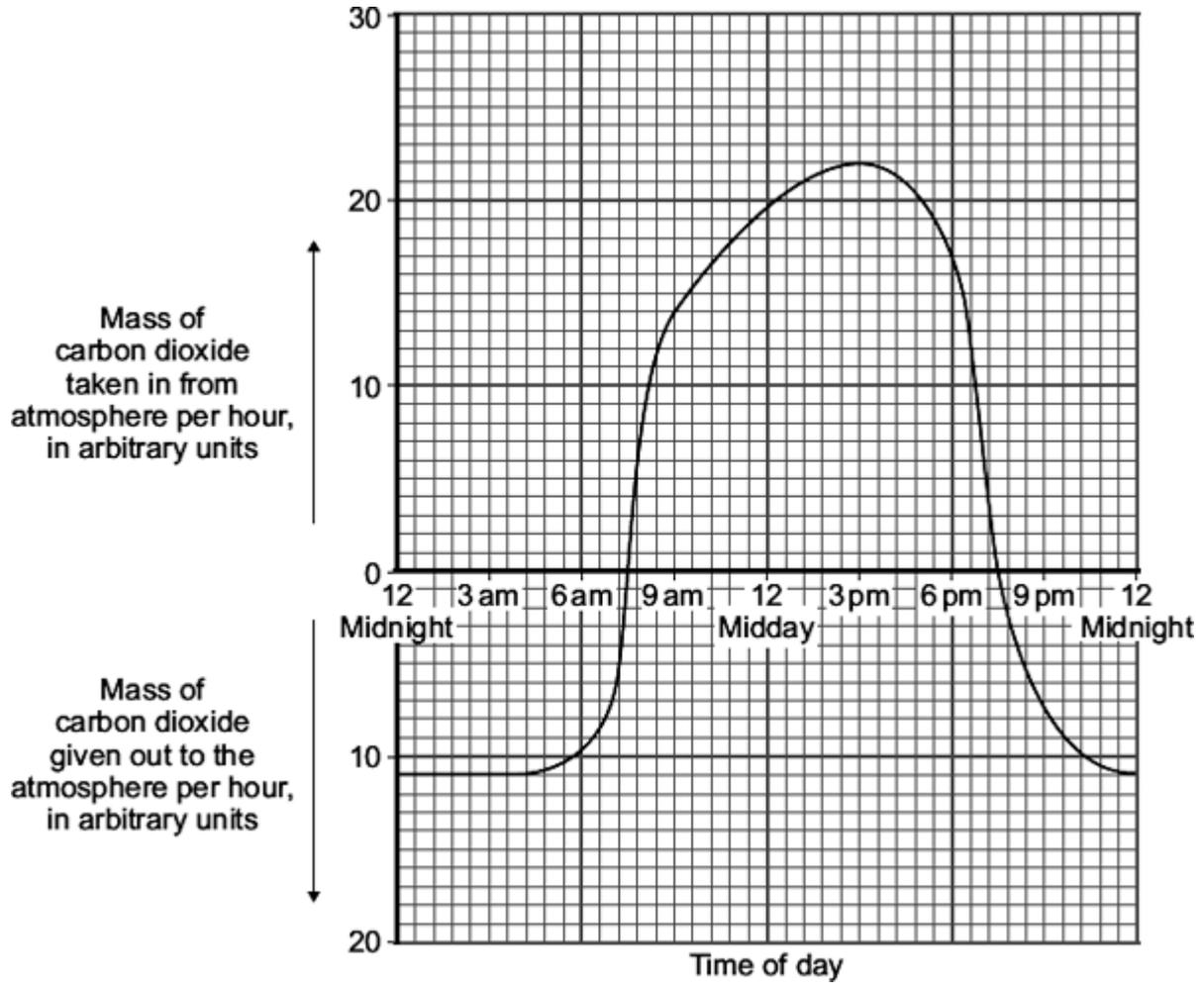


- 1 The graph shows the uptake of carbon dioxide and the release of carbon dioxide by a bean plant on a hot summer's day.



- (a) At which **two** times in the day did the rate of photosynthesis exactly match the rate of respiration in the bean plant?

1. _____ 2. _____

(1)

- (b) The bean plant respire at the same rate all through the 24 hour period.

- (i) How much carbon dioxide is released each hour during respiration?

_____ arbitrary units

(1)

- (ii) How much carbon dioxide is used by photosynthesis in the hour beginning at 3 pm?

Answer = _____ arbitrary units

(1)

- (c) Over the 24 hour period, the total amount of carbon dioxide taken in by the bean plant was greater than the total amount of carbon dioxide given out by the bean plant.

Explain, in detail, why this was important for the bean plant.

(2)

(Total 5 marks)

2

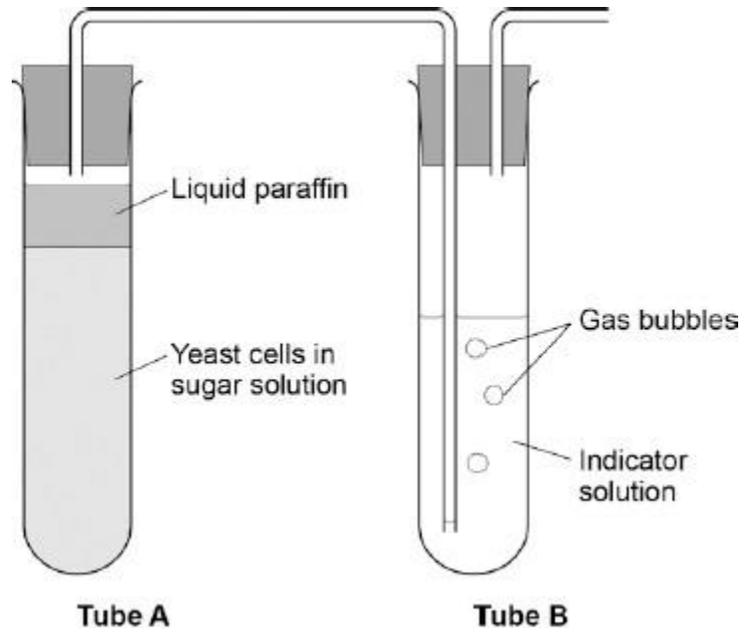
All living cells respire.

- (a) Respiration transfers energy from glucose for muscle contraction.

Describe how glucose from the small intestine is moved to a muscle cell.

(2)

(b) The diagram below shows an experiment to investigate **anaerobic** respiration in yeast cells.



What is the purpose of the liquid paraffin in Tube A?

Tick **one** box.

To prevent evaporation

To stop air getting in

To stop the temperature going up

To stop water getting in

(1)

- (c) The indicator solution in Tube **B** shows changes in the concentration of carbon dioxide (CO₂).

The indicator is:

- **blue** when the concentration of CO₂ is very low
- **green** when the concentration of CO₂ is low
- **yellow** when the concentration of CO₂ is high.

What colour would you expect the indicator to be in Tube **B** during maximum rate of anaerobic respiration?

Tick **one** box.

Blue

Green

Yellow

(1)

- (d) Suggest how the experiment could be changed to give a reproducible way to measure the rate of the reaction.

Include any apparatus you would use.

(2)

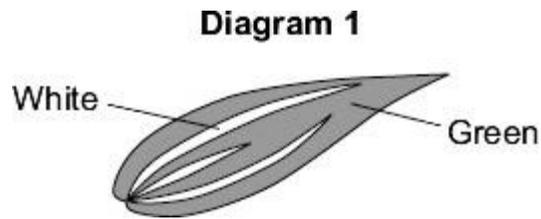
(e) Compare anaerobic respiration in a yeast cell with anaerobic respiration in a muscle cell.

(3)

(Total 9 marks)

- 3 Students investigated the effect of changing the carbon dioxide concentration on the rate of photosynthesis in pieces of leaf.

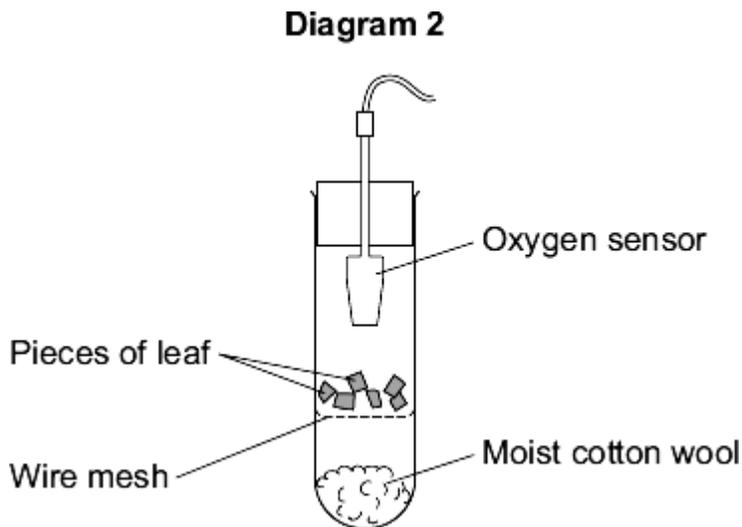
Diagram 1 shows the type of leaf used by the students.



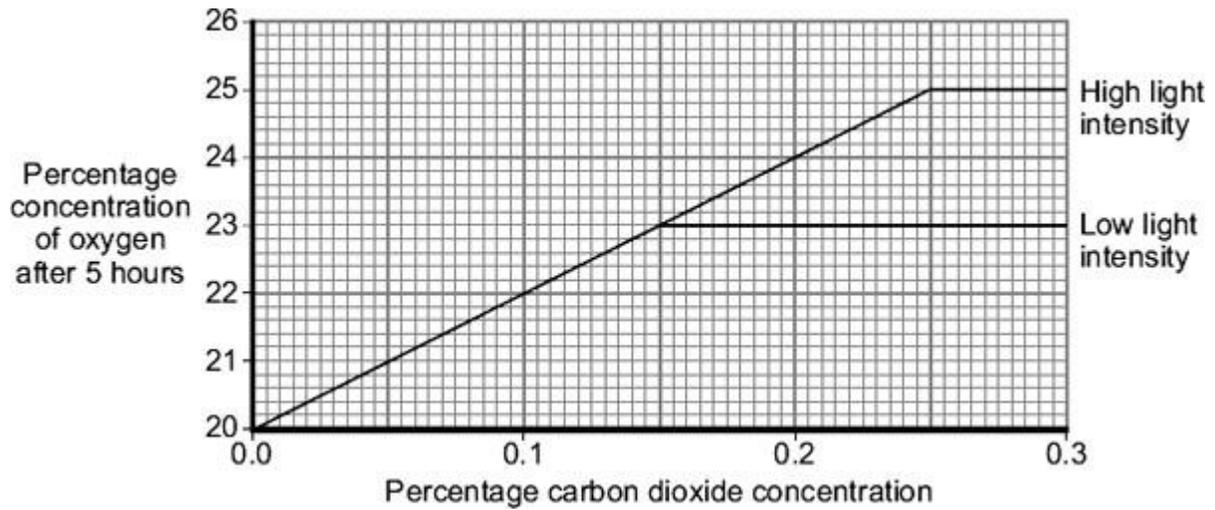
The students:

- cut pieces of leaf from the green region
- put the pieces into tubes
- added different concentrations of carbon dioxide to each tube
- shone lights on the tubes with either high or low light intensity
- recorded the concentration of oxygen in the tubes after 5 hours.

Diagram 2 shows how each experiment was set up.



The graph shows the results of the investigation.



- (a) (i) Describe the effect of increasing carbon dioxide concentration on the rate of photosynthesis at low light intensity.

(1)

- (ii) Explain the effect that you have described.

In your answer you should refer to limiting factors.

(2)

- (b) What would have been the effect on oxygen concentration over the five-hour period if a white region of the leaf had been used, instead of a green region?

Effect _____

Explain your answer.

Explanation _____

(2)

- (c) Some people keep indoor plants which have variegated leaves (leaves with green and white regions).

If plants with variegated leaves are kept in dim light conditions the white areas of the leaves start to turn green.

This is an advantage to the plant.

Suggest why.

(2)

(Total 7 marks)

4 Green plants can make glucose.

- (a) Plants need energy to make glucose.

How do plants get this energy?

(2)

(b) Plants can use the glucose they have made to supply them with energy.

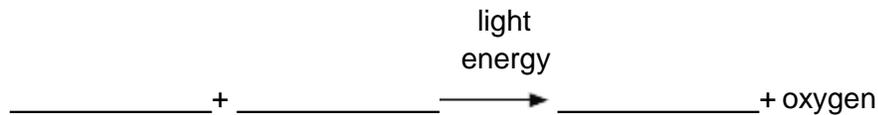
Give **four** other ways in which plants use the glucose they have made.

(4)

(Total 6 marks)

5

(a) Complete the equation for photosynthesis.



(2)

(b) Scientists investigated how temperature affects the rate of photosynthesis. The scientists grew some orange trees in a greenhouse. They used discs cut from the leaves of the young orange trees.

The scientists used the rate of oxygen production by the leaf discs to show the rate of photosynthesis.

(i) The leaf discs did not produce any oxygen in the dark.

Why?

(1)

(ii) The leaf discs took in oxygen in the dark.

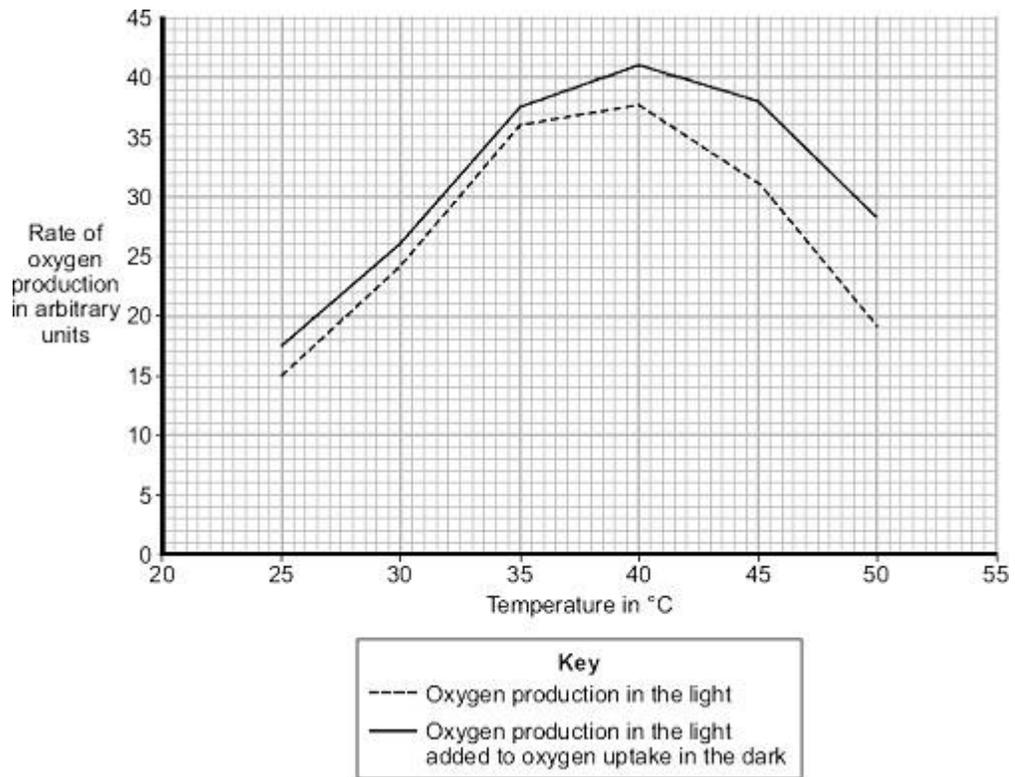
Explain why.

(2)

(c) In their investigation, the scientists measured the rate of oxygen release by the leaf discs in the light. The scientists then measured the rate of oxygen uptake by the leaf discs in the dark.

The graph shows the effect of temperature on

- oxygen production in the light
- oxygen production in the light added to oxygen uptake in the dark.



Use the information from the graph to answer each of the following questions.

- (i) Describe the effect of temperature on oxygen production in the light.

(2)

- (ii) Explain the effect of temperature on oxygen production in the light when the temperature is increased:

from 25 °C to 35 °C

from 40 °C to 50 °C.

(2)

- (d) A farmer in the UK wants to grow orange trees in a greenhouse. He wants to sell the oranges he produces at a local market.
He decides to heat the greenhouse to 35 °C.

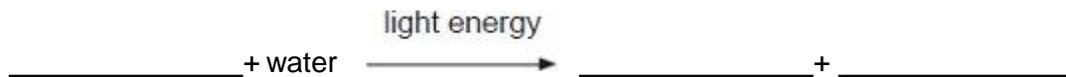
Explain why he should **not** heat the greenhouse to a temperature higher than 35 °C.
Use information from the graph in your answer.

(3)

(Total 12 marks)

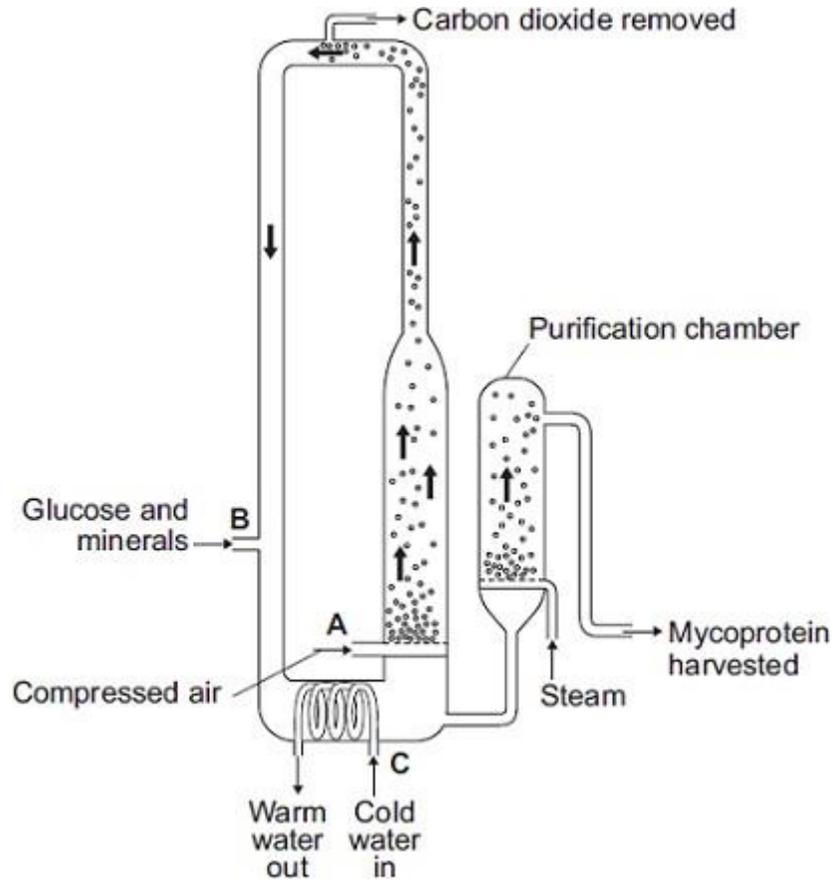
6

- (a) Complete the equation for photosynthesis.



(3)

- 7 The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium*.
Fusarium is used to make mycoprotein.



- (a) Bubbles of air enter the fermenter at **A**.

Give **two** functions of the air bubbles.

1. _____

2. _____

(2)

- (b) Why is glucose added to the fermenter?

(1)

- (c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C**.

Name the process that causes the fermenter to heat up.

(1)

- (d) It is important to prevent microorganisms other than *Fusarium* growing in the fermenter.

- (i) Why is this important?

(1)

- (ii) Suggest **one** way in which contamination of the fermenter by microorganisms could be prevented.

(1)

- (e) Human cells cannot make some of the amino acids which we need. We must obtain these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

Name of amino acid	Amount of amino acid per 100 g in mg			Daily amount needed by a 70 kg human in mg
	Mycoprotein	Beef	Wheat	
Lysine	910	1600	300	840
Methionine	230	500	220	910
Phenylalanine	540	760	680	980
Threonine	610	840	370	490

Mark schemes

- 1** (a) 7.15 to 7.45 am and 7.15 to 7.45 pm
both required, either order
accept in 24 hr clock mode 1
- (b) (i) 11 1
- (ii) 32.5 to 33
allow answer to (b)(i) + 21.5 to 22 1
- (c) any **two** from:
 - more photosynthesis than respiration
 - more biomass / carbohydrate made than used
allow more food made than used
 - so plant able to grow / flower
accept plant able to store food 2
- 2** (a) glucose is absorbed by diffusion into the bloodstream 1
then blood delivers glucose to muscles in capillaries 1
- (b) to stop air getting in 1
- (c) yellow 1
- (d) collect the CO₂ / gas with a measuring cylinder / gassyringe 1
(volume collected) in a certain time using a timer / watch 1
- (e) yeast produces ethanol but muscles produce lactic acid
marks can be awarded from correct word or balanced symbol equations 1
yeast produces CO₂ but muscles do not
answers must be comparative 1
both release small amounts of energy 1

[5]

ignore both occur without oxygen

[9]

- 3 (a) (i) increase (and then level off) **and** max / up to at 0.15 (%) (carbon dioxide)
ignore references to oxygen concentration only
ignore mention of 23 1
- (ii) CO₂ is limiting at low CO₂ / at first
ignore specific numbers 1
- light is limiting at high CO₂ / at end 1
- (b) **mark both parts together**
- effect: (oxygen) falls 1
- explanation: (oxygen) used for respiration
if no other marks awarded allow (effect) no change and (explanation) no photosynthesis for 1 mark 1
- (c) more chlorophyll / chloroplasts 1
- allows more photosynthesis / description
for both marks must refer to more at least once 1

[7]

- 4 (a) light is trapped / absorbed / used
extra answers cancel mark
ignore solar / sunshine 1
- by chlorophyll / chloroplasts
if no other marks awarded, allow 1 mark for photosynthesis / equation for photosynthesis 1
- (b) (to make) starch (for storage)
ignore 'for growth' unqualified
ignore respiration 1
- (to make) fat / oil (for storage) 1
- (to make) amino acids / proteins / enzymes 1

(to make) cellulose / cell walls

allow for active transport

allow any other correct, named organic substances (eg DNA / ATP / chlorophyll / hormone)

*if no named examples, allow 'to make **named** cell structures' for max. 1 mark*

1

[6]

5

(a) LHS: carbon dioxide **AND** water

in either order

*accept CO₂ **and** H₂O*

allow CO₂ and H₂O

if names given ignore symbols

*do **not** accept CO₂ / H₂O / Co / CO*

ignore balancing

1

RHS: sugar(s) / glucose / starch / carbohydrate(s)

accept C₆H₁₂O₆

allow C₆H₁₂O₆

*do **not** accept C⁶H¹²O⁶*

1

(b) (i) light is needed for photosynthesis

or

no photosynthesis occurred (so no oxygen produced)

1

(ii) oxygen is needed / used for (aerobic) respiration

full statement

*respiration occurs **or** oxygen is needed for anaerobic respiration
gains 1 mark*

2

(c) (i) (with increasing temperature) rise then fall in rate

1

use of figures, ie

max. production at 40 °C

or maximum rate of 37.5 to 38

1

(ii) 25 – 35 °C

either faster movement of particles / molecules / more collisions

or particles have more energy / enzymes have more energy

1

or temperature is a limiting factor over this range

40 – 50 °C

denaturation of proteins / enzymes

ignore denaturation of cells

ignore stomata

1

- (d) above 35 °C (to 40 °C) – little increase in rate
or > 40 °C – causes decrease in rate

1

so waste of money or less profit / expensive

1

because respiration rate is higher at > 35 °C

or

respiration reduces the effect of photosynthesis

1

[12]

6

- (a) LHS – carbon dioxide / CO₂

allow CO₂

ignore CO²

1

RHS

in either order

glucose / carbohydrate / sugar

allow starch

allow C₆H₁₂O₆/C6H12O6

ignore C⁶H¹²O⁶

1

oxygen

allow O₂ / O₂

ignore O² / O

1

(b) any **five** from:

- factor 1: CO₂ (concentration)
- effect - as CO₂ increases so does rate and then it levels off or shown in a graph
- explanation:
(graph increases) because CO₂ is the raw material or used in photosynthesis / converted to organic substance / named eg
or
(graph levels off) when another factor limits the rate.
accept points made via an annotated / labelled graph
- factor 2: temperature
allow warmth / heat
- effect – as temperature increases, so does the rate and then it decreases or shown in a graph
allow 'it peaks' for description of both phases
- explanation:
(rise in temp) increases rate of chemical reactions / more kinetic energy
allow molecules move faster / more collisions
or
(decreases) because the enzyme is denatured.
context must be clear = high temperature

*allow other factor plus effect plus explanation:
eg light wavelength / colour / pigments / chlorophyll / pH / minerals / ions / nutrients / size of leaves
2nd or 3rd mark can be gained from correct description and explanation*

5

[8]

7

(a) circulating / mixing / described **or** temperature maintenance

1

supply oxygen

or for aerobic conditions

or for faster respiration

*do **not** allow oxygen for anaerobic respiration*

1

(b) energy supply / fuel / use in respiration

*do **not** allow just food / growth*

ignore reference to aerobic / anaerobic

or material for growth / to make mycoprotein

1

(c) respiration

allow exothermic reaction

allow catabolism

ignore metabolism

ignore aerobic / anaerobic

1

(d) (i) any **one** from:

- compete (with *Fusarium*) for food / oxygen **or** reduce yield of *Fusarium*
- make toxic waste products or they might cause disease / pathogenic **or** harmful to people / to *Fusarium*
*do **not** allow harmful unqualified*

1

(ii) steam / heat treat / sterilise fermenter (before use)

***not** just clean*

or

steam / heat treat / sterilise

glucose / minerals / nutrients / water (before use)

or

filter / sterilise air intake

or

check there are no leaks

*allow sterilisation unqualified **not** just use pure glucose*

1

(e) any **three** from:

- beef is best or beef is better than mycoprotein
- mycoprotein mainly better than wheat
- more phenylalanine in wheat than in mycoprotein
allow equivalent numerical statements
- but no information given on other amino acids / costs / foods

3

overall conclusion:

statement is incorrect because

either

it would be the best source for vegetarians

or

for given amino acids, beef is the best source

or

three foods provide insufficient data to draw a valid conclusion

1

[10]