Caroline Chisholm School
Ambition Confidence Success
Everyone Every Lesson Every Opportunity

AQA GCSE BIOLOGY PAPER 1

REVISION BOOKLET

Name:..... Class: .....

AQA GCSE Biology Paper 1 Content

For your End of Year exam, you will be sitting a full AQA GCSE Biology Paper 1. You will be examined on the following topics.

What's assessed	Time	Marks available
• Cell biology • Organisation • Infection and response • Bioenergetics	1 hr 45 mins	100

Cell Biology	
1. Cell structure and transport - Microscopes - Animal and plant cells - Eukaryotic and prokaryotic cells - Specialisation in animal cells - Specialisation in plant cells - Diffusion - Osmosis - Osmosis in plants - Active transport - Exchanging materials **Required Practical**: Microscopy – Use a light microscope to observe, draw, and label a selection of plant and animal cells and include a scale magnification **Required Practical:** Osmosis – Investigate osmosis by measuring how the mass of plant tissue changes n a range of concentrations of salt or sugar solutions	**2. Cell division** - Cell division - Growth and differentiation - Stem cells - Stem cell dilemmas

Organisation	
3. The human digestive system - Principles of organisation - The human digestive system - The chemistry of food - Catalysts and enzymes - Factors affecting enzyme action - How the digestive system works - Making digestion efficient **Required Practical: Food tests** – Detect sugars, starch, and proteins in food by using Benedict's test, the iodine tests, and Biuret reagent **Required Practical: Enzymes** – Use a continuous sampling techniques to determine the time taken to completely digest a starch solution at a range of pH values	**4. Organisation in animals and plants** - The blood - The blood vessels - The heart - Helping the heart - Breathing and gas exchange - Tissues and organs in pants - Transport systems in plants - Evaporation and transpiration - Factors affecting transpiration

AQA GCSE Biology Paper 1 Content

Infection and Response	
5. Communicable diseases - Health and disease - Pathogens and disease - *Growing bacteria in the lab (Biology only)* - *Preventing bacterial growth (Biology only)* - Preventing infection - Viral diseases - Bacterial diseases - Diseases caused by fungi and protists - Human defence responses - *more about plants (Biology only)* - *Plant defence responses (Biology only)* **Required Practical**: Microbiology – Use agar plates and measure the zones of inhibition produced around colonies *(Biology only)*	**6. Preventing and treating disease** - Vaccination - Antibiotics and painkillers - Discovering drugs - Developing drugs - *Making monoclonal antibodies (Biology only)* - *Please note, Uses of Monoclonal antibodies (Biology only)*
7. Non-communicable diseases - Non-communicable diseases - Cancer - Smoking and risk of diseases - Diet, exercise and disease - Alcohol and other carcinogens	

Bioenergetics	
8. Photosynthesis - Photosynthesis - The rate of photosynthesis - How plants use glucose - Making the most of photosynthesis	**9. Respiration** - Aerobic respiration - The response to exercise - Anaerobic respiration - Metabolism and the liver

B1 Cell Structure and Transport – Paper 1

Lesson	Aiming for 4		Aiming for 6		Aiming for 8	
The world of the microscope	I can use a light microscope.		I can describe the difference between magnification and resolution.		I can compare and contrast the magnification and resolution obtained by using light and electron microscopes.	
	I can state why microscopes are useful in the study of cell biology.		I can describe the advantages and disadvantages of using a light and electron microscope.		I can justify the use of an electron microscope.	
	I can calculate total magnification.		I can use the formula: magnification = size of image/size of real object.		I can re-arrange the magnification equation and measure the size of cells.	
Animal and plant cells	I can identify a plant and animal cell from a diagram.		I can describe the functions of the parts of cells.		I can explain how the main structures of cells are related to their functions.	
	I can name the main parts of cells.		I can compare plant and animal cells.		I can suggest reasons why some cells do not contain all cell structures.	
	I can prepare a microscope slide.		I can use a microscope to study plant and algal cells.		I can compare sizes of cells using units of length and standard form.	
Eukaryotic cells and prokaryotic cells	I can identify structures in prokaryotic cells.		I can compare prokaryotic and eukaryotic cells.		I can explain how the main structures of prokaryotic cells are related to their functions.	
	I can state that bacterial (prokaryotic) cells do not contain a nucleus and eukaryotic cells do.		I can describe the functions of the parts of a prokaryotic cell.		I can perform calculations to work out orders of magnitude.	
	I can use orders of magnitude to correctly order objects according to size.		I can use orders of magnitude to compare sizes of organisms.			
Specialisation in animal cells	I can identify specialised animals cells from diagrams.		I can explain why animals have specialised cells.		I can discuss how the structure of specialised animal cells are related to their function within the organ and whole organism.	
	I can describe the function of specialised animal cells.		I can compare the structure of a specialised and generalised animal cell.		I can suggest the function of an unknown specialised cell based on its structure.	
	I can write a basic explanation of how animal cells are adapted.		I can write a coherent explanation of how animal cells are adapted.		I can write an effectively structured explanation of how animal cells are adapted.	
Specialisation in plant cells	I can identify specialised plant cells from diagrams.		I can compare the structure of a specialised and generalised plant cell.		I can discuss how the structure of specialised plant cells is related to their function within the organ and whole organism.	
	I can describe the function of specialised plant cells.		I can describe the adaptations of specialised plant cells.		I can design a cell, tissue or organ to perform a certain function.	
	I can use a light microscope to view a root hair cell.		I can draw a scientific drawing of a root hair cell observed using a light microscope.		I can measure a root hair cell observed using a light microscope.	

B1 Cell Structure and Transport – Paper 1

Diffusion	I can state that diffusion is the spreading of the particles of any substance in solution, or particles of a gas.		I can predict which way substances will move across a cell membrane.		I can explain how temperature and concentration gradient affects rate of diffusion.		
	I can list the factors that affect the rate of diffusion.		I can explain why surface area affects the rate of diffusion.		I can write a hypothesis using detailed scientific knowledge and explain how it could be tested.		
	I can write a simple hypothesis.		I can write a hypothesis using scientific knowledge.				
Osmosis	I can describe what osmosis is.		I can state the differences between osmosis and diffusion.		I can explain how a model shows osmosis in a cell.		
	I can state that if animal cells lose or gain too much water by osmosis they can stop working properly.		I can use ideas about osmosis to explain why maintaining constant internal conditions in living organisms is important.		I can use the terms isotonic, hypotonic or hypertonic to explain the movement of water across a cell membrane.		
			I can write a prediction using scientific knowledge of osmosis.				
Osmosis in plants	I can state that if a plant loses too much water from its cells they become soft.		I can use use osmosis to explain the effect of placing plant tissue in salt or sugar solutions.		I can explain the mechanisms that lead to turgid or flaccid plant cells and plasmolysis.		
	I can write a simple method with support.		I can write a suitable plan to investigate into the effect of salt or sugar solutions on plant tissue.		I can write a detailed plan independently.		
	I can use given data to plot a suitable graph with some support.		I can calculate percentage change and use this to plot a line graph with negative numbers and draw a line of best fit.		I can use a line graph to estimate the concentration of solution inside a plant cell.		
Active transport	I can define active transport as the movement of a substance against a concentration gradient using energy.		I can explain why active transport is important for living organisms.		I can describe how active transport takes place.		
	I can identify where active transport takes place.		I can explain the differences between diffusion, osmosis, and active transport.		I can suggest how a cell that carries out active transport is adapted to this function.		
	I can use a representational model to show active transport.		I can suggest some improvements/ limitations to a representational model that shows active transport.		I can design and evaluate a representational model to show active transport.		
Exchanging materials	I can state the function of exchange surfaces in plants and animals.		I can describe how the effectiveness of exchange surfaces is increased.		I can link ideas about diffusion to explain how the adaptations of exchange surfaces increases their effectiveness.		
	I can state that a single-celled organism has a relatively large surface area to volume ratio.		I can use ideas about surface area to volume ratio to describe why multicellular organisms need exchange surfaces.		I can use ideas about surface area to explain the shape of a leaf.		
	I can calculate the surface area to volume ratio of a cube.		I can calculate the surface area to volume ratio of a cylinder.		I can calculate the surface area to volume ratio of a sphere.		

B2 Cell Division – Paper 1

Lesson	Aiming for 4		Aiming for 6		Aiming for 8	
Cell division	I can state that human body cells have 46 chromosomes and gametes have 23.		I can explain why chromosomes in body cells are normally found in pairs.		I can explain why genetic material must be doubled during mitosis.	
	I can state that mitosis is a stage in cell division.		I can describe situations where mitosis is occurring.		I can explain in detail what happens at each stage of the cell cycle.	
	I can state the meaning of most of the keywords – mitosis, chromosomes, gene, gametes.		I can use the keywords to describe the process of mitosis.		I can use the keywords to write detailed explanations on why mitosis is an important process in living things and how characteristics are inherited.	
Growth and differentiation	I can define the terms growth and differentiation.		I can describe the importance of cell differentiation in multicellular organisms.		I can compare and contrast differentiation in plants and animals.	
	I can state why plant clones are genetically identical to each other.		I can explain how using tissue culture creates a clone of a plant.		I can explain why it is easier to clone a plant compared to an animal.	
	I can attempt to clone a plant by using apparatus correctly.		I can attempt to clone a plant by using the apparatus correctly and following safety rules.		I can explain and carry out a practical accurately and safely in order to successfully clone a plant.	
Stem cells	I can state that a stem cell is a cell that is not differentiated.		I can describe differences between embryonic and adult stem cells.		I can explain why embryonic stem cells are more useful for helping medical conditions.	
	I can state that plant stem cells can be used to create clones.		I can explain why plant clones are produced in the agriculture industry.		I can write a well-structured article about stem cells which has impact by the use of precise vocabulary and real-life examples.	
	I can write a simple article which states ways that stem cells can be used to help medical conditions.		I can write a well-structured article which communicates effectively how stem cells can be used to help medical conditions.			
Stem cell dilemmas	I can list some arguments for and against the use of stem cells.		I can describe what therapeutic cloning can be used for.		I can explain the process of therapeutic cloning organism.	
	I can verbally communicate simple ideas during a group discussion.		I can explain the reasons for ethical and religious objections against stem cells.		I can evaluate the use of stem cells.	
			I can verbally communicate well-constructed arguments.		I can clearly communicate strong, well-researched arguments in a persuasive manner.	

B3 Organisation and Digestion – Paper 1

Lesson	Aiming for 4		Aiming for 6		Aiming for 8	
Tissues and organs in animals	I can state examples of cells, tissues, organs, and organ systems.		I can define the terms tissue, organ, and organ system.		I can relate levels of organisation to familiar organ systems in order to give examples of cells, tissues, and organs.	
	I can name organs found in a given organ systems.		I can describe the function of certain organs and organ systems.		I can explain why the cells of multicellular organisms are organised into tissues, organs, and organ systems.	
	I can order cells, tissues, organs, and organ systems according to their relative sizes.		I can identify tissues that make up organs.		I can suggest the function of glandular, epithelial, and muscular tissue in organs.	
The human digestive system	I can identify some of the organs of the digestive system.		I can name all of the organs of the digestive system.		I can link the process of digestion to other processes in the body in order to explain its function.	
	I can state the function of some of the organs of the digestive system.		I can state the functions of the organs.		I can explain in detail how the small intestine is adapted to its function.	
	I can state simply what happens to food during digestion.		I can summarise the process of digestion.		I can explain in detail what happens to food during digestion.	
The chemistry of food	I can recall that food contains the molecules carbohydrates, lipids (fats), and protein.		I can describe the structure of simple sugars, starch, lipids, and proteins.		I can explain which food molecules are polymers.	
	I can state the function of each food molecule in the diet.		I can carry out multiple food tests in an organised manner.		I can apply knowledge of the function of food molecules in the body to give diet advice.	
	I can carry out a food test and record results in a table.		I can design a results table to clearly record results from food tests.		I can use scientific knowledge to make predictions of what nutrients a food contains	
Catalysts and enzymes	I can recall that enzymes are proteins which are biological catalysts – they speed up reactions.		I can describe how enzymes are used in digestion.		I can explain how enzymes speed up reactions.	
	I can state one function of enzymes inside the body.		I can use the 'lock and key theory' to explain why the shape of the enzyme is vital for it to function.		I can explain how enzymes control metabolism.	
	I can state the independent variable in an investigation.		I can state the variables in an investigation.		I can plan an experiment to investigate how different catalysts affect the rate of a reaction.	
Factors affecting enzyme action	I can state that temperature and pH affects how well an enzyme works.		I can explain why high temperatures and changes in pH prevent enzymes from catalysing reactions.		I can explain in detail how a change in temperature or pH affects the rate of an enzyme-catalysed reaction.	
	I can plan a simple method to carry out an investigation.		I can plan and carry out an investigation in order to gather accurate results.		I can plot a line graph with error bars.	
	I can state simply what a line graph shows about how temperature or pH affects the rate of an enzyme catalysed reaction.		I can plot a line graph and use it to draw conclusions about how temperature and pH affects the rate of an enzyme catalysed reaction.		I can analyse results in order to evaluate a method and the validity of conclusions, explaining suggestions for possible improvements.	

B3 Organisation and Digestion – Paper 1

How the digestive system works	I can recall that enzymes are used in digestion to break down food molecules.		I can explain why enzymes are needed for digestion.		I can suggest how to test for substrates and products in the model gut.	
	I can identify that carbohydrases break down carbohydrates, proteases break down proteins, and lipases break down lipids.		I can for each food molecule, name the enzyme that acts on it, where it is produced, and which products are formed.		I can make a prediction with a scientific explanation.	
	I can follow a method to set up and test for substances in a model gut.		I can make a prediction on the results from the model gut.		I can evaluate a model by discussing its limitations.	
Making digestion efficient	I can state that the stomach contains acid.		I can describe the functions of bile.		I can explain how acid in the stomach increases the efficiency of pepsin.	
	I can state that the liver produces bile.		I can calculate the mean rate of an enzyme-catalysed reaction.		I can explain how bile increases the efficiency of fat digestion.	
	I can write a simple hypothesis and prediction.		I can analyse data in order to determine if a hypothesis is correct.		I can explain how the rate of an enzyme catalysed reaction shows how efficient the reaction is.	

B4 Organising Animals and Plants – Paper 1

Lesson	Aiming for 4		Aiming for 6		Aiming for 8	
The blood	I can state the main components in blood.		I can summarise the process of blood clotting.		I can suggest how white blood cells are adapted to their function.	
	I can recognise the components of blood from photomicrographs.		I can view blood under a light microscope and recognise components.		I can estimate the diameter of a red blood cell and comment on its uncertainty.	
	I can describe the function of each component in blood.		I can explain how red blood cells are adapted to their function.		I can evaluate in detail a model of the blood.	
The blood vessels	I can state the three main types of blood vessel and recognise them from diagrams.		I can explain how the structure relates to the functions of blood vessels.		I can explain in detail the importance of a double circulatory system.	
	I can estimate heart rate.		I can comment on how accurate estimations are.		I can explain how to make estimates more accurate in terms of precision of data.	
The heart	I can state the function of the heart.		I can describe the function of the main structures of the human heart.		I can explain in detail how the structure of the different parts of the human heart is related to their function.	
	I can state the main structures of the human heart.		I can describe the problems that can develop with blood vessels in the heart and their treatments.		I can recognise the main structures of the heart when carrying out a heart dissection.	
	I can state examples of problems that can develop in blood vessels in the human heart.		I can suggest advantages and disadvantages of using stents and statins.		I can evaluate the use of stents and statins in treating problems with blood vessels.	
Helping the heart	I can state that heartbeat is maintained by a group of cells that act as a pacemaker.		I can explain why an irregular heartbeat is detrimental to health.		I can explain how a natural pacemaker maintains the heartbeat.	
	I can state some ways in which the heart can stop functioning efficiently.		I can describe why people may have objections to heart transplants.		I can suggest how an artificial pacemaker regulates an irregular heartbeat.	
	I can describe why a person may need an artificial pacemaker or an artificial heart.		I can summarise the advantages and disadvantages different treatments of heart problems.		I can evaluate in detail the different methods used in the treatment of heart problems.	
Breathing and gas exchange	I can list the main structures of the gas exchange system.		I can describe the function of the main structures of the gas exchange system.		I can evaluate in detail a model of the lungs.	
	I can state that gas exchange happens in the alveoli.		I can describe how alveoli are adapted.		I can explain in detail how adaptations of alveoli result in efficient gas exchange.	
	I can use data in the form of percentages to describe the differences in the composition of inhaled and exhaled air.		I can describe the processes of ventilation and gas exchange.		I can explain the differences between the composition of inhaled and exhaled air.	

B4 Organising Animals and Plants – Paper 1

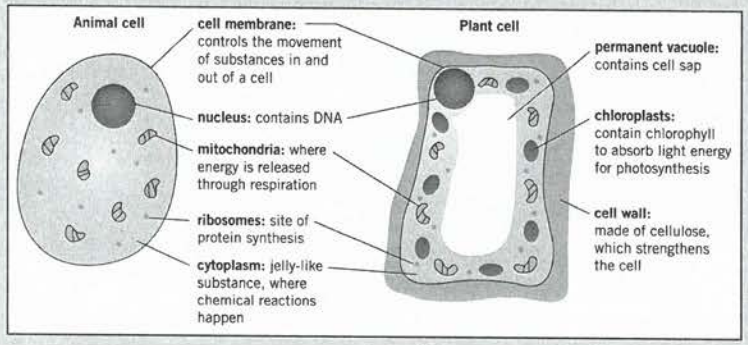
Tissues and organs in plants	I can recognise examples of plant organs and state their functions.		I can describe how plant organs are involved in the transport system.		I can suggest what type of plant organs unfamiliar structures are.		
	I can use a light microscope to view a cross-section of a leaf.		I can use a microscope to identify the different tissues in a cross-section of a leaf.		I can use a light microscope to draw a leaf cross-section and calculate scale.		
	I can state the functions of different plant tissues.		I can explain how the structures of tissues in the leaf are related to their functions.		I can suggest functions for unknown plant tissues.		
Transport systems in plants	I can state the function of xylem and phloem tissue.		I can describe why transport in plants is important.		I can apply knowledge of the plant transport system to explain how systemic pesticides work and evaluate their use.		
	I can collect evidence for movement of water through xylem.		I can explain how the structure of xylem and phloem are adapted to their functions.		I can explain in detail how the rate of transport through a plant can be measured.		
Evaporation and transpiration	I can state that transpiration is the evaporation of water vapour from the leaves.		I can describe how transpiration maintains the movement of water from roots to leaves.		I can evaluate drinking from a straw as a model for transpiration.		
	I can state the function of stomata.		I can describe how the opening and closing of stomata is controlled by guard cells.		I can explain in detail how stomata control transpiration.		
	I can calculate the mean number of stomata on a given area of leaf.		I can use sampling to estimate the number of stomata on a leaf.		I can suggest reasons for differences in the number and distribution of stomata, as well as their adaptations.		
Factors affecting transpiration	I can recognise the factors that affect transpiration.		I can explain why temperature, humidity, light intensity and the amount of air flow affect the rate of transpiration.		I can apply particle model to explain in detail why temperature, humidity, light intensity and the amount of air flow affect the rate of transpiration.		
	I can describe how a potometer can be used to estimate the volume of water lost by a plant.		I can describe the differences between a moving bubble potometer and a mass photometer.		I can summarise adaptations to control water loss and explain how they work.		
	I can identify variables when investigating rate of transpiration.		I can make a prediction using scientific knowledge when investigating rate of transpiration.		I can evaluate in detail the use of a potometer to measure the rate of transpiration.		

Chapter 1: Cell biology and transport

Knowledge organiser

Eukaryotic cells

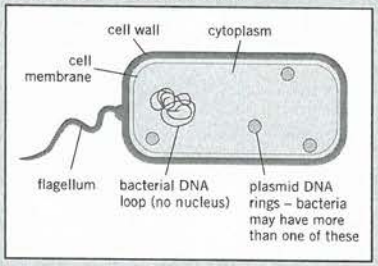
Animal and plant cells are eukaryotic. They have genetic material (DNA) that forms **chromosomes** and is contained in a **nucleus**.



Prokaryotic cells

Bacteria have the following characteristics:

- single-celled
- no nucleus – have a single loop of DNA
- have small rings of DNA called **plasmids**
- smaller than eukaryotic cells.



Microscopes

Light microscope	Electron microscope
uses light to form images	uses a beam of electrons to form images
living samples can be viewed	samples cannot be living
relatively cheap	expensive
low magnification	high magnification
low resolution	high resolution

Electron microscopes allow you to see sub-cellular structures, such as ribosomes, that are too small to be seen with a light microscope.

L To calculate the **magnification** of an image:

$$\text{magnification} = \frac{\text{image size}}{\text{actual size}}$$

Specialised cells

Cells in animals and plants differentiate to form different types of cells. Most animal cells differentiate at an early stage of development, whereas a plant's cells differentiate throughout its lifetime.

Specialised cell	Function	Adaptations
sperm cell	fertilise an ovum (egg)	• tail to swim to the ovum and fertilise it • lots of mitochondria to release energy from respiration, enabling the sperm to swim to the ovum
red blood cell	transport oxygen around the body	• no nucleus so more room to carry oxygen • contains a red pigment called haemoglobin that binds to oxygen molecules • flat bi-concave disc shape to increase surface area-to- volume ratio
muscle cell	contract and relax to allow movement	• contains protein fibres, which can contract to make the cells shorter • contains lots of mitochondria to release energy from respiration, allowing the muscles to contract
nerve cell	carry electrical impulses around the body	• branched endings, called dendrites, to make connections with other neurones or effectors • myelin sheath insulates the axon to increase the transmission speed of the electrical impulses
root hair cell	absorb mineral ions and water from the soil	• long projection speeds up the absorption of water and mineral ions by increasing the surface area of the cell • lots of mitochondria to release energy for the active transport of mineral ions from the soil
palisade cell	enable photosynthesis in the leaf	• lots of chloroplasts containing chlorophyll to absorb light energy • located at the top surface of the leaf where it can absorb the most light energy

Comparing diffusion, osmosis, and active transport

	Diffusion	Osmosis	Active transport
Definition	The spreading out of particles, resulting in a net movement from an area of higher **concentration** to an area of lower concentration. Factors which affect the rate of diffusion: difference in concentration, temperature, and surface area of the membrane.	The diffusion of water from a **dilute** solution to a concentrated solution through a **partially permeable membrane**.	The movement of particles from a more dilute solution to a more concentrated solution using energy from respiration.
Movement of particles	Particles move down the concentration **gradient** – from an area of *high* concentration to an area of *low* concentration.	Water moves from an area of *lower* solute concentration to an area of *higher* solute concentration.	Particles move against the concentration gradient – from an area of *low* concentration to an area of *high* concentration.
Energy required?	no – passive process	no – passive process	yes – energy released by respiration
Examples	**Humans** • Nutrients in the small intestine diffuse into the **capillaries** through the **villi**. • Oxygen diffuses from the air in the **alveoli** into the blood in the capillaries. Carbon dioxide diffuses from the blood in the capillaries into the air in the alveoli. • **Urea** diffuses from cells into the blood for excretion in the kidney. **Fish** • Oxygen from water passing over the gills diffuses into the blood in the **gill filaments**. • Carbon dioxide diffuses from the blood in the gill filaments into the water. **Plants** • Carbon dioxide used for photosynthesis diffuses into leaves through the **stomata**. • Oxygen produced during photosynthesis diffuses out of the leaves through the stomata.	**Plants** • Water moves by osmosis from a dilute solution in the soil to a concentrated solution in the **root hair cell**.	**Humans** • Active transport allows sugar molecules to be absorbed from the small intestine when the sugar concentration is higher in the blood than in the small intestine. **Plants** • Active transport is used to absorb mineral ions into the root hair cells from more dilute solutions in the soil.

Key terms

Make sure you can write a definition for these key terms.

cell membrane, cell wall, chloroplast, chromosome, concentration, cytoplasm, dilute, DNA, eukaryotic, gill filaments, gradient, magnification, mitochondria, nucleus, partially permeable membrane, passive process, permanent vacuole, plasmid, prokaryotic, resolution, ribosome, root hair cell, stomata

Chapter 1: Cell biology and transport

Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

B1 questions	Answers
1 What are two types of eukaryotic cell?	animal and plant
2 What type of cell are bacteria?	prokaryotic
3 Where is DNA found in animal and plant cells?	in the nucleus
4 What is the function of the cell membrane?	controls movement of substances in and out of the cell
5 What is the function of mitochondria?	site of respiration to transfer energy for the cell
6 What is the function of chloroplasts?	contain chlorophyll to absorb light energy for photosynthesis
7 What is the function of ribosomes?	enable production of proteins (protein synthesis)
8 What is the function of the cell wall?	strengthens and supports the cell
9 What is the structure of the main genetic material in a prokaryotic cell?	single loop of DNA
10 How are electron microscopes different to light microscopes?	electron microscopes use beams of electrons instead of light, cannot be used to view living samples, are much more expensive, and have a much higher magnification and resolution
11 What is the function of a red blood cell?	carries oxygen around the body
12 Give three adaptations of a red blood cell.	no nucleus, contains a red pigment called haemoglobin, and has a bi-concave disc shape
13 What is the function of a nerve cell?	carries electrical impulses around the body
14 Give two adaptations of a nerve cell.	branched endings, myelin sheath insulates the axon
15 What is the function of a sperm cell?	fertilises an ovum (egg)
16 Give two adaptations of a sperm cell.	tail, contains lots of mitochondria
17 What is the function of a palisade cell?	carries out photosynthesis in a leaf
18 Give two adaptations of a palisade cell.	lots of chloroplasts, located at the top surface of the leaf
19 What is the function of a root hair cell?	absorbs minerals and water from the soil
20 Give two adaptations of a root hair cell.	long projection, lots of mitochondria

21 What is diffusion?	net movement of particles from an area of high concentration to an area of low concentration along a concentration gradient – this is a passive process (does not require energy from respiration)
22 Name three factors that affect the rate of diffusion.	concentration gradient, temperature, membrane surface area
23 How are villi adapted for exchanging substances?	• long and thin – increases surface area • one-cell-thick membrane – short diffusion pathway • good blood supply – maintains a steep concentration gradient
24 How are the lungs adapted for efficient gas exchange?	• alveoli – large surface area • moist membranes – increases rate of diffusion • one-cell-thick membranes – short diffusion pathway • good blood supply – maintains a steep concentration gradient
25 How are fish gills adapted for efficient gas exchange?	• large surface area for gases to diffuse across • thin layer of cells – short diffusion pathway • good blood supply – maintains a steep concentration gradient
26 What is osmosis?	diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane
27 Give one example of osmosis in a plant.	water moves from the soil into the root hair cell
28 What is active transport?	movement of particles against a concentration gradient – from a dilute solution to a more concentrated solution – using energy from respiration
29 Why is active transport needed in plant roots?	concentration of mineral ions in the soil is lower than inside the root hair cells – the mineral ions must move against the concentration gradient to enter the root hair cells
30 What is the purpose of active transport in the small intestine?	sugars can be absorbed when the concentration of sugar in the small intestine is lower than the concentration of sugar in the blood

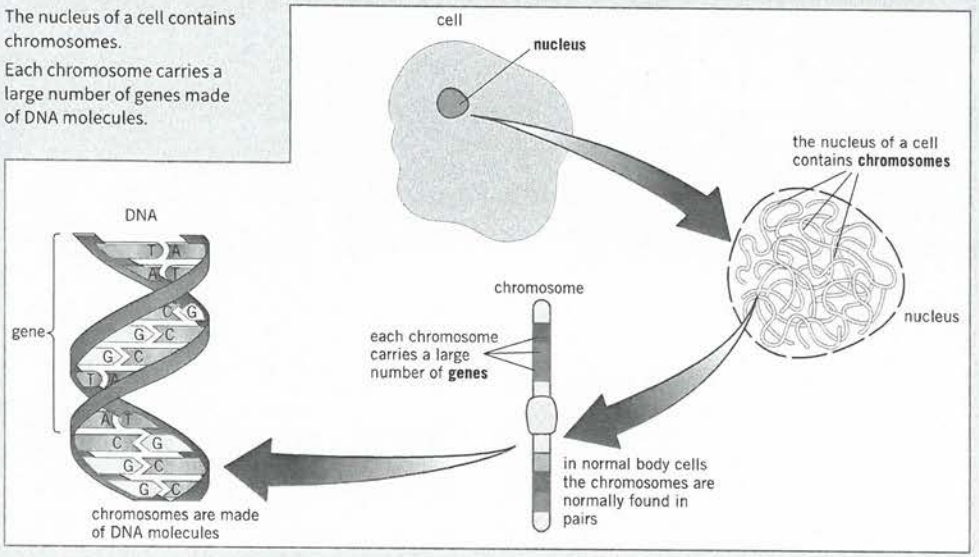
Chapter 2: Cell division

Knowledge organiser

Chromosomes

The nucleus of a cell contains chromosomes.

Each chromosome carries a large number of genes made of DNA molecules.

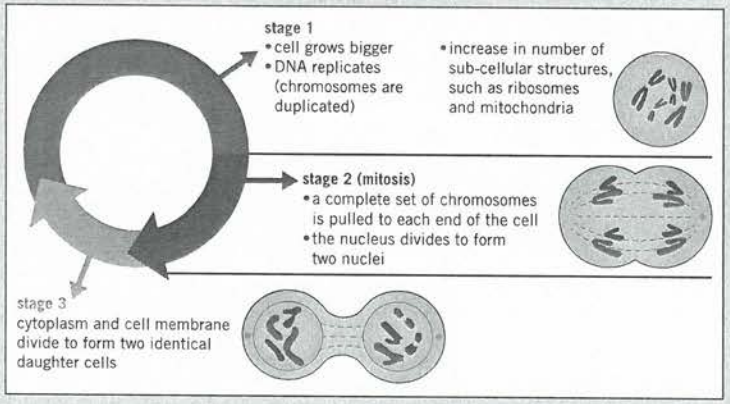


The cell cycle

Body cells divide to form two identical **daughter cells** by going through a series of stages known as the **cell cycle**.

Cell division by **mitosis** is important for the growth and repair of cells, for example, the replacement of skin cells. Mitosis is also used for asexual reproduction.

There are *three* main stages in the cell cycle:



Stem cells in medicine

A stem cell is an undifferentiated cell that can develop into one or more types of specialised cell.

There are two types of stem cell in mammals: **adult stem cells** and **embryonic stem cells**.

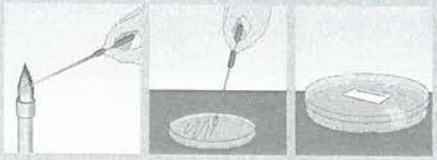
Stem cells can be **cloned** to produce large numbers of identical cells.

Type of stem cell	Where are they found?	What can they differentiate into?	Advantages	Disadvantages
adult stem cells	specific parts of the body in adults and children – for example, bone marrow	can only differentiate to form certain types of cells – for example, stem cells in bone marrow can only differentiate into types of blood cell	• fewer ethical issues – adults can consent to have their stem cells removed and used • an already established technique for treating diseases such as leukaemia • relatively safe to use as a treatment and donors recover quickly	• requires a donor, potentially meaning a long wait time to find someone suitable • can only differentiate into certain types of specialised cells, so can be used to treat fewer diseases
embryonic stem cells	early human embryos (often taken from spare embryos from fertility clinics)	can differentiate into any type of specialised cell in the body – for example, a nerve cell or a muscle cell	• can treat a wide range of diseases as can form any specialised cell • may be possible to grow whole replacement organs • usually no donor needed as they are obtained from spare embryos from fertility clinics	• ethical issues as the embryo is destroyed and each embryo is a potential human life • risk of transferring viral infections to the patient • newer treatment so relatively under-researched – not yet clear if they can cure as many diseases as thought
plant meristem	meristem regions in the roots and shoots of plants	can differentiate into all cell types – they can be used to create clones of whole plants	• rare species of plants can be cloned to prevent extinction • plants with desirable traits, such as disease resistance, can be cloned to produce large numbers of identical plants • fast and low-cost production of large numbers of plants	• cloned plants are genetically identical, so a whole crop is at risk of being destroyed by a single disease or genetic defect

Binary fission

Cell division in bacteria is called binary fission. In optimum temperature and nutrients, bacteria can multiply as often as every 20 minutes. In a lab, bacteria can be grown in sterile conditions on an agar gel plate or in a nutrient broth.

The lid of the petri dish must be sealed but not all the way so that oxygen can still get in. This is so that harmful bacteria that do not need oxygen aren't able to grow.



Therapeutic cloning

In **therapeutic cloning**

- cells from a patient's own body are used to create a cloned early embryo of themselves
- stem cells from this embryo can be used for medical treatments and growing new organs
- these stem cells have the same genes as the patient, so are less likely to be rejected when transplanted.

Key terms

Make sure you can write a definition for these key terms.

adult stem cell, binary fission, cell cycle, chromosome, clone, daughter cells, embryonic stem cell, gene, meristem, mitosis, nucleus, therapeutic cloning

Chapter 2: Cell division

Retrieval questions

Learn the answers to the questions below, then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

B2 questions	Answers
1 What is a stem cell?	undifferentiated cell that can differentiate into one or more specialised cell types
2 What are adult stem cells?	stem cells from adults that can only differentiate into certain specialised cells
3 Where can adult stem cells be found?	bone marrow
4 What are embryonic stem cells?	stem cells from embryos that can differentiate into any specialised cell
5 Where are embryonic stem cells found?	early human embryos (usually from spare embryos from fertility clinics)
6 What is therapeutic cloning?	patient's cells are used to create an early embryo clone of themselves – stem cells from the embryo can then be used to treat the patient's medical conditions
7 Give one advantage of using therapeutic cloning.	stem cells from the embryo are not rejected when transplanted because they have the same genes as the patient
8 Give one advantage of using adult stem cells.	fewer ethical issues as obtained from adults who can consent to their use
9 Give two disadvantages of using adult stem cells.	can take a long time for a suitable donor to be found • can only differentiate into some specialised cell types, so treat fewer diseases
10 Give two advantages of using embryonic stem cells.	• can differentiate into any specialised cell, so can be used to treat many diseases • easier to obtain as they are found in spare embryos from fertility clinics
11 Give two disadvantages of using embryonic stem cells.	• ethical issues surrounding their use, as every embryo is a potential life • potential risks involved with treatments, such as transfer of viral infections
12 What are plant meristems?	area where rapid cell division occurs in the tips of roots and shoots
13 Give two advantages of using plant meristems to clone plants.	• rare species can be cloned to protect them from extinction • plants with special features (e.g., disease resistance) can be cloned to produce many copies
14 Give one disadvantage of using plant meristems to clone plants.	no genetic variation, so, for example, an entire cloned crop could be destroyed by a disease
15 What is cell division by mitosis?	body cells divide to form two identical daughter cells
16 What is the purpose of mitosis?	growth and repair of cells, asexual reproduction
17 What happens during the first stage of the cell cycle?	cell grows bigger, chromosomes duplicate, number of subcellular structures (e.g., ribosomes and mitochondria) increases
18 What happens during mitosis?	one set of chromosomes is pulled to each end of the cell and the nucleus divides
19 What happens during the third stage of the cell cycle?	the cytoplasm and cell membrane divide, forming two identical daughter cells
20 What is the term for cell division in bacteria?	Binary fission

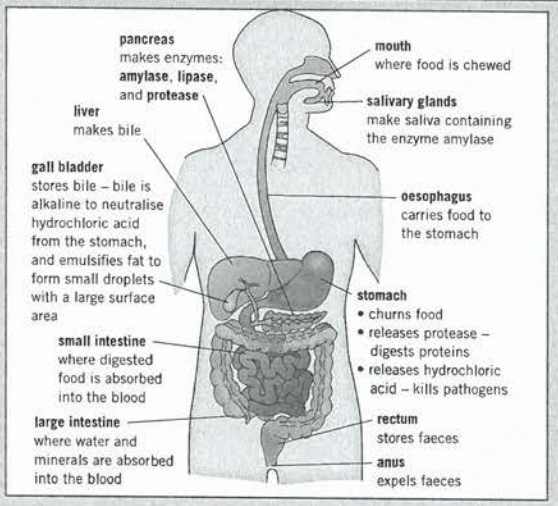
Chapter 3: Organisation and the digestive system

Knowledge organiser

There are five **levels of organisation** in living organisms:

- **cells** – basic building blocks
- **tissues** – groups of cells that have similar structures and functions
- **organs** – groups of tissues working together to perform a specific function
- **organ systems** – groups of organs working together
- **organisms** – organ systems work together, forming an organism

Digestive system



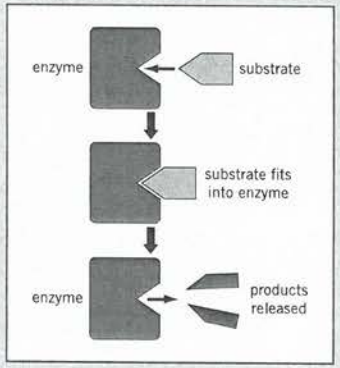
Digestive enzymes

Digestive enzymes convert food into small, soluble molecules that can then be absorbed into the bloodstream. For example, carbohydrases break down carbohydrates into simple sugars.

Enzyme	Sites of production	Reaction catalysed
amylase	salivary glands pancreas small intestine	starch → glucose
proteases	stomach pancreas small intestine	proteins → amino acids
lipases	pancreas small intestine	lipids → fatty acids and glycerol

Enzymes

Enzymes are large proteins that **catalyse** (speed up) reactions. Enzymes are not changed in the reactions they catalyse.



Lock and key theory

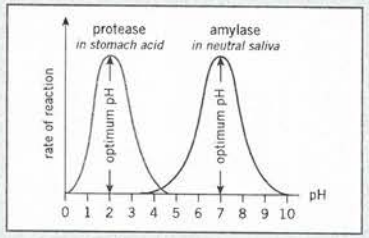
This is a simple model of how enzymes work:

1. The enzyme's **active site** (where the reaction occurs) is a specific shape.
2. The enzyme (the lock) will only catalyse a specific reaction because the **substrate** (the key) fits into its active site.
3. At the active site, enzymes can break molecules down into smaller ones or bind small molecules together to form larger ones.
4. When the products have been released, the enzyme's active site can accept another substrate molecule.

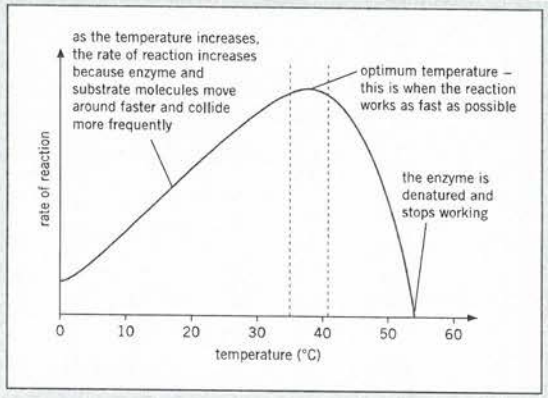
The effect of pH on enzymes

Different enzymes have different **optimum** pH values.

This allows enzymes to be adapted to work well in environments with different pH values. For example, parts of the digestive system greatly differ in pH.

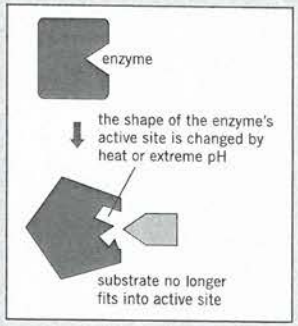


The effect of temperature on enzymes



Denaturation

At extremes of pH or at very high temperatures, the shape of an enzyme's active site can change.



The substrate can no longer bind to the active site, so the enzyme cannot catalyse the reaction – the enzyme has been **denatured**.

Key terms

Make sure you can write a definition for these key terms.

active site, amylase, catalyse, denatured, enzyme, lipase, optimum, organ, organ system, pH, protease, substrate, temperature, tissue

Chapter 3: Organisation and digestive system

Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

	B3 questions	Answers
1	Name the five levels of organisation.	cells → tissues → organs → organ systems → organisms
2	What is a tissue?	group of cells with similar structures and functions
3	What is an organ?	group of tissues working together to perform a specific function
4	What is the function of the liver in digestion?	produces bile, which neutralises hydrochloric acid from the stomach and emulsifies fat to form small droplets with a large surface area
5	What is the function of saliva in digestion?	lubrication to help swallowing – contains amylase to break down starch
6	Name three enzymes produced in the pancreas.	amylase, protease, lipase
7	What are enzymes?	protein molecules that catalyse specific reactions in organisms
8	Why are enzymes described as specific?	each enzyme only catalyses a specific reaction, because the active site only fits together with certain substrates (like a lock and key)
9	Describe the function of amylase.	to break down starch into glucose
10	Where is amylase produced?	salivary glands, pancreas, and small intestine
11	Describe the function of proteases.	to break down proteins into amino acids
12	Where are proteases produced?	stomach, pancreas, and small intestine
13	Describe the function of lipases.	to break down lipids into fatty acids and glycerol
14	Where are lipases produced?	pancreas and small intestine
15	What are two factors that affect the rate of activity of an enzyme?	temperature and pH
16	What does denatured mean?	shape of an enzyme's active site is changed by high temperatures or an extreme pH, so it can no longer bind with the substrate
17	Describe the effect of temperature on enzyme activity.	as temperature increases, rate of reaction increases until it reaches the optimum for enzyme activity – above this temperature enzyme activity decreases and eventually stops
18	Describe the effect of pH on enzyme activity.	different enzymes have a different optimum pH at which their activity is greatest – a pH much lower or higher than this enzyme activity decreases and stops
19	Why do different digestive enzymes have different optimum pHs?	different parts of the digestive system have very different pHs – the stomach is strongly acidic, and the pH in the small intestine is close to neutral
20	What is an organ system?	a group of organs working together to perform a specific function

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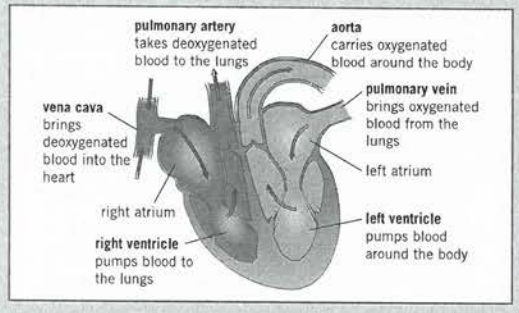
Chapter 4: Organising animals and plants 1

Knowledge organiser

The heart

The heart is the organ that pumps blood around your body. It is made from **cardiac** muscle tissue, which is supplied with oxygen by the **coronary artery**.



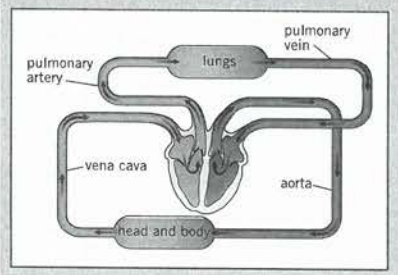
Heart rate is controlled by a group of cells in the right atrium that generate electrical impulses, acting as a pacemaker.

Artificial pacemakers can be used to control irregular heartbeats.

Double circulatory system

The human circulatory system is described as a **double circulatory system** because blood passes through the heart twice for every circuit around the body:

- the right ventricle pumps blood to the lungs where gas exchange takes place
- the left ventricle pumps blood around the rest of the body.



blood is a tissue made up of four main components

- red blood cells – bind to oxygen and transport it around the body
- plasma – transports substances and blood cells around the body
- platelets – form blood clots to create barriers to infections
- white blood cells – part of the immune system to defend the body against pathogens

Blood vessels

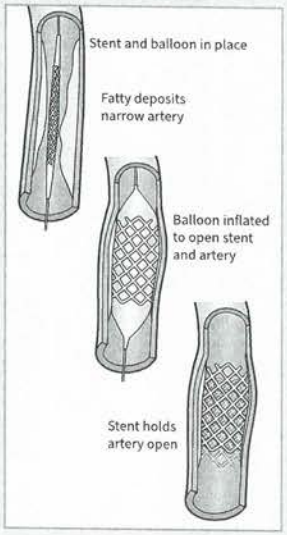
Vessel	Function	Structure	Diagram
artery	carries blood *away from* the heart (high pressure)	• thick, muscular, and elastic walls • the walls can stretch and withstand high pressure • small lumen	
vein	carries blood *to* the heart (low pressure)	• have valves to stop blood flowing the wrong way • thin walls • large lumen	
capillary	• carries blood to tissues and cells • connects arteries and veins	• one cell thick – short diffusion distance for substances to move between the blood and tissues (e.g., oxygen into cells and carbon dioxide out) • very narrow lumen	

Heart issues

Coronary heart disease is caused by a build up of fatty material in the coronary arteries, making them narrow, and reducing blood flow. Stents can be used to help keep the coronary arteries open.

Patients with heart failure often have to use artificial hearts before a donor heart becomes available for a heart transplant.

People with faulty heart **valves** may feel symptoms of breathlessness as valves do not fully open, making the heart less efficient. These can be replaced with biological valves (from animals), or mechanical valves (made from titanium and polymers).

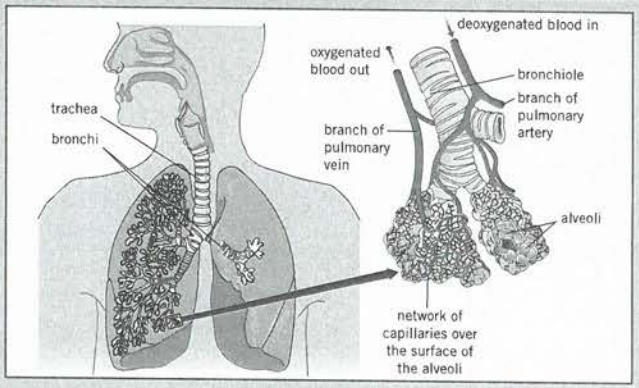


Lungs

When breathing in, air moves

1. into the body through the mouth and nose
2. down the trachea
3. into the **bronchi**
4. through the **bronchioles**
5. into the **alveoli** (air sacs).

Oxygen then diffuses into the blood in the network of **capillaries** over the surface of the alveoli.



Key terms

Make sure you can write a definition for these key terms.

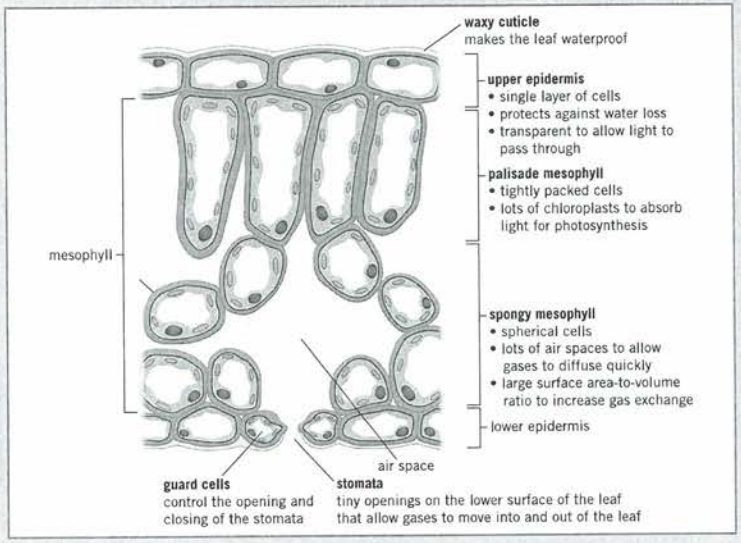
alveoli aorta artery atrium bronchi bronchiole capillary cardiac coronary double circulatory system plasma platelet pulmonary valve vein vena cava ventricle

Chapter 4: Organising animals and plants 2

Knowledge organiser

Tissues in leaves

Leaves are organs because they contain many tissues that work together to perform photosynthesis.



Stomata

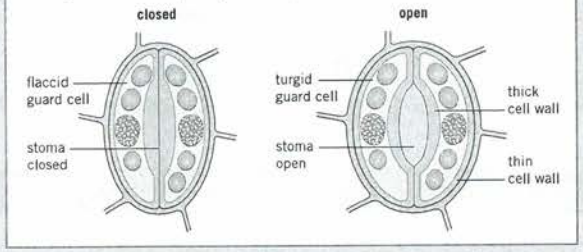
Stomata are tiny openings in the undersides of leaves – this placement reduces water loss through evaporation.

They control gas exchange and water loss from leaves by:

- allowing diffusion of carbon dioxide into the plant for photosynthesis
- allowing diffusion of oxygen out of the plant.

Guard cells are used to open and close the stomata.

When a plant has plenty of water, the guard cells become turgid. The cell wall on the inner surface is very thick, so it cannot stretch as much as the outer surface. So as the guard cells swell up, they curve away from each other, opening the stoma.



Transpiration

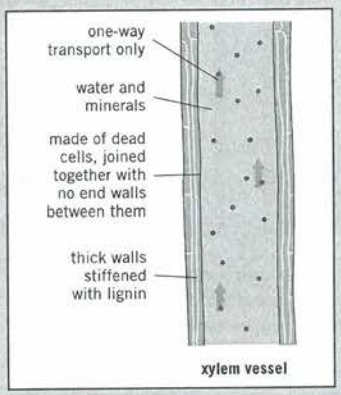
Description

Water is lost through the stomata by evaporation. This pulls water up from the roots through the **xylem** and is called transpiration. The constant movement of water up the plant is called the **transpiration stream**.

Importance

- provides water to cells to keep them **turgid**
- provides water to cells for photosynthesis
- transports mineral ions to leaves

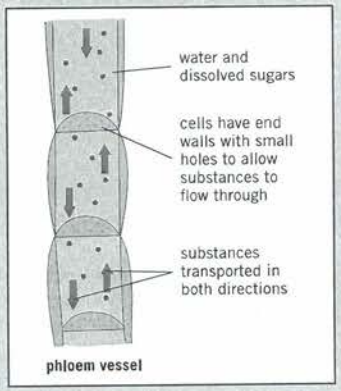
Specialised tissues



Translocation

The movement of dissolved sugars from the leaves to the rest of the plant through the **phloem**.

- moves dissolved sugars made in the leaves during photosynthesis to other parts of the plant
- this allows for respiration, growth, and glucose storage



Factors affecting the rate of transpiration

Factor	Effect on transpiration	Because...
temperature	higher temperatures *increase* the rate of transpiration	water evaporates faster in higher temperatures
humidity	lower humidity *increases* the rate of transpiration	the drier the air, the steeper the concentration gradient of water molecules between the air and leaf
wind speed	more wind *increases* the rate of transpiration	wind removes the water vapour quickly, maintaining a steeper concentration gradient
light intensity	higher light intensity *increases* the rate of transpiration	stomata open wider to let more carbon dioxide into the leaf for photosynthesis

Key terms

Make sure you can write a definition for these key terms.

photosynthesis stomata guard cells transpiration translocation
light intensity temperature humidity wind speed phloem xylem

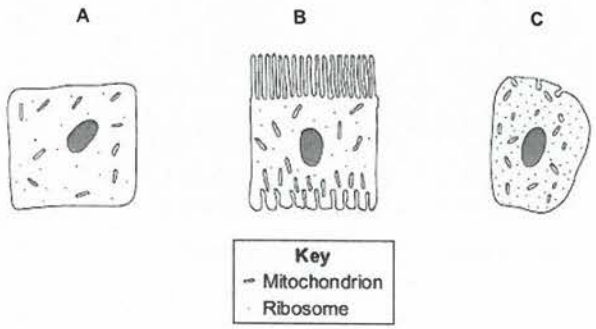
Chapter 4: Organising animals and plants

Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

B4 questions	Answers
1 Name the four main components of blood.	red blood cells, white blood cells, plasma, platelets
2 What is the function of platelets?	form blood clots – prevent the loss of blood and stop wounds becoming infected
3 Why is the human circulatory system a double circulatory system?	blood passes through the heart twice for every circuit around the body – deoxygenated blood is pumped from the right side of the heart to the lungs, and the oxygenated blood that returns is pumped from the left side of the heart to the body
4 How does the structure of an artery relate to its function?	carries blood away from the heart under high pressure – has a small lumen and thick, elasticated walls that can stretch
5 How does the structure of a vein relate to its function?	carries blood back to the heart at low pressure –doesn't need thick, elasticated walls, but has valves to prevent blood flowing the wrong way
6 How does the structure of a capillary relate to its function?	carries blood to cells and tissues – has a one-cell-thick wall to provide a short diffusion distance
7 List the structures air passes through when breathing in.	mouth/nose → trachea → bronchi → bronchioles → alveoli
8 What is the function of the red blood cells?	Bind to oxygen and transport it around the body
9 What is the function of the white blood cells?	Defend the body against pathogens
10 What is the function of the plasma?	Transports blood cells and substances around the body
11 Why is a leaf an organ?	there are many tissues inside the leaf that work together to perform photosynthesis
12 How is the upper epidermis adapted for its function?	• single layer of transparent cells allow light to pass through • cells secrete a waxy substance that makes leaves waterproof
13 How is the palisade mesophyll adapted for its function?	tightly packed cells with lots of chloroplasts to absorb as much light as possible for photosynthesis
14 How is the spongy mesophyll adapted for its function?	air spaces increase the surface area and allow gases to diffuse quickly
15 What is the function of the guard cells?	control the opening and closing of the stomata
16 What is the function of the xylem?	transport water and mineral ions from the roots to the rest of the plant
17 Give three adaptations of the xylem.	• made of dead cells • no end wall between cells • walls strengthened by a chemical called lignin to withstand the pressure of the water
18 What is the function of the phloem?	transport dissolved sugars from the leaves to the rest of the plant
19 What is the purpose of translocation?	transport dissolved sugars from the leaves to other parts of the plant for respiration, growth, and storage
20 Define the term transpiration.	movement of water from the roots to the leaves through the xylem
21 What is the purpose of transpiration?	• provide water to keep cells turgid • provide water to cells for photosynthesis • transport mineral ions to leaves
22 Name four factors that affect the rate of transpiration.	temperature, light intensity, humidity, and wind speed
23 What effect does temperature have on the rate of transpiration?	higher temperatures increase the rate of transpiration
24 What effect does humidity have on the rate of transpiration?	higher levels of humidity decrease the rate of transpiration
25 Why does increased light intensity increase the rate of transpiration?	stomata open wider to let more carbon dioxide into the leaf for photosynthesis
26 What is the function of the stomata?	allow diffusion of gases into and out of the plant
27 Where are most stomata found?	underside of leaves
28 What is the advantage to the plant of having a high number of stomata at this location?	reduces the amount of water loss through evaporation

1 Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



(a) Which cell, **A**, **B** or **C**, appears to be best adapted to increase diffusion into or out of the cell?

Give **one** reason for your choice.

_____

_____

(1)

(b) (i) Cell **C** is found in the salivary glands.

Name the enzyme produced by the salivary glands.

_____

(1)

(ii) Use information from the diagram to explain how cell **C** is adapted for producing this enzyme.

_____

_____

_____

_____

(2)

(Total 4 marks)

2 A student carried out an investigation using leaf epidermis.

This is the method used.

1. Peel the lower epidermis from the underside of a leaf.
2. Cut the epidermis into six equal sized pieces.
3. Place each piece of lower epidermis into a different Petri dish.
4. Add 5 cm^3 of salt solution to the six Petri dishes. Each Petri dish should have a different concentration of salt solution.
5. After 1 hour, view each piece of epidermis under a microscope at ×400 magnification.
6. Count and record the total number of stomata present and the number of open stomata that can be seen in one field of view.

The student's results are shown in the table.

Concentration of salt solution in mol / dm^3	Number of stomata in field of view	Number of open stomata in field of view	Percentage (%) of open stomata in field of view
0.0	7	7	100
0.1	8	8	100
0.2	7	6	**X**
0.3	9	6	67
0.4	10	4	40
0.5	9	2	22

(a) Calculate value **X** in the table above.

_____

_____

X = _____ %

(1)

(b) Give **one** conclusion from the results in the table above.

_____

_____

(1)

(c) How could the student find out what concentration of salt solution would result in half of the stomata being open?

_____

_____

(1)

(d) The student measured the real diameter of the field of view to be 0.375 mm.

Calculate the number of open stomata per mm^2 of leaf for the epidermis placed in 0.4 mol / dm^3 salt solution.

Use information from the table above.

Take π to be 3.14

_____

_____

_____

_____

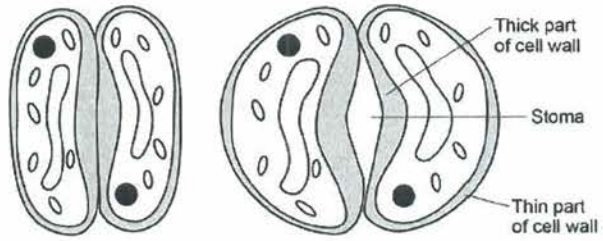
_____

_____

Number of open stomata = _____ per mm^2

(3)

(e) The diagram below shows two guard cells surrounding a closed stoma and two guard cells surrounding an open stoma.



Closed stoma **Open stoma**

When light intensity is high potassium ions are moved into the guard cells.

Describe how the movement of potassium ions into the guard cells causes the stoma to open.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

3 A student investigated the effect of different sugar solutions on potato tissue.

This is the method used.

1. Add 30 cm^3 of 0.8 mol dm^{-3} sugar solution to a boiling tube.
2. Repeat step **1** with equal volumes of 0.6, 0.4 and 0.2 mol dm^{-3} sugar solutions.
3. Use water to give a concentration of 0.0 mol dm^{-3}.
4. Cut five cylinders of potato of equal size using a cork borer.
5. Weigh each potato cylinder and place one in each tube.
6. Remove the potato cylinders from the solutions after 24 hours.
7. Dry each potato cylinder with a paper towel.
8. Reweigh the potato cylinders.

The table below shows the results.

Concentration of sugar solution in mol dm^{-3}	Starting mass in g	Final mass in g	Change of mass in g	Percentage (%) change
0.0	1.30	1.51	0.21	16.2
0.2	1.35	1.50	0.15	**X**
0.4	1.30	1.35	0.05	3.8
0.6	1.34	1.28	−0.06	−4.5
0.8	1.22	1.11	−0.11	−9.0

(a) Calculate the value of **X** in the table above.

Percentage change in mass = _____ %

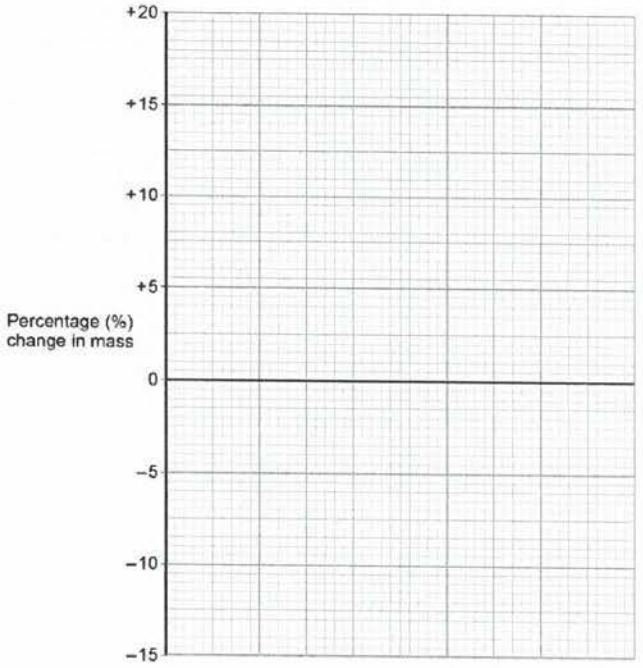
(2)

(b) Why did the student calculate the percentage change in mass as well as the change in grams?

(1)

(c) Complete the graph using data from the table above.

- Choose a suitable scale and label for the *x*-axis.
- Plot the percentage (%) change in mass.
- Draw a line of best fit.



(4)

(d) Use your graph to estimate the concentration of the solution inside the potato cells.

Concentration = _____ mol dm^{-3}

(1)

(e) The results in the table above show the percentage change in mass of the potato cylinders.

Explain why the percentage change results are positive **and** negative.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(f) Suggest **two** possible sources of error in the method given above.

1. _____

_____

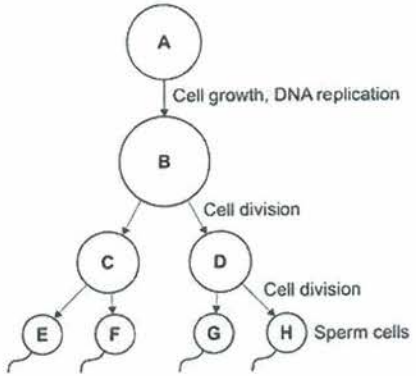
2. _____

_____

(2)

(Total 13 marks)

4 The diagram below shows the production of human sperm cells.



(a) Name the organ where the processes shown in the diagram above take place.

_____

(1)

(b) (i) Not every cell in the diagram above contains the same amount of DNA.

Cell **A** contains 6.6 picograms of DNA (1 picogram = 10^{-12} grams).

How much DNA is there in each of the following cells?

Cell **B** _____ picograms

Cell **C** _____ picograms

Cell **E** _____ picograms

(2)

(ii) How much DNA would there be in a fertilised egg cell?

_____ picograms

(1)

(iii) A fertilised egg cell divides many times to form an embryo.

Name this type of cell division.

_____

(1)

(c) After a baby is born, stem cells may be collected from the umbilical cord. These can be frozen and stored for possible use in the future.

(i) What are stem cells?

_____

_____

_____

_____

(2)

(ii) Suggest why it is ethically more acceptable to take stem cells from an umbilical cord instead of using stem cells from a 4-day-old embryo produced by In Vitro Fertilisation (IVF).

_____

_____

(1)

(iii) Stem cells taken from a child's umbilical cord could be used to treat a condition later in that child's life.

Give **one** advantage of using the child's own umbilical cord stem cells instead of using stem cells donated from another person.

_____

_____

(1)

(iv) Why would it **not** be possible to treat a genetic disorder in a child using his own umbilical cord stem cells?

_____

_____

(1)

(Total 10 marks)

5 The diagrams show the same cell of a common pond plant.

Diagram A shows the cell in a hypotonic solution.

Diagram B shows the same cell in a hypertonic solution.

Diagram A

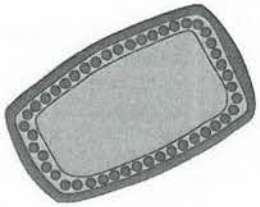
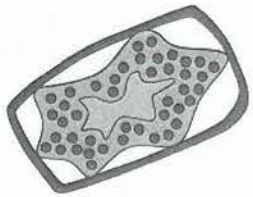


Diagram B



(a) What is a **hypertonic** solution?

_____

_____

_____

_____

(2)

(b) What word is used to describe plant cells placed in:

(i) a **hypotonic** solution

_____

(1)

(ii) a **hypertonic** solution?

_____

(1)

(c) Explain what has happened to the plant cell in **diagram B**.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(d) Animal cells will also change when placed in different solutions.

Some red blood cells are put in a hypotonic solution.

Describe what would happen to these red blood cells **and** explain why this is different from what happened to the plant cell in **diagram A**.

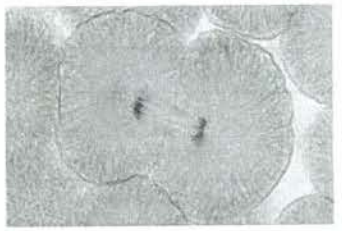
(4)

(Total 12 marks)

6 **Figure 1** shows photographs of some animal cells at different stages during the cell cycle.

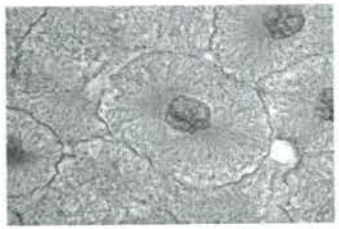
Figure 1

A



B

C



A © Ed Reschke/Photolibrary/Getty Images
B © Ed Reschke/Oxford Scientific/Getty Images
C © Ed Reschke/Photolibrary/Getty Images

(a) Which photograph in **Figure 1** shows a cell that is **not** going through mitosis?

Tick **one** box.

A ☐ B ☐ C ☐

(1)

(b) Describe what is happening in photograph **A**.

_____

_____

_____

_____

_____

(2)

(c) A student wanted to find out more about the cell cycle.

The student made a slide of an onion root tip.

She counted the number of cells in each stage of the cell cycle in one field of view.

The table below shows the results.

		Stages in the cell cycle				
	Non-dividing cells	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**	**Total**
Number of cells	20	9	4	2	1	36

Each stage of the cell cycle takes a different amount of time.

Which stage is the fastest in the cell cycle?

Give a reason for your answer.

Stage _____

Reason _____

_____

(2)

(d) The cell cycle in an onion root tip cell takes 16 hours.

Calculate the length of time **Stage 2** lasts in a typical cell.

Give your answer to 2 significant figures.

_____

_____

_____

_____

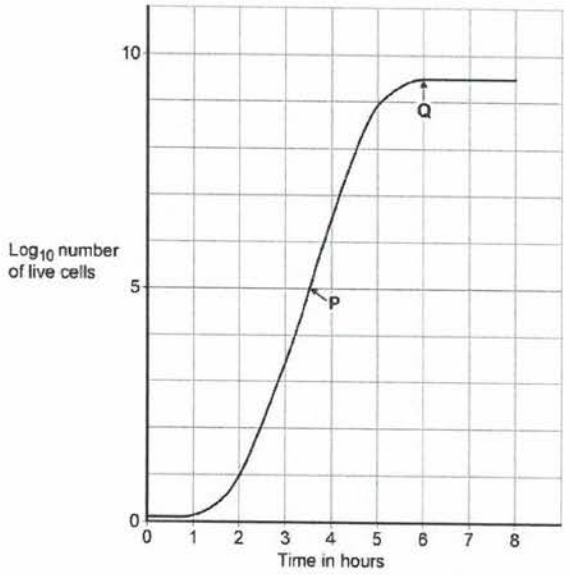
Time in **Stage 2** = _____ minutes

(3)

(e) Bacteria such as *Escherichia coli* undergo cell division similar to mitosis.

Figure 2 shows a growth curve for *E. coli* grown in a nutrient broth.

Figure 2



What type of cell division causes the change in number of *E. coli* cells at **P**?

_____

(1)

(f) Suggest why the number of cells levels out at **Q**.

_____

_____

_____

_____

_____

_____

(2)

(Total 11 marks)

Mark schemes

1 (a) **B**

*no mark for "B" alone, the mark is for B **and** the explanation.*

large(r) surface / area **or** large(r) membrane

accept reference to microvilli

ignore villi / hairs / cilia

accept reasonable descriptions of the surface eg folded membrane / surface

*do **not** accept wall / cell wall*

1

(b) (i) any **one** from:

- (salivary) amylase
- carbohydrase

1

(ii) many ribosomes

*do **not** mix routes. If both routes given award marks for the greater.*

1

ribosomes produce protein

accept amylase / enzyme / carbohydrase is made of protein

or

(allow)

many mitochondria (1)

mitochondria provide energy to build / make protein (1)

accept ATP instead of energy

1

[4]

2 (a) 86

allow this answer only

*do **not** accept 85.7*

if no answer given, check for answer in the table

1

(b) as salt concentration increases, percentage of open stomata (in field of view) decreases (above 0.1 mol / dm^3)
or
allow percentage of open stomata stays the same between 0.0 and 0.1 (mol / dm^3 then decreases as salt concentration increases)

ignore references to number of open stomata

allow converse

allow idea that mean concentration (of salt) in guard cells is between 0.3 and 0.4 mol per dm^3

1

(c) use concentrations between 0.3 (mol / dm^3) and 0.4 (mol / dm^3)
or
draw a graph of the data and read off the value at 50% (open stomata)

allow a list of appropriate concentrations i.e. 0.32 mol / dm^3), 0.34 (mol / dm^3), 0.36 (mol / dm^3) etc.

1

(d) $(\pi \times 0.1875^2) = 0.11$ (mm^2)

*an answer of 36 scores **3** marks*

1

$\frac{4}{0.11}$

1

36 (per mm^2)

*allow 36.22 / 36.23 **or** 36.2*

*if answer is incorrect allow for **2** marks for sight of number of open stomata = 9 per mm^2 (diameter used instead of radius)*

*if no other marks awarded allow for **1** mark any **one** from:*

- *sight of area = 0.44(mm^2) (diameter used instead of radius)*
- *sight of number of open stomata = 9.1 / 9.05 / 9.06 per mm^2 (diameter used instead of radius and no rounding)*

1

(e) (potassium) ions increase the concentration of the solution (inside guard cells)
or
(potassium) ions make cell more concentrated / less dilute

allow (potassium) ions decrease concentration of water / water potential (of guard cells)

1

water moves into the (guard) cell by osmosis

1

cell swells unevenly (so stoma opens)

1

as inner wall is less flexible than outer wall **or** thick part of the wall is less flexible than the thin part (of the wall)

1

[10]

3 (a) (0.15 / 1.35) × 100

1

11.1 (%)

*allow 11.1 (%) with no working shown for **2** marks*

1

(b) to allow results to be compared
or
they had different masses at the start

1

(c) axis correct scale and labelled

1

5 points correctly plotted

*allow ecf from **05.1***

*allow **1** mark for 4 points correctly plotted*

2

line of best fit

1

(d) 0.5

allow 0.45–0.55

1

(e) (0.0 to 0.4) water moves into cells

1

(0.6 to 0.8) water leaves cells

1

by osmosis

1

(f) any **two** from:
- concentration of solutions
- drying of chips
- accuracy of balance
- evaporation from tubes

2

[13]

4 (a) testis / testes

allow testicle(s)

1

(b) (i) **B** = 13.2
C = 6.6
E = 3.3

all 3 correct = 2 marks

2 or 1 correct = 1 mark

*If no marks awarded allow ecf for C **and** E based on answer to B*

ie C = ½ B and E = ½ C for one mark

2

(ii) 6.6

*allow twice answer for cell **E** in part bi*

1

(iii) mitosis

correct spelling only

1

(c) (i) any **two** from:
- cells that are able to divide
- undifferentiated cells / not specialised
- can become other types of cells / tissues **or** become specialised/differentiated

allow pluripotent

2

(ii) 4-day embryo is a (potential) human life

or

destroying/damaging (potential) human life

allow cord would have been discarded anyway

ignore reference to miscarriage

allow cannot give consent

1

(iii) perfect tissue match **or** hard to find suitable donors

allow same/matching antigens

allow no danger of rejection

allow no need to take immunosuppressant drugs (for life)

*ignore genetically identical **or** same DNA*

1

(iv) stem cells have same faulty gene / allele / DNA / chromosomes

allow genetically identical

ignore cells have the same genetic disorder

1

[10]

5 (a) more concentrated

must be a comparison

1

than the cell / cytoplasm

accept more salty / solutes / ions

*accept cell is less concentrated than solution for **2** marks*

1

(b) (i) turgid

1

(ii) plasmolysed

accept flaccid

1

(c) any **four** from:
- water left the cell (in A)
- by osmosis
- from dilute to more concentrated solution

accept high to low water potential or from high to low water concentration
- via partially permeable membrane
- so cell membrane shrank away from cell wall

4

(d) water enters the cells (by osmosis)

*allow **1** mark for:*

1

they burst / lyse / lysis occurs

water leaves and cell shrinks (if they think it is hypertonic solution)

1

animal cells have no cell wall **or** plant cells have a cell wall

1

cell wall prevents lysis / bursting / allows turgidity

allow correct description

1

[12]

6 (a) **C**

1

(b) cytoplasm **and** cell membrane dividing
*accept cytokinesis for **1** mark*

1

to form two identical daughter cells

1

(c) stage 4

1

only one cell seen in this stage

1

(d) (4 / 36) × 16 × 60

1

107 / 106.7

1

110 (minutes)
*allow 110 (minutes) with no working shown for **3** marks*

1

(e) binary fission
*do **not** accept mitosis*

1

(f) shortage of nutrients / oxygen

1

so cells die
or
death rate = rate of cell division

1

[11]

B5 Communicable Diseases – Paper 1

Lesson	Aiming for 4		Aiming for 6		Aiming for 8	
B5.1 Health and disease	I can describe health as a state of physical and mental wellbeing.		I can describe the difference between communicable and non-communicable diseases.		I can suggest how communicable diseases are spread.	
	I can state some causes of ill health.		I can use a scatter diagram to identify a correlation between two variables.		I can suggest links between lifestyle and health.	
	I can draw a simple conclusion from data on health.		I can construct and interpret bar charts, frequency tables, frequency diagrams and histograms.		I can discuss the validity of a statement based on evidence in the form of data.	
B5.2 Pathogens and disease	I can state that pathogens are microorganisms that cause disease.		I can describe how bacteria and viruses cause disease.		I can explain why viruses are always pathogens but not all bacteria are.	
	I can describe ways that pathogens can be spread.		I can explain why communicable diseases spread rapidly following a natural disaster.		I can explain how pathogens are passed from one organism to another and use this to suggest ways of preventing the spread.	
B5.3 Preventing infections	I can list some ways in which communicable diseases spread.		I can describe how the spread of diseases can be reduced or prevented.		I can use scientific knowledge to explain in detail how methods reduce or prevent the spread of disease.	
	I can take a role in designing a form of communication to inform the public about how to prevent the spread of a disease.		I can communicate to the public about how to stop the spread of a disease.		I can use an example to explain how the scientific method has been applied to help prevent the spread of disease.	
B5.4 Viral diseases	I can name some diseases that are caused by viruses.		I can describe how measles, HIV and tobacco mosaic virus affect the infected organism.		I can explain how measles, HIV and tobacco mosaic virus affect the infected organism.	
	I can describe how measles and HIV are spread.		I can interpret data to describe how the number of people infected with measles in the UK has changed over time.		I can explain why viral infections are often more difficult to prevent and treat than bacterial infections.	
	I can summarise information in a table.		I can design a table and use it to summarise information.		I can write a persuasive letter to parents urging them to vaccinate their children against measles.	
B5.5 Bacterial diseases	I can name some diseases that are caused by bacteria.		I can describe similarities and differences between salmonella and gonorrhoea.		I can suggest why more people die from viral diseases compared to bacterial diseases.	
	I can describe how salmonella and gonorrhoea are spread.		I can describe how the spread of salmonella and gonorrhoea is controlled.		I can explain in detail how methods to control the spread of salmonella and gonorrhoea work.	
B5.6 Diseases caused by fungi and protists	I can state that rose black spot is caused by fungi and malaria is caused by protists.		I can describe how rose black spot affects the plant and how it is treated.		I can explain how rose black spot affects the growth of a plant.	
	I can use a diagram to describe the life cycle of the malaria protist.		I can link ways of controlling the spread of malaria to specific parts of the protist's life cycle.		I can explain why it is so expensive to stop the spread of malaria.	
	I can state some ways that malaria is controlled.					
B5.7 Human defence responses	I can describe some ways in which the human body defends itself against the entry of pathogens.		I can describe how human body defence mechanisms stop the entry of pathogens.		I can explain how a reduced or over active immune system can cause illness.	
	I can state that white blood cells help defend the body against pathogens.		I can describe the role of white blood cells in the defence against disease.		I can explain in detail how antibody production fights pathogens.	
	I can show how one part of a model is similar to real life.		I can use a model to explain how the body defends itself against disease.		I can evaluate an analogy of the human defence systems against disease.	

B6 Preventing and Treating Disease – Paper 1

Lesson	Aiming for 4		Aiming for 6		Aiming for 8	
Vaccination	I can describe why people are vaccinated.		I can explain how vaccination works.		I can explain why, if a large proportion of the population is vaccinated, the spread of the pathogen is reduced.	
	I can state that vaccines contain dead or inactive forms of a pathogen.		I can describe what an antibody and antigen are.		I can apply ideas about specificity of antibodies.	
Antibiotics and painkillers	I can describe what an antibiotic is.		I can describe how antibiotics work.		I can suggest a reasoned explanation for a pattern in data.	
	I can state that viral infections cannot be treated with antibiotics.		I can describe what is meant by antibiotic resistant bacteria.		I can explain in detail how antibiotic resistant bacteria arise.	
	I can decide when a painkiller or antibiotic should be used to treat an illness.		I can explain why it is difficult to develop drugs to treat viral infections.		I can explain why scientists are constantly developing new antibiotics.	
Discovering drugs	I can name some drugs based on extracts from plants or microorganisms.		I can describe how new antibiotics are tested for effectiveness.		I can suggest why mould naturally produces antibiotics.	
	I can order the events that led to the production of penicillin.		I can discuss the advantages and disadvantages of looking for new drugs from living organisms.		I can discuss how effective herbal remedies are.	
	I can state a simple conclusion using data.		I can analyse data to draw conclusions on the effectiveness of new antibiotics.		I can analyse data to evaluate the effectiveness of new antibiotics and make a reasoned decision which one to develop further.	
Developing drugs	I can state that new medical drugs have to be tested to check that they are safe and effective.		I can explain why each procedure in drugs testing and trialling is used.		I can describe in some detail how new medical drugs are tested and trialled for safety, effectiveness, toxicity, efficacy, and dose.	
	I can state the procedures used to trial a new drug in the correct order.		I can describe how a double blind trial is carried out.		I can critically analyse the results from a double blind trial.	
	I can state what is meant by a placebo.		I can explain why a placebo is used during drug trialling.		I can explain why the results of drug trials are published in journals.	

B6 Preventing and Treating Disease – Paper 1

HT only Producing monoclonal antibodies			I can describe what a monoclonal antibody is.		I can explain why hybridoma cells are used to produce monoclonal antibodies.	
			I can outline the procedure used to produce monoclonal antibodies.		I can explain in detail how pregnancy tests work.	
			I can state some uses of monoclonal antibodies.		I can describe how monoclonal antibodies are used to produce ELISA tests and outline how they are used.	
HT only Using monoclonal antibodies			I can describe the ways that monoclonal antibodies can be used to treat cancer.		I can explain in detail how the methods of using monoclonal antibodies to treat cancer work.	
			I can outline the advantages and disadvantages of using monoclonal antibodies.		I can evaluate the use of monoclonal antibodies in treating cancer compared to other treatments.	

B2 B7 Non-communicable diseases – Paper 1

Lesson	Aiming for 4		Aiming for 6		Aiming for 8	
Non-communicable diseases	I can name some non-communicable diseases.		I can classify diseases as communicable and non-communicable.		I can describe some impacts of non-communicable diseases.	
	I can list some risk factors that are linked to an increased rate of disease.		I can draw conclusions from data on risk factors.		I can identify risk factors from data.	
	I can identify correlations in data.		I can decide whether a link is causal.		I can explain why a correlation does not prove a causal mechanism.	
Cancer	I can define a tumour as a mass of abnormally growing cells.		I can describe the difference between benign and malignant tumours.		I can explain how benign and malignant tumours can be life-threatening.	
	I can state some causes of cancer.		I can describe why carcinogens and ionising radiation increase the risk of tumours.		I can link a lack of control in the cell cycle to tumour formation.	
	I can list some of the benefits and risks of chemotherapy.		I can analyse data to assess the risks and benefits of chemotherapy.		I can evaluate the risks of chemotherapy in relation to data, drug testing, and consequences in order to come to an informed decision.	
Smoking and the risk of disease	I can name the harmful substances found in tobacco smoke.		I can describe the effects of the harmful substances found in tobacco smoke.		I can explain in detail the effects of the harmful substances found in tobacco smoke.	
	I can state that smoking increases your risk of developing lung diseases.		I can analyse data to describe evidence for the link between smoking and lung disease.		I can suggest possible causal mechanisms to explain trends shown in data, and explain how the causal link between smoking and lung cancer was identified.	
Diet, exercise, and disease	I can describe some health problems caused by a poor diet and lack of exercise.		I can describe causal mechanisms for the link between exercise and health.		I can suggest reasons for the correlation between exercise and health, and decide which are causal.	
	I can list some ways in which people can avoid becoming overweight.		I can suggest measures to prevent a further rise in the number of people with type 2 diabetes.		I can explain in detail why eating a poor diet can lead to health problems.	
Alcohol and other carcinogens	I can state that drinking too much alcohol can affect liver and brain function.		I can describe the short- and long-term effects of drinking alcohol.		I can explain in detail how drinking alcohol affects the nervous system.	
	I can state that alcohol can affect unborn babies.		I can describe the effects of alcohol on unborn babies.		I can evaluate the evidence on the effects of alcohol on a developing baby.	
	I can define the term carcinogen.		I can describe the link between ionising radiation and cancer.		I can explain the link between radiation and cancer.	

B2 B7 Non-communicable diseases – Paper 1

B8 Photosynthesis – Paper 1

Lesson	Aiming for 4		Aiming for 6		Aiming for 8	
Photosynthesis	I can describe how plants get the materials they need for growth.		I can describe how the leaf is adapted for photosynthesis.		I can explain how adaptations of the leaf make photosynthesis efficient.	
	I can state the word equation for photosynthesis.		I can write the balanced symbol equations for photosynthesis.		I can explain how adaptations of the leaf make photosynthesis efficient.	
	I can describe why plants need light to carry out photosynthesis.		I can describe an experiment to prove that plants carry out photosynthesis when exposed to light.		I can explain why chlorophyll is needed for photosynthesis.	
The rate of photosynthesis	I can list the factors that affect the rate of photosynthesis (temperature, carbon dioxide concentration, light intensity, amount of chlorophyll).		I can describe why low temperature, shortage of carbon dioxide, shortage of light and shortage of chlorophyll limit the rate of photosynthesis.		I can apply knowledge of enzymes to explain why a high temperature affects the rate of photosynthesis.	
	I can state simply the relationship between these factors and the rate of photosynthesis.		I can suggest which factor limits the rate of photosynthesis in a given situation.		I can predict how the rate of photosynthesis will be affected with more than one limiting factor.	
	I can plot a line graph and write a simple conclusion.		I can interpret and explain graphs of photosynthesis rate involving one limiting factor.		I understand and can use the inverse square law and light intensity in the context of photosynthesis.	
How plants use glucose	I can list some ways in which plants use glucose.		I can describe all the ways in which plants use glucose, including how they make proteins.		I can explain how carnivorous plants are adapted to their environment.	
	I can test a leaf for starch and state some safety rules.		I can evaluate risks involved in the starch test.		I can explain how and why plants convert glucose to starch for storage.	
Making the most of photosynthesis			I can describe why greenhouse increase plant growth.		I can explain in detail how using greenhouses can help control limiting factors and increase the rate of photosynthesis.	
			I can comment on the cost-effectiveness of adding heat, light, or carbon dioxide to greenhouses.		I can use data to comment on the cost-effectiveness of greenhouses.	
			I can discuss the benefits of using greenhouses and hydroponics.		I can evaluate the use of greenhouses and hydroponics in terms of economics.	

B9 Respiration – Paper 1

Lesson	Aiming for 4		Aiming for 6		Aiming for 8	
Aerobic respiration	I can state the word equation for aerobic respiration.		I can write the balanced symbol equation for respiration.		I can apply understanding of respiration in new contexts.	
	I can list ways in which living organisms use energy.		I can describe respiration as an exothermic reaction.		I can explain why respiration is an exothermic reaction.	
	I can identify a control.		I can plan an investigation to include a control.		I can explain why a control is necessary in some scientific investigations.	
The response to exercise	I can describe how heart rate, breathing rate, and breath volume change with exercise.		I can explain why heart rate, breathing rate, and breath volume change with exercise.		I can explain why stores of glycogen change with exercise.	
	I can draw a suitable chart/graph to display data with some support.		I can choose the best way to display data and calculate percentage changes.		I can justify he choice of chart/graph used to display data.	
Anaerobic respiration	I can state the word equation for anaerobic respiration in animals, plants, and microorganisms.		I can write the balanced symbol equation for anaerobic respiration in plants and microorganisms.		I can compare and contrast anaerobic respiration in animals, plants, and microorganisms.	
	I can describe the reason why cells respire anaerobically.		I can compare and contrast aerobic and anaerobic respiration.		I can explain in detail why heart and breathing rate continue to be high for a period of time after exercise.	
	I can give some uses of fermentation.		I can explain why muscles get tired during exercise.		I can write a prediction based on scientific knowledge.	
Metabolism and the liver	I can define metabolism as the sum of all reactions on a cell or the body.		I can describe the role of the liver in repaying the oxygen debt.		I can explain the link between protein consumption and concentration of urea in urine.	
	I can list some metabolic reactions.		I can discuss whether it is possible to increase metabolism.		I can evaluate information to assess credibility.	

Chapter 5: Communicable diseases

Knowledge organiser

Communicable diseases

Communicable diseases can be spread from one organism to another.

Viruses live and reproduce rapidly inside an organism's cells. This can damage or destroy the cells.

Viruses

	Spread by	Symptoms
measles	inhalation of droplets produced by infected people when sneezing and coughing	• fever • red skin rash • complications can be fatal – young children are vaccinated to immunise them against measles
HIV (human immunodeficiency virus)	• sexual contact • exchange of body fluids (e.g., blood when drug users share needles)	• flu-like symptoms at first • virus attacks the body's immune cells, which can lead to AIDS – where the immune system is so damaged that it cannot fight off infections or cancers
TMV (tobacco mosaic virus – plants)	• direct contact of plants with infected plant material • animal and plant vectors • soil: the pathogen can remain in soil for decades	• mosaic pattern of discolouration on the leaves – where chlorophyll is destroyed • reduces plant's ability to photosynthesise, affecting growth

Bacteria reproduce rapidly inside organisms and may produce **toxins** that damage tissues and cause illness.

Bacteria

	Spread by	Symptoms	Prevention and treatment
Salmonella	bacteria in or on food that is being ingested	*Salmonella* bacteria and the toxins they produce cause • fever • abdominal cramps • vomiting • diarrhoea	poultry are vaccinated against *Salmonella* bacteria to control spread
gonorrhoea	direct sexual contact – gonorrhoea is a **sexually transmitted disease** (STD)	• thick yellow or green discharge from the vagina or penis • pain when urinating	• treatment with antibiotics (many antibiotic-resistant strains have appeared) • barrier methods of contraception, such as condoms

Fungi

	Spread by	Symptoms	Prevention and treatment
rose black spot	water and wind	• purple or black spots on leaves, which turn yellow and drop early • reduces plant's ability to photosynthesise, affecting growth	• **fungicides** • affected leaves removed and destroyed

Protists

	Spread by	Symptoms	Prevention and treatment
malaria	mosquitos feed on the blood of infected people and spread the protist pathogen when they feed on another person – organisms that spread disease by carrying pathogens between people are called **vectors**	• recurrent episodes of fever • can be fatal	• prevent mosquito vectors breeding • mosquito nets to prevent bites • anti-malarial medicine

Detection and identification of plant diseases

Signs that a plant is diseased

- stunted growth
- spots on leaves
- areas of rot or decay
- growths
- malformed stems or leaves
- discolouration
- pest infestation

Ways of identifying plant diseases

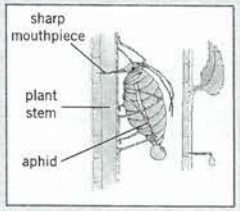
- gardening manuals and websites
- laboratory testing of infected plants
- testing kits containing monoclonal antibodies (Chapter 9 *Monoclonal antibodies*)

Plant diseases and insects

Plant diseases can also be directly caused by insects.

Aphids are insects that suck sap from the stems of plants. This results in

- reduced rate of growth
- wilting
- discolouration of leaves.



Ladybirds can be used to control aphid infestations as ladybird larvae eat aphids.

Plant defences

Physical barriers

- cellulose cell walls – provide a barrier to infection
- tough waxy cuticle on leaves
- bark on trees – a layer of dead cells that can fall off

Chemical barriers

- many plants produce antibacterial chemicals
- poison production stops animals eating plants

Mechanical adaptations

- thorns and hairs stop animals eating plants
- leaves that droop or curl when touched to scare herbivores or dislodge insects
- some plants **mimic** the appearance of unhealthy or poisonous plants to deter insects or herbivores

Controlling the spread of communicable disease

There are a number of ways to help prevent the spread of communicable diseases from one organism to another.

Hygiene

Hand washing, disinfecting surfaces and machinery, keeping raw meat separate, covering mouth when coughing/sneezing, etc.

Isolation

Isolation of infected individuals – people, animals, and plants can be isolated to stop the spread of disease.

Controlling vectors

If a vector spreads a disease destroying or controlling the population of the vector can limit the spread of disease.

Vaccination

Vaccination can protect large numbers of individuals against diseases.

Key terms

Make sure you can write a definition for these key terms.

aphid, bacterium, communicable disease, fungicide, fungus, isolation, mimic, pathogen, protist, sexually transmitted disease (STD), toxin, vaccination, vector, virus

Chapter 5: Communicable diseases

Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

B5 questions		Answers
1	What is a communicable disease?	a disease that can be transmitted from one organism to another
2	What is a pathogen?	a microorganism that causes disease
3	Name four types of pathogen.	bacteria, fungi, protists, viruses
4	How can pathogens spread?	air, water, direct contact
5	How do bacteria make you ill?	produce toxins that damage tissues
6	How do viruses make you ill?	reproduce rapidly inside cells, damaging or destroying them
7	Name three examples of viral diseases.	measles, HIV, tobacco mosaic virus
8	Name two examples of bacterial diseases.	*Salmonella*, gonorrhoea
9	Name four methods of controlling the spread of communicable disease.	good hygiene, isolating infected individuals, controlling vectors, vaccination
10	Describe an example of a protist disease.	malaria – caused by a protist pathogen that is spread from person to person by mosquito bites, and causes recurrent fevers
11	Describe an example of a fungal disease in plants.	rose black spot – spread by water and wind, and affects plant growth by reducing a plant's ability to photosynthesise
12	How can the cause of a plant disease be identified?	gardening manuals and websites, laboratory testing, monoclonal antibody kits
13	What are three mechanical defences that protect plants?	thorns and hairs, leaves that droop or curl, mimicry to trick animals
14	Give three physical defences of plants.	cellulose cell walls, tough waxy cuticles, bark on trees
15	How can aphids be controlled by gardeners?	introduce ladybirds to eat the aphids
16	How can plant diseases be detected?	areas of decay, discolouration, growths, malformed stems or leaves, presence of pests, spots on leaves, and stunted growth

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Chapter 6: Preventing and treating disease

Knowledge organiser

Non-specific defences

Non-specific defences of the human body against all pathogens include:

Skin

- physical barrier to infection
- produces antimicrobial secretions
- microorganisms that normally live on the skin prevent pathogens growing

Nose

Cilia and **mucus** trap particles in the air, preventing them from entering the lungs.

Trachea and bronchi produce mucus, which is moved away from the lungs to the back of the throat by cilia, where it is expelled.

Stomach

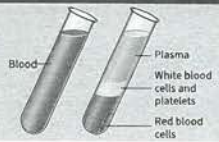
Produces strong acid (pH 2) that destroys pathogens in mucus, food, and drinks.

White blood cells

If a pathogen enters the body, the immune system tries to destroy the pathogen.

The function of **white blood cells** is to fight pathogens.

There are two main types of white blood cell – lymphocytes and phagocytes.



Lymphocytes

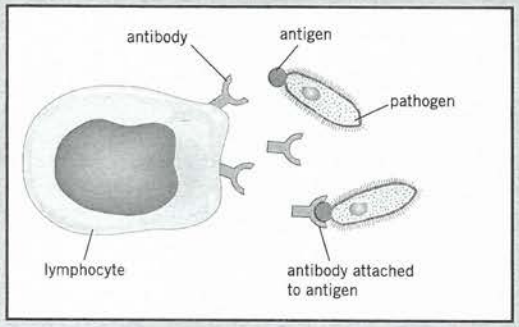
Lymphocytes fight pathogens in two ways:

Antitoxins

Lymphocytes produce **antitoxins** that bind to the toxins produced by some pathogens (usually bacteria). This *neutralises* the toxins.

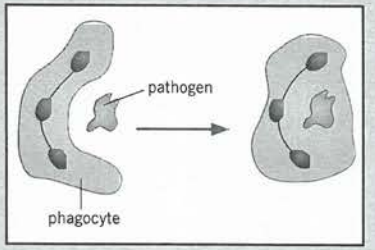
Antibodies

Lymphocytes produce **antibodies** that target and help to destroy specific pathogens by binding to **antigens** (proteins) on the pathogens' surfaces.



Phagocytes

1. Phagocytes are attracted to areas of infection.
2. The phagocyte surrounds the pathogen and engulfs it.
3. Enzymes that digest and destroy the pathogen are released.



Monoclonal antibodies (HT only)

Monoclonal antibodies are produced by mouse lymphocytes which are combined with a tumour cell to make a hybridoma cell. These can divide to make an antibody which can later be cloned and used to treat diseases such as cancer or used in pregnancy tests.

Key terms

Make sure you can write a definition for these key terms.

antibiotic, antibody, antigen, antitoxin, dose, double-blind trial, efficacy, Herd immunity, monoclonal antibodies, mucus, peer review, placebo, toxicity, vaccination, white blood cell

Treating diseases

Antibiotics

- **Antibiotics** are medicines that can kill *bacteria* in the body.
- Specific bacteria need to be treated by specific antibiotics.
- Antibiotics have greatly reduced deaths from infectious bacterial diseases, but antibiotic-resistant strains of bacteria are emerging.

Treating viral diseases

- Antibiotics *do not* affect viruses.
- Drugs that kill viruses often damage the body's tissues.
- Painkillers treat the symptoms of viral diseases but do not kill pathogens.

Discovering and developing new drugs

Drugs were traditionally extracted from plants and microorganisms, for example

- the heart drug digitalis comes from foxglove plants
- the painkiller aspirin originates from willow trees
- penicillin was discovered by Alexander Fleming from *Penicillium* mould.

Most modern drugs are now synthesised by chemists in laboratories.

New drugs are extensively tested and trialled for

- **toxicity** – is it harmful?
- **efficacy** – does it work?
- **dose** – what amount is safe and effective to give?

Stages of clinical trials

Pre-clinical trials

Drug is tested in cells, tissues, and live animals.

Clinical trials

1. Healthy volunteers receive very low doses to test whether the drug is safe and effective.
2. If safe, larger numbers of healthy volunteers and patients receive the drug to find the optimum dose.

Peer review

Before being published, the results of clinical trials will be tested and checked by independent researchers. This is called **peer review**.

Double-blind trials

Some clinical trials give some of their patients a **placebo** drug – one that is known to have no effect.

Double-blind trials are when neither the patients nor the doctors know who has been given the real drug and who has been given the placebo. This reduces biases in the trial.

Vaccinations

Vaccinations involve injecting small quantities of dead or inactive forms of a pathogen into the body. This stimulates lymphocytes to produce the correct antibodies for that pathogen. If the same pathogen re-enters the body, the correct antibodies can be produced quickly to prevent infection. If a large proportion of the population is vaccinated against a disease, it is less likely to spread. This is called **herd immunity**.

Chapter 6: Preventing and treating disease

Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

	B6 questions	Answers
1	What non-specific systems does the body use to prevent pathogens getting into it?	• skin • cilia and mucus in the nose, trachea, and bronchi • stomach acid
2	What three functions do white blood cells have?	phagocytosis, producing antibodies, producing antitoxins
3	What happens during phagocytosis?	phagocyte is attracted to the area of infection, engulfs a pathogen, and releases enzymes to digest the pathogen
4	What are antigens?	proteins on the surface of a pathogen
5	Why are antibodies a specific defence?	antibodies have to be the right shape for a pathogen's unique antigens, so they target a specific pathogen
6	What is the function of an antitoxin?	neutralise toxins produced by pathogens by binding to them
7	What does a vaccine contain?	small quantities of a dead or inactive form of a pathogen
8	How does vaccination protect against a specific pathogen?	vaccination stimulates the body to produce antibodies against a specific pathogen – if the same pathogen reenters the body, white blood cells rapidly produce the correct antibodies
9	What is herd immunity?	when most of a population is vaccinated against a disease, meaning it is less likely to spread
10	What is an antibiotic?	a drug that kills bacteria but not viruses
11	What do painkillers do?	treat some symptoms of diseases and relieve pain
12	What properties of new drugs are clinical trials designed to test?	toxicity, efficacy, and optimum dose
13	What happens in the pre-clinical stage of a drug trial?	drug is tested on cells, tissues, and live animals
14	What is a placebo?	medicine with no effect that is given to patients instead of the real drug in a trial
15	What is a double-blind trial?	a trial where neither patients nor doctors know who receives the real drug and who receives the placebo
16	What is a monoclonal antibody?	A monoclonal antibody is an antibody produced by a single clone of cells.
17	Give two examples in which monoclonal antibodies can be used for.	Treating cancer, in pregnancy tests

Put paper here

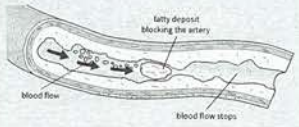
Chapter 7: Non-communicable diseases

Knowledge organiser

Coronary heart disease

Coronary heart disease (CHD) occurs when the coronary arteries become narrowed by the build-up of layers of fatty material within them.

This reduces the flow of blood, resulting in less oxygen for the heart muscle, which can lead to heart attacks.



Health issues

Health is the state of physical and mental well-being.

The following factors can affect health:

- communicable and non-communicable diseases
- diet
- stress
- exercise
- life situations.

Different types of disease may interact, for example:

- defects in the immune system make an individual more likely to suffer from infectious diseases
- viral infection can trigger cancers
- immune reactions initially caused by a pathogen can trigger allergies, for example skin rashes and asthma
- severe physical ill health can lead to depression and other mental illnesses.

Treating cardiovascular diseases

Treatment	Description	Advantages	Disadvantages
stent	inserted into blocked coronary arteries to keep them open	• widens the artery – allows more blood to flow, so more oxygen is supplied to the heart • less serious surgery	• can involve major surgery – risk of infection, blood loss, blood clots, and damage to blood vessels • risks from anaesthetic used during surgery
statins	drugs that reduce blood **cholesterol** levels, slowing down the deposit of fatty material in the arteries	• effective • no need for surgery • can prevent CHD from developing	• possible side effects such as muscle pain, headaches, and sickness • cannot cure CHD, so patient will have to take tablets for many years
replace faulty heart valves	heart valves that leak or do not open fully, preventing control of blood flow through the heart, can be replaced with biological or mechanical valves	• allows control of blood flow through the heart • long-term cure for faulty heart valves	• can involve major surgery – risk of infection, blood loss, blood clots, and damage to blood vessels • risks from anaesthetic used during surgery
transplants	if the heart fails a donor heart, or heart and lungs, can be transplanted **artificial hearts** can be used to keep patients alive whilst waiting for a heart transplant, or to allow the heart to rest during recovery	• long-term cure for the most serious heart conditions • treats problems that cannot be treated in other ways	• transplant may be rejected if there is not a match between donor and patient • lengthy process • major surgery – risk of infection, blood loss, blood clots, and damage to blood vessels • risks from anaesthetic used during surgery

Risk factors and non-communicable diseases

A **risk factor** is any aspect of your lifestyle or substance in your body that can increase the risk of a disease developing.

Some risk factors cause specific diseases. Other diseases are caused by factors interacting.

Risk factor	Disease	Effects of risk factor
diet (obesity) and amount of exercise	Type 2 diabetes	body does not respond properly to the production of insulin, so blood glucose levels cannot be controlled
	cardiovascular diseases	increased blood cholesterol can lead to CHD
alcohol	impaired liver function	long-term alcohol use causes liver cirrhosis (scarring), meaning the liver cannot remove toxins from the body or produce sufficient bile
	impaired brain function	damages the brain and can cause anxiety and depression
	affected development of unborn babies	alcohol can pass through the placenta, risking miscarriages, premature births, and birth defects
smoking	lung disease and cancers	cigarettes contain carcinogens, which can cause cancers
	affected development of unborn babies	chemicals can pass through the placenta, risking premature births and birth defects
carcinogens, such as ionising radiation, and genetic risk factors	cancers	for example, tar in cigarettes and ultraviolet rays from the Sun can cause cancers
		some genetic factors make an individual more likely to develop certain cancers

Cancer

Cancer is the result of changes in cells that lead to uncontrolled growth and division by mitosis.

Rapid division of abnormal cells can form a **tumour**.

Malignant tumours are cancerous tumours that invade neighbouring tissues and spread to other parts of the body in the blood, forming secondary tumours.

Benign tumours are non-cancerous tumours that do not spread in the body.

Treatment

Treatment of non-communicable diseases linked to lifestyle risk factors – such as poor diet, drinking alcohol, and smoking – can be very costly, both to individuals and to the Government.

A high incidence of these lifestyle risk factors can cause high rates of non-communicable diseases in a population.

Key terms

Make sure you can write a definition for these key terms.

artificial heart benign carcinogen cholesterol coronary heart disease
health malignant risk factor statin stent transplant tumour

Chapter 7: Non-communicable diseases

Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

	B7 questions	Answers
1	What is coronary heart disease?	layers of fatty material that build up inside the coronary arteries, narrowing them – resulting in a lack of oxygen for the heart
2	What is a stent?	a device inserted into a blocked artery to keep it open, allowing more blood and oxygen to the heart
3	What are statins?	drugs that reduce blood cholesterol levels, slowing the rate of fatty material deposit
4	What is a faulty heart valve?	heart valve that doesn't open properly or leaks
5	How can a faulty heart valve be treated?	replace with a biological or mechanical valve
6	When do heart transplants take place?	in cases of heart failure
7	What are artificial hearts used for?	keep patients alive whilst waiting for a transplant, or allow the heart to rest for recovery
8	Define health.	state of physical and mental well-being
9	What factors can affect health?	disease, diet, stress, exercise, life situations
10	What is a risk factor?	aspect of lifestyle or substance in the body that can increase the risk of a disease developing
11	Give five risk factors.	poor diet, smoking, lack of exercise, alcohol, carcinogens
12	What is cancer?	a result of changes in cells that lead to uncontrolled growth and cell division by mitosis
13	What are malignant tumours?	cancerous tumours that can spread to neighbouring tissues and other parts of the body in the blood, forming secondary tumours
14	What are benign tumours?	non-cancerous tumours that do not spread in the body
15	What two types of risk factor affect the development of cancers?	lifestyle and genetic risk factors
16	What is a carcinogen?	a substance that can cause cancers to develop

Chapter 8: Photosynthesis

Knowledge organiser

Photosynthetic reaction

Photosynthesis is a chemical reaction in which energy is transferred from the environment as light from the Sun to the leaves of a plant. This is an **endothermic** reaction.

Chlorophyll, the green pigment in **chloroplasts** in the leaves, absorbs the light energy. Leaves are well-adapted to increase the rate of photosynthesis when needed.

L

carbon dioxide + water $\xrightarrow{\text{light}}$ **glucose** + oxygen

$6CO_2 + 6H_2O \xrightarrow{\text{light}} C_6H_{12}O_6 + 6O_2$

Rate of photosynthesis

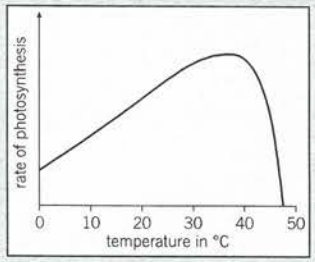
A **limiting factor** is anything that limits the rate of a reaction when it is in short supply.

The limiting factors for photosynthesis are

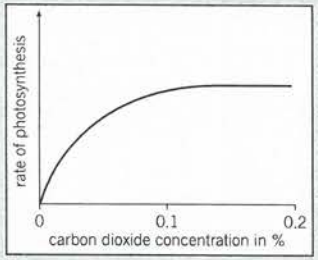
- temperature
- carbon dioxide concentration
- light intensity
- amount of chlorophyll.

Less chlorophyll in the leaves reduces the rate of photosynthesis. More chlorophyll may be produced by plants in well-lit areas to increase the photosynthesis rate.

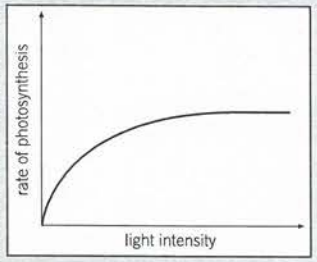
Limiting factors and photosynthesis rate (HT only)



- At low temperatures the rate of photosynthesis is low because the reactant molecules have less kinetic energy.
- Photosynthesis is an enzyme-controlled reaction, so at high temperatures the enzymes are denatured and the rate quickly decreases.



- Carbon dioxide is used up in photosynthesis, so increasing carbon dioxide concentration increases the rate of photosynthesis.
- At a certain point, another factor becomes limiting.
- Carbon dioxide is often the limiting factor for photosynthesis.

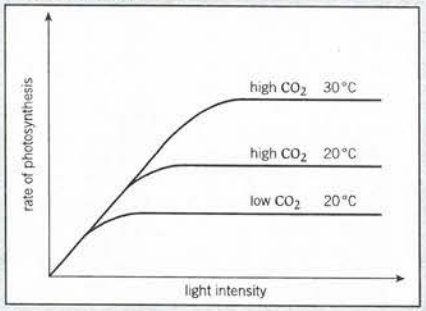


- Light energy is needed for photosynthesis, so increasing light intensity increases the rate of photosynthesis.
- At a certain point, another factor becomes limiting.
- Photosynthesis will stop if there is little or no light.

Interaction of limiting factors (HT only)

Limiting factors often interact, and any one may be limiting photosynthesis.

For example, on the graph the lowest curve has both carbon dioxide and temperature limiting photosynthesis. Temperature is limiting for the middle curve, and the highest curve shows photosynthesis rate increases when both temperature and carbon dioxide are increased until another factor becomes limiting.



Inverse square law (HT only)

As the distance of a light source from a plant increases, the light intensity decreases – this is called an inverse relationship. This relationship is not linear, as light intensity varies in inverse proportion to the square of the distance:

L

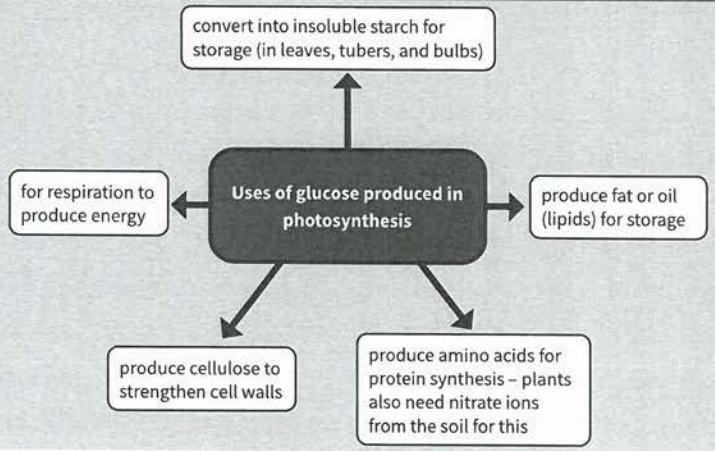
$$\text{light intensity} \propto \frac{1}{\text{distance}^2}$$

For example, if you double the distance between a light source and a plant, light intensity falls by three-quarters.

Greenhouse economics

Commercial greenhouses control limiting factors to get the highest possible rates of photosynthesis so they can grow plants as quickly as possible or produce the highest yields, whilst still making a profit.

Uses of glucose



Key terms

Make sure you can write a definition for these key terms.

carbon dioxide | chlorophyll | chloroplast | concentration | endothermic | glucose | greenhouse gases | light intensity | inverse square law | limiting factor | photosynthesis | protein synthesis

Chapter 8: Photosynthesis

Retrieval questions

Learn the answers to the questions below, then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

	B8 questions	Answers
1	Where does photosynthesis occur?	chloroplasts in the leaves of a plant
2	What is the name of the green pigment in the leaves?	chlorophyll
3	What type of reaction is photosynthesis?	endothermic
4	What type of energy is used in photosynthesis?	light energy
5	Give the word equation for photosynthesis.	carbon dioxide + water → glucose + oxygen
6	Give the balanced symbol equation for photosynthesis.	$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
7	Define the term limiting factor.	anything that limits the rate of a reaction when it is in short supply
8	Give the limiting factors of photosynthesis.	• temperature • carbon dioxide concentration • light intensity • amount of chlorophyll
9	Describe how light intensity affects the rate of photosynthesis.	increasing light intensity increases the rate of photosynthesis until another factor becomes limiting
10	Describe how carbon dioxide concentration affects the rate of photosynthesis.	increasing carbon dioxide concentration increases the rate of photosynthesis until another factor becomes limiting
11	Describe how temperature affects the rate of photosynthesis.	increasing temperature increases the rate of photosynthesis as the reaction rate increases – at high temperatures enzymes are denatured so the rate of photosynthesis quickly decreases
12	Give the equation for the inverse square law for light intensity.	light intensity $\propto \frac{1}{\text{distance}^2}$
13	Why are limiting factors important in the economics of growing plants in greenhouses?	greenhouses need to produce the maximum rate of photosynthesis whilst making profit
14	How do plants use the glucose produced in photosynthesis?	• respiration • convert it into insoluble starch for storage • produce fat or oil for storage • produce cellulose to strengthen cell walls • produce amino acids for protein synthesis

Put paper here

Chapter 9: Respiration

Knowledge organiser

Cellular respiration

Cellular **respiration** is an **exothermic** reaction that occurs continuously in the **mitochondria** of living cells to supply the cells with energy.

The energy released during respiration is needed for all living processes, including

- chemical reactions to build larger molecules, for example, making proteins from amino acids
- muscle contraction for movement
- keeping warm.

Respiration in cells can take place aerobically (using oxygen) or anaerobically (without oxygen).

Type of respiration	Oxygen required?	Relative amount of energy transferred
aerobic	✓	complete **oxidation** of glucose – large amount of energy is released
anaerobic	✗	incomplete oxidation of glucose – much less energy is released per glucose molecule than in aerobic respiration

Aerobic respiration

glucose + oxygen → carbon dioxide + water

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

Anaerobic respiration in muscles

glucose → lactic acid

$C_6H_{12}O_6 \rightarrow 2C_3H_6O_3$

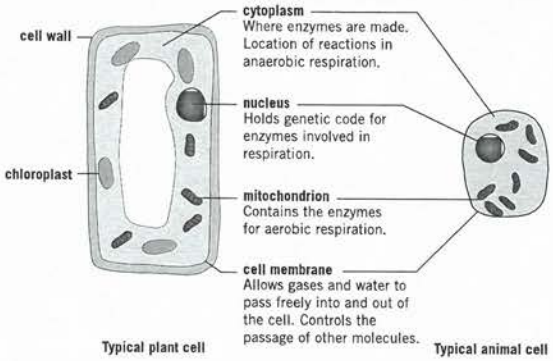
Fermentation

Anaerobic respiration in plant and yeast cells is represented by the equation

glucose → ethanol + carbon dioxide

Anaerobic respiration in yeast cells is called **fermentation**.

The products of fermentation are important in the manufacturing of bread and alcoholic drinks.



Key terms

Make sure you can write a definition for these key terms.

aerobic amino acids anaerobic carbohydrates cellulose exothermic fermentation fatty acid glycerol glycogen lactic acid lipids metabolism mitochondria oxidation oxygen debt proteins respiration starch

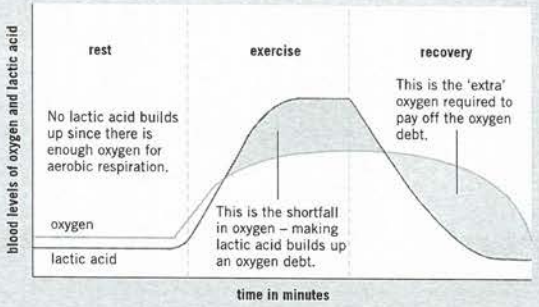
Response to exercise

During exercise the human body reacts to the increased demand for energy.

To supply the muscles with more oxygenated blood, heart rate, breathing rate, and breath volume all increase.

If insufficient oxygen is supplied, anaerobic respiration takes place instead, leading to the build-up of **lactic acid**.

During long periods of vigorous exercise, muscles become fatigued and stop contracting efficiently.



Oxygen debt (HT only)

After exercise, the lactic acid accumulated during anaerobic respiration needs to be removed. **Oxygen debt** is the amount of oxygen needed to react with the lactic acid to remove it from cells.

Removal of lactic acid

lactic acid in the muscles

↓

transported to the liver in the blood

↓

lactic acid is converted back to glucose

Metabolism

Metabolism is the sum of all the reactions in a cell or the body.

The energy released by respiration in cells is used for the continual enzyme-controlled processes of metabolism that produce new molecules.

Metabolic processes include the synthesis and breakdown of:

Carbohydrates

- synthesis of larger carbohydrates from sugars (starch, glycogen, and cellulose)
- breakdown of glucose in respiration to release energy

Lipids

- synthesis of lipids from one molecule of glycerol and three molecules of fatty acid

Proteins

- synthesis of amino acids from glucose and nitrate ions
- amino acids used to form proteins
- excess proteins broken down to form urea for excretion

Chapter 9: Respiration

Retrieval questions

Learn the answers to the questions below, then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

	B9 questions		Answers
1	Define the term cellular respiration.	Put paper here	an exothermic reaction that occurs continuously in the mitochondria of living cells to release energy from glucose
2	What do organisms need energy for?		• chemical reactions to build larger molecules • muscle contraction for movement • keeping warm
3	What is the difference between aerobic and anaerobic respiration?	Put paper here	aerobic respiration uses oxygen, anaerobic respiration does not
4	Write the word equation for aerobic respiration.		glucose + oxygen → carbon dioxide + water
5	Write the word equation for anaerobic respiration in muscles.	Put paper here	glucose → lactic acid
6	Write the balanced symbol equation for aerobic respiration.		$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
7	Why does aerobic respiration release more energy per glucose molecule than anaerobic respiration?	Put paper here	oxidation of glucose is complete in aerobic respiration and incomplete in anaerobic respiration
8	What is anaerobic respiration in yeast cells called?		fermentation
9	Write the word equation for anaerobic respiration in plant and yeast cells.	Put paper here	glucose → ethanol + carbon dioxide
10	How does the body supply the muscles with more oxygenated blood during exercise?		heart rate, breathing rate, and breath volume increase
11	What substance builds up in the muscles during anaerobic respiration?	Put paper here	lactic acid
12	What happens to muscles during long periods of activity?		muscles become fatigued and stop contracting efficiently
13	What is oxygen debt?	Put paper here	amount of oxygen the body needs after exercise to react with the accumulated lactic acid and remove it from cells
14	How is lactic acid removed from the body?		lactic acid in muscles → blood transports to the liver → lactic acid converted back to glucose
15	What is metabolism?	Put paper here	sum of all the reactions in a cell or the body

1 A virus called RSV causes severe respiratory disease.

(a) Suggest **two** precautions that a person with RSV could take to reduce the spread of the virus to other people.

1. _____

_____

2. _____

_____

(2)

(b) One treatment for RSV uses monoclonal antibodies which can be injected into the patient.

Scientists can produce monoclonal antibodies using mice.

The first step is to inject the virus into a mouse.

Describe the remaining steps in the procedure to produce monoclonal antibodies.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) Describe how injecting a monoclonal antibody for RSV helps to treat a patient suffering with the disease.

_____

_____

_____

_____

(2)

A trial was carried out to assess the effectiveness of using monoclonal antibodies to treat patients with RSV.

Some patients were given a placebo.

(d) Why were some patients given a placebo?

_____

_____

(1)

A number of patients had to be admitted to hospital as they became so ill with RSV.

The results are shown in the table below.

Treatment received by patient	**% of patients within each group admitted to hospital with RSV**
Group **A**: Monoclonal antibody for RSV	4.8
Group **B**: Placebo	10.4

The trial involved 1 500 patients.

- Half of the patients (group **A**) were given the monoclonal antibodies.
- Half of the patients (group **B**) were given the placebo.

(e) Calculate the total number of patients admitted to hospital with RSV during the trial.

_____

_____

_____

_____

Total number of patients admitted to hospital = _____

(2)

(f) Evaluate how well the data in the table above supports the conclusion:

'monoclonal antibodies are more effective at treating RSV than a placebo'.

_____

_____

_____

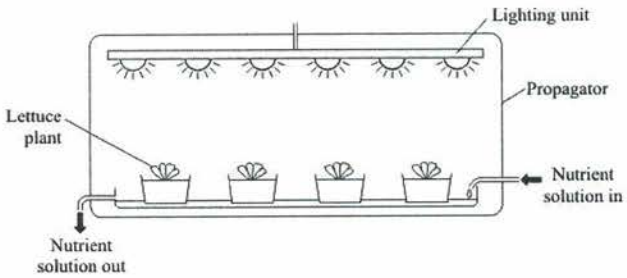
_____

(2)

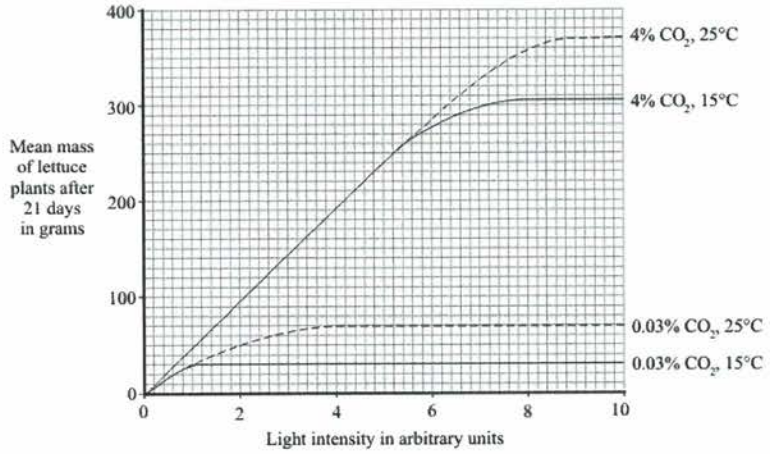
(Total 12 marks)

2 Changing the conditions in which plants grow affects how fast they grow.

The diagram shows a propagator in which scientists can control temperature, light intensity and carbon dioxide concentration.



The graph shows the effects of changing the temperature, light intensity and carbon dioxide concentration on the growth of lettuce plants.



(a) Describe and explain the effect of increasing light intensity on the mean mass of lettuce plants at 4% carbon dioxide and 15 °C.

(3)

(b) Growers wish to make maximum profits from their lettuces.

What do they need to consider before making decisions about the growing conditions for their lettuces?

(2)

(c) The nutrient solution contains nitrate ions and magnesium ions.

Complete the table to show the functions of these ions in plants and their deficiency symptoms.

Ion	Function in plants	Deficiency symptoms
Nitrate		
Magnesium		

(4)

(Total 9 marks)

3 A gardener is looking at the plants in his greenhouse.

(a) Some of the plants have a disease.

Give **two** ways the gardener could identify the pathogen infecting the plants.

1. _____

_____

2. _____

_____

(2)

(b) Plants can become unhealthy if they do not have essential mineral ions.

Describe the appearance of plants with:

- **nitrate** deficiency
- **magnesium** deficiency.

Nitrate deficiency _____

_____

Magnesium deficiency _____

_____

(2)

(c) Plants need other mineral ions.

- Potassium ions are needed for healthy root growth.
- Phosphate ions are needed for healthy flowers and fruits.

The gardener makes his own garden compost.

The percentage (%) of minerals in his compost was compared with two fertilisers he could buy.

The data are shown in the table below.

	Percentage (%) mineral content			
	Nitrate ions	**Phosphate ions**	**Potassium ions**	**Cost in £ / kg**
Garden compost	0.5	0.3	0.8	0.00
Fertiliser S	5.0	1.3	6.6	4.99
Fertiliser T	3.0	12.0	6.0	9.99

The gardener buys Fertiliser **S**.

Explain why he chose Fertiliser **S**.

(4)

(Total 8 marks)

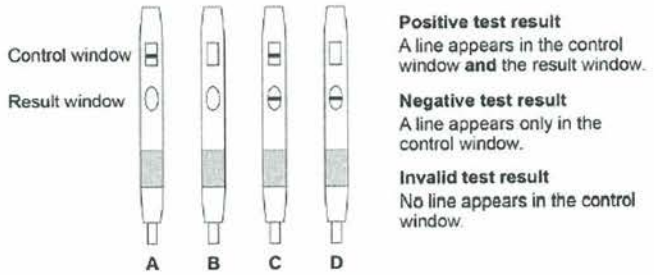
4 Monoclonal antibodies are used to measure the levels of hormones in the blood.

Pregnant women produce the hormone HCG.

HCG is excreted in urine.

Figure 1 shows four pregnancy test strips.

Figure 1



(a) Which test strip shows a negative test result?

Tick **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

(b) Monoclonal antibodies are used for pregnancy testing.

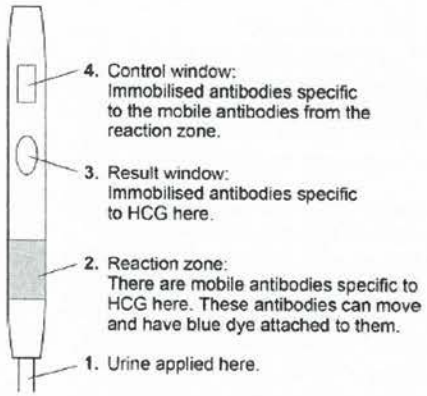
Give **one other** use of monoclonal antibodies.

_____

(1)

(c) **Figure 2** shows the parts of a pregnancy test strip.

Figure 2



The pregnancy test strip will show a positive test result when a woman is pregnant.

Explain how the pregnancy test strip works to show a positive result.

(6)

(Total 8 marks)

5 Some students investigated the effect of pH on the growth of one species of bacterium.

They transferred samples of bacteria from a culture of this species to each of eight flasks. Each flask contained a solution of nutrients but at a different pH.

After 24 hours, the students measured the amount of bacterial growth.

(a) It was important that the flasks in which the bacteria grew were not contaminated with other microorganisms.

Describe **two** precautions the students should have taken to prevent this contamination.

1. _____

_____

2. _____

_____

(2)

(b) To see the effect of pH on the growth of the bacteria, other conditions should be kept constant.

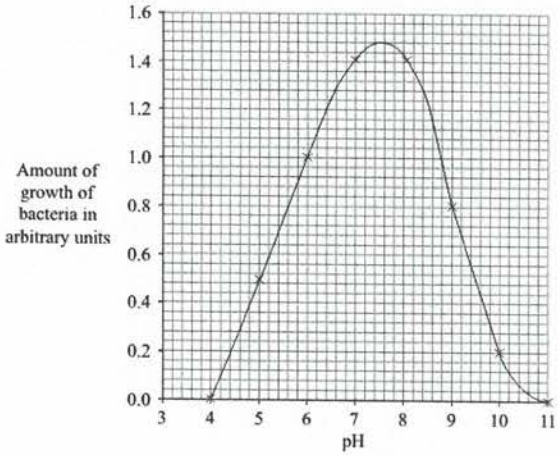
Suggest **two** conditions which should have been kept constant for all eight flasks.

1. _____

2. _____

(2)

(c) The graph shows the results of the investigation.



The students wanted to find the best pH for the growth of this species of bacterium.

(i) Use the graph to estimate the pH at which the bacteria would grow best.

pH _____

(1)

(ii) What could the students do to find a more accurate value for the best pH for growth of the bacteria?

_____

_____

(1)

(Total 6 marks)

Mark schemes

1 (a) any **two** from:

- regular hand washing
  or
  use hand sanitiser / alcohol gel
- cover nose / mouth when coughing / sneezing
  allow wear a face mask
- put used tissues (straight) in the bin
- don't kiss uninfected people
  allow isolate patient from others
  or
  don't share cutlery / cups / drinks with uninfected people
- clean / disinfect / sterilise surfaces regularly
  ignore responses referring to infected people

2

(b) any **three** from:

- stimulate (mouse) lymphocytes to produce antibody
  for marking points 1 and 2 lymphocyte must be used at least once
- combine (mouse) lymphocyte with tumour cell
  or
  (create a) hybridoma
- clone (hybridoma) cell
- (hybridoma) divides rapidly **and** produces the antibody

3

(c) any **two** from:

- (monoclonal) antibody binds to virus **or** antibody binds to antigen on surface of virus
- (monoclonal) antibody is complementary (in shape) / specific to antigen (on surface of virus)
- white blood cells / phagocytes kill / engulf the virus(es)

2

(d) as a control
or
to see / compare the effects of the treatment (vs. no treatment)

1

(e) $(4.8 + 10.4) \div 2 \div 100 \times 1500$
or
$(4.8 \div 100 \times 750) + (10.4 \div 100 \times 750)$

1

114
*an answer of 114 scores **2** marks*
*allow 228 for **1** mark*

1

(f) **(supports the conclusion because)**
over double the number / % of patients (in the trial) were hospitalised with the placebo (compared to MAB)

1

(does not support the conclusion because)
no information on patients not hospitalised / still unwell at home
or
other factors may have affected those admitted to hospital
allow correct named factor e.g. age / gender / other illness
or
don't know if it was a double blind trial

1

[12]

2 (a) any **three** from:

- ((mean) mass) increases up to 7 / 8 units (of light) then levels off
- light limiting factor up to 7 / 8 units
- for photosynthesis
  must be in correct context
- other factor / temperature limiting above 7 / 8 units

3

(b) any **two** from:

- cost of providing conditions / heat / light / CO_2
- effect of treatment on profit
  allow too much of factor is wasteful
- relevant use of data from graph eg limiting factors
- named other factors eg fertiliser / pest control / weeds / density of planting
  allow taste / appearance

2

(c) **nitrate function**

produce amino acids / proteins / enzymes
ignore DNA
*do **not** allow chlorophyll*

1

nitrate deficiency

stunted growth
allow description
ignore plant dies

1

magnesium function

produce chlorophyll
ignore chloroplasts

1

magnesium deficiency

yellow leaves / plant
ignore plant dies

1

[9]

3 (a) compare them to (pictures in) a gardening manual / website

1

send to laboratory (for testing)

1

(b) (nitrate) stunted growth

1

(magnesium) yellowing of leaves
allow chlorosis

1

(c) (fertiliser **S**)

has most nitrogen for good growth
*if no other marks awarded allow **1** mark for (fertiliser **s**) has more minerals than compost*

1

(and) has high(est) potassium content for stronger roots

1

(it is also) cheaper than fertiliser **T**

1

(however) has less phosphate than fertiliser **T** (although more than compost) so flowers / fruit perhaps less important for the gardener

1

[8]

4 (a) **A**

1

(b) any **one** from:

- identify / locate specific molecules / other hormones
- locate blood clots
- diagnose / treat some cancers

1

(c) (as) urine passes through reaction zone

1

HCG hormone binds to the mobile HCG antibody (in the reaction zone)

1

(passes up the stick) HCG hormone binds to the immobilised HCG antibodies in the results zone

1

(the other) antibodies which do not attach to HCG

1

bind to antibodies in control zone

1

blue dye appears in both control and results zones (to show positive result)

1

[8]

5 (a) any **two** from:

- sterilise / kill microorganisms
  ignore 'cleaning' / 'disinfect'
  ignore 'germs'
- method of sterilisation eg apparatus / media sterilised in oven / autoclave
  allow pressure cooker / boiling water
- pass flask mouth / pipette tip / loop / test tube mouth through flame
- work near a flame
- minimise opening of flask / test tube **or** hold non-vertical
  *allow idea of sealing / covering **or** prevent entry of air*

2

(b) any **two** from:

- temperature
  ignore references to time / type of bacterium
- concentration / amount of nutrients / ions
- type of nutrient
- volume / amount of solution
- amount of bacteria added
- agitation **or** amount of oxygen

2

(c) (i) 7.5
accept in range 7.4 – 7.6

1

(ii) use more pH values around / close to pH 7.5 / between 7 and 8

1

[6]