

Sparx Science

A Level Transition Booklet



Biology

This booklet contains questions from key topics that you will have seen in GCSE and that contain the key knowledge and skills for you to be successful in your AS Level and A-Levels.

If you have access to Sparx Science, you can also use the topic codes (the codes starting with a Z or and R) to access even more questions which come with targeted support. Simply search the topic codes on your Independent Learning page.

Below is a summary of the topics included in this booklet for you to keep track of your learning.

	Topic	Introduction	Pages	Complete?
1	Cells	Cells are the basic building blocks of all living organisms. In this section, we reinforce your knowledge of sub-cellular structures and how different types of cells are adapted for their functions.	3 - 15	
2	Transport processes	Substances are constantly moving in and out of cells. In this section, we recap the principles of diffusion, osmosis and active transport, and how these processes are used by living organisms.	16 - 25	
3	Transport and exchange systems	Large organisms need specialised exchange and transport systems. This topic revisits exchange surfaces and transport systems in mammals and plants.	26 - 36	
4	Enzymes and digestion	Enzymes are proteins that control many important reactions in living organisms. Here, we recap the fundamentals of enzymes and the role they play in digestion.	37 - 44	
5	Genetics and inheritance	DNA carries the genetic information that influences our characteristics. In this topic, we reinforce key ideas in genetics, including inheritance, variation, stem cells and genetic diagrams.	45 - 63	
6	Energy transfers between organisms	Photosynthesis and respiration are essential processes that transfer energy in living organisms. In this section, we recap the core ideas behind both processes before you explore them in more depth at A Level.	64 - 70	
7	Homeostasis and control	Homeostasis keeps the internal conditions of the body stable. Here, we revisit control mechanisms, including blood glucose regulation and body temperature control. We also recap how the nervous system works to respond to stimuli.	71 - 80	
8	Ecology and evolution	Biologists study how organisms interact with each other and with their environment. In this section, we recap evolution, ecosystems and the key terms and concepts used in ecology.	81 - 89	

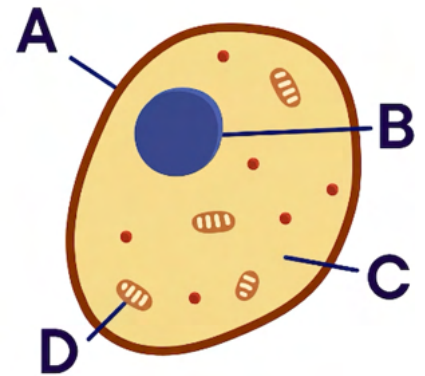
- 1.1** The diagram represents an animal cell.
Name each labelled part of the cell.

A:

B:

C:

D:



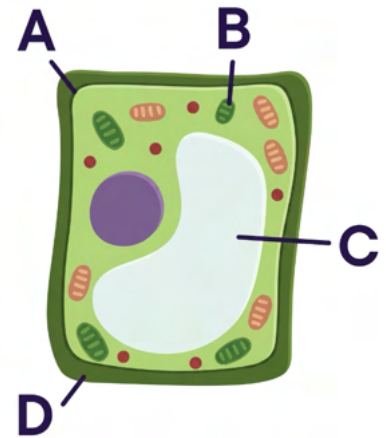
- 1.2** The diagram represents a plant cell.
Name each labelled part of the cell.

A:

B:

C:

D:



- 1.3** Different parts of an animal cell have particular functions.
Name the part of the cell that has each of these functions.
- a) It releases energy from respiration.

.....

- b) It controls what enters and leaves the cell.

.....

- c) It carries out protein synthesis.

.....

- d) It is where chemical reactions occur.

.....

1.4

Different parts of a plant cell have particular functions.
Name the part of the cell that has each of these functions.

a) It contains sap to keep the cell rigid.

.....

b) It is made of cellulose, so it can support and protect the cell.

.....

c) It contains chlorophyll to carry out photosynthesis.

.....

1.5

Plant cells contain both a cell wall and a cell membrane.

Tick one box in each row of the table to show if the statement describes the cell wall or cell membrane.

	Cell wall	Cell membrane
Controls what enters and leaves the cell		
Is made of cellulose		
Is always found on the outside layer		
Supports and protects the cell		

1.6

a) In which type of cell would you expect to find chloroplasts?

In animal
cells only ☐

In plant
cells only ☐

In animal and
plant cells only ☐

b) Describe the function of the chloroplasts.

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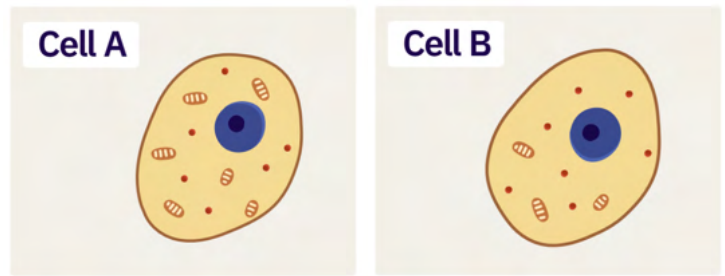
1.7

This diagram compares two cells.

a) Which cell is more likely to carry out processes requiring lots of energy?

Cell A ☐

Cell B ☐



b) Explain your answer.

.....

.....

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1.8

White blood cells produce a large number of antibodies, which are made of proteins.

Explain which cell part you would expect to find lots of in white blood cells.

Use the information in the question to help you.

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Prokaryotic and eukaryotic cells

R489

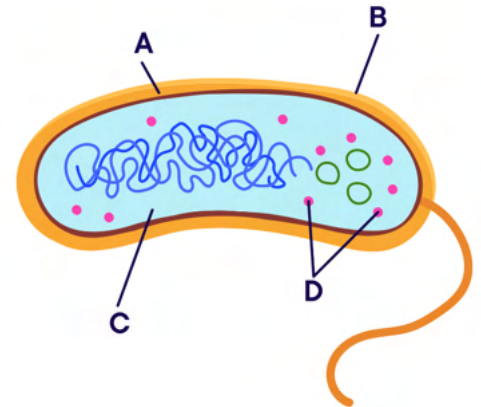
2.1

Tick one box in each row of the table to show whether each of these types of cell is eukaryotic or prokaryotic.

	Eukaryotic cell	Prokaryotic cell
Animal cell		
Plant cell		
Bacterial cell		

2.2

This diagram represents a bacterium.
Name each labelled part of the cell.



A:

B:

C:

D:

2.3

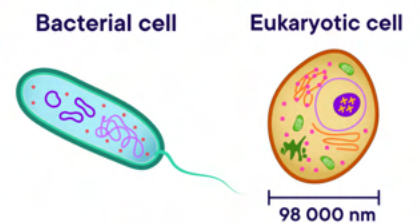
This image shows two different cells.
The images are not to scale.

a) Which type of cells are smaller in real life?

Bacterial cell

☐

Eukaryotic cell

☐


b) The length of the eukaryotic cell can be written in standard form as:

$$9.8 \times 10^x \text{ nm}$$

What is the value of x ?

$x =$

2.4

These diagrams represent different cells.

a) Which cell is a prokaryotic cell?

Cell A

☐

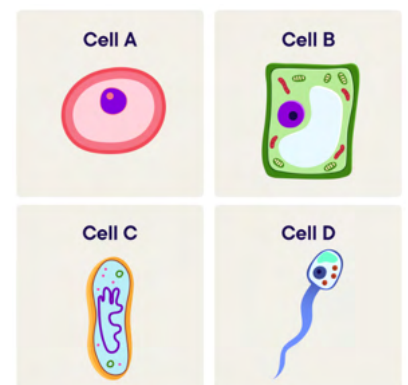
Cell B

☐

Cell C

☐

Cell D

☐


b) Give a reason how you know.

.....

.....

2.5

The table contains some examples of different cells.

Tick one box in each row to show whether each cell is eukaryotic or prokaryotic.

Example	Type of cell	
	Prokaryotic cell	Eukaryotic cell
Ciliated cell lining the trachea		
Clostridium tetani (bacteria that cause tetanus)		
Photosynthetic plant cell		

2.6

The genetic material is arranged differently in the cells of bacteria compared with animal cells. Describe how the genetic material is arranged in each type of cell.

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2.7

The diagram shows a unicellular organism known as an euglenid.

a) What type of cell is an euglenid cell?

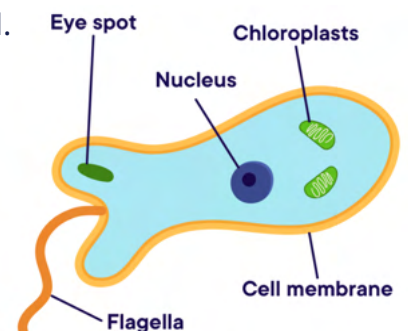
Eukaryotic cell

☐

Prokaryotic cell

☐

b) Give **two** features of the cell that support your answer.



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3.1

When using microscopes, the terms magnification and resolution are often used.
Match each term to its correct definition.

Term**Definition**

Resolution

Magnification

The brightness of the image seen through
the microscope

The ability to distinguish two points that are
close together as separate

How many times larger the image is compared
with the real object

The amount of light passing through the specimen

3.2

Part of a method to prepare onion cells for viewing under a microscope is shown below.
Complete the method by filling in the gaps.

Choose from the words:

cover slip, ethanol, glass rod, petri dish, slide, stain

Step 1. Carefully cut a section of onion tissue and peel off a thin layer.

Step 2. Place the layer of onion on a microscope

Step 3. Add a few drops of to the sample.

Step 4. Cover the sample with a

3.3

A scientist wants to use a microscope to view the mitochondria and ribosomes in a cell.

a) Name the type of microscope that they should use.

.....

b) What are the advantages of using this type of microscope?

tick **all** that apply.

They have a
higher resolution. ☐

They allow living cells to
be viewed in real time. ☐

They are cheap
and portable. ☐

They produce highly
detailed images. ☐

They produce coloured images
without the need for staining. ☐

3.4 A scientist views human cheek cells under a light microscope and an electron microscope, using the same magnification.

Give **two** ways in which the cells would look different under the electron microscope.

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3.5 The image shows *E.coli* bacteria underneath a microscope.

a) What type of microscope was used to take this image?

.....



b) Give a reason for your answer.

.....

.....

Calculating magnification

R585, Z414

4.1 A white blood cell has a diameter of $15\text{ }\mu\text{m}$.
When viewed under a microscope, it has a diameter of $6000\text{ }\mu\text{m}$.
Calculate the magnification of the microscope.

×

4.2

A frog has a red blood cell with an actual length of $21.4\text{ }\mu\text{m}$.
A scientist views the blood cell under a microscope with a magnification of $\times 400$.
Calculate the length of the red blood cell in the image.

..... μm

4.3

A student looks at a cat's skin cell under a microscope.

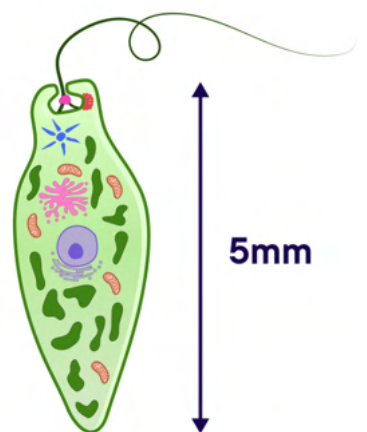
- It appears $8750\text{ }\mu\text{m}$ long.
- They used a microscope with a magnification of $\times 250$.

Calculate the actual length of the cat's skin cell.

..... μm

4.4

A student viewed a single-celled organism using a light microscope.
A sketch of the image formed is shown.
The actual size of the single-celled organism is $250\text{ }\mu\text{m}$.
Calculate the magnification used.



$\times$

4.5

The width of a cell is $36\text{ }\mu\text{m}$.

Calculate the width of the image of the cell when viewed with a magnification of $\times 1200$.

Give your answer in millimetres.

.....mm

4.6

A palisade cell is viewed using a magnification of $\times 1750$.

The width of the image formed is 35 mm .

Calculate the actual width of the plant cell.

Give your answer in micrometres.

..... μm

4.7

A scientist viewed a ribosome using an electron microscope.

The image formed is 2 mm in length.

The actual length of the ribosome was 20 nm .

a) Calculate the magnification used.

$\times$

b) What can you say about the magnification of an electron microscope, compared to a light microscope?

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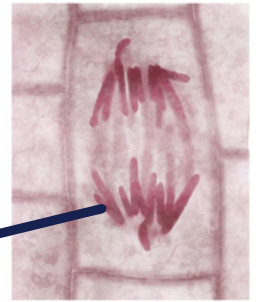
.....

5.1

This diagram shows a cell under a microscope.
The cell is undergoing mitosis.
Name the structure labelled Z.

.....

Z



5.2

The body makes new cells by mitosis.
Give **one** reason why a person needs to make new body cells.

.....

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5.3

During mitosis, a cell divides to produce two new cells.
Describe how cells produced by mitosis compare to each other.

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5.4

Cells divide by a process called mitosis.
Describe the process of mitosis and the formation of new cells.

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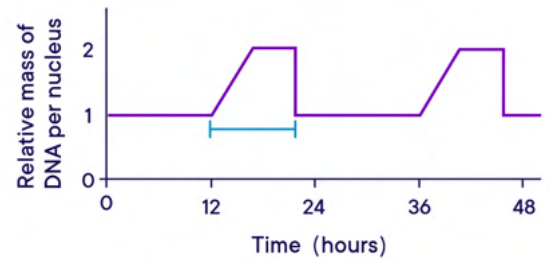
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5.5

The graph shows the mass of DNA per nucleus during two full cell cycles.

Explain the change in the mass of DNA per nucleus between 12 and 20 hours.



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The immune system

Z912

6.1

Name the type of blood cell that responds when a pathogen enters the body.

.....

6.2

Some bacteria enter the body.

They cause symptoms of disease by producing poisons.

Give the name of the substance released by blood cells to counteract these poisons.

.....

6.3

Fungi and bacteria are microbes that can cause disease.

Name **two** other types of microbes which cause disease in humans.

..... and

6.4

White blood cells defend against disease by releasing antitoxins.
Give **two** other ways that white blood cells defend against disease.

.....

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Vaccination

Z664

7.1

A person is vaccinated against a virus.
Complete the sentences to describe how this helps protect them from the virus.
Choose from the words:

active, antibodies, clone, destroy, inactive, platelets, quickly, slowly

The body is injected with an form of the pathogen.

White blood cells produce to the virus.

These the virus.

If the person is reinfected, the white blood cells respond

7.2

The table shows information about the severity of a COVID infection in vaccinated and unvaccinated people.

During a COVID outbreak, it was recommended that people be vaccinated.

Explain how the data in the table supports this recommendation.

	Mild cases (%)	Severe cases (%)
Vaccinated	45	12
Unvaccinated	55	23

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7.3

A child is given a vaccination against measles.

Write the steps A-E in order to show how this prevents future infection.

- A.** White blood cells produce antibodies to the inactive virus.
- B.** An inactive form of the measles virus is injected into the body.
- C.** If the active virus enters the body, antibodies are produced quickly.
- D.** Antibodies attach to the inactive virus.
- E.** Antibodies destroy the inactive virus.

First step _____ Last step

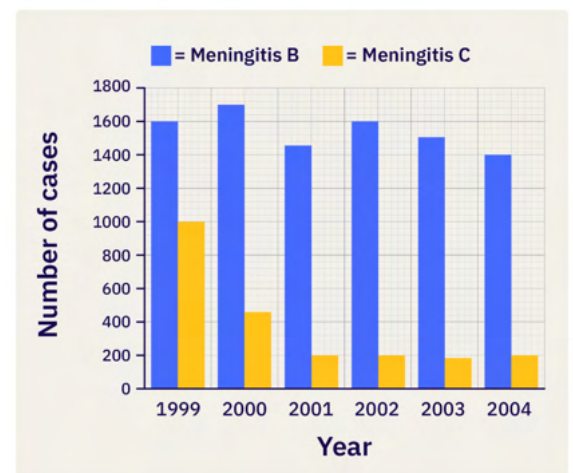
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7.4

The graph shows the number of cases of two types of meningitis (B and C) in the UK.

A vaccination for meningitis C was introduced in 1999.

Calculate the percentage decrease in the number of cases of meningitis C from 1999 to 2004.



.....%

7.5

During the COVID pandemic, many people were vaccinated against COVID.

People were given two vaccinations.

Which graph shows the concentration of COVID antibodies in a person's blood after each vaccination?

A



B



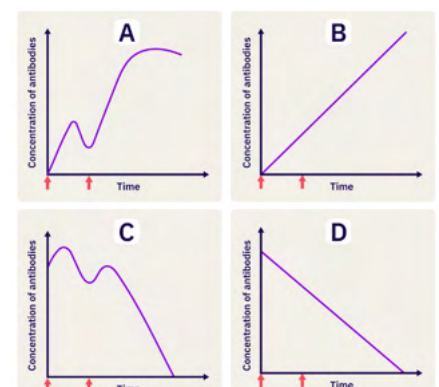
C



D



Key ↑ = Vaccination given



1.1 Describe what is meant by the term "diffusion".

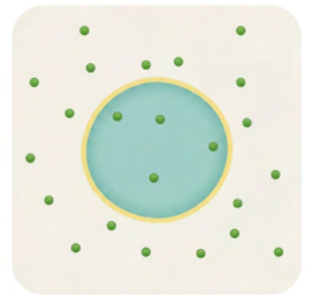
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1.2 The diagram shows a cell surrounded by oxygen molecules. Oxygen molecules move into the cell from the surroundings.
a) Name the process by which the oxygen molecules move into the cell.



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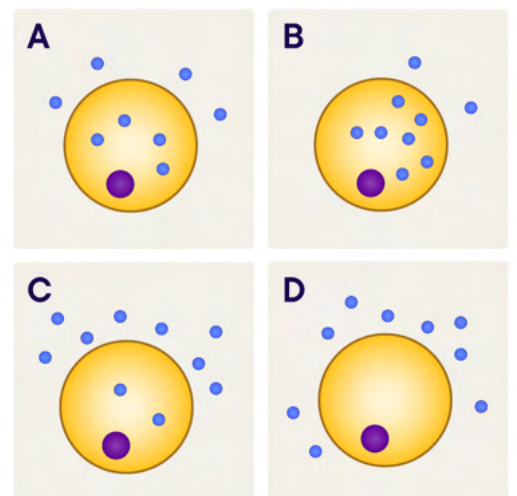
b) Suggest why the oxygen molecules move by this process.

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1.3 Urea is transported out of cells into the blood plasma by diffusion.
It is then transported to the kidneys to be excreted.
Which diagram represents the concentration of urea inside and outside a cell before diffusion?

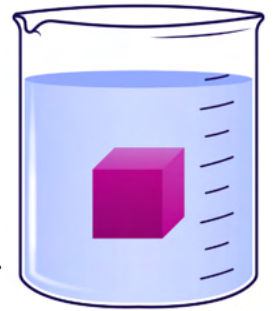
A	☐	B	☐
C	☐	D	☐



2. Transport processes

1.4

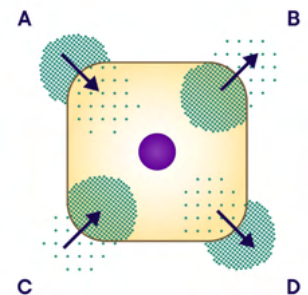
A student investigated diffusion in organisms. They used gel cubes to model small organisms. The cubes change colour as acid diffuses into them. Give a limitation of using cubes to model small organisms.



1.5

This diagram represents a cell.

- The arrows show four ways in which substances can move in and out of the cell.
- The dots represent the relative concentration of the substance. Imagine the cell is respiring aerobically.



Carbon dioxide and oxygen will move between the cell and the blood.

a) Complete the table to show which arrow represents the movement of each gas.

Gas	Arrow			
	A	B	C	D
Carbon dioxide				
Oxygen				

b) Name the process by which these gases move in and out of the cell.

1.6

The table shows information about four cells of a frog.

a) Which cell has the largest difference in percentage of oxygen between the outside and the inside of the cell?

A ☐ B ☐ C ☐ D ☐

Cell	% of oxygen outside cell	% of oxygen inside cell
A	9	8
B	12	8
C	12	10
D	9	12

b) Therefore, into which cell will oxygen diffuse fastest?

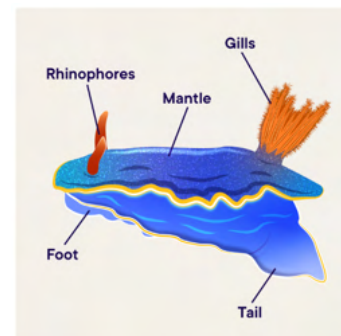
A ☐ B ☐ C ☐ D ☐

2. Transport processes

1.7

This image shows a type of sea slug that lives in water. Oxygen enters the sea slug's bloodstream through the gills by diffusion.

Explain **one** way that the sea slug's gills are adapted to increase the rate of diffusion of oxygen. Use information from the image.



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1.8

A student investigated the effect of surface area on diffusion.

- They placed agar cubes of different sizes stained with indicator into boiling tubes containing acid.
- The indicator turns colourless as the acidic solution diffuses through it.

The table shows their results.

Side length of cube (cm)	Time for cube to go colourless (s)
1	5
2	15
3	30
4	90

a) Describe the effect of the side length of the cube on the time it takes for the cube to go colourless.

.....

.....

b) Which of the following would reduce the effect of random errors in the results?

Repeat the method three times and calculate a mean for each size cube.

☐

Repeat the method with five cubes all of the same size.

☐

Repeat the method with a different size beaker for each size cube.

☐

2. Transport processes

1.9

The image shows a single-celled organism called an amoeba.

a) Which is the best description of the surface area to volume (SA:V) ratio of the amoeba?

The amoeba has a large SA:V ratio

☐

The amoeba has a small SA:V ratio

☐

The amoeba has equal surface area and volume

☐

b) Describe the effect of this surface area to volume ratio on the rate of diffusion.

.....

.....

1.10

Complete the sentences to describe how exchange surfaces are adapted to maximise efficiency.

Choose from the words:

blood, enzymes, nucleus, surface area, thick, thin, volume

Exchange surfaces have a large

To minimise the diffusion distance, they also have a surface.

To maintain a steep concentration gradient,

they have a good supply of

1.11 Information about some cubes is shown in the table.

Cube	Length of sides (cm)	Surface area (cm ²)	Volume (cm ³)	surface area: volume ratio
W	0.5	1.5	0.125	12:1
X	1	6	1	
Y	2	24	8	
Z	4	96	64	1.5:1

- a) Calculate the surface area to volume ratio for cube X and cube Y.
Give your answers in the form n:1.

surface area:volume ratio X:

surface area:volume ratio Y:

- b) Use your answers and the table to complete this sentence.

As the side length increases, the surface area to volume ratio

decreases.
increases.
stays constant.

Osmosis

R949, R110

2.1 Describe the process of osmosis.

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2. Transport processes

2.2

The diagram shows two solutions separated by a membrane.

a) In which direction will the net movement of water occur?

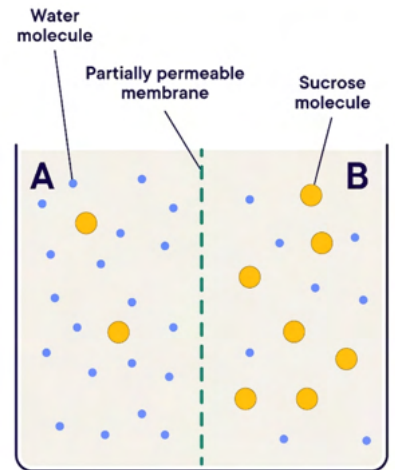
From A to B

☐

From B to A

☐

There is no net movement

☐

b) Explain your answer.

.....

.....

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2.3

A plant cell and an animal cell are both placed in pure water.

- The animal cell swells and bursts.
- The plant cell swells and does not burst.

Name the cell part that prevents the plant cell from bursting.

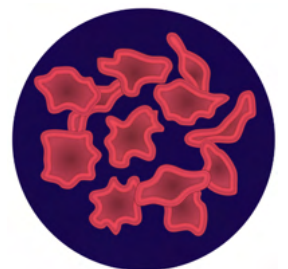
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2.4

A scientist investigated the effect of different concentrations of sugar solution on red blood cells.

The image shows the effect of placing the cells into a sugar solution.

Suggest what the image tells you about the concentration of sugar inside and outside of the cell.



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2. Transport processes

2.5

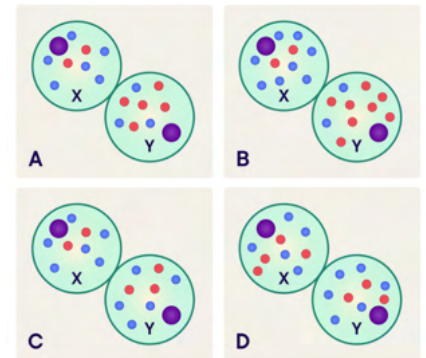
These diagrams represent cells containing glucose solutions. In each case, water can move between the two cells.

a) Tick one box in each row of the table to show the direction in which there will be a net movement of water by osmosis.

Cells	From X to Y	From Y to X
A		
B		
C		
D		

Key

● = Water molecule ● = Glucose molecule



b) In which diagram will osmosis occur at the fastest rate?

A ☐ B ☐ C ☐ D ☐

Active transport

R786

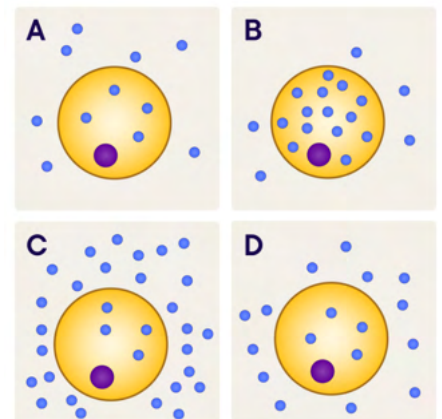
3.1

The image shows four cells.

Molecules are moving into each cell.

Into which cell are the molecules being transported by active transport?

A ☐ B ☐
C ☐ D ☐



3.2

One transport process is active transport.

What does the term active mean in this context?

.....

.....

2. Transport processes

3.3

Plants must use active transport to move some substances from the soil into root hair cells. Active transport requires energy.

a) Name the part of the cell that releases most of this energy.

.....

b) Name the cellular process that is carried out to provide this energy.

.....

3.4

The table shows information about the potassium ion concentration in two places.

Location	Concentration (mmol/dm ³)
In cell cytoplasm	150
In blood plasma	4

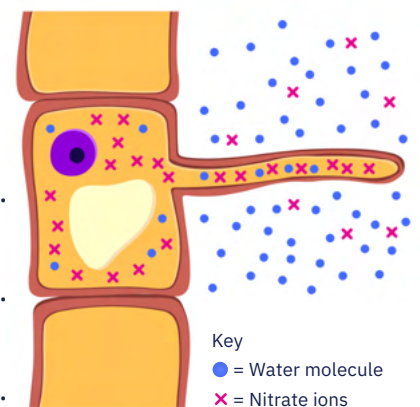
Explain how potassium ions are moved from the blood plasma into the cell cytoplasm.

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3.5

This diagram shows a root hair cell. Explain how the nitrate ions are transported into the root hair cell.

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2. Transport processes

3.6

Glucose and oxygen are required by all cells for aerobic respiration.

- a) Glucose can move across the cell membrane into the cell using a process that requires energy.

Give the name of this process.

.....

- b) Oxygen enters the cells by a different process.

Give the name of this process.

.....

3.7

Cells, tissues and organs are adapted to take in different substances and get rid of different substances.

The table shows the concentration of four ions outside cells and inside cells.

Ion	Concentration outside cells (mmol/dm ³)	Concentration inside cells (mmol/dm ³)
Calcium	0.001	28
Chloride	120	4
Potassium	8	142
Sodium	130	10

Complete the sentences by naming the correct transport process.

Chloride and sodium ions will move into cells by

Calcium and potassium ions will move into cells by

2. Transport processes

3.8

This image shows the concentration of different molecules inside and outside of a root hair cell.

- a) Name the transport process by which water and potassium move into the root cell.

Water moves into the cell by

Potassium ions move into the cell by

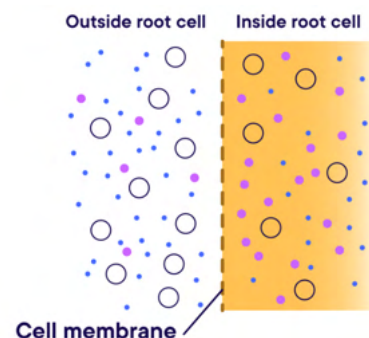
- b) Suggest why substance C does **not** move into the root cell.

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Key

● = Water ● = Potassium ion ○ = Substance C



3. Transport and exchange systems

The blood

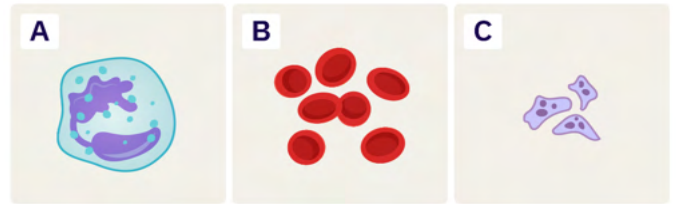
Z104

1.1

These images show components of the blood.

a) Which image shows a red blood cell?

A ☐ B ☐ C ☐



b) What is the main function of a red blood cell?

To engulf and digest pathogens

☐

To transport hormones around the body

☐

To transport oxygen around the body

☐

To produce substances that clot the blood

☐

1.2

Explain how these adaptations help the red blood cell to carry out its function.

a) Has biconcave shape (pushed in on both sides).

.....

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.....

b) Does not contain a nucleus.

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3. Transport and exchange systems

The structure of blood vessels

R350

2.1

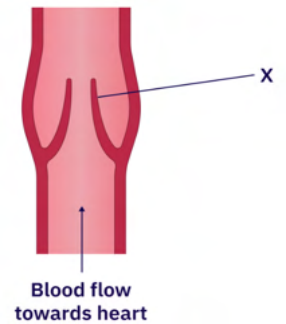
The diagram represents a vein in the human body.

a) What is the name of structure X?

.....

b) Describe the role of structure X in the vein.

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.....
.....



2.2

Match each adaptation to the way it helps a capillary carry out its role.

Adaptation

Walls that are one cell thick

Extremely narrow lumen

How it helps it carry out its role

Slows the flow of blood to allow the exchange of substances

Creates a short distance for substances to diffuse in and out of the blood

Helps to maintain blood pressure

3. Transport and exchange systems

2.3

The microscope image shows two blood vessels.
Tick one box in each row of the table to show if the statement describes blood vessel X or blood vessel Y.

Blood vessel X



Blood vessel Y

	Blood vessel X	Blood vessel Y
Carries blood away from the heart		
Carries blood at high pressure		
Contains deoxygenated blood		
Is a vein		
Is an artery		

2.4

The table shows some information about different blood vessels in the human body.

	Vessel A	Vessel B	Vessel C
Walls	One cell thick	Thin	Thick
Lumen	Very narrow	Wide	Narrow

Name blood vessels A, B and C.

A:

B:

C:

3. Transport and exchange systems

2.5

Arteries and veins are major blood vessels that carry blood around the body.
Describe **two** ways the structure of an artery is different from the structure of a vein.

.....

.....

.....

.....

2.6

The thickness of an artery wall is 0.75 mm.
In the same tissue, a vein wall is 0.25 mm thick.
Calculate the ratio of the artery wall thickness to the vein wall thickness.
Give your ratio in its simplest integer form

.....

The heart

R806

3.1

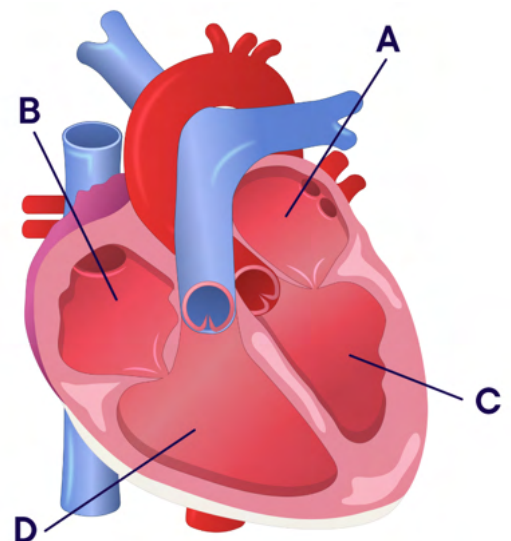
Here is a diagram of a heart.
Name each labelled part.

A:

B:

C:

D:



3. Transport and exchange systems

3.2

As the heart beats, the atria relax and contract.

a) What happens when the atria in the heart relax?

Blood is forced into
the ventricles ☐

The blood fills with
oxygen ☐

The atria fill with blood ☐

Carbon dioxide is
transported to the lungs ☐

b) What happens when the atria in the heart contract?

Blood is forced into
the ventricles ☐

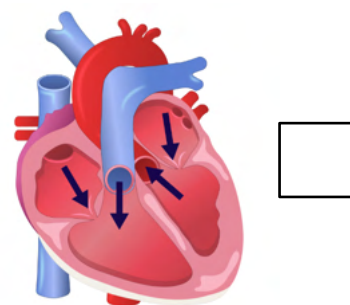
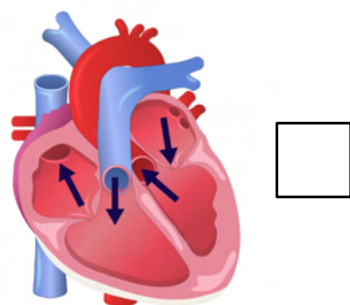
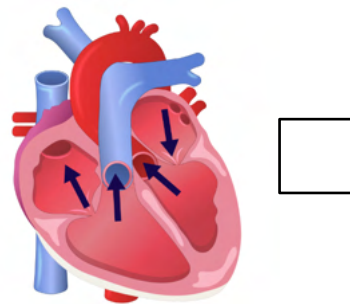
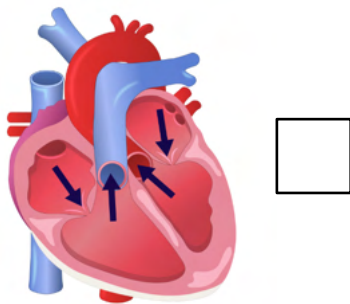
The blood fills with
oxygen ☐

The atria fill with blood ☐

Carbon dioxide is
transported to the lungs ☐

3.3

Which diagram shows the correct direction of blood flow through the heart?



3.4

There is a valve between the atrium and ventricle on each side of the heart.
Describe the role of the valves in the heart.

.....

.....

3. Transport and exchange systems

- 3.5** Tick one box in each row of the table to show whether each blood vessel carries deoxygenated or oxygenated blood.

Blood vessel	Type of blood carried	
	Deoxygenated blood	Oxygenated blood
Aorta		
Pulmonary artery		
Pulmonary vein		
Vena cava		

- 3.6** The heart is an organ that pumps blood around the body in a double circulatory system. Describe what is meant by a 'double circulatory system'.

.....

.....

.....

.....

- 3.7** The table shows some information about the blood in the vessels connected to the heart.

Option	Pressure	Oxygen content
A	High	Low
B	Low	Low
C	Low	High
D	High	High

Which row of the table shows the blood in the...

a) ...aorta?

A ☐ B ☐ C ☐ D ☐

b) ...vena cava?

A ☐ B ☐ C ☐ D ☐

4.1 Tick one box in each row of the table to categorise these methods of treating heart disease.

Treatment	Life-long medication	Surgical procedure	Lifestyle change
Increasing exercise			
Taking statins			
Having a stent installed			
Giving up smoking			

4.2 Coronary heart disease is a non-communicable disease.
Explain what a **non-communicable** disease is.

.....

.....

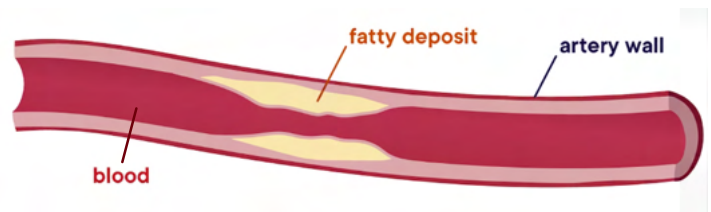
.....

4.3 A person has a healthy BMI and eats a balanced diet.
Suggest **one** reason why this person may still have a high risk of developing coronary heart disease.

.....

.....

4.4 The image shows a fatty deposit lining the walls of a coronary artery.
Explain how a fatty deposit such as this affects the oxygen supply to the heart.



.....

.....

.....

.....

3. Transport and exchange systems

The lungs

R652, Z944

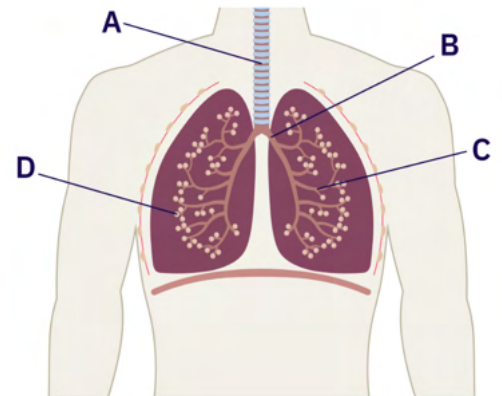
- 5.1** The diagram shows the human respiratory system.
Name each labelled part.

A:

B:

C:

D:



- 5.2** Match each adaptation of the alveoli to how it supports efficient gas exchange.

Adaptation

Moist surfaces

Large surface area to
volume ratio

Walls that are one
cell thick

Surrounded by
capillaries

How it increases the rate of diffusion

Gases dissolve in water and diffuse faster

Greater surface over which diffusion can occur

Releases oxygen easily in the muscles

Maintains a steep concentration gradient

Creates a short distance for diffusion

- 5.3** Complete the sentences to describe the lungs and respiratory system.

Choose from these words:

alveoli, capillaries, diffusion, oesophagus, osmosis, trachea, veins

Air enters the body through the, which carries air to the lungs.

The lungs contain millions of tiny air sacs called Gases move

from a high to low concentration by The concentration gradient

is maintained as the air sacs are surrounded by many

3. Transport and exchange systems

5.4 Explain why a steep concentration gradient between the alveoli and the blood is important for cells to function normally.

.....

.....

.....

.....

5.5 During gas exchange in the lungs, oxygen moves from the alveoli to the blood. Describe how oxygen moves from the alveoli into the blood.

.....

.....

.....

.....

Plant organs and tissues

R451, R318, R419

6.1 The diagram shows the cross-section of a leaf. Match each label to the name of the correct layer or structure.

Label

A

B

C

D

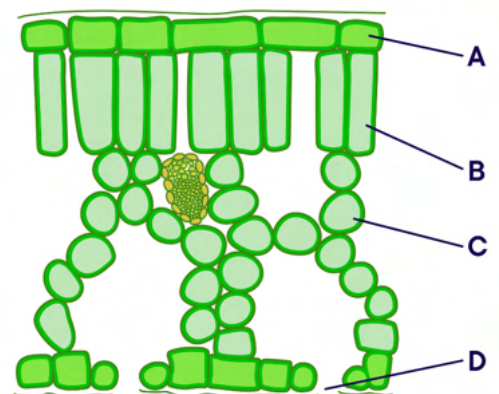
Name

Palisade mesophyll

Spongy mesophyll

Epidermis

Stoma



3. Transport and exchange systems

6.2

This image shows part of a leaf under a microscope.

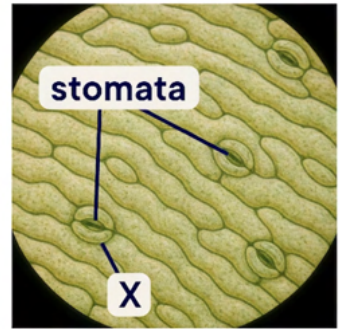
a) What is the name of the cells labelled X?

.....

b) Describe the role of these cells.

.....

.....



6.3

This table shows some substances and transport methods.

Which row correctly describes the substance and how it is transported in the

a) xylem?

	Substance	Transport method
A	Dissolved sugars	Transpiration
B	Dissolved sugars	Translocation
C	Starch	Transpiration
D	Starch	Translocation
E	Water	Transpiration
F	Water	Translocation

A ☐ B ☐ C ☐ D ☐ E ☐ F ☐

b) phloem?

A ☐ B ☐ C ☐ D ☐ E ☐ F ☐

6.4

Complete the table to show whether each statement describes the xylem or phloem vessels.

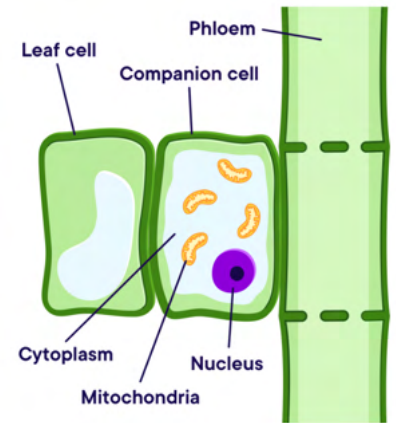
Feature	Phloem	Xylem
End walls contain pores		
Is hollow		
Made from dead cells		
Strengthened by lignin		

3. Transport and exchange systems

6.5

Phloem tissue is made of elongated cells and companion cells.

Match each feature of phloem tissue to the correct explanation of how it helps transport dissolved sugars.



Adaptation

No nucleus

Have pores in the end walls

Comes with companion cells

Thick cell wall

Reason

To maximise space for the movement of dissolved sugars

To allow dissolved sugars to move from cell to cell

To withstand the pressure inside the cell

Cells contain many mitochondria to provide energy for transport

6.6

Describe the structure of xylem tissue.

.....

.....

.....

.....

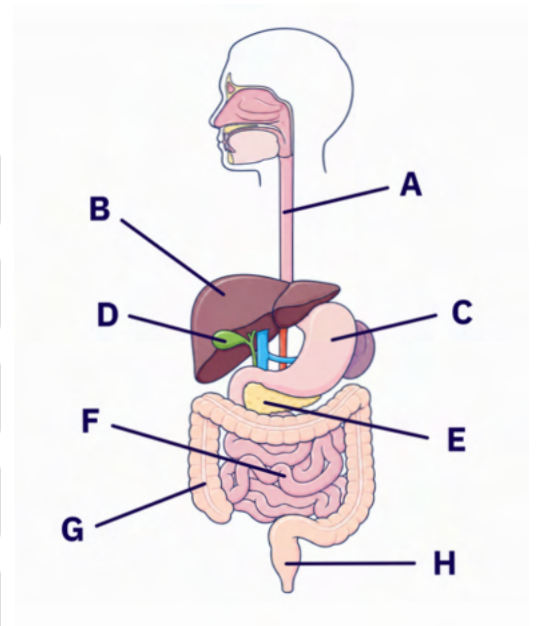
4. Enzymes and digestion

The human digestive system

R154

- 1.1** The image shows the human digestive system.
Match each organ to the correct label.

Organ	Label
Liver	A
Small intestine	B
Stomach	C
Oesophagus	D
Large intestine	E
Gallbladder	F
Pancreas	G
	H



- 1.2** a) Which organ produces bile?

.....

- b) Which statement describes the role of bile in digestion?

It helps to break down lipids. ☐

It helps to break down carbohydrates. ☐

It absorbs small, soluble nutrients into the bloodstream. ☐

It kills harmful microorganisms using acid. ☐

4. Enzymes and digestion

1.3

Match each adaptation of the small intestine to how it improves the absorption of nutrients.

Adaptation

Surrounded by capillaries

Thin walls

Villi

How it improves absorption of nutrients

Short diffusion distance

Maintains a steep concentration gradient

Increases surface area

Moves food along by peristalsis

Produces digestive enzymes

1.4

The small intestine is lined with small projections called villi.

Each villus has even smaller projections called microvilli.

This increases the surface area for maximum absorption of nutrients.

Explain **two** other ways that the villi are adapted for efficient absorption of nutrients.

.....

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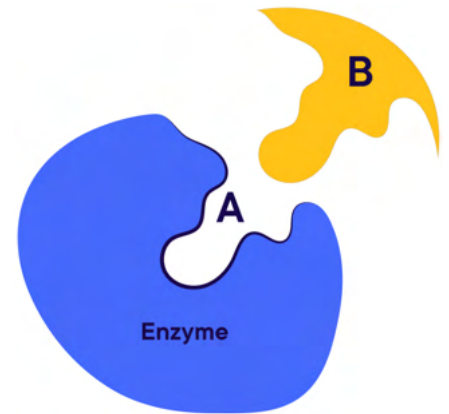
4. Enzymes and digestion

Enzymes

R667, R800, R244

- 2.1** The diagram represents the 'lock and key' model of an enzyme.
Match region A and B to the correct name.

Region	Name
	Substrate
	Tissue
A	Catalyst
	Activation energy
B	Active site



- 2.2** Describe the role of enzymes in digestion.

.....

.....

.....

.....

- 2.3** Some sentence starters are listed below.
Match each one to the correct ending.

Starter	Ending
	fatty acids and glycerol.
Protease breaks down protein into...	simple sugars.
Lipase breaks down fat (lipids) into...	carbon dioxide and water.
Amylase breaks down starch into...	amino acids.
	lactic acid.

4. Enzymes and digestion

2.4

The activity of a digestive enzyme is summarised in the equation below.



a) Give the name of enzyme X.

.....

b) Which of the following words best describes the role of an enzyme?

Catalyst

☐

Product

☐

Electrolyte

☐

Reactant

☐

2.5

a) Which statement correctly describes the relationship between monomers and polymers?

A monomer is a long chain made up of repeating units called polymers

☐

A monomer is another word for a polymer

☐

A polymer is a long chain made up of repeating units called monomers

☐

A monomer is an atom in a larger compound called a polymer

☐

b) The table contains some substances involved in digestion.

Tick one box in each row to show whether each substance is a monomer or a polymer.

Substance	Monomer	Polymer
Glucose		
Amino acid		
Protein		
Starch		

2.6

Describe what is meant by the term 'enzyme specificity'.

.....

.....

.....

.....

4. Enzymes and digestion

2.7 Describe what happens to enzymes at temperatures above the optimum temperature.

.....

.....

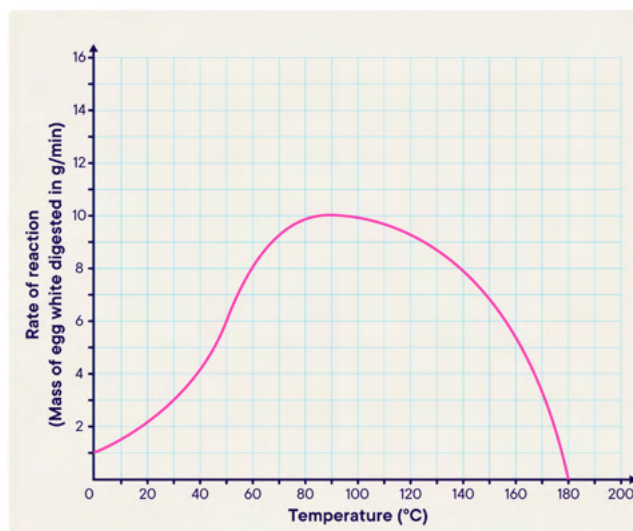
2.8 This graph shows a typical enzyme-controlled reaction.

a) What is the optimum temperature for the enzyme in this reaction?

.....°C

b) What is the rate of reaction at 50°C?

.....g/min



2.9 Explain why the rate of reaction decreases when the pH is higher or lower than the optimum.

.....

.....

.....

.....

2.10

A student investigated how pH affects the activity of amylase.

They recorded how long amylase took to break down starch at different pH levels.

Use the results to describe how the activity of amylase changes with pH.

pH	Time taken (s)
4	390
5	250
6	130
7	80
8	140

.....

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.....

2.11

A group of students investigated how long lipase takes to break down lipids in milk at different temperatures.

Student A

Test Number	Time taken (s)
1	90
2	95
3	120
4	85

Student B

Test Number	Time taken (s)
1	85
2	89
3	78
4	88

Student C

Test Number	Time taken (s)
1	91
2	92
3	88
4	87

Each student repeated the experiment four times.

Their results at 30°C are shown in the tables.

a) The students identified one anomalous result in their data.

Which student and test gave an anomalous result?

.....

b) Calculate the mean time taken for lipase to break down lipids at 30°C.

You should use the results from all students, but ignore the anomalous result.

.....S

- 2.12** A student carried out an experiment to find the optimum pH of an enzyme. The results are shown in the table.

pH	Time taken (mins)
2	15
3	12
4	8
5	10
6	13

- a) Suggest the optimum pH.

.....

- b) Explain why the enzyme activity decreases on either side of the optimum pH.

.....

.....

.....

.....

2.13

A group of students were investigating the effect of temperature on the enzyme amylase. They combined amylase and starch in five different test tubes. They then placed each test tube in a water bath at a different temperature for eight minutes. The table shows their results.

Temperature (°C)	Colour of iodine after 8 mins
5	Blue-black
15	Blue-black
35	Yellow-brown
50	Blue-black
75	Blue-black

The students concluded that the optimum temperature of amylase is 35°C.

a) Explain the result at 5°C.

.....

.....

.....

.....

b) Explain the result at 75°C.

.....

.....

.....

.....

- 1.1** A DNA molecule is made from two strands twisted around each other.
What scientific term describes the structure of DNA?

.....

- 1.2** Complete the sentence to describe how DNA controls the structure of a protein.
Choose from the words:
amino acids, cellulose, DNA, nucleus, ribosome

A gene is a small section of on a chromosome.

It codes for a particular sequence of to make a specific protein.

- 1.3** What is meant by the term genome?

.....

.....

- 1.4** DNA is the genetic material of human cells.
Describe where DNA is found in a human cell.

.....

.....

.....

.....

2.1 Describe what is meant by genetic engineering.

.....

.....

.....

.....

2.2 These are steps involved in genetically engineering an organism.
Write steps A to D in the correct order to show how genetic engineering is carried out.

- A.** An enzyme is used to cut out the desired gene from a chromosome.
- B.** The vector is used to insert the gene into the target cell.
- C.** The gene is inserted into a vector.
- D.** The gene is introduced at an early stage of development.

First step —————> Last step

.....,,,

2.3 A painkiller can be extracted from poppies.
A scientist genetically engineered yeast cells to produce the painkiller.
Give **one** possible benefit and **one** possible risk of using the genetically engineered yeast cells, rather than poppies, to produce the painkiller.

.....

.....

.....

.....

2.4 Which of these are used as vectors during genetic engineering?
Tick **all** that apply.

Mosquitoes

☐

Viruses

☐

Chromosomes

☐

Plasmids

☐

Enzymes

☐

2.5

Cows have been genetically engineered to produce a human protein called antithrombin. This can be used in medicine as a blood thinner.

a) What could be used to cut out the antithrombin gene from DNA?

.....

b) What is the gene inserted into?

.....

2.6

Scientists have genetically engineered bacteria to produce human insulin.

After the human insulin gene is inserted into the bacteria, what step must be taken to produce large amounts of insulin?

.....

.....

2.7

Human growth hormone can be used as a medical treatment.

Before 1980, it was extracted from humans after they had died.

Now, it is produced by bacteria that have been genetically engineered.

Describe the advantages of producing human growth hormone using genetic engineering.

.....

.....

.....

.....

5. Genetics and inheritance

2.8

Tomato plants can be genetically engineered to produce an antifreeze protein.

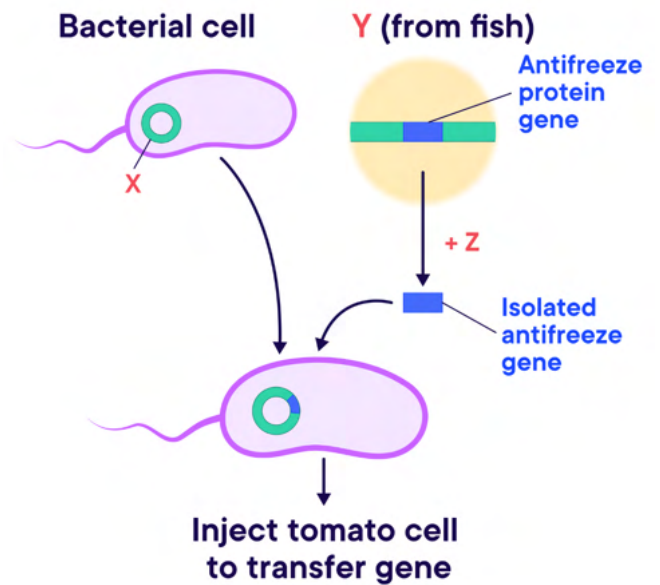
This helps the tomato plants to survive in cold conditions.

This antifreeze gene was originally found in a type of fish that lives in the Arctic Ocean.

It is transferred into the tomato plant through genetic engineering.

The image illustrates this process.

Complete the diagram by matching each missing label with the correct term.



Label

X

Y

Z

Term

Bacteria

Plasmid

Enzyme

DNA

Loop

Stem cells

R478

3.1

Name **one** tissue in plants where stem cells are found.

.....

5. Genetics and inheritance

3.2

Tick one box in each row of the table to show whether each statement refers to embryonic or adult stem cells.

	Embryonic stem cells	Adult stem cells
Found in some tissues of fully developed animals		
Found in bone marrow		
Can produce any type of specialised cell		
Can only produce specialised cells of their surrounding tissue		
Found in early-stage embryos		

3.3

A common use of stem cells is in medical treatments.

a) Which of these conditions are most likely to be treated with stem cells?

Tick **all** that apply.

HIV

☐

Paralysis

☐

Asthma

☐

Diabetes

☐

Tuberculosis

☐

b) Match each feature of stem cells to the reason why it is useful for medical treatments.

Feature

Stem cells are unspecialised

Stem cells can differentiate

Stem cells can multiply many times

Reason why it is useful

They can produce large numbers of cells

They have many different functions

They can form many cell types to repair damaged tissues

They have no specific job or function

3.4

Some medical uses of stem cells are still experimental and may have issues. For example, some scientists are concerned about the potential risk of transferring viral infections.

Explain **one** other medical concern that scientists may have about the use of stem cells when treating a patient.

.....

.....

.....

.....

3.5

Scientists are researching how stem cells can treat neurodegenerative diseases like Parkinson's disease.

To treat Parkinson's disease, scientists can turn stem cells into neurones that send signals from the brain to coordinate movement.

Describe the process by which stem cells are used to produce the cells needed to treat Parkinson's disease.

.....

.....

.....

.....

Meiosis

R969

4.1

In humans, a normal body cell contains 46 chromosomes.

How many chromosomes are in each cell produced during

a) mitosis?

.....

b) meiosis?

.....

5. Genetics and inheritance

4.2

Gametes contain only half the number of chromosomes compared to normal body cells.
Name the type of cell division during which gametes are produced.

.....

4.3

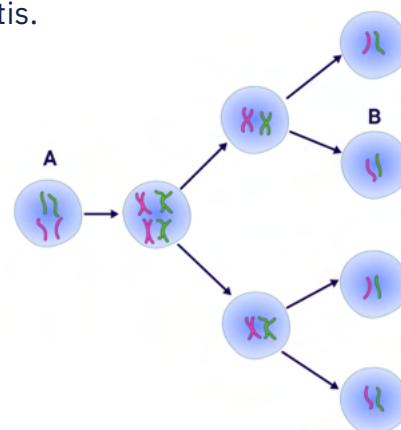
This diagram represents a cell dividing by meiosis in a human testis.
How many chromosomes are in the following cells?

a) Cell A

.....

b) Cell B

.....



4.4

Write steps A to D in the correct order to describe meiosis in a human ovary.

- A.** Each cell divides without copying its chromosomes.
- B.** Two cells containing 46 chromosomes are produced.
- C.** A cell in the ovary copies its chromosomes and divides.
- D.** Four daughter cells, each containing 23 chromosomes, are formed.

First step —————> Last step

.....,,,

4.5

Meiosis and mitosis are both forms of cell division.

Tick boxes in each row of the table to show which process each statement describes.
You may tick more than one box per row.

	Type of cell division	
	Meiosis	Mitosis
All cells produced are genetically identical		
Involves DNA replication		
The cells produced contain one set of chromosomes		

5. Genetics and inheritance

4.6 The diagram is a summary of meiosis in a human male.

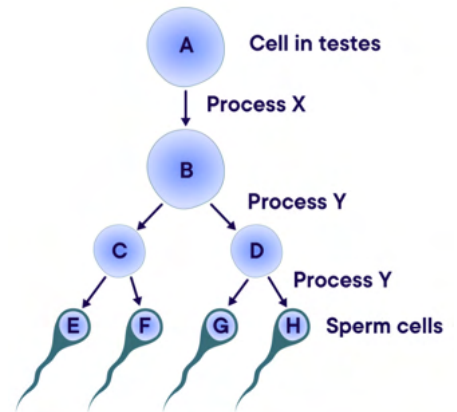
a) State the name of process Y.

.....

b) Describe what happens during process X.

.....

.....



Sexual and asexual reproduction

R320

5.1 Many species of plants are able to reproduce by asexual reproduction.
What is a feature of asexual reproduction?

Two gametes fuse

☐

The offspring show variation

☐

It drives natural selection

☐

Only one parent is involved

☐

5.2 Mitosis occurs in a species of plant during asexual reproduction.
The plant cells contain 16 chromosomes.
How many chromosomes will each new plant cell have after mitosis?

.....

5.3 Tick one box in each row of the table to show whether each statement applies to asexual or sexual reproduction.

	Type of reproduction	
	Asexual	Sexual
Involves gametes		
Involves one parent only		
Produces variation in the offspring		
Produces identical offspring		
Mixes genetic material		

5. Genetics and inheritance

5.4 Explain why sexual reproduction causes variation in the offspring.

.....

.....

.....

.....

Variation

R276

6.1 Tick one box in each row of the table to show whether each of these examples is an example of mainly genetic or environmental variation.

Example	Type of variation	
	Genetic	Environmental
Native language		
Natural hair colour		
Weight		
Shoe size		
Blood group		

6.2 The ability to roll your tongue is a type of variation where people fall into two distinct groups:

- People who can roll their tongues.
- People who cannot roll their tongues.

Complete the sentence to describe this type of variation.

Choose from the words: **continuous**, **discontinuous**, **measurable**, **random**

Variation that falls in distinct groups is known as variation.

6.3

The image shows a type of plant called the sunflower.

- a) Yellow flowers are a physical characteristic of the sunflower.

In genetics, what is the term for a physical characteristic?



.....

- b) In a field of sunflowers

- all the plants have yellow flowers
- the plants range in height from 75 cm to 1.5 metres.

Match each characteristic of the sunflowers to its most likely cause.

Characteristic

Height

Yellow flowers

Cause

Both genetic and environmental

Only environmental

Only genetic

6.4

What is a mutation in genetics?

.....

.....

6.5

A species of moth called the peppered moth lives on the bark of trees.

The peppered moth has two variations.

- One version has light coloured wings.
- The other has a mutation which gives it darker coloured wings.

During the Industrial Revolution, black soot started to cover trees and buildings.

- a) Suggest which variation of peppered moth became more common during the Industrial Revolution.

.....

.....

- b) Explain your answer.

.....

.....

.....

.....

.....

.....



7.1 Match each definition to the correct key term.

Definition

A short section of the DNA molecule that controls a particular characteristic.

A different version of the same gene.

A structure in the nucleus that carries the genetic material.

Key term

Genotype

Zygote

Chromosome

Phenotype

Gene

Allele

7.2 a) How many **pairs** of chromosomes are found in the nucleus of a human body cell?

.....

b) How many chromosomes are found in the nucleus of a human body cell **in total**?

.....

7.3 Give the correct scientific words for each of the following definitions.

a) The alleles that are contained in the cells of an organism.

.....

b) The appearance of an organism caused by the alleles in its cells.

.....

7.4

Organisms inherit two alleles (one from each parent) for every characteristic.

a) What word describes an organism that has two **identical** alleles for a specific characteristic?

.....

b) What word describes an organism that has two **different** alleles for a specific characteristic?

.....

7.5

Tick one box in each row of the table to show whether each statement describes recessive or dominant alleles.

	Recessive allele	Dominant allele
Always expressed even if only one copy of the allele is present		
Only expressed if two copies of the allele are present		
Represented with a lowercase letter (e.g. t)		
Represented with an uppercase letter (e.g. T)		

7.6

In a certain species of insect, wing shape is controlled by a single gene with two alleles; one for straight wings and one for curved wings.

An insect has one of each allele and has straight wings.

Suggest what this tells you about the two alleles.

.....

.....

.....

.....

5. Genetics and inheritance

7.7

A student draws a Punnett square using these alleles:

- B = brown eyes
- b = blue eyes

The Punnett square suggests that for two parents with blue eyes, there is a 100% chance their offspring has blue eyes.

Why is it possible for the offspring to **not** have blue eyes?

	b	b
b	bb	bb
b	bb	bb

A mutation in the alleles may change the eye colour at birth

☐

Eye colour is the result of multiple genes, rather than single gene

☐

Eye colour is mostly an environmental trait rather than

☐

Blue eye colour is a recessive trait so will not present, even if the alleles are bb

☐

7.8

The alleles for the fur colour of mice are:

- B = black fur
- b = brown fur

The black fur allele (B) is dominant over the brown fur allele (b).

A mouse has black fur and is heterozygous for this trait.

a) What is the mouse's phenotype?

.....

b) What is the mouse's genotype?

.....

7.9

The alleles for smooth and wrinkled peas are:

- R = smooth
- r = wrinkled

These alleles can produce three possible genotypes for peas: Rr, rr and RR.

Match each genotype to the correct description.

Genotype

Rr

rr

RR

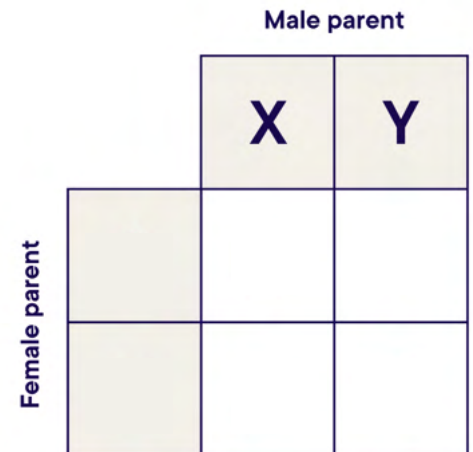
Description

Heterozygous

Homozygous recessive

Homozygous dominant

- 8.1** Complete this Punnett square to show how sex is inherited.



- 8.2** The diagram shows the inheritance of cystic fibrosis in a family. Cystic fibrosis is caused by a recessive allele (f).

a) What is the genotype of person 2?

.....

- b) Parents 4 and 5 do not have cystic fibrosis. One of their daughters has cystic fibrosis (CF). What conclusion may be made about the parents' genes?

They do not have the healthy gene

☐

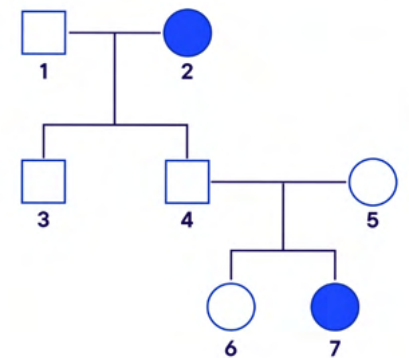
They both have different genes

☐

Neither have the cystic fibrosis gene (both FF)

☐

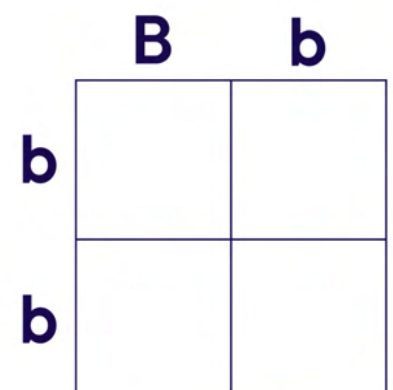
They are carriers of the CF gene (both Ff)

☐


Key

- = Female with cystic fibrosis
- = Female without cystic fibrosis
- = Male with cystic fibrosis
- = Male without cystic fibrosis

- 8.3** In parrots, the brown eye allele (B) is dominant to the red eye allele (b). A homozygous recessive male parrot breeds with a heterozygous female parrot. Complete the Punnett square, showing the cross between these two parrots.



5. Genetics and inheritance

8.4

The alleles for the colour of pea plants are:

- G = green
- g = yellow

The Punnett square shows the cross between a heterozygous green plant and an unknown plant.

- Complete the Punnett square.
- What is the genotype and phenotype of the unknown plant?

Genotype:

Phenotype:

- How could the genotype of the unknown plant be described?

Homozygous
dominant

☐

Heterozygous

☐

Homozygous
recessive

☐

G	Gg	Gg
g	gg	gg

8.5

The diagram shows how Tay-Sachs disease (TSD) has been inherited within a family.

- Describe how the diagram shows that TSD is recessive.

.....

.....

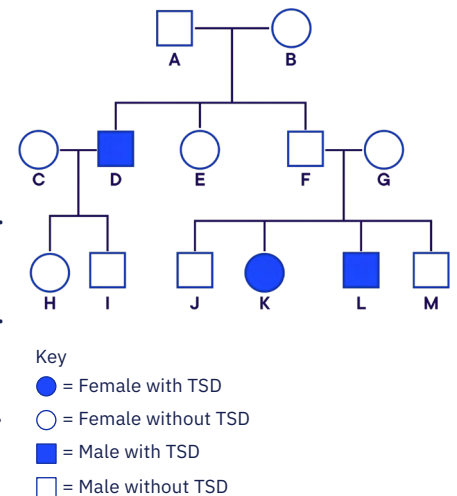
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- The allele used for TSD is t.
What are the genotypes of parents A and B?

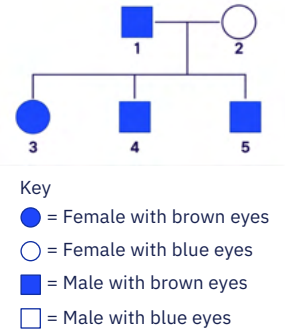
A:

B:

5. Genetics and inheritance

8.6

The diagram shows eye colour inheritance for one family. Both parents 1 and 2 are homozygous. Complete the sentences to describe the inheritance of eye colour, shown by this chart.



Brown eyes must be a codominant
dominant
recessive trait.

Because the parents are both homozygous, all the offspring will be homozygous
heterozygous
homozygous.

All of the offspring have brown eyes because the brown allele is always expressed
only expressed in pairs
sometimes expressed.

8.7

Someone develops cystic fibrosis if they have the genotype cc. This Punnett square shows how the offspring of two carriers of cystic fibrosis may develop cystic fibrosis. What is the probability that the offspring will have cystic fibrosis?

	C	c
C	CC	Cc
c	Cc	cc

.....%

8.8

Having dimples is a dominant trait. The alleles for dimples are:

- D = Dimples
- d = No dimples

The Punnett square shows the inheritance of dimples from one parent with dimples (DD) and one parent without (dd). The parents have a child.

Describe the only possible phenotype for the child.

	D	D
d	Dd	Dd
d	Dd	Dd

.....

.....

5. Genetics and inheritance

8.9

Cystic fibrosis is an inherited disorder caused by a recessive allele. The alleles for cystic fibrosis are:

- N = normal
- n = cystic fibrosis

The Punnett square shows the inheritance of cystic fibrosis from a non-carrier and a carrier parent.

	N	N
N	NN	NN
n	Nn	Nn

a) Which word best describes the parent with the alleles Nn?

Homozygous dominant

☐

Heterozygous

☐

Homozygous recessive

☐

b) If these parents had a child, what is the probability that their child would have cystic fibrosis?

.....%

8.10

The alleles for the fur colour of mice are:

- B = black fur
- b = brown fur

Two black mice were crossed together, as shown in the Punnett square.

What is the likely proportion of the offspring that will have brown fur?

Give your answer as a decimal.

	B	b
B	BB	Bb
b	Bb	bb

.....

5. Genetics and inheritance

8.11

Sickle cell anaemia is a condition where the patient's red blood cells cannot function properly. It is caused by a recessive allele.

The Punnett square shows a genetic cross with the alleles:

- D = does not have sickle cell anaemia
- d = has sickle cell anaemia

a) Which of the following best describes the parents shown in the Punnett square?

	D	d
d	Dd	dd
d	Dd	dd

Someone with sickle cell anaemia and a carrier for sickle cell anaemia ☐

Two people with sickle cell anaemia ☐

Two carriers of sickle cell anaemia ☐

Someone with sickle cell anaemia and someone without the allele for sickle cell anaemia ☐

b) What is the ratio of offspring with sickle cell anaemia and without in its simplest form?

..... :

8.12

The alleles for the height of pea plants are:

- T = tall
- t = short

Two tall plants with the genotype Tt are crossed.

What is the percentage probability that this cross will have offspring that are short?

You may want to draw a Punnett square to help you.

.....%

6. Energy transfers between organisms

Photosynthesis

R827

1.1 Write the word equation and balanced symbol equation for photosynthesis.

word equation:

symbol equation:

1.2 Chloroplasts contain a green pigment that is needed for photosynthesis.

a) Give the name of this pigment.

.....

b) What is the function of this pigment?

Stores DNA

☐

Stores sap

☐

Releases energy

☐

Absorbs sunlight

☐

Protects the cell

☐

1.3 Photosynthesis is an endothermic reaction.
Describe what is meant by an "endothermic" reaction.

.....

.....

1.4 Photosynthesis requires energy to occur.
Describe how plants gain the energy needed for photosynthesis.

.....

.....

.....

.....

6. Energy transfers between organisms

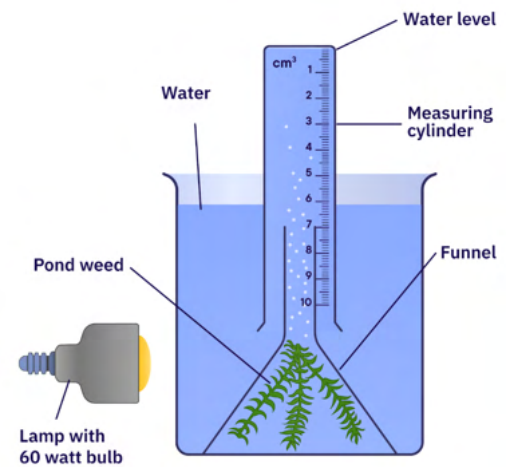
1.5

A student used this equipment to investigate pondweed.
As the experiment continues, a gas is collected in the measuring cylinder.
a) Name the gas which is collected in the measuring cylinder.

.....

b) Name the process by which this gas is produced.

.....

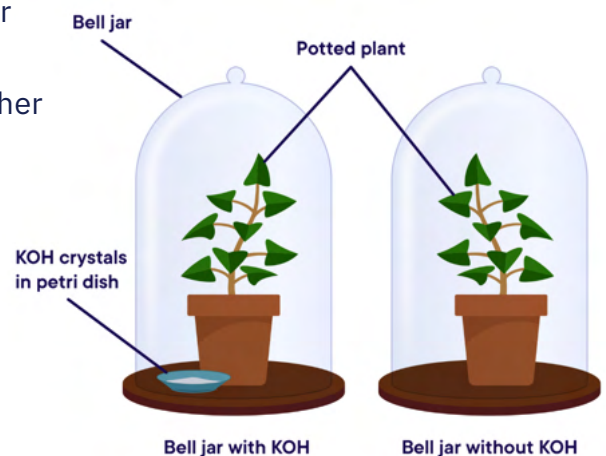


1.6

A teacher placed two plants in a dark cupboard for 24 hours so any starch in the plants was used up.
They then placed them into two bell jars for a further 24 hours, as shown in the diagram.
Potassium hydroxide (KOH) absorbs carbon dioxide from the atmosphere.

After 24 hours, the teacher tested a leaf from each plant for the presence of starch.

Plant	Starch present?
With KOH	No
Without KOH	Yes



Explain the teacher's results.

.....

.....

.....

.....

6. Energy transfers between organisms

1.7

A scientist measured the mass of some plants over 5 weeks. The table shows the mean mass of the plants over this time.

Explain the role of photosynthesis in the change in mean plant mass.

Week	Mean mass (g)
1	0.08
2	2.23
3	5.55
4	8.90
5	12.45

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6. Energy transfers between organisms

Factors affecting photosynthesis

R732

- 2.1** The rate of photosynthesis can be affected by limiting factors.
What is meant by a limiting factor?

.....

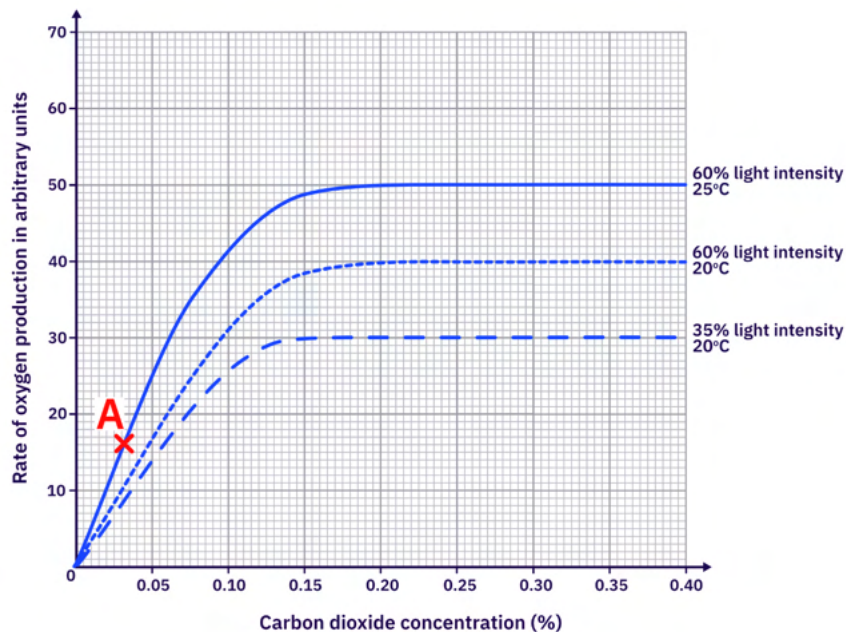
.....

- 2.2** A farmer is growing tomato plants inside a greenhouse.
The temperature is at the optimum level, and the plants have maximum light intensity.
They notice that the rate of photosynthesis is not increasing.
Give **one** factor that is limiting the rate of photosynthesis.

.....

.....

- 2.3** Farmers investigated the factors that affect the rate of photosynthesis in chilli plants.
The plants were grown in a greenhouse.
The graph shows how changing different factors affects the rate of photosynthesis.
The rate of photosynthesis is measured using the rate of oxygen production.



What is the limiting factor for the rate of photosynthesis at point A on the graph?

.....

6. Energy transfers between organisms

2.4

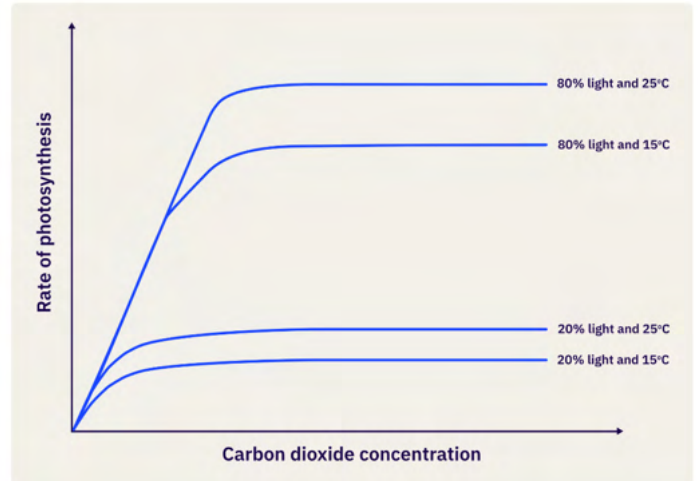
The graph shows how the rate of photosynthesis changes with increasing carbon dioxide concentration under different light intensities and temperatures. Explain the effect of increasing temperature on the rate of photosynthesis.

.....

.....

.....

.....



Aerobic respiration

R336

3.1

Energy is released in respiration.
Which of the following are uses of the energy released in respiration?

Movement

☐

Keeping warm

☐

Producing oxygen

☐

Building larger molecules

☐

3.2

Write the word equation for aerobic respiration.

.....

3.3

Tick boxes in each row of the table to show whether each statement describes respiration or photosynthesis.

You may tick more than one box per row.

	Respiration	Photosynthesis
Glucose is a product		
Energy is released		
The reaction is exothermic		
It occurs in plants		

6. Energy transfers between organisms

3.4

Muscle cells use oxygen for respiration.
Explain why muscle cells need to respire.

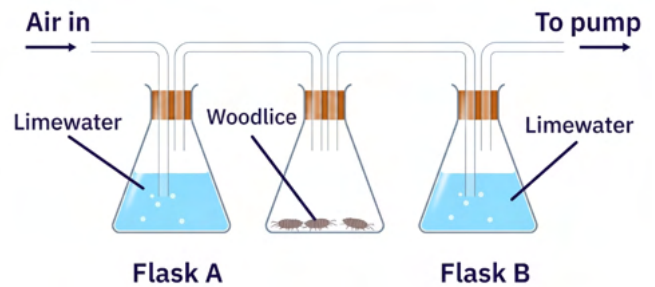
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3.5

A student used this apparatus to investigate aerobic respiration in woodlice.
After 10 minutes, the limewater in flask B was cloudy but the limewater in flask A remained colourless.
Limewater turns cloudy when mixed with carbon dioxide.



Explain why the limewater in flask B went cloudy, but the limewater in flask A did not.

.....

.....

.....

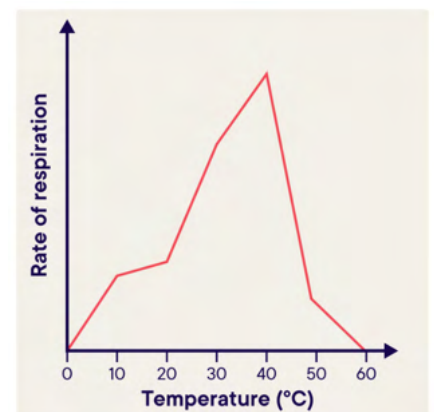
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3.6

A scientist investigated the rate of respiration in some germinating peas.
This graph was plotted from the results of the investigation.
a) Estimate the optimum temperature for these enzymes.

.....°C

b) Why does the rate of respiration change after this temperature?



Anaerobic respiration starts to happen

☐

The enzymes are denatured

☐

The peas die

☐

Lactic acid starts to build up

☐

6. Energy transfers between organisms

Anaerobic respiration

R268

4.1 Write the word equation for anaerobic respiration in animals.

.....

4.2 Yeast can carry out anaerobic respiration to produce ethanol and carbon dioxide.
Give the name of this process.

.....

4.3 Tick boxes in each row of the table to show whether each statement describes anaerobic respiration in humans or microorganisms.
You may tick more than one box per row.

	Anaerobic respiration in humans	Anaerobic respiration in microorganisms
Energy is released		
Glucose is the only reactant		
Lactic acid is produced		
Carbon dioxide is produced		

4.4 A student leaves an open beaker of yeast and sugar solution in a warm cupboard for a week.

a) What would happen to the total mass of the beaker and its contents over the week?

It would increase

☐

It would decrease

☐

It would stay the same

☐

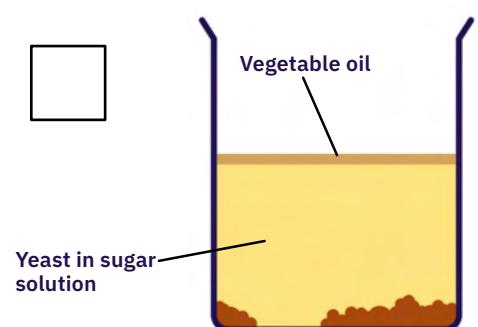
b) Explain your answer.

.....

.....

.....

.....



1.1

Name the neurone that carries out each of the following functions.

a) Carries electrical impulses from receptors to the central nervous system.

.....

b) Carries an electrical impulse inside the central nervous system (brain and spinal cord).

.....

c) Carries an electrical impulse away from the central nervous system to an effector (muscle or gland).

.....

1.2

The diagram shows the path of an impulse when someone touches a hot object.

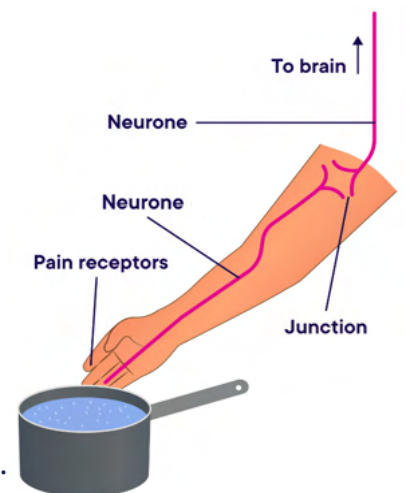
a) What is the junction between the neurones called?

.....

b) Describe how information crosses the junction between neurones.

.....

.....



1.3

If you knock a tendon found just below the knee cap, it pulls on cells which are sensitive to stretching.

a) What are cells which are sensitive to stimuli called?

.....

b) If you knock the tendon, the lower leg kicks forward involuntarily. What is the effector in this response?

.....

.....

7. Homeostasis and control

1.4

A driver sees an animal in the road.

The receptor cells in their eyes send information to the central nervous system to coordinate a response.

In what form is the information sent?

.....

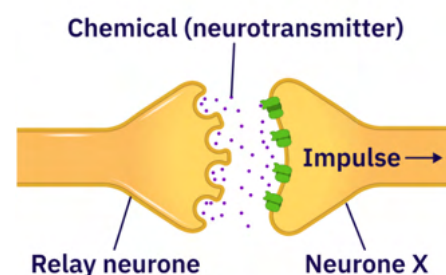
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1.5

The diagram shows how an electrical impulse passes across a synapse to neurone X.

What type of neurone is neurone X?

.....



1.6

Write steps A to E in the correct order to describe how the body responds to a stimulus.

- A.** The electrical impulse reaches the effector.
- B.** A sensory neurone carries the impulse to the coordinator (the CNS).
- C.** The coordinator processes the information and sends an electrical impulse along a motor neurone.
- D.** The receptor generates an electrical impulse.
- E.** The stimulus is detected by the receptor.

First step —————> Last step

.....,,,,

The reflex arc

R936

2.1

The knee-jerk response is an example of a reflex action.

Describe what is meant by a reflex action.

.....

.....

.....

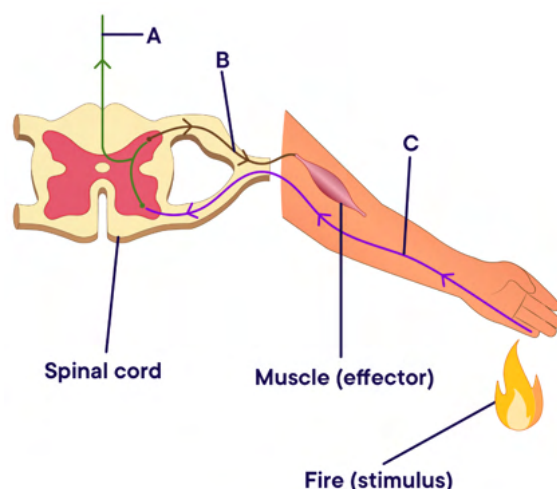
.....

- 2.2** The diagram shows the direction that an impulse travels in a reflex action.
Name the neurones marked A, B and C.

A:

B:

C:



- 2.3** Reflexes coordinated by the spinal cord are faster than those coordinated by the brain.
This is because spinal reflexes do not need impulses to travel to the brain for processing before generating a response.
Suggest **one** other reason why reflexes coordinated by the spinal cord are faster.

.....

.....

- 2.4** A piece of dust blows near a person's eye. The person blinks.
This is a reflex action.
Fill in the gaps to complete the coordination system for this reflex action.
Choose from the words:

brain, cornea, heart, muscles, retina

1. Stimulus: Light reflecting from the dust

2. Receptor:

3. Coordinator:

4. Effector:

5. Response: The person blinks

3.1 Define the term homeostasis.

.....

.....

.....

.....

3.2 Homeostasis is carried out by control systems in the body.
Match each part of a control system to its role.

Part of control system

Receptor

Coordination centre

Effector

Role

Carries out the response

Detects changes in the environment

Receives and processes information

3.3 During homeostasis, the body responds to both internal and external changes.
Tick one box in each row of the table to show if each condition is caused by an internal or external stimulus.

	Type of stimulus	
	Internal	External
Increase in blood glucose		
Decreasing water level in the blood		
Increasing air temperature		
Decreasing core body temperature		

3.4

A scientist investigated the effect of increasing external temperature on the internal body temperature of an organism.

Their results are shown in the table.

Time (hrs)	External temperature (°C)	Internal temperature (°C)
0	10	36.9
1	12	37.0
2	15	36.9
3	18	37.0
4	20	36.8
5	22	37.0

Suggest how the scientist's results provide evidence that the body temperature of this organism is regulated by homeostasis.

.....

.....

Negative feedback

R275

4.1

What is the role of negative feedback in the human body?

To maintain internal conditions within a narrow ☐

To increase the speed of nerve impulses ☐

To alert the body to danger in the environment ☐

To refract light rays entering the ☐

4.2

Describe the conditions that would cause adrenaline to be secreted.

.....

.....

4.3

The level of a substance in the blood becomes too high.
Negative feedback causes the level of the substance to decrease.
Write steps A to E in the correct order to show how this happens.
The first step has been done for you.

- A. The coordination centre sends impulses to a gland.
- B. A hormone is released, which reduces levels of the substance in the blood.
- C. The level of the substance falls within the normal range.
- D. Impulses are sent to the coordination centre in the brain.
- E. Receptor cells detect high levels of a substance in the blood.

First step —————→ Last step

E

.....,,,,

4.4

Explain why the release of adrenaline is not an example of negative feedback.

.....

.....

.....

.....

4.5

If there is a decrease in body temperature, there is an increase in thyroxine production.
Explain how the production of thyroxine causes an increase in body temperature.

.....

.....

.....

.....

5.1 Hormones help to control blood glucose concentration.
Complete the sentences by naming the correct hormone.

If blood glucose concentration is too low, is produced.

If blood glucose concentration is too high, is produced.

5.2 Insulin is a hormone produced to help regulate blood glucose concentration.
How does insulin travel around the body?

.....
.....

5.3 Insulin is released if the blood glucose concentration gets too high.
It causes some cells in the body to convert glucose into an insoluble storage material.
a) Give the name of this insoluble storage material.

.....

b) Which cells are able to convert glucose into this storage material?
Tick all that apply.

Liver cells

☐

Muscle cells

☐

Kidney cells

☐

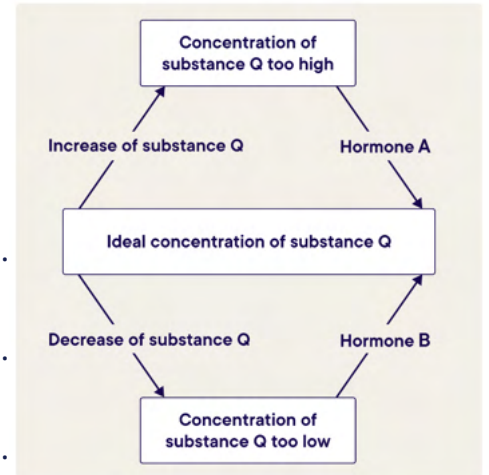
5.4 After a meal, there is usually a spike in blood glucose concentration.
The body responds by releasing insulin.
Explain the effect that a release of insulin has on blood glucose concentration.

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.....
.....

7. Homeostasis and control

5.5

The diagram shows how the concentration of substance Q in the blood is controlled by negative feedback. Explain how the concentration of substance Q in the blood is controlled by negative feedback.



5.6

People with diabetes have difficulty controlling the concentration of glucose in their blood.

Give **two** ways that a person can reduce the chance of developing type 2 diabetes.

5.7

Type 1 diabetes is treated with insulin injections to lower glucose levels in the blood. How do insulin injections help to lower blood glucose levels?

They increase the production of insulin by the pancreas ☐

They prevent glucose from being absorbed in the small intestine ☐

They cause glucose to move from the blood into cells ☐

They cause glycogen to be converted to glucose in cells ☐

5.8

A doctor gives two patients identical meals. They monitor their blood glucose concentration after the meal.

a) Which person is more likely to have diabetes?

Patient A

☐

Patient B

☐

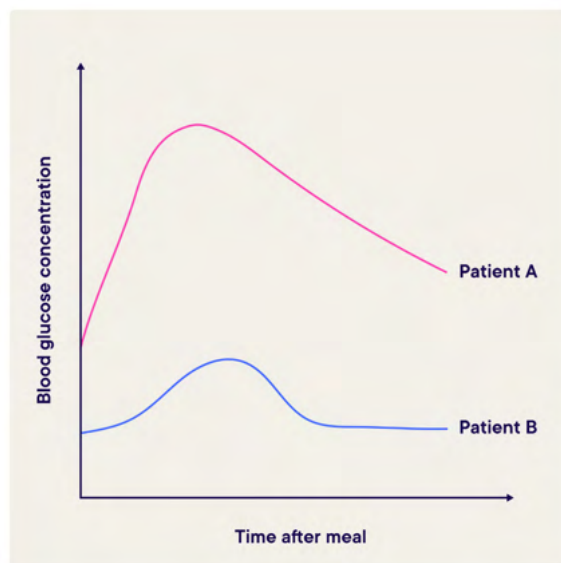
b) Explain your answer to part a).

.....

.....

.....

.....



5.9

A doctor takes a blood sample of a patient who they suspect has type 2 diabetes. Their results are shown in the table, along with the result for a person without diabetes.

Substance	Levels in patient	Normal levels
Cholesterol(mmol/dm^3)	5.89	5.20
Glucose (mmol/dm^3)	9.68	4.50
Insulin (arbitrary units)	25.25	14.80

Give **two** ways that the results of the test show that the patient might have type 2 diabetes.

.....

.....

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.....

- 5.10** Type 2 diabetes occurs when the body cells do not respond properly to insulin. Explain why a person with type 2 diabetes often has a higher blood insulin concentration than a non-diabetic person.

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1.1 Describe what is meant by biodiversity.

.....

.....

1.2 Deforestation contributes to the global reduction in biodiversity. Suggest **one** way in which deforestation can reduce biodiversity.

.....

.....

1.3 The invertebrate biodiversity in two areas was sampled.

The table shows the results.

Species	Number in area A	Number in area B
Bog spider	10	0
Sphagnum mite	2	34
Hover fly	12	6
Marsh grasshopper	3	0
Caddisfly larvae	12	80
Bush-cricket	14	1
Peatland snail	1	0
Crane fly	28	44

a) Which area had greater biodiversity?

Area A

☐

Area B

☐

b) Give a reason for your answer.

.....

.....

2.1 What is the best description of a stable community?

One species is declining rapidly
and another is increasing rapidly

☐

All the species and the environment
are in balance with each other

☐

All the species living in a
changing environment

☐

All the species in an
ecosystem have a similar

☐

2.2 Complete the sentences to describe an ecosystem.

Choose from the words:

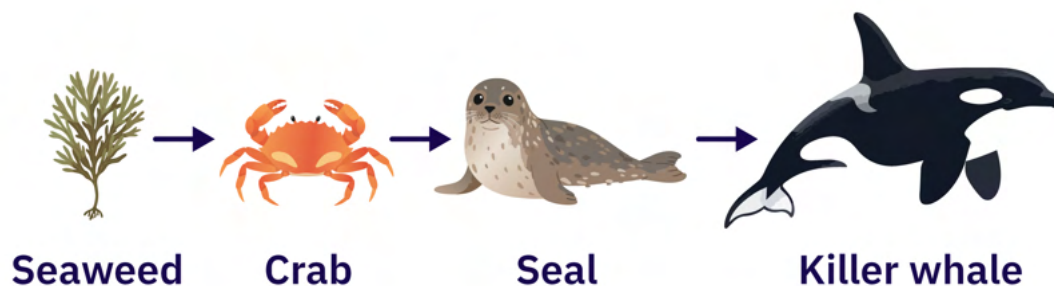
abiotic, antibiotic, arrangement, biotic, interaction, predation

An ecosystem is the of living organisms and the non-living parts
of their environment.

The non-living parts of the environment are known as factors.

The living organisms are known as factors.

2.3 Look at the food chain.



a) How many populations are shown in the diagram?

.....

b) How many communities are shown in the diagram?

.....

2.4

A freshwater pond contains frogs, fish, algae and insects.
The pond is surrounded by grasses and trees.
Match each scientific term to the correct example.

Scientific term

Community

Ecosystem

Population

Example

The frogs, fish, algae, insects, grasses and trees

The amount of nutrients in the soil next to the pond

All the frogs living in the pond

The pond, its surroundings and the organisms living in the pond

The temperature of the pond water

2.5

The table shows the number of different species living in four forests over a period of 20 years.

Year	Forest A	Forest B	Forest C	Forest D
2000	5966	8621	10 751	9465
2005	5977	7901	10 822	9431
2010	5960	7008	10 884	9458
2015	5955	6422	10 835	9470
2020	5941	6210	10 813	9501

a) Which forest does **not** have a stable ecosystem?

Forest A

☐

Forest B

☐

Forest C

☐

Forest D

☐

b) Justify your answer.

.....

.....

.....

.....

- 3.1** a) Name the process by which plants produce glucose.

.....

- b) Suggest **one** abiotic factor that is likely to directly affect the rate of glucose production in a plant.

.....

.....

- 3.2** The factors shown in the table are factors in an aquatic environment. Tick boxes in each row of the table to show whether each factor will likely affect plants or animals in the environment. You may tick more than one box per row.

Factor	Which species are affected?	
	Plants	Animals
Light intensity		
Water pH		
Water temperature		

- 3.3** Pathogens are an example of a biotic factor. Why are pathogens classed as biotic factors?

Pathogens are living organisms ☐

Pathogens can be introduced into an ecosystem ☐

Pathogens affect living organisms ☐

Pathogens only have negative impacts on species ☐

8. Ecology and evolution

3.4

Which of the following are abiotic factors?

Tick all that apply.

Light intensity

☐

Temperature

☐

Moisture levels

☐

Pathogens

☐

Wind intensity

☐

Air composition

☐

3.5

The graph shows the soil pH in which four different species of plants can live.

a) What type of environmental factor is pH?

.....

b) Which species can grow in pH levels less than 5.0?

Tick all that apply.

Azalea

☐

Lavender

☐

Maple tree

☐

Pine tree

☐

c) Which species can tolerate the greatest range of pH?

Azalea

☐

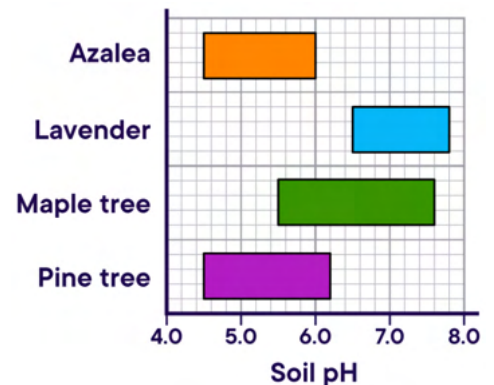
Lavender

☐

Maple tree

☐

Pine tree

☐

3.6

Flatworms are simple organisms that live in water.

They eat small invertebrates, dead matter and microscopic organisms.

Suggest **one** biotic factor that could affect the size of a flatworm population.

.....

.....

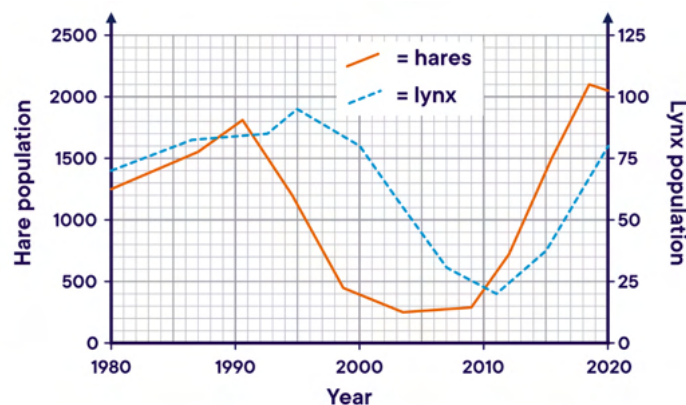
3.7

This graph shows how the number of lynx and hare vary in an ecosystem.

- a) Suggest how the graph shows that there were more hare than lynx in 2000.

.....

.....



- b) The number of lynx is one biotic factor that could affect the size of the hare population. Give **one** other biotic factor that affects the size of the hare population.

.....

.....

3.8

Some factors that affect biodiversity are listed in the table.

Tick one box in each row to show whether each factor is biotic or abiotic.

	Biotic factor	Abiotic factor
Rising temperatures caused by global warming		
Decreased biodiversity because of an invasive species		
Decline in water quality because of plastic pollution		
Increase in parasites in the salmon population because of fish farming		

Evolution

R738

4.1

Evolution happens by favouring traits that help organisms survive and reproduce. What is the name of the biological process responsible for this?

.....

4.2 Which of these defines the term “evolution”?

Sudden changes in species

☐

Changes to the climate and environment

☐

The gradual change in a species over time

☐

The change in animal behaviour caused by climate

☐

The gradual loss of biodiversity

☐

4.3 Write steps A to E in the correct order to describe the process of evolution by natural selection.

- A.** Some organisms have a random mutation making them better adapted.
- B.** These individuals survive and reproduce.
- C.** The advantageous allele (mutation) is passed on to offspring.
- D.** This is repeated over many generations.
- E.** There is a change in the environment.

First step —————→ Last step

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4.4 Mutations create genetic variation, which can lead to evolution through natural selection. What is a mutation?

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4.5

The development of antibiotic resistance in bacteria is driven by natural selection. Complete the sentences below to explain how antibiotic resistance develops in bacteria.

Choose from the words:

cells, forced, gene, many, mate, random, reproduce some

Step 1: An antibiotic is introduced to a population of bacteria.

Step 2: Some bacteria develop antibiotic resistance due to a mutation.

Step 3: These bacteria are more likely to survive and

Step 4: The offspring of these bacteria will also have the antibiotic

resistance

Step 5: Most bacteria in the population will have antibiotic resistance after the process is

repeated over generations.

4.6

The peppered moth has two phenotypes:

- Light-winged
- Dark-winged

During the Industrial Revolution, black soot started to be deposited on trees and buildings.

a) What would you expect to happen to the number of moths with the light and dark winged phenotypes?

Light moths would increase in number ☐

Dark moths would increase in number ☐

Both moths would increase in number equally ☐

Both moths would decrease in number equally ☐

b) Explain your answer.

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4.7

Suggest why natural selection is faster in bacteria.

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