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EDEXCEL GCSE BIOLOGY: QUESTIONS BY TOPIC

Key Concepts in Biology (1)

GCSE Biology (Foundation) Topic 1

28 questions · 263 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Biology 1BI0, Foundation Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

QUESTION		SOURCE	MARKS	PAGE
1. Q2		Paper 1 November 2020	6	4
2. Q2		Paper 1 June 2018	7	7
3. Q1		Paper 1 November 2021	7	9
4. Q2		Paper 1 June 2022	7	11
5. Q1		Paper 1 June 2023	7	13
6. Q2		Paper 1 June 2023	7	16
7. Q1		Paper 1 June 2024	7	19
8. Q2		Paper 1 June 2024	7	21
9. Q1		Paper 2 June 2024	7	23
10. Q1		Paper 1 June 2025	7	25
11. Q2		Paper 1 June 2025	7	27
12. Q5	<i>also Topic 3</i>	Paper 1 November 2021	9	30
13. Q4		Paper 2 June 2022	9	33
14. Q5		Paper 1 June 2018	10	37
15. Q4		Paper 1 November 2020	10	39
16. Q6		Paper 1 November 2020	10	43
17. Q6		Paper 1 November 2021	10	46
18. Q6	<i>also Topic 8</i>	Paper 2 November 2021	10	50
19. Q4		Paper 1 June 2025	10	53
20. Q8		Paper 1 June 2022	11	57
21. Q8		Paper 1 June 2024	11	59
22. Q10	<i>also Topic 5</i>	Paper 2 June 2025	11	62
23. Q6		Paper 1 June 2018	12	67
24. Q7		Paper 2 June 2023	12	70
25. Q9		Paper 1 June 2018	13	75
26. Q9		Paper 2 November 2020	13	79
27. Q9	<i>also Topic 8</i>	Paper 2 June 2023	13	83
28. Q9		Paper 1 June 2025	13	86



QUESTIONS

28 questions · 263 marks · lowest tariff first



6-MARK QUESTIONS

1 question in this booklet



2 (a) Figure 4 shows three cells.

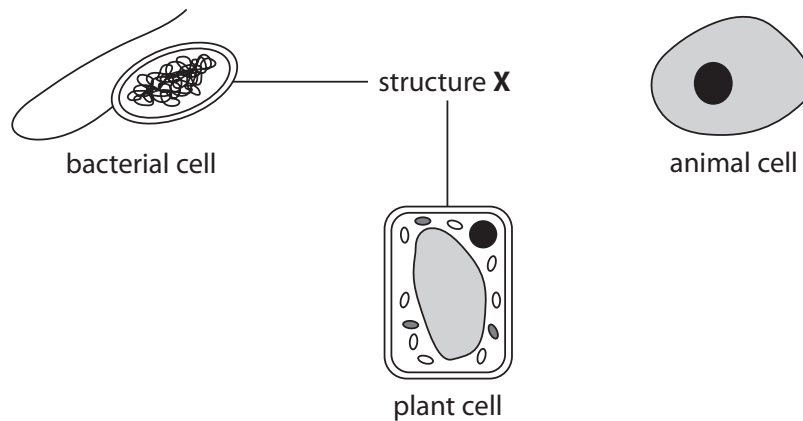


Figure 4

(i) What is structure **X**?

(1)

- ☒ **A** cell membrane
- ☒ **B** cell wall
- ☒ **C** cytoplasm
- ☒ **D** nucleus

(ii) The bacterial cell in Figure 4 has a flagellum.

State the function of a flagellum.

(1)

(iii) Give **one** other difference between the bacterial cell and the animal cell shown in Figure 4.

(1)

(b) Substances move into and out of cells.

How does oxygen move into and out of cells?

(1)

- ☐ A transpiration
- ☐ B active transport
- ☐ C diffusion
- ☐ D osmosis

(c) A plant leaf cell is 0.04 mm long.

Calculate the length of the image after this cell has been magnified 500 times.

(2)

length of image = ...mm

(Total for Question 2 = 6 marks)



7-MARK QUESTIONS

10 questions in this booklet



2 Figure 2 shows part of a DNA molecule.

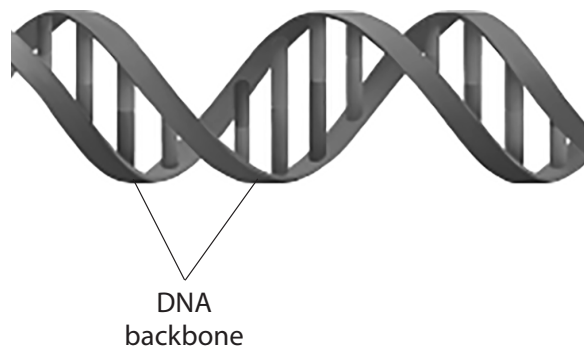


Figure 2

(a) (i) What is the shape of a DNA molecule?

(1)

- ☐ A single helix
- ☐ B double helix
- ☐ C complementary helix
- ☐ D triple helix

(ii) Which molecules are present in the DNA backbone?

(1)

- ☐ A sugars and phosphates
- ☐ B amino acids and bases
- ☐ C sugars and bases
- ☐ D amino acids and phosphates

(iii) State the type of bond that joins the bases together in the DNA molecule.

(1)

(b) DNA can be extracted from fruit.

Describe how cells are broken down to release DNA.

(2)

.....

.....

.....

.....

(c) In 2003, scientists finished sequencing the 3 billion base pairs in the human genome.

State **two** benefits that the Human Genome Project could have for medicine.

(2)

1.

.....

2.

.....

.....

(Total for Question 2 = 7 marks)



1 (a) Animals and plants are made of cells.

Figure 1 shows two types of cell from a human.

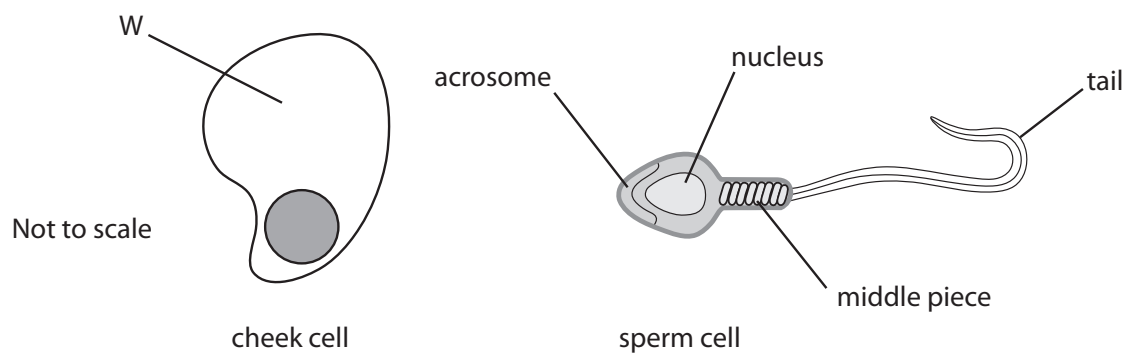


Figure 1

(i) Which part of the cheek cell is labelled W?

(1)

- ☒ **A** cell wall
- ☒ **B** nucleus
- ☒ **C** cell membrane
- ☒ **D** cytoplasm

(ii) Which labelled part of the sperm cell is also found in the cheek cell?

(1)

- ☒ **A** nucleus
- ☒ **B** tail
- ☒ **C** middle piece
- ☒ **D** acrosome

(b) Name the part of a plant cell that gives the cell support and protection.

(1)

(c) Some cells contain starch.

Describe the chemical test for starch.

(2)

.....

.....

.....

.....

(d) Figure 2 shows the results of some food tests.

food sample	Benedict's test	Biuret test	ethanol (alcohol) test
J	brick red	blue	colourless
K	brick red	purple	colourless
L	blue	blue	white emulsion

Figure 2

(i) Give the letter of the food sample that contains fat.

(1)

.....

(ii) Give the letter of the food sample that contains reducing sugars and protein.

(1)

.....

(Total for Question 1 = 7 marks)



2 Stone tools can be found at sites used by our human ancestors.

(a) Figure 3 shows tool P.

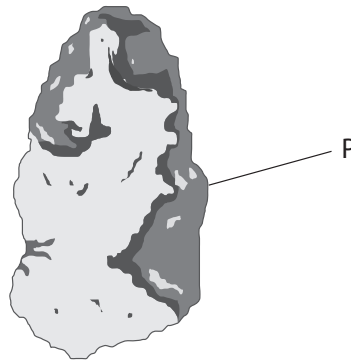


Figure 3

(i) Describe how tool P was made.

(2)

(ii) Figure 4 shows tool Q which was found at the same site as tool P.

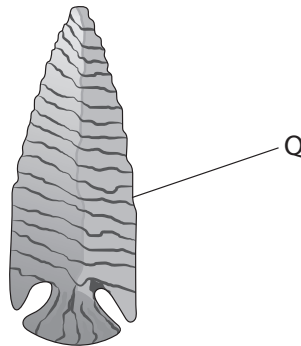


Figure 4

A scientist stated that tool Q was made by a more evolved human ancestor than tool P.

Which observation supports this statement?

(1)

- ☐ A tool Q is a darker colour than tool P
- ☐ B tool Q is more pointed than tool P
- ☐ C tool Q is a lighter colour than tool P
- ☐ D tool Q is less pointed than tool P

(iii) Tools provide evidence for human evolution.

Use words from the box to complete the sentences.

(2)

enlarge	human	migrate
mutate	natural	negative

Evolution is the change of inherited characteristics through

..... selection.

These changes occur because genes

(b) Fossils were also found in the soil around tool Q.

Describe **two** ways that stone tools and fossils can be dated to find out how old they are.

(2)

1

.....

2

.....

(Total for Question 2 = 7 marks)



1 (a) Figure 1 shows an animal cell.

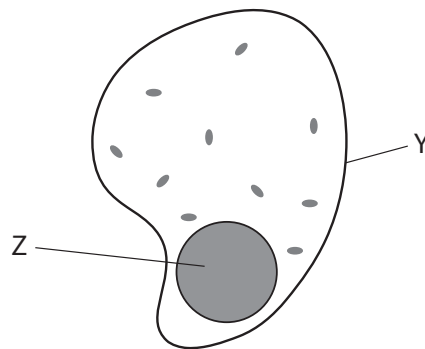


Figure 1

(i) Which part of the cell is labelled Y?

(1)

- ☐ A cell wall
- ☐ B cell membrane
- ☐ C nucleus
- ☐ D cytoplasm

(ii) Which structures are found in the part labelled Z?

(1)

- ☐ A chromosomes
- ☐ B mitochondria
- ☐ C ribosomes
- ☐ D vacuoles

(iii) Name the part of an animal cell where respiration occurs.

(1)

.....

- (b) A microscope can be used to observe the structure of a cell.

Figure 2 shows a microscope.



© RouDhi/Shutterstock

Figure 2

- (i) Give **one** advantage of using a microscope to look at cells.

(1)

(ii) Draw **one** straight line from each part of the microscope to its function.

(2)

part of the microscope

function

eyepiece •

stage •

• to place a slide on

• to carry the microscope

• to make the cells
look brighter

• to look through to see
the cells

• to reflect light onto
the cells

(c) Figure 3 shows some of the units used when cells and organelles are measured.

micrometre = 10^{-6} m picometre = 10^{-12} m
nanometre = 10^{-9} m millimetre = 10^{-3} m

Figure 3

Give the name of the smallest unit shown in Figure 3.

(1)

(Total for Question 1 = 7 marks)



2 (a) Figure 4 shows fossils in different layers of rock.

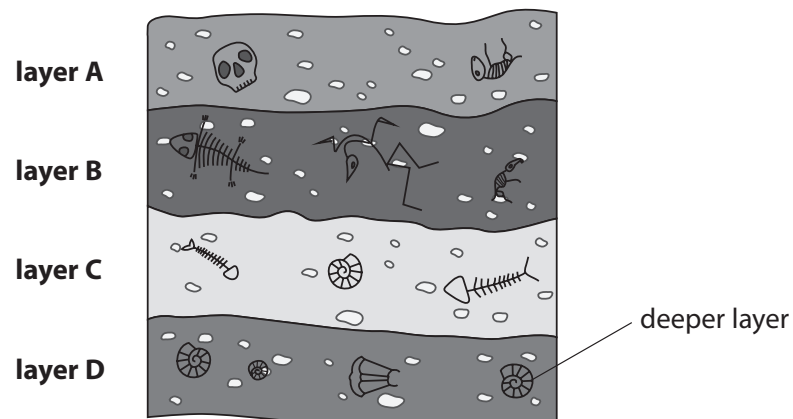


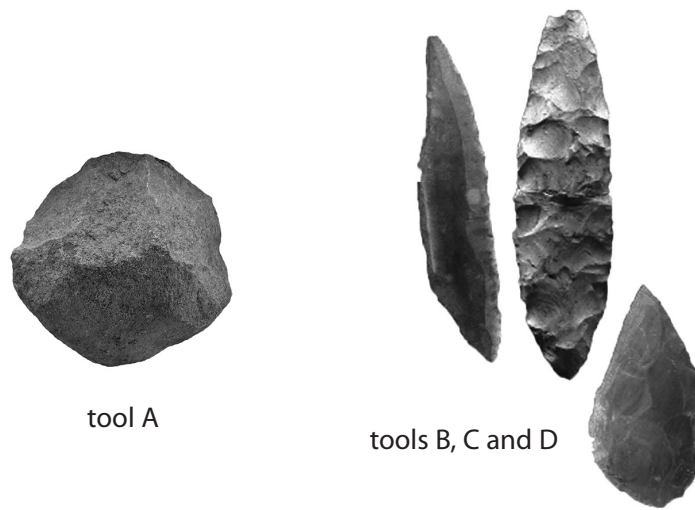
Figure 4

(i) Which layer of rock is likely to contain the most recent fossils?

(1)

- ☐ A layer A
- ☐ B layer B
- ☐ C layer C
- ☐ D layer D

Figure 5 shows some stone tools from two different periods of time.



© Yes058 Montree Nanta/Shutterstock

Figure 5

(ii) Explain **one** difference between tool A and tools B, C and D.

(2)

.....

.....

.....

.....

(b) Our human ancestors domesticated animals.

Animals were domesticated to use as working animals and to keep as pets.

(i) Use words from the box to complete the sentences.

(2)

asexual

characteristics

evidence

ideas

inherited

selective

Animals with the most desirable were bred together.

This is called breeding.

(ii) Scientists have analysed the genomes of domestic animals.

Which is the definition of a genome?

(1)

- ☐ **A** all the cells of an organism
- ☐ **B** all the enzymes of an organism
- ☐ **C** all the DNA of an organism
- ☐ **D** all the structures of an organism

(iii) Give **one** advantage of domesticating animals.

(1)

.....

.....

.....

(Total for Question 2 = 7 marks)



1 (a) Figure 1 shows a bacterial cell.

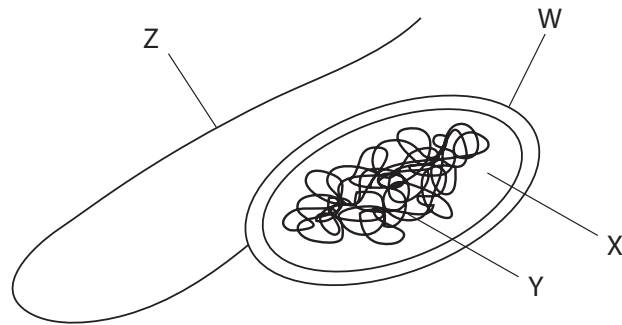


Figure 1

(i) What is structure W?

(1)

- ☐ A cell wall
- ☐ B cytoplasm
- ☐ C chromosomal DNA
- ☐ D plasmid

(ii) Give the name of structure Z.

(1)

.....

(iii) State the function of structure Z.

(1)

.....

.....

(b) The human body has defences to protect against infection by bacteria.

Draw **one** straight line from each body defence to its function.

(2)

body defence

function

hydrochloric acid •

skin •

• moves pathogens away from the lungs

• makes antibodies

• destroys pathogens in the stomach

• makes antigens

• stops pathogens entering the body

(c) Smoking tobacco is a lifestyle factor that can cause disease.

Name **two** other lifestyle factors that can cause disease.

(2)

1

2

(Total for Question 1 = 7 marks)



2 Figure 2 shows a method used to extract DNA from strawberries.

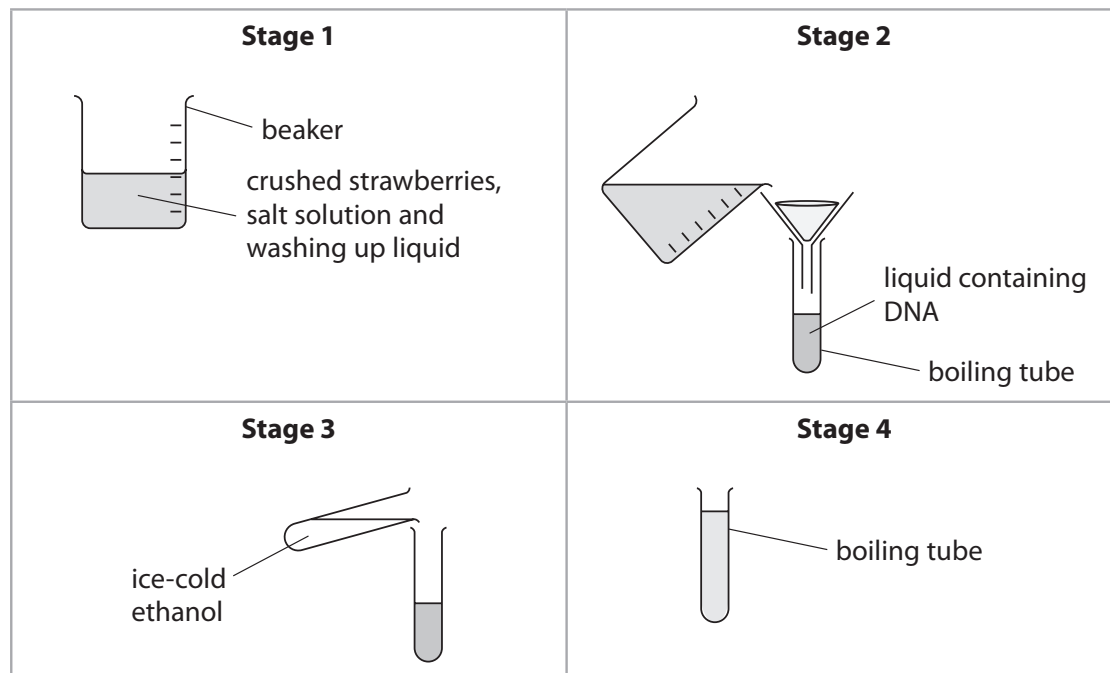


Figure 2

(a) (i) Complete the sentences using words from the box.

(2)

indicator	membranes	salt
substrates	sugar	vacuoles

Crushed strawberries are mixed with washing up liquid and
..... solution.

Washing up liquid helps to release DNA by breaking open cell
.....

(ii) Describe the method shown in stage 2.

(2)

.....

.....

.....

.....

(iii) What is the colour of the DNA precipitate?

(1)

- ☐ **A** blue
- ☐ **B** orange
- ☐ **C** white
- ☐ **D** red

(b) A scientist used this method to find the mass of DNA in four strawberries.

Figure 3 shows the results.

strawberry	mass of DNA in ng
1	11.8
2	6.5
3	5.9
4	1.4

Figure 3

(i) The range is the difference between the largest value and smallest value in a set of numbers.

Which is the range of these results?

(1)

- ☐ **A** 13.2
- ☐ **B** 10.4
- ☐ **C** 5.9
- ☐ **D** 5.3

(ii) Calculate the mean mass of DNA.

(1)

mean mass of DNA = ... ng

(Total for Question 2 = 7 marks)

1 Scientists use microscopes to study cells.

Figure 1 shows a light microscope.

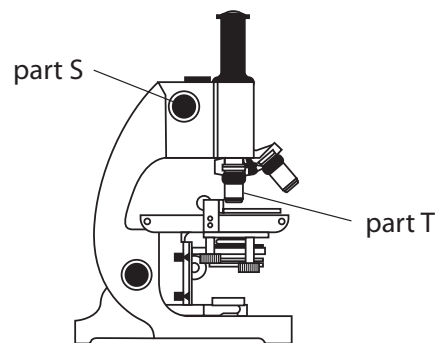


Figure 1

(a) Draw **one** straight line from each part of the microscope to its function.

(2)

part of microscope

function

part S

part T

to stain the cells

to focus the image so that it is clear

to magnify the image

to hold the slide in place

to provide light to see the image

(b) Figure 2 shows two photographs of bacteria.

Photograph A was taken through a light microscope.

Photograph B was taken using an electron microscope.

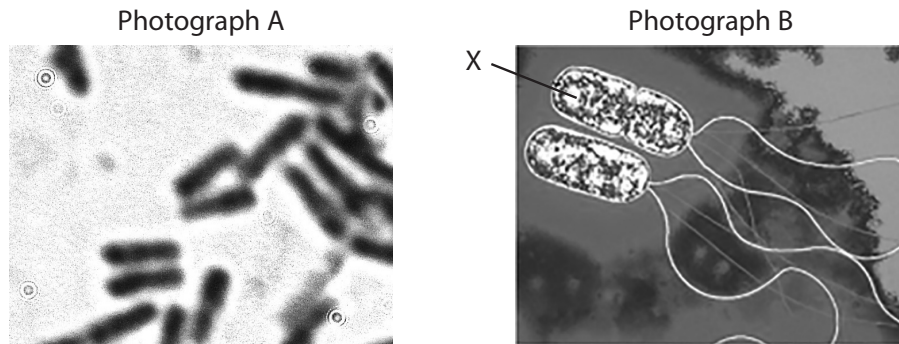
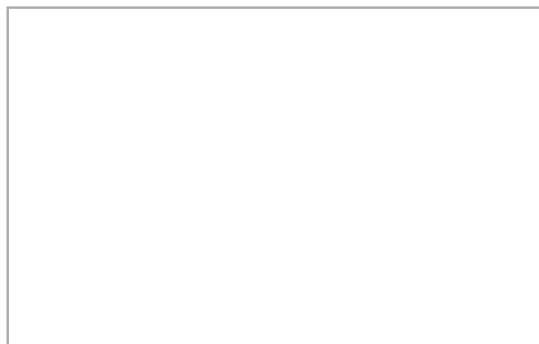


Figure 2

(i) Draw, in the box, the bacterial cell labelled X.

Label **one** part of the bacterial cell on your diagram.

(3)



(ii) State **one** advantage of using a light microscope and **one** advantage of using an electron microscope to study these bacterial cells.

(2)

A light microscope

.....

An electron microscope

.....

(Total for Question 1 = 7 marks)

1 (a) Genes control natural hair colour in humans.

(i) Which term describes the differences in hair colour?

(1)

- ☐ A variation
- ☐ B tissue culture
- ☐ C elongation
- ☐ D fertilisation

(ii) Genes are found on chromosomes.

Name the part of the human cell where chromosomes are found.

(1)

(b) The hair colour of 24 students was recorded.

Figure 1 shows the results.

brown	black	blonde	black	blonde	brown
black	black	red	brown	brown	black
blonde	brown	black	brown	brown	blonde
brown	blonde	blonde	black	brown	brown

Figure 1

(i) Complete Figure 2 to show the tally and the total for brown hair.

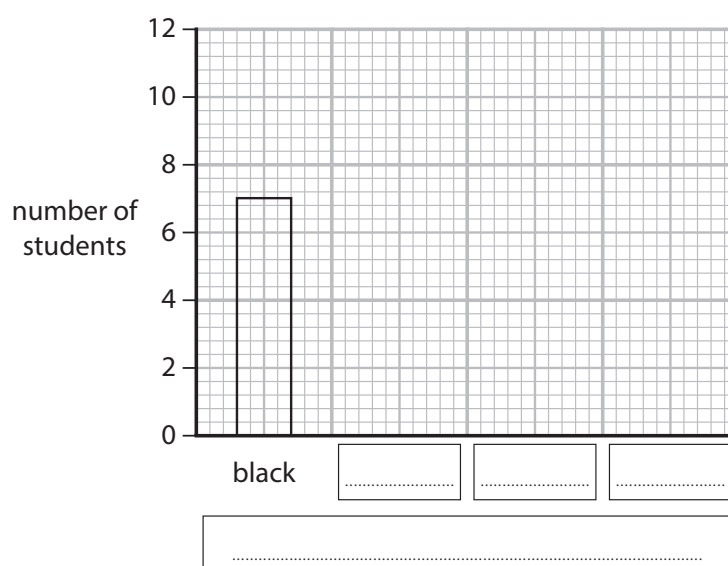
(2)

hair colour			
black	blonde	brown	red
total = 7	total = 6	total =	total = 1

Figure 2

(ii) Complete the bar chart to show the totals in Figure 2 and label the x-axis.

(3)



(Total for Question 1 = 7 marks)

2 (a) Figure 3 shows a sperm cell.

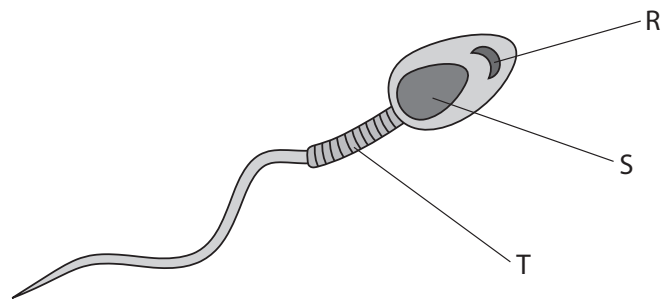


Figure 3

(i) Name the part labelled R.

(1)

(ii) Draw **one** straight line from each part of the sperm cell to its function.

(2)

part of the sperm cell

function

S

T

• produces glucose

• releases energy

• controls the cell

• helps the sperm enter the egg

• helps the egg enter the sperm

(b) Animal and plant cells are both eukaryotic.

State **one** structure found in a plant cell that is **not** found in an animal cell.

(1)

(c) DNA is found in cells.

Figure 4 shows part of a DNA molecule.



Figure 4

(i) Which type of large molecule is DNA?

(1)

- ☐ A monomer
- ☐ B protein
- ☐ C polymer
- ☐ D starch

(ii) Describe how the bases of a DNA molecule are held together.

(2)

(Total for Question 2 = 7 marks)

9-MARK QUESTIONS

2 questions in this booklet



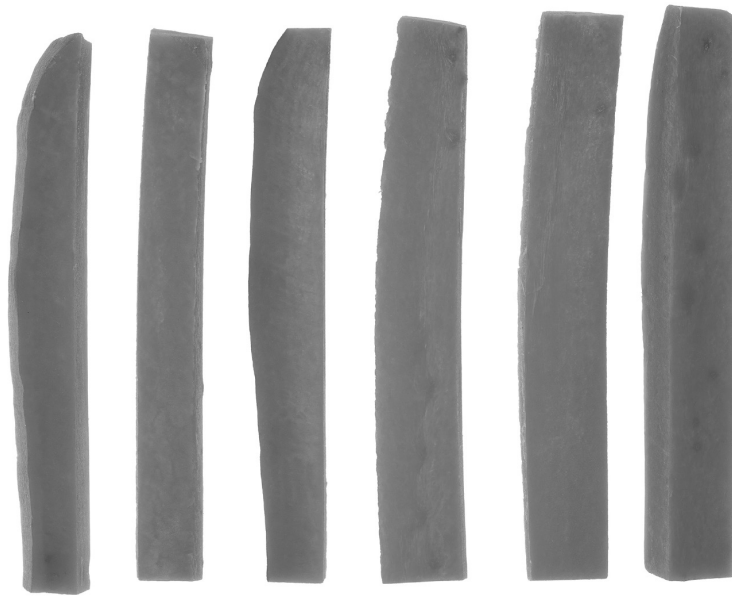
- 5 (a) Carrots have different physical characteristics such as colour.

Which genetic term describes the physical characteristics of a carrot?

(1)

- ☐ A genotype
- ☐ B monohybrid
- ☐ C phenotype
- ☐ D heterozygous

- (b) Figure 10 shows some carrot sticks.



(Source: © rukxstockphoto/Shutterstock)

Figure 10

A student chose three carrot sticks and weighed each one.

The carrot sticks were placed in 50 cm³ of distilled water.

After two hours the student weighed each carrot stick again.

Figure 11 shows the results for these carrot sticks P, Q and R.

carrot stick	mass at the start in grams	mass after two hours in grams	change in mass in grams
P	4.0	4.9	0.9
Q	4.2	5.0	0.8
R	4.1	5.0	0.9

Figure 11

- (i) Give **one** reason why the student used three carrot sticks instead of just one carrot stick.

(1)

.....

.....

- (ii) Give **two** ways that this method could be improved.

(2)

1

.....

2

.....

- (iii) Calculate the percentage change in mass of carrot stick Q.

(3)

Use the equation

$$\text{percentage change} = \frac{\text{change in mass}}{\text{mass at the start}} \times 100$$

Give your answer to 2 significant figures.

percentage change = ... %



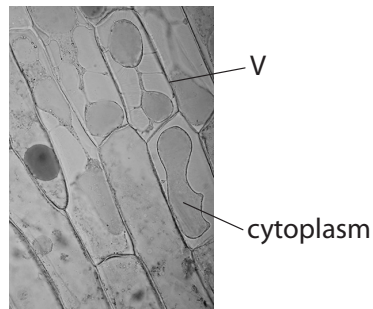
(iv) Explain the change in mass of the carrot sticks.

(2)

(Total for Question 5 = 9 marks)



- 4 (a) Figure 5 shows some onion cells that have been soaked in a concentrated salt solution.



(Source: © Rattiya Thongdumhyu/Shutterstock)

Figure 5

- (i) The cells in Figure 5 have been stained.

Give **one** reason why the cells have been stained.

(1)

- (ii) Which is the name of the structure labelled V?

(1)

- ☐ A chloroplast
- ☐ B vacuole
- ☐ C nucleus
- ☐ D cell wall

- (iii) The salt solution outside the cell has a higher concentration than the solution inside the cell.

Explain why the cytoplasm shrinks away from the sides of the cell when the cells are in salt solution.

(2)

.....

.....

.....

.....

(b) Figure 6 shows the equipment used to prepare a microscope slide of onion cells.

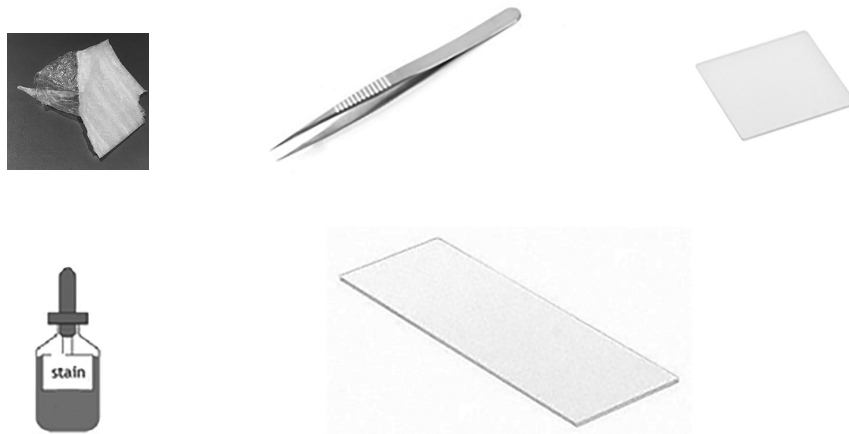


Figure 6

Describe how this equipment could be used to prepare a slide of onion cells to view under a microscope.

(3)

.....

.....

.....

.....

.....

.....

- (c) A student investigated the percentage change in mass of potato cylinders placed in sucrose solutions of different concentrations.

Figure 7 shows the results of the student's investigation.

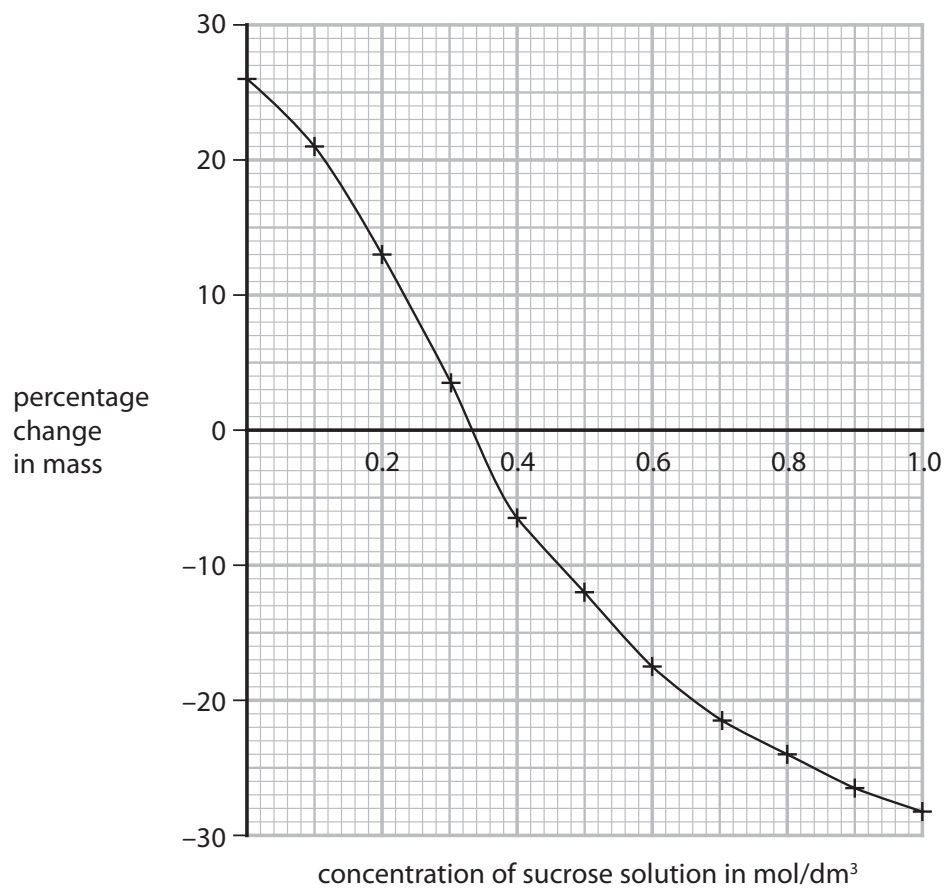


Figure 7

State **two** conclusions that can be made from these results.

(2)

1

.....

2

.....

(Total for Question 4 = 9 marks)



10-MARK QUESTIONS

6 questions in this booklet



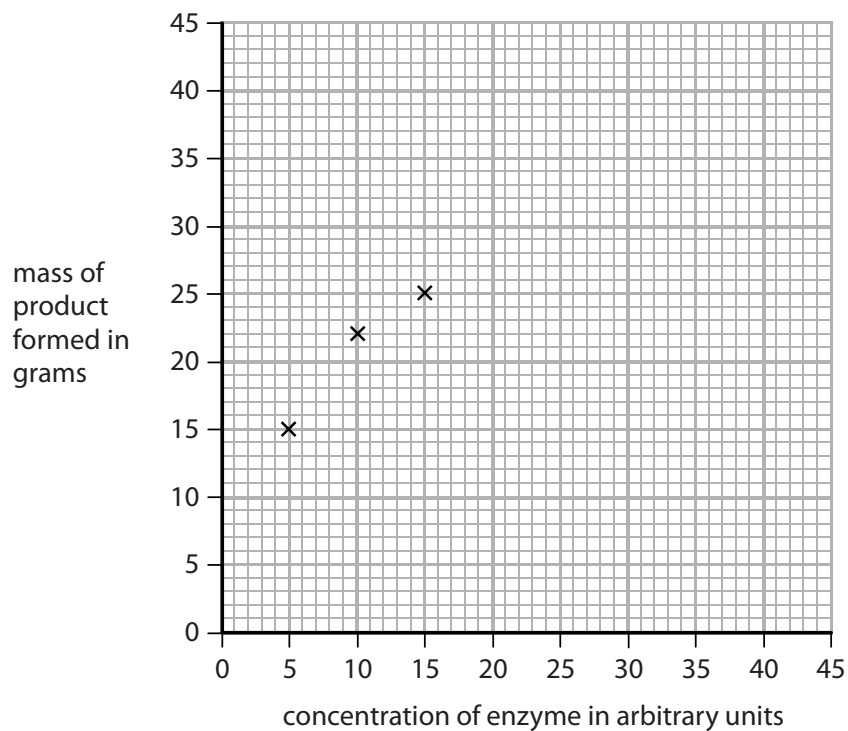
- 5 A student investigated the effect of enzyme concentration on the mass of product formed in one hour.
Figure 6 shows the results of this investigation.

concentration of enzyme in arbitrary units	mass of product formed in grams
5	15
10	22
15	25
20	32
25	38
30	40
35	40
40	40

Figure 6

- (a) Complete the graph by plotting the points and drawing a line to show the trend in the data.
The first three points have been plotted for you.

(2)



(b) Describe the effect that enzyme concentration has on the mass of product formed.

(2)

(c) The ratio of enzyme concentration to the mass of product formed, using an enzyme concentration of 40 arbitrary units, is 1:1.

Calculate the ratio of enzyme concentration to product formed when the enzyme concentration is 5 arbitrary units.

(2)

ratio.....

(d) The investigation used the enzyme pepsin from the stomach, at a temperature of 37°C and at a pH of 7.

(i) Which statement gives one way to increase the mass of product formed in this investigation?

(1)

- ☐ A increase the pH
- ☐ B decrease the temperature
- ☐ C decrease the enzyme concentration
- ☐ D increase the substrate concentration

(ii) Explain why a temperature of 80°C was not used in this investigation.

(3)

(Total for Question 5 = 10 marks)



- 4 (a) A student placed three different sized cubes of agar jelly into separate beakers containing the same concentration of hydrochloric acid.

The cubes contained a pink indicator.

This indicator becomes clear when in contact with an acid.

Figure 7 shows the results of the investigation after the cubes had been in the acid for 120 seconds.

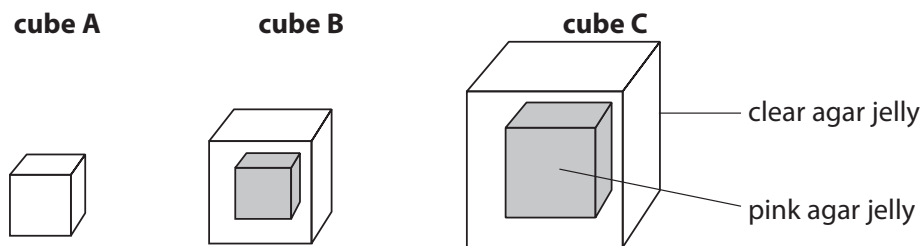


Figure 7

- (i) The distance from the outside of cube B to the pink area was 3mm.

Calculate the distance diffused by hydrochloric acid in **one** second.

(2)

..... mm

(ii) The student wanted to confirm their results.

Give **one** improvement the student should make to this investigation to confirm their results.

(1)

(b) Devise a method, using cubes of agar jelly, to investigate how temperature affects the rate of diffusion.

(3)

(c) Some substances move into and out of cells by active transport.

Which is the correct description of the movement of a substance by active transport?

(1)

- ☒ **A** against a concentration gradient using energy
- ☒ **B** down a concentration gradient using energy
- ☒ **C** against a concentration gradient without using energy
- ☒ **D** down a concentration gradient without using energy



(d) Some drugs used to treat cancer are taken into cells by active transport.

Figure 8 shows some causes of preventable cases of cancer in 2015.

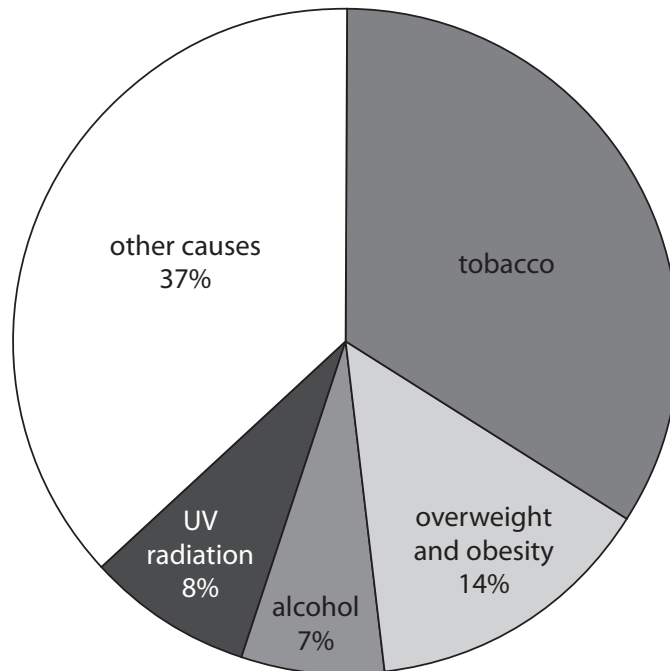


Figure 8

(i) What is the percentage of preventable cases of cancer that are caused by tobacco? (1)

- ☐ A 41%
- ☐ B 37%
- ☐ C 34%
- ☐ D 26%

- (ii) In 2015, data from Cancer Research UK suggested that 163 440 cases of cancer could have been prevented.

Calculate the number of preventable cases of cancer caused by alcohol.

Give your answer to the nearest whole number.

(2)

number of preventable cases of cancer caused by alcohol

(Total for Question 4 = 10 marks)



- 6 (a) A student investigated the activity of a human enzyme at different temperatures. The student measured the mass of product formed after 10 minutes at different temperatures. Figure 10 shows the results of this investigation.

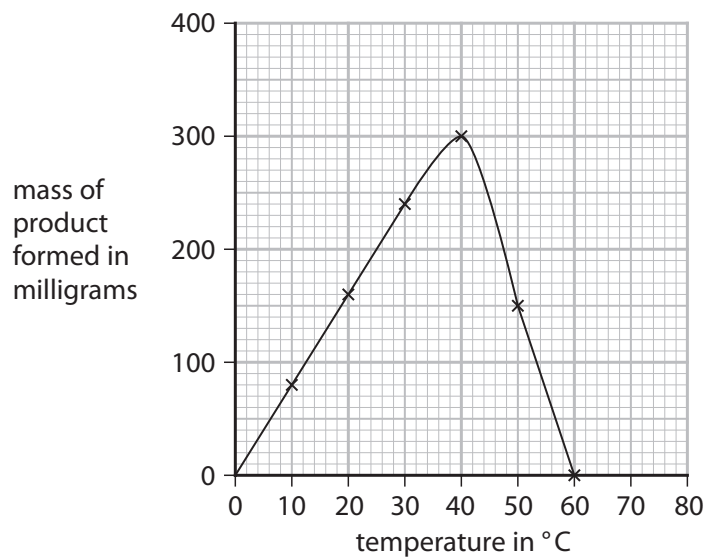


Figure 10

- (i) Describe the trends shown in Figure 10.

(2)

.....

.....

.....

.....

.....

- (ii) Explain the results obtained for temperatures from 40°C to 60°C.

(2)

.....

.....

.....

.....

.....

.....

.....

.....



(b) Some enzymes are involved in the breakdown of food substances.

- (i) Draw **one** straight line from each food group to the products of digestion for that food group.

(2)

food group

carbohydrate

fat

products of digestion

fatty acids and glycerol

amino acids

glucose

starch

ethanol

- (ii) Which enzyme breaks down fat?

(1)

- ☐ **A** carbohydrase
- ☐ **B** amylase
- ☐ **C** protease
- ☐ **D** lipase



(c) Figure 11 shows an enzyme and two substrates, P and Q.

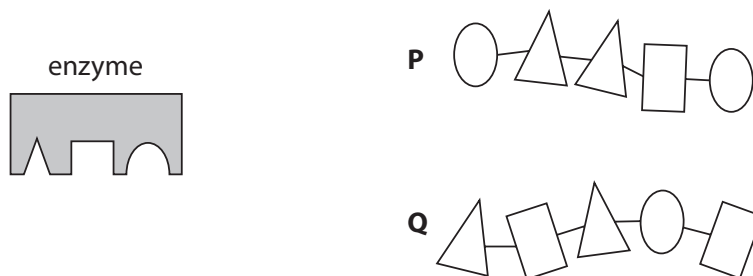


Figure 11

Explain the reason why no product will be formed if the enzyme is mixed with substrate **Q**.

(3)

(Total for Question 6 = 10 marks)

6 (a) Why are enzymes called biological catalysts?

(1)

- ☐ A because they slow down biological processes
- ☐ B because they speed up biological processes
- ☐ C because they denature biological processes
- ☐ D because they stop biological processes

(b) Many cells contain an enzyme called catalase.

Catalase breaks down hydrogen peroxide into water and oxygen.

A scientist investigated the effect of hydrogen peroxide concentration on the time taken to produce 20 cm^3 of oxygen.

Figure 12 shows the equipment used.

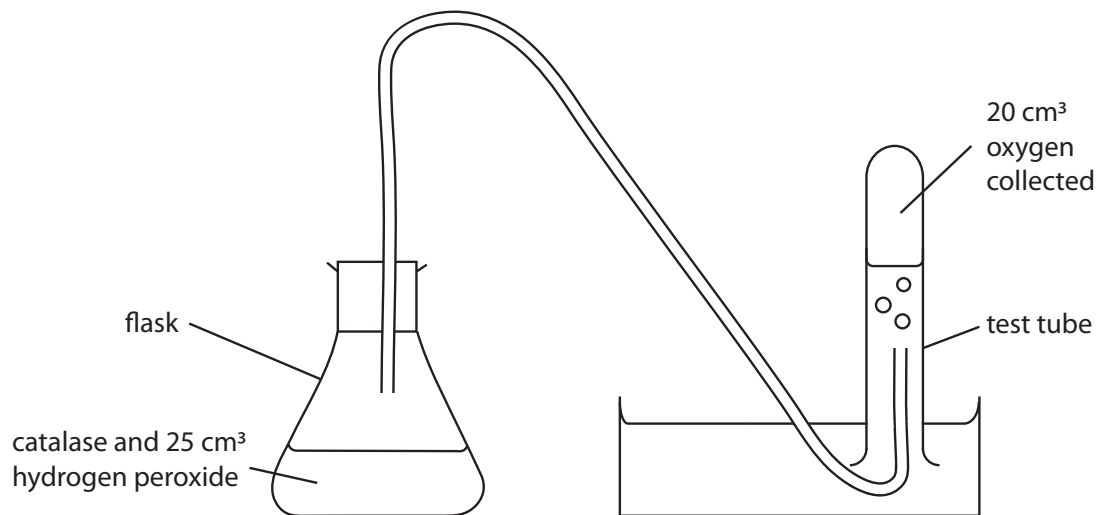


Figure 12

(i) State how the scientist could control the temperature of the flask.

(1)

.....

.....

(ii) Explain why the temperature should be controlled in this investigation. (3)

(iii) This investigation used five different concentrations of hydrogen peroxide.
Figure 13 shows the results of this investigation.

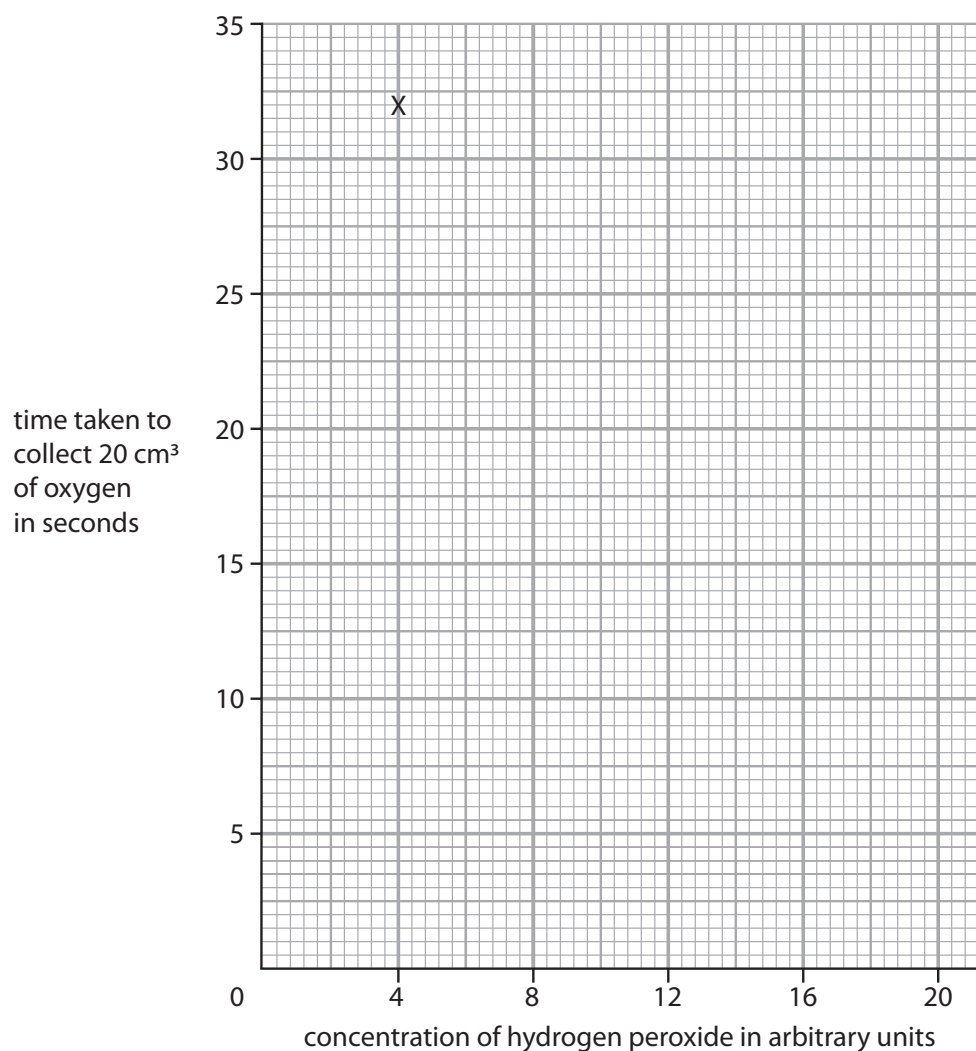
concentration of hydrogen peroxide in arbitrary units	time taken to collect 20 cm ³ of oxygen in seconds
4	32
8	14
12	9
16	7
20	6

Figure 13

Complete the graph by plotting the points and drawing a line to show the trend in the data.

The first point has been plotted for you.

(2)



(iv) Describe the trend shown in the graph.

Use data from the table in Figure 13 to support your answer.

(3)

(Total for Question 6 = 10 marks)



- 6 (a) Figure 10 shows a single-celled pond organism (*Amoeba proteus*).

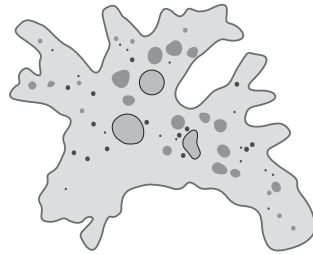


Figure 10

- (i) Which row of the table allows the net diffusion of oxygen into *Amoeba proteus*? (1)

	concentration of oxygen in water in ppm	concentration of oxygen in <i>Amoeba proteus</i> in ppm
☐ A	4	4
☐ B	10	10
☐ C	4	10
☐ D	10	4

- (ii) *Amoeba proteus* uses oxygen for aerobic respiration.

Complete the equation for aerobic respiration.

(1)

glucose + oxygen → + ... (+ energy is released)

(b) Humans breathe faster when they exercise.

(i) Which **two** changes allow the rate of respiration in the muscle to increase?

(1)

	heart rate	amount of glucose delivered to the muscles
☐ A	increases	increases
☐ B	increases	decreases
☐ C	decreases	increases
☐ D	decreases	decreases

(ii) Figure 11 shows breathing data for a human at rest and when running at 5 metres per second on a running machine.

activity	mean number of breaths per minute	mean volume of air in one breath in dm ³	mean volume of air breathed in dm ³ per minute
at rest	5.0	0.8	4.0
running at 5 metres per second	24.7	2.7	?

Figure 11

Calculate the mean volume of air breathed per minute when running at 5 metres per second.

Give your answer to one decimal place.

(2)

..... dm³ per minute



(iii) Devise an investigation to compare the mean number of breaths per minute for men, with the mean number of breaths per minute for women, when running at 5 metres per second on a running machine.

(4)

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(c) Whilst running, the leg muscles of an athlete tightened up, causing cramp.

Name the product of anaerobic respiration that can cause cramp.

(1)

.....

(Total for Question 6 = 10 marks)



- 4 (a) Figure 7 shows the times when *Homo sapiens* (modern humans) and some of their ancestors are thought to have lived.

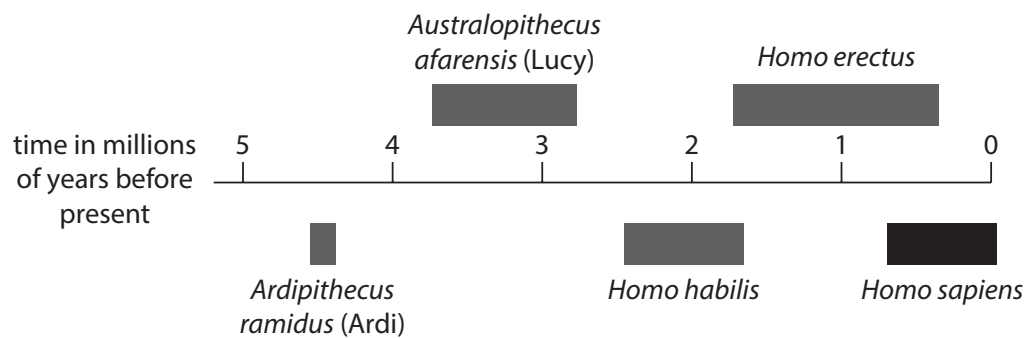


Figure 7

- (i) Which term is used to describe changes in species over time?

(1)

- ☐ A resistance
- ☐ B evolution
- ☐ C mitosis
- ☐ D inheritance

- (ii) Estimate the length of time *Homo habilis* is thought to have lived on Earth.

(1)

..... million years

- (iii) Describe **two** methods scientists used to date the fossils of Ardi or Lucy, as shown in Figure 7.

(2)

1

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2

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- (b) The ancestors of modern humans used selective breeding to improve the plants they used for food.

- (i) Complete the sentences using words from the box.

(2)

medicine	zygotes	generations
kingdoms	characteristics	domains

Selective breeding involves choosing parents with

desirable

The best offspring are bred together and this process is repeated over

many

- (ii) Suggest **one** feature of a banana that could be improved by selective breeding.

(1)

.....

.....



(c) The DNA of fruit can be modified to produce new varieties.

Figure 8 shows part of a method used to extract DNA from fruit.

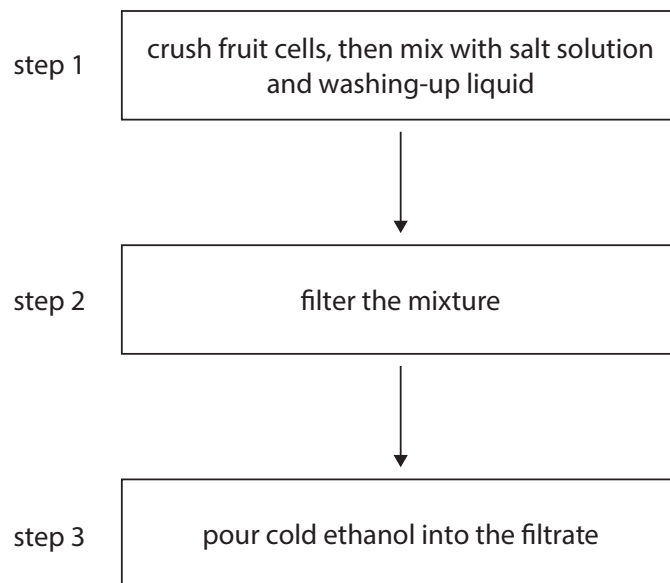


Figure 8

(i) State the purpose of both step 1 and step 2.

(2)

step 1

.....

step 2

.....

(ii) State why the cold ethanol was added in step 3.

(1)

.....

.....

.....

(Total for Question 4 = 10 marks)

11-MARK QUESTIONS

3 questions in this booklet



8 (a) DNA molecules contain base pairs.

Describe how the base pairs are bonded together in a DNA molecule.

(2)

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(b) Figure 16 shows part of a DNA molecule.

T	T	G	A	T	T	G	C	G	T	A	A
---	---	---	---	---	---	---	---	---	---	---	---

--	--	--	--	--	--	--	--	--	--	--	--

Figure 16

(i) Write the code for the complementary DNA strand in Figure 16.

(2)

(ii) Three bases code for each amino acid.

Which is the maximum number of amino acids coded for by this strand of DNA?

(1)

- ☐ **A** 3
- ☐ **B** 4
- ☐ **C** 6
- ☐ **D** 12

(iii) What is the shape of a DNA molecule?

(1)

- ☐ **A** triple stranded
- ☐ **B** single stranded
- ☐ **C** single helix
- ☐ **D** double helix

(c) A student wanted to extract the DNA from fresh peas.

The student crushed the peas and added washing up liquid and water.

The enzyme protease was then added to this mixture.

(i) Explain why the enzyme protease was added to the mixture.

(2)

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(ii) The mixture was then heated and filtered.

Finally, the student poured the filtrate into a test tube and ice-cold ethanol was poured down the side of the test tube into the filtrate.

State why ice-cold ethanol was poured into the filtrate.

(1)

.....

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.....

(iii) The student wanted to compare the mass of DNA found in fresh peas with the mass of DNA found in fresh beans.

Give **two** variables the student would need to control to make this a valid comparison.

(2)

1.....

.....

2.....

.....

(Total for Question 8 = 11 marks)



- 8 A student investigated the effect of temperature on the rate of reaction of the enzyme pepsin.

Figure 15 shows the data collected.

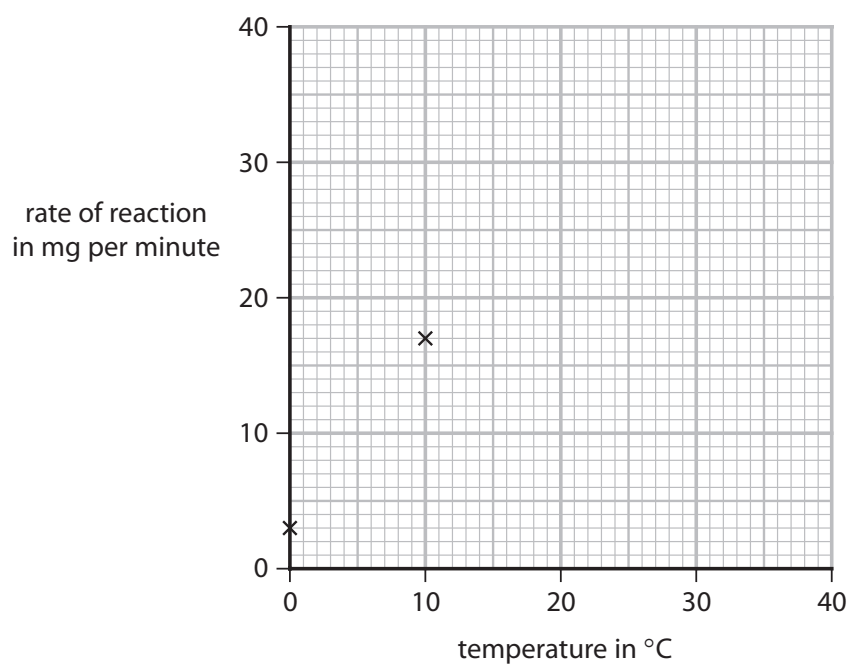
temperature in °C	rate of reaction in mg per minute
0	3.0
10	17.0
20	26.0
30	32.0
40	34.0

Figure 15

- (a) Complete the graph by plotting the results shown in Figure 15 and drawing a line of best fit.

The first two points have been plotted for you.

(2)



(b) Pepsin and trypsin are enzymes that break down proteins.

Figure 16 shows the results of an investigation into the activity of pepsin and trypsin at different pH levels.

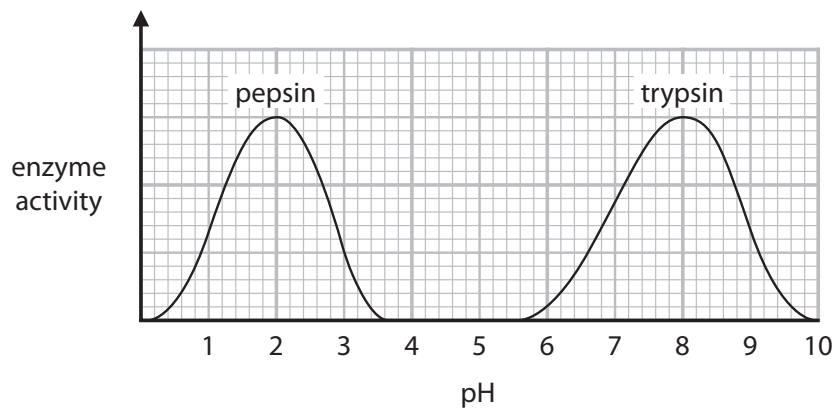


Figure 16

(i) Which molecules are produced when a protein is broken down?

(1)

- ☐ A sugars
- ☐ B amino acids
- ☐ C fatty acids
- ☐ D starches

(ii) Describe the trend in the graph for the enzyme pepsin.

Use data from the graph to support your answer.

(3)

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(iii) State the optimum pH for the enzyme trypsin.

(1)

(iv) Explain why there is no trypsin activity at pH 5.

(3)

(v) Temperature is a variable that should be controlled in this investigation.

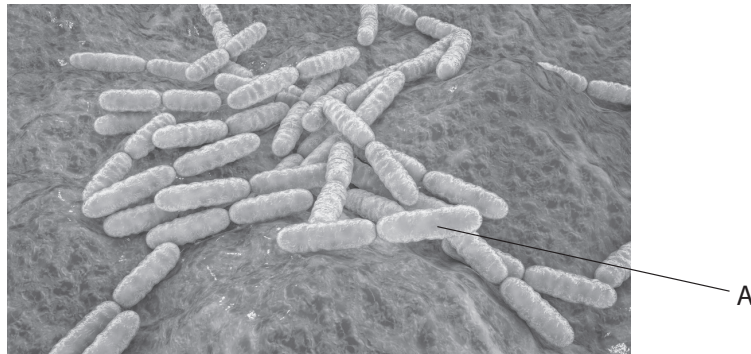
Give **one** way the temperature could be controlled.

(1)

(Total for Question 8 = 11 marks)



- 10 (a) Figure 22 shows a type of bacteria (*Lactobacillus acidophilus*) that is found in cow's milk.



(Source: © Kateryna Kon/Shutterstock)

Figure 22

The magnification of this image is $\times 18\,000$.

Measure the length of the bacterium labelled A.

Use your measurement to calculate the actual length of this bacterium in millimetres.

Give your answer in standard form.

(3)

..... mm

(b) Figure 23 shows the growth rate of two species of bacteria at different pH values.

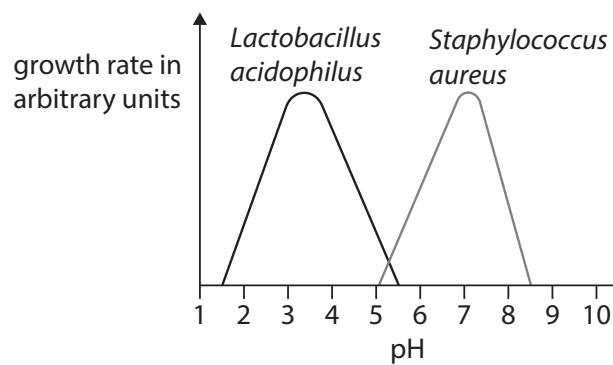


Figure 23

- (i) State a pH that allows the growth of both *Lactobacillus acidophilus* and *Staphylococcus aureus*.

(1)

- (ii) Describe the relationship between pH and the growth of *Staphylococcus aureus*, as shown in Figure 23.

(2)

(c) A student investigated the effect of temperature on the decay of milk.

Milk was placed in a beaker in a water bath at 5 °C for 72 hours.

The pH of the milk was measured every 24 hours using a pH probe.

The investigation was repeated at different temperatures.

Figure 24 shows the results of this investigation.

temperature in °C	pH			
	at 0 hours	at 24 hours	at 48 hours	at 72 hours
5	6.6	6.6	6.6	6.5
10	6.6	6.5	6.4	6.3
20	6.6	6.0	5.6	5.2
30	6.6	5.8	5.0	4.8

Figure 24

(i) Which is a variable that the student needs to control in this investigation?

(1)

- ☐ **A** pH of the milk
- ☐ **B** temperature of the milk
- ☐ **C** incubation time
- ☐ **D** volume of the milk



- (ii) Describe the changes in the pH of the milk at 30 °C from 0 hours to 72 hours, as shown in Figure 24.

(2)

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- (iii) Calculate the rate of decay of the milk at 20 °C for the 72 hours of this investigation.

Use the equation:

$$\text{rate of decay} = \frac{\text{change in pH}}{\text{time taken}}$$

(2)

..... change in pH per hour

(Total for Question 10 = 11 marks)



12-MARK QUESTIONS

2 questions in this booklet



6 (a) A student cut a piece of onion and placed it on a microscope slide.

The student then placed this slide on the stage of a light microscope and looked through the eyepiece.

No cells could be seen in the piece of onion.

Explain **two** ways this method could be improved to see details of the onion cells.

(4)

1.

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2.

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(b) Figure 7 shows mitosis occurring in some plant cells.

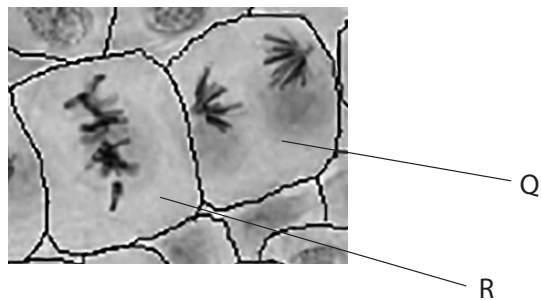


Figure 7

(i) The cells in Figure 7 were taken from a rapidly growing part of a plant.

Which part of a plant has rapidly dividing cells?

(1)

- ☐ A chloroplast
- ☐ B epithelium
- ☐ C meristem
- ☐ D vacuole

(ii) Which stage of mitosis is shown in cell R?

(1)

- ☐ A prophase
- ☐ B metaphase
- ☐ C anaphase
- ☐ D telophase

(iii) Describe **two** genetic similarities of the new cells that would be produced by cell Q in Figure 7.

(2)

1

2

(iv) The cells in Figure 7 were heated in hydrochloric acid.

State **two** safety precautions that should be taken when heating hydrochloric acid.

(2)

1

2

(c) Explain **one** advantage of using an electron microscope to observe plant cells.

(2)

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.....

(Total for Question 6 = 12 marks)



7 (a) Figure 13 shows three organisms that live in pond water.

Oxygen diffuses across the cell membranes of these organisms.

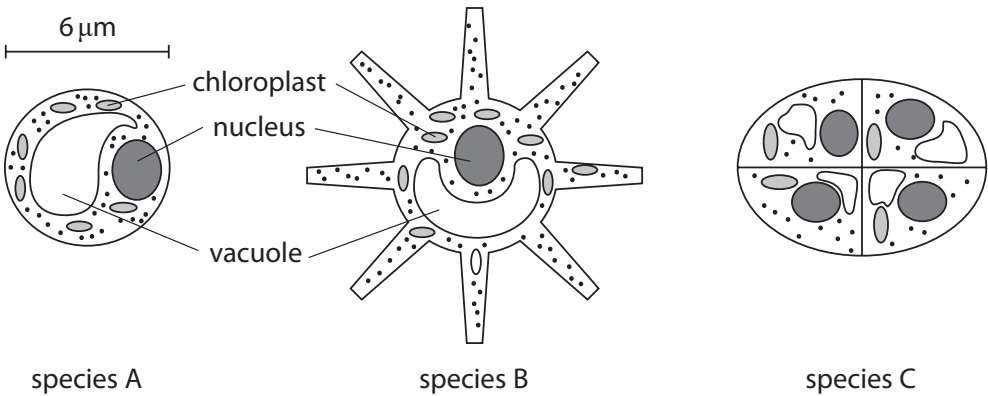


Figure 13

(i) Which row of the table shows the conditions needed for oxygen to diffuse from species A into the pond water?

(1)

	concentration of oxygen in species A in parts per million	concentration of oxygen in pond water in parts per million
☒ A	10	10
☒ B	12	10
☒ C	10	12
☒ D	12	12

(ii) Species B has a surface area of 9 000 μm² and a volume of 6 000 μm³.

Calculate surface area to volume ratio for species B.

(2)

ratio

(iii) The surface area to volume ratio for a cell of species A is 1 : 1.

The surface area to volume ratio for each cell in species C is 1 : 4.

Explain how the different surface areas will affect the diffusion of oxygen out of the cells of species A and species C.

(2)

(b) Some species of algae that photosynthesise have vacuoles that are filled with gas.

These vacuoles help the algae to float in water.

State how these vacuoles help the algae survive.

(1)

(Total for Question 7 = 12 marks)

13-MARK QUESTIONS

4 questions in this booklet



9 (a) Figure 11 shows two potato chips.

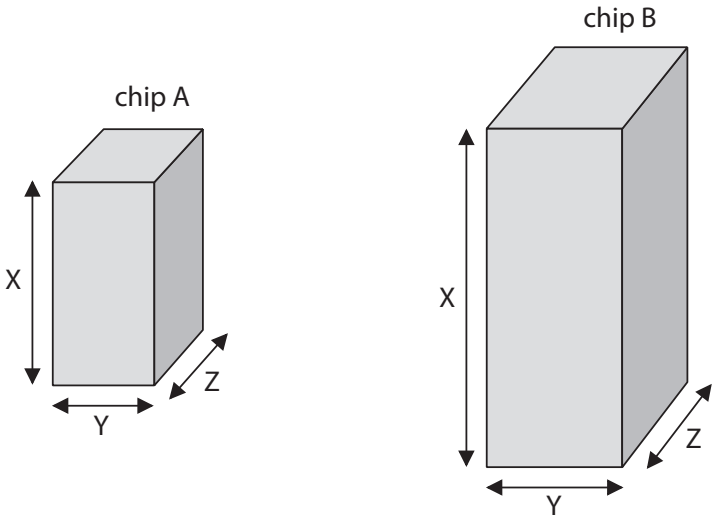


Figure 11

Figure 12 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 12

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

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

(2)

total surface area = ... cm²

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

Figure 13 shows the increase in mass of each potato chip.

potato chip	increase in mass in grams
A	0.1
B	0.3

Figure 13

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

(2)

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(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)

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.....

*(b) Figure 14 shows two varieties of potato plant.

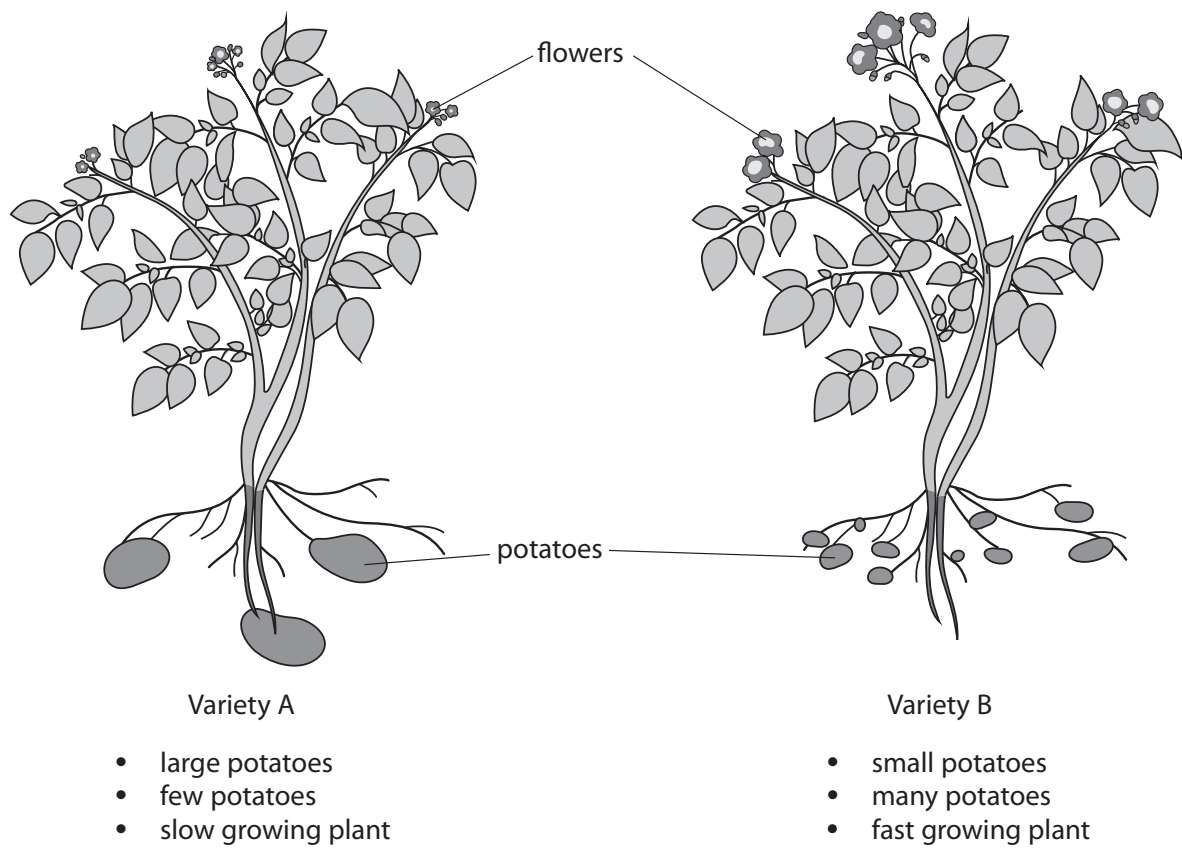


Figure 14

New varieties of potato plant can be produced by selective breeding.

Explain how selective breeding of the two varieties of potato plants can produce new potato plants that are all faster growing and produce many, large potatoes.

(6)

(Total for Question 9 = 13 marks)



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

Figure 20 is a drawing of the slide showing starch grains in the potato cells.

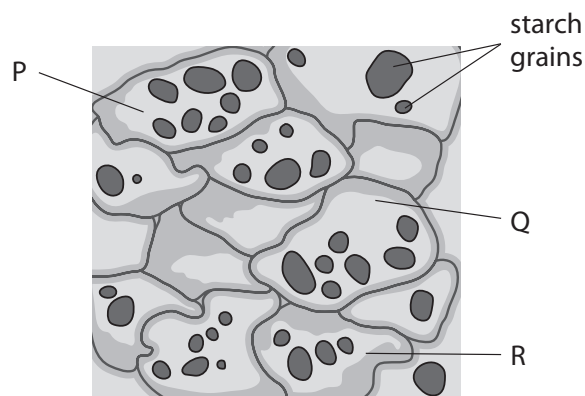


Figure 20

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

(1)

..... 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 21 shows a potato after being stored in the dark.

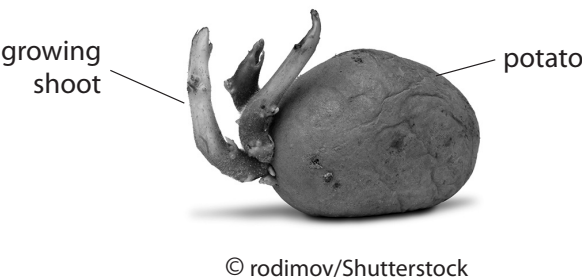


Figure 21

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 were measured in potato 2 after 5 weeks in the dark.

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

Figure 22 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 22

(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)

.....%

(ii) State **two** variables the scientist should have controlled to improve this investigation. (2)

1

.....

2

.....

(iii) The starch grains in the potatoes became smaller as the starch was converted into glucose.

State why the potatoes need glucose.

(1)

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.....



*(c) Figure 23 shows a diagram of some equipment that can be used to investigate the rate of photosynthesis.

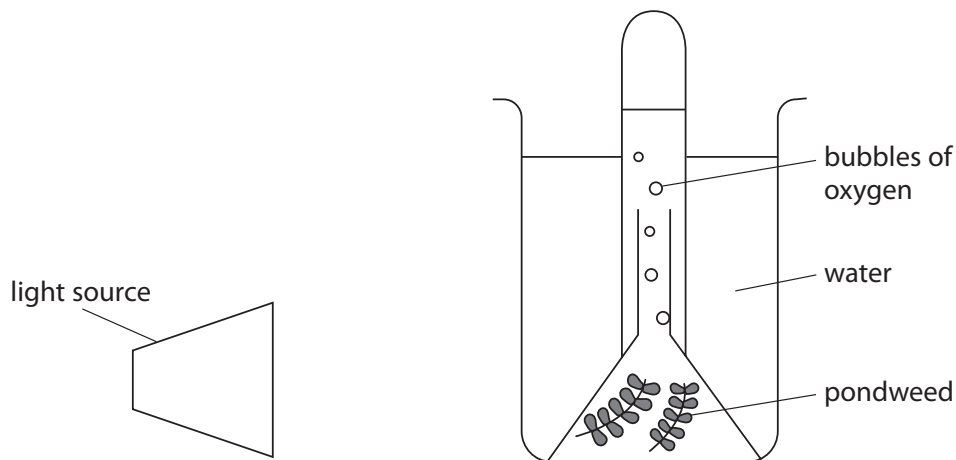


Figure 23

Devise a plan to investigate the effect of light intensity on the rate of photosynthesis.

Include variables you would need to control.

(6)

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(Total for Question 9 = 13 marks)

9 Respiration occurs in cells.

(a) Why do cells respire?

(1)

- ☐ **A** to produce nitrogen
- ☐ **B** to release oxygen
- ☐ **C** to produce glucose
- ☐ **D** to release energy

(b) An athlete runs every day as part of their training.

(i) Explain why the breathing rate of the athlete increases when running.

(2)

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(ii) When the athlete is running, their muscle cells use both aerobic respiration and anaerobic respiration.

State **two** differences between aerobic respiration and anaerobic respiration.

(2)

1

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2

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.....



(c) Bromothymol blue (BTB) solution is an indicator of pH.

Figure 16 shows the colour of BTB at different pH levels.

pH	4	5	6	7 (neutral)	8
colour	yellow	yellowy green	light green	green	blue

Figure 16

When air is passed through green BTB, for one minute, the solution stays green.

When a person breathes out through a straw into BTB for one minute the solution turns yellow.

(i) Explain why the air breathed out turns the BTB solution yellow.

(2)

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*(ii) Devise a plan, using green BTB solution, to investigate the amount of carbon dioxide in the air athletes breathe out after they have been running at different speeds.

Include:

- how you would use green BTB solution.
- how you would control at least two variables.

(6)

(Total for Question 9 = 13 marks)



- 9 (a) Figure 17 shows a beaker containing a potato cylinder in distilled water.

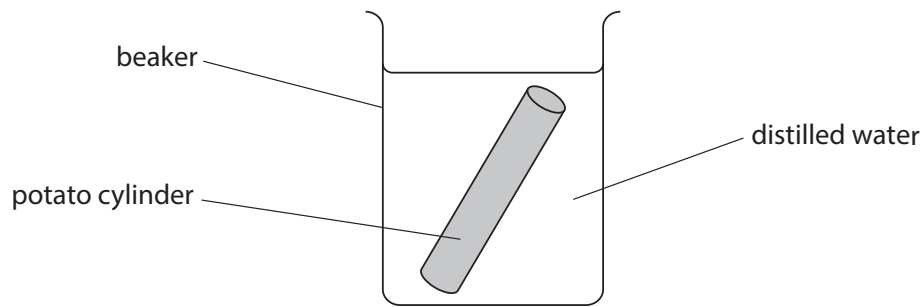


Figure 17

Explain why the mass of this potato cylinder will change when it is placed in distilled water.

(3)

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(b) A scientist investigated the rate of diffusion using three agar cubes of different sizes.

Each cube contained a pH indicator that changed from pink to colourless when placed in acid.

The cubes were placed in a beaker containing an acid.

Figure 18 shows some information about each cube.

cube	length of each side of cube in cm	surface area in cm ²	volume in cm ³	surface area to volume ratio	time taken for the cube to become colourless in seconds
A	1.0	6	1	6 : 1	170
B	2.0	24	8	3 : 1	260
C	3.0	54	?	2 : 1	500

Figure 18

(i) Calculate the volume of cube C.

(2)

..... cm³

(ii) Explain the difference in the times taken for cubes A and B to become colourless.

(2)

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* (c) Liquid agar was poured into a Petri dish and allowed to set.

A well was cut in the centre of the set agar.

Kiwi fruit juice was poured into the well.

Kiwi fruit juice contains an enzyme that causes set agar to break down into a liquid.

Figure 19 shows the results after 30 minutes.

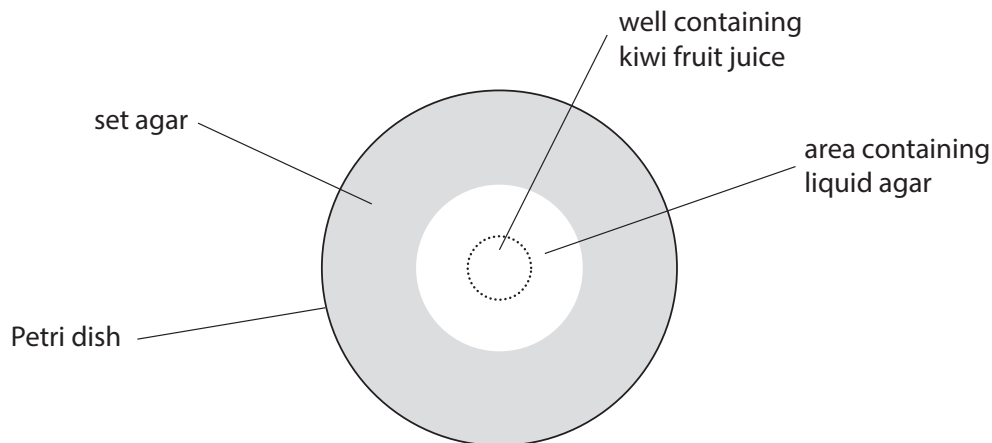


Figure 19

Devise a plan to investigate the effect of different concentrations of kiwi fruit juice on the breakdown of set agar, using the equipment shown in Figure 19.

Your plan should include:

- measurements that need to be taken
- variables that need to be controlled.

(6)

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Handwriting practice area with 12 horizontal dotted lines.

(Total for Question 9 = 13 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question number	Answer	Mark
2(a)(i)	B cell wall The only correct answer is B <i>A is not correct because X is not the cell membrane</i> <i>C is not correct because X is not the cytoplasm</i> <i>D is not correct because X is not the nucleus</i>	(1)

Question number	Answer	Mark
2(a)(ii)	(allows) movement / swim / motility	(1)

Question number	Answer	Additional guidance	Mark
2(a)(iii)	(bacteria) have no nucleus / have chromosomal DNA / have a cell wall	accept converse for all differences	(1)

Question number	Answer	Mark
2(b)	C diffusion The only correct answer is C <i>A is not correct because oxygen does not move into and out of cells by transpiration</i> <i>B is not correct because oxygen does not move into and out of cells by active transport</i> <i>D is not correct because oxygen does not move into and out of cells by osmosis</i>	(1)

Question number	Answer	Additional guidance	Mark
2(c)	Substitution 500 × 0.04 (1) Evaluation 20 (mm)	award two marks for correct answer with no working	(2)

(Total for question 2 = 6 marks)

Question Number	Answer	Mark
2(a) (i)	B double helix 1. The only correct answer is B <i>A is not correct because the shape of a DNA molecule is not a single helix</i> <i>C is not correct because the shape of a DNA molecule is not a complementary helix</i> <i>D is not correct because the shape of a DNA molecule is not a triple helix</i>	(1) AO 1 1

Question Number	Answer	Mark
2(a) (ii)	A sugars and phosphates 1. The only correct answer is A <i>B is not correct because amino acids and bases are not present in the DNA backbone</i> <i>C is not correct because bases are not present in the DNA backbone</i> <i>D is not correct because amino acids are not present in the DNA backbone</i>	(1) AO 1 1

Question Number	Answer	Mark
2(a) (iii)	(weak) hydrogen (bonds)	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
2(b)	- homogenise cells(1) - mix cells with a salt/detergent (solution)(1)	allow grind /crush/squash cells (using pestle and mortar)(1) accept use alcohol/ethanol(1)	(2) AO 1 2

Question Number	Answer	Additional guidance	Mark
2(c)	Any two from: - locate genes associated with diseases (1) - treat (genetic) disorders (1) - personalised medicine (1)	accept genetic screening(1) accept genetic counselling/named disorders(1) accept develop new treatment/medicine (1)	(2) AO 1 1

Total for Question 2 = 7 marks

Question Number	Answer	Mark
1(a)(i)	D cytoplasm The only correct answer is D <i>A is not correct because W is not the cell wall</i> <i>B is not correct because W is not the nucleus</i> <i>C is not correct because W is not the cell membrane</i>	(1) AO1 1

Question Number	Answer	Mark
1(a)(ii)	A nucleus The only correct answer is A <i>B is not correct because a tail is not found in cheek cells</i> <i>C is not correct because a middle piece is not found in cheek cells</i> <i>D is not correct because an acrosome is not found in cheek cells</i>	(1) AO2 1

Question Number	Answer	Mark
1(b)	cell wall	(1) AO1 1

Question Number	Answer	Mark
1(c)	An answer including: • (add) iodine (solution) (1) • (iodine solution changes from brown to) blue-black / black (1)	(2) AO1 2

Question Number	Answer	Mark
1(d)(i)	L	(1) AO2 2

Question Number	Answer	Mark
1(d)(ii)	K	(1) AO2 2

(Total for question 1 = 7 marks)

Question number	Answer	Additional guidance	Mark
2(a)(i)	A description including two from: - by hitting it (1) - with another stone / rock / flint / something hard (1) - to knock flakes /chips off (1)	not just another object accept knapped (2)	(2) A02 1

Question number	Answer	Mark
2(a)(ii)	B tool Q is more pointed than tool P The only correct answer is B <i>A is incorrect because colour does not tell you how advanced the maker of the tool was.</i> <i>C is incorrect because colour does not tell you how advanced the maker of the tool was.</i> <i>D is incorrect because Q is more pointed than P.</i>	(1) A03 2a

Question number	Answer	Mark
2(a)(iii)	- natural (1) - mutate (1) Must be in the correct order Reject migrate against either mark	(2) A01 1

Question number	Answer	Additional guidance	Mark
2(b)	A description including two from: - compare with other tools / fossils (that have already been dated) (1) - from the (layer of) rock in which they are found / how deep down each was found (1) - radiometric dating / description of radiometric dating (1) - comparing to other finds (of known age) from the same layer (of rock) (1)	accept compare to other tools that are less well / better made	(2) AO2 1

(Total marks for question 2 = 7 marks)

Question number	Answer	Mark
1(a)(i)	B cell membrane The only correct answer is B <i>A is not correct because Y is not the cell wall</i> <i>C is not correct because Y is not the nucleus</i> <i>D is not correct because Y is not the cytoplasm</i>	(1) AO1 1

Question number	Answer	Mark
1(a)(ii)	A chromosomes The only correct answer is A <i>B is not correct because mitochondria are not found in Z</i> <i>C is not correct because ribosomes are not found in Z</i> <i>D is not correct because vacuoles are not found in Z</i>	(1) AO1 1

Question number	Answer	Additional guidance	Mark
1(a)(iii)	mitochondria	accept cytoplasm	(1) AO1 1

Question number	Answer	Mark
1(b)(i)	cells appear {larger / magnified} / can be seen in more detail / organelles can be seen	(1) AO1 2

Question Number	Answer	Mark
1(b)(ii)	part of the microscope eyepiece stage function to place a slide on to carry the microscope to make the cells look brighter to look through to see the cells to reflect light onto the cells do not award mark if more than one line drawn from eyepiece box do not award mark if more than one line drawn from stage box	(2) AO1 2

Question number	Answer	Additional guidance	Mark
1(c)	picometre		(1) AO1 1

(Total for question 1 = 7 marks)



Question number	Answer	Mark
2(a)(i)	A layer A The only correct answer is A <i>B is not correct because layer B will not contain the most recent fossils</i> <i>C is not correct because layer C will not contain the most recent fossils</i> <i>D is not correct because layer D will not contain the most recent fossils</i>	(1) AO2 1

Question number	Answer	Additional guidance	Mark
2(a)(ii)	An explanation including • tool A is less refined (than B, C and D) (1) • (because) tool A was worked less (1) • (because) it is older / made by earlier humans / less evolved humans (1)	accept reverse arguments	(2) AO3 1ab

Question number	Answer	Additional guidance	Mark
2(b)(i)	characteristics (1) selective (1)	answers must be in the correct order	(2) AO1 1

Question Number	Answer	Mark
2(b)(ii)	C all the DNA of an organism The only correct answer is C <i>A is not correct because the genome is not all the cells of an organism</i> <i>B is not correct because the genome is not all the enzymes of an organism</i> <i>D is not correct because the genome is not all the structures of an organism</i>	(1) AO1 1

Question number	Answer	Mark
2(b)(iii)	food security / animals are less dangerous / make jobs easier / companionship / give humans protection	(1) AO1 1

(Total for question 2 = 7 marks)



Question number	Answer	Mark
1(a)(i)	A cell wall The only correct answer is A <i>B is incorrect because structure W is not cytoplasm</i> <i>C is incorrect because structure W is not chromosomal DNA</i> <i>D is incorrect because structure W is not a plasmid</i>	(1) AO1 1

Question number	Answer	Additional guidance	Mark
1(a)(ii)	flagellum / tail	accept flagella accept phonetic spellings	(1) AO1 1

Question number	Answer	Additional guidance	Mark
1(a)(iii)	movement	accept swimming ignore references to sperm and eggs	(1) AO1 1

Question number	Answer	Mark
1(b)	body defence function hydrochloric acid moves pathogens away from the lungs skin makes antibodies destroys pathogens in the stomach makes antigens stops pathogens entering the body do not award mark if two lines are drawn from hydrochloric acid box do not award mark if two lines are drawn from skin box	(2) AO1 1

Question number	Answer	Additional guidance	Mark
1(c)	Any two from: • drinking alcohol (1) • taking drugs (1) • malnutrition / overeating / poor diet (1) • lack of exercise (1)	accept smoking other substances / vaping ignore obesity	(2) AO1 1
		accept other named lifestyle factors	

Total marks for question 1 = 7 marks

Question number	Answer	Mark
2(a)(i)	• salt (1) • membranes (1) must be in the correct order	(2) AO1 1

Question number	Answer	Additional guidance	Mark
2(a)(ii)	A description including: • pour the contents (of the beaker) into the funnel (1) • (into) filter paper / to filter (it) (1) • to separate DNA (1)	accept filtration accept separate liquid from solids pour the contents of the beaker into the filter funnel is two marks	(2) AO3 1a

Question number	Answer	Mark
2(a)(iii)	C white The only correct answer is C <i>A is incorrect because the precipitate is not blue</i> <i>B is incorrect because the precipitate is not</i>	(1) AO1 1

Question number	Answer	Mark
2(b)(i)	B 10.4 The only correct answer is B <i>A is incorrect because the range is not 13.2</i> <i>C is incorrect because the range is not 5.9</i> <i>D is incorrect because the range is not 5.3</i>	(1) AO2 1

Question number	Answer	Additional guidance	Mark
2(b)(ii)	6.4		(1) AO1 1

Total marks for question 2 = 7 marks

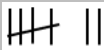
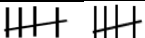
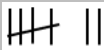
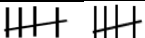
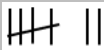
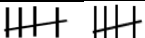
Question Number	Answer	Additional guidance	Mark
1(b)ii	An answer including: a light microscope - is affordable / easy to use / large field of view / portable (1) an electron microscope - gives higher resolution / shows (more) detail (1)	accept it shows colour / living cells accept can magnify image more / can show {more/smaller} structures of the cell ignore clearer image	(2)

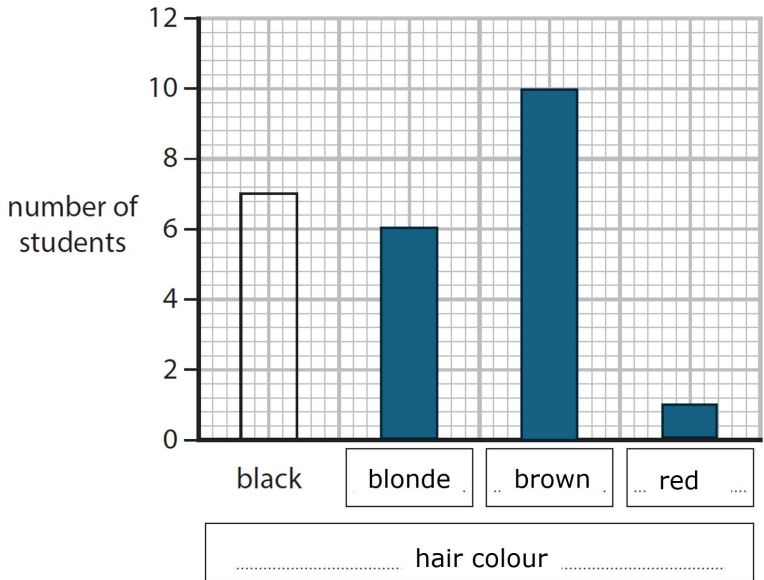
Total for question 1 = 7 marks



Question number	Answer	Mark
1(a)(i)	A variation The only correct answer is A B, C and D are incorrect because they do not describe differences in hair colour	(1) AO2 1

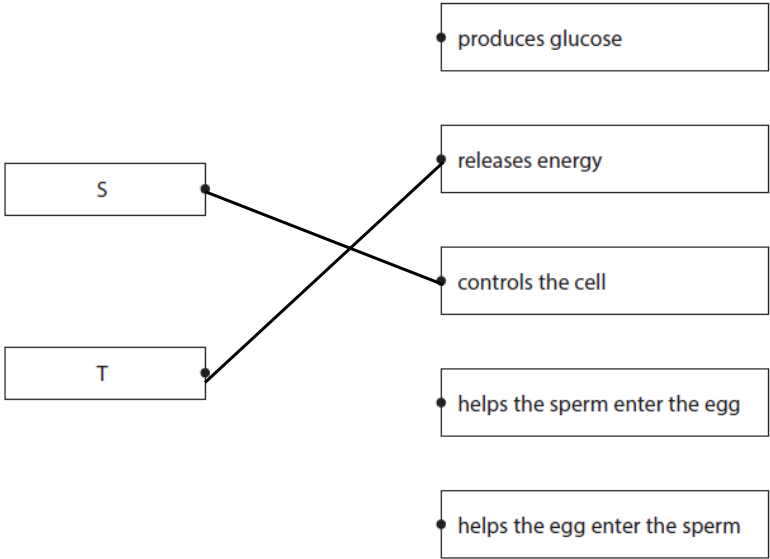
Question number	Answer	Additional guidance	Mark
1(a)(ii)	nucleus	accept mitochondria	(1) AO1 1

Question number	Answer	Mark																
1(b)(i)	tally for brown completed (1) total for brown completed (1) <table><tr><th colspan="4">hair colour</th></tr><tr><th>black</th><th>blonde</th><th>brown</th><th>red</th></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>total = 7</td><td>total = 6</td><td>total = 10</td><td>total = 1</td></tr></table>	hair colour				black	blonde	brown	red					total = 7	total = 6	total = 10	total = 1	(2) AO3 1a
hair colour																		
black	blonde	brown	red															
																		
total = 7	total = 6	total = 10	total = 1															

Question number	Answer	Additional guidance	Mark
1(b)(ii)	- bars for blonde, brown and red plotted (from Figure 2) (1) - labels for blonde, brown and red (1) - x-axis labelled (hair) colour (1)  number of students black blonde brown red hair colour	accept plotting +/- 1/2 small square	(3) A02 1 A03 1a

Total for Question 1 = 7 marks

Question number	Answer	Mark
2(a)(i)	acrosome accept phonetic spellings	(1) AO1 1

Question number	Answer	Mark
2(a)(ii)	part of the sperm cell function  Do not award mark if more than one line drawn from box S Do not award mark if more than one line drawn from box T	(2) AO1 1

Question number	Answer	Additional guidance	Mark
2(b)	chloroplast / cell wall / vacuole		(1) AO2 1

Question number	Answer	Mark
2(c)(i)	C polymer The only correct answer is C A is incorrect because DNA is not a monomer B is incorrect because DNA is not a protein D is incorrect because DNA is not starch	(1) AO1 1

Question number	Answer	Additional guidance	Mark
2(c)(ii)	A description including two from: • complementary bases (pairing) (1) • A with T / C with G (1) • joined by weak (bonds) (1) • hydrogen bonds (1)	award 2 marks for weak hydrogen bonds	(2) AO1 1

Total for Question 2 = 7 marks

Question Number	Answer	Mark
5(a)	C phenotype The only correct answer is C <i>A is not correct because genotype does not describe the physical characteristics</i> <i>B is not correct because monohybrid does not describe the physical characteristics</i> <i>D is not correct because heterozygous does not describe the physical characteristics</i>	(1) AO1 1

Question Number	Answer	Additional guidance	Mark
5(b)(i)	Any one from: - a single result could be anomalous (1) - to calculate a mean (1)	accept to see if the results are the same / similar ignore references to increasing accuracy	(1) AO1 2

Question Number	Answer	Additional guidance	Mark
5(b)(ii)	Any two from: • measure the length / width of the carrot sticks (1) • cut sticks from the same carrot / same part of carrot (1) • use the same variety of carrot (1) • (surface) dry the carrot sticks before weighing (1)	accept other valid ways of improving this method, e.g. using more than three carrot sticks (1)	(2) AO3 3b

Question Number	Answer	Additional guidance	Mark
5(b)(iii)	substitution ($0.8 \div 4.2$) $\times$ 100 (1) evaluation 19.048 (1) 2 significant figures 19 (%)	full marks for correct answer without any working accept 19.0476 / 19.05 (2) award one mark for rounding an incorrectly calculated answer to 2 significant figures	(3) AO2 1

Question Number	Answer	Mark
5(b)(iv)	An explanation linking any two from: - the carrot sticks gained mass (1) - because water moved into the carrot (cells) (1) - by osmosis / description of osmosis (1)	(2) AO3 2a 2b

(Total for question 5 = 9 marks)

4(a)(i)	To make the {cell / nucleus} more visible	(1) AO2 2
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Question Number	Answer	Mark
4(b)	A description linking three from: • use forceps to {pick up / peel} a (thin layer of) onion (cells) (1) • place (onion cells) onto microscope slide (1) • add a drop of stain / named stain (1) • place coverslip on top (of onion) (1) • lower coverslip slowly / at an angle (1)	(3) AO1 2

Question Number	Answer	Additional Guidance	Mark
4(c)	Any two from the following: • at any point between 0 to 0.33 {mass / water} is gained (1) • from 0 to 0.33 the change in mass decreases (1) • 0.33 is where the concentration inside and outside (of the cell) is the same (1) • above 0.33 {mass / water} is lost (1) • from 0.33 to 1.0 the change in mass increases (1)	accept 0.33 mol/dm ³ is the isotonic point	(2) AO3 2a 2b

(Total for Question 4 = 9 marks)

Question Number	Answer	Additional guidance	Mark
5(a)	- all points plotted correctly to $\pm \frac{1}{2}$ small square (1) - a line showing a steady increase that levels off at 30au/40g (1)	accept dot-to-dot line	(2) AO 2 2

Question Number	Answer	Additional guidance	Mark
5(b)	Any two from: - mass of product formed increases as enzyme concentration increases (1) - then (the mass of product formed) remains the same (1) 30 au/40 g is point where mass of product remains the same (1)	accept then levels off (1)	(2) AO 3 1a AO 3 1b

Question Number	Answer	Additional guidance	Mark
5(c)	5:15 (1) 1:3	allow full marks for correct final answer with no working	(2) AO 2 1

Question Number	Answer	Mark
5(d) (i)	D increase the substrate concentration 1. The only correct answer is D <i>A is not correct because increasing the pH will not increase the mass of product formed in this investigation</i> <i>B is not correct because decreasing the temperature will not increase the mass of product formed in this investigation</i> <i>C is not correct because decreasing the enzyme concentration will not increase the mass of product formed in this investigation</i>	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
5(d) (ii)	Any three from: 37°C is the optimum for this enzyme (1) 80°C /it will denature the enzyme/pepsin (1) - change in the shape of the enzyme/active site (1) - No reaction will take place / no enzyme-substrate complexes formed / no product formed (1)	accept 37°C is best temperature for this enzyme (1) accept high temperatures will denature the enzyme accept substrate no longer fits active site (1)	(3) AO 2 1

Total for Question 5 = 10 marks



Question number	Answer	Additional guidance	Mark
4(a)(i)	Substitution $3 \div 120$ (1) 0.025 (mm)	award two marks for correct answer with no working	(2)

Question number	Answer	Additional guidance	Mark
4(a)(ii)	Repeat (the investigation)	accept compare with results from other groups	(1)

Question number	Answer	Additional guidance	Mark
4(b)	A logical plan including three from the following: • heat (hydrochloric) acid to different temperatures (1) • use same size agar jelly cubes (1) • use same volume/ concentration of acid (1) • for same amount of time (1) • measure clear distance (from outside of cube) at each temperature (1)	accept heat agar jelly cubes to different temperatures ignore amount of acid accept for 2 marks time how long for agar jelly to go clear (mp 4 and 5)	(3)

Question number	Answer	Mark
4(c)	A against a concentration gradient using energy The only correct answer is A <i>B is not correct because active transport is not down a concentration gradient using energy</i> <i>C is not correct because active transport is not against a concentration gradient without using energy</i> <i>D is not correct because active transport is not down a concentration gradient without using energy</i>	(1)

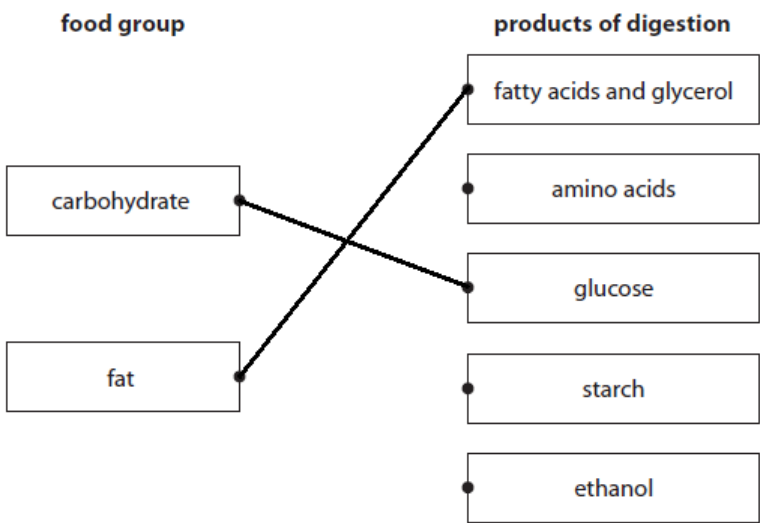
Question number	Answer	Mark
4(d)(i)	C 34% The only correct answer is C <i>A is not correct because the percentage of preventable cases of cancer caused by tobacco is not 41%</i> <i>B is not correct because percentage of preventable cases of cancer caused by tobacco is not 37%</i> <i>D is not correct because percentage of preventable cases of cancer caused by tobacco is not 26%</i>	(1)

Question number	Answer	Additional guidance	Mark
4(d)(ii)	Substitution $(7 \times 163440) \div 100 / 163440 \times 7\% / 163440 \times 0.07$ (1) Correctly rounded to 11441	accept 11440.8 (1) award two marks for correct answer with no working	(2)

(Total for question 4 = 10 marks)

Question number	Answer	Additional guidance	Mark
6(a)(i)	Any two from: • mass of product increases up to 40°C / 300mg (1) • mass of product decreases after 40°C / 300mg (1) • mass of product decreases faster than it increases (1)	accept maximum mass is 300mg / 40°C is the optimum temperature (1) accept increases then decreases for 1 mark	(2)

Question number	Answer	Mark
6(a)(ii)	An explanation linking two from: • (maximum product at 40°C) because the enzyme is at its optimum temperature (1) • (between 40°C and 60°C the amount of product decreases) because the enzyme is becoming less active/ is being denatured /at 60°C the enzyme is denatured (1) • (because) the active site is changing shape / substrate can't bind to the active site / fewer enzyme-substrate complexes formed (1)	(2)

Question number	Answer	Mark
6(b)(i)	Two lines drawn correctly as shown.  Reject more than one line from each food group	(2)

Question number	Answer	Mark
6(b)(ii)	D lipase The only correct answer is D <i>A is not correct because carbohydrase does not break down fat</i> <i>B is not correct because amylase does not break down fat</i> <i>C is not correct because protease does not break down fat</i>	(1)

Question number	Answer	Additional guidance	Mark
6(c)	An explanation linking: • (shape of) <u>active site</u> of enzyme (1) • not complementary to / will not fit substrate Q (1) • (therefore) the enzyme cannot cause the reaction to occur (so no product is formed) (1)	accept lock and key are not complementary/ enzyme and substrate don't fit together	(3)

(Total for question 6 = 10 marks)

Question Number	Answer	Mark
6(a)	B because they speed up biological processes The only correct answer is B <i>A is not correct because enzymes do not slow down biological processes</i> <i>C is not correct because enzymes do not denature biological processes</i> <i>D is not correct because enzymes do not stop biological processes</i>	(1) AO1 1

Question Number	Answer	Mark
6(b)(i)	use a water bath / description of a water bath	(1) AO1 2

Question Number	Answer	Additional guidance	Mark
6(b)(ii)	An explanation linking three from: - enzymes have an optimum temperature (1) - so temperature will affect the rate of enzyme activity / the time taken to produce 20cm³ of oxygen (1) - enzyme activity increases as temperature increases (up to the enzyme's optimum temperature) (1) {enzymes / active sites} are denatured / enzyme activity stops at high temperatures (1)	accept hydrogen peroxide concentration is the independent variable, so other variables (such as temperature) must be controlled (1)	(3) AO2 1

Question Number	Answer	Additional guidance	Mark
6(b)(iii)	- all 4 points plotted accurately ($\pm$ half a small square) (1) - smooth curve / dot-to-dot line drawn (1)	ignore extrapolations	(2) AO3 1a 1b

Question Number	Answer	Additional guidance	Mark
6(b)(iv)	A description including: - the time taken to collect 20 cm³ oxygen decreases as hydrogen peroxide concentration increases (1) - the curve flattens (1) - the correct use of data from the table (1)	accept negative correlation data must be used not just quoted from the table	(3) A03 1a 1b

(Total for question 6 = 10 marks)

Question Number	Answer	Additional guidance	Mark
6a(i)	D 10 4 The only correct answer is D <i>A is not correct because for oxygen to diffuse into the Amoeba the concentration must be lower than in the water.</i> <i>B is not correct because for oxygen to diffuse into the Amoeba the concentration must be lower than in the water.</i> <i>C is not correct because for oxygen to diffuse into the Amoeba the concentration must be lower than in the water.</i>		(1) AO2.1

Question Number	Answer	Additional guidance	Mark
6(aii)	carbon dioxide + water	accept CO ₂ for carbon dioxide H ₂ O for water	(1) AO1.1

Question Number	Answer	Mark
6(b)(i)	A increases increases The only correct answer is A <i>B is not correct because a decrease in blood glucose concentration would decrease the rate of respiration</i> <i>C is not correct because a decrease in heart rate would decrease the rate of respiration</i> <i>D is not correct because a decrease in heart rate and blood glucose concentration would decrease the rate of respiration</i>	(1) AO1.1

Question Number	Answer	Additional guidance	Mark
6(b)(ii)	Evaluation $(24.7 \times 2.7) = 66.69$ (1) rounded to one decimal place: 66.7	award 1 mark for correctly rounding an incorrectly calculated answer award full marks for correct answer with no working shown.	(2) AO1.1

Question Number	Answer	Mark
6(b)(iii)	An investigation including four from:	(4) AO1.2

Question Number	Answer	Additional guidance	Mark
6(c)	lactic acid	accept lactate	(1) AO1.1

(Total for question 6 = 10 marks)

Question Number	Answer	Mark
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Question number	Answer	Mark
4(a)(i)	B evolution The only correct answer is B A, C and D are not correct as they do not describe the changes in species over time.	(1) AO1 1

Question number	Answer	Additional guidance	Mark
4(a)(ii)	0.7 (million years)	accept answers in the range 0.6 to 0.8 million years	(1) AO3 1a

Question number	Answer	Additional guidance	Mark
4(a)(iii)	An answer including two from: - compare the fossils / fossil features to other fossils (of a known age) (1) - radiometric dating (of surrounding rocks) (1)	accept depth in the rock layer / stratigraphy (1) accept (dating) the type of tools found with the fossils (1)	(2) AO2 1

Question number	Answer	Additional guidance	Mark
4(b)(i)	characteristics (1) generations (1)	answers must be in the correct order	(2) AO1 1

Question number	Answer	Additional guidance	Mark
4(b)(ii)	Any one from: size / taste / colour / {ripening time / storage time} / disease resistance	accept any other feature that could be improved	(1) AO2 1

Question number	Answer	Additional guidance	Mark
4(c)(i)	Step one: One from: - break cells open / cell {walls / membranes} burst (1) - to release DNA (1) Step two: - to separate the liquid / DNA from the solids (1)		(2) AO2 2

Question number	Answer	Additional guidance	Mark
4(c)(ii)	to precipitate the DNA / make the DNA visible		(1) AO2 2

Total for question 4 = 10 marks



Question number	Answer	Additional guidance	Mark
8(a)	A description linking two from: weak (1) hydrogen bonds (1) complementary bases (1) A – T / C – G (1)	accept H bonds reject hydro bonds accept the names of the base pair	(2) AO1 2

Question number	Answer	Additional guidance	Mark																								
8(b)(i)	<table><tr><td>T</td><td>T</td><td>G</td><td>A</td><td>T</td><td>T</td><td>G</td><td>C</td><td>G</td><td>T</td><td>A</td><td>A</td></tr><tr><td>A</td><td>A</td><td>C</td><td>T</td><td>A</td><td>A</td><td>C</td><td>G</td><td>C</td><td>A</td><td>T</td><td>T</td></tr></table> award 1 mark for all the As and Ts in the top line correctly paired (1) award 1 mark for all the Cs and Gs in the top line correctly paired (1)	T	T	G	A	T	T	G	C	G	T	A	A	A	A	C	T	A	A	C	G	C	A	T	T	accept lower case letters	(2) AO2 1
T	T	G	A	T	T	G	C	G	T	A	A																
A	A	C	T	A	A	C	G	C	A	T	T																

Question number	Answer	Mark
8(b)(ii)	B 4 The only correct answer is B <i>A is incorrect because 3 amino acids would need 9 bases to be present</i> <i>C is incorrect because 6 amino acids would need 18 bases</i> <i>D is incorrect because 12 amino acids would need 36 bases</i>	(1) AO2 1

Question number	Answer	Mark
8 (b)(iii)	D double helix The only correct answer is D A is incorrect because a DNA molecule is not three separate strands B is incorrect because the DNA molecule consists of two strands C is incorrect because a DNA molecule is a double helix not a single helix	(1) AO1 2

Question number	Answer	Additional guidance	Mark
8 (c)(i)	An explanation linking two from: • (protease) breaks down proteins (1) • in the {cell/nuclear} membrane (1) • destroys enzymes that may break down the DNA (1)	accept break down {the cell / nucleus/ cell wall}	(2) AO1 2

Question number	Answer	Additional guidance	Mark
8 (c)(ii)	to precipitate the DNA / because DNA is insoluble in ethanol	accept to see the DNA	(1) AO1 2

Question number	Answer	Additional guidance	Mark
8(c)(iii)	Any two from: • mass of peas and beans (1) • method of crushing (1) • volume of {washing up liquid / detergent} / water (1) • volume of protease (1) • temperature if qualified (1) • volume of ethanol (1) • time if qualified (1)	accept weight accept keep the temperature of the mixture the same accept time the mixture was heated / time exposed to ethanol	(2) A03 3a 3b

(Total for question 8 = 11 marks)

Question number	Answer	Additional guidance	Mark
8(a)	- all points plotted correctly $\pm$ one small square (1) - one curved line drawn through all the points $\pm$ two small squares (1)	ecf accept a line of best fit for their plotted points ignore any extrapolation reject points joined dot-to-dot with straight lines / multiple lines	(2) AO2 2

Question number	Answer	Mark
8(b)(i)	B amino acids The only correct answer is B <i>A is incorrect because sugars are not produced when a protein is broken down.</i> <i>C is incorrect because fatty acids are not produced when a protein is broken down.</i> <i>D is incorrect because starches are not produced when a protein is broken down.</i>	(1) AO1 1

Question number	Answer	Additional guidance	Mark
8(b)(ii)	A description including three from: • (activity) increases (1) • from pH 0.2 / to pH 2 (1) • optimum (activity) at pH 2 (1) • (pepsin activity) decreases {from pH 2 / to pH 3.5} (1)	accept best / maximum / most active / optimal / peak for optimum accept pH 3.6	(3) A03 1a

Question number	Answer	Mark
8(b)(iii)	(pH) 8 / 8.0 / eight accept phonetic spellings of eight	(1) A03 1a

Question number	Answer	Additional guidance	Mark
8(b)(v)	(use a) water bath / incubator / idea of how temperature can be set in a room	accept a description of a water bath	(1) A01 2
		ignore in the same room / use a thermometer	

Total marks for question 8 = 11 marks

Question number	Answer	Additional guidance	Mark
10(a)	Measurement 15 mm (1) Substitution $15 \div 18\,000 = 0.00083$ (1) Standard form 8.3×10^{-4}	accept correct answer for full marks with no working. accept 14 mm – 16 mm accept reading in cm accept 0.00078 / 0.00086 / 0.00089 accept 8.9×10^{-4} 8.6×10^{-4} 7.8×10^{-4}	(3)

Question number	Answer	Mark
10(b)(i)	5 / 5.0 / 5.1 / 5.2 / 5.3 / 5.4	(1)

Question number	Answer	Mark
10(b)(ii)	A description including - from pH 5 to pH 7 the growth of the bacterium increased (1) - pH 7 is optimum (1) - from pH 7 to pH 8.5 the growth of the bacteria decreased (1)	(2)

Question number	Answer	Mark
10(c)(i)	The only correct answer is D volume of the milk A is incorrect as pH is a dependent variable B is incorrect as temperature is an independent variable C is incorrect as incubation time is set by the student	(1)

Question number	Answer	Additional guidance	Mark
10(c)(ii)	An answer including: - pH decreases (1) (from 6.6) to 4.8 / by 1.8 (1)	accept becomes more acidic	(2)

Question number	Answer	Additional guidance	Mark
10(c)(iii)	Substitution Change in pH = 1.4 (1) Evaluation: answer divided by 72 0.019	award full marks for correct answer with no working accept 0.0194 / 0.02	(2)

Total for Question 10 = 11 marks

Question Number	Answer	Additional guidance	Mark
6(a)	Any two linked pairs from: - a single/thin layer (of cells) needs to be used (1) - so light passes through (the cells) (1) OR - use a stain/named stain(1) - to stain structures/see parts of the cell (1) OR - adjust focus of microscope (1) - to see cells/structures clearly (1) OR - select a higher power lens (1) - to increase magnification (1) OR - change light intensity/adjust mirror (1) - to see cells/structures clearly (1)	accept dye (1) accept to make cells/structures more visible (1) ignore zoom in/out accept clearer image/greater resolution accept increase magnification(1) accept to see cells/structures clearly (1)	(4) AO 3 3b

Question Number	Answer	Mark
6(b) (i)	C meristem 1. The only correct answer is C <i>A is not correct because a chloroplast does not have rapidly dividing cells</i> <i>B is not correct because epithelium does not have rapidly dividing cells</i> <i>D is not correct because a vacuole does not have rapidly dividing cells</i>	(1) AO 1 1

Question Number	Answer	Mark
6(b) (ii)	B metaphase 1. The only correct answer is B <i>A is not correct because the stage of mitosis shown in cell R is not prophase</i> <i>C is not correct because the stage of mitosis shown in cell R is not anaphase</i> <i>D is not correct because the stage of mitosis shown in cell R is not telophase</i>	(1) AO 3 2a

Question Number	Answer	Additional guidance	Mark
6(b) (iii)	- same genes/ DNA/ chromosomes/ alleles (1) - diploid (1)	accept they are (genetically) identical accept 2n/ same number of chromosomes	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
6(b) (iv)	Any two from: • wear goggles (1) • avoid contact with acid/wear gloves (1) • use a water bath to heat acid (1)	accept do not boil/ overheat acid (1) accept heat in fume cupboard (1)	(2) AO 3 2a

Question Number	Answer	Mark
6(c)	One advantage explained: • higher resolution (1) • so more detail seen/higher magnification can be used (1) or • higher magnification (1) • so more detail seen (1)	(2) AO 1 1

Total for Question 6 = 12 marks



Question number	Answer	Additional guidance	Mark			
7(a)(i)	The only correct answer is <table><tr><td>B</td><td>12</td><td>10</td></tr></table> A is incorrect because there has to be a difference in concentration to allow net diffusion to take place C is incorrect because this would lead to diffusion of oxygen into species A D is incorrect because there has to be a difference in concentration to allow net diffusion to take place	B	12	10		(1)
B	12	10				



Question number	Answer	Additional guidance	Mark
7(a)(ii)	Substitution $9000 \div 6000$ (1) Evaluation $= 3 : 2 / 1.5 : 1$	Award full marks for correct answer no working	(2)

Question number	Answer	Additional guidance	Mark
7(a)(iii)	An explanation linking two of the following: - cell A {has a larger surface area (to volume ratio) / has a bigger surface area (for each unit volume)} (1) - so {more oxygen will diffuse / oxygen will diffuse faster} (out of cell A) (1)		(2)

Question number	Answer	Additional guidance	Mark
7(b)	the algae will get (more) light / heat (for photosynthesis)		(1)



Question number	Indicative content	Mark
7(c)*	- leaves are arranged on the plant so they do not overlap each other (too much). - so that all / more leaves are in (direct) light / to absorb more light - as light is needed for / supplies the energy used in photosynthesis - leaves are green / have (large amounts of) chloroplasts / chlorophyll - to absorb (more) light - as light is needed for / supplies the energy used in photosynthesis - chlorophyll is mainly in the {palisade cells / upper part of leaf} - to absorb (more) light / as the sun shines on the top of leaves - as light is needed for / supplies the energy used in photosynthesis - the leaves are flat / have a large surface / have a large area - to absorb more light - as light is needed for / supplies the energy used in photosynthesis - leaves have ribs / veins - to strengthen them / to hold them up so they absorb more light / are facing the sun - as light is needed for / supplies the energy used in photosynthesis - leaves are thin - so that carbon dioxide diffuses / gets to chloroplasts / chlorophyll (quickly) - as carbon dioxide is a reactant of / needed for photosynthesis - leaves have many stomata - to absorb carbon dioxide - as carbon dioxide is a reactant of / needed for photosynthesis - leaves have / are connected to xylem (vessels) - which supply the leaves with water - as water is a reactant of / needed for photosynthesis	(6) exp



Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	- The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. - Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3-4	- The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. - Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5-6	- The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. - Lines of reasoning are supported by sustained application of relevant evidence. (AO2)



Level	Mark	Additional guidance	General additional guidance The level is driven by the adaptations. The mark within the level is determined by linkage to explanations.
	0	No rewardable material.	
Level 1	1–2	• makes a simple reference about an adaptation of leaves • the adaptation is linked to an explanation / photosynthesis	• leaves are green • leaves are green because they have chlorophyll / leaves are green to absorb light
Level 2	3–4	• adaptations are identified • an adaptation is linked to an explanation / photosynthesis	• leaves are green and flat • leaves are green and flat to absorb more light / to increase the rate of photosynthesis
Level 3	5–6	• more than two adaptations are identified • more than one adaptation is linked to an explanation with one linked to photosynthesis	• leaves have chloroplasts, are flat and have stomata • as above + chloroplasts absorb light which is needed for photosynthesis and carbon dioxide enters the leaf through the stomata

Total for question 7 = 12 marks



Question Number	Answer	Additional guidance	Mark
9(a)(i)	$(2 \times 5.0 \times 2.0) + (2 \times 5.0 \times 2.0) + (2 \times 2.0 \times 2.0)$ or $20 + 20 + 8$ (1) 48.0	Allow full marks for correct final answer accept 48	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
9(a)(ii)	- chip B has greater surface area (1) - therefore more water {absorbed / moved into the potato chip} (1)	accept chip B is bigger / has more cells	(2) AO 3 2a AO 3 2b

Question Number	Answer	Additional guidance	Mark
9(a)(iii)	An explanation that links the following: (cells) lose water / become plasmolysed (1) followed by (water moves out) by <u>osmosis</u> (1) - from a high concentration of water molecules (in the potato) to a low concentration of water molecules (in the solution) / through the partially permeable membrane (to the salt solution) (1)	accept get smaller/shrink/lose mass accept from low solute concentration to a high solute concentration accept from high to low water potential	(3) AO 1 1

Question number	Indicative content		Mark
*9(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are therefore not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. • Select variety A because it has large potatoes ; • Select variety B because is faster growing and produces many potatoes ; • Crossbreed variety A with variety B; • Transfer pollen from flower of variety A to flower of variety B / ORA; • Grow the new plants • Select the offspring with the desired characteristics • Repeat the process over many generations; • until all offspring show desired characteristics;		(6) AO 2 1
Level	Mark	Descriptor	
	0	No rewardable material.	
Level 1	1–2	• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. • Lines of reasoning are unsupported or unclear. (AO2)	
Level 2	3–4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)	
Level 3	5–6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)	

Total for Question 9 = 13 marks



Question number	Answer	Mark
9(a)(i)	6 / six	(1)

Question number	Answer	Mark
9(a)(ii)	D cell wall, chloroplast, large vacuole. The only correct answer is D cell wall, chloroplast, large vacuole A is incorrect because both the cell membrane and nucleus are also found in animal cells B is incorrect because the cell membrane and cytoplasm are also found in animal cells C is incorrect because the nucleus is also found in animal cells	(1)

Question number	Answer	Additional guidance	Mark
9(b)(i)	Substitution $(50 - 30 =) 20$ (1) $(20 \div 50 \times 100 =) -40(\%)$	Accept 40% Award full marks for answer without working	(2)



Question number	Answer	Additional guidance	Mark
9(b) (ii)	Any two from: • variety of potato (1) • mass of potato (1) • age of potato (1) • temperature (1) • storage conditions/humidity (1)	accept type / species accept weight/size accept potato cells taken from the same part of each potato	(2)

Question number	Indicative content	Additional guidance	Mark
9(b) (iii)	for energy / respiration	ignore make / produce energy accept to produce ATP	(1)

Question number	Indicative content	Mark
9(c) *	Plan for the investigation • put a light (source) at a distance away from the pondweed • measure the volume of oxygen / count the number of bubbles • in a set time • repeat with the light at different distances Variables and how to control them ambient light • use darkened room / close curtains / turn lights out • use a light meter to measure light intensity • use the same light source at each distance temperature (of water) • use a heat shield • use a thermometer and add cold water as necessary carbon dioxide concentration (in water) • add sodium hydrogen carbonate to the water bubbles contain different volumes of gas • measure volume of oxygen in the test tube • replace the test tube with a measuring cylinder acclimatisation period • wait for the rate to settle down before you count the bubbles amount of pondweed • use the same pondweed each time.	(6)



Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	- The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) - Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3-4	- The plan is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5-6	- The plan is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)



Level	Mark	Additional Guidance	General additional guidance The level is determined by the detail of the plan The mark within the level is determined by the number of variables and how to control them
	0	No rewardable material	
Level 1	1–2	- A simple answer stating at least one correct aspect of a plan - A reference to one variable that can be controlled	<u>Possible candidate responses</u> - Move the light to different distances. - You need to control the temperature of the water.
Level 2	3–4	- An answer that describes a workable plan - A detailed answer of how to control one variable OR a reference to more than one variable that need to be controlled	<u>Possible candidate responses</u> - Count the number of bubbles. Move the light further away and count again - Control the temperature of the water by using a water bath - Control the temperature of the water and close the blinds
Level 3	5-6	- A detailed workable plan - A detailed answer of how to control one variable AND at least one other reference to a different variable to be controlled	<u>Possible candidate responses</u> - Place the light at 10cm from the pondweed. Count the bubbles in one minute. Move the light to other distances and count the number of bubbles in one minute again. - Put a sheet of glass between the light and pondweed to stop it heating up. The amount of pondweed should be the same.

Total for question 9 = 13 marks



Question number	Answer	Additional guidance	Mark
9(a)	The only correct answer is D to release energy A is incorrect because nitrogen is not involved in respiration. B is incorrect because oxygen is used during respiration, not released C is incorrect because glucose is used during respiration, not produced		(1)



Question number	Answer	Additional guidance	Mark
9(b)(i)	An explanation linking two from: - to absorb more oxygen (into the blood / body) (1) - so that more respiration can occur / more energy is released (1) OR - to remove more carbon dioxide (from the blood / body) (1) - from more respiration / because carbon dioxide makes the blood more acidic (1)	accept to absorb oxygen (into the blood) more quickly accept so that respiration can occur more quickly / energy is released more quickly	(2)



Question number	Answer	Additional guidance	Mark
9(b)(ii)	An answer including two from: - aerobic respiration uses oxygen / anaerobic does not use oxygen (1) - aerobic respiration releases more energy / anaerobic releases less energy (1) - aerobic produces {carbon dioxide / water} / anaerobic respiration produces lactic acid (1)	accept ATP for energy accept lactate for lactic acid accept aerobic respiration takes place in the mitochondria / anaerobic respiration takes place in the cytoplasm (1) ignore references to types of exercise / when the types of respiration occur	(2)

Question number	Answer	Additional guidance	Mark
9(c)(i)	An explanation linking: - you breathe out (air with a high concentration of) carbon dioxide (1) - which forms a (weak) acid (when it dissolves) (1)	accept it contains carbon dioxide accept lowers the pH	(2)



Question number	Indicative content	Mark
9(c)(ii)*	Plan: Running • athletes run at different speeds • method to vary speed, e.g. distance covered in a fixed time / use of treadmill BTB • breathe (out) through green BTB (at the end of each run and note the colour / time how long BTB takes to get to a set colour) • relate the results (colour of BTB / time it takes to get to a set colour) to the pH or to how much carbon dioxide is being breathed out Controlled variables include • same age range, same sex balance, same lifestyle (of different athletes) • length of time / distance run for each 'running speed' • use of a treadmill to standardise speed • volume / concentration of green BTB • ensure colour of green BTB is the same at the start • standardised recovery times between running speeds (if the same athletes are running at each different speed) Control: • include the colour change of green BTB at rest	(6)



Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	- The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) - Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3–4	- The plan is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5–6	- The plan is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)



Level	Mark	Additional guidance	General additional guidance The level is driven by the workability of the plan. The mark within the level is determined by the control of variables.
	0	No rewardable material.	
Level 1	1–2	States a relevant part of a plan or states a variable to control	<u>Possible candidate responses</u> - Get athletes to run at different speeds - Get athletes to run the same distance at different speeds
Level 2	3–4	States parts of a plan including a reference to BTB Controls one variable or includes a control	<u>Possible candidate responses</u> - Get athletes to run at different speeds then breathe out through BTB - As above + use the same volume of BTB each time
Level 3	5–6	Produces a workable plan including the use of BTB to measure the pH or carbon dioxide concentration Controls variables or controls one variable and includes a control	<u>Possible candidate responses</u> - Get athletes to run at different speeds. The athletes then breathe into BTB and relate the colour change to pH / CO₂ concentration. - As above + the athletes need to be the same age and run the same distance

Total for question 9 = 13 marks



Question number	Answer	Additional guidance	Mark
9(a)	An explanation including three from: • (the mass) will increase (1) • because water will move into the potato cells (1) • water moves across a {partially / semi} permeable membrane (1) • by <u>osmosis</u> (1) • from a high water concentration to low water concentration (1)	accept weight for mass accept potato absorbs water accept correct references to down a water concentration gradient / water potential / low to high {solute / named solute} concentrations maximum two marks if mass change or direction of water movement incorrect	(3) A02 1

Question number	Answer	Additional guidance	Mark
9(b)(i)	$3 \times 3 \times 3 / 3^3$ (1) 27 (cm³)	award full marks for the correct answer with no working accept $54 \div 2$	(2) A02 1

Question number	Answer	Additional guidance	Mark
9(b)(ii)	An explanation linking two from: • cube A takes less time (1) • because cube A {is smaller / has a smaller volume} / surface area to volume ratio of cube A is greater (1) • as A has a shorter diffusion distance (1)	accept reverse argument for B against all three marking points ignore the surface area of cube A is smaller	(2) A03 1a1b

Question number	Indicative content	Mark
9(c)*	Plan: - any step in preparing the agar plate with a well - use two or more concentrations of kiwi fruit juice / enzyme - method of producing different concentrations of kiwi fruit juice - use a separate Petri dish for each concentration / several wells on one Petri dish - repeat each concentration - use a control / use a Petri dish with a well containing (distilled) water or boiled kiwi fruit juice Measurements: - measure the diameter of the liquid agar / calculate the area of liquid agar (using πr^2) / measure the volume of liquid agar - measure how long the set agar takes to be broken down with each different concentration Controlled variables include: - same size Petri dishes - same type / concentration of agar - same depth / volume of agar - plates left for the same length of time - plates left at same temperature / in an incubator / in the same place in a room - same volume of kiwi fruit juice - same source / age of kiwi fruit juice - same size well	(6) AO2 2 A03 3a

Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	- The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) - Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3–4	- The plan is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5–6	- The plan is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)

Level	Mark	Additional guidance	General additional guidance
	0	No rewardable material	The level is driven by the workability of the plan. The mark within the level is determined by the control of variables.
Level 1	1–2	States a relevant part of a plan or a measurement to be taken Includes a variable to control.	<u>Possible candidate responses</u> - Get more than one Petri dish (of agar) - Get more than one Petri dish with the same volume of agar in each one
Level 2	3–4	States parts of a plan including a reference to using different kiwi fruit juice concentrations. Controls more than one variable or one variable and a control.	<u>Possible candidate responses</u> - Get two different kiwi fruit juice concentrations and pour into wells in set agar plates. - Get two different kiwi fruit juice concentrations and pour into wells in set agar plates. Make the wells the same size.
Level 3	5–6	Produces a plan including using different kiwi fruit juice concentrations and measures the area / volume of liquid agar or time taken for agar to break down Controls more than one variable or one variable and a control.	<u>Possible candidate responses</u> - Get two different kiwi fruit juice concentrations and pour into wells in set agar plates. Measure the diameter of the liquid agar. - Get two different kiwi fruit juice concentrations and pour into wells in set agar plates. Measure the diameter of the liquid agar. Make the wells the same size and keep the agar plates at the same temperature

Total for question 9 = 13 marks

