

KS5 Biology

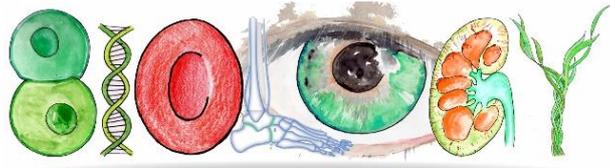
GCSE to A Level Transition Workbook

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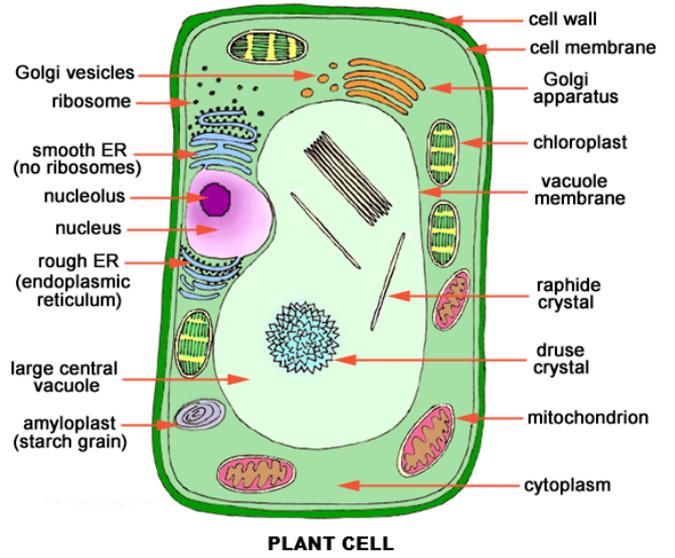
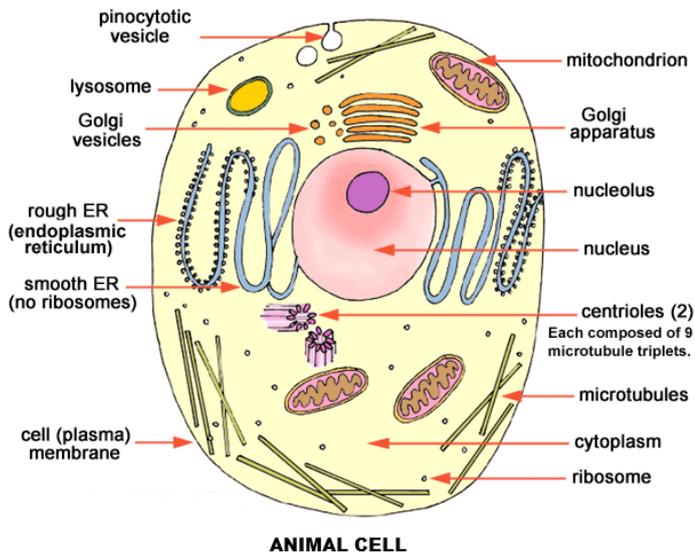
GCSE Biology/Science Grade:

WWW:

EBI:



Section A: Cells

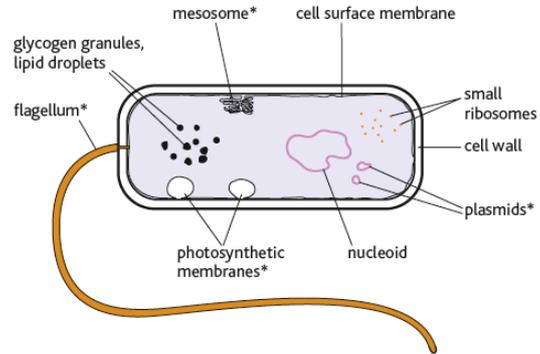


Summary sheet 1: Cell structure

Prokaryotes are single celled organisms, including bacteria. They are simpler and smaller than Eukaryotic cells.

Bacterial cells have:

- no nucleus with circular DNA free in the cytoplasm
- cell wall made from peptidoglycan
- no membrane-bound organelles
- small ribosomes.

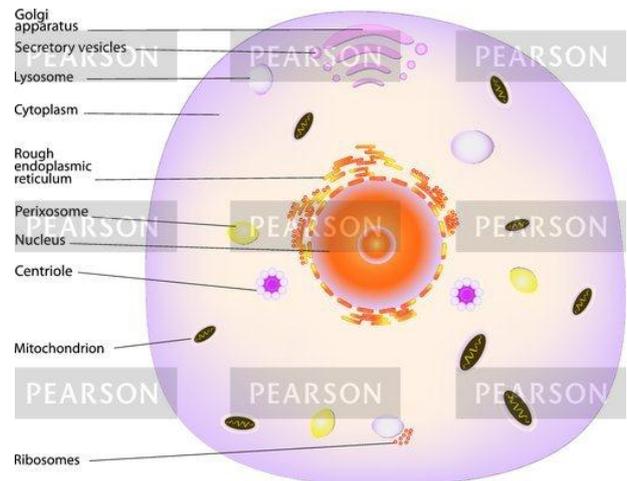


* = not present in all bacteria

Eukaryotic cells include animal and plant cells. They are larger and more complex than prokaryotic cells.

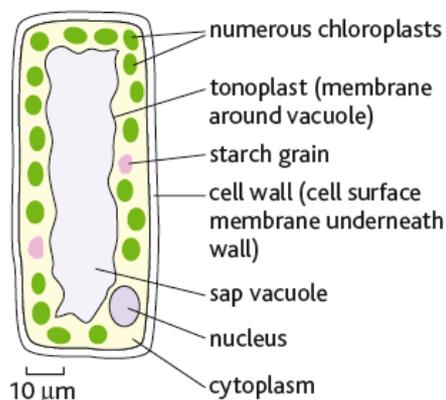
Animal cells have:

- linear DNA contained inside a nucleus
- no cell wall
- larger ribosomes and many membrane-bound organelles including mitochondria where aerobic respiration occurs and endoplasmic reticulum and golgi which are involved in the processing of proteins.

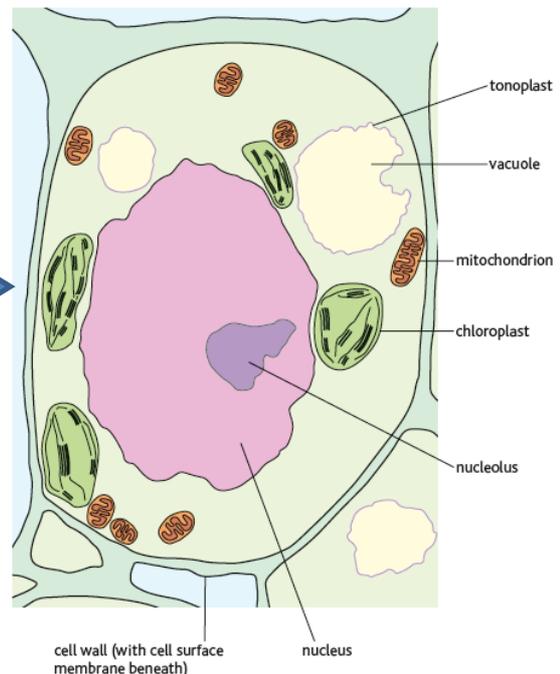


Plant cells have the same organelles as animal cells but they also have:

- a cell wall
- a large vacuole containing cell sap
- chloroplasts for photosynthesis.



greater detail

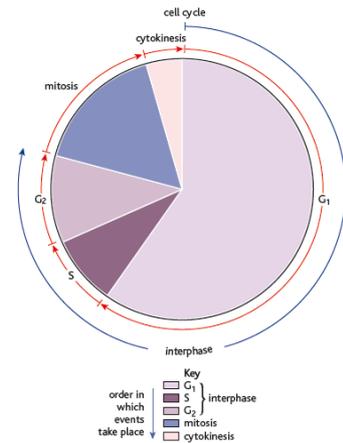


Summary sheet 2: Mitosis

Mitosis results in the production of two genetically identical diploid body cells. It occurs during growth, repair and asexual reproduction.

Mitosis occurs during the cell cycle. The cell cycle consists of a period of cell growth and DNA replication known as interphase and then a period of cell division called mitosis followed by cytokinesis where the cytoplasm divides and the cell membrane constricts to form the two daughter cells.

Mitosis is broken down into stages – prophase, metaphase, anaphase and telophase, followed by cytokinesis.



	<p>A Interphase: before mitosis the tangled, uncoiled mass of chromosomes fills the nucleus. DNA is replicated during this stage.</p>
	<p>B Prophase: the chromosomes coil and condense, each one appearing as two chromatids. The nucleolus breaks down and the centrioles begin to separate and start to form the spindle.</p>
	<p>C Metaphase: the nuclear membrane breaks down. Spindles made of microtubules have been formed by the centrioles. The chromatids line up on the equator.</p>
	<p>D Anaphase: the centromeres separate and each chromatid is pulled along a spindle tubule towards one of the poles centromere first.</p>
	<p>E Early telophase: the chromatids reach the poles of the cell where they are now known as chromosomes. The membrane begins to reform and the cytoplasm to divide.</p>
	<p>F Late telophase: the chromosomes begin to 'decondense'. The nuclear membranes and nucleoli are fully reformed and centrioles are present again. The division of the cytoplasm continues until two new identical cells are formed which once more enter interphase.</p>

Summary sheet 3: Microscopy

Magnification is how much bigger the image is than the specimen on the microscope slide.

The size of the specimen can be calculated using the formula:

$$\text{length of the specimen} = \frac{\text{length of the image}}{\text{magnification}}$$

With a light microscope the magnification is the combination of the magnification of the objective lens and the eye piece lens.

For example a 40× objective lens and a 10× eye piece lens produce a total magnification of 400×.

When you are doing magnification calculations you must have all the lengths in the same units.

1 cm	10 mm
1 mm	1000 μm
1 μm	1000 nm

Calculation

Calculate the actual size of a cell with a diameter of 8 mm using 100× magnification.

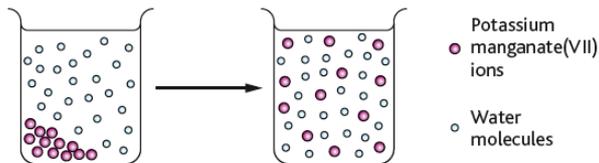
$$\begin{aligned}\text{Actual size} &= \frac{8}{100} = 0.08 \text{ mm} \\ &= 80 \mu\text{m}\end{aligned}$$

Resolution is a measure of how easy it is to distinguish between two points that are close together i.e. how much detail can be distinguished. Electron microscopes have a better resolution than light microscopes so they can see more detail.

Summary sheet 4: Diffusion, osmosis and active transport

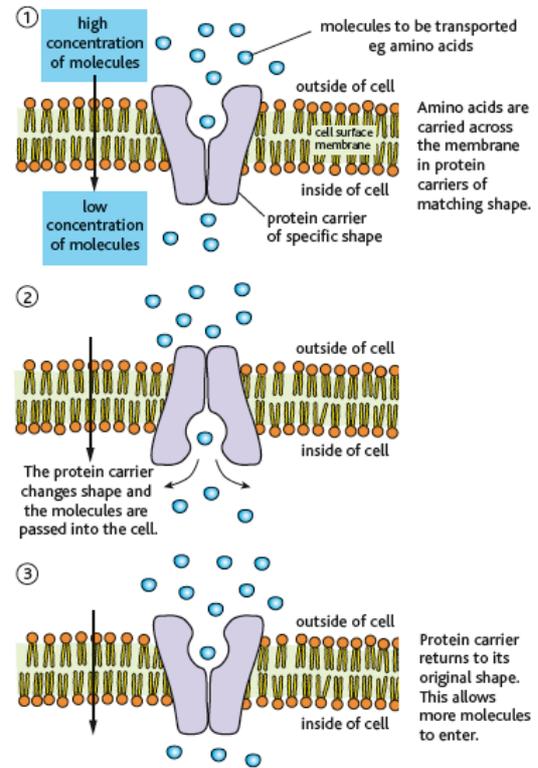
Diffusion

Liquid and gas particles are constantly moving which causes particles to move from an area of high concentration to an area of low concentration.



Observing the process of diffusion. If the beaker is left to stand the random motion of both the water and the purple manganate(VII) ions will ensure they are eventually evenly mixed.

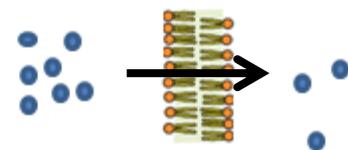
Small particles can diffuse across cell membranes and no energy is required. Some molecules, such as glucose, are too large to diffuse across the cell membrane so they must be helped by carrier proteins. Each molecule has its own carrier protein that allows the molecule through the cell membrane without the need for energy. This is known as facilitated diffusion.



Facilitated diffusion acts as a ferry across the lipid membrane sea. But this is a boat with no oars, sails or engine – it can only work when the tide (the concentration gradient) is in the right direction.

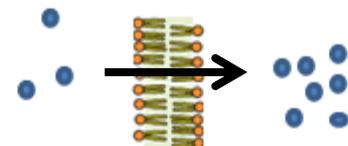
Osmosis

Osmosis is the diffusion of water molecules from an area of higher concentration of water molecules to an area of lower concentration of water molecules across a partially permeable membrane.



Active transport

Active transport uses energy to transport substances across membranes from an area of lower concentration to an area of higher concentration



Worksheet 1: Cell structures 1

Extracting key information from text is an important study skill for A-level candidates.

Read through the passage below about animal, plant and bacterial cells. Use the information and your own knowledge to complete the table to list some of the structural features of animal, plant and bacterial cells.

The plant cell and the animal cell possess a nucleus containing chromosomes and a nucleolus. In a bacterial cell the DNA is located in the cytoplasm. Only the bacterial cell and the plant cell have a cell wall but all three cells have a cell membrane. The plant cell wall is made of cellulose and the bacterial cell wall is made of peptidoglycan.

Centrioles are present only in the animal cell and chloroplasts are found only in the plant cell. Mitochondria and rough endoplasmic reticulum are not present in the bacterial cell. All three cells contain structures called ribosomes which are involved in the synthesis of protein. Bacterial cells can have pili or a capsule.

Features present in animal cells	Features present in plant cells	Features present in bacterial cells

Extension activity – research a function for each feature listed.

Worksheet 2: Cell structures 2

Extracting key information from text is an important study skill for A-level candidates.

Read through the passage below about animal, plant and bacterial cells. Use the information and your own knowledge to draw and label an animal, plant and bacterial cell. You should include the features listed if appropriate.

The plant cell and the animal cell possess a nucleus containing chromosomes and a nucleolus. In a bacterial cell the DNA is located in the cytoplasm. Only the bacterial cell and the plant cell have a cell wall but all three cells have a cell membrane. The plant cell wall is made of cellulose and the bacterial cell wall is made of peptidoglycan.

Centrioles are present only in the animal cell and chloroplasts are found only in the plant cell. Mitochondria and rough endoplasmic reticulum are not present in the bacterial cell. All three cells contain structures called ribosomes which are involved in the synthesis of protein. Bacterial cells can have pili or a capsule.

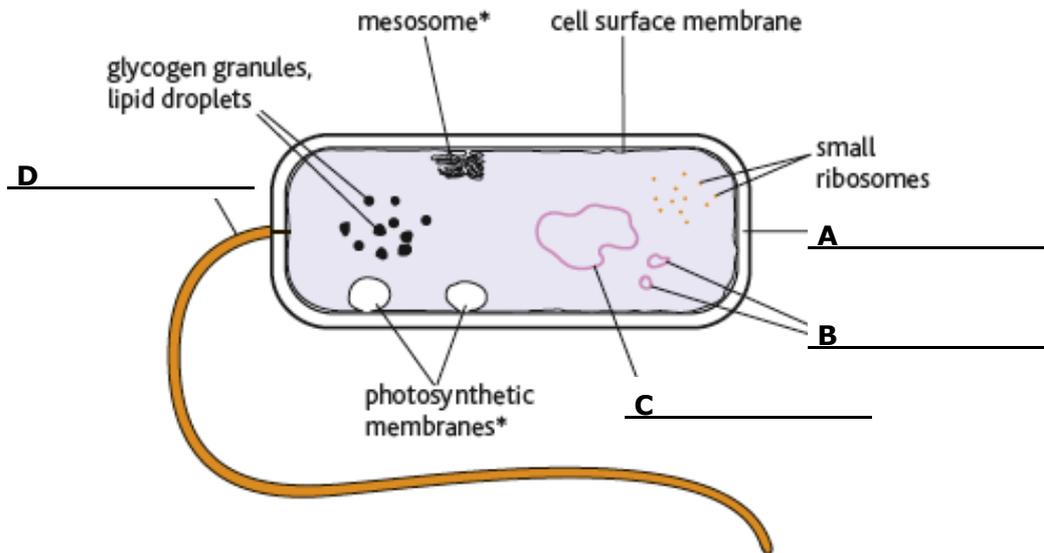
cell wall	nucleus	cell membrane	ribosome	capsule
mitochondria	cytoplasm	chloroplast	plasmid	chromosome

Animal cell	Plant cell
Bacterial cell	

Extension activity – research any unfamiliar features and add them to your cell diagrams.

Practice questions

1 The diagram shows a bacterial cell with some of the key features labelled.



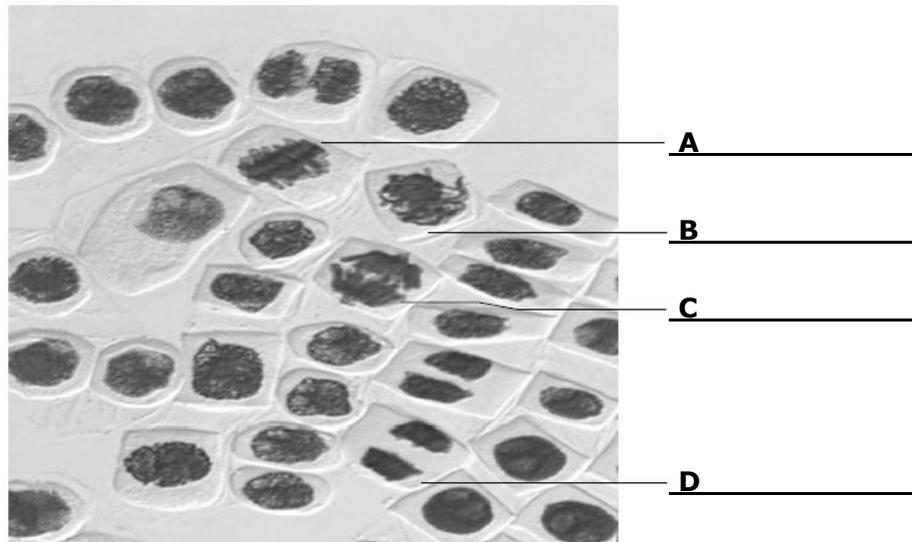
- a Label cell features A, B, C and D.
- b Complete the table to identify three features present in animal cells and describe their function.

Animal cell feature	Function

- c Some antibiotics prevent protein synthesis by targeting the ribosome. Ribosomes in eukaryotes have a different structure to prokaryotes. In no more than 50 words, explain why these types of antibiotics can be used to treat bacterial infections without effecting human cells.

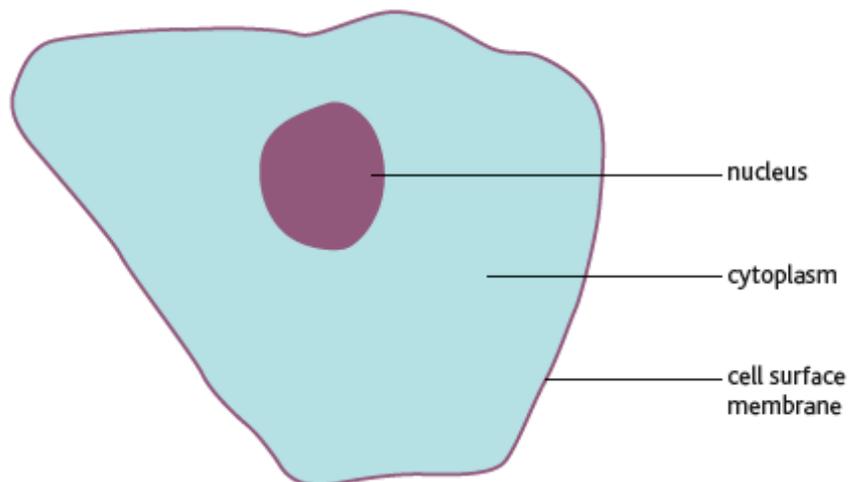
Concise writing which refers to key scientific ideas is effective.

2 The image shows root tip cells at different stages of the cell cycle.



- a Identify the stages of mitosis for cells A, B, C and D.
- b The microscope used to view the cells had a 10× eye piece lens. Which objective lens was needed to view the cells at this magnification level?
- c Calculate the length of cell A.

3 The diagram shows an animal cell with three key features labelled.



a Identify three additional features which are found in animal cells and describe their functions.

1

2

3

b An image of an animal cell nucleus with a diameter of $6\ \mu\text{m}$ was obtained using a $10\times$ eye piece lens and $20\times$ objective lens. Calculate the diameter of the nucleus on the image.

Substances can be transported into cells through diffusion, osmosis and active transport.

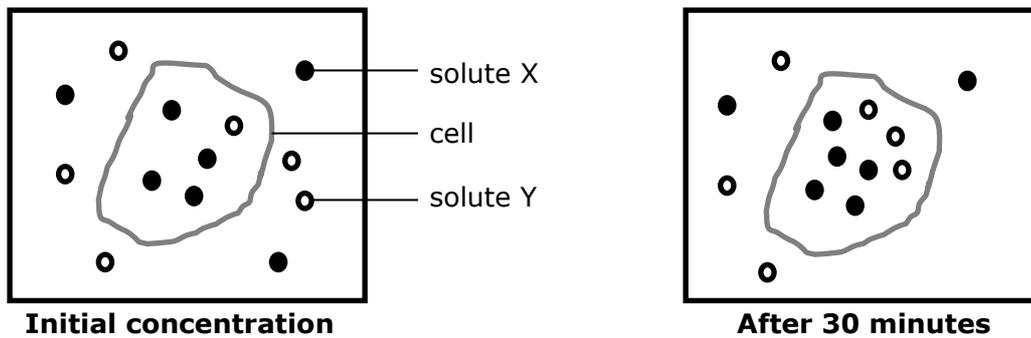
4 Write a definition for diffusion, osmosis and active transport.

Diffusion:

Osmosis:

Active transport:

- 5 Cells were placed in a solution containing solute X and solute Y.
The diagram below represents the concentration of the two solutes inside and outside one of the cells, when this cell was placed in the solution and then after 30 minutes.



Explain the movement of solute X and solute Y into the cell.

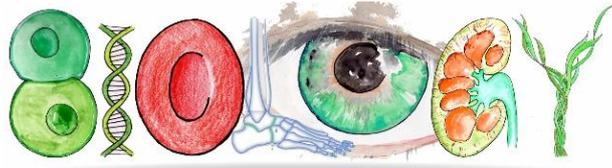
- 6 A red blood cell was placed in a solution of distilled water.
Explain the effect on the red blood cell of being placed in a solution of distilled water.

- 7 Explain the key word 'isotonic'.

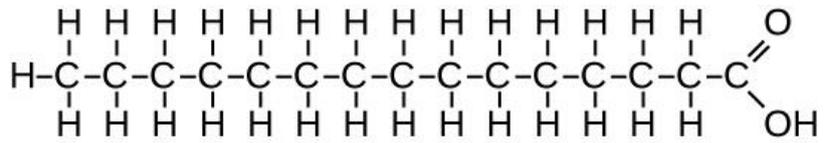
- 8** A student took 15 identical sized potato chips. The mass of each chip was recorded and the chips were placed in 4 salt solutions (0.1M, 0.2M, 0.3M and 0.4M) and pure water for 30 minutes. The chips were dried and the mass recorded. The mass change and % change in mass was calculated.

Design a table to record the students raw and processed data.

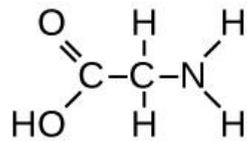
When recording data in tables units must be included in headers of the tables. All units should be SI.



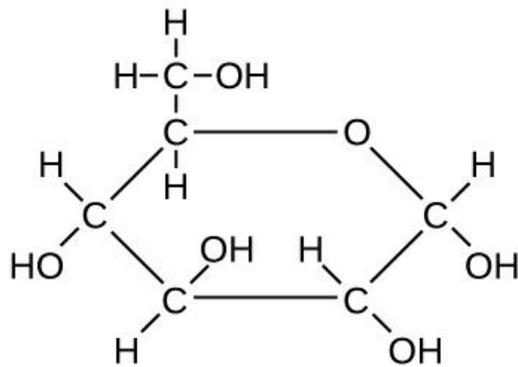
Section B: Molecules



(a)



(b)

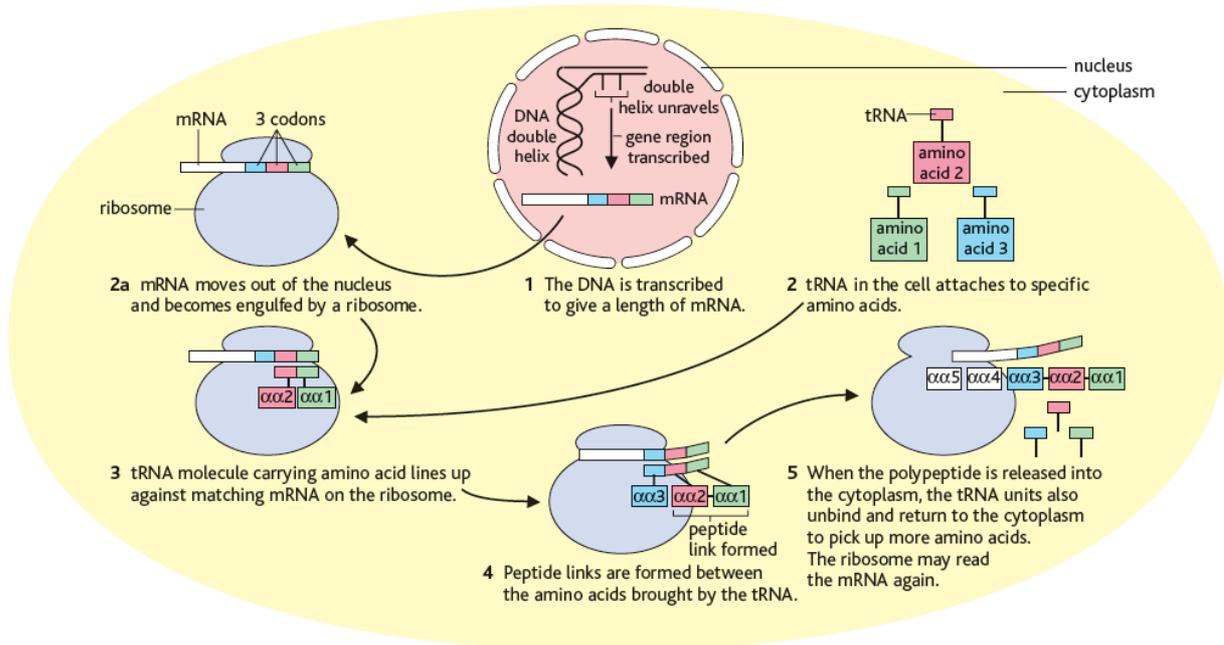


(c)

Summary sheet 1: Protein synthesis

A gene is a sequence of DNA which codes for a protein. Proteins are synthesised in a two-step process – transcription and translation.

Transcription takes place in the nucleus and translation takes place at the ribosome. A complementary mRNA strand is made using the DNA as a template. The mRNA leaves the nucleus and attaches to the ribosome in the cytoplasm. A triplet of bases on the mRNA (a codon) code for specific amino acids. The amino acids are delivered to the ribosome by tRNA. Peptide bonds are formed between the amino acids to make the polypeptide.



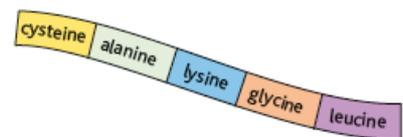
The DNA gene sequence is ACA CGG AAA CCT GAC.

The mRNA sequence is UGU GCC UUU GGA CUG.

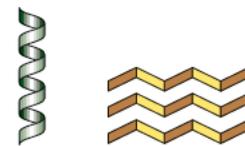
This codes for the amino acid sequence is:

Cys-Ala-Lys-Gly-Leu

The protein folds into a specific structure. For enzymes this means that the active site forms a specific shape that binds specific substrates.



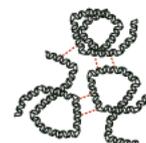
Primary structure – the linear sequence of amino acids in a peptide.



Secondary structure – the repeating pattern in the structure of the peptide chains, such as an α -helix or pleated sheets.



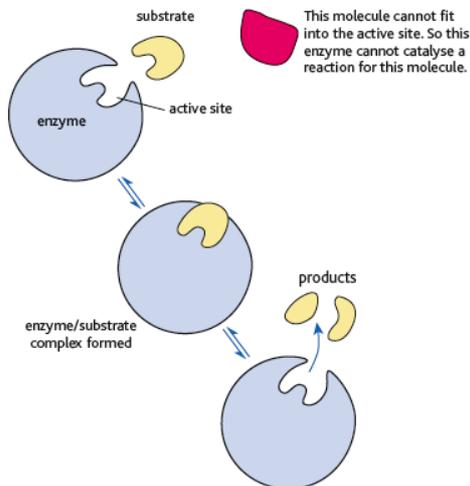
Tertiary structure – the three-dimensional folding of the secondary structure.



Quaternary structure – the three-dimensional arrangement of more than one tertiary polypeptide.

Summary sheet 2: Enzymes activity

Enzymes are biological catalysts that speed up chemical reactions. Enzymes work by reducing the amount of activation energy needed for the reaction to occur.

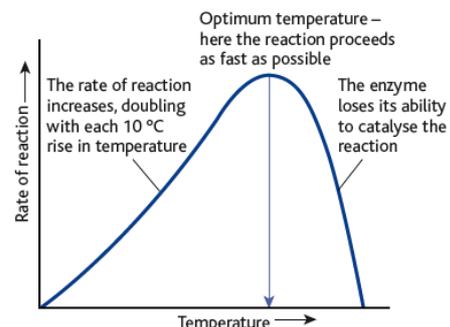


The active site of the enzyme is where the substrate binds. It has a specific shape which means enzymes can only bind to a specific substrate.

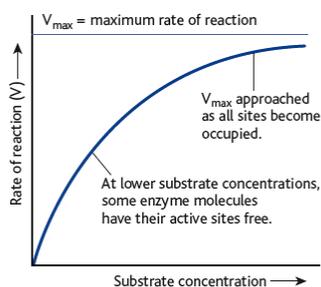
The substrate binds to the active site forming an enzyme-substrate complex. The reaction is catalysed and the products released.

Different factors can affect how quickly the enzymes work. These include temperature, pH, enzyme concentration and substrate concentration.

As temperature increases there is more chance of a collision between the enzyme and substrates, as they have more kinetic energy. This continues until the optimum temperature where the rate of reaction is highest. As the temperature continues to rise the enzyme denatures, as the active site changes shape, when bonds holding the protein together break.



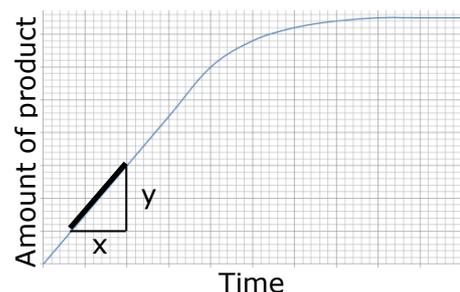
Enzymes also have an optimum pH, above and below the optimum pH the enzyme denatures.



As the substrate concentration increases there is more chance of a collision between the substrate and the enzyme. The rate of reaction increases until all the active sites are occupied.

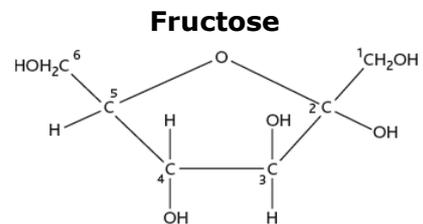
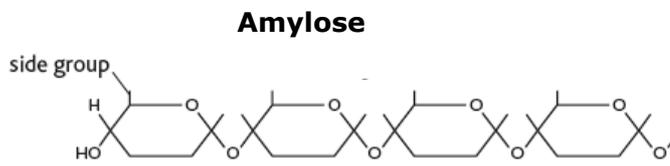
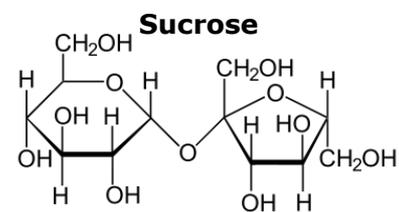
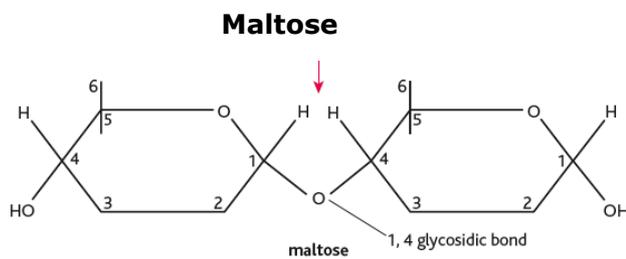
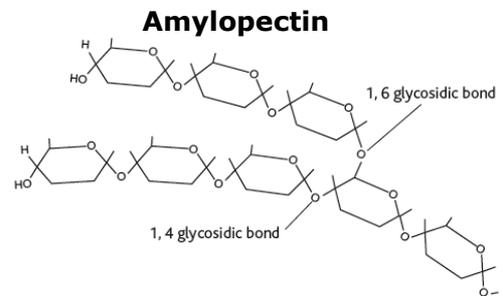
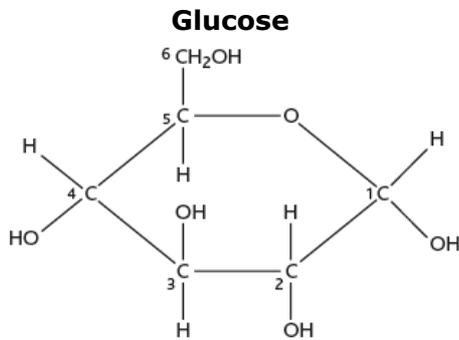
The rate of reaction increases as enzyme concentration increases until all the substrate is bound to an enzyme.

In practical situations you can sometimes measure the amount of product formed over time. The initial rate of the reaction for an enzyme can be calculated by measuring the gradient of the graph. If the line is curved a tangent to the curve can be used: $\text{gradient} = y \div x$.



Worksheet 1: Carbohydrates

The diagram shows the chemical structures of some monosaccharides, disaccharides and polysaccharides. Giving a reason, separate the molecules into these three groups.



Monosaccharides	Disaccharides	Polysaccharides

Worksheet 2: Data analysis

Processed data should be recorded to the same number of decimal places as the primary data

This table shows the same data recorded to different numbers of decimal places.

Data set 1	Data set 2
2.4	2.37
3.6	3.55
4.1	4.05
2.8	2.76
3.5	3.51

- 1 Compare the mean values for data set 1 and data set 2.
- 2 Express data set 2 to 1 decimal place. What do you notice?
- 3 Explain why it is incorrect to record 3.28 as the mean for data set 1.

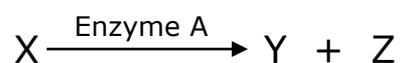
Being able to convert data, using standard form and different units, is an important skill

- 4 Convert the data in the table below.

Data		Value
45 100 g	into standard form	
45 100 g	into kilograms	
34 ms	into seconds	
780 μm	into millimetres	
$0.25 \times 10^{-9} \text{ s}$	into nanoseconds	

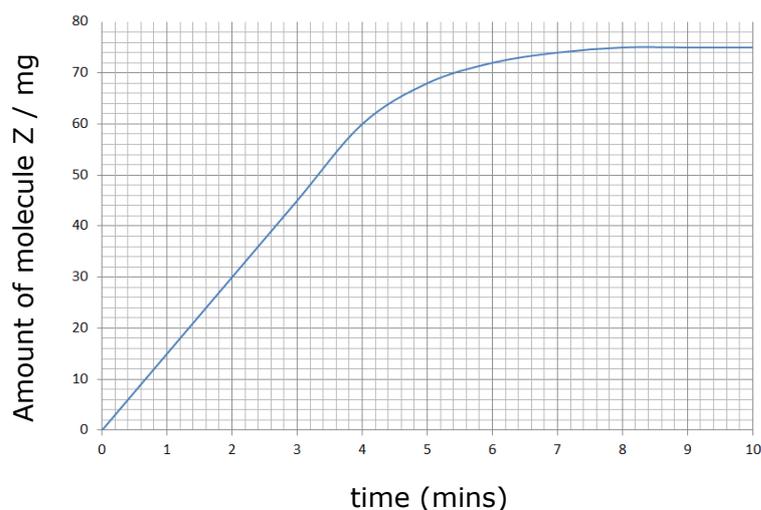
Practice questions

- 1** Enzyme A catalyses the breakdown of molecule X into Y and Z.



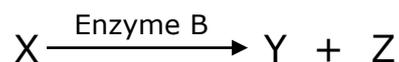
Molecule X and enzyme A were mixed together at 30°C at pH 6.8.

This graph shows the mass of molecule Z formed over a 10 minute time period.



- a** Calculate the initial rate of reaction of enzyme A.
- b** What is the rate of reaction of enzyme A after 8 minutes?
- c** Suggest a reason for the rate of reaction calculated in **b**.

2 Enzyme B catalyses the breakdown of molecule X into Y and Z.



Molecule X and enzyme B were mixed together at different temperatures.

This table shows the initial rate of reaction of enzyme B at 15°C, 25°C, 30°C, 35°C, 40°C and 50°C.

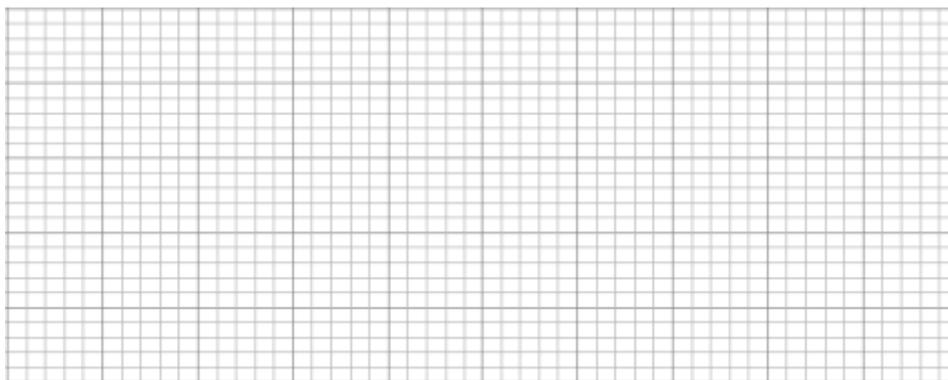
Temperature	Initial rate of reaction of enzyme B (mmol.min ⁻¹)
15	8
25	14
30	18
35	20
40	18
50	12

a The table has some missing information. Add the missing information to the table.

b Plot the data from the table on graph to show the initial rate of reaction of enzyme B at different temperatures.

You should consider:

- the variable which should be on the x-axis
- the labels for the axis
- the title of the graph.



c Compare different rates of reaction of enzyme B at 20°C, 37°C and 45°C.

For questions which involve the use of data from a graph you must use scientific knowledge to explain the data you have extract from the graph.

3 Mutations in DNA can impact on the activity of enzymes.

This DNA sequence is from the region of the gene which codes for the active site of an enzyme.

GAA GAG AGT GGA CTC ACA GCT CGG

The table shows the amino acid coded for by some codons.

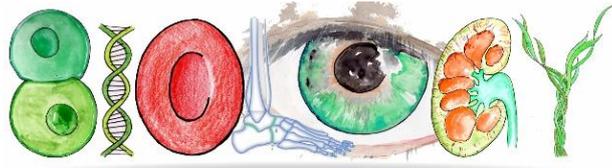
Amino acid/stop signal	DNA triplet codons
Proline	GGT GGG GGA
Alanine	CGG CGA CGT CGC
Cysteine	ACA ACG
Serine	AGG AGA AGT AGC
Leucine	GAA GAG GAT GAC
Arginine	GCA GCG GCT GCC
Glutamine	CTT CTC
Glycine	CCT CCG CCA CCC
Threonine	TGC TGA TGT TGG
Stop signal	ATT ATC ACT

- a** State the amino acid sequence coded for by the sequence above.
- b** Using the information above explain the effect on the protein produced for the following mutations.

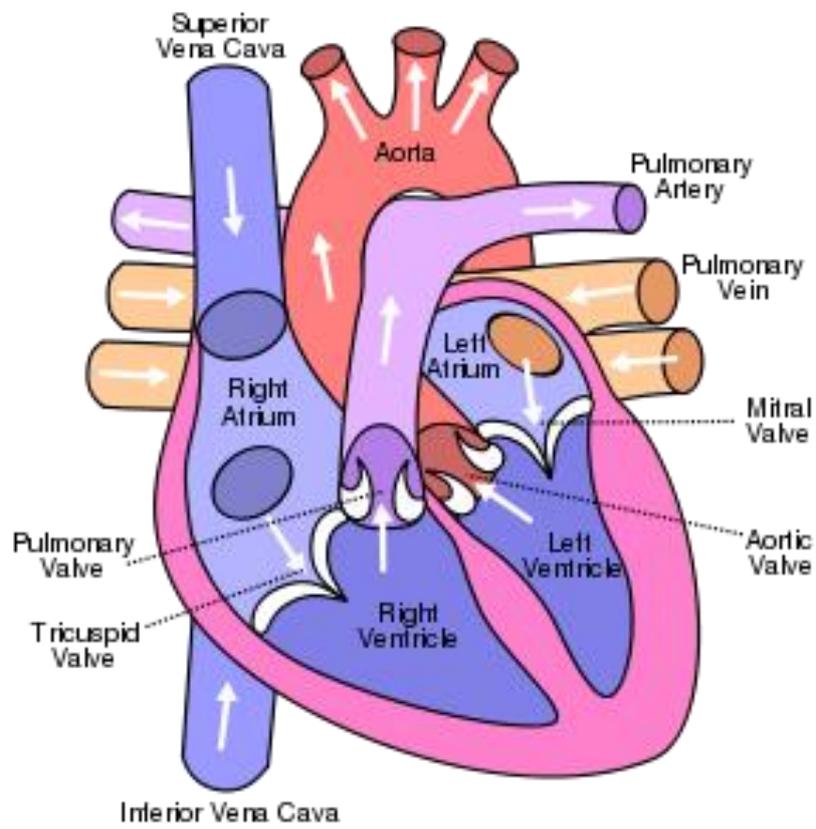
GAA GAT AGT GGA CTC ACA GCT CGG

GAA GAG AGT GGA CTC CCA GCT CGG

GAA GAG AGT GGA CTC ACA ACT CGG

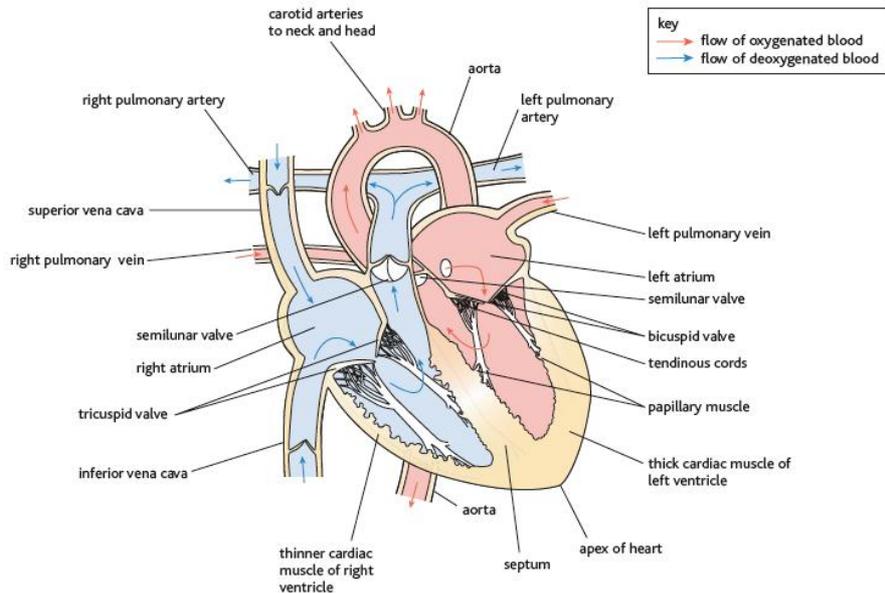


Section C: Human Biology

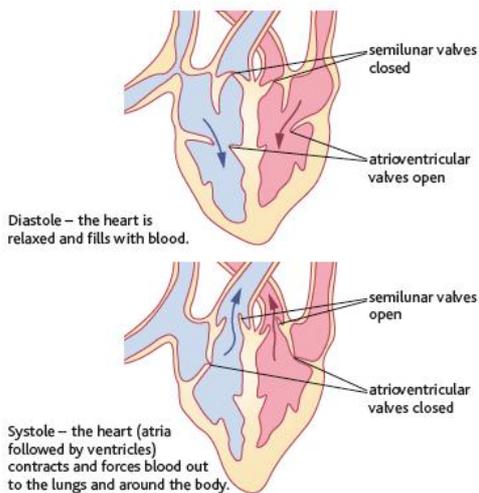


Summary sheet 1: Heart and lungs

The left side of the heart pumps oxygenated blood from the lungs around the body. The blood enters the left atrium from the pulmonary vein. It flows through the atrioventricular or bicuspid valve to the left ventricle. The blood is then pumped into the aorta, through a semi-lunar valve, and around the body.



The right side of the heart pumps deoxygenated blood from the body back to the lungs. The blood returns from the body to the right atrium via the vena cava. It flows through the atrioventricular or tricuspid valve to the right ventricle. The blood is then pumped into the pulmonary artery, through a semi-lunar valve, and to the lungs.

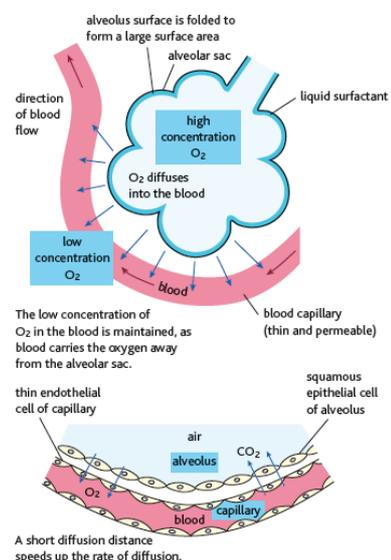


The atrioventricular valves between the atrium and ventricles open to allow blood to flow from the atrium into the ventricles and close when the pressure in the ventricles rises to prevent back flow.

The semi-lunar valves in the aorta and pulmonary artery open to allow blood from the ventricles to flow into the arteries. They close to prevent backflow into the ventricles as the heart relaxes.

Oxygen enters the blood in the alveoli of the lungs. Oxygen in the alveolus is at a high concentration and it diffuses down the concentration gradient into the blood which has a low concentration of oxygen. This low concentration is maintained because the blood is moving and carries the oxygen away.

The walls of the alveolus and capillaries are only one cell thick. This creates a short diffusion distance between the alveolus and the blood allowing a high rate of diffusion.

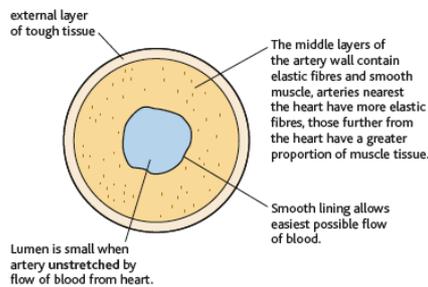
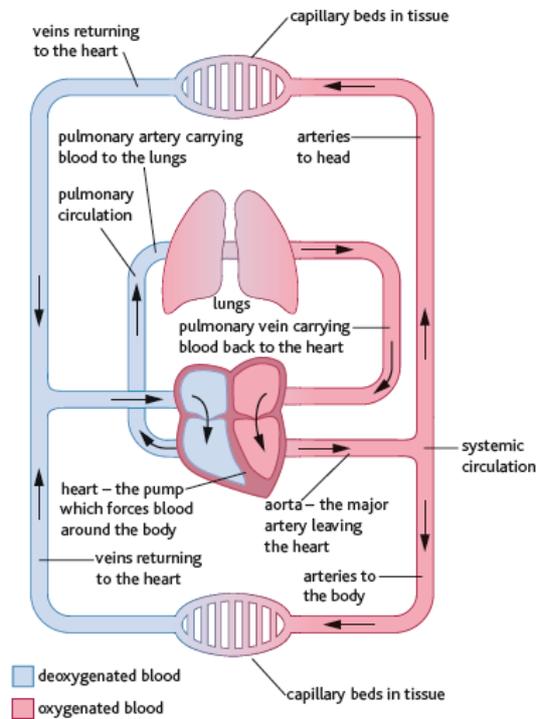


Summary sheet 2: Circulatory system

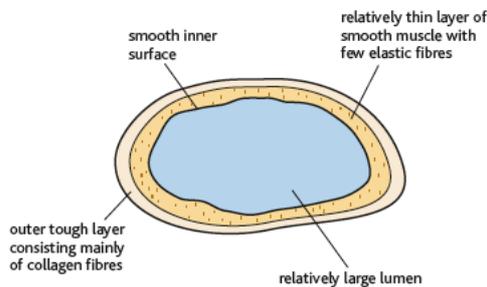
Blood flows around the body via a network of arteries, veins and capillaries.

The double circulation system of mammals means that blood flows through the heart twice in one complete cycle of the body.

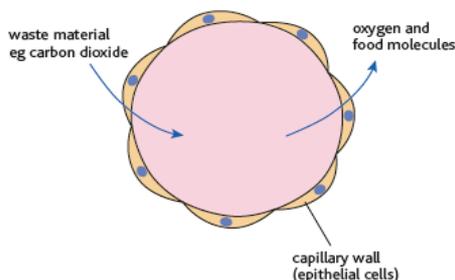
The pulmonary system pumps blood around the lungs and the systemic system pumps blood around the rest of the body.



Arteries carry blood away from the heart. The vessel walls are thick and muscular with elastic fibres to withstand the high pressure generated by the heart.



Veins carry blood from capillary beds back to the heart. The blood is at low pressure and the walls of the vessels are relatively thin with less elastic fibre. The contraction of muscles help push the blood through veins and the vessels have valves to prevent backflow.



Capillaries are thin vessels that form capillary networks around tissues. They allow the exchange of substances such as oxygen, glucose and waste materials between cells and the blood.

Worksheet 1: Prefixes

Scientific terms use common prefixes. Find out the definition/meaning of the prefixes shown in the table.

Word/prefix	Definition/meaning
endo	
exo	
pulmonary	
cardiac	
hepatic	
mono	
di	
photo	
haem	
bio	
chemo	

Worksheet 2: Keywords

Candidates frequently lose marks in examinations because they do not use sufficient key words in detailed responses.

Read the responses to the questions below. Using the keywords from the box write improved answers to the questions.

concentration	capillaries	vein
diffusion	thin	semi-lunar
right	pulmonary	valve
gradient	atrioventricular	left
aorta	vena cava	artery
thick	osmosis	

- 1** Explain how oxygen enters the blood at the alveoli.

In the alveolus oxygen from the air moves into the blood vessels through the walls of the alveolus. The blood is moving so there is always a low concentration in the blood.

- 2** Describe the route blood takes from the lungs to the body.

Blood from the lungs blood travels through a vein to the atrium. The blood is pumped from the atrium into the ventricle and then into the aorta.

Practice questions

- 1 a** Write a definition for each key word in the box. If possible give a structural feature for each key word.

atria	ventricles	aorta	vena cava	pulmonary artery
	pulmonary vein	atrioventricular valves	septum	
	semi-lunar valves	diastolye	systole	

atria:

ventricles:

aorta:

vena cava:

pulmonary artery:

pulmonary vein:

atrioventricular valves:

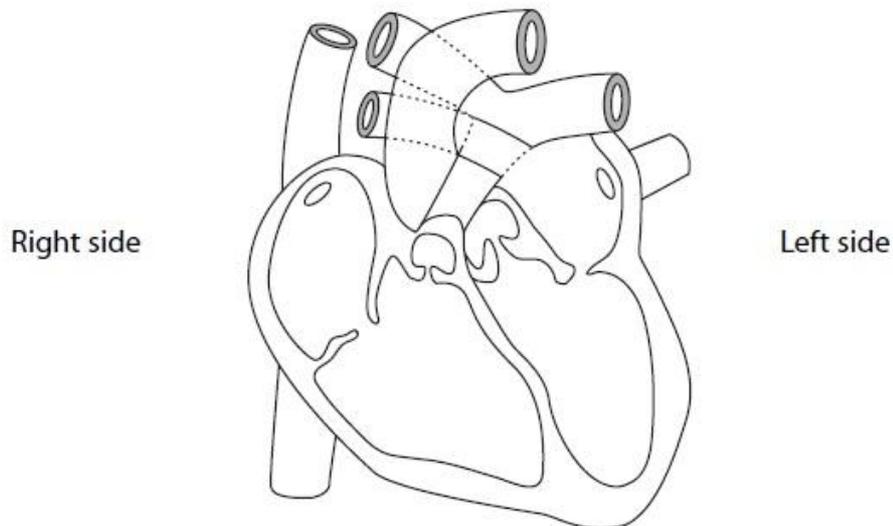
septum:

semi-lunar valves:

diastolye:

systole:

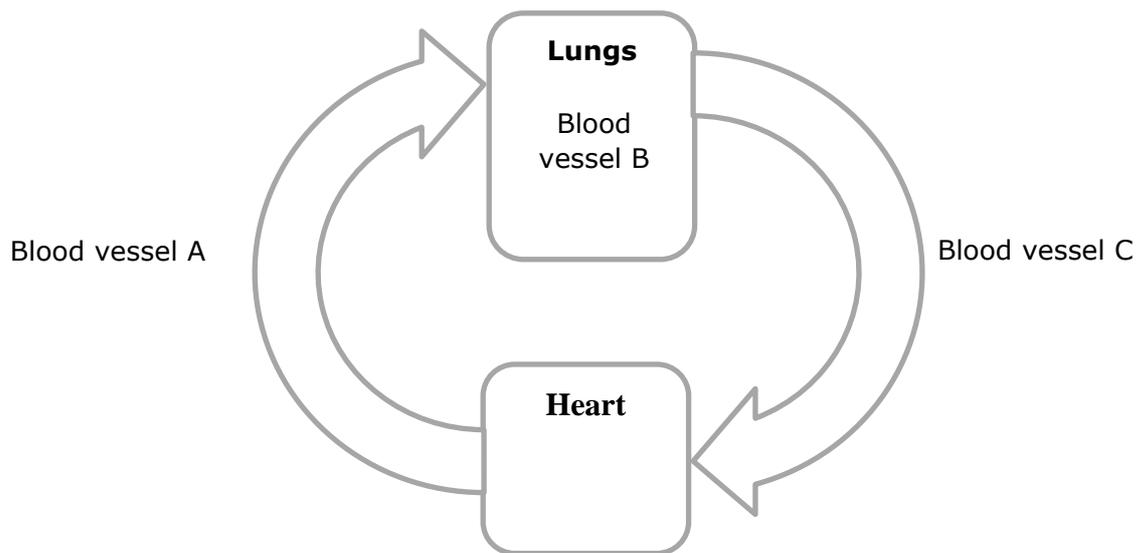
- b** Label this diagram of the heart using as many of the key words from **1 a** as possible.



- c** Use the keywords from **1 a** in your answers to the following questions.
- i** Explain why the left ventricle has thicker chamber walls than the right ventricle and the atria.

 - ii** Describe the role of the atrioventricular valves.

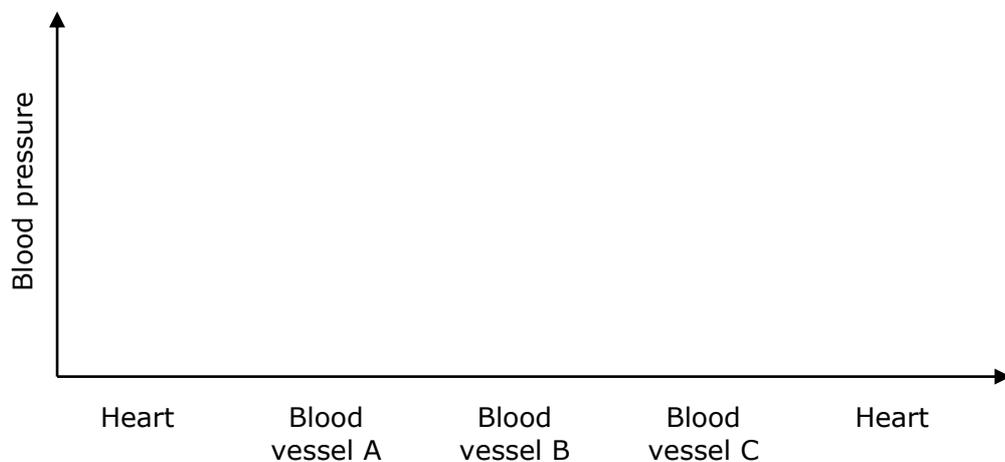
2 This flow diagram shows the part of the circulation system in a mammal.



a Complete a table to show conditions of blood vessel A, B and C.

Blood vessel	Type of vessel	Level of oxygen saturation	Relative pressure of the blood	Valves present in the vessel	Thickness of blood vessel walls
A					
B					
C					

b Draw a line on the axis to show the blood pressure changes in the blood as it flows from the heart to the lungs before returning to the heart.



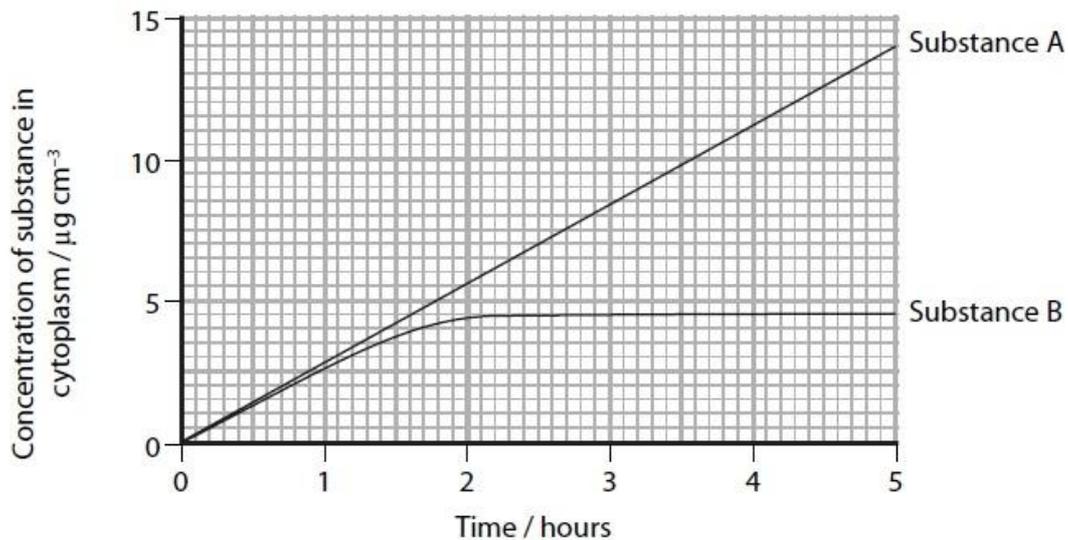
- 3 *Amoeba* is a single-celled aquatic organism. Substances in the water can enter the cell by a variety of mechanisms.

An experiment was carried out to compare the uptake into *Amoeba* of substance A and substance B.

Some of these organisms were placed in a solution containing equal concentrations of both substances and kept at 25°C.

The concentration of substances A and B, in the cytoplasm of these organisms, was measured every 30 minutes over a period of 5 hours.

The results of this experiment are shown in the graph below.



- a Using the information in the graph, compare the uptake of substance A with the uptake of substance B during this period of 5 hours.
- b Substance B enters the cells by diffusion. Describe and explain how the results of this experiment support this statement.
- c Substance A enters the cells by active transport. Give **two** differences between active transport and diffusion.
- 1
- 2