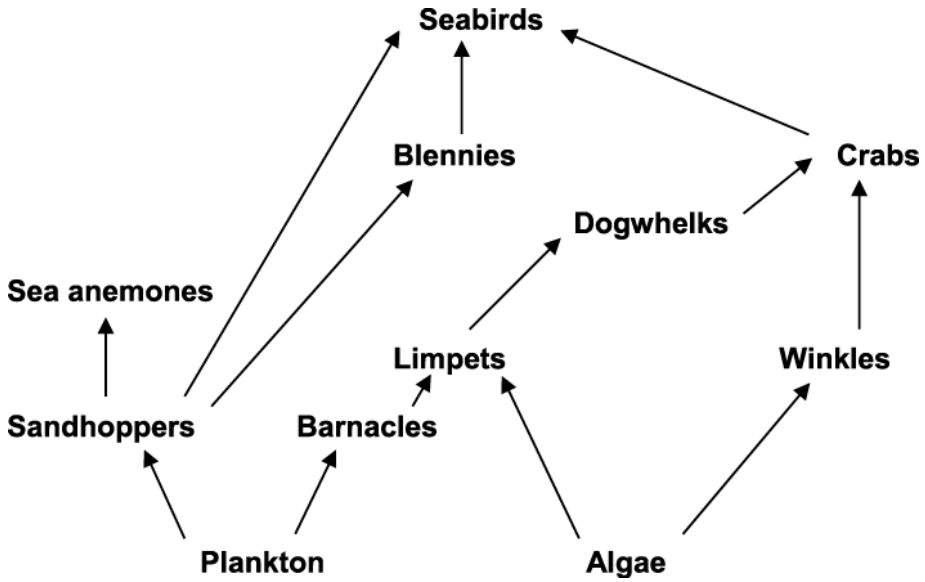
Some cells may shrink. ☐

There will be no change to the cells. ☐

Some cells will burst, others will shrink. ☐

**[1]**

(d). This is a food web for the species that can live on a rocky shore.




Explain the impact of an increase in the number of dogwhelks on one species in this food web.

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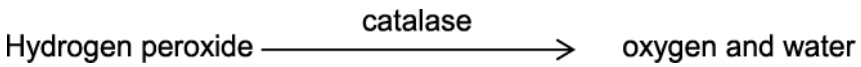
[2]

2(a). A group of students carry out an enzyme investigation. The equation below shows the reaction.




Name the substrate and the enzyme in the reaction above.

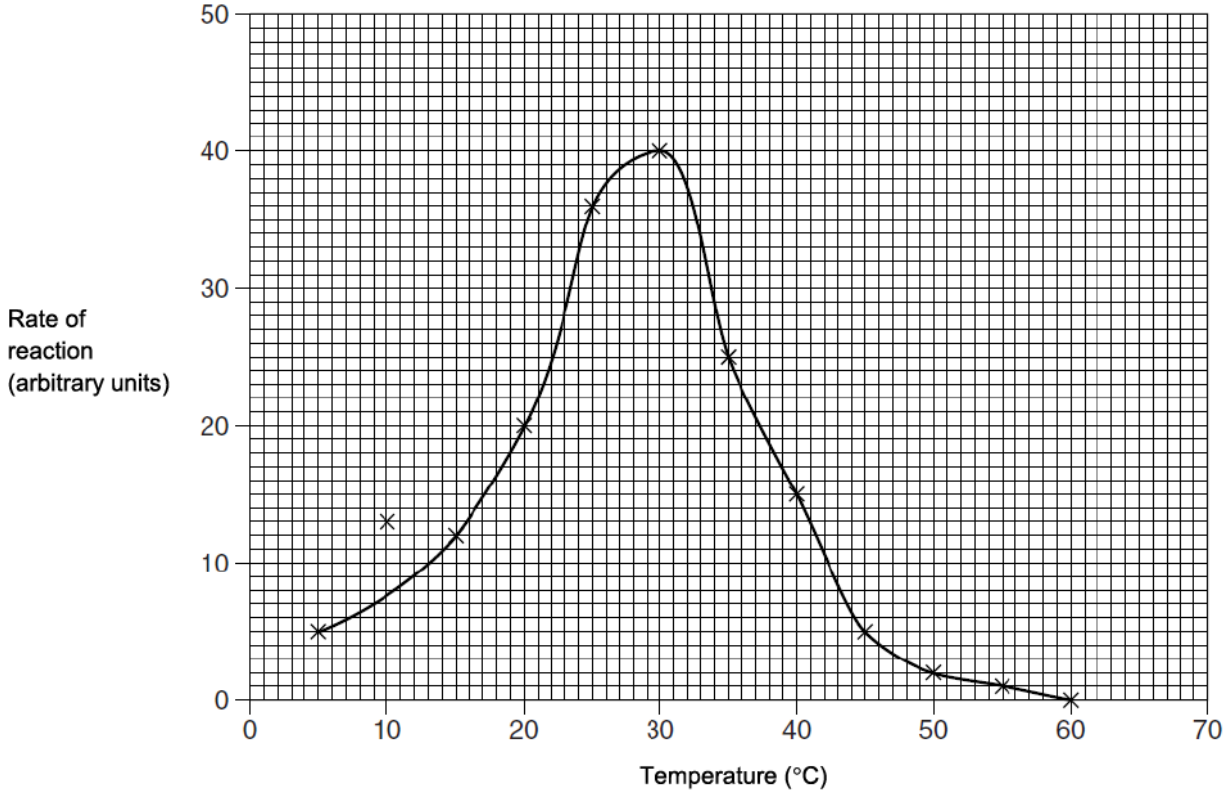
Substrate: _____

Enzyme: _____

[1]

(b). * The students investigated the effect of temperature on the rate of the enzyme controlled reaction.

Their results are shown in the graph below.



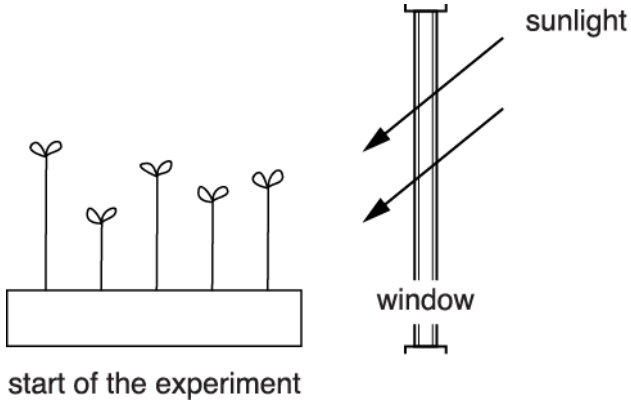

Use the graph above to describe and explain the effect of temperature on an enzyme such as this.

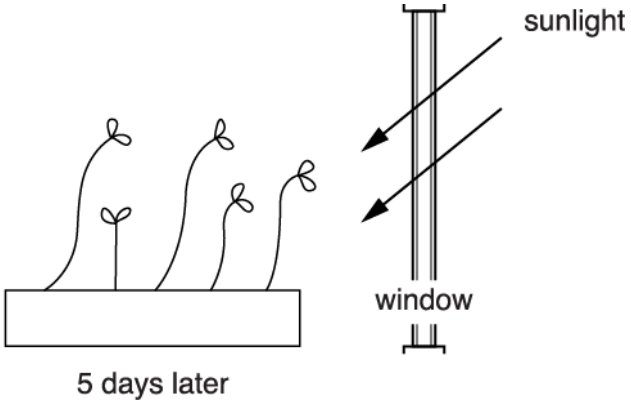
[6]

3. James investigates the effect of light on shoot growth.

He places a tray of 5 cress seedlings on a windowsill and leaves them for 5 days.

He notes the appearance of the seedlings at the start of the experiment and again 5 days later.




all cress seedlings grow upright

only 1 cress seedling is growing upright

James concludes that the seedlings have grown towards the sunlight. James thinks that there are problems with his experimental design.

Evaluate the experimental design. In your answer you should:

- identify some of the problems
- suggest how the experiment could be improved.

*The quality of written communication will be assessed in your answer.*

[6]

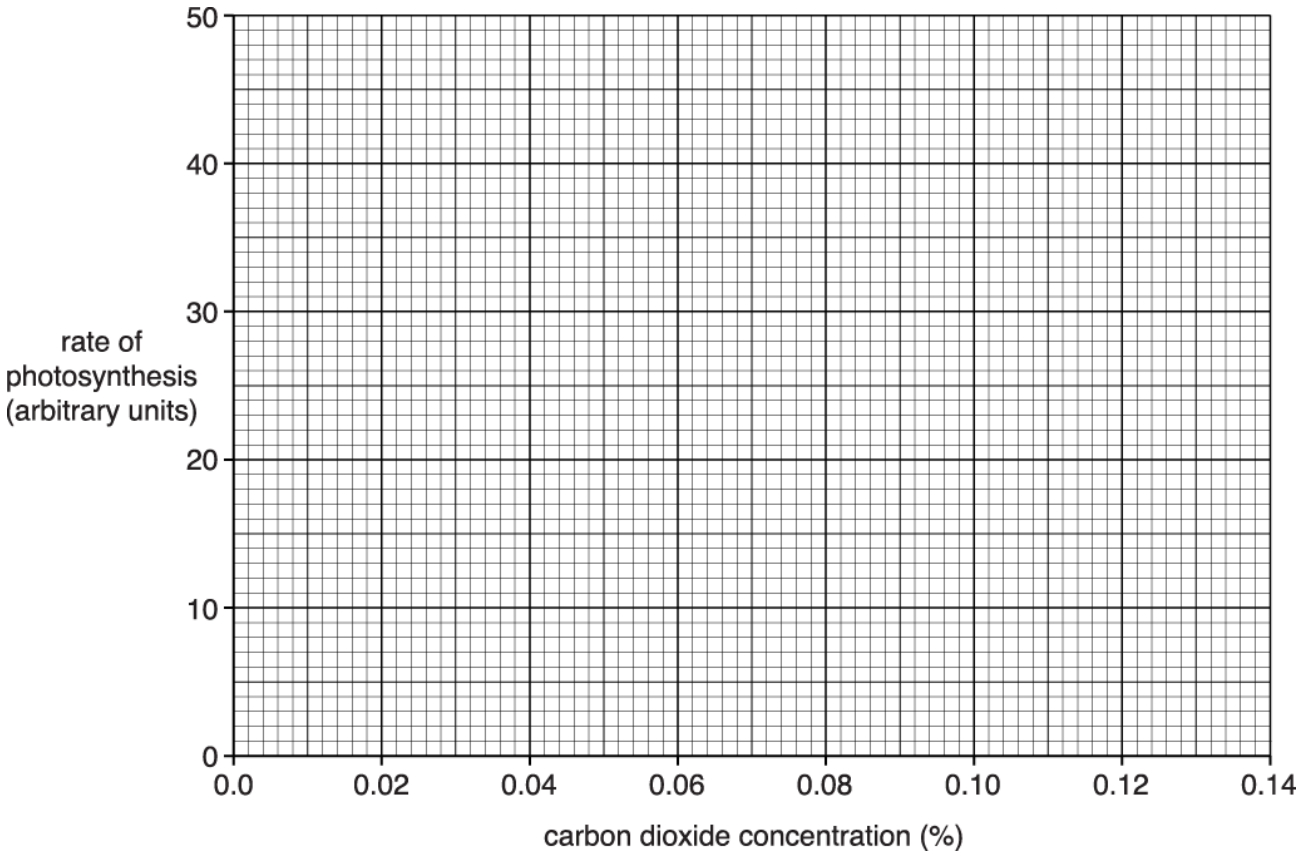
4(a). Paresh does an experiment to investigate the effect of carbon dioxide on the rate of photosynthesis.

His results are shown below.

| Carbon dioxide concentration in the air (%) | Rate of photosynthesis (arbitrary units) |
|---|---|
| 0.00 | 0 |
| 0.02 | 20 |
| 0.04 | 28 |
| 0.06 | 35 |
| 0.08 | 40 |
| 0.10 | |
| 0.12 | 43 |
| 0.14 | 43 |

**[2]**

(i) Plot the data on the grid below.



[1]

(ii) Use the points to draw an appropriate line of best fit.

(iii) The table does not show the rate of photosynthesis when the concentration of carbon dioxide was 0.10%.

Use the graph to find the rate of photosynthesis when the carbon dioxide concentration was 0.10%.

rate of photosynthesis _____ [1]

(iv) What conclusions can be made about the effect of carbon dioxide concentration on the rate of photosynthesis?

_____

_____

_____

_____ [2]

(v) Paresh measures the rate of photosynthesis at 0.13%.

The rate of photosynthesis was 22 (arbitrary units).

He decides **not** to include this in the data set.

Suggest why.

_____

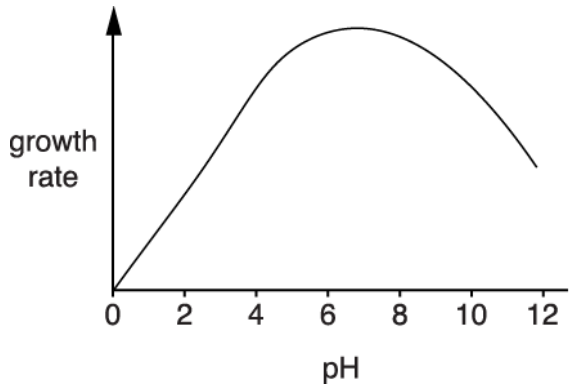
_____

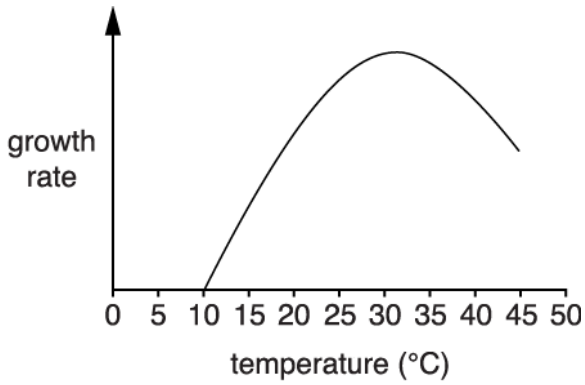
_____ [2]

(b). Paresh is a keen gardener. He wants to improve the growth rate of his tomatoes.

To do this he needs to provide the optimum conditions for growth.

Paresh read the information below in a gardening magazine. It shows the effects of pH and temperature on the growth rate of tomatoes.




Describe what conditions he should provide to grow his tomatoes. Use the information above and your biological knowledge in your answer.

*The quality of written communication will be assessed in your answer.*

[6]

5. Explain how phototropism increases a plant's chance of survival.

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[2]

6(a). This question is about chemical reactions taking place in living things.

Both photosynthesis and respiration are a series of chemical reactions.

Complete the sentences.

Use words from the list.

The words can be used once, more than once or not at all.

break down

build up

digest

electricity

energy

oxygen

sunlight

water

Photosynthesis uses carbon dioxide and water.

It needs energy from _____ .

It involves a series of reactions that _____ large food molecules.

Respiration releases carbon dioxide and water.

It also releases _____ from food.

It involves a series of reactions that _____ large food molecules.

**[4]**

(b). The processes of photosynthesis and respiration are made up of a series of reactions.

Each reaction needs a specific enzyme.

This means that each enzyme only works for one reaction.

Explain why.

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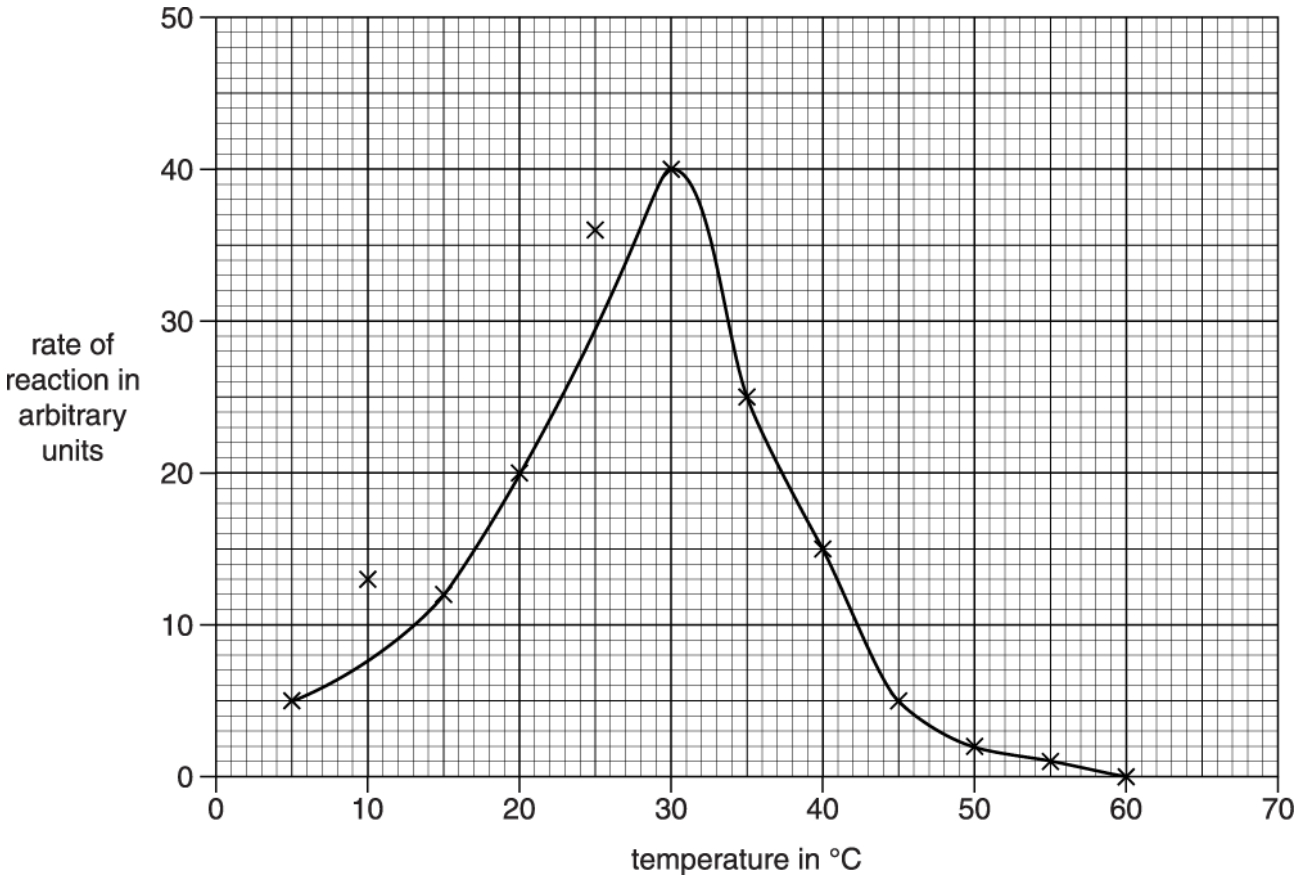
[2]

(c). A group of students carry out an investigation using enzymes.

They record the rate of an enzyme reaction across a range of temperatures.




(i) Use information in the graph to complete the table.

| Temperature in °C | Rate of reaction in arbitrary units |
|---|---|
| _____ | 40 |
| 45 | _____ |

**[2]**

(ii) Describe the change in the rate of reaction between the two temperatures in the table and explain this difference.

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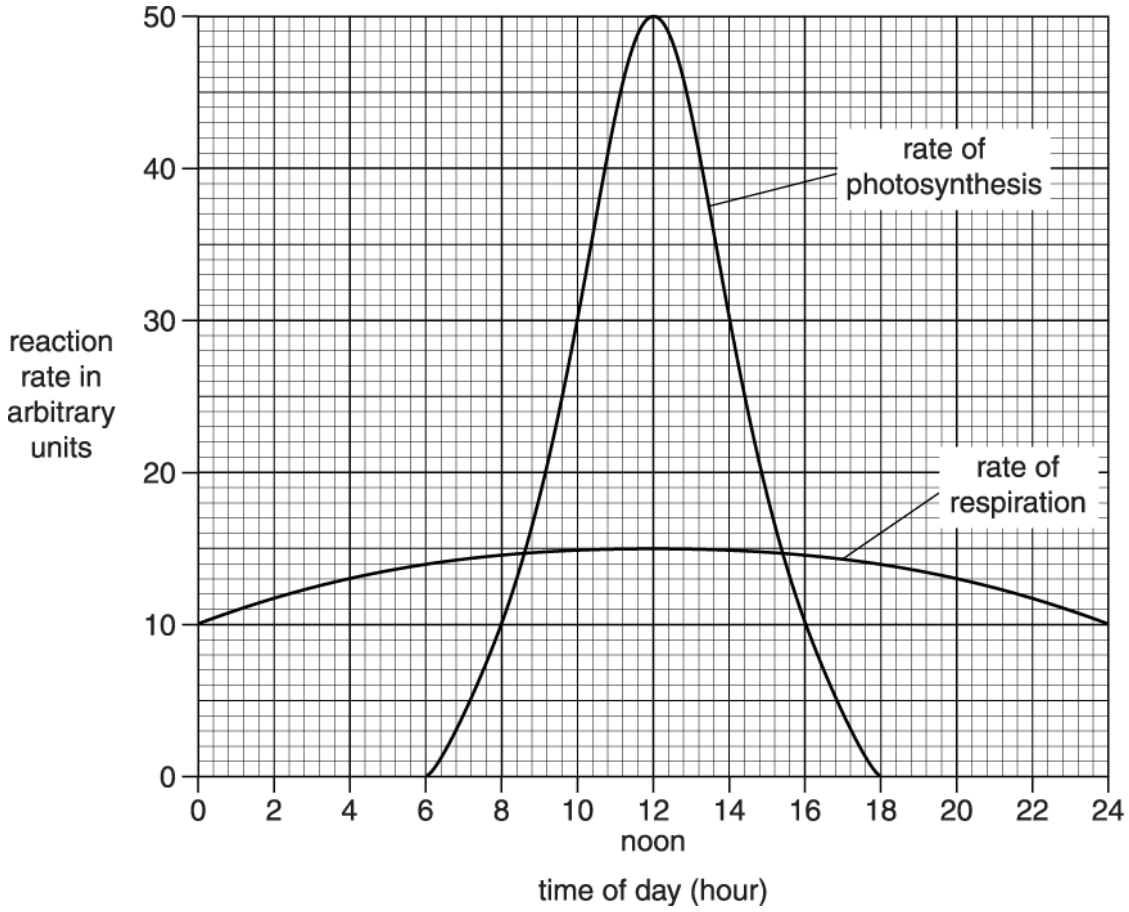
**[2]**

(iii) The students have drawn a line of best fit on the graph.

On the graph, put a ring around each of the **two** points that the students think are outliers.

**[1]**

(d). The reaction rates for photosynthesis and respiration in a plant on a sunny day are plotted over a 24-hour period.




(i) The maximum rate of photosynthesis is at 12.00 noon.

What is the most likely explanation for this?

Put a tick (✓) in the box next to the **best** answer.

More water is available. ☐

The light intensity is at its highest. ☐

The temperature of the soil is at its highest. ☐

**[1]**

(ii) At 12.00 noon, the rate of respiration is also at its maximum.

Calculate the difference between the maximum rate of photosynthesis and the maximum rate of respiration.

difference = _____ arbitrary units **[1]**

(iii) Suggest how the value you calculated in part **(ii)** would change if the experiment was done on a **cloudy** day.

Explain your answer.

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**[2]**

(iv) Look at the graph.

During which of the following times of day are plants using up more carbon dioxide for photosynthesis than they produce by respiration?

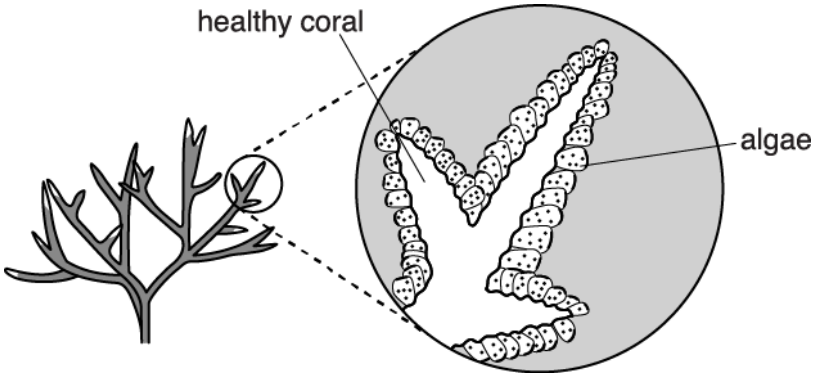
Draw a ring around the correct answer.

**6.00–8.00** **10.00–12.00** **16.00–18.00**

**[1]**

7(a). Scientists have found that some algae in the coral are dying.

This is thought to be caused by increases or decreases in sea temperature.




Photosynthesis is controlled by enzymes.

Explain how changes in the sea temperature can result in the algae dying.

*The quality of written communication will be assessed in your answer.*

[6]

(b). Some scientists think that temperature changes are killing the algae.

Other scientists think that increased UV light could be the cause.

How would scientists show whether UV light or temperature change is the cause of the algae dying in their natural habitat?

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[3]

(c). Coral reefs are found in tropical seas.

They are made by living organisms called reef-building corals.

Reef-building corals have a symbiotic relationship with microscopic algae. Algae are single-celled plants.

In a symbiotic relationship both organisms **benefit** from each other.

(i) Using your knowledge of photosynthesis, what are the benefits for the organisms in this symbiotic relationship?

Put a tick (✓) in the **three** correct boxes.

| | |
|---|---|
| Algae give carbon dioxide to the coral. | ☐ |
| Algae give chlorophyll to the coral. | ☐ |
| Algae give glucose to the coral. | ☐ |
| Algae give oxygen to the coral. | ☐ |
| Coral gives carbon dioxide to the algae. | ☐ |
| Coral gives chlorophyll to the algae. | ☐ |
| Coral gives glucose to the algae. | ☐ |
| Coral gives oxygen to the algae. | ☐ |

**[3]**

(ii) Algae can convert glucose into other substances.

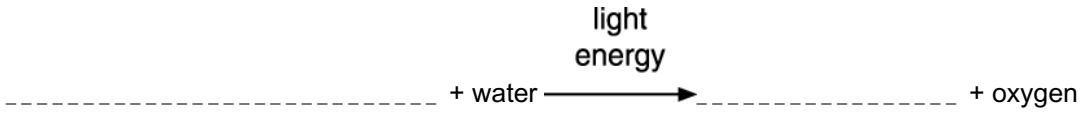
Put a ring around **two** substances that the algae can make from glucose.

**calcium** **carbon** **cellulose** **nitrogen** **starch**

**[2]**

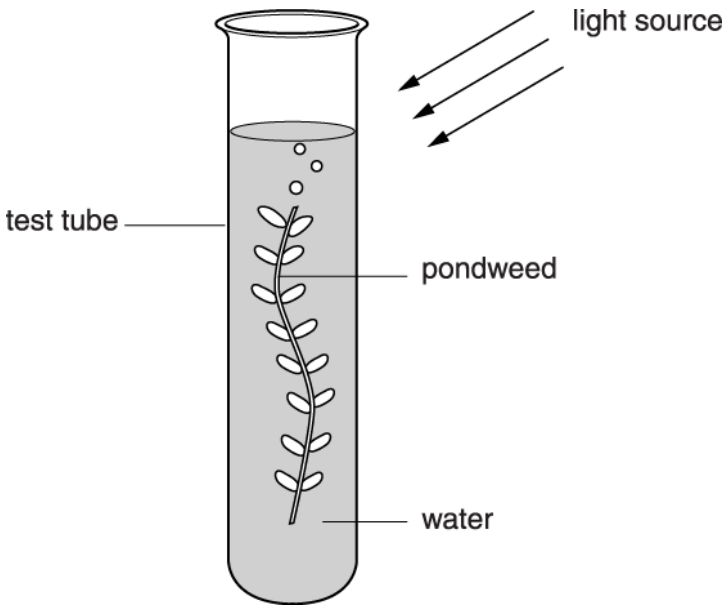
8(a). Photosynthesis takes place in plants.

Complete the word equation for photosynthesis.




[2]

(b). Jason is studying the rate of photosynthesis for pondweed under **low** and **high** light intensities.




- Jason cuts 20 pieces of pondweed and puts each piece in a separate test tube in water.
- He puts 10 test tubes under **low** light intensity and 10 under **high** light intensity.
- He records the number of oxygen bubbles produced by each of the pieces of pondweed during a 1 minute period.
- Jason records the data in **Table 1**.

**Table 1**

| Light intensity | Number of bubbles produced per minute | | | | | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| low | 8 | 7 | 5 | 9 | 6 | 10 | 7 | 8 | 6 | 6 | 7.2 |
| high | 10 | 11 | 9 | 13 | 15 | 8 | 11 | 10 | 9 | 12 | |

(i) Calculate the mean number of bubbles produced under **high** light intensity.

Write your answer in the empty box in **Table 1**.

**[1]**

(ii) Another student repeats the experiment using five species of pondweed, **A, B, C, D** and **E**.

The mean number of bubbles produced per minute for each species of pondweed is shown in **Table 2**.

Table 2

| Light intensity | Mean number of bubbles produced per minute | | | | |
|---|---|---|---|---|---|
| | Pondweed species | | | | |
| | A | B | C | D | E |
| low | 7 | 5 | 7 | 6 | 8 |
| high | 15 | 10 | 11 | 17 | 13 |

Use the results in **Table 1** and **Table 2** to identify which species, **A, B, C, D** or **E**, was the one also used by Jason.

species used by Jason = _____ **[1]**

(iii) How confident can you be about your conclusion?

Explain why

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---**[2]**

(iv) Suggest **two** improvements for Jason's experiment.

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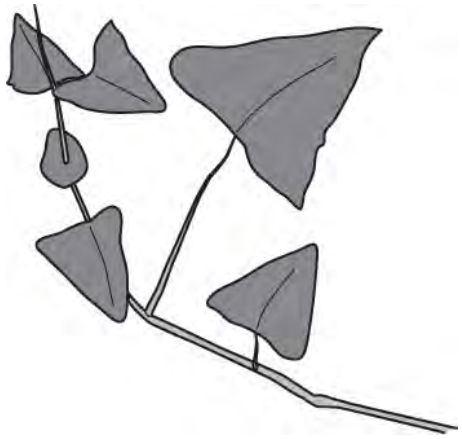
---**[2]**

9. The mile-a-minute vine is a plant. It grows very quickly.



The vine makes its food using a process called photosynthesis.

Describe the process of photosynthesis.

Suggest why the rate of photosynthesis in this plant is very fast.

*The quality of written communication will be assessed in your answer.*

[6]

10(a) Put ticks (?) in the boxes next to the **three** statements that describe enzymes.

.

| | |
|---|---|
| Enzymes are made from starch. | ☐ |
| Enzymes are sections of DNA. | ☐ |
| Enzymes have an active site. | ☐ |
| Enzymes are made from instructions in genes. | ☐ |
| The four types of enzymes are A, T, C and G. | ☐ |
| Enzymes are proteins. | ☐ |
| Enzymes are waste products. | ☐ |

**[3]**

(b). Washing powders are used to remove food stains from clothes.

Some washing powders contain enzymes.

(i) Suggest what enzymes do to the food stains.

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**[1]**

(ii) Manufacturers recommend a wash temperature of 30°C rather than 90°C for washing powders containing enzymes.

Suggest why.

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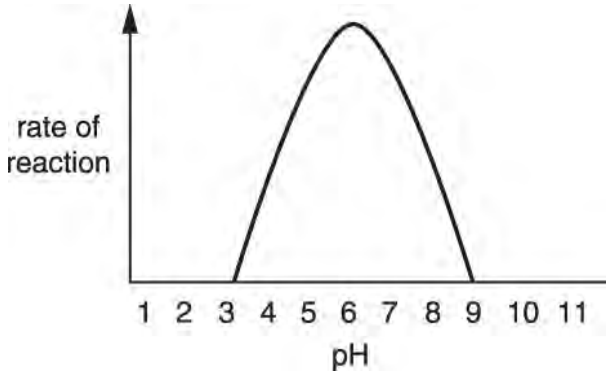
**[2]**

(c). The graph shows how pH affects the rate of reaction of an enzyme.




A student concludes that the enzyme only works at pH 6.

Is the student correct?

Explain your answer.

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[3]

END OF QUESTION PAPER

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 1 | a | | Any two from<br>1. Idea of interdependence ✓<br>2. Example of interdependence e.g. food / shelter / reproduction ✓<br>3. Maintaining genetic diversity ✓<br>4. May be required in the future for medicines ✓<br>5. Maintains the stability of the food web ✓ | 2 | MP3 IGNORE 'genetic variation' |
| | b | | 1. Advantage: (can be) fast / no need to find a mate ✓<br>2. Disadvantage: lack of genetic diversity / are all genetically identical ✓ | 2 | MP2 ALLOW 'are clones'<br>DO NOT ALLOW 'are all identical' |
| | c | i | Enzymes will become denatured ✓ | 1 | If more than one box is ticked, do not award the mark even if the correct box is also ticked |
| | | ii | Some cells may burst ✓ | 1 | If more than one box is ticked, do not award the mark even if the correct box is also ticked |
| | d | | Limpets will decrease in numbers ✓<br>As more are eaten ✓<br>OR<br>Crabs will increase in numbers ✓<br>As more food ✓ | 2 | ALLOW any correct species with correct explanation |
| | | | Total | 8 | |
| 2 | a | | Substrate – hydrogen peroxide AND enzyme – catalase ✓ | 1 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | b | | * Please refer to the marking instructions for guidance on how to mark this question.<br><br>**Level 3 (5–6 marks)**<br>*Describes in detail the pattern of the graph*<br>***AND***<br>*Links this to an explanation of the effect of all temperatures on enzyme function*<br>***AND***<br>*Identifies the optimum temperature for the enzyme*<br>*There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*<br><br>**Level 2 (3–4 marks)**<br>*Describes the pattern of the graph*<br>***AND***<br>*Links this to an explanation of the effect of temperature on enzyme function*<br>***OR***<br>*Identifies the optimum temperature for the enzyme*<br>*There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*<br><br>**Level 1 (1–2 marks)**<br>*Describes the pattern of the graph*<br>***AND***<br>*Makes reference to the effect of temperature on enzyme function between 0 and 30 °C*<br>***OR***<br>*Makes reference to the effect of temperature on enzyme function between 30 °C and 60 °C*<br><br>*The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.*<br><br>**0 marks**<br>*No response or no response worthy of credit.* | 6 | **AO3.1a Identification of patterns in graph**<br>For example:<br><br>• Rate of reaction increases between 0 °C and 30 °C<br>• Rate of reaction decreases between 30 °C and 60 °C<br><br>**AO2.1 Details of effect of temperature on enzyme function**<br>For example:<br><br>• Increase between 0 and 30 °C is because there is more kinetic energy<br>• So more collisions<br>• So more ESC form<br>• Decrease between 30 °C and 60 °C is because enzyme is denatured<br>• Loss of 3D structure<br>• ESC can no longer form as substrate does not fit into the enzyme<br><br>**AO3.2a Identification of the optimum temperature of the enzyme**<br>For example:<br><br>• Optimum temperature is 30 °C |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | | Total | 7 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 3 | | | **Level 3 (5-6 marks)**<br>Identifies some problems with experimental design **AND** suggests improvements directly linked to the problem.<br><br>Quality of written communication does not impede communication of the science at this level<br><br>**Level 2 (3-4 marks)**<br>Identifies some problems with experimental design **and** suggests improvements, unlinked.<br><br>Quality of written communication partly impedes communication of the science at this level<br><br>**Level 1 (1-2 marks)**<br>Identifies either a problem **OR** an improvement.<br><br>Quality of written communication impedes communication of the science at this level<br><br>**Level 0 (0 marks)**<br>Insufficient or irrelevant science. Answer not worthy of credit | 6 | **This question is targeted at grades up to C**<br><br>**Indicative scientific points may include**<br><br><u>Problem</u> — <u>Improvement</u><br><br>Only 5 cress seedlings used — Increase the number of cress seedlings<br><br>Light is from other sources — Eliminate light from other areas / grow in a box with light from one direction only<br><br>Could be due to another factor — Try light source from other angles to see if results are similar<br><br>5 days may not be long enough — Extend experiment beyond 5 days<br><br>No repeats carried out — Repeat experiment<br><br>One seedling did not grow towards the light — Repeat experiment<br><br>Some blocked from light because seedlings not all the same size — Use seedlings all the same size / put smaller plants near front / ensure evenly lit<br><br>Idea that sunlight can be variable — Use fixed light source / lamp (from side)<br><br>**Examiner's Comments**<br><br>Candidates were given a description of an experiment on the effect of light on shoot growth and were asked to suggest |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | | | | problems and solutions in the experimental design. Many candidates did not realise the purpose of the experiment, so suggested measures to get the cress seedlings to grow upright. Others suggested problems which were not visible in the diagram, such as lack of water. Higher scoring candidates related the improvements to the problems identified. |
| | | | Total | 6 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 4 | a | i | All correctly plotted (2 marks)<br><br>Five or six correctly plotted (1 mark) | 2 | **Allow**1 square error margin<br><br>**If plotted points invisible**, score marks from line of best fit.<br><br>**ignore** bar chart<br><br>Points to be plotted:<br>0.00, 0<br>0.02, 20<br>0.04, 28<br>0.06, 35<br>0.08, 40<br>0.12, 43<br>0.14, 43<br><br>**Examiner's Comments**<br><br>Candidates were asked to plot a graph of data for the effect of carbon dioxide on the rate of photosynthesis, candidates performed well. Some lost a mark by not plotting the first point at 0,0. |
| | | ii | Continuous, correct and smooth line of best fit, going through all plotted points, including the origin | 1 | **Accept** points joined with straight lines dot-to-dot<br><br>**Allow** 1 square error margin.<br><br>**If plotted points invisible**, score marks if line passes through the correct points on the graph<br><br>**Do not accept** straight line of best fit<br>**Allow** ecf<br><br>**Examiner's Comments**<br><br>Some very poor best fit lines were seen. In some cases, several lines were drawn, in others, the line was not smooth or was double in places. Random straight lines were common and also failed to score. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | iii | 42 | 1 | **Allow** 41 – 43<br>**Allow** ecf - correct reading of data from line<br><br>**Examiner's Comments**<br><br>The great majority correctly read a figure from the graph for a value for carbon dioxide concentration not given. |
| | | iv | Any two from<br><br>as carbon dioxide increases (the rate of) photosynthesis / reaction increases OR there is a positive correlation;<br><br>idea that increasing carbon dioxide has no further effect/ rate remains constant / rate plateaus;<br><br>because there is another limiting factor/ named limiting factor / $CO_2$ is no longer a limiting factor; | 2 | **do not accept** in reverse: as photosynthesis increases, carbondioxide increases / OWTTE<br><br>**do not accept** rate of photosynthesis decreases<br><br>**Examiner's Comments**<br><br>Most gave the original correlation but few gave valid statements about the levelling off or the effect of another limiting factor to score 2 marks. |
| | | v | (it is an) outlier / anomalous result / anomaly (1)<br><br>it does not fit the trend / pattern / line of best fit (1) | 1 | **Allow** does not fit in<br>**Ignore** does not match /look similar to other results<br><br>**Examiner's Comments**<br><br>The idea of an outlier was very well known, but fewer were able to state why it was not included, with reference to the pattern or trend of other results. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | b | | **Level 3 (5-6 marks)**<br>Uses point(s) of information provided alongside biological knowledge.<br>Quality of written communication does not impede<br>communication of the science at this level<br><br>**Level 2 (3-4 marks)**<br>Uses point(s) of information provided.<br>Quality of written communication partly impedes<br>communication of the science at this level<br><br>**Level 1 (1-2 marks)**<br>States condition(s) required for growth.<br>Quality of written communication impedes communication of the science at this level<br><br>**Level 0 (0 marks)**<br>Insufficient or irrelevant science. Answer not worthy of credit | 6 | **This question is targeted at grades up to C**<br><br>**Indicative scientific points may include:**<br><br>**Conditions**<br><br>• Temperature<br>• use heaters / greenhouse (to raise temperature)<br>• pH (of soil)<br>• light (intensity)<br>• use lamps to increase light intensity<br>• water<br>• minerals /nitrates<br>• provide fertilisers (to provide minerals)<br>• carbon dioxide levels should be above that of atmospheric levels<br>• burn fuels to produce $CO_2$<br><br>**Using information provided**<br><br>• pH (of the soil) 6-8/neutral ORA<br>• temperature 28-35 ORA<br><br>**Biological knowledge**<br><br>• optimising conditions for **enzymes ORA**<br>• correct reference to limiting factors<br><br>**Examiner's Comments**<br><br>Candidates were asked to use graphs and their biological knowledge to describe what conditions should be provided to grow tomatoes. It was generally well answered, with many candidates scoring 4 marks for reference to the information provided. Few gained the full 6 marks, which required an understanding of optimum conditions for enzyme action or a clear explanation of limiting factors. Even weaker candidates gained 1 or 2 marks by referring to temperature and pH. |
| | | | **Total** | **14** | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 5 | | | any two from<br><br>plants get more light;<br>more photosynthesis / growth / food;<br>plants can compete better | 2 | OWTTE<br><br>Examiner's Comments<br><br>This question had one mark available for the idea that the plant gets more light, and a second mark for the idea that more light leads to more photosynthesis. Many candidates failed to score at all on this question, and for those who did it was unfortunate that they seemed unprepared to construct an argument based on the recall of a plain statement in the specification. |
| | | | Total | 2 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 6 | a | | sunlight;<br>build up;<br>energy;<br>break down | 4 | Examiner's Comments<br><br>Nearly all candidates scored at least two marks, and many did even better than that. Where marks were lost it was most common to have the idea that photosynthesis builds up large food molecules wrong. |
| | b | | any two from<br><br>each step contains different molecules / substrates / reactants;<br>each enzyme / substrate molecule has a different / specific shape;<br>molecules must be the correct shape to fit together (into the active site of the enzyme);<br>correct reference to 'lock and key' model; | 2 | not "same shape"<br><br>"fit" has to clearly refer to enzyme and substrate<br><br>Examiner's Comments<br><br>This question was one where the weaker candidates struggled to express their ideas clearly. While there was a good deal of mention of the lock and key model few seemed able to link this to other ideas on the markscheme for a second mark, and it was surprising to see so many responses which had a confused idea such as the enzyme has to fit into the active site. |
| | c | i | 30 (°C) = 40 (units);<br>45°C = 5 (units) | 2 | Examiner's Comments<br><br>This question was generally very well answered, The great majority of candidates seemed well able to read data from the graph. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | ii | as the temperature increases the rate of reaction decreases / negative correlation;<br><br>enzymes not at optimum / stop working | 2 | **ignore** description of increase from 0 to 30<br><br>**allow** denatured<br><br>**Examiner's Comments**<br><br>This was an area where candidates often struggled to express themselves clearly, their biggest difficulty being to link a comment about the rate of reaction to the temperature. It is true to say that the rate of reaction increases and then decreases across the whole temperature range, but the question is about the range from 30°C to 45°C, and so the correct response is that the rate decreases. More were able to score a mark on the explanation than on the description of the pattern of results. |
| | | iii | two plots:<br><br>one at 10°C **and** one at 25°C | 1 | **Examiner's Comments**<br><br>This question tended to be very well answered, with most candidates able to correctly identify both outliers. Some candidates lost a mark here by being careless and drawing such a large ring around the point at 10°C that they included the point at 15°C as well and so could not be awarded the mark. |
| | d | i | More water is available.<br>The light intensity is at its highest. ?<br>The temperature of the soil is at its highest. | 1 | **Examiner's Comments**<br><br>Was generally very well answered, with most candidates picking up on the idea that the highest rate of photosynthesis is best explained by the light intensity being highest, which should have been helpful to them in part iii. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | ii | 35 (arbitrary units) | 1 | Examiner's Comments<br><br>This question called for a calculation of the difference between 50 and 15, and it might have been expected from the high degree of skill in reading the graphs demonstrated in other questions that even more candidates would have scored this mark than actually did. |
| | | iii | the difference would be less;<br>reduced (rate of) photosynthesis (but not as much for respiration) | 2 | Examiner's Comments<br><br>Many scored one mark on part iii for the idea that the difference would be less, or for the idea that the rate of photosynthesis would be lower on a cloudy day, but very few candidates seemed able to put the two ideas together and it may be that this was simply a failure to give enough detail for two marks here rather than a problem with Biological knowledge. |
| | | iv | 10.00–12.00 | 1 | Examiner's Comments<br><br>This question was generally well answered, showing that many of the candidates were able to draw a conclusion based on the evidence in the graph. |
| | | | Total | 16 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 7 | a | | **Level 3 (5–6 marks)**<br>Explanation uses ideas from: photosynthesis, temperature and enzymes<br><br>Quality of written communication does not impede communication of the science at this level<br><br>**Level 2 (3–4 marks)**<br>Explanation uses ideas from two of: photosynthesis, temperature, enzymes<br><br>Quality of written communication partly impedes communication of the science at this level<br><br>**Level 1 (1–2 marks)**<br>Makes ref. to either photosynthesis OR temperature OR enzymes<br><br>Quality of written communication impedes communication of the science at this level<br><br>**Level 0 (0 marks)**<br>Insufficient or irrelevant science. Answer not worthy of credit | 6 | **This question is targeted at grades up to C**<br><br>**Indicative scientific points may include**<br><br>**Photosynthesis**<br><br>• (If enzymes do not function) the rate of photosynthesis drops / stops<br>• If there is no photosynthesis less / no glucose will be made<br>• Less / no respiration<br>• Idea of (temp) limiting factor for P/S<br><br>**Temperatures**<br><br>• temperature is **too** hot / high / low / cold (algae die) **ignore** ref to figures<br>• Reaction slows (photosynthesis)<br>• Fewer collisions / ref to kinetic energy changes<br><br>**NB** Credit “reaction slows” only once (either temperature or photosynthesis)<br><br>**Enzyme**<br><br>• enzyme works best / fastest at optimum temperature<br>• Enzyme is damaged / denatured / changes shape (at **high** temperatures); **Ignore** killed / dies<br>• Ref. To active site<br>• ref to lock and key / substrate no longer complementary AW<br><br>**Examiner's Comments**<br><br>This question asked for explanation of how changes in sea water temperature can lead to algae dying. Six marks were available for a full answer describing the effect on photosynthesis, the role of temperature and the effect on enzyme function. Weaker answers did not refer to photosynthesis, referred to temperature changes rather than being too hot or too cold, and |

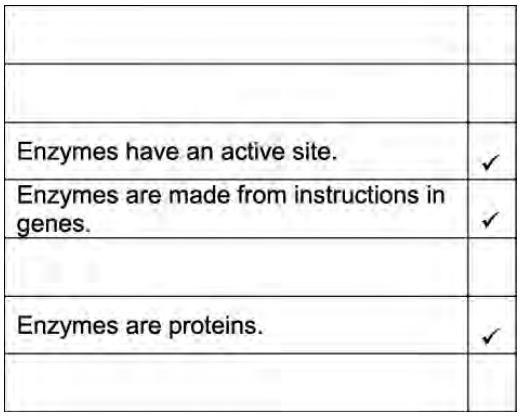
| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | | | | reference to enzymes being killed, or being denatured above or below optimum temperature. Good answers covered points such as photosynthesis producing glucose and temperature being a limiting factor, at temperatures which are too high the enzymes will be denatured and correct references to active site and substrate. Few described the effect of temperature on particle collisions. |
| | b | | *any three from*<br>sample or look at different areas of coral (where algae dead and alive);<br><br>measure / change temperature;<br><br>measure / change UV / light;<br><br>record amount of living / dead algae;<br><br>ref. to correlation between either factor and dead algae; | 3 | **Award marks for natural habitat OR experimental situation**<br>**Accept** coral for algae throughout<br>**Accept** appropriate sampling techniques<br><br>e.g. more UV, less algae<br><br>**Examiner's Comments**<br><br>Only the best candidates gained full marks here. Candidates were asked to describe how scientists could show whether light or temperature is the cause of algae dying in their natural habitat. Many did not appreciate this and described a laboratory experiment, but credit was also available for answers along these lines. Few described a field investigation where temperature and UV were measured and related to the amount of living and dead coral in a number of areas, and references to sampling techniques were rarely seen. Where a laboratory experiment was suggested, ideas of control of variables were missing. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | c | i | Algae give carbon dioxide to the coral ☐<br>Algae give chlorophyll to the coral ☐<br>Algae give glucose to the coral ✓<br>Algae give oxygen to the coral ✓<br>Coral gives carbon dioxide to the algae ✓<br>Coral gives chlorophyll to the algae ☐<br>Coral gives glucose to the algae ☐<br>Coral gives oxygen to the algae ☐ | 3 | remove one mark for each additional incorrect answer<br><br>**Examiner's Comments**<br><br>In this question aspects of the role of symbiotic algae in coral were explored. In this part, the benefits to both organisms were required. Although most candidates scored, few gained all three marks available. |
| | | ii | cellulose (1) starch (1) | 2 | **Examiner's Comments**<br><br>Most candidates were able to give at least one substance which the algae can make from glucose produced in photosynthesis. Starch was better known than cellulose, and calcium was a common incorrect answer. |
| | | | **Total** | **14** | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 8 | a | | carbon dioxide (1)<br>glucose (1) | 2 | responses must be in the correct order<br>**accept** correct formulae ie (6)$CO_2$ $C_6H_{12}O_6$ if formula must be subscript<br>**accept** starch, sugar or any named carbohydrate on RHS<br><br>Examiner's Comments<br><br>This question was well attempted and those who knew the equation for photosynthesis knew both answers. Candidates who attempted this but failed to score tended to write the answers the wrong way around. |
| | b | i | 10.8 (1) | 1 | Examiner's Comments<br><br>This question was attempted by most candidates with most correctly calculating the mean value as 10.8 |
| | | ii | C(1) | 1 | **accept** correct references to value<br>if A given as response then check mean value of high and if between 14.8–15.2 then accept answer<br><br>Examiner's Comments<br><br>Most candidates were able to correctly identify the species as C. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | iii | *(confident because):*<br>the (mean) values are the same / similar / very close / closest (1)<br>the results were repeated (ten times) (1)<br>(repeats mean) results are repeatable / reliable / valid (1)<br><br>*(not confident because):*<br>size of bubbles vary (1)<br>difficult to count bubbles (1)<br>size of pondweed might be different (in the two tubes) (1)<br><br>the temperature might be different (in the two tubes) (1)<br>need more data / tests (to be sure) (1) | 2 | mark whole answer crediting any two points<br><br>must imply both values<br><br>**ignore** accurate<br><br>**ignore** ref to different species of pondweed (as given in the question)<br><br>**allow** any other reasonable difference in variables<br><br>**ignore** idea of human error<br>**ignore** idea that data is wrong / inaccurate<br><br>Examiner's Comments<br><br>In this question there were 2 marks available for 2 reasons as to why the candidate would be confident or not about their answer to (ii). Most candidates gave only one reason in their answer limiting their mark to 1. |
| | | iv | *any two from:*<br>control the (water) temperature (in the test tubes) (1)<br>control the pH (using a buffer) (1)<br>use the same length / mass / amount / size of pondweed (1)<br>same number of leaves (1)<br>collect the (oxygen) bubbles to measure the volume (1)<br>control carbon dioxide levels (1)<br>use different species of pondweed (1)<br>use other / specific light intensity (1)<br>leave experiment longer time (1) | 2 | **accept** any other feasible improvement<br>**accept** use more replicates<br><br>**ignore** amount<br><br>Examiner's Comments<br><br>Here candidates were asked to suggest 2 improvements to the experiment. Most failed to follow the rubric command explaining one improvement in detail rather than 2 and therefore limiting their answer to 1 mark. |
| | | | Total | 8 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 9 | | | [Level 3]<br>Correct description or correct word equation AND suggestion why rate is fast.<br>Quality of written communication does not impede communication of the science at this level.<br><br>(5 – 6 marks)<br><br>[Level 2]<br>Description or correct word equation OR partial description and suggestion why rate is fast.<br>Quality of written communication partly impedes communication of the science at this level.<br><br>(3 – 4 marks)<br><br>[Level 1]<br>Product / reactant / light / chlorophyll OR suggestion why rate is fast.<br>Quality of written communication impedes communication of the science at this level.<br><br>(1 – 2 marks)<br><br>[Level 0]<br>Insufficient or irrelevant science. Answer not worthy of credit.<br><br>(0 marks) | 6 | This question is targeted at grades up to E<br><br>Indicative scientific points for photosynthesis may include:<br><br>• chlorophyll / pigment / green used<br>• takes place in leaf<br>• needs light<br>• uses carbon dioxide<br>• uses water<br>• makes oxygen<br>• makes glucose<br>• word equation<br><br>Link stated between a suggested feature of the plant and photosynthesis and rapid growth e.g.<br>idea that photosynthesis is more efficient<br>more chloroplasts / leaves darker green<br>leaves spread out to catch a lot of light / lots of leaves<br>good roots<br><br>Use the L1, L2, L3 annotations in Scoris; do not use ticks.<br><br>Examiner's Comments<br><br>This was a well answered question by those who coupled a clear description of photosynthesis with features of the plant which could account for the rapid growth. The very best used an equation to summarise photosynthesis. Far from all responses showed a clear or complete description of photosynthesis, and this greatly limited the marks they could score. |
| | | | Total | 6 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 10 | a | |  | 3 | minus 1 mark for each additional incorrect tick.<br><br>**Examiner's Comments**<br><br>The answer called for three ticks, which most candidates did offer. It was most common for marks to be scored for “active site” and “enzymes are proteins”. Only the most successful candidates were able to link this to “made from instructions in genes”. |
| | b | i | Break down (stains); | 1 | **accept** makes stains soluble / digests stains<br>**ignore** removes / destroys / eats stains<br><br>**Examiner's Comments**<br><br>The question was best answered by those who used technical vocabulary e.g. 'digests'. Some responses which did not score were couched in vague terms which often restated the question. |
| | | ii | **30°C** optimum temperature;<br>enzymes will not work / denatured at 90°C / at high temperatures; | 2 | **accept** “works best at 30°C”<br><br>**Examiner's Comments**<br><br>Those who did score a mark most often did so for the idea of the enzyme denaturing at high temperature. It was much less common for candidates to score the optimum temperature marking point, and many were explicit in giving 37°C or body temperature as the optimum, showing that their thinking was limited to the context of the human body. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | c | | works best at pH6;<br>works over a range of pH3 to pH9;<br>does not work at all below pH3 / above pH9; | 3 | **accept** (pH6) is optimum<br>**accept** range of pH4 to pH8<br>**ignore** reference to “temperature”<br><br>**Examiner's Comments**<br><br>This question was often well answered in terms of giving pH6 as the optimum, and some were able to score a further mark for describing the range. Few went on to explain that the enzyme does not work below pH3 or above pH9 clearly enough for a mark to be awarded. |
| | | | **Total** | **9** | |