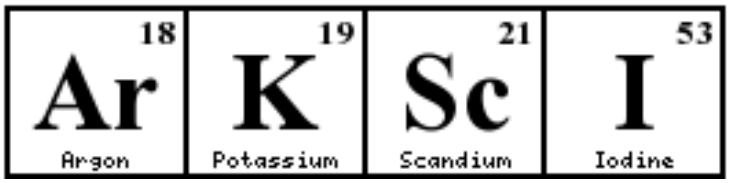
Biology Study Pack for GCSE

Biology (University of Oxford)



BIOLOGY STUDY PACK

AQA GCSE Combined Science: Trilogy 8464

AQA GCSE Biology 8461

Paper	Exam Date
<u>Paper 1</u> Cell Biology Organisation Infection and Response Bioenergetics	15th May 2018
<u>Paper 2</u> Homeostasis and Response Inheritance, Variation and Evolution Ecology	11th June 2018

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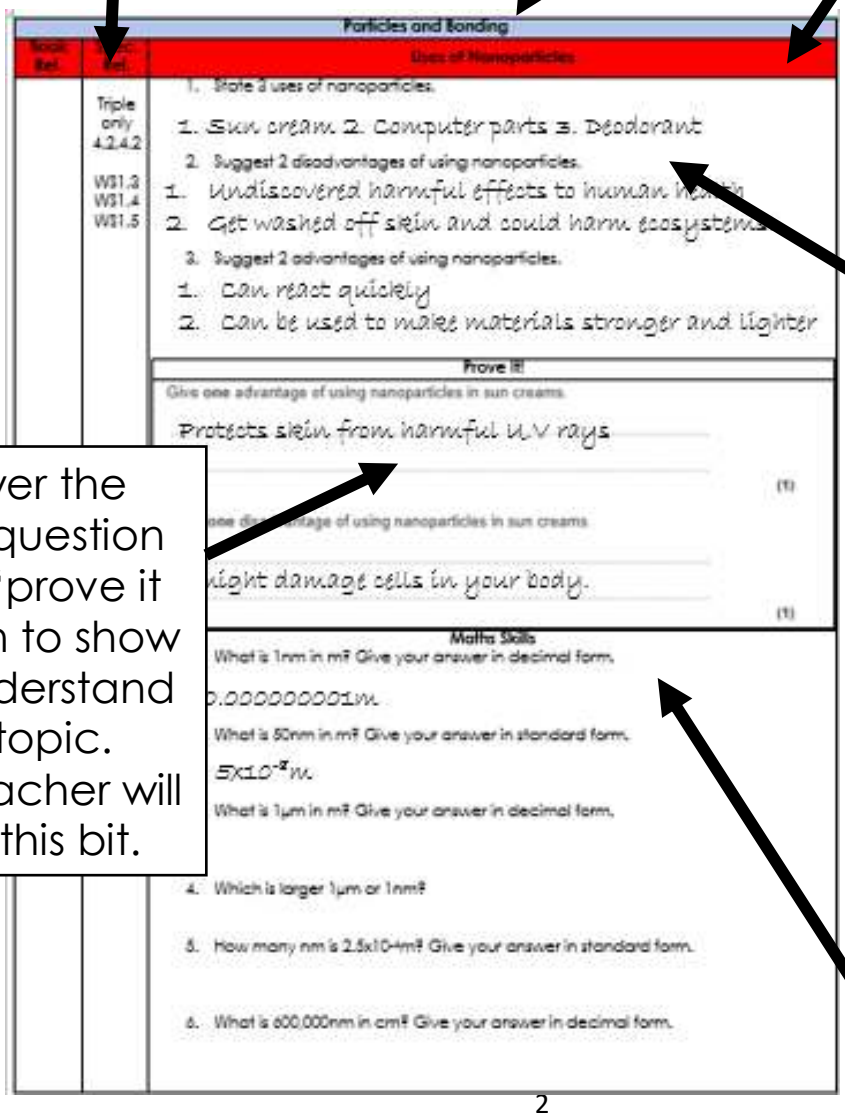
How To Use Your Study Pack

This tells you which bit of the specification you are studying. If says here if it is a triple only topic.

This is the big idea this topic is part of

This is the topic you are studying



Particles and Bonding

Uses of Nanoparticles

1. State 3 uses of nanoparticles.

1. Sun cream 2. Computer parts 3. Deodorant

2. Suggest 2 disadvantages of using nanoparticles.

1. Undiscovered harmful effects to human health
2. Get washed off skin and could harm ecosystems

3. Suggest 2 advantages of using nanoparticles.

1. Can react quickly
2. Can be used to make materials stronger and lighter

Triple only 4.2.4.2

WS1.3 WS1.4 WS1.5

Prove it!

Give one advantage of using nanoparticles in sun creams.

Protects skin from harmful UV rays

(1)

Give one disadvantage of using nanoparticles in sun creams

Might damage cells in your body.

(1)

Maths Skills

What is 1nm in m? Give your answer in decimal form.

0.000000001m

What is 50nm in m? Give your answer in standard form.

5×10^{-8}m

What is 1μm in m? Give your answer in decimal form.

4. Which is larger 1μm or 1nm?

5. How many nm is 2.5x10-4m? Give your answer in standard form.

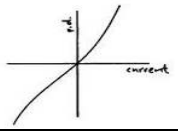
6. What is 600,000nm in cm? Give your answer in decimal form.

1. Try and answer the questions in this box.
2. Use your revision guide to check your answers and correct any you got wrong.
3. Use the revision guide to help you answer the questions you didn't know.

Answer the exam question in the 'prove it 'section to show you understand the topic. Your teacher will mark this bit.

This section will help you prepare for any questions that involve maths in the exam.

GCSE Command Words

Command Word	Definition	Example Question	Example Answer
State, give, name, write down	Short answer only and does not require an explanation.	**State** the units for acceleration.	m/s^2
Describe (not graphs or practical)	Recall facts, events or process in an accurate way.	**Describe** how quadrats should be used to estimate the number of plants in a field.	Place a large number of quadrats randomly in the field. Count the number of plants in the quadrat. Calculate the mean number in each quadrat then use the area of the quadrat and field to estimate the number of plants.
Describe (graphs)	Identify the pattern in the graph and use numbers from the graph to make this clear.	**Describe** the pattern of tooth decay in Figure 3 for water without fluoride.	The percentage of tooth decay increases with age by 4% for each age group in figure 3.
Describe (practical)/ Plan	Write the method for the practical or the results that you would expect to see.	**Plan** an experiment to test the hypothesis "the higher the temperature, the faster the rate of reaction".	Measure the rate of reaction by adding a set amount of metal to set type, volume and concentration of acid and time how long it takes to stop fizzing. Repeat the experiment at 5 different temperatures.
Determine	Use given data or information to obtain and answer.	**Determine** the half-life of a sample if it decreases from 1000g to 250g in 2.6million years.	1.3 million years
Explain	Make something clear or state the reasons for something happening. You will need to state what is happening and then say why it happens.	**Explain** why soot forms.	Soot forms during incomplete combustion when not enough oxygen is present.
Evaluate	Use the information supplied and your own knowledge to consider the evidence for and against a point. You may also be required to include a *justified conclusion*.	A company stated: 'A Life Cycle Assessment shows that using plastic bags has less environmental impact than using paper bags'. **Evaluate** this statement.	Paper bags are made from a renewable resource whereas plastic bags are made from finite resources. However, paper bags are bad because they produce much more solid waste and more CO_2 is released when they are produced therefore the negative impacts of paper bags outweigh the problem of plastic coming from a finite resource.
Compare	Describe the similarities and/or differences between things. Avoid writing about just one.	**Compare** the differences between cracking and distillation.	Cracking involves a catalyst *whereas* distillation does not.
Sketch	Draw approximately.	**Sketch** a current–potential difference graph for a filament lamp.	

Cells and Systems Keywords

Add all the important keywords for this big idea in the grid below as you come across them in the study pack.

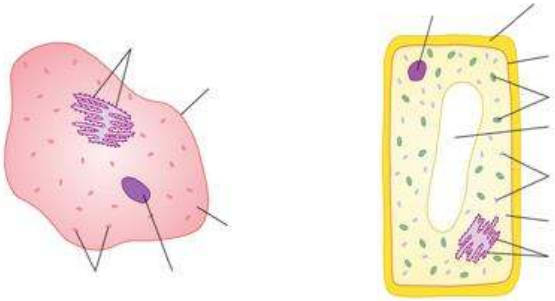
Word	Definition

Cells and systems

Book Ref.	Spec. Ref.	Eukaryotes and prokaryotes
	4.1.1.1	**Key information:** - Plant and animal cells (eukaryotic cells) have: - genetic material enclosed in a nucleus to control the activity of the cell - a cell membrane to control what enters and exits the cell - cytoplasm to allow reactions to take place - Bacterial cells (prokaryotic cells) are much smaller in comparison. The genetic material is not enclosed in a nucleus. It is a single DNA loop and there may be one or more small rings of DNA called plasmids. They also have cytoplasm, a cell membrane and a cell wall to provide strength and support to the cell.
		1. What type of cells are eukaryotic cells? 2. What type of cells are prokaryotic cells? 3. **Outline** 3 differences between prokaryotes and eukaryotes.
		Maths Skills
	MS2h	

Size of image (mm)	Magnification	Size of real object (mm)
5	40	
10	1000	
12	60	
8	200	
15	500	

How many orders of magnitude bigger is the first sample compared to the second?

Cells and systems		
Book Ref.	**Spec. Ref.**	**Animal and plant cells**
	4.1.1.2	**Key information:** Most animal cells have the following parts: a nucleus, cytoplasm, a cell membrane, mitochondria to carry out aerobic respiration which releases energy for the cell, ribosomes to carry out protein synthesis by joining many amino acids. In addition to the parts found in animal cells, plant cells often have: • chloroplasts filled with chlorophyll to absorb light for photosynthesis • a permanent vacuole filled with cell sap to provide support to the cell Plant and algal cells also have a cell wall made of cellulose, which strengthens the cell.
		1. Label the cells: 

2. Fill in the table with the functions of each organelle.

Organelle	Function
Nucleus	
Cytoplasm	
Cell membrane	
Mitochondria	
Ribosomes	
Chloroplasts	
Vacuole	
Cell wall	

3. **Identify** three organelles found in plant cells but not animal cells.

Prove It!

Living organisms are made of cells.

(a) Animal and plant cells have several parts. Each part has a different function.

Draw **one** line from each cell part to the correct function of that part.

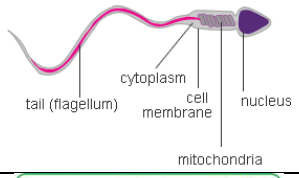
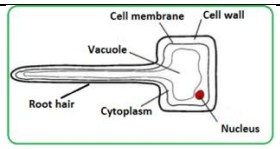
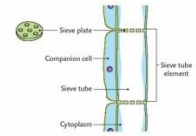
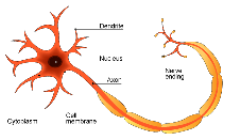
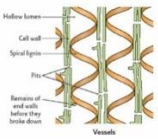
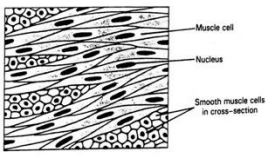
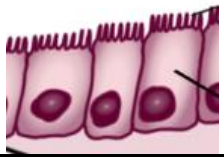
Cell part	Function
Cell membrane	Where most energy is released in respiration
Mitochondria	Controls the movement of substances into and out of the cell
Nucleus	Controls the activities of the cell
	Where proteins are made

(3)

Cells and systems		
Book Ref.	**Spec. Ref.**	**Required practical 1: Use a light microscope to observe, draw and label a selection of plant and animal cells.**
	4.1.1.2 AT 1 and 7	**Key information:** - A light microscope shines a beam of light across a thin, dead, stained specimen. - The resolution (ability to distinguish between two points) and magnification of a light microscope is high enough the view the nucleus and cell membrane. - Most organelles are too small to be viewed with a light microscope. - When drawing an image from a microscope a pencil must be used. Labels should
	WS 1.2	 1. The image shows human cheek cells. In the space below, draw a biological drawing of this image. Label the organelles which are visible. 2. **Describe** how the slide of cheek cells would have been prepared. 3. **State** what is meant by the term resolution. 4. Give the equation that links magnification, image size and actual size.
		Maths Skills
	Ma 1a, 1b, 2a	Convert the following: 1. 3cm into mm = 2. 3mm into µm = 3. 50µm into mm = Put these numbers into standard form: 1. 6 000 2. 400 3. 80 000 4. 0.007 Answer the following questions: 1. A heart muscle cell with a length of 23µm is magnified 200x. What is the image size? Give your answer in metres in standard form. 2. A root hair cell image is 7.8 cm in length. The image is being magnified 4500x. Calculate the real length of the object in metres. Giving your answer in standard form to 3 significant figures. 3. The image of a nerve cell measures 3.5 cm. It has been magnified 3000x. Calculate the real size of the nerve cell, giving your answer in metres and standard form.

Cells and systems

Book Ref.	Spec. Ref.	Cell specialisation
	4.1.1.3	**Key information:** Cells may be specialised to carry out a particular function: • sperm cells, nerve cells and muscle cells in animals • root hair cells, xylem and phloem cells in plants.

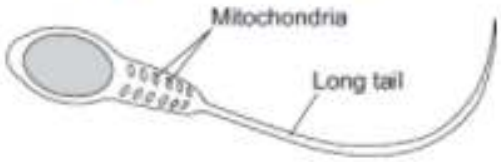
NAME OF CELL	PICTURE	STRUCTURE	FUNCTION
PHLOEM CELLS		Has a large surface area because of a long finger-like projection	Allows electrical impulses to pass around the body
ROOT HAIR CELL		Has a long flagella and lots of mitochondria	Transports water and mineral ions around a plant
NERVE CELL		Has a long axon and a cell body found in the CNS	Fertilises an egg cell
SPERM CELL		Consists of long hollow tubes strengthened with lignin	Absorbs water for a plant
XYLEM CELLS		Consists of long hollow tubes	Transports dissolved sugars around a plant
MUSCLE CELLS		Have hairs on the tops of cells to increase surface area	Control movement of the skeleton in animals
CILIATED CELLS		Have lots of mitochondria to release extra energy	Absorb nutrients from the small intestine

Prove It!

1. Describe how the structure of a sperm cell relates to its function.

2. Describe how the structure of a root hair cell relates to its function.

3. Describe how the structure of a nerve cell relates to its function.

Cells and systems		
Book Ref.	**Spec. Ref.**	**Cell differentiation**
	4.1.1.4	**Key information:** As an organism develops, cells differentiate to form different types of cells. • Most types of animal cell differentiate at an early stage. • Many types of plant cells can differentiate throughout life. In mature animals, cell division is mainly restricted to repair and replacement. As a cell differentiates it gets different sub-cellular structures so it can carry out a certain function. It has become a specialised cell.
		1. **State** what is meant by the term 'differentiation'. 2. **Describe** why cell division is important for animals. 3. **Give** one example of a specialised cell and outline how it is specialised to carry out its function. 4. **State** the name of the tissue in plants which allows plant cells to differentiate throughout life.
		Prove It!
		(b) Cells can be specialised for a particular job. The diagram shows the structure of a human sperm cell.  Describe how the long tail and the mitochondria help the sperm to do its job. Long tail..... .... Mitochondria..... .... (4)

Cells and systems		
Book Ref.	**Spec. Ref.**	**Microscopy**
	4.1.1.5	**Key information:** An electron microscope has much higher magnification and resolving power than a light microscope. This means that it can be used to study cells in much finer detail. This has enabled biologists to see and understand many more sub-cellular structures.
		1. What is a microscope used for? 2. **Describe** the difference between the terms 'resolution' and 'magnification'. 3. **Outline** the main differences between a light and electron microscope. Give examples of structures we can see with each.
		Prove It!
	WS 2.6	The image below shows some muscle cells from the wall of the stomach, as seen through a light microscope.  (a) Describe the function of muscle cells in the wall of the stomach. .... **(2)** (b) **Figure above** is highly magnified. The scale bar in **Figure above** represents 0.1 mm. Use a ruler to measure the length of the scale bar and then calculate the magnification of **Figure above**. .... Magnification = ... times **(2)**
Cells and systems		

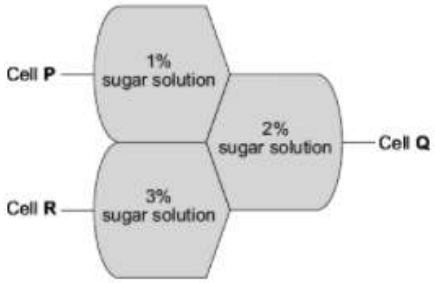
Book Ref.	Spec. Ref.	Culturing microorganisms (biology only)
	4.1.1.6	**Key information:** Bacteria multiply by simple cell division (binary fission) as often as once every 20 minutes if they have enough nutrients and a suitable temperature. Bacteria can be grown in a nutrient broth solution or as colonies on an agar gel plate. Uncontaminated cultures of microorganisms are required for investigating the action of disinfectants and antibiotics.
	MS 1a, 2a 2h, **(HT only)** 1b	1. **State** two methods of growing microorganisms. 2. **State** two substances contained within the culture medium that the microorganisms need in order to grow. 3. Which two other conditions do microorganisms need to grow? 4. Why do scientists culture microorganisms in the lab? 5. By which method do bacteria divide? 6. a) The mean division time for a population of bacteria is 24 minutes. **Calculate** how many bacteria will result from each individual bacterium after 6 hours. Use the formula: Bacteria at end of growth period = bacteria at beginning of growth period x $2^{\text{number of divisions}}$ b) **(HT only)** Express your answer in standard form to 3 s.f.
		Maths skills
	MS 1a, 2a 2h, **(HT only)** 1b	*Salmonella* bacteria are responsible for many cases of food poisoning. In the right conditions *Salmonella* bacteria can reproduce once every 40 minutes. a) Describe the process by which bacteria divide. …… (1) b) Calculate how many bacteria there would be from a single bacterium after 24 hours using the formula: Bacteria at end of growth period = bacteria at beginning of growth period x $2^{\text{number of divisions}}$ (3) c) (HT only) Express your answer to b) in standard form to 3 s.f. (1)
		Cells and systems
Book Ref.	**Spec. Ref.**	**Required practical 2 (biology only): investigate the effect of antiseptics or antibiotics on bacterial growth using agar plates and measuring zones of inhibition**

	4.1.1.6 AT 1, 3, 4, 8 MS 5c	**Key information:** Bacteria multiply by simple cell division (binary fission) as often as once every 20 minutes if they have enough nutrients and a suitable temperature. Bacteria can be grown in a nutrient broth solution or as colonies on an agar gel plate. Uncontaminated cultures of microorganisms are required for investigating the action of disinfectants and antibiotics.
		1. **Define** the following terms: - Disinfectant - Antibiotic 2. **Explain** why cultures of microorganisms must be uncontaminated. 3. **Explain** the purpose of the following steps in the practical: • Sterilising the Petri dish and culture media before use • Passing the inoculating loop through a flame before and after inoculation • The lid of the Petri dish should be secured with adhesive tape but not completely sealed • The Petri dish should be stored upside down • The cultures should be incubated at 25 °C even though this is below the optimum temperature for growth. 4. A student set up a culture plate of bacteria and placed three filter paper circles containing different concentrations of antibiotic onto the surface. They were labelled A, B and C. After 5 days, the diameters of the zones of inhibition were 5.0 mm, 10.2 mm, 15.8 mm. **Calculate** the surface area of agar cleared by the three discs. 5. **Explain** why clear areas (zones of inhibition) appear on the agar jelly around the filter paper circles, which contain antibiotics.
		Prove It!
		A student is given a tube containing a liquid nutrient medium. The medium contains one type of bacterium. (a) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.* The student is told to grow some of the bacteria on agar jelly in a Petri dish. Describe how the student should prepare an uncontaminated culture of the bacterium in the Petri dish. You should explain the reasons for each of the steps you describe. (6)

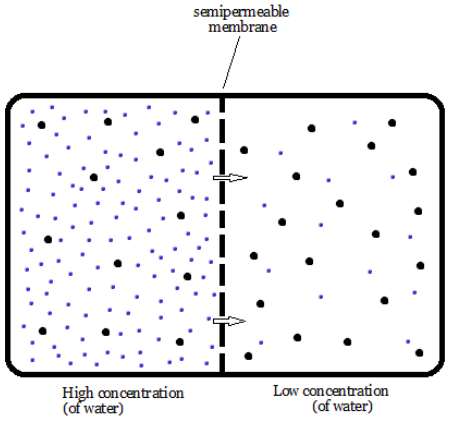
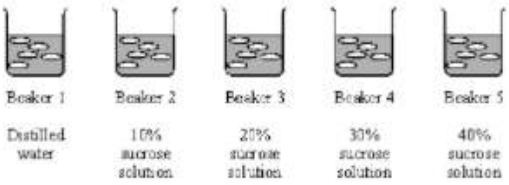
Cells and systems		
Book Ref.	**Spec. Ref.**	**Diffusion**
	4.1.3.1	**Key information:** - Diffusion is the spreading out of the particles of any substance in solution, or particles of a gas, resulting in a net movement from an area of higher concentration to an area of lower concentration.
		1. **Define** the term 'diffusion'. 2. **Give** two examples of molecules which diffuse in and out of cells. **Name** the process these molecules are involved in. 3. **State** three factors that affect the rate of diffusion. 4. **Describe** the relationship between surface area: volume ratio and the rate of diffusion. 5. Complete the table to show how the following are adapted for exchanging materials.

Organ	How it is adapted for exchange
Lungs	
Small intestine	
Gills	
Leaves	
Roots	

		Prove It!
		Diffusion is an important process in animals and plants. The movement of many substances into and out of cells occurs by diffusion. Describe why diffusion is important to animals and plants. In your answer you should refer to: • animals • plants • examples of the diffusion of named substances. **(6)**

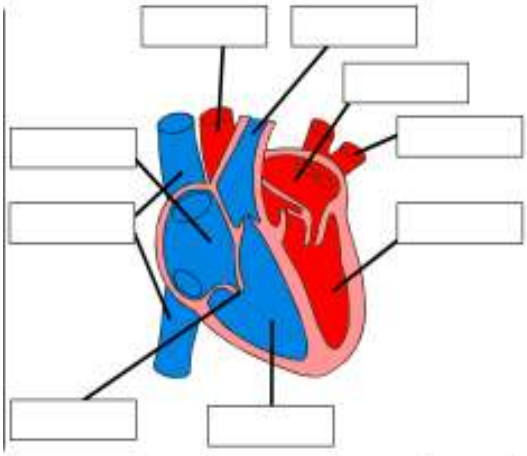
Cells and systems		
Book Ref.	**Spec. Ref.**	**Osmosis**
	4.1.3.2	**Key information:** Water may move across cell membranes via osmosis. Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane.
		1. **Define** the term 'osmosis'. 2. The information shows the percentage concentration of sugar solution in cells **P**, **Q** and **R**. **Diagram 2**  Water can move from cell to cell. Into which cell, **P**, **Q** or **R**, will water move the fastest? ☐
		Prove It!
		Plant roots absorb water from the soil by osmosis. (a) What is osmosis? .... **(3)** (b) The image below shows part of a plant root.  The plant root is adapted for absorbing water from the soil. Use information from the diagram to explain how this plant root is adapted for absorbing water. **(3)**

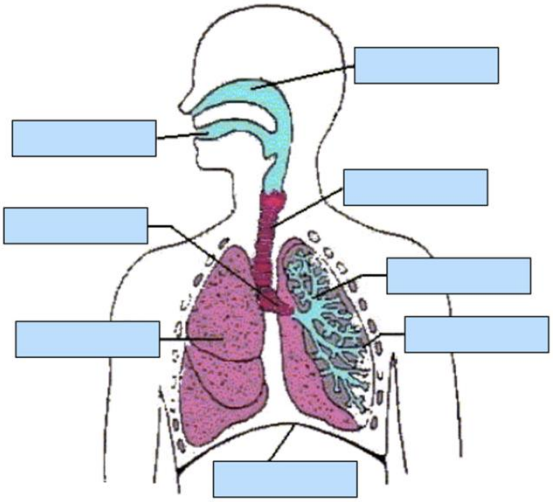
Cells and systems

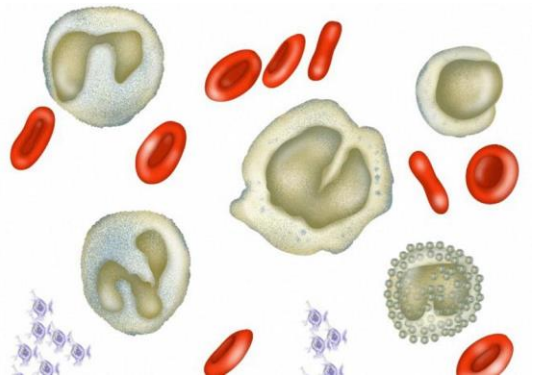
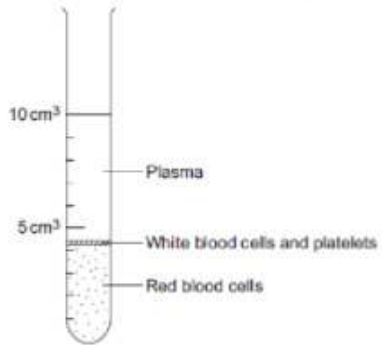
Book Ref.	Spec. Ref.	Required practical 2 (biology: required practical 3): Investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue.
	AT 1, 3, 5	**Key information:** - Plant tissue can be used to measure the rate of uptake of water in different solutions. - During these experiments, only the water moves. Salt and sugar molecules are too large to pass across the partially permeable membranes. - The higher the concentration of salt or sugar, the lower the concentration of water.
		 **1. Describe** why the water moves from the left to the right side. 2. **Explain** why the sugar molecules do not move.
		Maths Skills
	MS1a, 1c	Some students set up an experiment using osmosis to find the concentration of sucrose solution in potato cell sap. They used discs of potato cut to the same size and weighing approximately 10 gms. The discs were put into each of five beakers.  (a) (i) After two hours they reweighed the discs after carefully blotting them first. Why did the students blot the potato before weighing it? .... (1) (ii) Their results are shown in the table below. | | Beaker 1 | Beaker 2 | Beaker 3 | Beaker 4 | Beaker 5 | | --- | --- | --- | --- | --- | --- | | Final mass in g | 13.0 | 12.2 | 9.0 | 7.9 | 7.3 | | Initial mass in g | 10.0 | 10.6 | 10.0 | 10.1 | 10.4 | The students calculated the % gain or loss in mass of potato. Complete this table of results for Beakers 2, 4 and 5. | Beaker 1 | Beaker 2 | Beaker 3 | Beaker 4 | Beaker 5 | | --- | --- | --- | --- | --- | | 13 – 10.0 = 3.0 $\frac{3.0}{10.0} \times 100\% = 30\%$ | | 9.0 – 10.0 = –1.0 $\frac{-1.0}{10.0} \times 100\% = -10\%$ | | | | Gain in mass = 30% | | Loss in mass = 10% | | | (3)

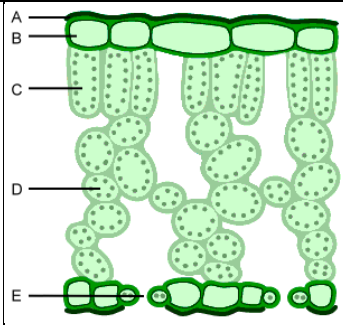
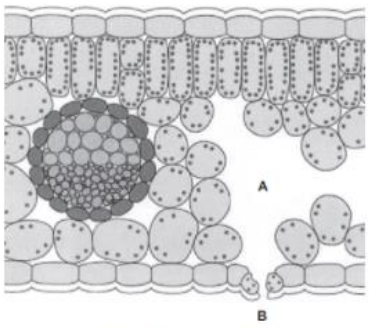
Cells and systems		
Book Ref.	**Spec. Ref.**	**Active transport**
	4.1.3.3	**Key information:** - Active transport moves substances from a more dilute solution to a more concentrated solution (against a concentration gradient). This requires energy from respiration. - Active transport allows mineral ions to be absorbed into plant root hairs from very dilute solutions in the soil. Plants require ions for healthy growth. It also allows sugar molecules to be absorbed from lower concentrations in the gut into the blood which has a higher sugar concentration. Sugar molecules are used for cell respiration.
		1. **Outline** the main differences between diffusion and active transport. 2. **Explain,** using examples, the importance of active transport for plant growth. 3. **Explain** why active transport cannot occur in the absence of oxygen. 4. **Describe** when active transport is used by the cells lining the small intestine.
		Prove It!
		Plants must use active transport to move some substances from the soil into root hair cells. (i) Active transport needs energy. Which part of the cell releases most of this energy? Tick (✓) **one** box. mitochondria ☐ nucleus ☐ ribosome ☐ (1) (ii) Explain why active transport is necessary in root hair cells. .... (2)

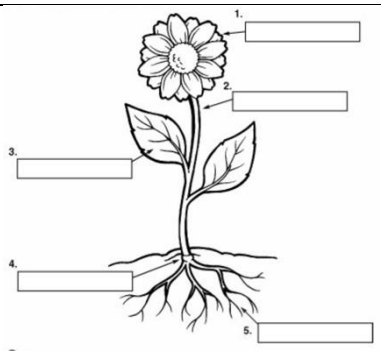
Cells and systems		
Book Ref.	**Spec. Ref.**	**Principles of organisation**
	4.2.1	**Key information:** Cells are the basic building blocks of all organisms. A tissue is a group of cells with a similar structure and function. Organs are aggregations of tissues performing specific functions. Organs are organised into organ systems, which work together to form organisms.
	MS 1c	1. Put the following in order of size (smallest to largest): Tissue Organ Cell Organ system _____ → _____ → _____ → _____ 2. **Describe** the difference between a tissue and an organ. 3. **Name** the three tissues of the stomach. Give the function of each. 4. **Give an example** of a plant organ and state its function.
		Prove It!
		In a living organism, the cells are organised into organs, systems and tissues. (a) Use words from the box to complete the list of these structures in order of size. **organs systems tissues** The smallest structure is at the top of the list and the largest is at the bottom. 1 cells (smallest) 2 ..... 3 ..... 4 ..... 5 organism (largest) (1) (b) **List A** gives three tissues found in the human body. **List B** gives four functions of tissues. Draw a straight line from each tissue in **List A** to its correct function in **List B**. **List A – Tissue**: Muscular tissue; Glandular tissue; Epithelial tissue **List B – Function**: Covers many parts of the body; Contracts to cause movement; Divides by meiosis; Releases hormones or enzymes (3)

Cells and systems		
Book Ref.	**Spec. Ref.**	**The heart and blood vessels**
	4.2.2.2	**Key information:** - The heart is an organ that pumps blood around the body in a double circulatory system. The right ventricle pumps blood to the lungs where gas exchange takes place. The left ventricle pumps blood around the rest of the body. - The natural resting heart rate is controlled by a group of cells located in the right atrium that act as a pacemaker. Artificial pacemakers are electrical devices used to correct irregularities. - The three different types of blood vessel are arteries, veins and capillaries.
		 1. **Label** the diagram of the heart 2. **Describe** the passage of blood through the left hand side of the heart. 3. **Explain** the importance of valves in the heart. 4. **Name** the artery that supplies the heart with blood. **Explain** the importance of the heart having its own blood supply. 5. Where are the group of cells that control the natural resting heart rate found? 6. **Outline** the difference in the structure of arteries and veins. 7. **Describe** how the structure of a capillary relates to its function.
		Prove It!
		The circulatory system contains arteries and veins. (a) (i) Describe how the structure of an artery is different from the structure of a vein. .... **(2)**

Cells and systems		
Book Ref.	**Spec. Ref.**	**The lungs**
	4.2.2.2	**Key information:** The lungs are specialised organs adapted to allow for efficient gas exchange. They have a large surface area: volume ratio to ensure that gas exchange can occur at a high rate.
		 1. **Label** the following parts: Trachea, bronchus, bronchiole, trachea, alveoli, lung, mouth, nasal cavity 2. **Describe** how the alveoli are adapted for efficient gas exchange.
		Maths Skills
		The table shows the composition of blood entering and leaving the lungs. **Gas** | **Concentration in arbitrary units** (Blood entering lungs / Blood leaving lungs) Oxygen: 40 / 100 Carbon dioxide: 46 / 40 (a) Describe, in as much detail as you can, the changes that take place in the composition of blood as it passes through the lungs. .... (3)

Cells and systems		
Book Ref.	**Spec. Ref.**	**Blood**
	4.2.2.3	**Key information:** Blood is a tissue consisting of plasma, in which the red blood cells, white blood cells and platelets are suspended.
		1. **Describe** the function of plasma. 2. **Identify** the part of the blood which transports oxygen. 3. **Describe** the role of white blood cells 4. **Describe** the role of platelets. 5. **Explain** why blood is described as a tissue. 6. **Label** the blood cells in this image. 
		Prove It!
	MS1a	The parts of the blood can be separated from each other by spinning the blood in a centrifuge. The image below below shows the separated parts of a 10 cm^3 blood sample.  (a) Calculate the percentage of the blood that is made up of plasma. .... Answer = ... % (2) (b) Name **three** chemical substances transported by the plasma. 1..... 2..... 3..... (3)

Cells and systems		
Book Ref.	**Spec. Ref.**	**Plant tissues**
	4.2.3.1	**Key information:** - Plant tissues include epidermal tissues, palisade mesophyll, spongy mesophyll, xylem and phloem, and meristem tissue. - The lead is a plant organ which is adapted in order to carry out photosynthesis.
		 1. Identify the structures in the cross-sectional diagram of the leaf. A = B = C = D = E = 2. Describe two ways in which the leaf is adapted for photosynthesis. 3. Describe the structure and function of a xylem vessel. 4. Describe the structure and function of a phloem vessel.
		Prove It!
		The diagram shows a section through a plant leaf.  (a) Use words from the box to name **two** tissues in the leaf that transport substances around the plant. epidermis mesophyll phloem xylem ..... and ..... (1) (b) Gases *diffuse* between the leaf and the surrounding air. (i) What is *diffusion*? .... (2) (ii) Name **one** gas that will diffuse from point **A** to point **B** on the diagram on a sunny day. ..... (1) **(Total 4 marks)**

<table>
<tr><th colspan="3">Cells and systems</th></tr>
<tr><th>Book Ref.</th><th>Spec. Ref.</th><th>Plant organ systems</th></tr>
<tr><td></td><td>4.2.3.2</td><td>Key information:
Transpiration occurs due to the evaporation of water vapour from the leaves. It is the movement of water from the roots to the atmosphere via the xylem and leaves.
Xylem vessels and hollow tubes strengthened by lignin. Their role is to transport water in the transpiration stream.
Phloem tissue is made up of long cells with pores in their ends. Dissolved sugars (sucrose) travel from the leaves to the rest of the plant for immediate use (in respiration) or for storage. The movement of sugar through the phloem tissue is called translocation.</td></tr>
<tr><td></td><td></td><td> 

1. Label the plant with the plant organs.

2. Describe the passage of water through the plant.

3. Explain how the structure of the root hair cell is adapted to its function.

4. Plants living in very hot areas have very few stomata on the underside of the leaf. Explain why.

5. Describe the difference in the structure and function of phloem and xylem vessels.

6. Complete the table to show the effects of changing conditions on rate of transpiration:
<table>
<tr><th>Condition Change</th><th>Effect on Rate of Transpiration</th></tr>
<tr><td>Increased temperature</td><td></td></tr>
<tr><td>Decreased humidity</td><td></td></tr>
<tr><td>Decreased air movement</td><td></td></tr>
<tr><td>Increased light intensity</td><td></td></tr>
</table></td></tr>
<tr><td></td><td></td><td>Prove It!</td></tr>
<tr><td></td><td></td><td>Describe how water moves from roots to the leaves.
.....
.....
.....
.....
(2)</td></tr>
</table>

Cells and systems		
Book Ref.	**Spec. Ref.**	**The stomata**
	4.2.3.2	**Key information:** - The stomata and guard cells are found on the underside of the leaf and are used to control gas exchange and water loss.
		1. **Describe** how the following equipment could be used to investigate the number of stomata on the underside of a leaf. Nail varnish Sticky tape Microscope 2. **Suggest** why the stomata are closed at night.
		Maths Skills
	MS 2a, 2b, 2d,	Plants lose water through the stomata in the leaves. The epidermis can be peeled from a leaf. The stomata can be seen using a light microscope. The table below shows the data a student collected from five areas on one leaf.

Leaf area	Number of stomata	
	Upper surface	Lower surface
1	3	44
2	0	41
3	1	40
4	5	42
5	1	39
Mean	**2**	**X**

Describe how the student might have collected the data.

(3)

What is the median number of stomata on the upper surface of the leaf?

.....

(1)

Calculate the value of **X** in the table.

Give your answer to 2 significant figures.

.....

.....

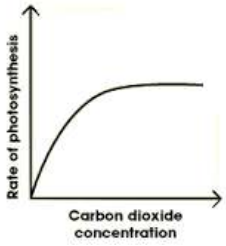
Mean number of stomata on lower surface of leaf = ...

(2)

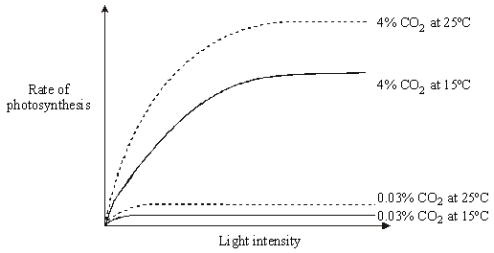
The plant used in this investigation has very few stomata on the upper surface of the leaf.

Explain why this is an **advantage** to the plant.

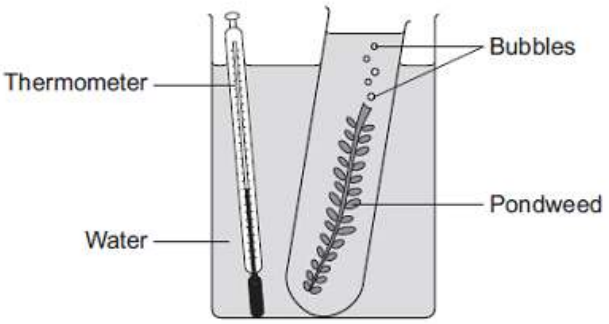
Cells and systems		
Book Ref.	**Spec. Ref.**	**Photosynthesis – the reaction**
	4.4.1.1	**Key information:** - Photosynthesis is an endothermic reaction in which energy is transferred from the environment to the chloroplasts by light to produce glucose.
		1. **Write** the word and symbol equation for photosynthesis. 2. **Explain** why photosynthesis only occurs during the day. 3. **Explain** why photosynthesis is described as an endothermic reaction. 4. **Describe** how a leaf is adapted in order to carry out photosynthesis.
		Prove It!
		(a) The equation describes the process of photosynthesis. carbon dioxide + ... + light energy ⟶ glucose + ... (i) Write in the names of the **two** missing substances. **(2)** (ii) Name the green substance which absorbs the light energy. ..... **(1)** (b) (i) In bright sunlight, the concentration of carbon dioxide in the air can limit the rate of photosynthesis. Explain what this means. .... **(2)** (ii) Give **one** environmental factor, other than light intensity and carbon dioxide concentration, which can limit the rate of photosynthesis. ..... **(1)** **(Total 6 marks)**

Book Ref.	Spec. Ref.	The rate of photosynthesis
	4.4.1.2	**Key information:** - The rate of photosynthesis can be limited by a number of different factors.
		1. **Name** four factors which limit the rate of photosynthesis. 2. The sketch graph shows the effect of carbon dioxide on photosynthesis. **Describe** and **explain** the shape of the graph.  3. **Explain** the effect of temperature on the rate of photosynthesis.
		Prove It!
		The rate of photosynthesis in a plant depends on several factors in the environment. These factors include light intensity and the availability of water. Describe and explain the effects of **two other** factors that affect the rate of photosynthesis. You may include one or more sketch graphs in your answer. **(5)**

Cells and systems

Book Ref.	Spec. Ref.	The rate of photosynthesis (HIGHER TIER ONLY)
	4.4.1.2	**Key information:** - Farmers and gardeners use their knowledge of limiting factors to design greenhouses which increase the rate of photosynthesis in plants to ensure profits. - The intensity of light at different distances from a light source can be described by the inverse square law. This states that the intensity of light is inversely proportional to the square of the distance from the source.
	MS 3a, 3d	1. Give the equation which links light intensity and distance. **State** the unit for light intensity. 2. **Describe** and **explain** the shape of the graph below. The graph shows how the rate of photosynthesis is affected by different conditions.  3. **Describe** how greenhouses are designed to ensure gardeners are able to maximise their profits.
		Prove It!
		Plants are grown in glasshouses to protect them from the weather or extend the growing season. Plants make food by photosynthesis. $6CO_2 + 6H_2O \xrightarrow[\text{light}]{\text{energy from}} C_6H_{12}O_6 + 6O_2$ glucose In winter, when days are shorter, glasshouses are heated to keep the enzyme reactions in plants at optimum rates. What else should a grower do to make sure that the plants are photosynthesising at the optimum rate? Give a reason for your answer. .... **(Total 3 marks)**

Cells and systems

Book Ref.	Spec. Ref.	Required practical 5 (biology: required practical 6): Investigating the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed.
	4.4.1.2 AT 1, 2, 3, 4, 5 WS2.2	1. **Name** the equipment needed for this experiment. 2. **Describe** how to change the light intensity. **Identify** the piece of equipment needed to record light intensity. 3. **Identify** the dependent variable in this investigation. **Suggest** how this is measured. 4. **Name** two control variables. **Describe** how you would ensure these variables are kept constant. 5. How are the dependent variable and one of the control variables used to calculate rate?
		Prove It!
		A student investigated the effect of temperature on the rate of photosynthesis in pondweed. The diagram shows the way the experiment was set up.  (i) The student needed to control some variables to make the investigation fair. State **two** variables the student needed to control in this investigation. 1..... 2..... **(2)** (ii) The bubbles of gas are only produced while photosynthesis is taking place. What **two** measurements would the student make to calculate the rate of photosynthesis? 1..... 2..... **(2)**

Cells and systems

Book Ref.	Spec. Ref.	Uses of glucose from photosynthesis
	4.4.1.3	**Key information:** - The glucose produced in photosynthesis is required by plants for a number of processes. It is often converted into different molecules required for plant survival. - Plants require nitrate ions from the soil in order to produce proteins.
		1. **State** five uses of glucose. 2. **Explain** why glucose is stored as starch. 3. **Explain** why a seed needs a store of fats/oils for growth. 4. **Name** the molecules necessary to synthesise proteins.
		Prove It!
		Green plants can make glucose. (a) Plants need energy to make glucose. How do plants get this energy? .... **(2)** (b) Plants can use the glucose they have made to supply them with energy. Give **four** other ways in which plants use the glucose they have made. .... **(4)** **(Total 6 marks)**

Cells and systems

Book Ref.	Spec. Ref.	Aerobic and anaerobic respiration
	4.4.2.1	**Key information:** - Cellular respiration is an exothermic reaction which is continuously occurring in living cells. - Respiration releases the energy needed for living processes. - Anaerobic respiration in yeast is also known as fermentation.
		1. **Write** a word and balanced symbol equation for aerobic respiration. 2. **Compare** the processes of aerobic and anaerobic respiration. Give at least three differences. 3. **Outline** three uses of the energy released in respiration. 4. **Using equations,** outline the difference between anaerobic respiration in muscles and in plants/yeast. 5. **State** two uses of fermentation.
		Prove It!
		Respiration is a process which takes place in living cells. What is the purpose of *respiration*? .... **(1)** (i) Balance the equation for the process of respiration when oxygen is available. $C_6H_{12}O_6$ + O_2 → CO_2 + H_2O **(1)** (ii) What is the name of the substance in the equation with the formula $C_6H_{12}O_6$? ..... **(1)** Compare anaerobic respiration in a yeast cell with anaerobic respiration in a muscle cell. **(3)**

Cells and systems

Book Ref.	Spec. Ref.	Response to exercise
	4.4.2.2	**Key information:** - During exercise the human body reacts to the increased demand for energy. - The heart rate, breathing rate and breath volume increase during exercise to supply the muscles with more oxygenated blood. - If insufficient oxygen is supplied, anaerobic respiration takes place in muscles. This causes a build-up of lactic acid which causes muscles to become fatigued and stop contracting. (HT ONLY) - Blood flowing through the muscles transports the lactic acid to the liver where it is converted back into glucose. Oxygen debt is the amount of extra oxygen the body needs after exercise to react with the accumulated lactic acid and remove it from the cells.
		1. **Explain** why the heart rate must increase during exercise. 2. **Explain** why the breathing rate must increase during exercise. **Suggest** what happens to the volume of breath breathed in. 3. **Explain** what causes cramp and why. 4. **Describe** what an oxygen debt is. 5. HT ONLY – **Describe** how lactic acid is converted into glucose.
		Prove It!
		An increased cardiac output will provide more oxygen and more glucose to the working muscles. Explain how this helps the athlete during exercise. .... **(4)**

Cells and systems

Book Ref.	Spec. Ref.	Metabolism (PLEASE NOTE: This section is covered in more detail throughout the course. It is important however to appreciate how all reactions in the body are linked.)
	4.4.2.3	**Key information:** - Metabolism is the sum of all reactions in a cell or the body.
		1. **Name** a metabolic reaction that occurs in all cells. 2. **Identify** the building blocks (monomers) of the following molecules: - Carbohydrates: - Lipids: - Proteins: 3. **Explain** why glucose is converted to starch in plants, and glycogen in animals. 4. **Describe** the structure of a lipid. 5. **Explain** how excess proteins are excreted.
		Prove It!
		Bread contains starch, protein and fat. (a) Complete each sentence by choosing the correct words from the box. **amino acids** **protein** **fat** **starch** **fatty acids** **sugar** Amylase speeds up the digestion of ..... . The product of this digestion is ..... . Protease speeds up the digestion of ..... . The product of this digestion is ..... . **(4)** (b) Why do molecules of starch, protein and fat need to be digested? .... **(2)** (c) In which part of the digestive system does the digestion of starch begin? Draw a ring around your answer. **large intestine** **mouth** **small intestine** **stomach** **(1)** (d) What do we call substances like amylase and protease which speed up chemical reactions? ..... **(1)**
		Cells and systems
Book Ref.	**Spec. Ref.**	**Homeostasis**

4.5.1

Key information:

- Homeostasis is the regulation of the conditions inside a cell or organism.

1. What 3 variables are controlled in the body by homeostasis?

2. Why do cells need optimum conditions?

3. Complete the table to explain what each part of the control centre does:

Part of the control system	Example	What it does
Receptors		
		Receive and process information from receptors
	Muscles or glands	

Prove It!

(b) A response is caused when information in the nervous system reaches an effector.

(i) There are two different types of effector.

Complete the table to show:

- the two different types of effector
- the response each type of effector makes.

Type of effector	Response the effector makes
1	....
2	....

(4)

(ii) Some effectors help to control body temperature.

Give **one** reason why it is important to control body temperature.

.....

.....

(1)

Cells and systems

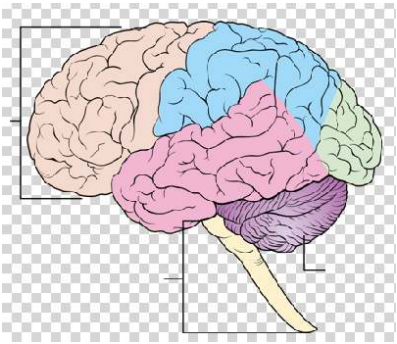
Book Ref.	Spec. Ref.	Structure and function of the human nervous system
	4.5.2.1	**Key information:** - The nervous system enables humans to react to their surroundings and to coordinate their behaviour. - Reflex actions are rapid; they do not involve the conscious part of the brain.
		4. What is the function of the central nervous system? **Identify** its two main parts. 5. Order the following into a reflex arc: COORDINATOR (CNS) STIMULUS EFFECTOR RESPONSE R ECEPTOR _____ → _____ → _____ → _____ → _____ 6. **Explain** why it is important that reflex actions are rapid. 7. **Describe** how information passes through the nervous system including the names of the neurones, a description of how the synapses work and what effectors and receptors are/do. 8. **Describe** how a sensory neurone is adapted to carry out its function.
		Prove It!
		Whilst observing mouse behaviour, a student drops a pen near the mouse's cage. The mouse jumps at the noise. Describe, as fully as you can, the processes by which the mouse responds to the stimulus of the dropped pen. **(6)**

Cells and systems

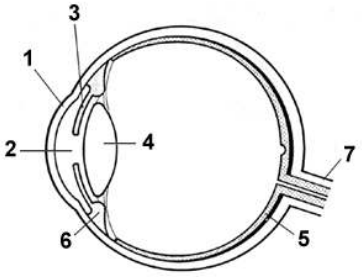
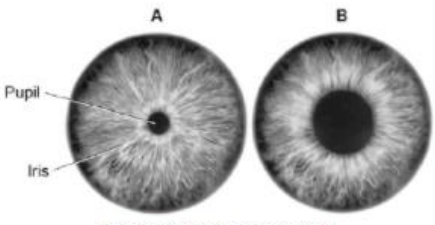
Book Ref.	Spec. Ref.	Required practical 6 (biology: required practical 7): Plan and carry out an investigation into the effect of a factor on human reaction time.
	4.5.2.1 AT 1, 3, 4	1. **Identify** two factors that can affect human reaction time. 2. **Describe** a method for using a ruler to investigate human reaction time. 3. **Describe** how to make sure that the results are reliable. 4. **State** the receptor and effector in the investigation you have described.
		Maths Skills
	MS 2c	**Table 1** shows the students' results. **Table 1** See table below. **Circle** the anomalous result in **Table 1** for Student **A**. **(1)** What is the **median** result for Student **B**? Calculate the value of **X** in **Table 1**. ..... Mean distance ruler dropped = ... cm **(1)**

Test number	Distance ruler dropped in cm	
	Student A	Student B
1	9	12
2	2	13
3	6	13
4	7	9
5	7	8
Mean	**7**	**X**

Cells and systems

Book Ref.	Spec. Ref.	The brain (biology only)
	4.5.2.2	**Key information:** - The brain controls complex behaviour. It is made of billions of interconnected neurones and has different regions that carry out different functions. HT ONLY - Neuroscientists have been able to map the regions of the brain to particular functions by studying patients with brain damage, electrically stimulating different parts of the brain and using MRI scanning techniques. The complexity and delicacy of the brain makes investigating and treating brain disorders very difficult.
		1. What is the brain made up of? 2. **Identify** the three main structures of the brain on the diagram. **Describe** the function of each.  3. **(HT) Describe** why treating brain disorders is very difficult. 4. **(HT) Outline** a method that can be used to study the brain.
		Prove It!
		A woman has a head injury. Her symptoms include: • finding it difficult to name familiar objects • not being able to remember recent events. Suggest which part of her brain has been damaged. ..... (1) A man has a head injury. He staggers and sways as he walks. Suggest which part of his brain has been damaged. ..... (1)

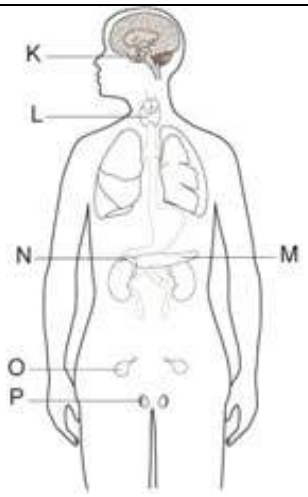
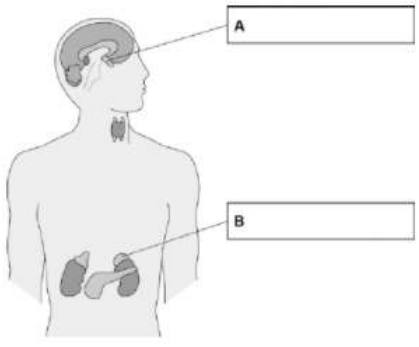
Cells and systems

Book Ref.	Spec. Ref.	The eye (biology only)
	4.5.2.3	**Key information:** - The eye is a complex organ which is capable of focusing on near and distant objects as well as adapting to see in dim light conditions. - As a sense organ, the eye contains receptors that are sensitive to light intensity and colour. - Accommodation is the process of changing the shape of the lens to focus on near or distant objects. - Myopia and hyperopia are two common defects of the eye in which rays of light do not focus on the retina.
		 1. **Label** the diagram of the eye: 1. 2. 3. 4. 5. 6. 7. 2. **Describe** how the iris and cornea control the amount of light entering the eye. 3. **Describe** how 4. the shape of the lens changes to focus on distant objects. 5. **Describe** how the distribution of rod and cone cells allows the eye to detect light intensity and colour. 6. **Describe** two defects of the eye and **outline** how these can be treated.
		Prove It!
		Figure 1 shows a reflex in the iris of the human eye in response to changes in light levels. **Figure 1**  @ Gandee Vasan/Stone/Getty Images (a) Describe the changes in the pupil and iris going from **A** to **B** in **Figure 1**. Explain how these changes occur. Refer to the changes in light level in your answer. **(4)**

Cells and systems

Book Ref.	Spec. Ref.	Control of body temperature (biology only)
	4.5.2.4	**Key information:** - Body temperature is monitored and controlled by the thermoregulatory centre in the brain. - Negative feedback occurs to keep body temperature within a safe range in order that enzymes can work at their optimum temperature.
		1. **Identify** the location of receptors that detect changes in: a) Core body temperature. b) External body temperature 2. **Describe** how the body responds when the temperature falls below optimum. 3. **Explain** how sweating cools the body. 4. **Explain** why shivering raises body temperature.
		Prove It!
		A walker falls through thin ice into very cold water.  The walker's core body temperature falls. He may die of hypothermia (when core body temperature falls too low). (a) (i) Which part of the brain monitors the fall in core body temperature? ..... (1) (ii) How does this part of the brain detect the fall in core body temperature? .... (2) (b) While in the water the walker begins to shiver. Shivering helps to stop the core body temperature falling too quickly. Explain how. .... (2)

Cells and systems

Book Ref.	Spec. Ref.	Human endocrine system
	4.5.3.1	**Key information:** - The endocrine system is composed of glands which secrete hormones directly into the bloodstream. The blood carries the hormone to a target organ where it produces an effect. - The pituitary gland in the brain is a 'master gland' which secretes several hormones into the blood in response to body conditions. These hormones in turn act on other glands to stimulate other hormones to be released to bring about effects
		 1. **Identify** the structures associated with the endocrine system: K: L: M: N: O: P: 2. **Describe, using an example**, the role of the pituitary gland. 3. **Name** the hormone released by: a) The testes b) The adrenal gland c) The thyroid gland 4. **Compare** the action of the endocrine system with the nervous system.
		Prove It!
		Glands in the body produce hormones. (a) Use words from the box to label gland **A** and gland **B** on the diagram below. **Adrenal** **Pancreas** **Pituitary** **Testis** **Thyroid**  **(2)** (b) Which gland produces oestrogen?

Cells and systems		
Book Ref.	**Spec. Ref.**	**Control of blood glucose concentration**

	4.5.3.2	**Key information:** - Blood glucose concentration is monitored and controlled by the pancreas. - Type 1 diabetes is a disorder in which the pancreas fails to produce sufficient insulin. - Type 2 diabetes is a disorder in which the body cells no longer respond to insulin.
		1. **State** the organ which monitors blood glucose concentration. 2. **(HT) State** the two hormones which are involved in the control of blood glucose. 3. **Describe** how excess glucose is removed from the blood. 4. **Explain** what doesn't happen in the body of someone with type 1 diabetes. 5. **Explain** why injections of insulin are unsuitable for a type 2 diabetic. What should they do instead? 6. **HT ONLY – Describe** the action of glucagon in a negative feedback cycle.
		Prove It!
		Homeostasis controls the internal conditions of the body. (a) Explain how blood glucose levels are controlled in the body of someone who does **not** have diabetes. .... **(4)** (b) Compare how each type of diabetes is caused. Suggest how each type of diabetes can be treated. .... **(4)**
Cells and systems		
Book Ref.	**Spec. Ref.**	**Maintaining water and nitrogen balance (biology only)**

	4.5.3.3	**Key information:** - The balance of water in the body must be maintained so that cells do not lose or gain too much water by osmosis. - The kidneys remove excess water and urea from the blood.
		1. **State** three ways in which excess water leaves the body. 2. **Explain** why it is important that the volume of water in the blood is controlled. 3. **Describe** the processes involved in the production of urine by the kidney. a) Filtration: b) Selective reabsorption: c) Excretion: 4. **Evaluate** (consider the advantages and disadvantages) of the treatment options (transplant or dialysis) available to people suffering from kidney failure. 5. **HT ONLY. Explain** how ADH controls the volume of water excreted in urine. 6. **Describe** how excess proteins are broken down and safely removed from the body.
		Prove It!
		A person had diseased kidneys. The table shows the concentrations of dissolved substances in this person's urine. **Substance** | **Concentration in grams per dm^3** Protein | 6 Glucose | 0 Amino acids | 0 Urea | 21 Mineral ions | 19 (a) One of the substances found in this person's urine would **not** be found in the urine of a healthy person. (i) Name this substance. ..... (1) (ii) Explain why this substance would **not** be found in the urine of a healthy person. .... (2) (b) A person with diseased kidneys may be treated by dialysis. Explain how dialysis trexatment restores the concentrations of dissolved substances in the blood to normal levels.
Cells and systems		
Book Ref.	**Spec. Ref.**	**Hormones in human reproduction**

	4.5.3.4	**Key information:** - During puberty reproductive hormones cause secondary sex characteristics to develop e.g. pubic hair. - The menstrual cycle of a woman is controlled by the interaction of four different hormones.
		1. **Name** the gland which secretes oestrogen. 2. **Describe** what is meant by the term 'ovulation'. **Identify** the day of the menstrual cycle on which ovulation occurs. 3. **Name** the hormones involved in the female menstrual cycle. **Outline** the role of each. 4. **HT ONLY – Explain** the role of oestrogen in the coordination of the menstrual cycle. 5. What is the main male reproductive hormone? Where is it produced? What does it do?
		Prove It!
		The human body produces many hormones. (a) (i) What is a *hormone*? .... (1) (ii) Name an organ that produces a hormone. ..... (1) (iii) How are hormones transported to their target organs? ..... (1) (b) Describe how the hormones FSH, oestrogen and LH are involved in the control of the menstrual cycle. .... (3) **(Total 6 marks)**

Cells and systems

Book Ref.	Spec. Ref.	Contraception
	4.5.3.5	1. **Complete** the table to explain how each method of controlling fertility works.

Contraceptive Method	How it works
Oral contraceptives (the pill)	
Injection/Implant/Patch	
Barrier method e.g. condoms/ diaphragms	
Intrauterine Devices e.g. coil	
Spermicidal agents	
Timed abstinence	
Surgical sterilisation e.g. vasectomy	

2. **Identify** the methods in the table above that are hormonal contraception.

3. **Explain** why some people oppose the use of contraception.

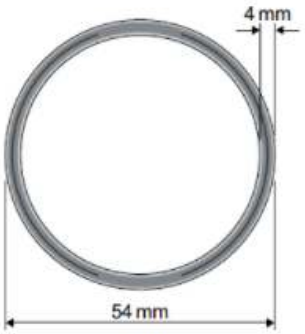
4. Some people choose to avoid having sexual intercourse when an egg may be in the oviduct. **Evaluate** this method of contraception.

Prove It!

Two methods of giving contraceptive hormones to a woman are the vaginal ring and the hormone implant.

Vaginal ring

The vaginal ring is a flexible ring 54 mm in diameter containing hormones.



The woman puts in and takes out the vaginal ring herself; there is no 'wrong' way to put the ring in.
Each ring is designed for one cycle of use, which is three weeks of continuous ring use, followed by one week without the ring.
About 0.3 % of women become pregnant in the first year of ring use.
4 % of women stop using the ring because of vaginal discomfort.

Hormone implant

A health professional puts the hormone implant under the skin of the woman's arm.
The implant releases contraceptive hormones for three years before the implant needs to be replaced.
The hormone implant is 100 % effective.
About 2 % of women stop using the hormone implant, mainly because of irregular menstrual bleeding.

Evaluate the use of the vaginal ring compared with the hormone implant.

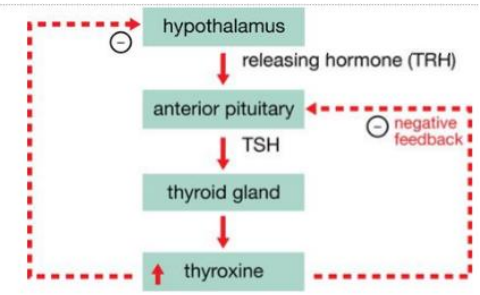
Remember to give a conclusion to your evaluation.

Cells and systems

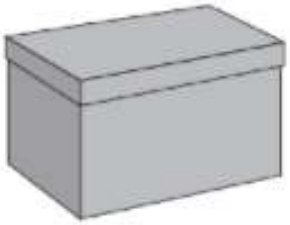
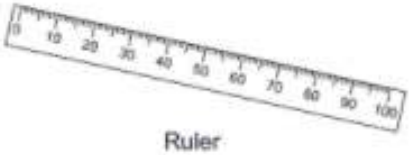
Book Ref.	Spec. Ref.	The use of hormones to treat infertility (HT ONLY)

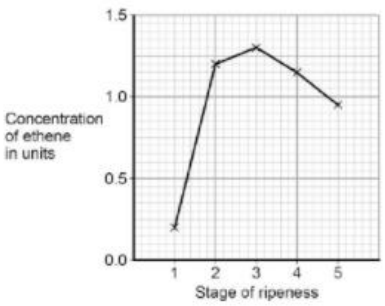
	4.5.3.6	**Key information:** - Fertility drugs can be given to women to help them become pregnant naturally. - In Vitro Fertilisation (IVF) is an alternative method used by couples unable to get pregnant.
	WS1.3 WS1.4	1. **Name** the hormones in the drug given to women to help them become pregnant 'normally'. 2. **Explain** how these drugs interact to trigger the release of an egg. 3. **Describe** the process of IVF. 4. **Evaluate** (outline the advantages of disadvantages) the use of IVF as a fertility treatment.
		Prove It!
		The hormones FSH and LH are used in fertility treatment. Give the function in fertility treatment of: (i) FSH .... **(1)** (ii) LH. .... **(1)** In the first stage of in-vitro fertilisation (IVF), eggs from the mother are fertilised with sperm from the father. Describe the next stages of IVF. .... **(2)**

Cells and systems

Book Ref.	Spec. Ref.	Negative feedback (HT ONLY)
	4.5.3.7	**Key information:** - Negative feedback processes ensure internal conditions are maintained within a narrow range.
		1. **Name** the hormone secreted by the adrenal gland. 2. **Describe** the effect of this hormone on heart rate. **Explain** the importance of this. 3. **Describe** the role of thyroxine in the human body.  4. **Explain** the concept of negative feedback, using thyroxine level control as an example.
		Prove It!
		Hyperthyroidism is caused by an overactive thyroid gland. Suggest what would happen in the body of a person with hyperthyroidism. .... (3)

Cells and systems		
Book Ref.	**Spec. Ref.**	**Plant hormones – control and coordination (biology only)**
	4.5.4.1	**Key information:** - Plants produce hormones to coordinate and control growth and responses to light and gravity. Unequal distributions of auxin cause unequal growth rates in plant roots and shoots.
		1. **Define** the following key terms: - Phototropism: - Geotropism: 2. **Describe** the role of auxin in the downward growth of roots and the upward growth of shoots. 3. **Explain** why shoots bend towards a light source. 4. **HT ONLY – Outline** the role of the following hormones in plants: - Gibberellins: - Ethene:
		Prove It!
		Plants respond to different environmental factors. Describe how different environmental factors affect: • the direction of growth of roots • the direction of growth of shoots. In your answer you should refer to the role of plant hormones. Do **not** refer to the artificial use of plant hormones by gardeners or scientists. .... **(6)**

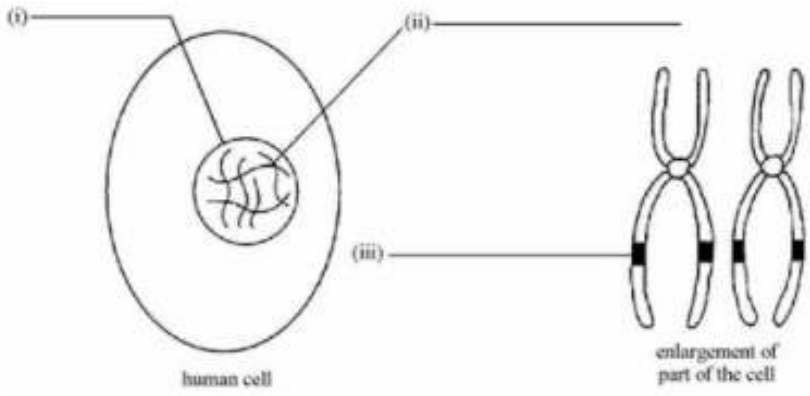
Cells and systems		
Book Ref.	**Spec. Ref.**	**Required practical activity 8 (biology only): Investigate the effect of light or gravity on the growth of newly germinated seedlings.**
	4.5.4.1 AT 1, 3, 4, 7	1. **Name** a suitable seedling for use in this experiment. 2. **Identify** the dependent variable. **Give** the most appropriate unit of measurement for this variable. **Justify** why this is the most appropriate unit. 3. **Describe** how you would use repeated readings from many seedlings to ensure your results are reliable.
		Prove It!
		The drawings show some apparatus and materials.  Lamp  Petri dishes  Forceps  50 maize seedlings on damp cotton wool  Supply of cardboard boxes with lids  Ruler  Scissors *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.* Describe how the students could use some or all of the apparatus and materials shown in the drawings to investigate the growth response of maize seedlings to light shining from one side. You should include a description of the results you would expect. (6)

Cells and systems		
Book Ref.	**Spec. Ref.**	**Use of plant hormones (biology only, HT ONLY)**
	4.5.4.2	**Key information:** - Plant growth hormones are used in agriculture (farming crops) and horticulture (growing flowers). - Ethene is used in the food industry to control the ripening of fruit during storage and transport.
	WS1.3 WS1.4	1. **State** three uses of auxins in agriculture and horticulture: 2. **State** three uses of gibberellins in agriculture and horticulture: 3. **Evaluate** the effect of the use of auxins on biodiversity. 4. **Suggest** why food distributors want to control the ripening of fruit using ethene.
		Prove It!
		Ethene causes fruit to ripen. Scientists measured the concentration of ethene found in fruit at different stages of ripeness. **Figure 2** shows the results. **Figure 2**  At which stage of ripeness is there most ethene? Tick **one** box. Stage **1** ☐ Stage **2** ☐ Stage **3** ☐ Stage **4** ☐ Stage **5** ☐ **(1)** Suggest how the scientists can find out if the result for Stage **1** was an anomaly. .... **(1)**

Genetics and Evolution Keywords

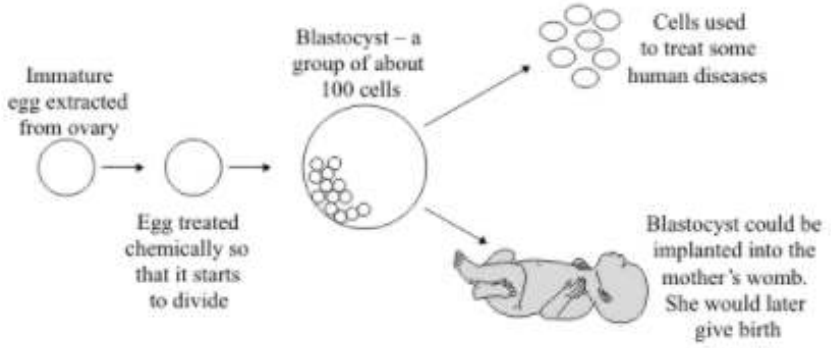
Add all the important keywords for this big idea in the grid below as you come across them in the study pack.

Word	Definition

Book Ref.	Spec. Ref.	Chromosomes
	4.1.2.1	**Key information:** - The nucleus of a cell contains chromosomes made of DNA molecules. Each chromosome carries a large number of genes. In body cells the chromosomes are normally found in pairs.
		1. Order the following in terms of size (smallest to largest) CHROMOSOME NUCLEUS GENE CELL 2. **Explain** why we have two copies of each chromosome. 3. **State** what is meant by the term 'gene'. 4. **Identify** the two types of cell in the human body which contain half a set of chromosomes. **Outline** the importance of this.
		Prove It!
		The diagram shows a human cell and some of its contents. (a) Choose words from this list to label the diagrams. **chromosome** **cytoplasm** **gene** **nucleus**  **(3)** (b) Choose words from this list to complete the sentence. **a body cell** **an egg cell** **a gamete** **a sperm cell** In the cell above, the chromosomes are found in pairs so this cell must be ..... **(1)** **(Total 4 marks)**

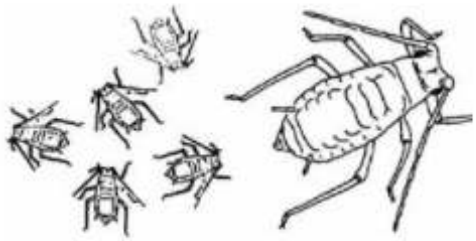
Genetics and evolution		
Book Ref.	**Spec. Ref.**	**Mitosis and the cell cycle**
	4.1.2.2	**Key information:** - Cells divide in a series of stages called the cell cycle. During the cell cycle, the genetic material is doubled and then divided into two genetically identical daughter cells. - Mitosis is important in the growth, repair and development of multicellular organisms.

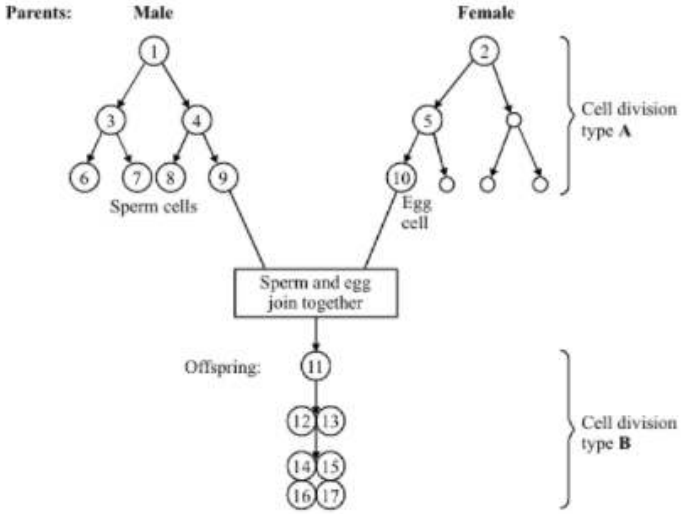
		1. **Name** the organelle which contains genetic material. 2. **Describe** what happens in the 3 phases of the cell cycle. 3. **Explain** why a cell needs to grow before dividing by mitosis. 4. **State** the number of chromosomes in a human body cell: a) During stage 1 of the cell cycle: b) Just before mitosis: c) Just after mitosis: 5. **Suggest** why a root tip can be used for observing mitosis under the microscope.
		Prove It!
		(a) How many pairs of chromosomes are there in a body cell of a human baby? ..... (1) (b) Place the following in order of size, **starting with the smallest,** by writing numbers **1 – 4** in the boxes underneath the words. chromosome nucleus gene cell ☐ ☐ ☐ ☐ (1) (c) For a baby to grow, its cells must develop in a number of ways. Explain how each of the following is part of the growth process of a baby. (i) Cell enlargement ..... (1) (ii) The process of cell division by mitosis .... (3)

Genetics and evolution		
Book Ref.	**Spec. Ref.**	**Stem cells**
	4.1.2.3	**Key information:** - A stem cell is an undifferentiated cell of an organism which is capable of giving rise to many more cells of the same type, and from which certain other cells can arise from differentiation. - Stem cells from embryos can be cloned and made to differentiate into most different types of human cells. Stem cells from adult bone marrow can form many types of cells including blood cells. Treatment with stem cells may be able to help conditions such as diabetes and paralysis. Meristem tissue in plants can differentiate into any type of plant cell, throughout the life of a plant.
	WS1.3	1. **Define** the term 'stem cell'. 2. **Describe** the function of stem cells in: a) Embryos b) Adult animals c) Meristems in plants 3. **Describe** the process of therapeutic cloning using embryos. 4. **Evaluate** the use of embryonic stem cells for the treatment of diseases such as diabetes. 5. Stem cells from meristems can be used to produce clones quickly and economically. **Describe** two uses of this technique.
		Prove It!
		The diagram shows how an immature egg could be used either to produce cells to treat some human diseases or to produce a baby.  Scientists may be allowed to use this technique to produce cells to treat some human diseases, but not to produce babies. Using information from the diagram, suggest an explanation for this. (4)

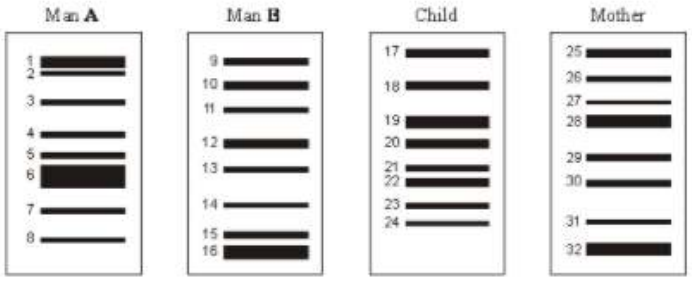
Genetics and evolution		
Book Ref.	**Spec. Ref.**	**Cancer**
	4.2.2.7	**Key information:** - Cancer is the result of changes in cells that lead to uncontrolled growth and division. - Tumours can be malignant or benign. - Both genetic factors and lifestyle choices can affect an individual's likelihood of developing cancer.
		1. What is cancer? 2. **Outline** the difference between a benign and a malignant tumour. 3. **Describe** how malignant tumours spread. 4. **Suggest** why cancer is more common in older people. 5. **Identify** three lifestyle choices that can increase an individual's risk of developing cancer. 6. Breast cancer is an example of a type of cancer that sometimes runs in families. **Suggest** why.
		Prove It!
		The number of people in the UK with tumours is increasing. (a) (i) Describe how tumours form. .... (1) (ii) Tumours can be malignant or benign. What is the difference between a malignant tumour and a benign tumour? .... (1) (b) Describe how some tumours may spread to other parts of the body. .... (1)

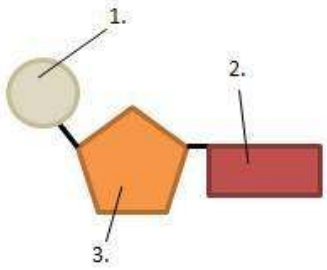
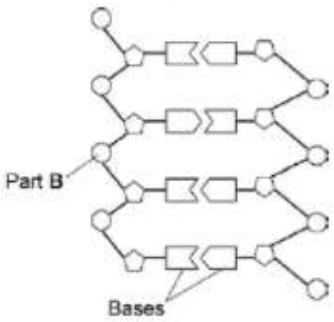
Genetics and evolution

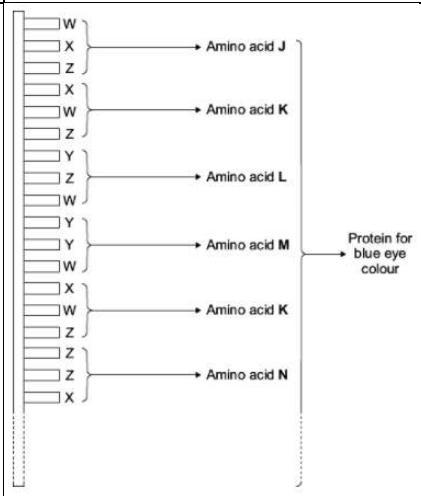
Book Ref.	Spec. Ref.	Sexual and asexual reproduction
	4.6.1.1	**Key information:** - Sexual reproduction involves the joining of male and female gametes. The offspring show variation due to mixing of genetic information. - Asexual reproduction involves only one parent. There is no mixing of genetic information so all offspring are genetically identical (clones).
		1. **Identify** the male and female gametes in: a) Animals b) Plants 2. **Compare** the processes of sexual and asexual reproduction. 3. **Name** the type of cell division that is required for: a) Sexual reproduction: b) Asexual reproduction: 4. **Describe** the process of tissue culture as an example of asexual reproduction.
		Prove It!
		The bean aphid is a type of black-fly which lives on broad bean plants in summer. In the autumn, males and females mate and produce eggs.  (a) Name the type of reproduction which produces the eggs. ..... **(1)** (b) In spring these eggs hatch. The young aphids are all female. Explain why they are all similar but not identical to each other. ..... **(1)** (c) These females are then able to produce offspring without needing any males. (i) Name the type of reproduction where females do **not** need males to produce offspring. ..... **(1)** (ii) How will the offspring from one of these females: A compare with each other ..... B compare with the offspring from other females? ..... **(2)**
Genetics and evolution		

Book Ref.	Spec. Ref.	Meiosis
	4.6.1.2	**Key information:** - Meiosis is a type of cell division during which the number of chromosomes is halved. It is used to produce gametes, which then fuse to produce a full set of chromosomes in the offspring.
		1. **State** where meiosis occurs in: a) Males. b) Females. 2. **Describe** the process of meiosis. 3. **Compare** the processes of mitosis and meiosis. 4. **Explain** the importance of meiosis. 5. An egg and sperm cell fuse together to create a fertilised egg. **Name** the process that results in this fertilised egg becoming an embryo. 6. **Explain** why meiosis results in genetic variation.
		Prove It!
	WS 1.2	The diagram shows two patterns of cell division. Cell division type **A** is used in gamete formation. Cell division type **B** is used in normal growth.  (a) Name the two types of cell division, **A** and **B**, shown in the diagram. Type **A** ..... Type **B** ..... **(2)** (b) Name the process in which an egg and sperm join together. ..... **(1)** (c) Cell **1** contains 46 chromosomes. How many chromosomes will there be in: (i) cell **10**; ..... **(1)** (ii) cell **14**? ..... **(1)** **(Total 5 marks)**
Genetics and evolution		

Book Ref.	Spec. Ref.	Advantages and disadvantages of sexual and asexual reproduction (biology only)
	4.6.1.3	**Key information:** - Some organisms are able to use both methods of reproduction depending on the circumstances.
		1. **Compare** the advantages of sexual and asexual reproduction. 2. **Identify** the type of reproduction which could result in a reduction in biodiversity. **Justify** your answer. 3. **Give two examples** of organisms which can reproduce both sexually and asexually. 4. **Suggest** the advantage to an organism of being able to reproduce both sexually and asexually.
		Prove It!
	WS1.2	A child saved apple seeds from an apple she ate. She planted the seeds in the garden. A few years later the apple trees she had grown produced apples. (a) The apples from the new trees did **not** taste like the original apple. Explain why. .... **(2)** (b) (i) Apple trees can be reproduced so that the apples from the new trees will taste the same as the apples from the parent trees. Give **one** method used to reproduce apple trees in this way. .... **(1)** (ii) Explain why the method you have suggested in part **(b)(i)** will produce apples that taste the same as the apples from the parent trees. .... **(2)** **(Total 5 marks)**

Genetics and evolution		
Book Ref.	**Spec. Ref.**	**DNA and the genome**
	4.6.1.4	**Key information:** - The genetic material in the nucleus is composed of a chemical called DNA. DNA is a polymer made up of two strands forming a double helix. The DNA is contained in structures called chromosomes. - Genes code for a particular sequence of amino acids which make a specific protein. - The genome of an organism is the entire genetic material of that organism. The whole human genome has now been studied and this will have great importance for medicine in the future.
		1. **Describe** the basic structure of DNA. 2. **State** the number of chromosomes in a normal human body cell. 3. **Define** the term 'gene'. **Outline** what a gene codes for. 4. **Explain** the difference between a *gene* and a *genome*. 5. **Name** the project which took twenty years to complete and involved mapping the entire human genome. 6. **Outline** the importance of understanding the human genome.
		Prove It!
		Chromosomes contain molecules of DNA. Genes are small sections of DNA. (a) Each gene contains a code. What does a cell use this code for? .... (2) (b) DNA fingerprints can be used to identify people. One example of the use of DNA fingerprints is to find out which man is the father of a child. The diagram shows the DNA fingerprints of a child, the child's mother and two men who claim to be the child's father. The numbers refer to the bars on the DNA fingerprints.  (i) Which man, **A** or **B**, is more likely to be the father of the child? ☐ Use the numbers on the DNA fingerprints to explain your choice. In your answer you should refer to all four people. (3)

Genetics and evolution		
Book Ref.	**Spec. Ref.**	**DNA structure (biology only)**
	4.6.1.5	**Key information:** - DNA is a polymer made from four different nucleotides. Each nucleotide consists of a common sugar, a phosphate group and one of the four different bases. - A sequence of three bases codes for a particular amino acid. The order of bases controls the sequence of amino acids and therefore the structure of the protein.
		1. What is DNA?  2. **Identify** each part of the DNA nucleotide: 1. 2. 3. 3. The structure of DNA is a bit like a twisted ladder. Which parts of DNA re represented by the 'straights' and which parts by the 'rungs'? 4. **Name** the four bases contained within DNA. 5. **Explain** how the sequence of bases in DNA codes for a protein.
		Prove It!
		Figure 1 shows an image of a small section of DNA. **Figure 2** shows the structure of a small section of DNA. **Figure 1**  © Svisio/iStock/Thinkstock **Figure 2**  (a) What is Part **B**? .... **(1)** (b) In **Figure 1** the structure of DNA shows four different bases. There are four different bases and they always pair up in the same pairs. Which bases pair up together? ..... **(1)**

Genetics and evolution		
Book Ref.	**Spec. Ref.**	**DNA structure (biology only – HT ONLY)**
	4.6.1.5	**Key information:** - Complementary base pairing occurs to link the two strands of DNA together. - Genes code for a particular sequence of amino acids which make a specific protein. If a mutation results in a change in the sequence of amino acids, the protein can change shape and is no longer able to carry out its function. - Protein synthesis converts the genetic code into functional proteins. - Not all of the DNA codes for proteins. Non-coding parts of DNA can switch genes on and off, so variation in these areas of DNA may affect how genes are expressed.
		1. **Describe**, using examples, what is meant by the term 'complementary base pairing'. 2. **Describe** the process of protein synthesis. 3. **Outline** the role of the ribosome during the process of protein synthesis. 4. **Explain** why proteins must be folded into a specific shape once synthesised. 5. **Explain** how a mutation in the DNA can result in a non-functional enzyme. 6. Non-coding DNA can switch genes on or off. **Suggest** what this means and when it happens. 7. **Explain** how a mutation in a non-coding part of DNA might affect the expression of a gene.
		Prove It!
		 -

(a) What word is used to describe '*a small section of a DNA molecule that controls the synthesis of a protein*'?

.....

(1)

(b) In the cell, where are proteins synthesised?

.....

(1)

(c) Describe how the protein for blue eye colour is synthesised.

To gain full marks you must use information from the diagram.

.....

.....

.....

.....

.....

.....

.....

(3)

(d) Mistakes sometimes occur when DNA molecules are copied during cell division.

Suppose that one of the **W** bases shown in the diagram was substituted by an **X** base.

(i) What would happen to the structure of the protein synthesised by this part of the DNA molecule?

.....

.....

(1)

(ii) What might be the effect of this change in structure of the protein?

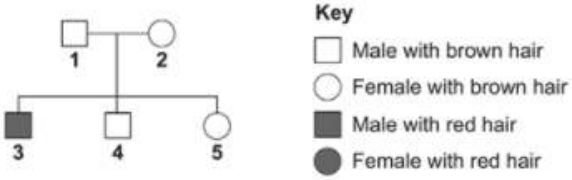
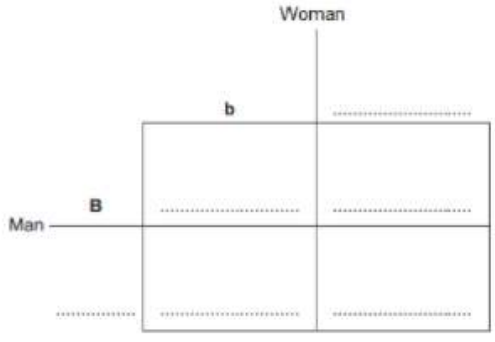
.....

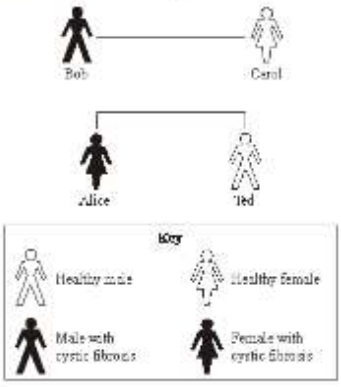
.....

(1)

(Total 7 marks)

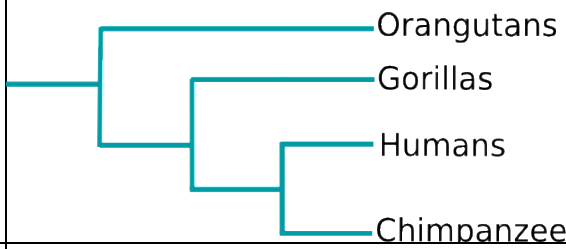
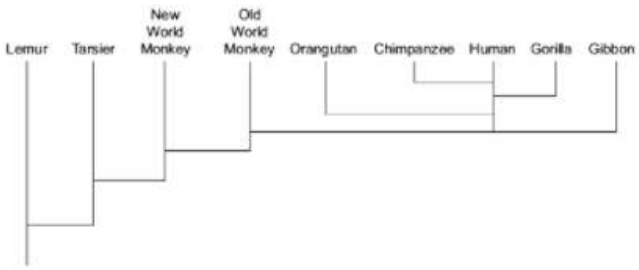
Genetics and evolution

Book Ref.	Spec. Ref.	Genetic inheritance
	4.6.1.6	**Key information:** - We inherit information from our parents. Most characteristics are the result of a number of genes interacting, but some are controlled by a single gene. - We have two copies of every gene, and the interaction of these two copies determines our characteristics. - We can use Punnett squares to predict the probability of two parents having offspring with certain characteristics.
		1. **Define** the following terms: a) Allele b) Dominant c) Recessive d) Homozygous e) Heterozygous f) Genotype g) Phenotype 2. **Give** an example of a characteristic controlled by: a) A single gene b) Multiple genes Figure 1  **3.** **Suggest** whether red hair is caused by a dominant or recessive allele. 4. **State** the genotype of *Person 1* from the diagram. **Explain** your answer using the diagram.
		Prove It!
		Eye colour is controlled by genes. The dominant allele of the gene **(b)** produces brown eyes. The recessive allele **(b)** produces blue eyes. A homozygous blue-eyed woman married a homozygous brown-eyed man. All of their three children had brown eyes. (a) (i) Complete the genetic diagram.  (2) (ii) Give the reason why all of the children had brown eyes. .... (1)

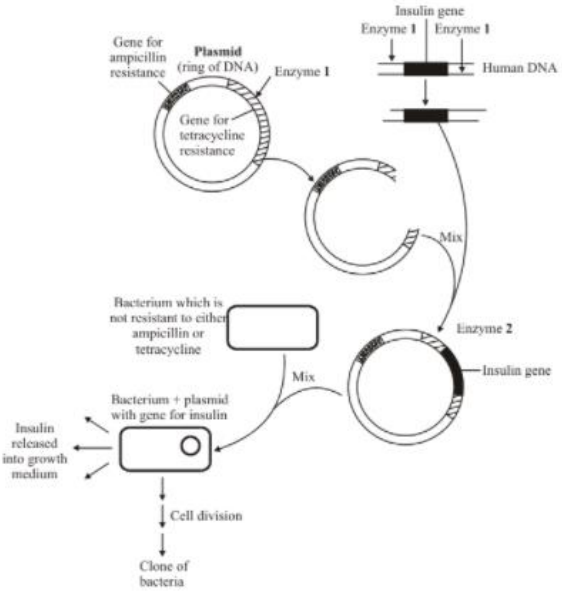
Genetics and evolution		
Book Ref.	**Spec. Ref.**	**Inherited disorders**
	4.6.1.7	**Key information:** - Some disorders are caused by the inheritance of certain alleles, e.g. cystic fibrosis and polydactyly.
	MS 2d	1. **Name** a genetic disorder caused by a recessive allele. **Describe** the symptoms of this disorder. 2. **Explain** why disorders caused by dominant alleles are more common than disorders caused by recessive alleles. 3. **HT ONLY:** Construct a Punnett Square to show the possible genotypes and phenotypes of the offspring between two cystic fibrosis *carriers*. What is the proportion of healthy offspring to offspring with cystic fibrosis? What is the probability that their child will have cystic fibrosis? 4. **Explain** why embryos are screened for genetic disorders. Suggest reasons why some people are against the screening of embryos for polydactyly, despite it being caused by a dominant allele. 5. **Describe** the role of gene therapy in reducing the number of individuals who suffer from cystic fibrosis.
		Prove It!
		Cystic fibrosis is an inherited disorder that can seriously affect health. (a) Which **one** of these is affected by cystic fibrosis? Draw a ring around your answer. **blood system** **cell membranes** **kidneys** **nervous** **(1)** (b) The diagram shows the inheritance of cystic fibrosis in a family. The allele that produces cystic fibrosis is recessive.  (i) Explain why Alice inherited cystic fibrosis. .... **(2)** (ii) Explain why Ted did **not** inherit cystic fibrosis. .... **(2)**

Genetics and evolution		
Book Ref.	**Spec. Ref.**	**Sex determination**
	4.6.1.8	**Key information:** - Human body cells contain a pair of chromosomes, which carry the genes that determine sex.
		1. **State** the number of chromosomes found in human body cells. 2. A person has the genotype XX. **State** whether this person is male or female. 3. **State** the probability of a couple having a male. **Carry out a genetic cross** to support your answer.
		Prove It!
		(a) Complete the following passage Chromosomes carry genetic information. Chromosomes are made up of ..... . Human body cells contain 46 chromosomes. There are twenty-two matching pairs but the final pair does not always match. It is these two that determine the gender, or sex, of the human. If you are a ..... the final pair of chromosomes matches. If you are a ..... the final pair of chromosomes does not match. **(2)** (b) Draw a labelled diagram to show that there is an equal chance of parents producing a baby boy or girl. Use the symbols **X** and **Y** for the chromosomes. **(4)** **(Total 6 marks)**

Genetics and evolution		
Book Ref.	**Spec. Ref.**	**Variation**
	4.6.2.1	**Key information:** - There is extensive variation within a population of a species. - The phenotype (observable characteristics) of an organism is affected by both genetics and the environment. - Mutations occur continuously. Very rarely, a mutation will lead to a new characteristic. If the new characteristic is advantageous it can lead to a change in the species.
		1. **Give two examples each of variation caused by:** • genes - • the environment - • both - 2. **State** what causes variation. 3. **Explain** why there is extensive variation in human skin colour. 4. **Describe, using an example,** how a mutation can result in a change in a species.
		Prove It!
		Peas grow in pods on pea plants.  A gardener grew four varieties of pea plants, **A** , **B** , **C** and **D** , in his garden. The gardener counted the number of peas in each pod growing on each plant. The table shows his results. **Variety** | **Range of number of peas in each pod** | **Mean number of peas in each pod** A | 2–6 | 4 B | 3–7 | 5 C | 3–8 | 6 D | 6–8 | 7 (a) Give **one** environmental factor and **one other** factor that might affect the number of peas in a pod. Environmental factor..... Other factor..... **(2)** (b) The gardener thinks that he will get the largest mass of peas from his garden if he grows variety **D**. Why is the gardener **not** correct? Suggest **one** reason. .... **(1)**

Genetics and evolution		
Book Ref.	**Spec. Ref.**	**Evolution**
	4.6.2.2	**Key information:** - The theory of evolution states that all species of living things have evolved from simple life forms that first developed more than three billion years ago. - Evolution is a change in the inherited characteristics of a population over time through a process of natural selection, which may result in the formation of a new species. - If two populations of one species become so different that they are no longer able to interbreed to produce fertile offspring, they have formed two new species.
		1. **State** what is meant by the term 'evolution'. 2. **Describe** the process of evolution by natural selection. 3. **Define** the term 'species'.  4. The diagram shows an evolutionary tree. **Identify** the species which is: a) the most closely related to humans. b) the most distantly related to humans.
		Prove It!
		The diagram shows the evolution of a group called the primates.  (a) Which primate evolved first? ..... (1) (b) Name **two** primates that developed most recently from the same common ancestor as humans. 1 ..... 2 ..... (2) (c) (i) The theory of evolution by natural selection was suggested in the 1800s. Which scientist suggested this theory? ..... (1) (ii) Use words from the box to complete the passage about natural selection. **evolution** **environment** **generation** **mutate** **survive** **variation** Individual organisms of a species may show a wide range of ..... because of differences in their genes. Individuals with characteristics most suited to the ..... are more likely to ..... and breed successfully. The genes that have helped these individuals to survive are then passed on to the next .....

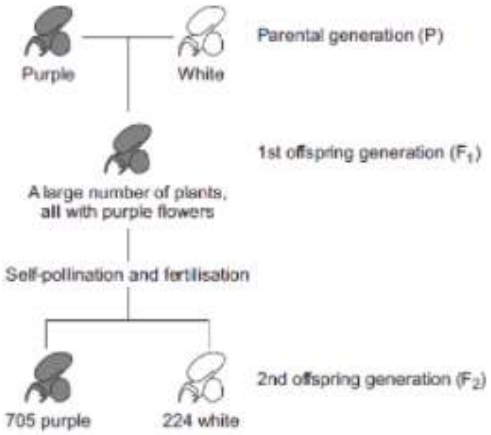
Genetics and evolution		
Book Ref.	**Spec. Ref.**	**Selective breeding**
	4.6.2.3	**Key information:** - Selective breeding is the process by which humans breed plants and animals for particular genetic characteristics. Humans have been doing this for thousands of years since they first bred food crops from wild plants and domesticated animals. - Selective breeding can lead to 'inbreeding', where some breeds are particularly prone to disease or inherited defects.
		1. **Give** three uses of selective breeding. 2. **Describe** why selective breeding is known as 'artificial selection'. 3. **Describe** the process of selective breeding. **Explain** why it occurs over many generations. 4. Pedigree dogs are often selectively bred. **Outline** the advantages and disadvantages of this.
		Prove It!
		Many different types of animals are produced using selective breeding. Some cats are selectively bred so that they do not cause allergies in people. (a) Suggest **two other** reasons why people might selectively breed cats. 1 .... 2 .... (2) (b) Selective breeding could cause problems of inbreeding in cats. Describe **one** problem inbreeding causes. ..... (1) (c) Many people have breathing problems because they are allergic to cats. The allergy is caused by a chemical called Fel D1. Different cats produce different amounts of Fel D1. A cat has been bred so that it does not produce Fel D1. The cat does **not** cause an allergic reaction. Explain how the cat has been produced using selective breeding. (4)

Genetics and evolution		
Book Ref.	**Spec. Ref.**	**Genetic engineering**
	4.6.2.4	**Key information:** - Genetic engineering involves modifying the genome of an organism by introducing a gene from another organism to give a desired characteristic.
		1. **What** is genetic engineering? 2. **Outline** two uses of genetic engineering. 3. **State** what is used to cut the desired gene from the original DNA.  4. **HT ONLY: Describe,** using the diagram, the process of genetic engineering. 5. **Explain** why the plasmid is known as a vector. 6. **Give two reasons why** some people are against genetic engineering. 7. **Evaluate** the use of genetic engineering in medicine and agriculture. 8. **Explain** why genes must be transferred at an early stage of development.
		Prove It!
		Insect pests can be controlled without using chemical insecticides. For example, the bacterium *Bacillus thuringiensis* produces a toxin extremely poisonous to certain species of insects. The gene which produces this toxin has been introduced into tomato plants. It gives them built-in resistance to a range of insect pests, but is not poisonous to humans. (a) Explain, step-by-step, how the tomato plant is made resistant to some insect pests. .... **(4)** (b) Give **two** arguments for and **two separate** arguments against controlling insect pests in this way. For: 1 ..... 2 ..... Against: 1 ..... 2 ..... **(4)** **(Total 8 marks)**
Genetics and evolution		

Book Ref.	Spec. Ref.	Cloning (biology only)
	4.6.2.5	**Key information:** - Tissue culture, cuttings, embryo transplant and adult cell cloning can all be used to produce clones of organisms.
		1. **Explain** why farmers might want to clone a particular plant or animal. 2. **Describe** how cuttings are used to grow new plants. 3. **Describe** how tissue culture can be used by farmers to grow new vegetables. 4. **Describe** the process of embryo transplantation. 5. **Describe** the process of adult cell cloning. 6. Some people oppose the process of adult cell cloning. **Explain** why they may be against this process but not against tissue culture.
		Prove It!
		(a) The drawings show one way of producing new plants. The new plants are identical to the parent plant.  Use words from the box to complete the sentences. asexual characteristics clones engineering genes sexual The colour and shape of the leaves are known as ..... The information for leaf colour is stored in parts of chromosomes called ..... The new plants are known as ..... The new plants have been produced by .....reproduction. (4) (b) (i) Name **one** other way of producing plants that are identical to their parents. ..... (1) (ii) Name **one** way of producing animals that are identical to each other. ..... (1) **(Total 6 marks)**
		Genetics and evolution

Book Ref.	Spec. Ref.	Theory of evolution (biology only)
	4.6.3.1	**Key information:** - Charles Darwin, after years of investigation, proposed the theory of evolution by natural selection. Darwin published his ideas in '*On the Origin of the Species*' (1859). There was much controversy surrounding these revolutionary new ideas. - Other theories, including that of Jean-Baptiste Lamarck, are based mainly on the idea that changes that occur in an organism during its lifetime can be inherited. We now know that in the vast majority of cases this type of inheritance cannot occur.
		1. **Describe** the evidence Charles Darwin used to propose his theory of natural selection. 2. **Explain** why many people opposed his theory of evolution. 3. **Explain** why, over time, the work of other scientists meant more people believed Darwin's theory. 4. Giraffes have long necks. Use Jean-Baptiste Lamarck's theory of inheritance to explain this.
		Prove It!
		Ancestors of swordfish had short swords. Modern swordfish have long swords. Swordfish use their swords to injure prey. The injured prey are easier to catch. The information in the box shows one theory of how the length of the sword of swordfish changed. The sword grew longer as each swordfish used its sword more and more. Each time a swordfish reproduced, the longer sword was passed on to its offspring.  Many generations (a) Which scientist suggested the theory shown in the box? ..... (b) (i) Darwin suggested that evolution is a result of natural selection. Describe how natural selection could result in modern swordfish with long swords developing from ancestors with short swords. (3) Scientists in the 1800s accepted both the theory shown in the box, and Darwin's theory. Now most scientists only accept Darwin's theory. Give **one** reason why. (1)
		Genetics and evolution

Book Ref.	Spec. Ref.	Speciation (biology only)
	4.6.3.2 WS 1.1	**Key information:** - Alfred Russel Wallace independently proposed the theory of evolution by natural selection. He published joint writings with Darwin in 1858 which prompted Darwin to publish his book the following year. - Wallace worked worldwide gathering evidence for evolution. He is best known for his work on speciation. More evidence over time has led to our current understanding of the theory of speciation.
		1. **Define** the term 'species'. 2. **Explain** why scientists often work together to develop new theories. 3. Darwin and Wallace did not know about DNA. **Suggest** how the discovery of DNA has supported their theories. 4. **Describe** the process of speciation.
		Prove It!
		Darwin observed birds called finches on the Galapagos Islands, 1000 km from the coast of South America. He saw that the birds were similar to, but not the same as, birds he had seen on the mainland of South America. Recent evidence suggests that 13 different species of finch on the islands evolved from 1 species of finch that arrived from the mainland about 1 million years ago. Describe how a new finch species may have evolved from the original species of finch that arrived from the mainland. .... **(4)**
Genetics and evolution		

Book Ref.	Spec. Ref.	The understanding of genetics (biology only)
	4.6.3.3 WS 1.1	**Key information:** - In the mid-19th century Gregor Mendel carried out breeding experiments on plants. One of his observations was that the inheritance of each characteristic is determined by 'units' that are passed on to descendants unchanged. - Many people did not believe Mendel's theory. The importance of his discovery was not recognised until after his death.
		1. **State** the type of organism Gregor Mendel used to develop his theory. 2. **Explain** why many people did not believe his theory. 3. **Identify** what we now know about the 'units' of inheritance Gregor Mendel described. 4. **Explain** why the importance of his work was not recognised until after his death.
		Prove It!
	MS 1c	In 1866, Gregor Mendel published the results of his investigations into inheritance in garden pea plants. The diagram below shows the results Mendel obtained in one investigation with purple-flowered and white-flowered pea plants.  (a) (i) Calculate the ratio of purple-flowered plants to white-flowered plants in the F_2 generation. Ratio of purple : white = ... (1) (ii) There was a total of 929 plants in the F_2 generation. Mendel thought that the production of a large number of offspring plants improved the investigation. Explain why. .... (2)
Genetics and evolution		

Book Ref.	Spec. Ref.	Fossils and extinction
	4.6.3.5 4.6.3.6 WS 1.3	**Key information:** - We can learn from fossils how much or how little different organisms have changed as life developed on Earth. Many organisms are now extinct. Fossils can help us learn more about extinct ancestors of some of the organisms alive today.
		1. **State** what is meant by the term 'fossil'. 2. **Describe** how fossils are formed. 3. **Explain** why we do not have fossils to give us evidence of how life on Earth began. 4. **State** what is meant by the term 'extinction'. 5. **Describe** three reasons why an organism may become extinct.
		Prove It!
		Studying fossils helps scientists understand how living things have evolved. The diagram below shows a fossilised snake.  © Peter Menzel/Science Photo Library Explain how the fossil in the diagram above may have formed. .... (3) Many species of snake have become extinct. Give **one** reason why a species might become extinct. .... (1)
Genetics and evolution		

Book Ref.	Spec. Ref.	Resistant bacteria
	4.6.3.7	**Key information:** - Bacteria can evolve rapidly because they reproduce at a fast rate. - Mutations of bacteria can produce new strains which might be resistant to antibiotics. - The development of new antibiotics is costly and slow. It is unlikely to keep up with the emergence of new resistant strains.
		1. **State** what is meant by the term 'mutation'. 2. **Identify** the process by which bacteria reproduce. **Explain** why the offspring are genetically identical to the parent cell. 3. **Describe** how the improper use of antibiotics gives rise to resistant strains of bacteria. 4. **Explain** why the evolution of antibiotic-resistant strains of bacteria can happen rapidly. 5. **Outline** how the rate of development of antibiotic resistant strains of bacteria is reduced. 6. **Explain** why the development of new antibiotics is unlikely to keep up with the emergence of new resistant strains.
		Prove It!
	MS 1c	Many strains of bacteria have developed resistance to antibiotics. The table shows the number of people infected with a resistant strain of one species of bacterium in the UK.

Year	2004	2005	2006	2007	2008
Number of people infected with the resistant strain	3499	3553	3767	3809	4131

(a) Calculate the percentage increase in the number of people infected with the resistant strain between 2004 and 2008.

Show clearly how you work out your answer.

.....

.....

Percentage increase = ...

(2)

(b) Explain, in terms of natural selection, why the number of people infected with the resistant strain of the bacterium is increasing.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(Total 5 marks)

Genetics and evolution		
Book Ref.	**Spec. Ref.**	**Classification of living organisms**
	4.6.4	**Key information:** - Traditionally living things have been classified into groups depending on their structure and characteristics in a system developed by Carl Linnaeus. - As evidence of internal structures become more developed due to improvements in microscopes, and the understanding of biochemical processes progressed, new models of classification were proposed. - Due to evidence available from chemical analysis there is now a three domain system developed by Carl Woese.
		1. **Outline** the Linnaeus system of classification. 2. **Describe** what is meant by the term 'binomial naming system'. 3. **Outline** the three domains proposed by Carl Woese. 4. Humans are known as *Homo sapiens*. **State** the genus of humans. 5. **Explain** why classification systems are continually developing.
		Prove It!
		Table 1 shows how a bird called the bluethroat (*Luscinia svecica*) is classified by biologists. **Table 1** Taxon / Name of taxon Domain: Eukaryota : Animalia : Chordata : Aves : Passeriformes : Muscicapidae Genus: Species: (a) Complete **Table 1** by filling the seven blank spaces with the correct terms.

Interdependence Keywords

Add all the important keywords for this big idea in the grid below as you come across them in the study pack.

Word	Definition

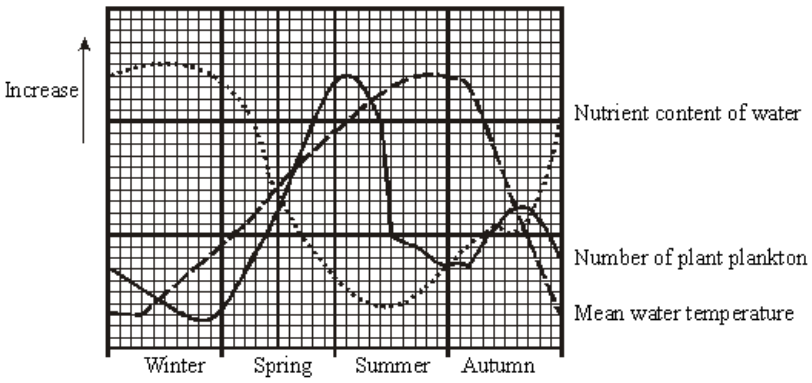
Book Ref.	Spec. Ref.	Communities
	4.7.1.1	**Key information:** - An **ecosystem** is the interaction of a community of living organisms with the non-living parts of their environment. - Organisms require a supply of materials from their surroundings and other living organisms there. - Plants compete with each other for light, space, water and mineral ions. - Animals compete with each other for food, mates and territory. - **Interdependence** means that communities of species depend on other species for food, shelter, pollination, water etc. If one species is removed, it can affect the whole community. - In a stable community, all the species and environmental factors are in balance and population sizes remain fairly constant.
		1. **Define** the term 'ecosystem'. 2. **Explain** why plants must compete for light. 3. Bees are pollinators. **Describe** the importance of bees to plants within a community. 4. Give another example of interdependence. 5. What is meant by the term 'stable community'?
	MS 4a	**Prove It!** Red squirrels are native to the UK. Grey squirrels were introduced to the UK from the USA over 100 years ago. **Table 2** gives information about the two types of squirrel. **Table 2** **(3)**

	Grey squirrel	Red squirrel
Population in UK	2.5 million	140 000
Main food types	Seeds, nuts, tree bark, birds' eggs, young birds	Cones from coniferous trees, nuts, tree bark, berries
Health	Can become immune to parapox virus	Cannot become immune to parapox virus
Reproduction	Up to 9 young, twice a year	Up to 6 young, twice a year
Survival rate of young in mixed populations	41 %	14 %
Length of life	2 – 4 years	Up to 7 years

In most parts of the UK the population of grey squirrels is increasing, but the population of red squirrels is decreasing.

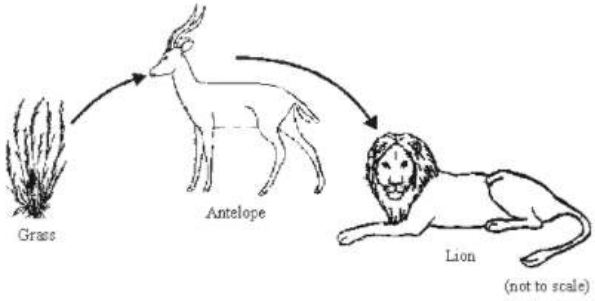
Suggest why.

Use information from **Table 2**.

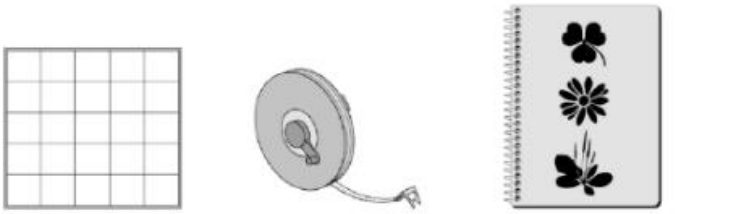
Interdependence		
Book Ref.	**Spec. Ref.**	**Biotic and Abiotic factors**
	4.7.1.2 4.7.1.3	**Key information:** - Non-living factors which affect a community are known as **abiotic factors.** - Examples include: light intensity (photosynthesis), temperature (enzymes), moisture levels, soil pH and mineral content, wind intensity and direction, carbon dioxide levels (plants), oxygen levels (aquatic animals). - Living factors which affect a community are known as **biotic factors.** - Examples include: availability of food, new predators arriving, new pathogens, one species outcompeting another so the numbers are no longer sufficient to breed.
		1. **Outline** the difference between biotic and abiotic factors, using examples. 2. **Give** two factors for which animals may compete. 3. **State** the process that occurs in animals and plants which requires oxygen. **Explain** the importance of this process for growth. 4. **Give two reasons why** plants grow slowly in winter.
	MS 4a WS 1.2	**Prove It!** Plant plankton are aquatic microscopic organisms that photosynthesise. The graph shows the numbers of plant plankton in the North Sea at different times of the year.  Use the data and your knowledge of photosynthesis and growth to explain: (a) why numbers of plant plankton were low in winter but increased rapidly during the spring, ... **(3)**
Interdependence		

Book Ref.	Spec. Ref.	Adaptations
	4.7.1.4	**Key information:** - Adaptations are features that enable them to survive in the conditions in which they normally live. These adaptations may be structural, behavioural or functional. - **Extremophiles** live in environments that are very extreme, such as at high temperature, pressure, or salt concentration.
		1. **Describe** how a cactus is adapted to survive in the desert. 2. **Explain** how having a large surface area to volume ratio keeps an organism cool. 3. **Describe** what is meant by the term 'extremophile', using an example.
		Prove It!
		In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate. Animals and plants have features (adaptations) that allow them to survive in the conditions in which they normally live. Describe how animals and plants are adapted to survive in dry conditions such as deserts. For each adaptation that you give, describe how the adaptation helps the animal or plant to survive in dry conditions. To obtain full marks you should refer to **both** animals and plants. **(6)**

Interdependence

Book Ref.	Spec. Ref.	Levels of organisation
	4.7.2.1	**Key information:** - Photosynthetic organisms (plants and algae) are the **producers** of biomass for life on Earth. - Transects and quadrats are used to determine the distribution and abundance of species in an ecosystem. - All organisms are part of a food chain: Producer → Primary consumer → Secondary consumer → Tertiary consumer - **Predators** kill and eat other animals. **Prey** are the animals eaten.
		The diagram shows a food chain. **oak tree** → **caterpillar** → **blue-tit** → **hawk** 1. **Name** the producer in this food chain. **State** the process that the producer uses to produce glucose. 2. **Name** the tertiary consumer. 3. **Describe**, using examples from the food chain, the relationship between a predator and prey. 4. Define the term 'biomass'.
		Prove It!
		Figure 1 shows a food chain containing three organisms.  **Figure 1** (a) (i) In this food chain, name: the predator; ..... the prey. ..... **(2)** (ii) What is the source of energy for the grass? Draw a ring around **one** answer. **carbon dioxide** **light** **nitrates** **water** **(1)** (iii) **Figure 2** shows a pyramid of biomass for the organisms in **Figure 1.** Write the names of the organisms on the correct lines in **Figure 2.**  **Figure 2** **(1)**

Interdependence

Book Ref.	Spec. Ref.	**Required practical 7 (biology: required practical 9): Measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species.**
	4.7.2.1 AT 1, 3, 4, 6	**Key information:** - Quadrats are used to measure the abundance of plants or slow moving organisms in an area. The area to be sampled is given grid references and a random number generator is used to randomly place the quadrat in different places. This reduces bias and increases validity. - Transects can be used to measure how the distribution and abundance of plants changes across a certain distance. - Repeats are used in order that a mean number of organisms can be calculated. This ensures repeatability - Other scientists may carry out the same investigation. This ensures reproducibility.
	WS 2.2	 Quadrat Tape Identification key Not drawn to scale **Describe** how the student would use the equipment shown to estimate how many clover plants there are in the school field.
		Maths skills
	MS 2b, 2f	The table below shows the student's results. **Quadrat number** | **Number of clover plants counted** 1 | 11 2 | 8 3 | 11 4 | 9 5 | 1 Total | 40 The area of the school field was 500 m^2. The quadrat used in the table above had an area of 0.25 m^2. 1. **Calculate** the mean average of clover plants. Make sure to remove anomalous results. 2. **Calculate** the estimated number of clover plants in the school field. 3. **Identify** the mode number of clover plants from the results in the table above.

Interdependence		
Book Ref.	**Spec. Ref.**	**How materials are cycled**
	4.7.2.2	**Key information:** - The carbon cycle returns carbon from organisms to the atmosphere as carbon dioxide to be used by plants in photosynthesis. - The water cycle provides fresh water for plants and animals on land before draining into the seas. Water is continuously evaporated and precipitated. - Microorganisms cycle materials through an ecosystem through the process of decay. As the microorganisms respire, they release the carbon trapped in materials as carbon dioxide into the atmosphere. At the same time, mineral ions are released to the soil.
		1. **Give** an example of a material that is cycled through an ecosystem. 2. **Name** the process plants carry out which converts carbon dioxide into organic compounds (glucose). **Outline** three uses of this glucose in plants. 3. **Name** the process carried out by animals and plants that releases carbon dioxide back into the atmosphere. 4. **Describe** the role of micro-organisms in the cycling of nutrients.
		Prove It!
		Some of the leaves from the gardener's strawberry plant die. The dead leaves fall off the strawberry plant onto the ground. The carbon in the dead leaves is recycled through the carbon cycle. Explain how the carbon is recycled into the growth of new leaves. .... (6)

Interdependence		
Book Ref.	**Spec. Ref.**	**Decomposition (biology only)**
	4.7.2.3	**Key information:** - Temperature, water and availability of oxygen all affect the rate of decay of biological material. - Gardeners and farmers try to provide optimum conditions for rapid decay of waste biological material. The compost produced is used as a natural fertiliser for growing garden plants or crops. - Anaerobic decay produces methane gas (a greenhouse gas). Biogas generators can be used to produce methane gas as a fuel.
		1. **Name** the three conditions required for decay. 2. **Suggest** how a compost bin could be designed to provide optimum conditions for decay. **State** what this compost is used for. 3. **Give an example** of a mineral ion released back into the soil during decay. **State** what this mineral ion is used for in plants. 4. **Explain** why the rate of decay increases as oxygen availability increases. 5. Write a word equation for the process of anaerobic decay. **Suggest** why the production of methane could be considered either an advantage or a disadvantage. 6. **Explain** why biogas generators must be airtight.
		Prove It!
	MS 1c	A gardener wants to add compost to the soil to increase his yield of strawberries. The gardener wants to make his own compost. (a) An airtight compost heap causes anaerobic decay. Explain why the gardener might be against producing compost using this method. .... (2) (b) The gardener finds this research on the Internet: **'A carbon to nitrogen ratio of 25:1 will produce fertile compost.'** Look at the table below.

Type of material to compost	Mass of carbon in sample in g	Mass of nitrogen in sample in g	Carbon:nitrogen ratio
Chicken manure	8.75	1.25	7:1
Horse manure	10.00	0.50	20:1
Peat moss	9.80	0.20	**X**

Determine the ratio **X** in the table above.

.....

Ratio .....

(1)

(c) Which type of material in the table above would be **best** for the gardener to use to make his compost?

Justify your answer.

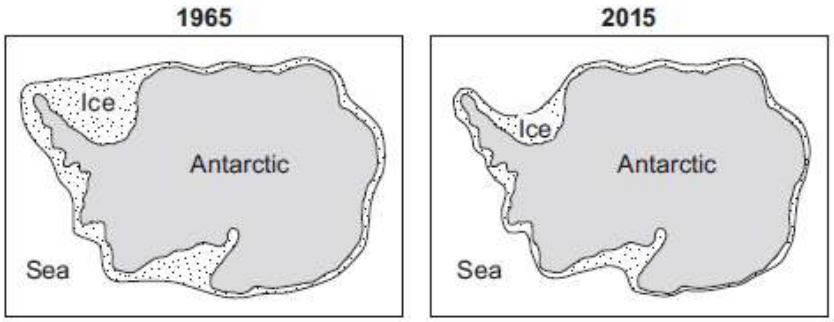
Interdependence

Book Ref.	Spec. Ref.	Required practical activity 10 (biology only): Investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change.
	4.7.2.3 AT 1, 3, 4, 5	**Key information:** - As temperature increases, the rate of decay increases. This is because the rate of enzyme activity increases until an optimum temperature is reached. - The fall in pH in natural decay would be due to the production of lactic acid. - When lactase has been added, the fall in pH is due mainly to the production of fatty acids. - Temperature can be controlled using a water bath.
	WS 2.3	**1.** Name the piece of equipment that should be used to heat the milk to different temperatures. **2.** Describe why the pH of milk decreases naturally over time. **3.** Name the piece of equipment that could be used to measure pH change. **4.** Using your knowledge of decay, **explain** why fresh milk is kept in the fridge.
		Prove It!
	WS 3.1, 3.7	1. Identify the independent and dependent variables in this investigation. 2. Explain, as fully as you can, the results shown in table 2. 3. At what temperature would milk decay the fastest? 4. Define the term 'precision'. Describe how to identify a more precise optimum temperature. 5. Describe, as fully as you can, how you would draw a graph to display the data in table 2.

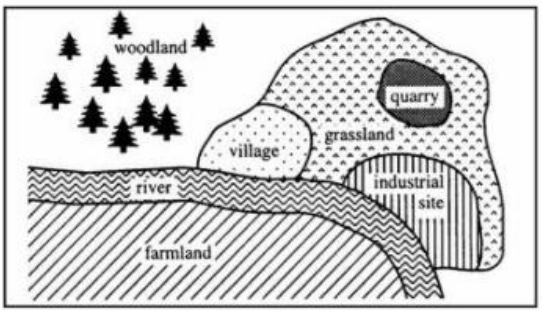
Table 2
Effect of temperature

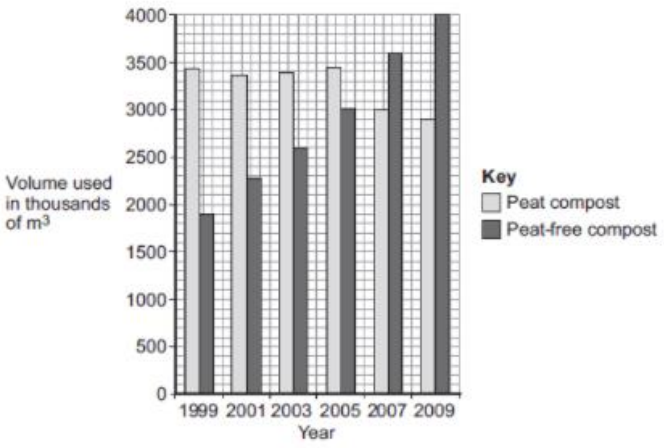
Temperature in °C	Time taken to digest lactose in minutes
25	20
30	14
35	11
40	6
45	29
50	No digestion

Interdependence

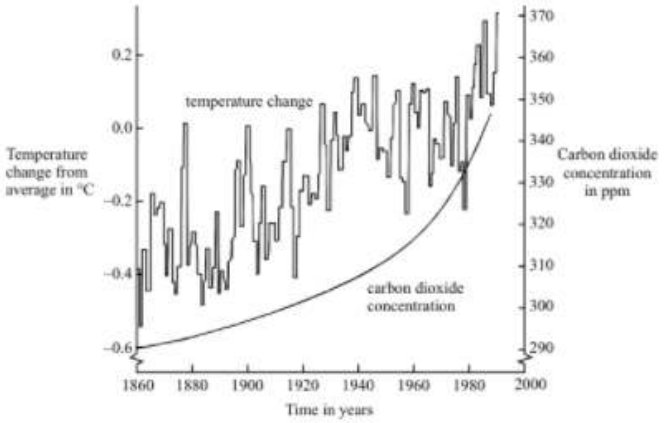
Book Ref.	Spec. Ref.	Impact of environmental change (biology only - HT only)
	4.7.2.4	**Key information:** - Environmental change affects the distribution of species in an ecosystem. These changes include temperature, availability of water and composition of atmospheric gases. - These changes can be seasonal, geographical or caused by human interaction.
		1. **Outline** how deforestation affects the composition of atmospheric gases. 2. **Suggest** why not all animal species are able to live in the Arctic. 3. Many bird species migrate during the winter. **Explain** why they do this.
		Prove It!
		Adelie penguins spend most of their time on the ice around the Antarctic. Chinstrap penguins live mainly in the sea around the ice. Since 1965 the number of Adelie penguins has **decreased** by 6 million. **Figure 2** shows changes to the ice around the Antarctic over the past 50 years. **Figure 2**  (i) Use information from **Figure 2** to explain why the number of Adelie penguins has decreased since 1965. .... **(2)**

Interdependence		
Book Ref.	**Spec. Ref.**	**Biodiversity**
	4.7.3.1	**Key information:** - Biodiversity is the variety of all the different species of organisms on Earth, or within an ecosystem. - A great biodiversity ensures the stability of ecosystems by increasing the availability of food and shelter for organisms. - Many human activities, such as deforestation, are reducing biodiversity. Only recently have measures been taken to try and stop this reduction. One way is carbon sequestration.
	WS 1.4	1. **Define** the term 'biodiversity'. 2. **Suggest** why deforestation causes a reduction in biodiversity. **Explain** the negative impact of this to human populations. 3. **Outline** one way in which carbon can be 'sequestered'. Give a reason why carbon sequestration is important.
		Prove It!
		Deforestation affects the environment in many ways. (a) Deforestation increases the amount of carbon dioxide in the atmosphere. Give **two** reasons why. 1 .... 2 .... **(2)** (b) Deforestation also results in a loss of *biodiversity*. (i) What is meant by *biodiversity*? .... **(1)** (ii) Give **two** reasons why it is important to prevent organisms becoming extinct. 1 .... 2 .... **(2)** **(Total 5 marks)**

Interdependence		
Book Ref.	**Spec. Ref.**	**Waste management**
	4.7.3.2	**Key information:** - Rapid growth in the human population and an increase in the standard of living mean that increasingly more resources are used and more waste is produced. - Pollution kills plants and animals which can reduce biodiversity. - Water pollution can occur from sewage, fertiliser or toxic chemicals. - Air pollution can occur from smoke and acidic gases. - Land pollution can occur from landfill and from toxic chemicals.
		1. **Describe** why pollution can result in a loss of biodiversity. 2. **Name** two human activities which result in air pollution. 3. Sewage reduces the concentration of oxygen in water. **Explain** why this results in a loss of biodiversity. 4. **Suggest** how we can reduce the amount of land pollution. 5. **Explain** why waste management is becoming more important.
		Prove It!
		The diagram shows a village and its surroundings.  (a) Use words from the list to complete the sentences about pollution. **oxygen** **pesticides** **sewage** **sulphur dioxide** The air might be polluted by ..... from the industrial site. The river might be polluted by ..... from the village and by ..... from the farmland. **(3)** (b) The owners of the quarry want to make it larger. Give **one** effect that this might have on wild plants and animals that live near the quarry. .... **(1)** **(Total 4 marks)**

Interdependence		
Book Ref.	**Spec. Ref.**	**Land use**
	4.7.3.3	**Key information:** - Humans reduce the amount of land available for other animals and plants by building, quarrying, farming and dumping waste. - Peat bogs are wetland areas made up of partially decomposing material. Peat is used as garden compost because it contains a high concentration of mineral ions. The destruction of peat bogs results in a loss of biodiversity. - The decay or burning of peat releases carbon dioxide into the environment.
	WS 1.4, 1.5	1. **Identify** four ways in which humans reduce the amount of land available for other animals and plants. 2. **Explain** why farmers often use peat as a fertiliser. 3. **Describe** why the burning of peat contributes to global warming. 4. **Evaluate** (consider the reasons for and against) the use of peat as a fertiliser for growing crops.
		Maths skills
	WS 3.5	Human activities have many effects on our ecosystem. The graph shows the volume of peat compost and peat-free compost used in gardening from 1999 to 2009.  (a) Describe the trends shown in the graph. .... (2) (b) What effect does the destruction of peat bogs have on the gases in the atmosphere? .... (1)

Interdependence		
Book Ref.	**Spec. Ref.**	**Deforestation**
	4.7.3.4	**Key information:** - Large-scale deforestation in tropical areas has occurred in order to provide land for cattle and rice fields, and grow crops for biofuel.
	WS 1.4	1. **Describe** why deforestation has occurred in tropical areas. 2. **Evaluate** (consider the reasons for and against) the carrying out of large-scale deforestation in order to provide land for cattle and rice fields. 3. **Explain**, using your knowledge of the carbon cycle, why deforestation affects the composition of atmospheric gases.
		Prove It!
		Clearing forests and replacing the forests with palm oil trees to produce fuel for motor vehicles will affect the composition of the atmosphere. Explain how. .... **(5)**

Interdependence		
Book Ref.	**Spec. Ref.**	**Global warming**
	4.7.3.5 WS 1.6	**Key information:** - Global warming is the observed increase in the average surface temperature due to the effect of greenhouse gases. Increasing levels of the two main greenhouse gases, carbon dioxide and methane, are contributing to global warming. - Scientific publications are always peer-reviewed. Scientists review each other's work regularly in order to understand more about global warming and climate change. During this process, scientists try and repeat each other's work in order to check its validity and give each other feedback.
		1. **Describe,** using examples, the consequences of global warming for biodiversity. 2. **Give three reasons** why the levels of carbon dioxide and methane in the atmosphere are increasing. 3. **Describe** the process of peer-review. Explain why it is important.
		Prove It!
	WS 1.4	The graph shows changes in temperature and in carbon dioxide concentration in the earth's atmosphere between 1860 and 1990.  (a) Give **two** human activities which may have helped to increase the concentration of carbon dioxide in the atmosphere. 1 ..... 2 ..... **(2)** (b) (i) Describe the changes in temperature shown by the graph between 1860 and 1990. .... **(2)** (ii) Do the data in the graph prove that increased carbon dioxide concentrations in the atmosphere caused the changes in temperature you described in part (b)(i)? Give a reason for your answer. .... **(1)** (c) Describe **one** way in which a change in temperature such as that shown in the graph might affect the environment. .... **(1)**

Interdependence		
Book Ref.	**Spec. Ref.**	**Maintaining biodiversity**
	4.7.3.6	**Key information:** - Scientists and concerned citizens have put in place programmes to reduce the negative effects of humans on ecosystems and biodiversity. These include breeding programmes for endangered species, protection and regeneration of rare habitats, re-introduction of hedgerows in agricultural areas where farmers grow only one type of crop, reduction of deforestation and carbon dioxide emissions and recycling initiatives.
		1) **Explain** why breeding programmes are important for maintaining biodiversity. 2) **Suggest** why rare habitats are protected. **Describe** the effect of this on global biodiversity. 3) **Explain** why hedgerows between fields are important for maintaining biodiversity. 4) **Give three examples** of materials which can be recycled. **Outline** two environmental benefits of recycling.
		Prove It!
	WS 1.4	The table below shows how the mass of household waste in the UK has changed from 2004 to 2012.

Year	Total mass of household waste in thousands of tonnes (including total household recycling)	Total mass of household recycling in thousands of tonnes	Percentage of household waste recycled
2004	25 658	5785	22.5
2006	25 775	7976	30.9
2008	24 334	9398	38.6
2010	23 454	9733	
2012	22 643	9782	43.2

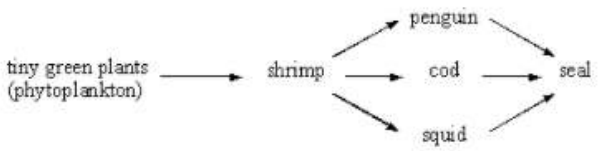
The UK government has been encouraging a 'zero waste economy'.

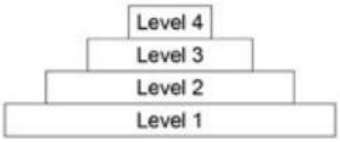
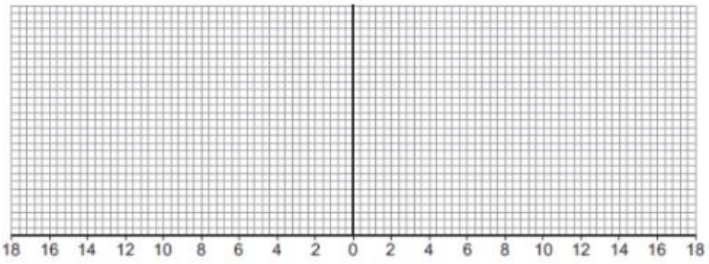
In a 'zero waste economy', we reduce, reuse and recycle as much waste as possible.

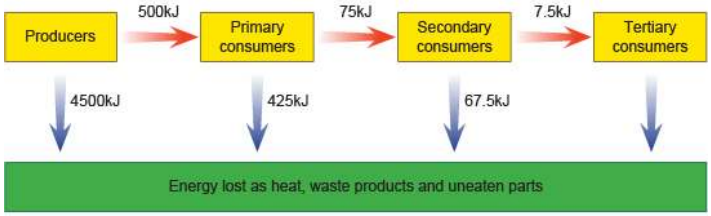
A newspaper concluded that: **'The government's 'zero waste economy' has been successful.'**

Use information from the table to describe the reasons for and against the newspaper's conclusion.

(4)

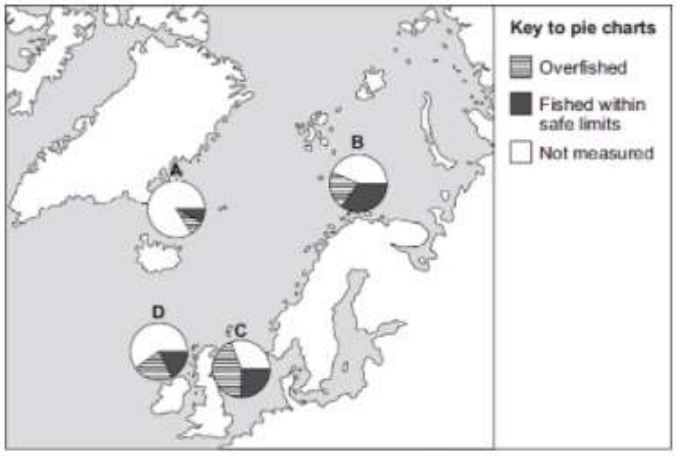
Interdependence		
Book Ref.	**Spec. Ref.**	**Trophic levels (biology only)**
	4.7.4.1	**Key information:** - The trophic level of a food chain is the position it occupies in a food chain. They can be represented by numbers. For example, level 1 represents producers (plants and algae) which make their own food using energy from the sun. - Decomposers break down dead plant and animal matter by secreting enzymes into the environment. Small soluble molecules then diffuse into the micro-organism and are used in respiration.
		Grass → Grasshopper → Bluebird → Snake → Owl Decomposers 1. **Identify** the primary consumer in this food web. 2. **Identify** the trophic level occupied by the owl. 3. **Identify** two carnivores in this food web. 4. **Describe** why the owl is known as an 'apex predator'. 5. **Explain** the importance of decomposers in the food web.
		Prove It!
		Scientists have found the following food web in the Antarctic Ocean.  (a) (i) Write down the name of the producer in this web. ..... (ii) Write down the names of **two** organisms which are prey in this web. .... **(3)** (b) Humans are removing large numbers of the cod. Some scientists argue that this could lead to a decrease in the numbers of squid and penguins. Others argue that the numbers of squid and penguins will stay the same. Carefully explain each argument. Why they might decrease. .... Why they might stay the same. .... **(2)**

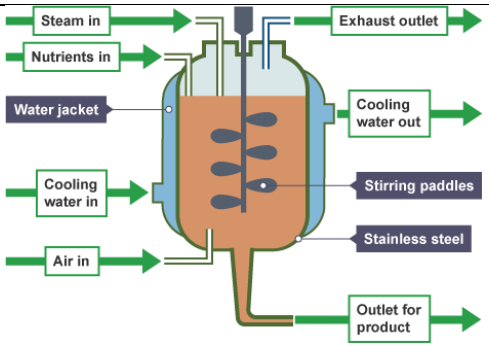
Interdependence		
Book Ref.	**Spec. Ref.**	**Pyramids of biomass (biology only)**
	4.7.4.2	**Key information:** - Pyramids of biomass are constructed to represent the relative amount of biomass in each level of a food chain. Trophic level 1 (producers) is always at the bottom of the pyramid. 
	WS 1.2 MS 2c	1. Draw a pyramid of biomass to represent the following food chain: Grass → Grasshopper → Bluebird → Snake 2. **Identify** what organisms in tropic level 3 eat. **Name** the type of feeder they are. *(carnivore, herbivore, top carnivore)*
		Prove It!
	MS 2c	Red kites are birds of prey. (a) The food chain for the wheat field is: Wheat grains → Field mice → Red kites What is the source of energy for the food chain? ..... **(1)** (b) The table shows the data the scientists collected. **Organism** | **Estimated number in the field** | **Biomass of one organism in kg** | **Total biomass for field in kg** Fallen wheat grains | 40 000 | 0.0006 | 24.0 Red kites | 2 | 1.0 | ..... Field mice | 200 | 0.04 | ..... (i) Complete the table by calculating the total biomass of red kites and of field mice. Write your answers in the table. **(2)** (ii) Use data from your completed table to draw a pyramid of biomass for the food chain shown in the table. You should label each layer of your pyramid.  **(3)**

Interdependence		
Book Ref.	**Spec. Ref.**	**Transfer of biomass (biology only)**
	4.7.4.3	**Key information:** - Producers (plants and algae) transfer just 1% of the energy received from light into glucose. This is because most of the light is reflected from the leaves or does not hit the chlorophyll molecules. - Energy is lost at every trophic level due to excretion of faeces and urea, and respiration (in order to release energy to keep warm or move). During respiration, energy is lost as carbon dioxide and water.
		 1. **Calculate** the total amount of energy received by the producers. **Explain** why most of this energy was not transferred to primary consumers. 2. **Calculate** the efficiency of the energy transfer between the primary and secondary consumer. 3. **Describe** three ways in which energy is lost by secondary consumers. 4. **Suggest** what happens to the number of organisms at each trophic level and why.
		Prove It!
		Some snails ate some lettuces. The lettuces contained 11 000 kJ of energy. Only 10% of this energy was transferred to the snails. Calculate the energy transferred to the snails from the lettuces. ..... Energy = ... kJ (1) Give **one** reason why only 10% of the energy in the lettuces is transferred to the snails. Tick **one** box. The lettuces carry out photosynthesis ☐ The snails do not eat the roots of the lettuces ☐ Not all parts of a snail can be eaten ☐ (1)

Interdependence		
Book Ref.	**Spec. Ref.**	**Factors affecting food security (biology only)**
	4.7.5.1	**Key information:** - Food security is having enough food to feed a population - Many biological factors are threatening food security, so sustainable methods must be found to feed all people on Earth.
		1. **Identify** three factors that are threatening food security: 2. **Describe** one example of how environmental change can cause widespread famine. 3. **Describe** why changing diets, such as increased consumption of avocados and quinoa in the developed world, are threatening food security in developing countries. 4. **Suggest** two sustainable methods that could be used to feed all people on Earth.
		Prove It!
		A newspaper reported that: **'Food security is a serious problem in remote communities in Canada. This is because Aboriginal communities are eating fewer traditional foods.'** One traditional food eaten by Aboriginal communities in Canada is seal. Look at the table below **Year** / **Number of seals caught in thousands** 2004 — 362 2005 — 316 2006 — 348 2007 — 224 2008 — 215 2009 — 91 2010 — 67 Calculate the percentage (%) decrease in the number of seals caught from 2004 to 2010. .... Decrease in seals = ... % (2) The conclusion in the newspaper might **not** be correct. Suggest **two** reasons why. 1 .... 2 .... (2)

Interdependence		
Book Ref.	**Spec. Ref.**	**Farming techniques (biology only)**
	4.7.5.2 WS 1.3	**Key information:** - The efficiency of food production can be improved by restricting energy transfer from food animals to the environment. This can be done by limiting their movement and by controlling the temperature of their surroundings. Some animals are fed high protein foods to increase growth. - Some people have ethical objections to some modern intensive farming methods.
		1. **Identify** three ways in which the efficiency of food production can be increased. 2. **Suggest** why some people have ethical objections to modern intensive farming methods. 3. Evaluate the advantages and disadvantages of keeping cows inside in warm barns.
		Prove It!
		Food security is when a population has enough food to stay healthy. Lack of food security is a global problem. One way to maintain food security is to increase the efficiency of food production. The diagram below shows how some pigs are farmed using intensive methods.  © Ingram Publishing/Thinkstock (a) Some people think the farming methods shown in the diagram above are unethical. Suggest **two** other possible disadvantages of intensive farming methods. 1 .... 2 .... (2) (b) Explain how the intensive farming of pigs increases the efficiency of food production. (4)

Interdependence		
Book Ref.	**Spec. Ref.**	**Sustainable fisheries (biology only)**
	4.7.5.3	**Key information:** - Fish stocks in the oceans are declining. It is important to maintain fish stocks at a level where breeding continues or certain species may disappear altogether in some areas. - Control on net size and the introduction of fishing quotas play important roles in conservation of fish stocks at a sustainable level.
		1. **Describe** why it is important for biodiversity to maintain fish stocks. 2. **Describe** how net size and mesh size should be controlled. **Explain** why these measures help maintain fish stocks. 3. **Outline** what is meant by the term 'quota'.
		Prove It!
	WS 1.4	The map shows pie charts, **A**, **B**, **C** and **D**, that give information about fisheries in some of the seas around Europe.  © European Environment Agency (a) Which pie chart, **A**, **B**, **C** or **D**, shows the fishery with the largest amount of overfishing? (1) (b) It is important to maintain fish stocks high enough for breeding to continue. Give the reason why. .... (1) (c) Give **two** ways fish stocks can be conserved. .... (2) **(Total 4 marks)**

Interdependence		
Book Ref.	**Spec. Ref.**	**The role of biotechnology (biology only)**
	4.7.5.4	**Key information:** - Genetic modification of crops is one solution to meet the demands of the growing human population. This is used to produce more food or food with an improved nutritional value (golden rice). - The fungus *Fusarium* is useful for producing mycoprotein, a protein-rich food suitable for vegetarians. The fungus is grown on glucose syrup, in aerobic conditions, and the biomass is harvested and purified. -
		 The diagram shows a vessel where mycoprotein is produced. 1. **Explain** why air and glucose syrup are added to the vessel. 2. **Explain** why the vessel is kept cool. 3. **Describe** what has to happen to the biomass product once it leaves the outlet. 4. **Describe** the process of genetic modification of crops. 5. **Describe** the role of bacteria in the production of human insulin.
		Prove It!
		(a) Bubbles of air enter the fermenter. Give **two** functions of the air bubbles. 1..... 2..... **(2)** (b) Why is glucose added to the fermenter? ..... **(1)** (c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at C. Name the process that causes the fermenter to heat up. ..... **(1)** (d) It is important to prevent microorganisms other than *Fusarium* growing in the fermenter. (i) Why is this important? ..... **(1)** (ii) Suggest **one** way in which contamination of the fermenter by microorganisms could be prevented. ..... **(1)**

Interdependence

Book Ref.	Spec. Ref.	The role of biotechnology (biology only)
	4.7.5.4	**Key information:** - Genetically modified bacteria produce human insulin. When harvested and purified this is used to treat people with diabetes.
		1. **Name** the ring of bacterial DNA which is modified to contain human insulin. 2. **State** the role of insulin in humans. 3. **Describe** why the genetically modified bacteria is grown in a culture medium. **Explain** why this has to be harvested and purified. 4. **State** the type of diabetes (type 1 or 2) that can be treated with insulin.
		Prove It!
		Insulin is now made by a biotechnological process. A description of the process is given below. Complete the gaps in the sentences. (a) The first step in the biotechnological process is that a special enzyme is used to cut the insulin ..... out from a human ..... . In a separate operation, a ring of bacterial ..... is cut open using a special enzyme. These two pieces of genetic material are combined together to form a new plasmid ring which is inserted into a bacterium. **(3)** (b) Explain why large quantities of insulin are produced when this bacterium is put into a culture medium. .... **(2)** (c) Before insulin was made in this way, it could only be obtained from sheep and pigs. Suggest **two** reasons, other than preventing the exploitation of animals, why it is better to obtain insulin by genetic engineering than from animals. 1 .... 2 .... **(2)** **(Total 7 marks)**

Microbes and Health Keywords

Add all the important keywords for this big idea in the grid below as you come across them in the study pack.

Word	Definition

Book Ref.	Spec. Ref.	The human digestive system
	4.2.2.1	**Key information:** - The digestive system is an organ system where several organs work together to absorb and digest food. - Digestive enzymes convert large insoluble molecules into smaller soluble ones so they can be absorbed into the blood stream.

1. **Complete** the table to summarise the role of the organs in the digestive system:

Organ	Role
Salivary glands	
Oesophagus	
Stomach	
Liver	
Pancreas	
Small intestine	
Large intestine	

2. What does a digestive enzyme do?

3. Complete the table about enzymes:

Enzyme	Large insoluble molecule the enzyme breaks down	Small soluble molecule(s) that are formed	Where the enzyme is produced	Where the enzyme works
Carbohydrase				
	Fats (lipids)			
		Amino acids		

4. **Explain** enzyme action using the lock and key theory.

5. **Describe** the 2 functions of bile and **state** where it is made and where it is stored.

Prove It!

A student has eaten a steak for dinner. The steak contains protein and fat.

(i) Describe how the **protein** is digested.

(3)

(ii) Explain **two** ways in which bile helps the body to digest **fat**.

(4)

Microbes and Health

<table>
<tr><th>Book Ref.</th><th>Spec. Ref.</th><th>Required practical 3 (biology: required practical 4): Use qualitative reagents to test for a range of carbohydrates, lipids and proteins.</th></tr>
<tr><td></td><td>4.2.2.1

AT2,8</td><td>1. Outline how you would prepare a sample of solid food for a food test.

2. Complete the table to summarise the 4 food tests:
<table>
<tr><th>Test</th><th>What type does it test for?</th><th>What is the method?</th><th>What does the positive result look like?</th></tr>
<tr><td>Benedict's</td><td></td><td></td><td></td></tr>
<tr><td>Iodine solution</td><td></td><td></td><td></td></tr>
<tr><td>Biuret</td><td></td><td></td><td></td></tr>
<tr><td>Sudan III</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td></td><td></td><td>Risk Assessment</td></tr>
<tr><td></td><td>WS2.4</td><td>Outline any hazards in this experiment along with the associated risks and how to minimise them.</td></tr>
</table>

Microbes and Health

Book Ref.	Spec. Ref.	Required practical 4 (biology: required practical 5): Investigate the effect of pH on the rate of reaction of amylase enzyme.
	4.2.2.1 AT1,2,5,8 WS2.1 WS2.2 WS2.5	1. **Outline** a method for this practical that uses a continuous sampling technique. 2. **Suggest** a hypothesis for the experiment outlined above. 3. **Identify** 3 possible sources of error in the experiment and identify how you would control or monitor them.

Microbes and Health

Book Ref.	Spec. Ref.	**Coronary heart disease: a non-communicable disease**
	4.2.2.4	1. **Describe** what has happened inside the body of someone who has coronary heart disease. 2. Describe the consequence of a person having a faulty valve and the methods used to treat it. 3. Complete the table to summarise some treatments for CHD:

Treatment	Description of treatment	When it is used
Statins		
Stents		
Mechanical or biological valves		
Transplant		

Prove It!

Explain how the build-up of fatty material can damage the heart.

.....

.....

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(4)

Describe how statins can help to reduce deaths from CHD.

.....

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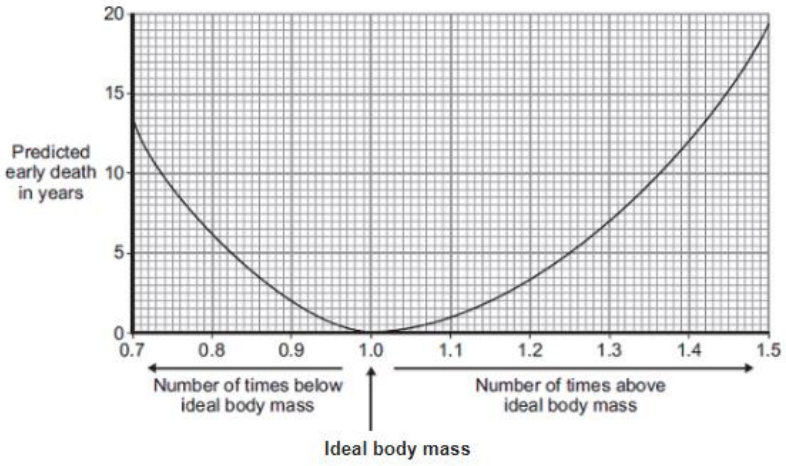
.....

Microbes and Health		
Book Ref.	**Spec. Ref.**	**Health Issues and the effect of lifestyle on some non-communicable diseases**
	4.2.2.5 4.2.2.6	1. **State** 3 lifestyle factors that can affect both mental and physical health. 2. Which type of pathogen, living in cells, can be a trigger for cancer? 3. What can immune reactions (originally caused by a pathogen) be a trigger for? 4. What mental illness can severe physical health problems cause? 5. What physical problems can smoking cause? 6. Which organs does drinking alcohol affect the most?
		Maths Skills
	MS2c MS4a	(b) Predicted early death is the number of years that a person will die before the mean age of death for the whole population. The predicted early death of a person is affected by their body mass. Scientists have calculated the effect of body mass on predicted early death. The graph shows the results of the scientists' calculations.  The number of times above or below ideal body mass is given by the equation: Actual body mass In the UK the mean age of death for women is 82. A woman has a body mass of 70 kg. The woman's ideal body mass is 56 kg. (i) Use the information from the graph to predict the age of this woman when she dies. .... Age at death = ... years **(2)**

Microbes and Health		
Book Ref.	**Spec. Ref.**	**Cancer**
	4.2.2.7	1. **Describe** what is happening to cells in someone with cancer. 2. What is a benign tumour? 3. How are malignant tumours different to benign tumours? 4. **Suggest** three factors that are linked with an increased risk of getting cancer.
		Prove It!
		(b) Why can cancers grow very large? Tick **one** box. Cancer cells are specialised ☐ Cell division is slow ☐ Cell division is uncontrolled ☐ (c) Give **one** factor which increases the risk of getting cancer. ..... (g) Suggest **two** reasons why the survival rates for all cancers have increased. 1 .... 2 ....

Book Ref.	Spec. Ref.	Communicable Diseases
	4.3.1.1	**Key information:** - Pathogens are microorganisms that can cause disease. They can infect plants or animals and can be spread by direct contact, water or air.
		1. **Define the term 'pathogen'.** 2. **State** the names of the 4 types of pathogen. 3. **Suggest** 2 ways the spread of disease can be reduced or prevented. 4. How do bacteria make you feel ill? 5. How do viruses make you feel ill?
		Prove it!
		1. a) What causes infectious diseases? (1) …… b) How do pathogens make you feel ill? (2) …… 2. a) Give two ways in which diseases are spread from one person to another. (2) …… …… b) Give two ways in which diseases are spread from one plant to another. (2) …… …… c) For each method given in part a) and part b), explain how the pathogens are passed from one organism to another. (4) …… …… …… ……

Book Ref.	Spec. Ref.	Viral and Bacterial Diseases
	4.3.1.2 4.3.1.3	**Key information:** - The flu (influenza), measles, HIV and tobacco mosaic virus (TMV) are all examples of viral diseases. - Salmonella which causes food poisoning and Gonorrhoea (a sexually transmitted infection) are caused by bacteria.

1. Complete the table about viral diseases.

Disease	Affects humans or plants?	Symptoms	How is it spread?	How can it be prevented or treated?
Measles				
HIV				
TMV			N/A	N/A

2. Complete the table about bacterial diseases.

Disease	Symptoms	How is it spread?	How can it be prevented or treated?
Salmonella			
Gonorrhoea			

Prove It!

TMV destroys chloroplasts in the leaf.

Explain how this could affect the growth of the plant.

(3)

Microbes and Health

Book Ref.	Spec. Ref.	Fungal and Protist Diseases
	4.3.1.4 4.3.1.5	**Key information:** - Rose black spot is a fungal disease affecting plant growth. - Malaria is caused by protists.

1. Complete the table about fungal and protist diseases.

Disease	Affects humans or plants?	Caused by protist or fungus?	Symptoms	How is it spread?	How can it be prevented or treated?
Rose black spot					
Malaria					

Prove It!

Pathogens cause infectious diseases in animals and plants.

(a) Draw **one** line from each disease to the type of pathogen that causes the disease.

Disease	Type of pathogen
Gonorrhoea	Bacterium
Malaria	Fungus
Measles	Protist
	Virus

Microbes and Health	
Book Ref.	**Spec. Ref.**
	Human Defence Systems

4.3.1.6

1. Complete the table to summarise the defence systems of the human body:

Body Part	How it defends against pathogens
Skin	
Nose	
Trachea and bronchi	
Stomach	

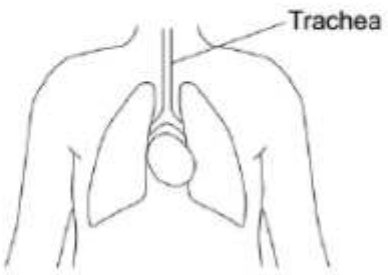
2. **Describe** the 3 ways which white blood cells defend the body against pathogens.

Prove It!

Some parts of the human body have adaptations to reduce the entry of live pathogens.

Look at **Figure 1**.

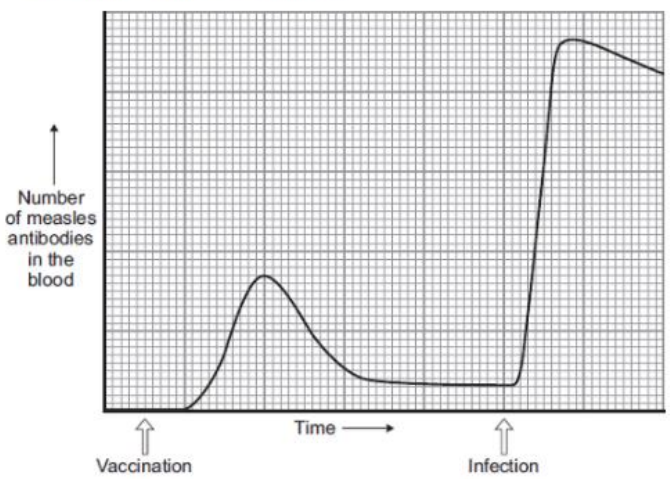
Figure 1



Explain how the trachea is adapted to reduce the entry of live pathogens.

(3)

Microbes and Health		
Book Ref.	**Spec. Ref.**	**Vaccination**

	4.3.1.7	**Key information:** - Spread of pathogens can be reduced by vaccinating a large amount of the population. - A vaccine prevents an individual becoming infected with and spreading a specific pathogen. - Vaccinations work by introducing small amounts of dead/inactive pathogens into the body causing the white blood cells to respond.
		1. What does a vaccination contain? 2. **Describe** how a vaccination protects a person from becoming infected by a specific pathogen. 3. **Evaluate** the idea that it should be compulsory for all parents to get their child vaccinated.
		Prove It!
		(ii) A few weeks after the vaccination, the child becomes infected with measles viruses from another person. The graph shows the number of measles antibodies in the child's blood from before the vaccination until after the infection.  More measles antibodies are produced after the infection than after the vaccination. 1. Describe other differences in antibody production after infection compared with after vaccination. (3) 2. Vaccination against measles will not protect a child against rubella. Why? (1) 3. What is the advantage of protecting a large proportion of the population against measles? (1)
		Microbes and Health
Book Ref.	**Spec. Ref.**	**Antibiotics and Painkillers**

	4.3.1.8	1. What is an antibiotic? Give an example. 2. Why are doctors being encouraged to reduce the amount of antibiotics they are prescribing? 3. Why can antibiotics not be used to treat the flu? 4. Why is it difficult to create a drug that kills the flu? 5. What is a painkiller? How is it different to an antibiotic?
		Prove It!
		Antibiotics are used to treat bacterial infections, but not viral infections. (a) Explain why antibiotics are **not** effective against viral infections. .... **(2)** (b) New strains of bacteria have developed that are resistant to antibiotics. There is no effective treatment against these resistant strains. What must be done to make sure we will be able to treat bacterial infections in the future? .... **(2)**

Microbes and Health

Book Ref.	Spec. Ref.	Discovery and development of drugs
	4.3.1.9	

1. Complete the table to show where some of today's drugs originated from.

Name of Drug	What is it used to treat?	Where did it originate from?
Digitalis		
		Willow
	Bacterial infections	

2. **State** 3 factors drugs are tested for before being given to the public. Explain what each of these terms mean.

3. What happens in pre-clinical testing?

4. **Outline** what happens in clinical trials.

5. Clinical trial results must be peer-reviewed by independent scientists. What are independent scientists and why must this work be peer reviewed?

Prove It!

After the outbreak began, drug companies started to develop drugs and vaccines for EVD.

A drug has to be thoroughly tested and trialled before it is licensed for use.

Testing, trialling and licensing new drugs usually takes several years.

Draw **one** line from each word about drug testing to the definition of the word.

Word about drug testing	Definition
Dose	Side effects making the person ill
Efficacy	The concentration of the drug to be used and how often the drug should be given
Toxicity	Whether the drug works to treat the illness

(2)

The results of drug testing and drug trials are studied in detail by other scientists.

Only then can the results be published by the drug company.

Suggest **one** reason why the results are studied by other scientists.

.....

.....

(1)

Microbes and Health

Book Ref.	Spec. Ref.	Producing monoclonal antibodies and their uses (biology only - HT only)
	Triple and HT only 4.3.2.1 4.3.2.2	1. What is a monoclonal antibody? 2. How are monoclonal antibodies produced? 3. Complete the table to explain how monoclonal antibodies are used:

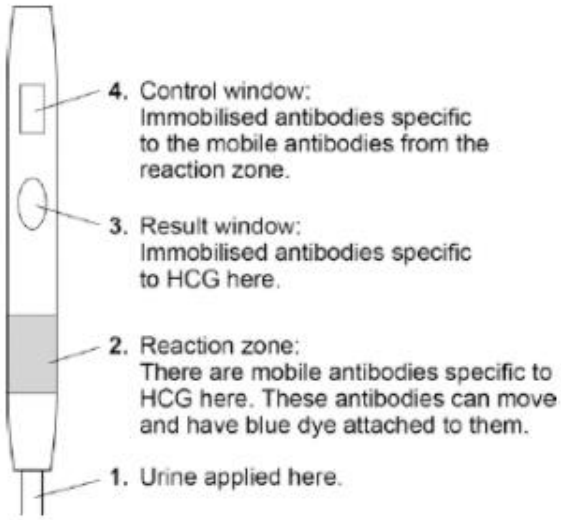
Use	How does it work?
Pregnancy tests	
Detecting pathogens in the blood	
Identifying specific molecules in a tissue	
Treating cancer	

4. Why are monoclonal antibodies not being used as widely as scientists first thought they would be?

Prove It!

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.

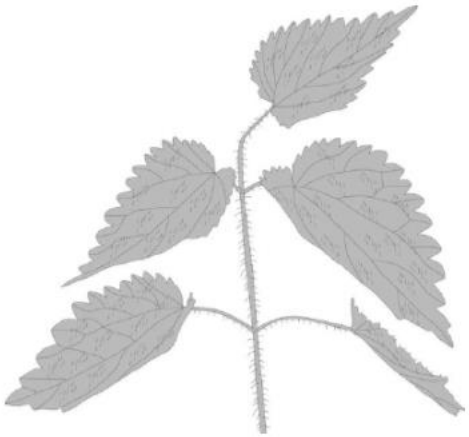
Explain how the pregnancy test strip works to show a positive result.

(6)

Microbes and Health		
Book Ref.	**Spec. Ref.**	**Detection and identification of plant diseases (biology only - HT only)**
	HT and triple only 4.3.3.1	**1. List** 7 ways plant diseases can be detected. **2. List** 3 ways an identification of a plant disease can be made. **3.** Other than pathogens, how else can plants get infected? Give an example. **4. Complete** the table to summarise the problems plants have with mineral deficiency:

Ion that is deficient	Problem caused	Process interfered with
Nitrate		
Magnesium		

		Prove It!
		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)**

Microbes and Health		
Book Ref.	**Spec. Ref.**	**Plant defence responses**
	4.3.3.2	1. **Describe** in detail 3 physical defence responses that plants have to resist invasion of microorganisms. 2. **Describe** 2 chemical plant defence responses. 3. **Suggest** 3 mechanical adaptations plants may have to defend against being eaten by animals.
		Prove It!
		Plants have adaptations to help defend themselves and to help them survive. **Figure 1** shows a nettle plant. **Figure 1**  (a) Explain how the nettle is adapted for defence and protection.

Graph drawing

Top tips for getting full marks in graph-drawing questions:

1. Axes should be drawn in pencil.

2. Labels (including units!) should only be written in pen when you are sure of them.

3. Your scale should be even – 0.1, 0.2, 0.3… or 10, 20, 30… or 100, 200, 300 .... ***not*** 18, 22,13.

4. When you draw a bar chart the bars should be of equal width.

5. If you draw a line graph then a line or curve of best fit should show the pattern of the points – they should not be connected dot to dot.

6. Your graph needs to take up over half of your graph paper. If it doesn't then you should redo your scale.

Important terms

Independent variable: this is the variable you have chosen to change. **These are always drawn on the x-axis.**

Dependent variable: this changes when you have changed the independent variable. It *depends* on the independent variable. **These are always drawn on the y-axis.**

Categoric variable: this is the names of groups such as eye colour or type of energy resource. You draw a **bar chart** to represent this type of variable.

Continuous variable: this is data such as temperature or time which can be any value. You draw a **line graph** to represent this type of variable.

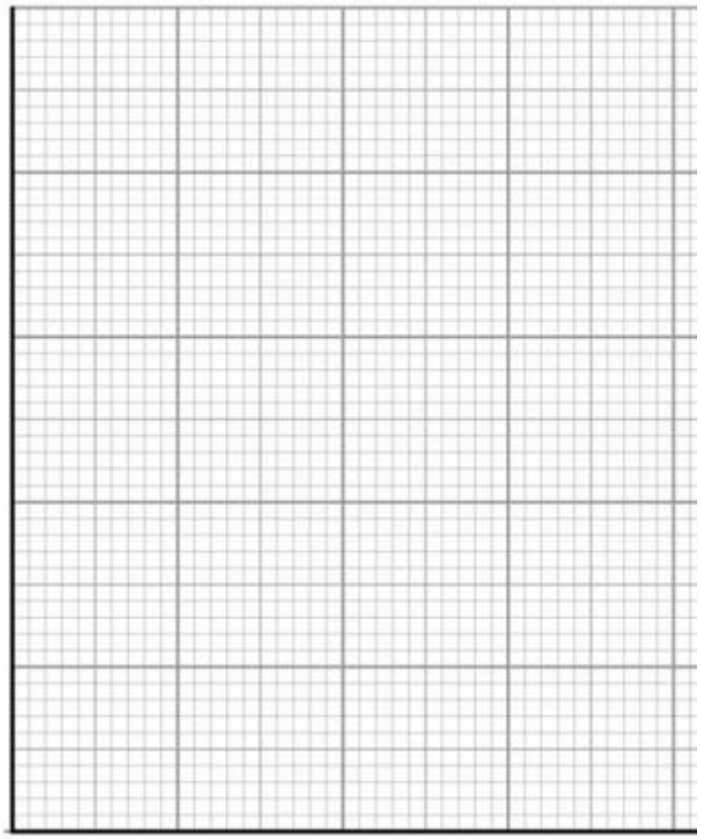
Graph drawing practice

1. Bar chart

A student carried out a survey to find out the blood group of each student in Year 11. He calculated the % of students in each blood group, as shown in the table below.

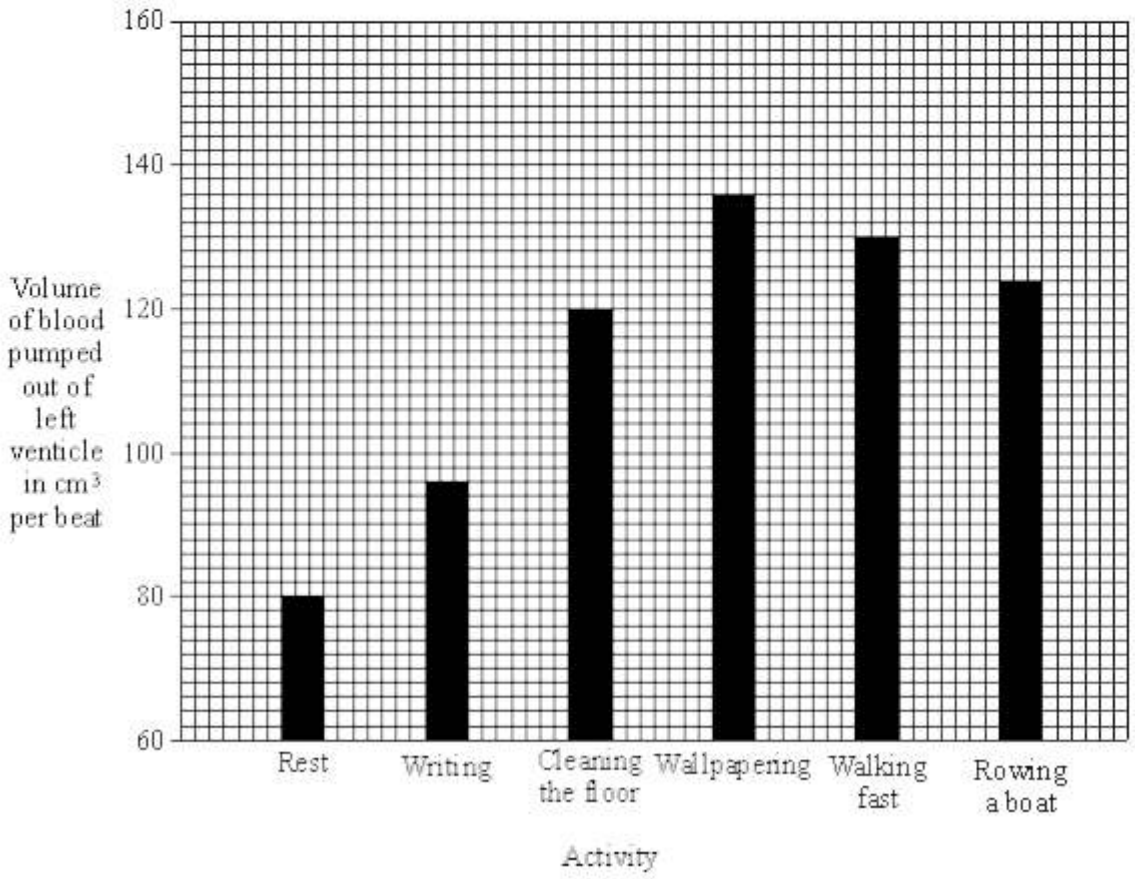
Blood group	% students
A	41
B	9
AB	4
O	46

Plot a bar graph of the data shown above.



Prove it!

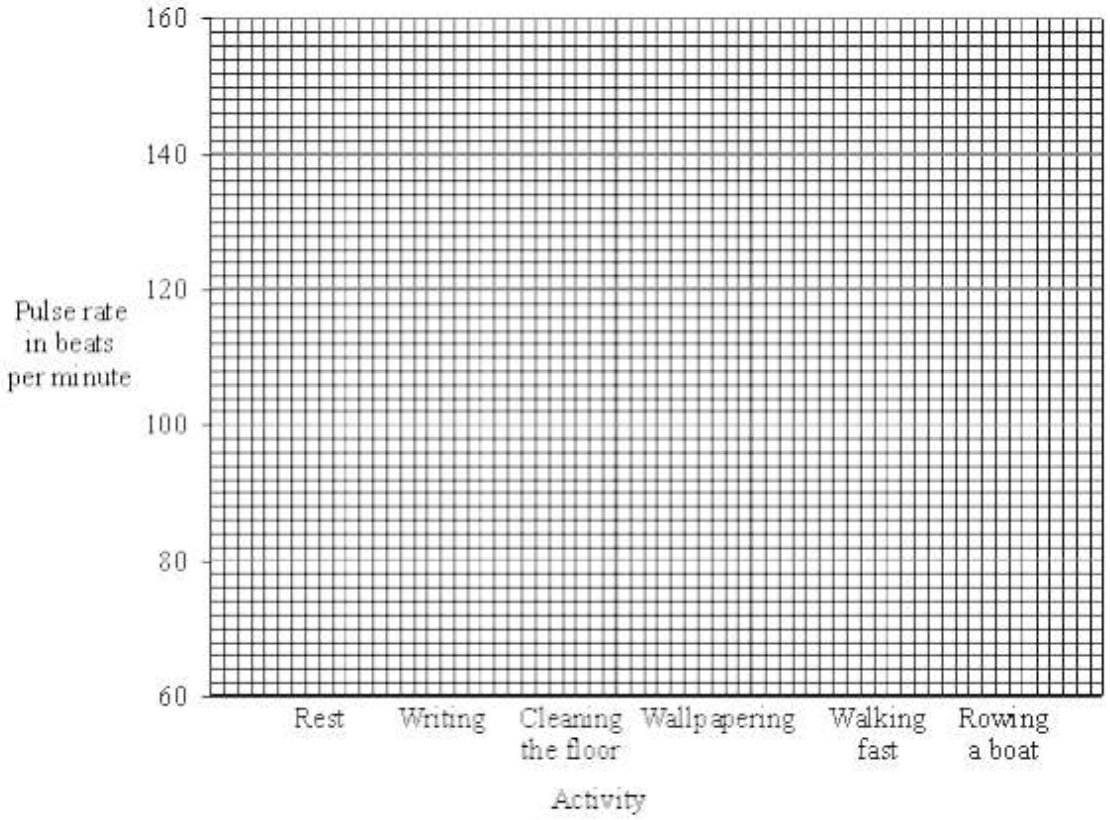
(a) The volume of blood pumped out of the left ventricle at each beat was measured for a person during six different activities. These activities showed an increasing energy demand, with rest requiring the least energy and rowing a boat the most. The results of these measurements are shown on the bar chart.



(i) The pulse rate was also measured for the person during the same activities. The table shows the results that were obtained.

Activity	Pulse rate in beats per minute
Rest	70
Writing	85
Cleaning the floor	100
Wallpapering	120
Walking fast	132
Rowing a boat	153

On the graph paper below draw a bar chart of the results obtained for the measurements of the pulse rate.



(2)

(ii) Undertaking activities with increasing energy demand has an effect on the volume of blood pumped from the left ventricle (per beat) and on the pulse rate. What do the bar charts show these effects to be? Use only information shown in the bar charts in your answer.

.....

.....

.....

(2)

(b) The pulse rate changed when the activity changed. Explain the reason for this.

.....

.....

.....

(2)
(Total 6 marks)

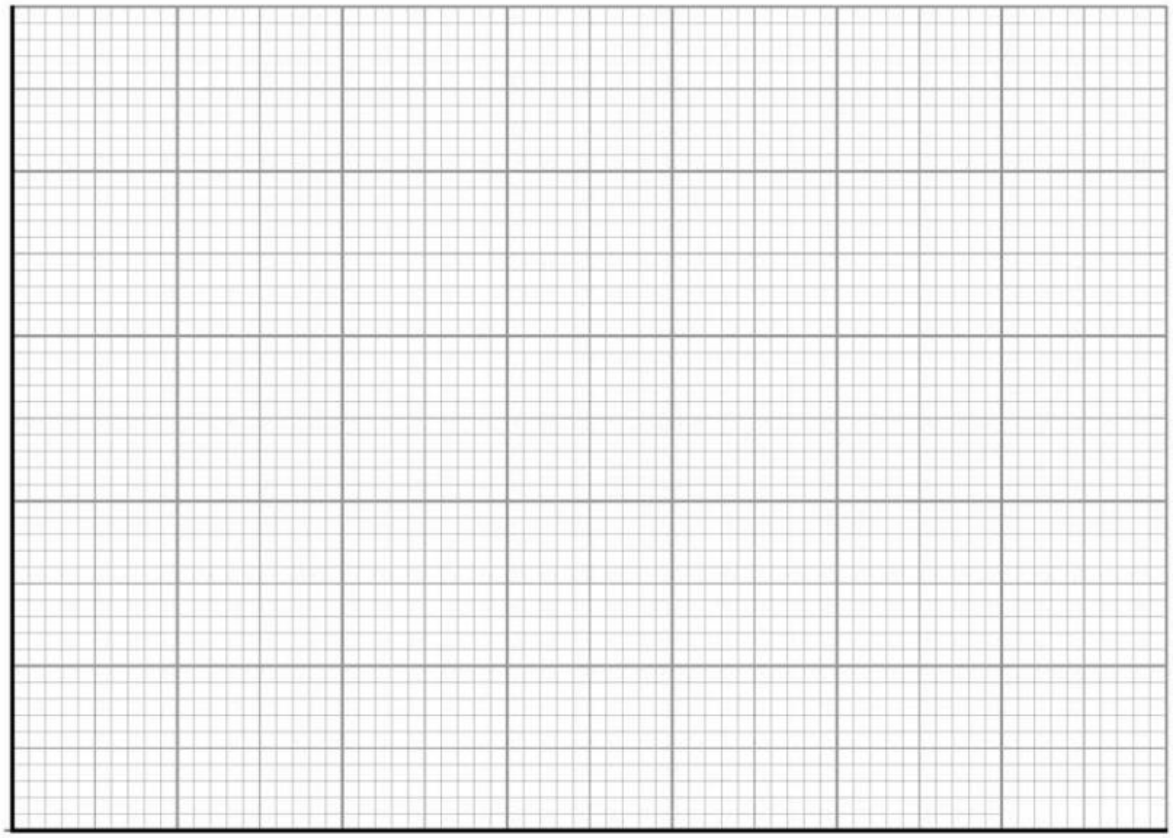
2. Line graph

A student investigated the effect of temperature on the rate of photosynthesis.

Her results are shown in the table below.

Temperature in °C	Number of bubbles produced in one minute
5	7
10	15
15	21
20	24
25	24

Draw a line graph of the data shown above.



Prove it!

(a) (i) What name is given to an enzyme which catalyses the breakdown of protein?

.....

(1)

(ii) What product is formed when protein is broken down by the enzyme?

.....

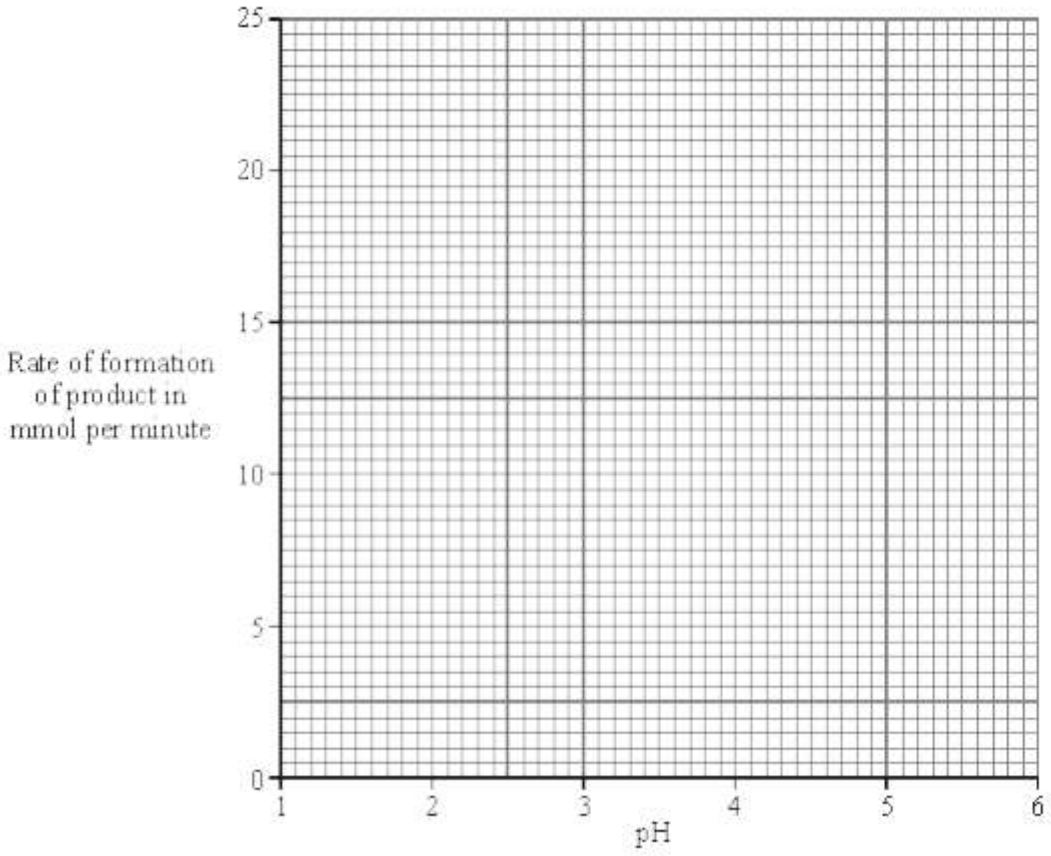
(1)

The table shows the effect of pH on the activity of an enzyme which catalyses the breakdown of protein.

pH	1.0	2.0	3.0	4.0	5.0
Rate of formation of product in mmol per minute	10.5	23.0	10.5	2.5	0.0

(b) Draw a graph of the data in the table.

(b) Draw a graph of the data in the table.



(3)

(c) The enzyme is produced by the human digestive system.

(i) At what pH does this enzyme work best? .....

(1)

(ii) Suggest which part of the digestive system produces this enzyme.

.....

(1)

(d) Why is it necessary to break down proteins in the digestive system?

.....

.....

.....

.....

.....

.....

(3)
(Total 10 marks)

3. Pie chart

The table below shows the world energy demand and sources of energy in 2013.

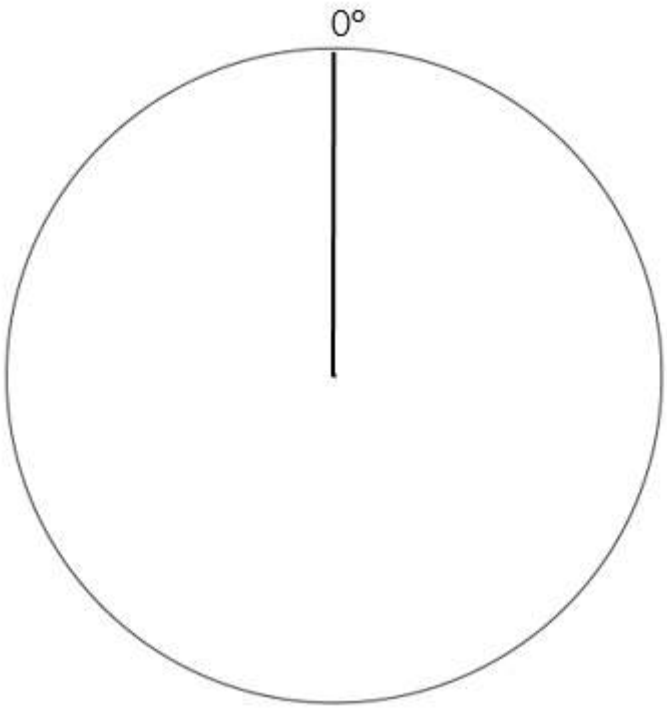
Energy source	%	Calculation	Degrees of a circle (°)
Coal	31	$(^{31}/_{100})$ x 360	112
Gas	24		
Oil	31		
Nuclear	4		
Hydroelectricity	7		
Other renewables	3		

Draw a pie chart of the data shown above.

Help! How do I work out the size of each part of the pie chart?

- To draw a pie chart, we need to represent each part of the data as a proportion of 360, because there are 360 degrees in a circle.
- For example, if 31% of world energy demand comes from coal, we will represent this on the circle as a segment with an angle of: $(^{31}/_{100})$ x 360 = 111.6, or 112°.
- *Complete the additional columns of the table shown in red above.*
- Once you have done this, check that all the values you have calculated add up to 360°!

Now draw your pie chart!



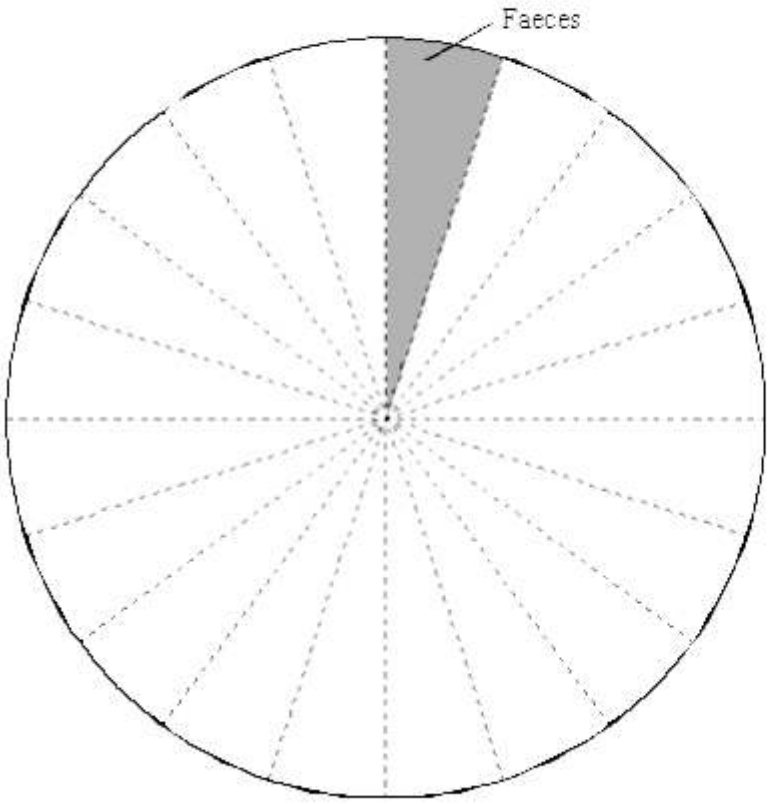
Prove it!

The table shows how much water is lost in different ways from a student's body.

Way in which water is lost	Percentage of total
Breath	15
Faeces	5
Sweat	50
Urine	30

(a) Complete the pie chart.

One part has been done for you. Remember to label the pie chart.



(3)

(b) The table is about waste products which are removed from the student's body.

Complete the table by using the correct words from the box.

amino acids	breath	circulation	digestion	fatty acids
glucose	respiration	sweat	urine	

Waste product	How it is produced	How it leaves the body
carbon dioxide	by	in .....
urea	from	in .....

(4)
(Total 7 marks)

Reflections Page

Each time you come across something you find hard, write it down here and ask your teacher to help you with it.

Topic I Found Hard	Page Number	What was difficult about this?	Tick when you have got help from your teacher