STEMpathy: OCR Biology A Style Practice Paper

30/70 42% C

Assessment Content: Modules 1, 2, 3 and 4

Time allowed: 1 hour 30 minutes

INFORMATION

- Total marks: 70
- Questions assessing the quality of an extended response are indicated with an asterisk (*).

INSTRUCTIONS

- Use a black pen for writing to ensure clarity. Use an HB pencil for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space, use the lined pages at the end of this document and number the question clearly at the start of your extended response.
- Answer all questions to the best of your ability. You may leave a comment to explain why you cannot answer the question if you like.
- Show your working, so that your approach can be analysed. Marks might also be given, even if your answer is wrong.

SECTION A

You should spend a maximum of 15 minutes on this section.
Write your answer for each question in the box provided.
Answer all the questions.

Question 1

Which row correctly matches each organelle to its function?

	Rough endoplasmic reticulum	Golgi apparatus	Lysosome
A	Synthesis of proteins	Modification of proteins	Digestion of worn-out organelles
B	Synthesis of lipids	Modification of proteins	Storage of digestive enzymes
C	Synthesis of proteins	Production of ATP	Digestion of worn-out organelles
D	Synthesis of lipids	Production of ATP	Storage of digestive enzymes

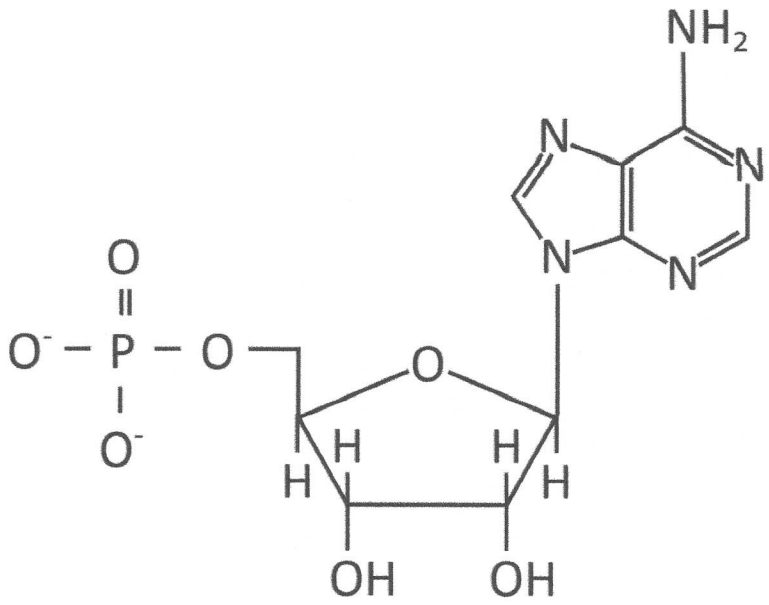
Your answer	B

X

[1]

Question 2

The diagram below shows the structure of a nucleotide.



Which statement about this nucleotide is correct?

	Statement
A	This nucleotide contains deoxyribose and could be found in DNA.
B	This nucleotide contains ribose and could be found in RNA.
C	The nucleotide has a pyrimidine base.
D	The base would form covalent bonds with a complementary base.

Your answer	A

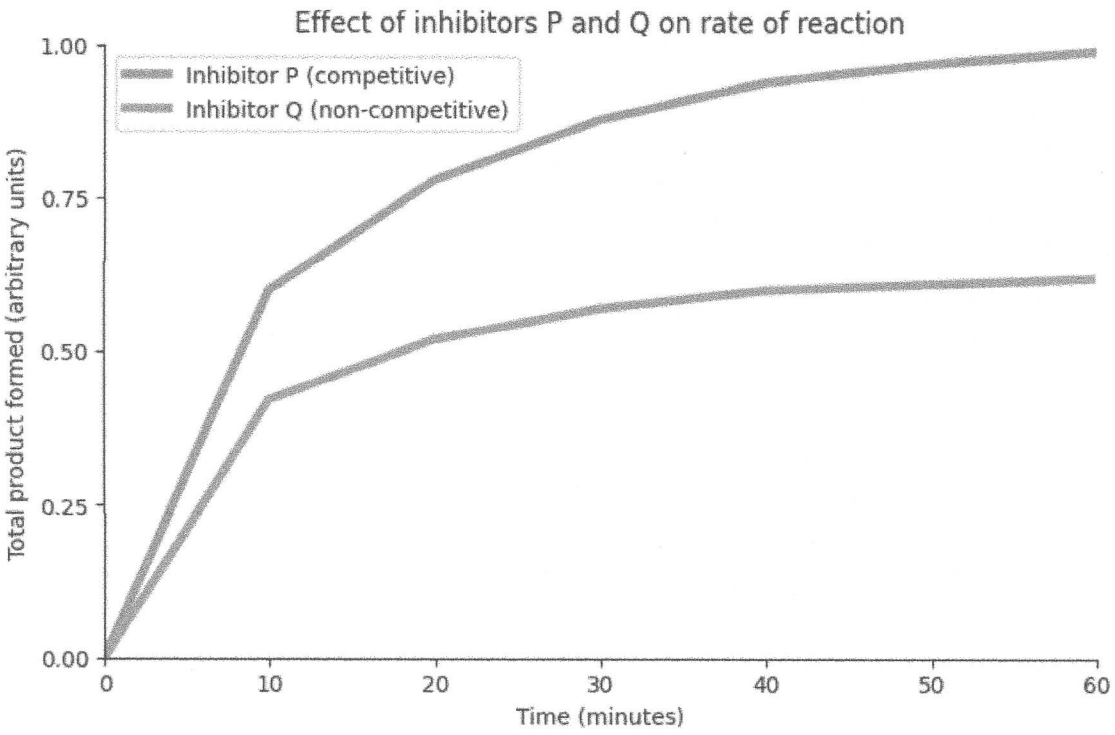
X

[1]

Question 3

A student investigated the effect of two different inhibitors on the rate of an enzyme-controlled reaction.

The below graph shows the results.



Which statement correctly describes the type of inhibition caused by inhibitor P and inhibitor Q?

	Inhibitor P	Inhibitor Q
A	Competitive inhibitor that binds to the active site	Non-competitive inhibitor that binds to an allosteric site
B	Competitive inhibitor that binds to an allosteric site	Non-competitive inhibitor that binds to the active site
C	Non-competitive inhibitor that binds to the active site	Competitive inhibitor that binds to an allosteric site
D	Non-competitive inhibitor that binds to an allosteric site	Competitive inhibitor that binds to the active site

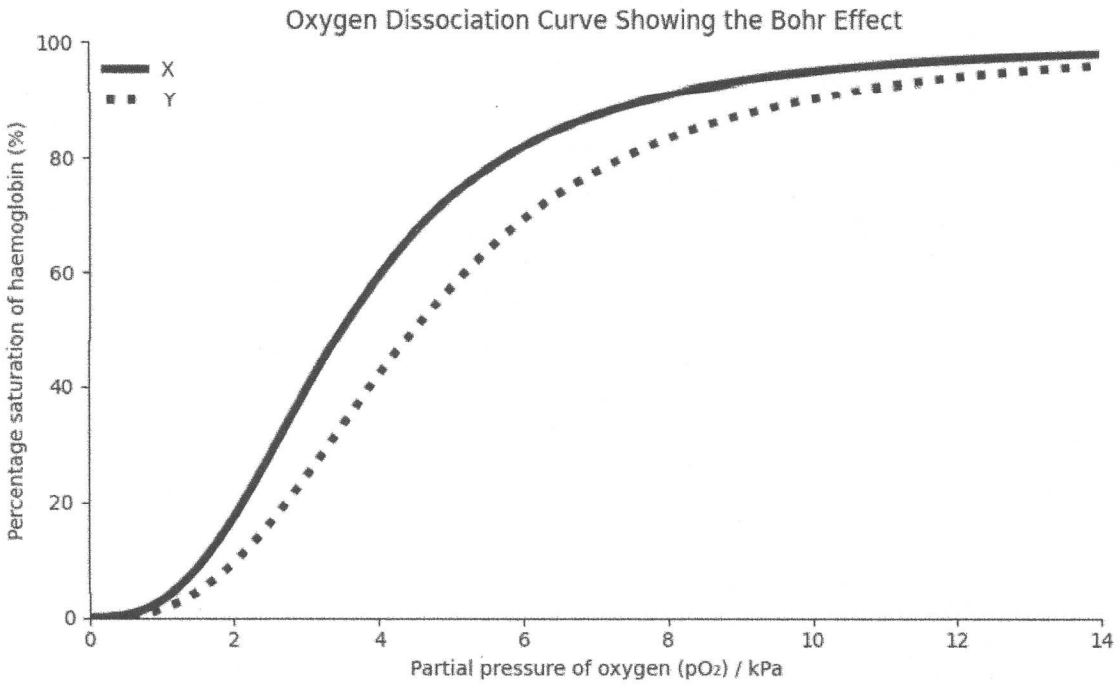
Your answer	C

X

~~[1]~~

Question 4

The graph shows oxygen dissociation curves for adult haemoglobin at two different concentrations of carbon dioxide.



Which statement correctly describes the curves in this graph?

	Statement
A	Curve Y shows that haemoglobin has a lower affinity for oxygen at low carbon dioxide concentrations.
B	At 4 kPa, haemoglobin releases more oxygen in the presence of high carbon dioxide concentrations.
C	The shift from curve X to curve Y is called the Bohr effect and occurs in the lungs.
D	Curve X shows that carbon dioxide increases the affinity of haemoglobin for oxygen.

Your answer	C

X

[1] 0

Question 5

Which row correctly matches each type of pathogen to a disease it causes?

	Bacterium	Virus	Protoctist
A	Tuberculosis	Influenza	Malaria
B	Malaria	Tuberculosis	Influenza
C	Influenza	Malaria	Tuberculosis
D	Tuberculosis	Malaria	Influenza

Your answer	A

✓

[1]

Question 6

A newborn baby receives antibodies from its mother through breast milk.

What type of immunity does this provide to the baby?

	Type of immunity
A	Artificial active immunity
B	Artificial passive immunity
C	Natural active immunity
D	Natural passive immunity

Your answer	C

X

~~[1]~~

Question 7

A student viewed a cell using a light microscope.

The image of the cell measured 30 mm in length.

The student calculated that the magnification of the microscope was ×500.

What is the actual length of the cell?

A 0.06 µm

B 0.6 µm

C 60 µm

D 600 µm

Your answer	A

X

[1]

Question 8

Which statement about biological classification is correct?

Statement

A The domain Archaea contains organisms from the kingdom Protoctista.

B The domain Eukarya contains organisms from four different kingdoms.

C The domain Bacteria contains organisms with membrane-bound organelles.

D The three domains were established based on observable physical features.

Your answer	A

X

[1]

Question 9

A student used a potometer to investigate transpiration in a leafy shoot and recorded the following measurements:

- Distance moved by air bubble in 5 minutes = 35 mm
- Diameter of capillary tube = 1 mm

What is the rate of water uptake?

Use the formula:
Volume of cylinder = $\pi r^2 l$

A 5.5 $mm^3\ min^{-1}$

B 7.0 $mm^3\ min^{-1}$

C 22.0 $mm^3\ min^{-1}$

D 27.5 $mm^3\ min^{-1}$

$\pi \times r^2 \times l$
$\pi \times 1^2 \times 35$
$= 109.9$

Your answer	?

X

[1]

Question 10

Scientists calculated Simpson's Index of Diversity (D) for two habitats.

- Habitat 1: D = 0.85
- Habitat 2: D = 0.32

Which statement correctly interprets these results?

Statement

A Habitat 1 has lower biodiversity because D is closer to 1.

B Habitat 2 has higher biodiversity because D is closer to 0.

C Habitat 1 has higher biodiversity because D is closer to 1.

D Both habitats have similar biodiversity because both values are less than 1.

Your answer	C

[1]

[TOTAL FOR SECTION A: 10 MARKS]

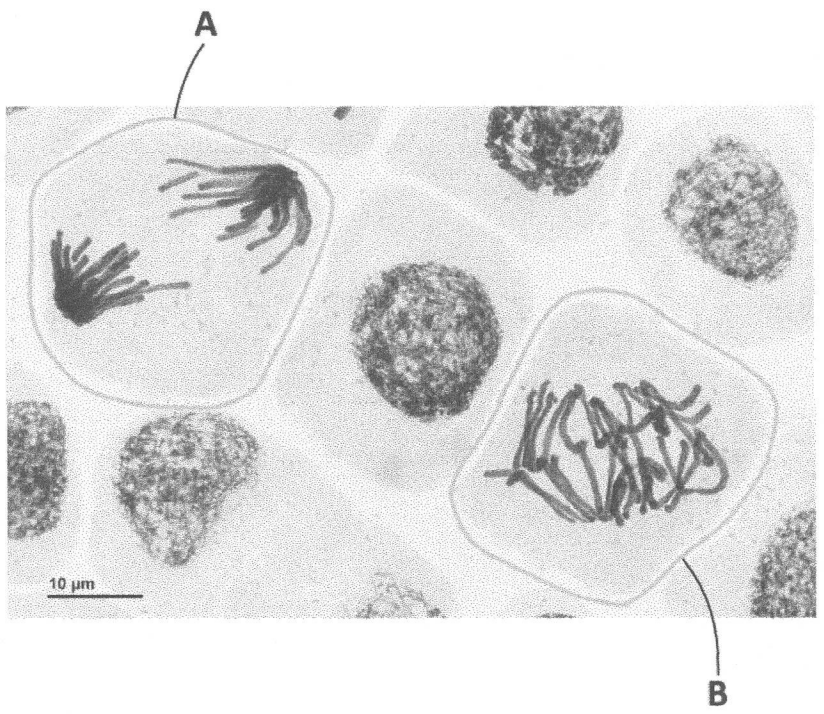
SECTION B

Answer all the questions.

If you need extra space, use the lined pages at the end of this document and number the question clearly at the start of your extended response.

Question 11

Fig. 11.1 is a photomicrograph showing animal cells in various stages of the cell cycle.



10.8

Figure 11.1

(a) (i) Calculate the magnification of Fig. 11.1.

Show your working.

10800 ÷ 10µm =

Magnification = 1080µm [2]

STEMpathy: - Scale bar measures approx. 12 mm.
- Image / actual = mag.
- 12000 um / 10 um = x12000

(a) (ii) Compared to using a transmission electron microscope to view these cells, the useful level of maximum magnification is limited.

State one other advantage of using a transmission electron microscope, rather than a light microscope, to produce this image.

It has a higher resolution ✓ so you can see the organelles in more detail. ✓✓

[1]

(b) For a cell to complete the cell cycle, it must begin the process with sufficient numbers of mitochondria.

Outline the importance of the mitochondria.

The mitochondria do aerobic respiration ✓✓ which makes ATP ✓✓ for cell activities.

[2]

(c) (i) Cell A in Fig. 11.1 is undergoing mitosis.

Describe what is happening to the chromosomes at the stage of mitosis shown in cell A in Fig. 11.1.

The chromosomes are on opposite sides of the cell, so are in telophase. X

[2]

STEMpathy: - Chromosomes are being pulled to opposite poles of the cell
- The centromere has been split
(The cell is in anaphase)

(c) (ii) State one reason why mitosis is important for this organism.

So it can repair it's damaged cells.

[1]

STEMpathy: - Growth
- REPAIR of damaged TISSUE
- REPLACEMENT of damaged CELLS

[Total for question 11: 8 Marks]

Question 12

Potatoes are storage organs that contain starch and other biological molecules.

A student investigated the biological molecules present in potato tissue.

(a) Fig. 12.1 shows two α-glucose molecules.

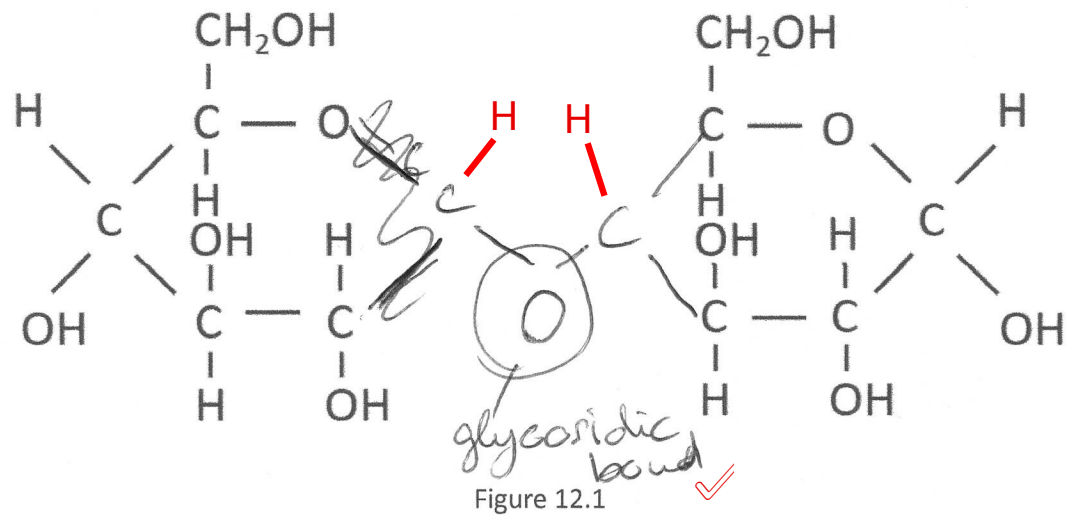


Figure 12.1

Complete Fig. 12.1 to show the disaccharide formed from these two α-glucose molecules, and label the bond that is formed between them.

[2] ①

(b) The student carried out biochemical tests on an extract from the potato tissue.

(b) (i) Name the reagent used to test for the presence of starch.

Benedicts regent

[1]

STEMpathy: - Iodine

(b) (ii) Describe how you would test for the presence of reducing sugars in the potato extract.

Include the expected result if reducing sugars are present.

Heat the mixture in a water bath and if it changes colour to brick red then it means that it contains reducing sugars.

[2]

STEMpathy: - Add Benedict's reagent AND heat to 80 degrees.
- Colour changes from blue to brick red (if positive).

(c) The student also separated amino acids from the potato tissue using thin-layer chromatography.

The results are shown in Fig. 12.2.

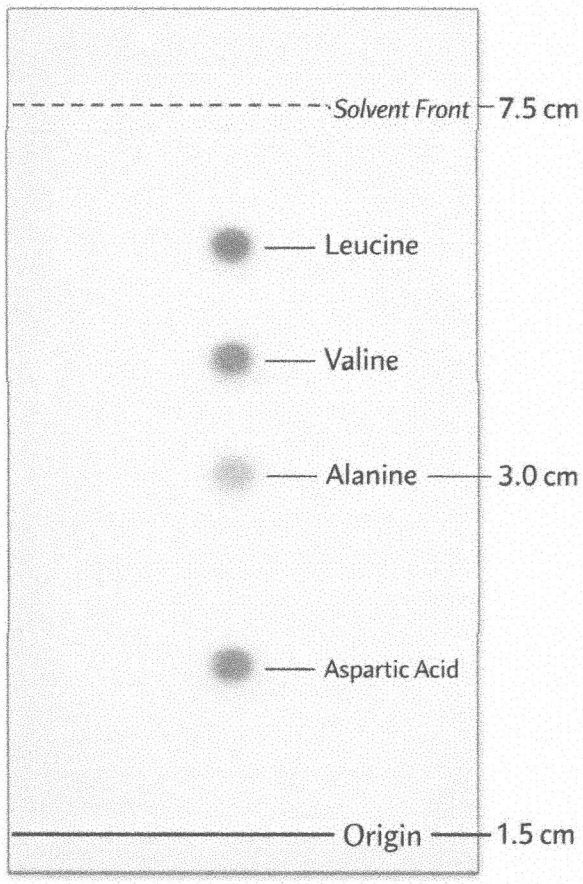


Figure 12.2

Calculate the Rf value of alanine.

Show your working.

1.5 ÷ 6.0 = 0.25

Rf = 0.25 [2]

(d) Explain why starch is a suitable molecule for energy storage in plants.

Plants can store lots of glucose inside starch for use later in aerobic respiration. [1]

STEMpathy: - Insoluble, so it does not affect cytoplasmic water potential.
- Compact, so a large amount of glucose can be stored in a small space.

[Total for question 12: 8 Marks]

Question 13

Cystic fibrosis is a genetic condition caused by a mutation in the gene that codes for a protein called CFTR. The CFTR protein is a channel protein found in cell surface membranes.

(a) Fig. 13.1 shows part of a DNA molecule.

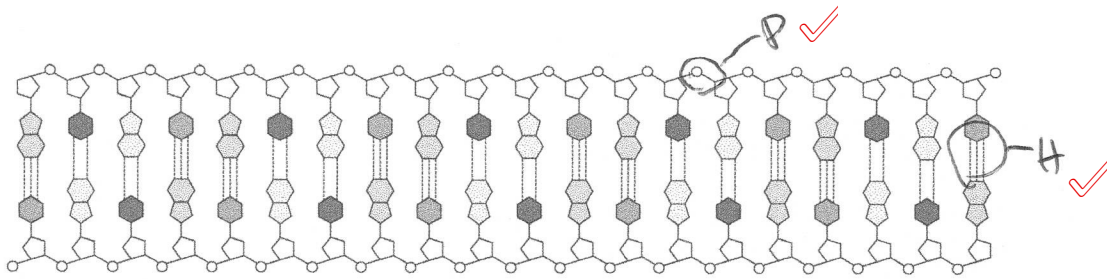


Figure 13.1

On Fig. 13.1:

- Label and circle one phosphodiester bond with the letter P
- Label and circle one hydrogen bond with the letter H

[2]

(b) Before a cell divides, the DNA must be replicated.

Describe and explain the role of DNA helicase and DNA polymerase in semi-conservative replication.

DNA helicase unwinds the DNA double helix and DNA polymerase makes a copy of the DNA template strands. Each new DNA molecule has 1 original strand and 1 new one.

[2]

STEMpathy: - DNA helicase unwinds the DNA molecule BY breaking the hydrogen bonds between bases.
- DNA polymerase joins nucleotides together SO that a complementary strand is built.

(c) (i) The genetic code is described as 'degenerate'.

State what is meant by the term 'degenerate' when describing the genetic code.

It can mutate.

[1]

STEMpathy: - More than one codon can code for the same amino acid.

(c) (ii) The CFTR protein is synthesised at ribosomes in the cytoplasm.

Outline how the information encoded by the gene for CFTR is transmitted to the ribosome.

the gene is transcribed in the nucleus which makes a copy of mRNA that can then travel out of the nucleus to go to the ribosome in the cytoplasm which binds to it and uses it to join amino acids in the right order with peptide bonds in protein synthesis. This is translation.

[3]

[Total for question 13: 8 Marks]

Question 14

The efficiency of gas exchange in organisms depends on several factors, such as the surface area to volume ratio.

(a) A student modelled a small organism as a cube with sides of 2 mm.

(a) (i) Calculate the surface area to volume ratio of this cube.

Show your working.

SA: $6 \times 2^2 = 24$

V: $2^3 = 8$

$24 \div 8 = 3$

3:1

Surface area to volume ratio = 3:1 [2]

(a) (ii) Explain why large, active organisms require specialised gas exchange surfaces.

They have a small surface to volume ratio, so not enough substances that the organism needs for its reaction to occur, like oxygen and glucose, can get to the cells.

~~[2]~~ 1

STEMpathy: - Diffusion is too slow to provide all of the oxygen / glucose / substances needed for a high metabolic rate / aerobic respiration

(b) Fish have evolved specialised structures for gas exchange called gills.

Fig. 14.1 shows the structure of a fish gill.

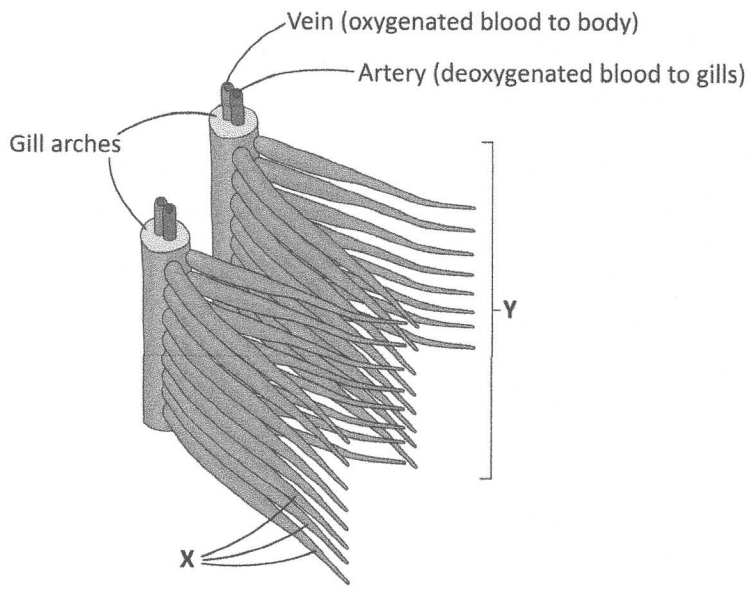


Figure 14.1

Name the structures labelled X and Y in Fig. 14.1.

X: ~~lamella~~ lamellae

Y: gills

[1]

STEMpathy: Gill filament

STEMpathy: Gill lamella

(c) Describe how counter-current flow increases the efficiency of gas exchange in fish gills.

The blood and the water flow in opposite directions which allows more oxygen to be absorbed. This is because of a concentration gradient between the blood and the water

[2]

STEMpathy: - (because) the concentration gradient is MAINTAINED along the length of the lamella.

(d) In mammals, blood transports oxygen from the lungs to respiring tissues. Tissue fluid is formed as blood passes through capillary beds in the tissues.

Explain how tissue fluid is formed at the arterial end of a capillary bed.

The water, glucose, and amino acids are pushed out of the capillary and into the tissue space. And the large proteins and red ~~blood~~ blood cells are too large so they are left behind inside the capillary.

[3] 1

[Total for question 14: 10 Marks]

STEMpathy: - High hydrostatic pressure at the arteriole end forces plasma fluid
- Containing DISSOLVED substances out of the capillary
- Through gaps in the endothelial cells
- Because hydrostatic pressure is greater than oncotic pressure

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Question 15

A group of students investigated the effect of light intensity on the rate of transpiration using a potometer.

(a) (i) State the cause of transpiration in plants.

Sunlight and heat causes water to evaporate from the surface of the leaf out from the stomata. [1]

(a) (ii) The students' results are shown in Table 15.1.

Table 15.1

Light intensity (a.u)	Trial 1	Trial 2	Trial 3	Mean distance (mm)	Rate of water uptake (mm min^{-1})
0	3	4	2	3.0	0.6
100	12	14	13	13.0	2.6
200	24	22	26	24.0	4.8
300	35	38	32	35.0	7.0
400	41	43	40	41.3	8.3
500	44	45	43	44.0	8.8
600	45	44	46	45.0	9.0

Describe the pattern shown in the results in Table 15.1.

As light intensity increases so does the rate of water uptake in transpiration. This is because greater light intensity means that more water is evaporating from the stomata of the leaf or being used in photosynthesis.

[2] ①

STEMpathy: - Rate increases by 8.4 mm min^-1 from 0 - 600 a.u
- Rate begins to level off above 400 a.u

(b) Suggest two improvements the students could make to their investigation to increase the repeatability of their results.

Improvement 1: Control the temperature

Improvement 2: Repeat at smaller light intervals

[2]

STEMpathy: - Use the same plant species
- Allow the plant to acclimatise to each light intensity
- Measure over a longer period

(c) Explain how water moves up the stem of a plant.

Water moves up the xylem by transpiration pulling it up. This is helped by adhesion between the water molecules and the xylem's lignin wall, and cohesion between the water molecules. The transpiration stream is formed from the hydrogen bonds of the water molecules forming a continuous chain from the root to the leaf where they evaporate.

[3]

[Total for question 15: 8 Marks]

Question 16

(a) Plant pathogens are microorganisms that cause disease in plants.
Complete the table below to give an example of a plant disease caused by each type of microorganism, with an appropriately matched method of transmission.

Microorganism	Transmission	Disease
Bacteria	Soil	Ring rot
Virus	Insect vectors	TMV
Protoctist	Wind	Potato late blight
Fungus	Spores	?

[2]

STEMpathy: Bacteria: Contaminated tools
Virus: TMC (Correct)
Protoctist: Water
Fungus: Black sigatoka

(b) White blood cells play an important role in protecting the body from pathogens.

(i) Describe the process of phagocytosis.

the white blood cell engulfs a bacteria which fuses with a phagosome containing lysozymes. these lysozymes digest the bacteria and breaks them down.

[2] ①

STEMpathy: - Bacteria is engulfed and trapped inside a phagosome.
- Lysosome fuses with phagosome and releases lysozymes.

(ii) Explain the role of T helper cells in the specific immune response.

T helper cells are activated by macrophages. T helper cells then go on to divide and differentiates to produce memory cells and allow B cells to make antibodies.

[2]

STEMpathy: - T helper cells release cytokines that:
- Stimulate B cells to divide (clonal expansion) and differentiate into plasma cells.
- Stimulate T killer cells to divide (clonal expansion).
- Stimulate phagocytosis.
- Only T and B cells with complementary antigen-receptors are activated (clonal selection).

(c) Fig. 16.1 shows data on the effectiveness of a vaccination programme for a disease between 2000 and 2020.

Fig. 16.1 Changes in Disease Cases and Vaccination Rate (2000–2020)

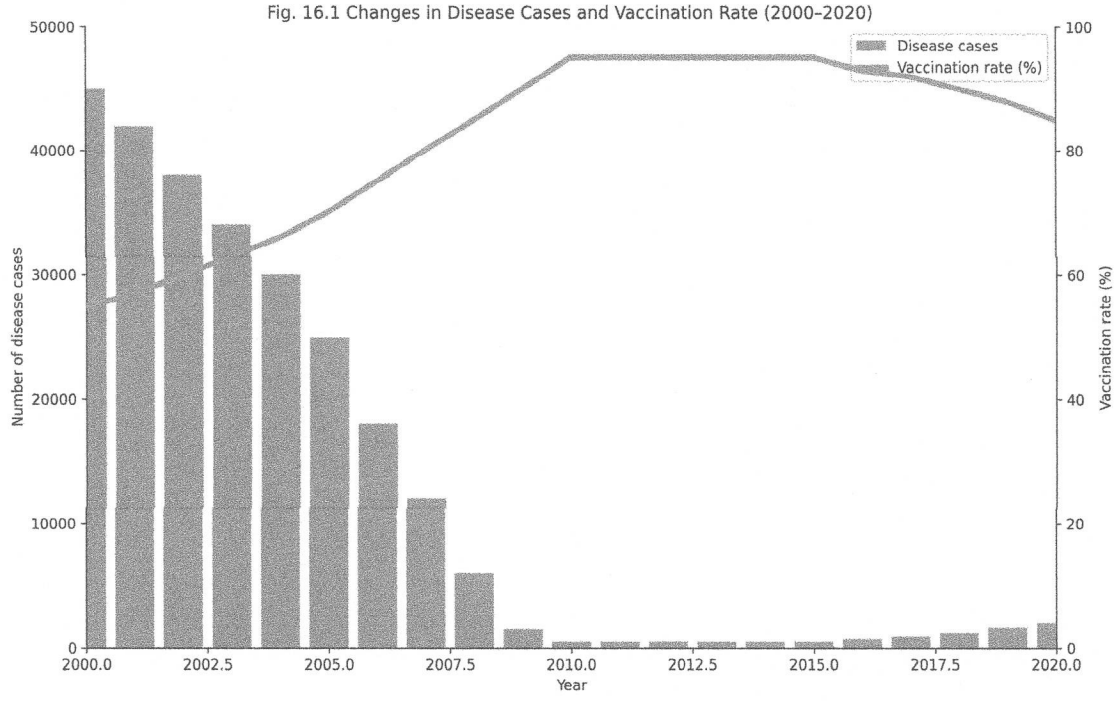

Figure 16.1

Explain what the data can tell us about the effectiveness of the vaccination programme.

The data in the graph shows us that as more people are vaccinated, the number of disease cases also decreases, showing us a correlation between the two factors. This means that the vaccination program is effective in preventing the spread of disease.

[3] 1

STEMpathy: - Cases fell from 45,000 to 500 as vaccination rose from 55% to 95%.
- Herd immunity occurs at higher rates of vaccination (95%).
- Cases increase when vaccination rate drops below 95%.
- Correlation does not mean causation.

(d) The treatment for bacterial infections is to give antibiotics. Some bacterial populations have become resistant to specific antibiotics.

Explain the implications of increasing antibiotic resistance.

It is harder to treat infections because the bacteria are resistant to the antibiotics that are being used to treat diseases.

[3] 1

STEMpathy: - Deaths will be more likely from bacterial infections.
- Need to develop new antibiotics.
- Routine surgery becomes more risky.
- Increased spread of resistant infections.

[Total for question 16: 12 Marks]

Question 17*

Scientists investigated a population of ground beetles living in an area that has experienced climate change over the past 50 years. The area has become significantly drier, with reduced rainfall and higher temperatures.

Field observations showed that modern beetles in this area have thicker cuticles (outer protective layer) compared to beetles collected from the same area 50 years ago. A thicker cuticle helps to reduce water loss in dry conditions.

Describe how the scientists could reliably estimate the beetle population in this area.

-Use a random number generator to place quadrats randomly across the area and count how many beetles are located within the area in the quadrat
- Repeat this many times (5) and calculate a mean for the area ✓
- the beetles should be marked and released so that the scientists know which ones they have already counted so that they do not overestimate how many beetles there are in the area ✓
-they should make sure that the area is dry, hot and not raining

[Total for question 17: 6 Marks] 3

STEMpathy: - Use a random number generator with a map of coordinates to place the quadrat randomly.
- Place pitfall traps at these random points.
- Leave the pitfall traps for 24 hours (to capture the beetles).

Feedback & Recommendations

- Responses are concise and direct, with little 'extra' detail. Many marks have been lost either through an omission of detail or a content gap/lack of knowledge that gives the wrong answer. Further practice questions to use their mark schemes to learn the detail needed by the examboard will help improve this.

- The STEMpathy textbook is aligned to the details required by the OCR A specification, and will support in filling content gaps, and clarifying important definitions and processes; our Revision Notes will also help.

- Multiple-choice questions were often reduced to the two most likely choices, with a knowledge gap or lack of attention to distractors as the final tripping point. Help break down the answer options by ticking off correct details in multiple-choice questions and crossing out incorrect ones to narrow down the correct answer.

- Related to the above, 'correct-sounding' options were often chosen instead of the more technically or oddly phrased correct answers. Do not rush to the correct answer, and make sure you take your time to read through each one and consider it individually.

- Categorising 'types' of phenomena with multiple components (e.g., enzyme inhibitors, types of immunity) was a weak point. Review and learn the meaning of the terms used within each.

- Check that questions providing values with units are calculated in the same unit - convert first.

- 'Explain why' questions are a prompt for you to link a described feature to the question's focus (e.g. effective energy storage, the need for exchange systems in large organisms). The 'why' should focus you on relevant mechanisms or processes that make that link.

- Recognising/naming structures in images is a weaker area. Review the specification and revise the points calling for identification and labelling.

- 'Explain how' questions can often be memorised, as they are asking for a description of a mechanism (that you have learnt about) that can be given in steps. You just have to ensure that you focus on the relevant parts of the mechanism to the question's context.

- Questions which award marks for 'quoting' data, or processed data, do not always give the prompt 'use'. It is helpful to use data ranges, and the change to support your answers and increase the likelihood of scoring marks.

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