Pearson Edexcel

Additional Assessment Materials Summer 2021

Pearson Edexcel GCSE in Biology (1BI0) Higher

Resource Set Topic 1: Key Concepts

Questions

(Public release version)

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

3 (a) Figure 5 shows two potato chips.

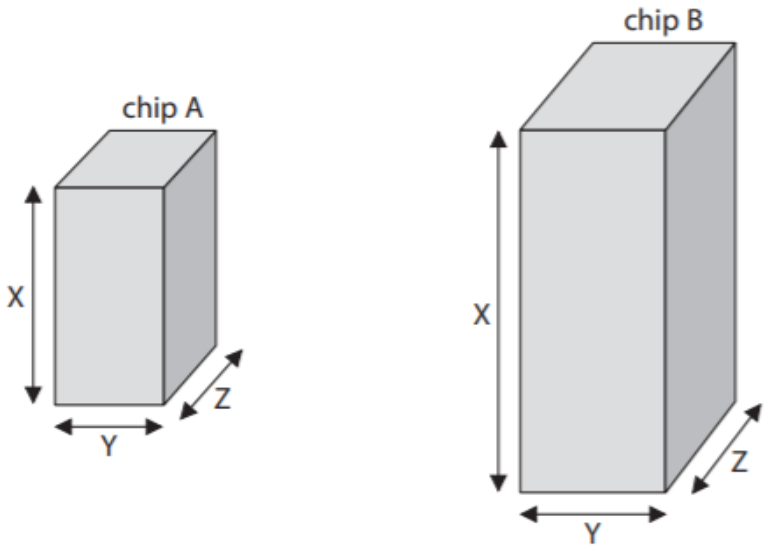


Figure 5

Figure 6 shows some information about each potato chip.

potato chip	length of X in cm	length of Y in cm	length of Z in cm	total surface area of four sides in cm^2	total surface area of top and bottom in cm^2	total surface area of chip in cm^2
A	3.0	1.5	1.5	18.0	4.5	22.5
B	5.0	2.0	2.0	?	?	?

Figure 6

Figure 6 shows some information about each potato chip.

potato chip	length of X in cm	length of Y in cm	length of Z in cm	total surface area of four sides in cm^2	total surface area of top and bottom in cm^2	total surface area of chip in cm^2
A	3.0	1.5	1.5	18.0	4.5	22.5
B	5.0	2.0	2.0	?	?	?

Figure 6

(i) Calculate the total surface area of potato chip B using the formula,

Total surface area = 2XY + 2XZ + 2YZ

$2(5.0)(2.0) + 2(5.0)(2.0) + 2(2.0)(2.0)$ (2)

$= 20.0 + 20.0 + 8.0$

$= 48.0\ cm^2$

total surface area = 48.0 cm^2

(ii) The potato chips were placed in distilled water for 20 minutes.

Figure 7 shows the increase in mass of each potato chip.

potato chip	increase in mass in grams
A	0.1
B	0.3

Figure 7

Explain why potato chip B has a greater increase in mass than potato chip A.

(2)

Potato chip B has a larger surface area so which allows more water molecules to travel into the cells via osmosis.

(iii) Potato chip A is transferred from the distilled water into a concentrated salt solution.

Explain what will happen to the cells in potato chip A.

(3)

When cells are placed in a hypertonic solution, water molecules will move out of the cells through osmosis down the water potential gradient, through the partially permeable cell membrane. Cells in potato chip A will shrink and become plasmolysed. This is because there are more water molecules inside the cell than in the salt solution.

(b) The potatoes of a potato plant develop underground.

Explain **one** difference in the sub-cellular structures in a cell in the potato and those in a cell in the leaf of the potato plant.

(2)

Cells in potato do not contain chloroplasts as they are not exposed to sunlight and do not photosynthesise, whereas cells in the leaf contain chloroplasts.

4.

(b) Crop plants provide a source of energy in the form of carbohydrates such as starch and sugars.

(i) Describe the test to identify starch.

(2)

Place a few drops of iodine solution on the sample. The iodine changes from brown to blue-black in the presence of starch.

(ii) The amount of energy in the sugars extracted from crop plants can be measured using the calorimeter shown in Figure 9.

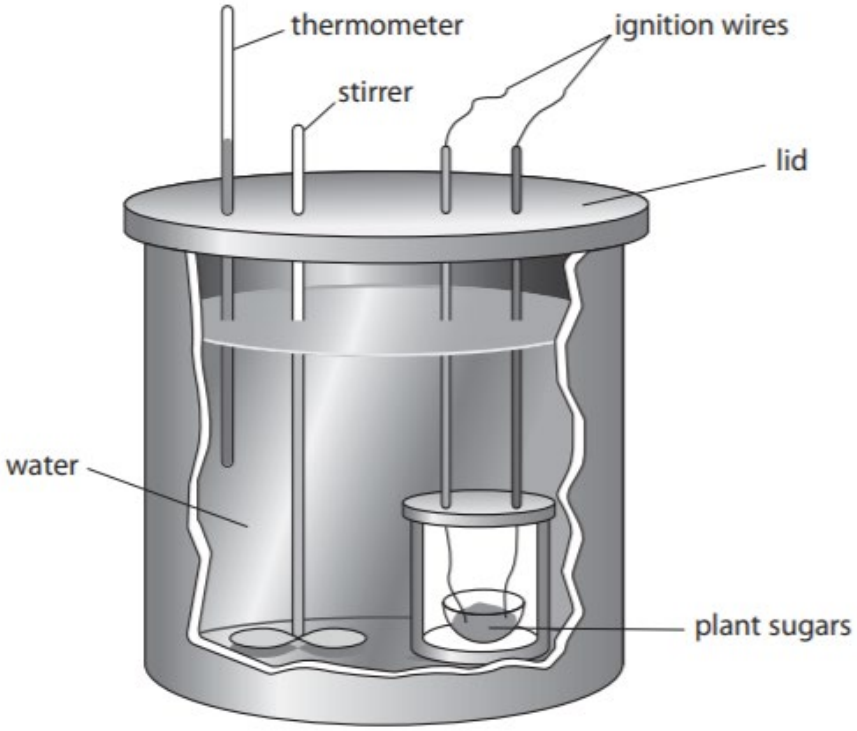


Figure 9

Explain why the calorimeter has a lid.

(2)

To reduce heat loss to the environment, which will cause the temperature measured to become lower and the measurement will be inaccurate.

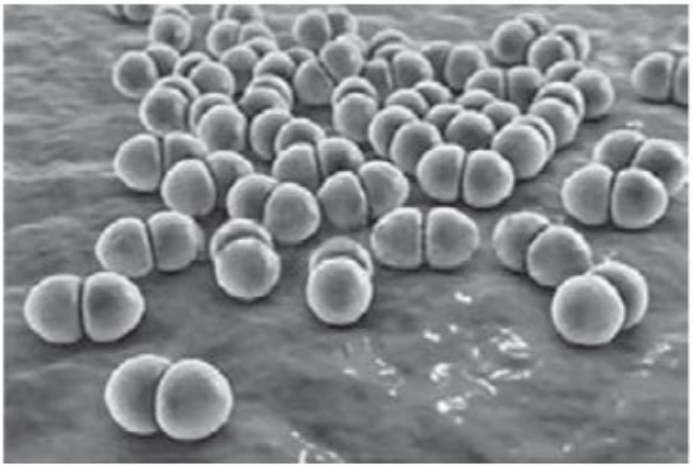
(iii) State why it is important to stir the water in the calorimeter.

(1)

To ensure the temperature throughout the water is the same.

5a.

(iii) Figure 10 shows some *Streptococcus* bacteria.



© Kateryna Kon/Shutterstock

Figure 10

Some bacteria are motile, meaning they can move themselves.

Why is a *Streptococcus* bacterium not motile?

(1)

☒ **A** it does not have flagella

☐ **B** it does not have plasmids

☐ **C** it does not have ribosomes

☐ **D** it does not have acrosomes

6.

(c) Figure 12 shows a root tip with cells in different stages of mitosis.

The image was magnified 400×.

Figure 12

Explain how a magnification of 400× can be obtained using the lenses on a light microscope.

(2)

using an ocular lens with magnification of 10× and an objective lens with a magnification of 40×, the total magnification will be 10 × 40 = 400×

8 Potato cells contain the enzyme catalase.

This enzyme catalyses the breakdown of hydrogen peroxide into oxygen and water.

Figure 15 shows what happened when a student placed a potato disc in a 5% hydrogen peroxide solution.

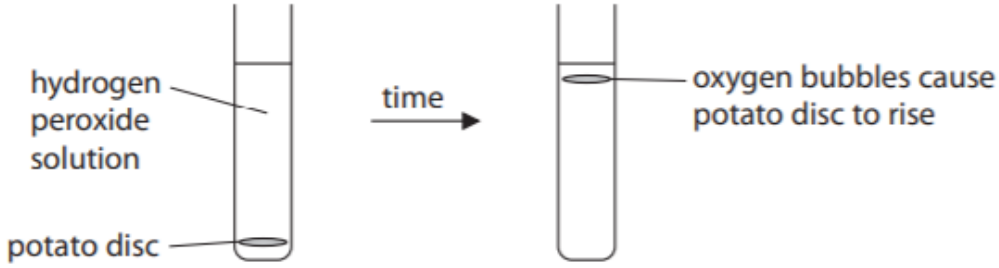


Figure 15

The student measured the time taken for the potato disc to rise.

The student repeated the investigation using 10%, 15% and 20% concentrations of hydrogen peroxide solution.

(a) (i) Which term describes the hydrogen peroxide in this reaction?

(1)

- ☐ **A** product
- ☒ **B** substrate
- ☐ **C** active site
- ☐ **D** control

(ii) The potato discs all had the same mass.

Explain why the student used potato discs with the same mass.

(2)

Potato discs with a higher mass will increase the rate of reaction as they would have more enzyme catalase present. Keeping the mass constant ensures that concentration of hydrogen peroxide is the only factor affecting rate of reaction.

(iii) State **two** other factors that need to be kept the same to improve this investigation.

(2)

temperature , surface area of potato discs

8.

(b) Figure 16 shows the results of this investigation.

The student calculated the rate of reaction using

$$\frac{1}{\text{time in seconds}}$$

concentration of hydrogen peroxide solution (%)	time taken for disc to rise (s)	rate (s^{-1})
5	325	0.003
10	245	0.004
15	132	0.008
20	72	0.014

Figure 16

(i) State and explain a conclusion based on these results.

(4)

At higher concentration of hydrogen peroxide solution, the time taken for disc to rise is shorter and rate of reaction is higher. This is because at higher concentrations there are more substrate molecules, so they collide with the enzymes more frequently.

(ii) The student repeated the investigation with a 25% hydrogen peroxide solution and recorded a time of 75 seconds.

Calculate the rate of reaction for the 25% hydrogen peroxide solution.

(2)

$\frac{1}{75} = 0.013$

0.013 s^{-1}

(iii) The student decided that the rate for the 25% hydrogen peroxide solution was not anomalous.

Give the reason why the result was not anomalous.

(1)

At 20% of hydrogen peroxide solution, all enzymes are saturated, so adding more substrate will not increase rate of reaction as there are no available active sites.

2 (a) Figure 3 shows a diagram of a red blood cell from a turtle and a diagram of a red blood cell from a human.

turtle human

Figure 3

(i) These cells are animal cells.

Animal cells do not have

(1)

☒ **A** cytoplasm

☒ **B** a cell membrane

☒ **C** a cell wall

☒ **D** mitochondria

(ii) The actual length of the red blood cell from a turtle is 20.5 μm.

Calculate the length of the magnified image of the red blood cell of the turtle when magnified 400×.

(2)

20.5 μm × 400 = 8200 μm

I = A × M

8200 .....μm

(iii) The width of the human red blood cell, when magnified 400×, is 3.08 mm.

Calculate the actual width of the cell and show your answer in standard form.

(2)

$3.08\text{ mm} \div 400 = 0.0077\text{ mm}$

$= 7.70 \times 10^{-3}\text{ mm}$

$A = \frac{I}{M}$

7.70×10^{-3} mm

1 (a) A student had solutions of four different foods labelled W, X, Y and Z.

Each solution was tested for starch and protein.

The colour of the solutions after the tests are shown in Figure 1.

solution	colour after testing for starch	colour after testing for protein
W	orange	purple
X	blue/black	purple
Y	blue/black	blue
Z	orange	blue

Figure 1

(i) Which solution contains starch but **not** protein?

(1)

☒ **A** solution W

☒ **B** solution X

☒ **C** solution Y

☒ **D** solution Z

(ii) Describe how a solution of food can be tested for reducing sugars.

(2)

The presence of reducing sugars can be tested using the Benedict's test. Add a few drops of Benedict's solution to the sample and heat in a boiling water bath. The blue colour changes in the presence of reducing sugars. A brick-red colour indicates a high concentration of reducing sugar and orange / yellow / green indicates a lower concentration.

(b) Figure 2 shows a calorimeter.

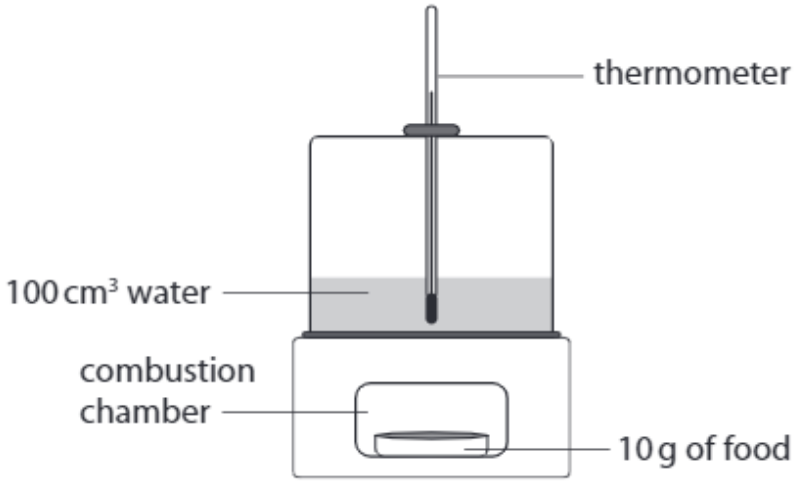


Figure 2

Describe how this calorimeter can be used to find the energy content of 10 g of food.

(3)

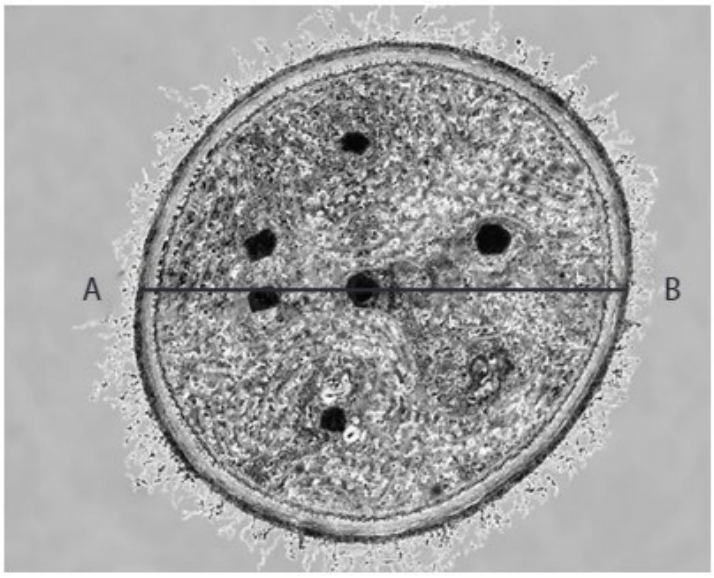
The temperature of the water before and after combustion of food was measured. The energy released can be calculated by the equation: mass of water in grams × specific heat capacity of water × temperature change.

The specific heat capacity of water is 4.2 J/g °C.

6.

(b) Figure 7 shows a cyanobacterium magnified 50 000 times.

The line AB shows the diameter of the bacterial cell.



(Source: © The Christian Science Monitor)

Figure 7

(i) Calculate the actual diameter of the cyanobacterium.

Give your answer in micrometres (μm).

(3)

$6.5\text{ cm} = (6.5 \times 10000)\ \mu m$

$= 65000\ \mu m$

$\frac{65000}{50000} = 1.3\ \mu m$

1.3 μm

(ii) Bacterial cells contain plasmids.

Describe **three** other features of a bacterial cell.

(3)

They have peptidoglycan cell walls, 70S ribosomes and some have a flagellum.

6 (a) Lactase is an enzyme that breaks down lactose into glucose and galactose.

A student made some alginate beads containing lactase.

The student added 10 beads to 20 cm^3 of a solution of lactose, as shown in Figure 9.

The student timed how long it took for glucose to be produced.

The experiment was repeated using 15, 20 and 25 beads.

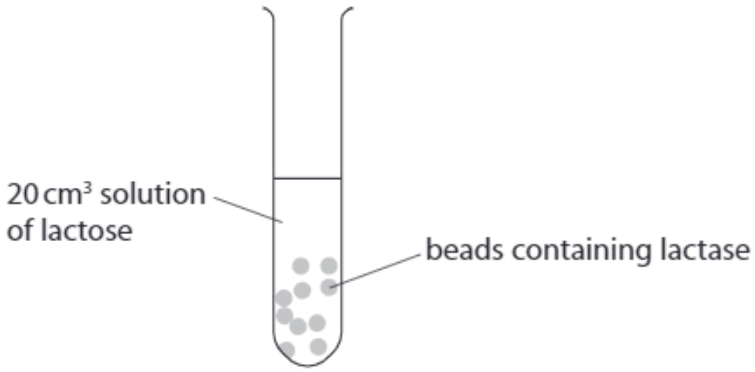


Figure 9

The results are shown in Figure 10.

number of beads containing lactase	time taken to produce glucose in seconds
10	240
15	210
20	150
25	120

Figure 10

(i) What is the rate of reaction for 25 beads?

(1)

- ☒ **A** $0.008\,s^{-1}$ $\frac{1}{120} = 0.0083\,s^{-1}$
- ☒ **B** $0.04\,s^{-1}$
- ☒ **C** $0.21\,s^{-1}$
- ☒ **D** $4.8\,s^{-1}$

(ii) Explain the conclusion that can be made from these results.

(3)

As the number of beads containing lactase increases, the time taken to produce glucose decrease and rate of reaction increase. This is because when there are more enzymes, there are more active sites available for substrate molecules to fit in so they are broken down faster.

(iii) Explain why the same volume of lactose solution was used for each test.

(2)

Using different volumes of lactose solution will change the number of substrate molecules available and affect the rate of reaction. Keeping the volume constant will ensure only the number of beads containing lactase affects the rate. (ensure fair test)

(b) Devise a method to find the optimum temperature for the enzyme lactase.

(3)

Keeping the number of beads containing lactase and volume of lactose solution constant, measure the time taken to produce glucose in seconds and calculate the rate at different temperatures (15°C, 20°C, 25°C, 30°C, 35°C, 40°C, 45°C, 50°C). Plot a graph of rate against temperature and draw a line of best fit. The rate is the highest at the optimum temperature.

10 (a) Figure 16 shows the number of neurones in the brain of different animals.

animal	number of neurones in the brain
lobster	1.0×10^5
frog	1.6×10^7
rat	2.0×10^8
human	8.6×10^{10}

Figure 16

(i) Calculate the difference between the number of neurones in the brain of the rat and the brain of the frog.

Give your answer in standard form.

(2)

$2.0 \times 10^8 - 1.6 \times 10^7 = (20 \times 10^7) - (1.6 \times 10^7)$

$= (20 - 1.6)(10^7)$

$= 18.4 \times 10^7$

$= 1.84 \times 10^8$

1.84×10^8 neurones

(b) Describe how a student could test a sample of urine for the presence of protein.

(2)

The presence of protein can be tested using a Biuret test. Add an equal amount of NaOH to the urine sample, followed by a few drops copper sulfate solution. A colour change from blue to purple indicates the presence of proteins.

(ii) A student took a sample of cells from a meristem to view under a light microscope. Describe how the student would prepare a microscope slide using these cells.

(3)

Place a small drop of water onto the microscope slide. Using forceps, place the sample on the drop of water, ensuring that it is laid flat and there are no air bubbles. Place the coverslip over the specimen. A drop of iodine can be placed next to the coverslip to stain the cells. Place a piece of filter paper next to the coverslip on the other side to draw the iodine under the cover slip.

3.

(b) Figure 3 is a drawing of a eukaryotic cell.

Structure **Z** is found in plant leaf cells.

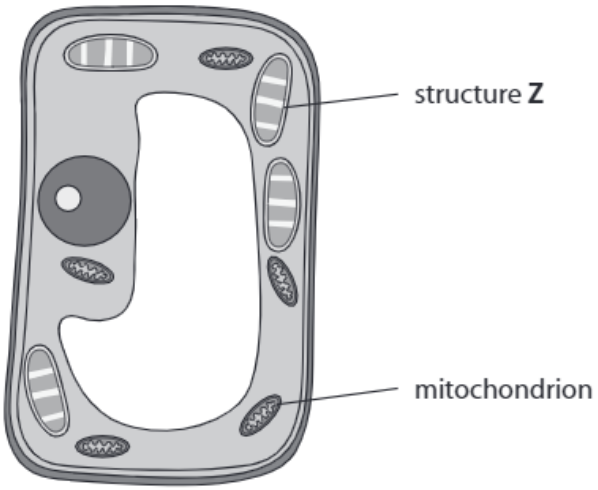


Figure 3

(i) Name structure **Z**.

(1)

chloroplast

(ii) Give **one** function of the mitochondrion.

(1)

produce energy in the form of ATP

(iii) Describe how a prokaryotic cell is different from the cell in Figure 3.

(2)

A prokaryotic cell has no nucleus and mitochondria. The cell wall is also not made of cellulose.

4.

(c) Peas contain small amounts of fat.

Describe a test to identify fat.

(2)

Crush the food and place into a test tube, Add ethanol to the test tube and transfer the liquid into another test tube containing water, leaving the food residue behind. If lipids are present, emulsion will be observed.

6 (a) A student mixed 10 cm^3 of starch solution with 5 cm^3 of amylase solution and kept the tube in a water bath at 25 °C.

The student tested the solution for starch and for glucose every 30 seconds.

Figure 6 shows the results.

time in seconds	starch detected	glucose detected
0	Yes	No
30	Yes	No
60	Yes	Yes
90	Yes	Yes
120	Yes	Yes
150	No	Yes
180	No	Yes

Figure 6

(i) Give **one** reason for the result at 150 seconds.

(1)

All of the starch has been broken down.

(ii) Another student repeated the investigation with the same volumes of solutions and at the same temperature of 25 °C.

Give **two** other variables that would need to be controlled in the investigation.

(2)

1 concentrations of solutions

2 pH

(iii) Both students also included a tube containing 10 cm^3 of starch solution with 5 cm^3 of distilled water instead of 5 cm^3 of amylase solution.

They tested the solution for starch and for glucose every 30 seconds.

Give **one** reason why this tube was included in their investigations.

(1)

The tube is used as a control to ensure that change in presence of starch and glucose is due to amylase.

(b) Amylase has an optimum pH of 6.8.

Devise a method the students could use to confirm the optimum pH for amylase.

(3)

Keeping the volumes and concentrations of starch and amylase solutions and the temperature constant, measure the time taken for all starch to be broken down using iodine test. Repeat this at different pH, adjusting the pH using a buffer. The time taken for all starch to be broken down will be the shortest at the optimum pH.

(c) Amylase is produced by salivary glands and the pancreas.

Explain why amylase is not produced in the stomach.

(3)

The stomach has a low pH of 2 which will denature the active site of amylase so the substrate, starch, cannot fit into the active site and be broken down. Amylase has an optimum pH of 7.

(b) (i) The white petals of the water lily flowers cannot photosynthesise.

Which structure in leaf cells is the site of photosynthesis?

(1)

- ☒ **A** nucleus
- ☒ **B** vacuole
- ☒ **C** mitochondrion
- ☒ **D** chloroplast

3 A slide of potato cells was viewed using a light microscope.

Figure 4 is a drawing of the slide showing starch grains in the potato cells.

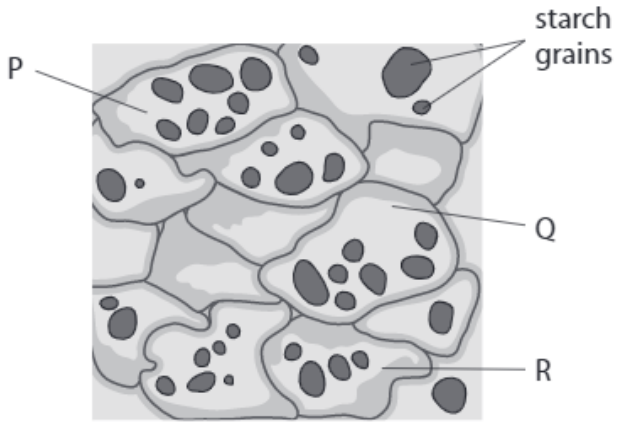


Figure 4

(a) (i) Calculate the mean number of starch grains in potato cells P, Q and R.

(1)

$\frac{7+7+4}{3} = 6$

6 starch grains

(ii) Which structures are found in plant cells but are **not** found in animal cells?

(1)

☒ **A** cell membrane, nucleus, chloroplast

☒ **B** cell wall, cell membrane, cytoplasm

☒ **C** nucleus, large vacuole, chloroplast

☒ **D** cell wall, chloroplast, large vacuole

(b) A scientist investigated how the length of starch grains in potatoes changed when the potatoes were stored in the dark.

Figure 5 shows a potato after being stored in the dark.

Figure 5

Three potatoes were used in the investigation.

The length of starch grains in potato 1 were measured at the start.

The length of starch grains in potato 2 were measured after 5 weeks in the dark.

The length of starch grains in potato 3 were measured after 10 weeks in the dark.

Figure 6 shows the results.

potato	time after placing in the dark in weeks	mean length of starch grains in μm
1	0	64
2	5	50
3	10	30

Figure 6

(i) Calculate the percentage difference in the mean length of starch grains in potato 2 at 5 weeks and in potato 3 at 10 weeks.

(2)

% difference = $\frac{50-30}{64} \times 100$

= 31.25

31.25 %

(ii) State **two** variables the scientist should have controlled to improve this investigation.

(2)

1 initial mass of potato

2 type of potato used

(iv) Describe how starch is broken down into glucose.

(2)

Starch is broken down to maltose by amylase, then maltose is broken down to glucose by maltase

4.

(b) Protein is an important nutrient.

Describe the laboratory test for protein.

(2)

Proteins can be tested using Biuret's test. Add an equal volume of NaOH to the sample solution, followed by a few drops of aqueous copper sulfate. If proteins are present, the colour changes from blue to purple.

5 Trypsin is a protease enzyme used in the manufacture of food for babies.

(a) (i) Which food group is digested by trypsin?

(1)

☒ **A** carbohydrates

☒ **B** lipids

☒ **C** fibre

☒ **D** proteins

(ii) The food is mashed before the trypsin is added.

Explain the advantage of mashing the food before adding the trypsin.

(2)

Mashing the food increases the surface area so there is more contact between trypsin and the substrate, and rate will be faster. of food being broken down

(b) A manufacturer of baby food wanted to find out the optimum pH for trypsin.

Equal volumes of different pH solutions were placed in six separate test tubes.

5 cm^3 of 1% trypsin solution was added to each test tube.

1.5 g of mashed food was placed in each test tube.

The time taken to digest the food was recorded.

(i) State **one** other variable that should be controlled in this investigation.

(1)

temperature

(ii) State how this variable could be controlled.

(1)

carry out the experiment in a thermostatically-controlled water bath.

(c) The results are shown in Figure 10.

pH	time taken to digest the food in minutes
1	42
2	15
3	9
4	2
5	16
6	40

Figure 10

(i) Describe the trends shown in this data.

(2)

As pH increases from 1 to 4, time taken to digest food decreases.

When pH increases from 4 to 6, time taken to digest food increases.

The time taken is the shortest at pH 4.

(ii) At pH 4, the trypsin digested 1.5 g of mashed food at a rate of 0.8 g per minute.

Calculate the rate of digestion at pH 1.

Give your answer to one significant figure.

(2)

$\frac{1.5}{42} = 0.0357$

$\simeq 0.04$ g per minute

0.04 g per minute

(iii) Explain the difference in the rate of reaction at pH 1 and the rate of reaction at pH 4.

(2)

pH 4 is the optimum temperature for trypsin so rate of reaction is the highest. At pH 1, the enzyme is denatured so the shape of the active site is no longer complementary to the shape of the substrate. It is more difficult for the substrate to fit into the active site, so rate of reaction is lower.

10 (a) A person with kidney disease may need kidney dialysis treatment.

Figure 15 shows an experiment to show how a dialysis membrane works.

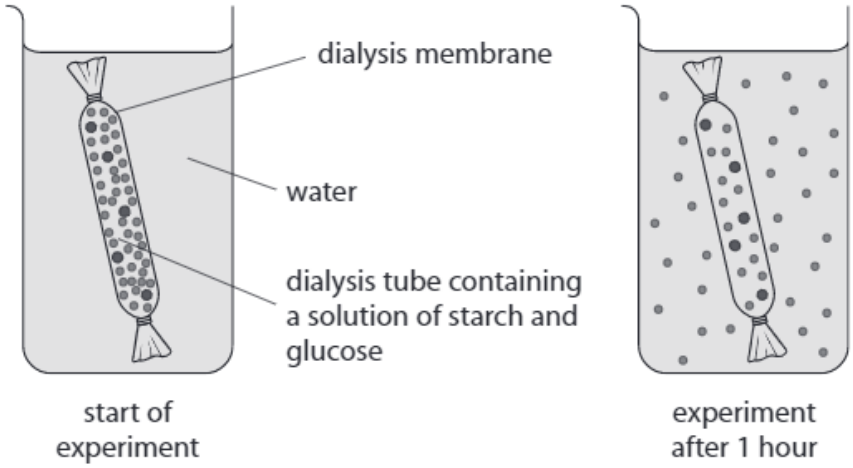


Figure 15

(i) Describe the method that would be used to find out what is present in the solution in the beaker, after one hour.

(4)

To find out if starch is present, a few drops of iodine can be added to a test tube containing the sample. The mixture will remain yellow as starch is absent.

Benedict's test can be used to test for the presence of glucose. Add equal volume of Benedict's reagent to the sample in a test tube. Heat the mixture in a boiling water bath. There will be a colour change from blue to brick-red / orange as glucose is present.

(ii) Explain how this experiment represents a simple model of kidney dialysis treatment.

(2)

The dialysis membrane is partially permeable which allows glucose to diffuse out down the concentration gradient, but starch cannot pass through the membrane since starch molecules are too large.

water molecules are free to move through the membrane. Like a healthy kidney, this ensures most of, useful product, glucose is reabsorbed.

TOTAL = 106 MARKS