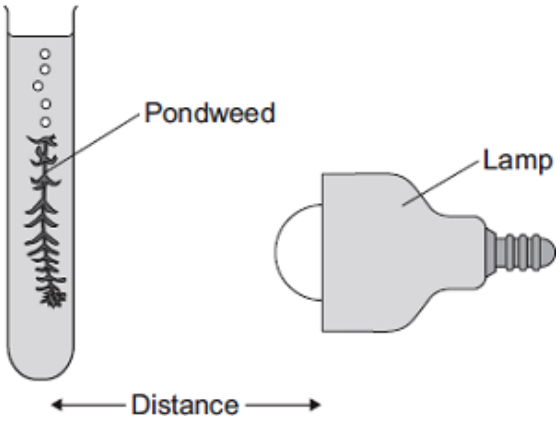
Q1. Some students investigated the effect of light intensity on the rate of photosynthesis.

They used the apparatus shown in **Diagram 1**.

Diagram 1



The students:

- placed the lamp 10 cm from the pondweed
- counted the number of bubbles of gas released from the pondweed in 1 minute
- repeated this for different distances between the lamp and the pondweed.

(a) The lamp gives out heat as well as light.

What could the students do to make sure that heat from the lamp did **not** affect the rate of photosynthesis?

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(1)

(b) The table shows the students' results.

Distance in cm	Number of bubbles per minute
10	84
15	84
20	76
40	52
50	26

(i) At distances between 15 cm and 50 cm, light was a limiting factor for photosynthesis.

What evidence is there for this in the table?

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(1)

(ii) Give **one** factor that could have limited the rate of photosynthesis when the distance was between 10 cm and 15 cm.

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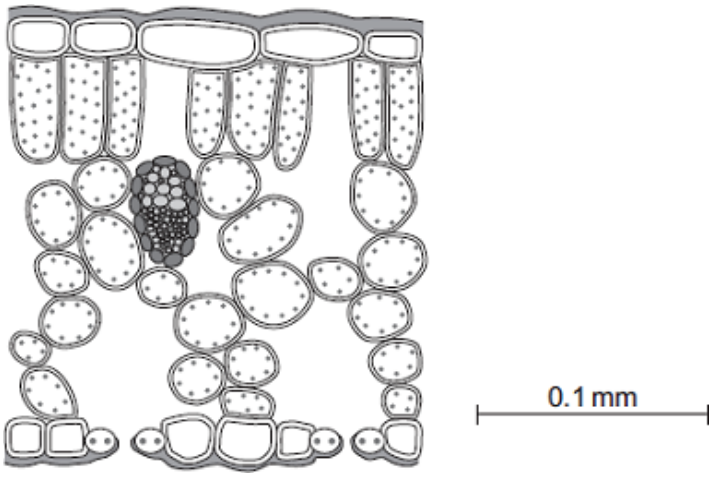
(1)

(c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Diagram 2 shows a section through a plant leaf.

Diagram 2



Describe the structure of the leaf and the functions of the tissues in the leaf.

You should use the names of the tissues in your answer.

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(6)
(Total 9 marks)

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(a) Complete the table to give one site where digestive substances are made.

Digestive substance	One site of production
bile	
amylase	
lipase	
protease	

(4)

(b) Describe **two** ways that the mouth can break down starchy foods.

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(2)

(c) Describe how the liver helps to digest fats.

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(2)

(Total 8 marks)

Q3. (a) (i) What name is given to an enzyme which catalyses the breakdown of protein?

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(1)

(ii) What product is formed when protein is broken down by the enzyme?

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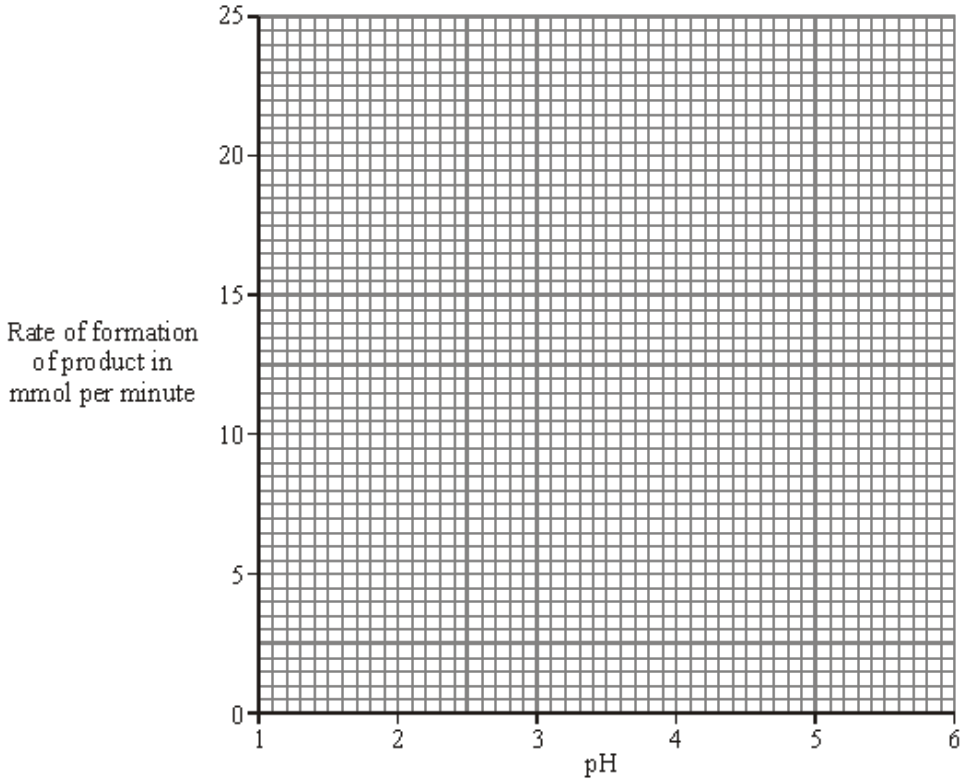
(1)

The table shows the effect of pH on the activity of an enzyme which catalyses the breakdown of protein.

pH	1.0	2.0	3.0	4.0	5.0
Rate of formation of product in mmol per minute	10.5	23.0	10.5	2.5	0.0

(b) Draw a graph of the data in the table.



(3)

(c) The enzyme is produced by the human digestive system.

(i) At what pH does this enzyme work best? .....

(1)

(ii) Suggest which part of the digestive system produces this enzyme.

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(1)

(d) Why is it necessary to break down proteins in the digestive system?

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(3)

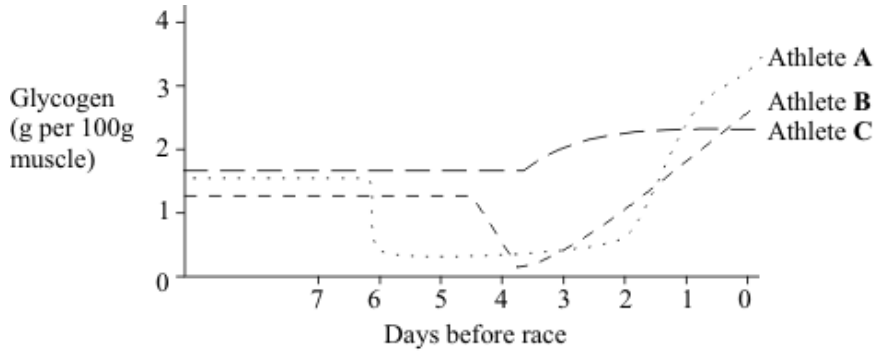
(Total 10 marks)

Q4. Marathon runners are recommended to have a high carbohydrate diet prior to a race. Three athletes tried out three dietary regimes prior to a marathon race.

These three dietry regimes were as follows.

Athlete A	Up to 7 days before the race	-	Normal mixed diet
	7 days before the race	-	Prolonged extreme physical activity
	6-3 days before the race	-	Protein and fat diet; no carbohydrate
	2 and 1 days before the race	-	Large carbohydrate intake
Athlete B	Up to 5 days before race	-	Normal mixed diet
	5 days before the race	-	Prolonged extreme physical activity
	4-1 days before the race	-	Large carbohydrate intake
Athlete C	Up to 4 days before the race	-	Normal mixed diet
	4-1 days before the race	-	Large carbohydrate intake

The graph below shows the effect of each of these dietary regimes on glycogen levels in the athletes' muscles



(a) (i) What is the immediate effect of extreme physical activity on the glycogen content of muscles?

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(1)

(ii) Describe how this effect occurs.

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(3)

(b) (i) Evaluate the three regimes as preparation for a marathon race.

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(3)

(ii) Suggest a possible explanation for the different effects of the three regimes.

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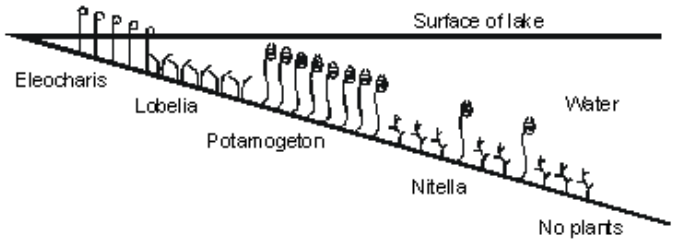
(2)
(Total 9 marks)

Q5. This is a diagram of a belt transect showing the major types of plants growing on the bottom of a lake.



(a) Suggest, and explain, **two** reasons why a much smaller population of Nitella plants is found amongst the Potamogeton plants than further down in the lake.

1. .....

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2. .....

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(4)

(b) Describe how you would use the belt transect technique to measure the abundance and distribution of plants which live on the bottom of a shallow lake.

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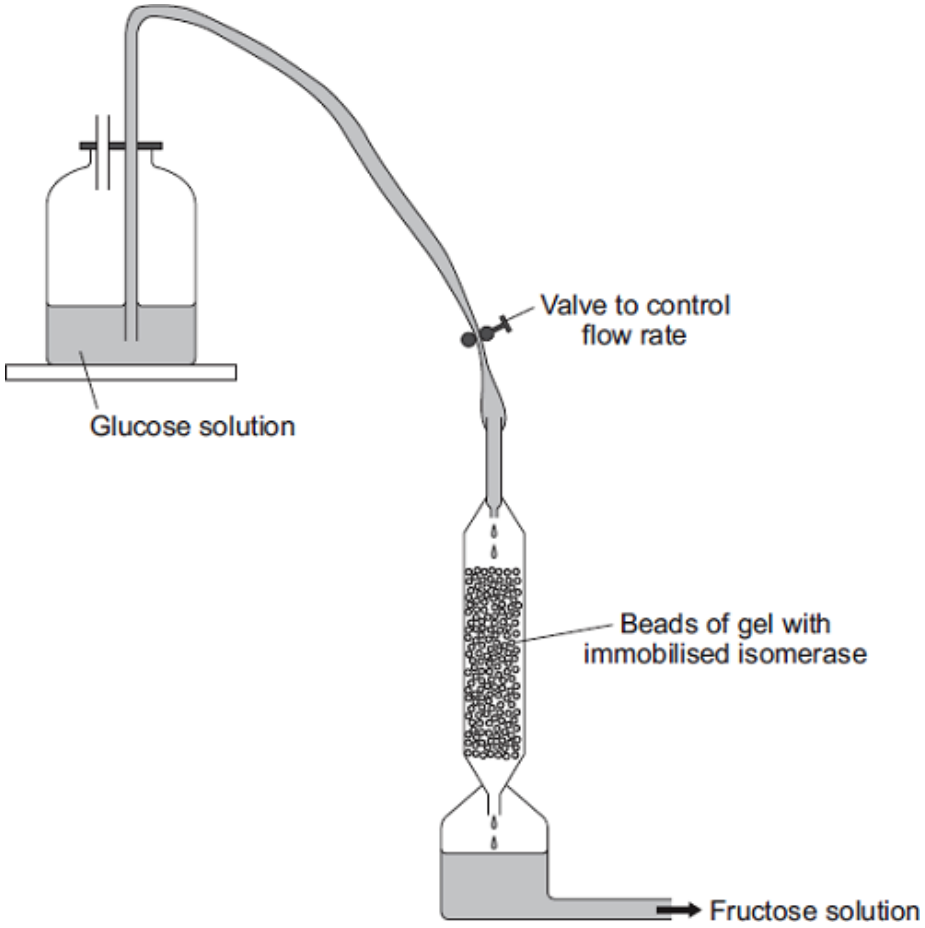
(3)
(Total 7 marks)

Q6. Isomerase is an enzyme which can change glucose into fructose.
Fructose is often used instead of glucose in products like slimming foods.

In industry, isomerase is often 'immobilised' within beads of gel.
The beads are placed in a glass column.
The isomerase stays attached to the beads and a solution of glucose is allowed to flow between the beads in the column.

The diagram shows how immobilised isomerase is used.



(a) An alternative method of changing glucose into fructose would be to mix a solution of the isomerase with the glucose solution in a large container.
Suggest **two** advantages of using isomerase immobilised in a column of beads.

1.....

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2.....

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(2)

(b) A manufacturer investigated the effect of using different flow rates of glucose solution on the rate of fructose production.

The table shows the results.

Flow rate in dm^3 per minute	Rate of fructose production in mg per minute
1	150
2	325
3	480
4	608
5	650
6	650
7	650

The manufacturer decides to use a flow rate of 5 dm^3 per minute.

Suggest why the manufacturer chose this flow rate.

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(2)

(c) Fructose is a much sweeter sugar than glucose.

Explain why manufacturers of slimming foods may wish to use fructose as a sweetener instead of glucose.

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(2)
(Total 6 marks)

Q7. (a) Complete the equation for photosynthesis.

..... + water $\xrightarrow{\text{light energy}}$ ..... + ...

(3)

(b) The rate of photosynthesis in a plant depends on several factors in the environment. These factors include light intensity and the availability of water.

Describe and explain the effects of **two other** factors that affect the rate of photosynthesis.

You may include one or more sketch graphs in your answer.

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(5)
(Total 8 marks)

M1. (a) any **one** from:

ignore 'check temperature'

- add a water bath
- heat screen
- use LED
- low energy bulb / described

1

(b) (i) rate / number of bubbles decreases

*accept converse with reference to increasing light **or** shorter distance*

or

less oxygen / gas released

ignore reference to rate of photosynthesis

1

(ii) temperature / CO_2 (concentration)

*accept 'it was too cool' **or** not enough CO_2*

accept number of chloroplasts / amount of chlorophyll

allow heat

allow CO2

*do **not** allow CO^2*

1

(c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a brief description of at least 1 tissue **or** at least 1 function of an indicated part of the leaf.

The account lacks clarity or detail.

Level 2 (3-4 marks)
There is a clear description which includes at least 1 named tissue and at least 1 correct function described for an indicated part of the leaf.

Level 3 (5-6 marks)
There is a detailed description of most of the structures and their functions.

Examples of responses:

- epidermis
- cover the plant
- mesophyll / palisade
- photosynthesises
- phloem
- xylem
- transport.

The following points are all acceptable but beyond the scope of the specification:

- (waxy) cuticle – reduce water loss
- epidermis – no chloroplasts so allows light to penetrate
- stomata / guard cells – allow CO_2 in (and O_2 out) **or** controls water loss
- palisade (mesophyll) – <u>many</u> chloroplasts to trap light

  – near top of leaf for receiving more light
- spongy (mesophyll) – air spaces for rapid movement of gases

6

[9]

M2. (a) liver

1

mouth or salivary glands **or**
duodenum **or** small intestine **or**
pancreas

1

pancreas

*accept duodenum **or** ileum **or** small intestine*

*do **not** accept stomach*

1

stomach **or** duodenum **or** ileum **or**
small intestine **or** pancreas

1

(b) teeth breakdown food

accept chewing

1

amylase **or** saliva (breaks down starch)

1

(c) produces bile (salts)

1

emulsifies (fat) **or** produces droplets
or disperses fat)

1

[8]

M3. (a) (i) protease

*accept peptidase **or** named protease*
e.g. pepsin / trypsin
allow 'proteinase'

1

(ii) amino acids

accept peptides / polypeptides / peptones

1

(b) points plotted accurately

$\pm \frac{1}{2}$ *square*

*deduct **1** mark per error*

2

best fit curve **or** ruled point-to-point

if double line within $\frac{1}{2}$ *square*
allow sharp apex
*do **not** allow single straight line*
if no points line defines points
*if (5,0) not plotted only penalise **1** mark*
*bar graph wide bars – **no** marks*

bar graph $\pm \frac{1}{2}$ *square max **2** for points*

1

(c) (i) 2 **or** correct from candidate's graph

$\pm \frac{1}{2}$ *square*

1

(ii) stomach

1

(d) proteins are large / product is small

1

proteins (may be) insoluble / product is soluble

1

cannot be absorbed / cannot enter blood **or** cannot pass through gut lining

accept reverse referring to product

1

[10]

M4. (a) (i) reduced sharply

for 1 mark

1

(ii) converted to glucose which is respired to produce energy

(allow answers in terms of glucagon)

gains 3 marks

3

(b) (i) athlete A's was most effective
since resulted in highest muscle glycogen level on day of race
for energy release during race

for 1 mark each

3

(ii) e.g. excess carbohydrate stored as glycogen rather than fat in short term
particularly if glycogen stores depleted

for 1 mark each

2

[9]

M5. (a) e.g.:
competition for light because potamogeton plants taller
competition for nutrients taller plants may have longer roots

each for 1 mark

4

(b) descriptions of:
measuring tape or similar quadrat
method of estimating cover (inside quadrat)

each for 1 mark

3

[7]

M6. (a) any **two** from:

- product not contaminated with enzyme or is pure
- enzyme can be reused
  allow enzyme not wasted / less enzyme is needed
- <u>continuous</u> flow process possible
- enzyme more stable / can be used at higher temperature
  allow enzyme lasts longer
  ignore refs. to cost / cheaper

2

(b) maximum fructose production / maximum enzyme activity
accept optimum / best

or

increase in flow rate does not increase production

1

higher rate leaves some glucose unchanged
allow glucose not wasted / extra glucose wastes money

1

(c) less (fructose) needed (for same sweetness)
ignore fructose is sweeter unqualified

1

(less fructose) → less fattening / fewer 'calories'
ignore refs. to cost / cheaper

1

[6]

M7. (a) LHS – carbon dioxide / CO_2
allow CO2
ignore CO^2

1

RHS
in either order

glucose / carbohydrate / sugar
allow starch
allow $C_6H_{12}O_6$ / C6H12O6
ignore $C^6H^{12}O^6$

1

oxygen

allow O_2 / O2

ignore O^2 / O

1

(b) any **five** from:

- factor 1: CO^2 (concentration)
- effect - as CO_2 increases so does rate and then it levels off or shown in a graph
- explanation:
  (graph increases) because CO_2 is the raw material or <u>used</u> 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]