

ALL Unit 1 Biology practice questions and answers

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Total Marks

/381

1 (a) Different groups of organisms have different features.

Complete the table by placing a tick [✓] in the boxes to show which features are present in each group of organisms.

Some have been completed for you.

Group	Cells have a cell wall	Cells are eukaryotic	Can carry out saprotrophic nutrition
Fungi			
Bacteria	✓		
Plant		✓	

Answer

The completed table is as follows...

Award 1 mark for each correct **row**:

Group	Cells have a cell wall	Cells are eukaryotic	Can carry out saprotrophic nutrition
Fungi	✓	✓	✓
Bacteria	✓		✓
Plant	✓	✓	

[Total: 3 marks]

(3 marks)

(b) Plants are able to store carbohydrates in their cells as starch or sucrose.

(i) Explain how plants are able to synthesise starch.

(2)

(ii) Describe the test that could be carried out to determine whether or not a plant cell contains starch.

(2)

Answer

(i) Plants synthesise starch by...

- (Joining together) glucose; [1 mark]
- (Excess) from photosynthesis; [1 mark]

Starch is a biological molecule that is made from many **molecules of glucose joined together** in a chain. Plants **make glucose during photosynthesis** and then the molecules of glucose are **joined together to produce starch**.

(ii) A test to identify starch in a plant cell is...

- Add iodine; [1 mark]
- Cells should turn blue/black in the (presence of starch); [1 mark]

[Total: 4 marks]

(4 marks)

(c) One of the features of plant cells is that they contain chloroplasts.

Suggest why root hair cells in plants do not contain chloroplasts.

Answer

Root hair cells do not contain chloroplasts because...

Any **two** of the following:

- Chloroplasts absorb light energy for photosynthesis; [1 mark]
- Root hair cells do not have access to light / are underground / do not carry out photosynthesis; [1 mark]
- Chloroplasts are not involved in the absorption of water/minerals from the soil (which is the role of root hair cells); [1 mark]

[Total: 2 marks]

It is also important to remember that chloroplasts are not unique to plant cells, for example, some protists can also contain chloroplasts.

(2 marks)

2 (a) Which of the following statements relating to respiration is **not** correct?

☐	A	Respiration produces ATP
☐	B	Respiration involves the breaking of bonds within biological molecules
☐	C	Respiration occurs in animals but not in plants
☐	D	Respiration releases energy in the form of heat

Answer

The correct answer is C because...

Respiration is one of the MRS C GREN life processes, and it occurs (in some form) in the cells of **all living organisms**. It is an essential chemical reaction that releases the energy needed by organisms for survival. The confusion around plants often comes from the fact that plants carry out photosynthesis; remember that **plants carry out respiration as well as photosynthesis** (in fact photosynthesis produces the glucose that plants then use in respiration).

A is a correct statement because the energy released during respiration is then stored within the bonds of a molecule known as ATP. The energy can be released quickly from ATP for any process that needs it.

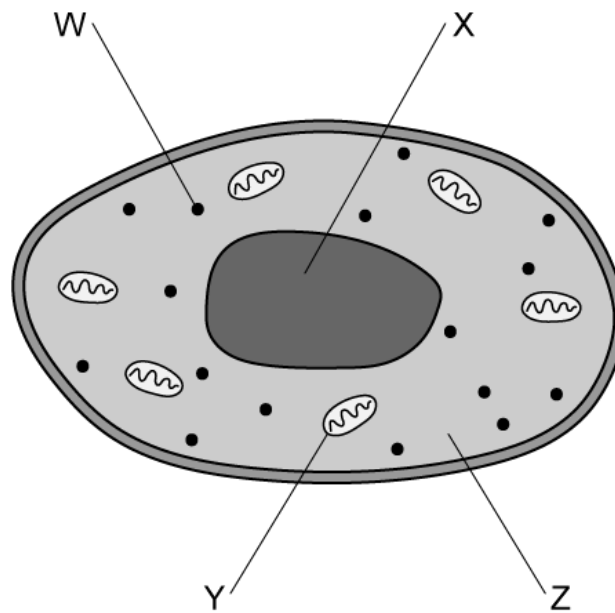
B is a correct statement because the bonds in glucose are broken during respiration, releasing the chemical energy stored within them.

D is a correct statement because some of the energy released during respiration is in the form of heat. This heat energy can be used by some organisms to assist in the regulation of body temperature

[Total: 1 mark]

(1 mark)

(b) The diagram shows an animal cell.



(i) Identify the letter, from **W-Z**, that indicates the sub-cellular structure where respiration takes place.

(1)

(ii) Name the sub-cellular structure identified in part (i),

(1)

Answer

(i) The sub-cellular structure where respiration takes place is....

- Y; [1 mark]

(ii) The name of the structure is the...

- Mitochondrion/mitochondria; [1 mark]

[Total: 2 marks]

(2 marks)

(c) Complete the following sentence about respiration:

glucose chemical protein cell muscle temperature nerve

Respiration releases energy from The energy release can be used in life processes such as reactions, contraction and maintaining a constant body

Answer

The sentence should be completed as follows...

- Respiration releases energy from **glucose**; [1 mark], to be used in life processes such as **chemical**; [1 mark] reactions, **muscle**; [1 mark] contraction and maintaining a constant body **temperature**; [1 mark].

[Total: 4 marks]

The energy stored in glucose is **chemical energy**. This energy is transferred to other forms of energy once it is released during the process of respiration.

(4 marks)

- (d) Complete the table with a (✓) or a (X) to show the products and reactants of aerobic respiration in animals.

	Product	Reactant
Oxygen		
Carbon dioxide		
Lactic acid		
Glucose		
Water		
Ethanol		

Answer

The table should be completed as follows...

Award 1 mark for each correct **column**:

	Product	Reactant
Oxygen	X	✓
Carbon dioxide	✓	X
Lactic acid	X	X
Glucose	X	✓
Water	✓	X
Ethanol	X	X

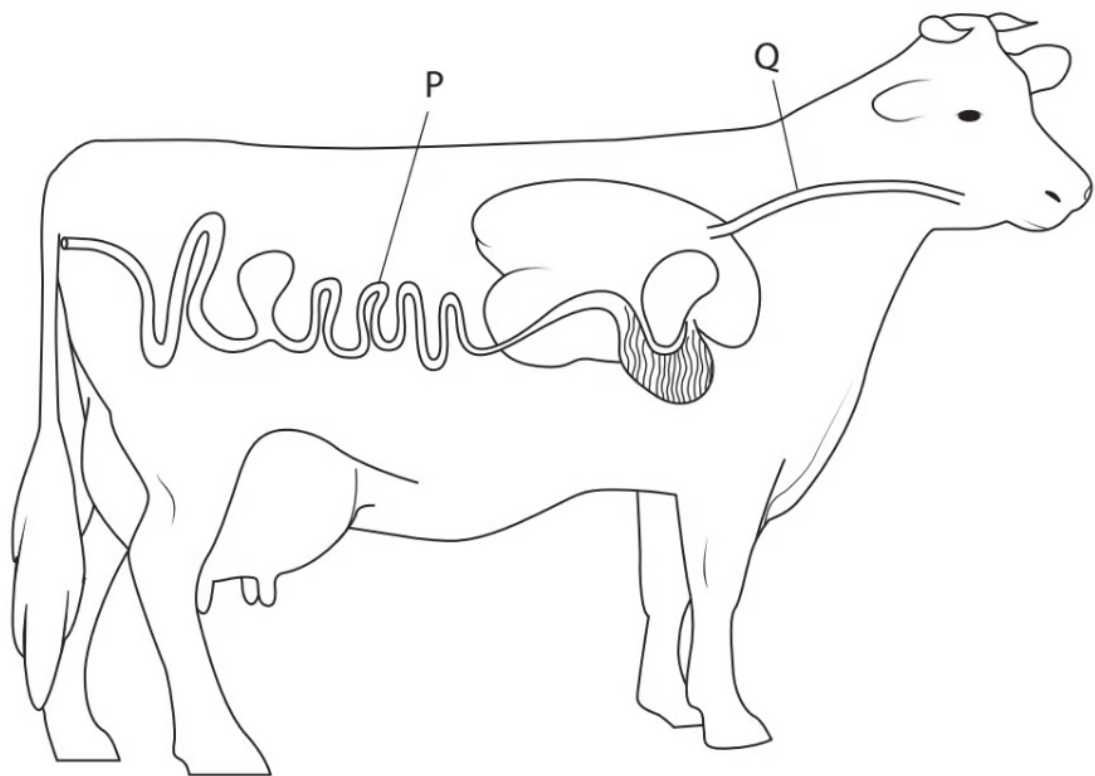
[Total: 2 marks]

It is important to make sure you read the instructions carefully and fill every box with either a (✓) or a (X). Leaving blank spaces will result in the marks being lost.

You must also note here that the question is asking you about **aerobic respiration in animals**; answers relating to anaerobic respiration or respiration in other groups of organisms will be incorrect.

(2 marks)

3 (a) The diagram shows part of the digestive system of a cow.



Name the parts labelled **P** and **Q**.

Answer

The parts of the cow labelled **P** and **Q** are...

- **P** = ileum / small intestine; [1 mark]
- **Q** = oesophagus; [1 mark]

Reject large intestine for marking point 1.

[Total: 2 marks]

(2 marks)

(b) The cow's stomach contains microorganisms that digest plant cell walls.

Suggest why these microorganisms are useful to a cow.

Answer

Microorganisms are useful to a cow because...

Any **two** of the following:

- Cellulose (in the plant cell walls is broken down); [1 mark]
- (This releases) glucose / energy; [1 mark]
- (Glucose is used in / energy is released during) respiration; [1 mark]

Allow "bacteria produce cellulase" for marking point 1.

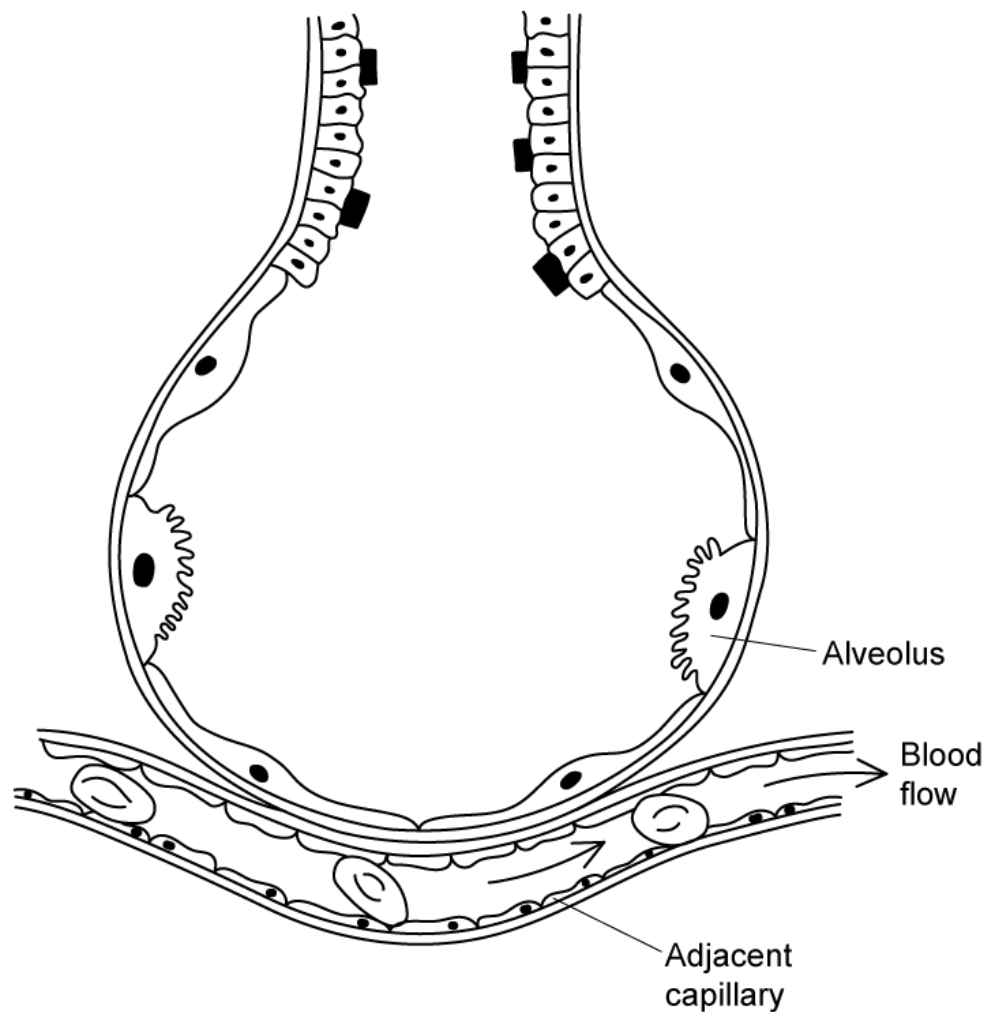
Reject references to energy being produced rather than released.

[Total: 2 marks]

The cow's digestive system does not contain enzymes to break down and digest the cellulose contained in plant cell walls. Therefore the microorganisms, which do contain these enzymes, are useful to ensure that the cellulose can be broken down and the products, namely glucose, used by the cow.

(2 marks)

4 (a) The diagram below shows an alveolus (plural alveoli).



Explain one feature seen in the alveolus in the diagram which allows efficient gas exchange.

Answer

The alveolus is adapted for efficient gas exchange as follows...

- Good blood supply / close to a capillary; [1 mark]
- To maintain/ensure a concentration gradient (between the air and the blood); [1 mark]

OR

- Alveolar/alveolus wall is one cell thick; [1 mark]

- To minimise diffusion distance / reduce the distance for the diffusion of gases (between the air and the blood); [1 mark]

Reject references to the alveolar cell wall.

[Total: 2 marks]

Be careful with questions like this which request you to identify things that are **clearly visible**. There are other characteristics of the alveoli and breathing system which aid gas exchange, e.g. many alveoli increase the surface area, but we cannot see them in the image so no credit can be awarded.

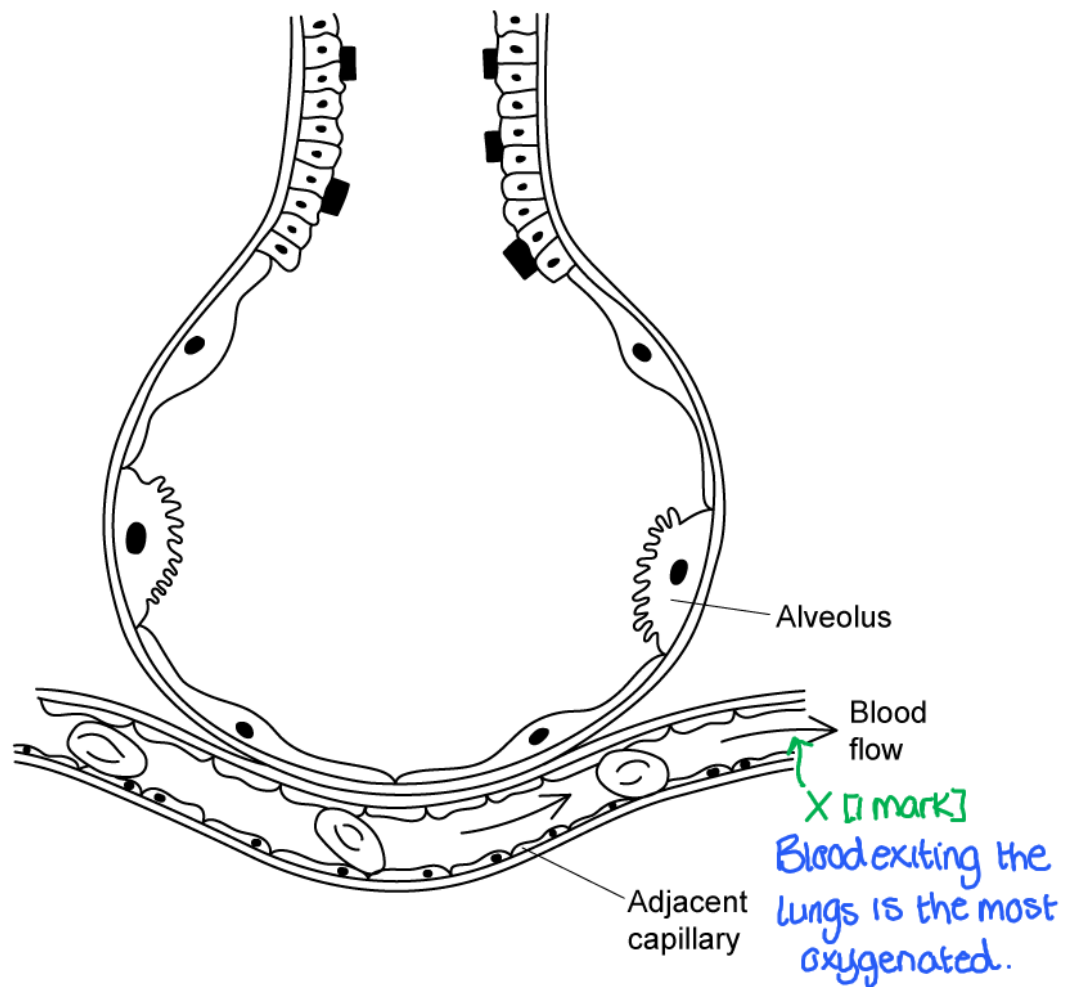
Beware of descriptions such as 'thin alveolar cell wall'; it is not cell walls that we are concerned with, but the thin **layer of cells** that makes up the **wall of the alveolus**. Quite apart from this, alveoli cells are animal cells and do not have cell walls!

(2 marks)

- (b)** Using an 'X' on the diagram in part (a), indicate where the oxygen content of the blood is the highest.

Answer

The oxygen content of the blood is highest at the position marked below...



[Total: 1 mark]

(1 mark)

- (c) The estimated surface area of the lung system of a new-born baby is 4.2 m^2 ; this is around one twentieth of the overall surface area of a typical adult's lungs.

Calculate the overall surface area of a typical adult's lungs.

Answer

The surface area of a typical adult's lungs is calculated as follows:

- $4.2 \text{ (m}^2\text{)} \times 20$ OR $4.2 \text{ (m}^2\text{)} \div \frac{1}{20}$; [1 mark]

- 84 m^2 ; [1 mark]

[Total: 2 marks]

- (d) There is estimated to be a surface area of 4.2 m^2 in the overall lung system of a typical new-born baby, around one twentieth of the overall surface area of a typical adult's lungs.

Calculate the overall surface area of a typical adult's lungs.

[2]

Multiply by twenty: [1 mark]

$$4.2 \times 20 = \underline{84 \text{ m}^2} \quad [1 \text{ mark}]$$

OR divide by $\frac{1}{20}$ [1 mark]

$$\frac{4.2}{\frac{1}{20}} = \underline{84 \text{ m}^2} \quad [1 \text{ mark}]$$

Hopefully you will know to look for a much larger surface area for the adult so you will choose correctly whether to $\times$ or $\div$

[Total: 2 marks]

This equates to the often-quoted statistic that the adult lungs' surface area is about

half the size of a tennis court; a singles tennis court is about 196 m² in area.

(2 marks)

(d) The following list contains structures found within the breathing system.

structure	order
bronchus	
nasal cavity	
alveolus	1
trachea	
bronchioles	

Complete the table by numbering the structures to show the sequence in which air passes through them during an **exhalation**. The first structure has been numbered for you.

Answer

The sequence in which air passes through the structures during an exhalation is...

structure	order
bronchus	3
nasal cavity	5
alveolus	1
trachea	4
bronchioles	2

[Total: 1 mark]

It's crucial that you read the question right through to the end; if you miss the word **exhalation** you may decide to order the steps for inhalation, and even with a solid knowledge of the various organs your list will be the wrong way around.

(1 mark)

(e) Describe the actions of the intercostal muscle and diaphragm during inhalation.

Answer

The actions of the intercostal muscles and diaphragm during inhalation are as follows...

- The diaphragm contracts / moves downwards/flattens; [1 mark]
- The (external) intercostal muscles contract / pull the ribs up/out; [1 mark]

[Total: 2 marks]

(2 marks)

5 (a) Bread contains starch.

Describe how you would test a piece of bread to show it contains starch.

Answer

To test a piece of bread to show it contains starch you would...

- (Use/add) iodine (solution); [1 mark]
- (Which would turn) blue-black/ blue / black (if starch was present); [1 mark]

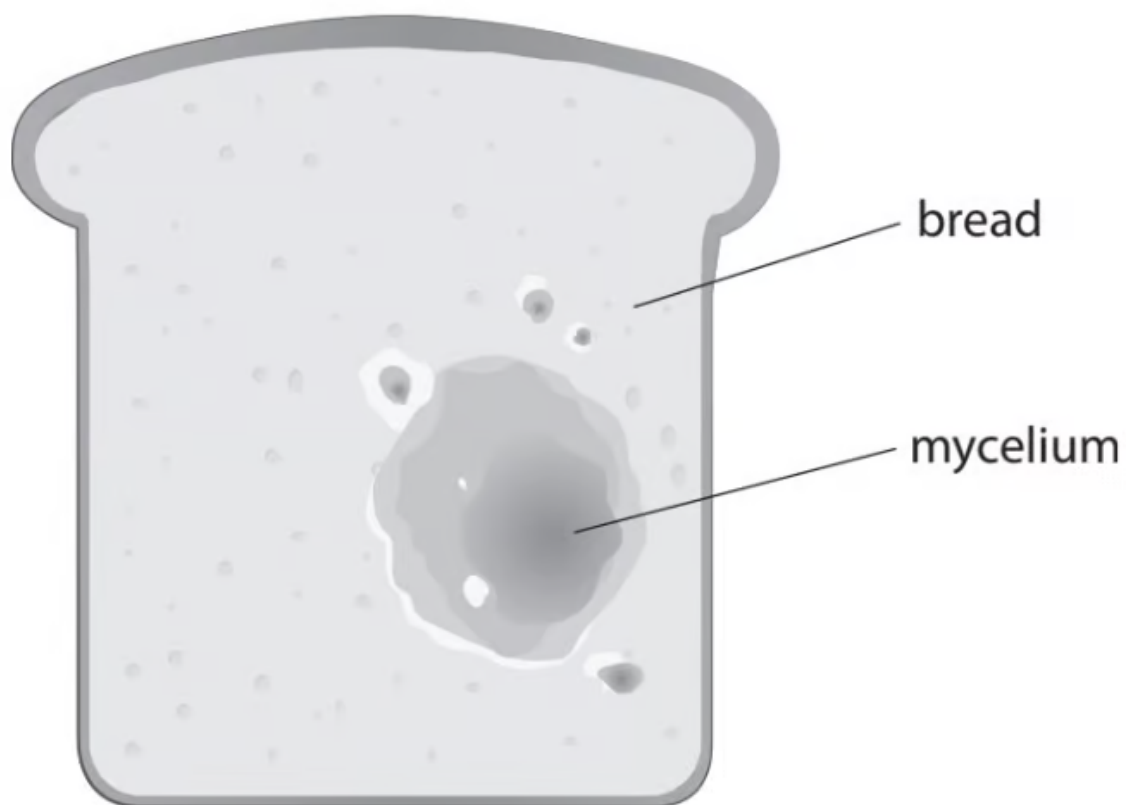
Accept purple for blue-black.

[Total: 2 marks]

You would also get the mark if you described the colour change as purple but the correct colour that examiners look for is blue-black.

(2 marks)

(b) The diagram shows the mycelium of an organism growing on a piece of bread.



(i) Which type of organism is shown growing on the bread?

(1)

☐	A	Bacterium
☐	B	Fungus
☐	C	Protoctist
☐	D	Virus

(ii) Which enzyme is released by the organism to digest starch?

☐	A	Amylase
☐	B	Ligase
☐	C	Lipase
☐	D	Protease

Answer

(i) **The correct answer is B because...**

Multicellular fungi are mainly made up of thread-like structures known as hyphae that contain many nuclei and are organised into a network known as a **mycelium**.

A is incorrect because mycelium is not found in bacterial cells.

C is incorrect because mycelium is not found in protocista.

D is incorrect because mycelium is not found in a virus

(ii) **The correct answer is A because...**

Amylase is a type of carbohydrase enzyme that digests starch into maltose.

B is incorrect because ligase is an enzyme that can catalyse the joining (ligation) of two large molecules by forming a new chemical bond.

C is incorrect because lipase is an enzyme that digests fats (lipids) into fatty acids and glycerol.

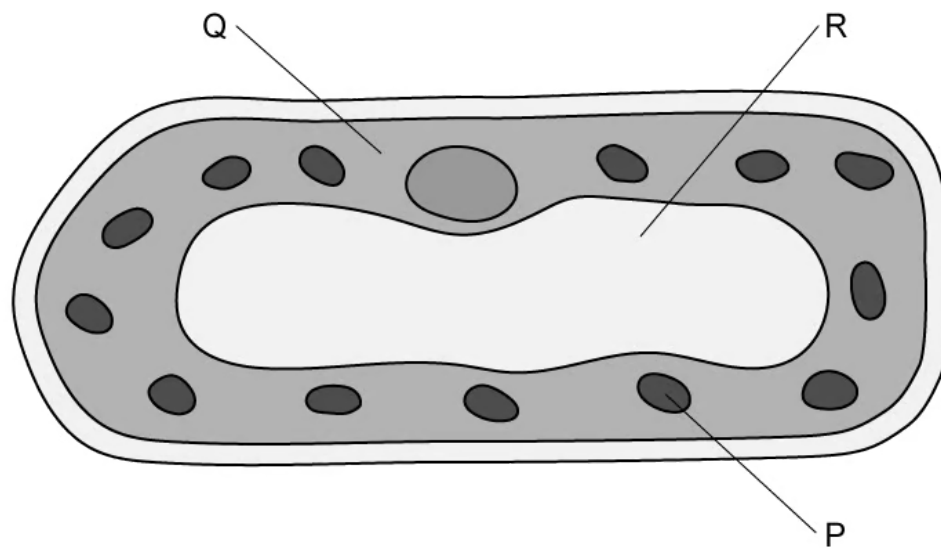
D is incorrect because proteases are a group of enzymes that digest proteins into amino acids.

Just because this question is not about humans, the same principles and knowledge applies to enzymes here. All living organisms make enzymes to support their survival.

[Total: 2 marks]

(2 marks)

6 (a) The diagram below shows an image of a plant cell.



Name structures **P**, **Q** and **R**.

Answer

Structures P, Q and R are....

- P = Chloroplast **OR** mitochondria; [1 mark]
- Q = Cytoplasm; [1 mark]
- R = Vacuole; [1 mark]

[Total: 3 marks]

In a simplistic diagram, such as that shown, the organelle labelled P could be either mitochondria (the site of respiration) or a chloroplast (the site of photosynthesis).

(3 marks)

(b) (i) Name one structure that is visible in the diagram that you did not identify in your answer to part (a).

(1)

(ii) State the function of the structure named in part (i)

(1)

Answer

(i) A structure visible in the diagram that was not identified in part (a) could be...

Any **one** of the following:

- Cell wall; [1 mark]
- Cell (surface) membrane; [1 mark]
- Nucleus; [1 mark]

Note that the question asks you to name a structure that is **visible in the diagram**, so you will not be credited for naming ribosomes or mitochondria. These structures are too small to be visible in the diagram shown.

(ii) The role of the structure named in part (i) is...

One relevant point from the following:

- (Cell wall =) provides strength/support/shape to the cell (and to the plant as a whole); [1 mark]
- (Cell membrane =) controls what passes into and out of the cell **OR** separates the cell contents from its surroundings; [1 mark]
- (Nucleus =) contains the DNA/genetic material/chromosomes (which controls the cell); [1 mark]

Do not accept 'controls the cell' without reference to DNA for the role of the nucleus.

[Total: 2 marks]

(2 marks)

(c) Which of the following structures is not found in a prokaryotic cell?

☐	A	A cell membrane
☐	B	Chloroplasts
☐	C	Plasmids
☐	D	Circular DNA

Answer

The structure not present in prokaryotic cells is B.

Prokaryotic cells do not contain internal membranes, so they cannot contain chloroplasts, which are surrounded by membrane.

Prokaryotic cells do have a cell wall (A), though the cell wall is different to plant cell walls as it is not made of cellulose.

Prokaryotic cells do contain plasmids (C), small loops of DNA.

Prokaryotic cells do contain circular DNA (D), though this DNA is not contained inside a nucleus but floats free in the cytoplasm.

(1 mark)

7 (a) Plant roots absorb water from soil.

This water is transported to the leaves and then moves into the air.

Which of these processes is used to absorb water from the soil?

☐	A	Active transport
☐	B	Diffusion
☐	C	Evaporation
☐	D	Osmosis

Answer

The correct answer is D because...

Osmosis is always how water moves from the soil into the roots. Osmosis involves the movement of water from a high water potential area to a low water potential across a partially permeable membrane.

A is incorrect because water is not transported by the process of active transport.

B is incorrect because osmosis is a form of diffusion but water specifically moves by osmosis.

C is incorrect because water does not evaporate from the soil into the roots of the plant. The water in the roots of the plant is liquid, not a gas.

[Total: 1 mark]

(1 mark)

(b) Name the tissue that transports water to the leaves.

Answer

The tissue that transports water to the leaves is...

- Xylem/xylem vessels; [1 mark]

[Total: 1 mark]

(1 mark)

(c) Give two uses of water in a plant.

Answer

Two uses of water in a plant are...

Any **two** of the following:

- Support/turgor / maintaining the rigid structure of plant cells; [1 mark]
- Photosynthesis; [1 mark]
- Cooling; [1 mark]
- Reactions/solvent / transport of mineral ions/named mineral ion; [1 mark]

[Total: 2 marks]

Transpiration is not a *use* of water in the plants because it is how plants lose water, although it does contribute to cooling.

(2 marks)

8 (a) Organisms must transport substances to and from the external environment.

Identify **one** substance which cells must transport across the cell membrane to support cell functions.

Answer

A substance that cells must transport across the cell membrane might include:

Any **one** from the following:

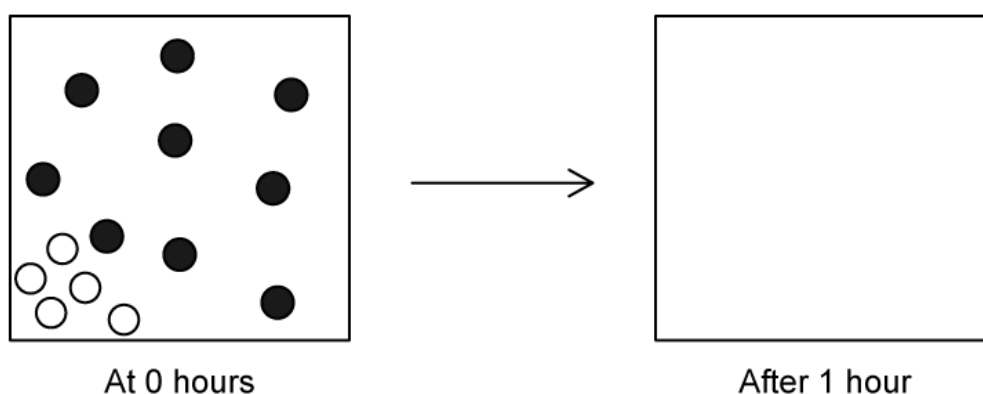
- Carbon dioxide / oxygen; [1 mark]
- Glucose / amino acids / fatty acids + glycerol; [1 mark]
- Mineral ions / water; [1 mark]

[Total: 1 mark]

There are many substances that cells need which exceed the list given in this mark scheme. The substances named in this question are key to the most fundamental processes that take place in cells, including photosynthesis and respiration.

(1 mark)

(b) The diagram shows particles of two gases.



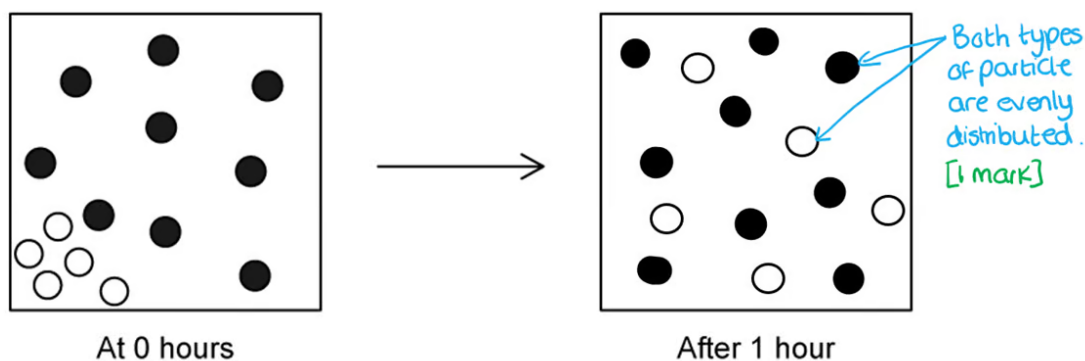
Complete the diagram by drawing the arrangement of the gas particles after 1 hour.

Answer

The gas particles should appear as follows:

- The particles should be evenly distributed in the space; [1 mark]

[Total: 1 mark]



(1 mark)

(c) Name the process shown in part (b).

Answer

The process in part (b) is...

- (Simple / gaseous) diffusion; [1 mark]

[Total: 1 mark]

This couldn't be osmosis as there are no water particles or partially permeable membrane.

(1 mark)

(d) Which of the following is an example of simple diffusion?

☐	A	Movement of water into the root of a plant
☐	B	Movement of mineral ions into the root of a plant
☐	C	Movement of oxygen into the leaf of a plant
☐	D	Movement of glucose into the epithelial cells of villi in the small intestine

Answer

The correct answer is C, movement of oxygen into the leaf of a plant.

B and **D** are both examples of where substances move from a low concentration to a higher concentration requiring the process of active transport.

A is referring to water molecules passing across a partially permeable membrane and therefore relates to osmosis.

[Total: 1 mark]

(1 mark)

- 9 (a) Which of the following correctly shows the levels of organisation in an organism in order of size from the smallest to the largest?

☐	A	Organelle, cell, organ, tissue, organ system
☐	B	Organelle, cell, tissue, organ, organ system
☐	C	Cell, organelle, tissue, organ, organ system
☐	D	Cell, tissue, organelle, organ, organ system

Answer

The levels of organisation from the smallest to the largest is **B**.

This is because organelles are found within cells, a group of cells makes up a tissue, a group of tissues makes up an organ, and several organs make up an organ system.

[Total: 1 mark]

(1 mark)

- (b) Define the term **organ**.

Answer

The term organ can be defined as follows...

- A group/collection of tissues...; [1 mark]
- ...working together to carry out a function; [1 mark]

[Total: 2 marks]

The term organ is one that you will be very familiar with, but it is essential that you can give the biological definition; an organ is a group of tissues that work together to perform a particular function, E.g. the heart contains muscle tissue, elastic tissue and connective tissue, all of which work together to pump the blood.

(2 marks)

(c) Name an example of an organ found in the following groups of organisms:

(i) Plants

(1)

(ii) Animals

(1)

Answer

(i) An example of an organ found in plants is...

Any **one** of the following:

- Stem; [1 mark]
- Root; [1 mark]
- Flower; [1 mark]
- Bulb; [1 mark]
- Tuber; [1 mark]
- Leaf; [1 mark]
- Fruit; [1 mark]

(ii) An example of an organ found in animals is...

Any **one** of the following:

- Brain; [1 mark]
- Skin; [1 mark]
- Heart; [1 mark]
- Lung; [1 mark]
- Liver; [1 mark]

- Kidney; [1 mark]
- Small / large intestine; [1 mark]
- Stomach; [1 mark]
- Eye; [1 mark]
- Ear;

Accept other examples of animal organs, e.g. from the reproductive system.

[Total: 2 marks]

There are many examples to choose from here, so make sure that you can name a few examples of organs in both plants and animals.

(2 marks)

- (d) Give two differences between organisms in the plant group and organisms in the animal group.

Answer

Differences between organisms in the plant and animal groups include...

Any **two** of the following:

- Plants carry out photosynthesis / have chloroplasts / make their own food **WHILE** animals do not / feed on other organisms; [1 mark]
- Plants have (cellulose) cell walls **WHILE** animals do not; [1 mark]
- Plants store carbohydrates as starch **WHILE** animals store carbohydrates as glycogen; [1 mark]
- Plants do not have a nervous system / nervous co-ordination **WHILE** animals do; [1 mark]
- Plants (usually) grow in one place / are immobile / not motile **WHILE** animals can (usually) move from place to place / are mobile/motile; [1 mark]

[Total: 2 marks]

This question covers content from section 1 on the variety of living organisms.

(2 marks)

- 10 (a)** Complete each row of the table with a tick (✓) or a cross (X) to indicate whether it is a feature of osmosis.

Feature	✓ / X
Involves the movement of gases	
Requires energy from respiration	
Movement occurs through a partially permeable membrane	
Particles move down a concentration gradient	

Answer

The table should be completed as follows:

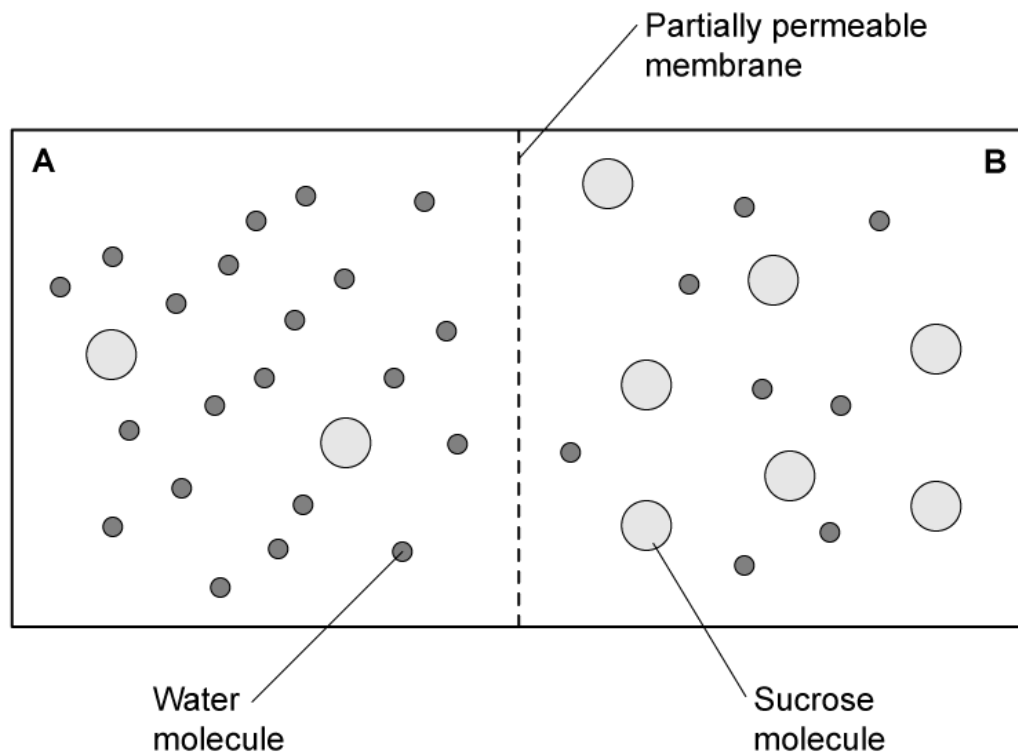
Feature	✓ / X
Involves the movement of gases	X
Requires energy from respiration	X
Movement occurs through a partially permeable membrane	✓
Particles move down a concentration gradient	✓

Allow [1 mark] for each correct ✓ or X

[Total: 4 marks]

(4 marks)

- (b) Draw an arrow on the diagram to show the overall direction that the water particles will move in (net water movement).

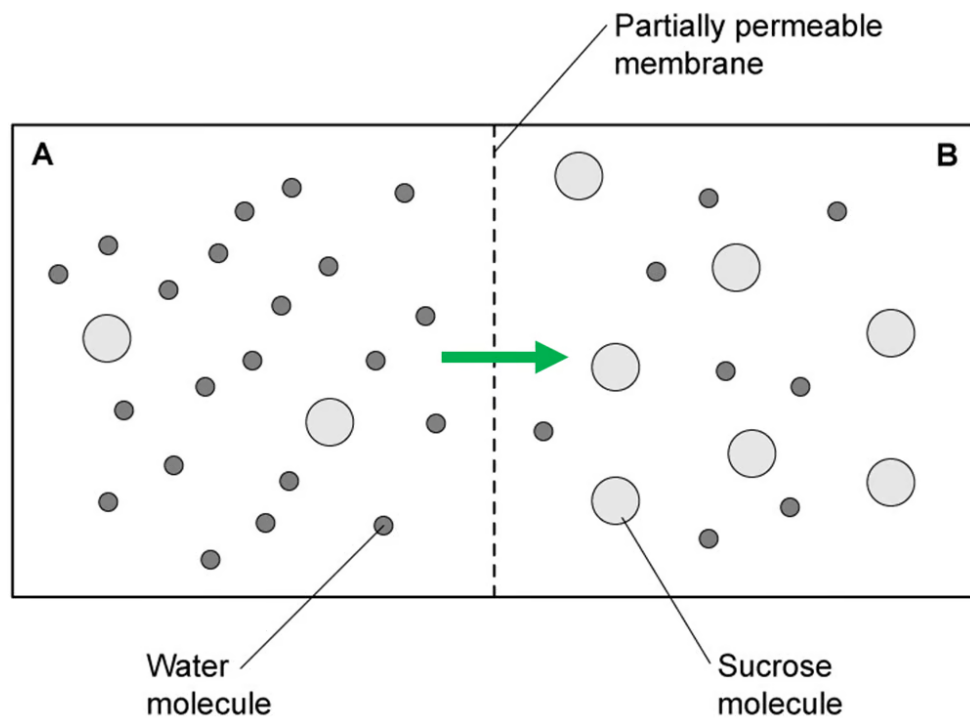


Answer

The water particles will move...

- From left to right; [1 mark]

[Total: 1 mark]



(1 mark)

- (c) Describe an example of where diffusion of gasses is important in multicellular organisms.

Answer

An example of where diffusion of gases are important in multicellular organisms may include...

Any **three** from the following:

- Gas exchange in the lungs (of animals) for respiration **OR** gas exchange in the leaves for respiration **OR** gas exchange in the gills for respiration; [1 mark]
- Oxygen moves from alveoli into the blood (animals) **OR** in from the air (spaces) into the spongy mesophyll cells (plants) **OR** from water in into the blood (fish); [1 mark]
- Carbon dioxide moves from the blood into the alveoli (animals) **OR** out from the spongy mesophyll cells into the air spaces (plants) **OR** from the blood to the water (fish); [1 mark]

OR

- Gas exchange in the leaves for photosynthesis; [1 mark]
- Oxygen moves out from the spongy mesophyll/palisade cells into the air (spaces); [1 mark]
- Carbon dioxide moves in from the air (spaces) into the palisade/spongy mesophyll cells; [1 mark]

[Total: 3 marks]

(3 marks)

(d) Identify **one** feature of a gas exchange surface which maximises the rate of diffusion.

Answer

A gas exchange surface may have the following features to maximise diffusion...

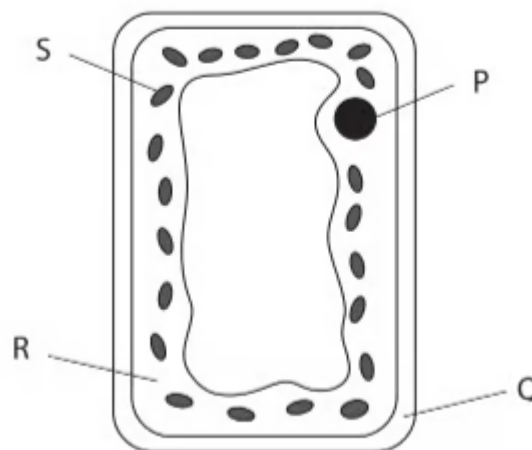
Any **one** from the following:

- Thin/short diffusion distance; [1 mark]
- Steep concentration gradient; [1 mark]
- Large surface area (to volume ratio) for gas exchange; [1 mark]

[Total: 1 mark]

(1 mark)

11 The diagram shows a plant cell.



(i) Which part of this cell contains chlorophyll?

(1)

☐	A	P
☐	B	Q
☐	C	R
☐	D	S

(ii) Which of these is found in chlorophyll?

(1)

☐	A	Calcium
☐	B	Iron
☐	C	Magnesium
☐	D	Water

(iii) Describe the role of chlorophyll.

(2)

Answer

(i) **The correct answer is D because...**

S labels the chloroplast which contains chlorophyll for absorbing light energy

A is incorrect as P labels the nucleus

B is incorrect as Q labels the cell wall

C is incorrect as R labels the cytoplasm

(ii) The correct answer is **C** because...

Magnesium is required to make chlorophyll.

All other answers are incorrect as they are not components of chlorophyll.

(iii) The role of chlorophyll is...

Any **two** of the following:

- To absorb/trap/capture light; [1 mark]
- For photosynthesis; [1 mark]
- To make carbohydrate/starch/glucose; [1 mark]

[Total: 4 marks]

(4 marks)

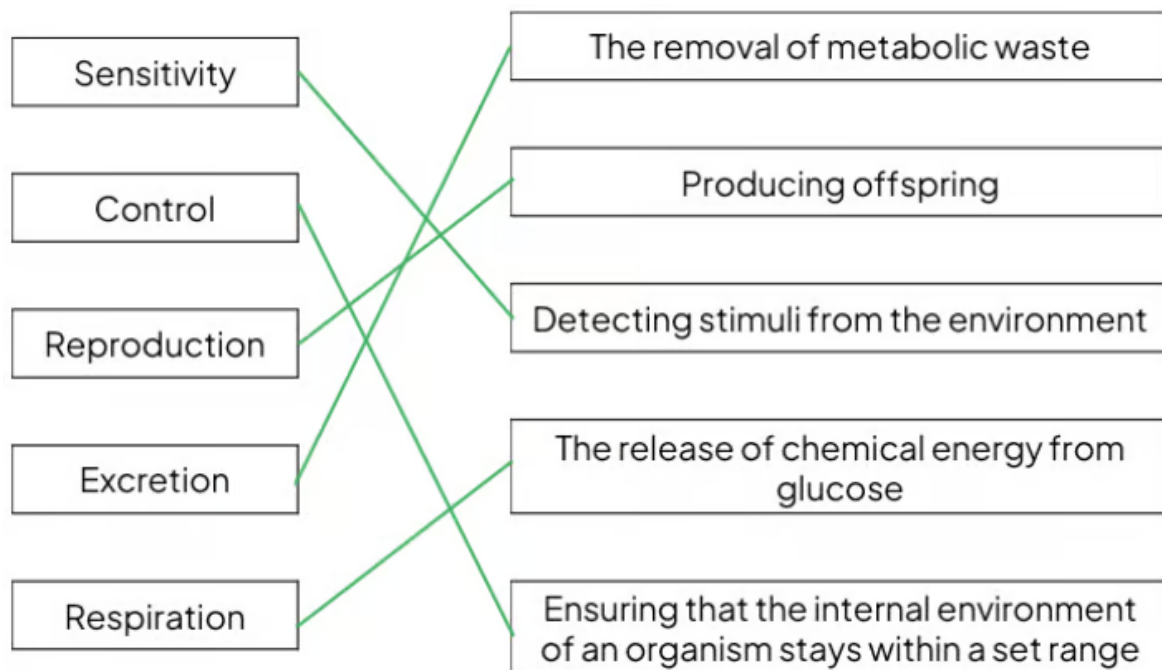
12 (a) Draw **five** lines to connect the characteristics of a living organism with the description of each characteristic.

Sensitivity	The removal of metabolic waste
Control	Producing offspring
Reproduction	Detecting stimuli from the environment
Excretion	The release of chemical energy from glucose
Respiration	Ensuring that the internal environment of an organism stays within a set range

Answer

The correct lines would be drawn as follows...

Award 1 mark for each correct line:



Reject marks for any characteristic that has more than one line drawn.

[Total: 5 marks]

Make sure to always draw lines with a ruler. Any curved or sketchy lines may not be clear to the examiner and you may not be given the mark.

(5 marks)

(b) Explain why viruses are not classified as living organisms.

Answer

Viruses are not classified as living organisms because...

Any **three** of the following:

- They cannot reproduce without a host; [1 mark]
- They do not move; [1 mark]
- They do not respire; [1 mark]
- They do not respond to stimuli; [1 mark]
- They do not grow/develop; [1 mark]
- They do not excrete; [1 mark]
- They do not feed; [1 mark]
- They do not control their internal conditions; [1 mark]

[Total: 3 marks]

These are all the different categories in the MRS C GREN system of classifying living organisms.

(3 marks)

(c) Viruses can be classified as pathogens.

(i) What is the definition of a pathogen?

(1)

(ii) Name three other groups of organisms that contain pathogens.

(3)

(iii) In the space below, draw and label a diagram of the basic structure of a virus.

Answer

(i) The definition of a pathogen is...

- A (micro)organism that causes (infectious) disease; [1 mark]

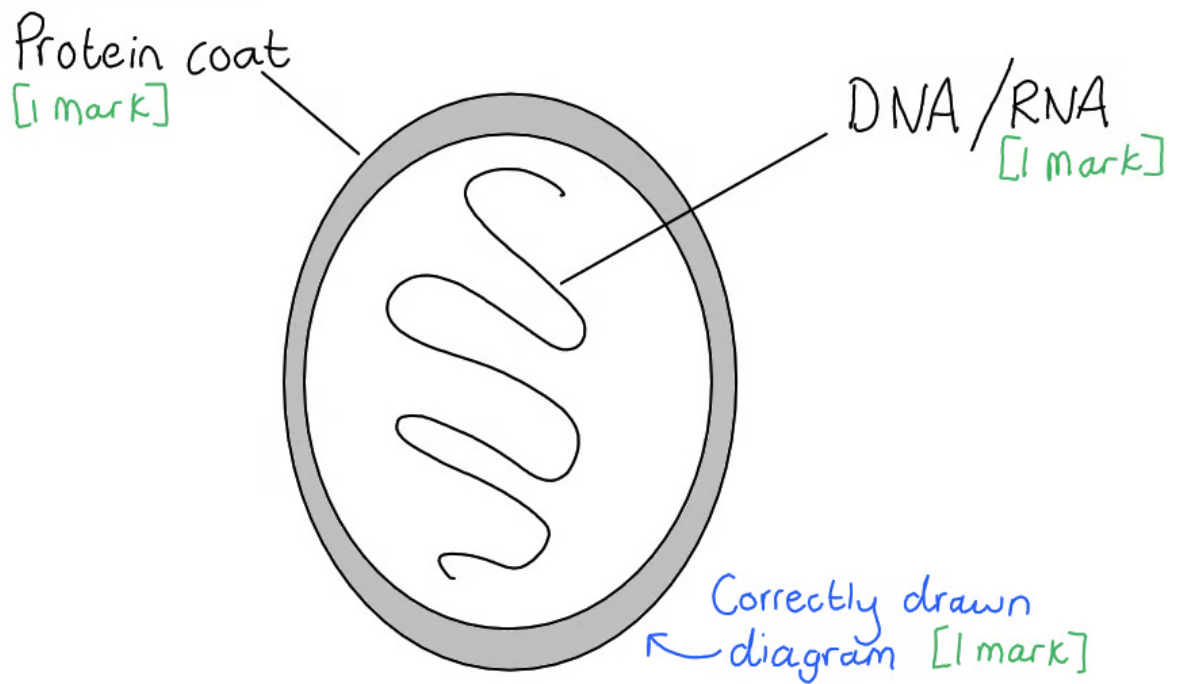
(ii) Three other groups of organisms that can contain pathogens are...

- Bacteria; [1 mark]
- Fungi; [1 mark]
- Protocist; [1 mark]

(iii) A diagram of a virus is...

- Diagram that shows an outer layer surrounded by an inner strand; [1 mark]
- Protein coat labelled; [1 mark]
- DNA/RNA/genetic material labelled; [1 mark]

[Total: 7 marks]



Remember that viruses can come in a variety of different shapes and sizes. You would never be expected to draw anything other than the most basic structure. If your diagram doesn't look exactly the same as this one, that is OK, as long as it shows the correct parts.

When labelling a diagram always use straight lines, using a ruler if possible. That will make it really clear where in the diagram you are pointing to.

(7 marks)

(d) One example of a virus pathogen is tobacco mosaic virus (TMV).

Explain the effect of TMV on the plants it infects.

Answer

TMV causes...

Any **two** of the following:

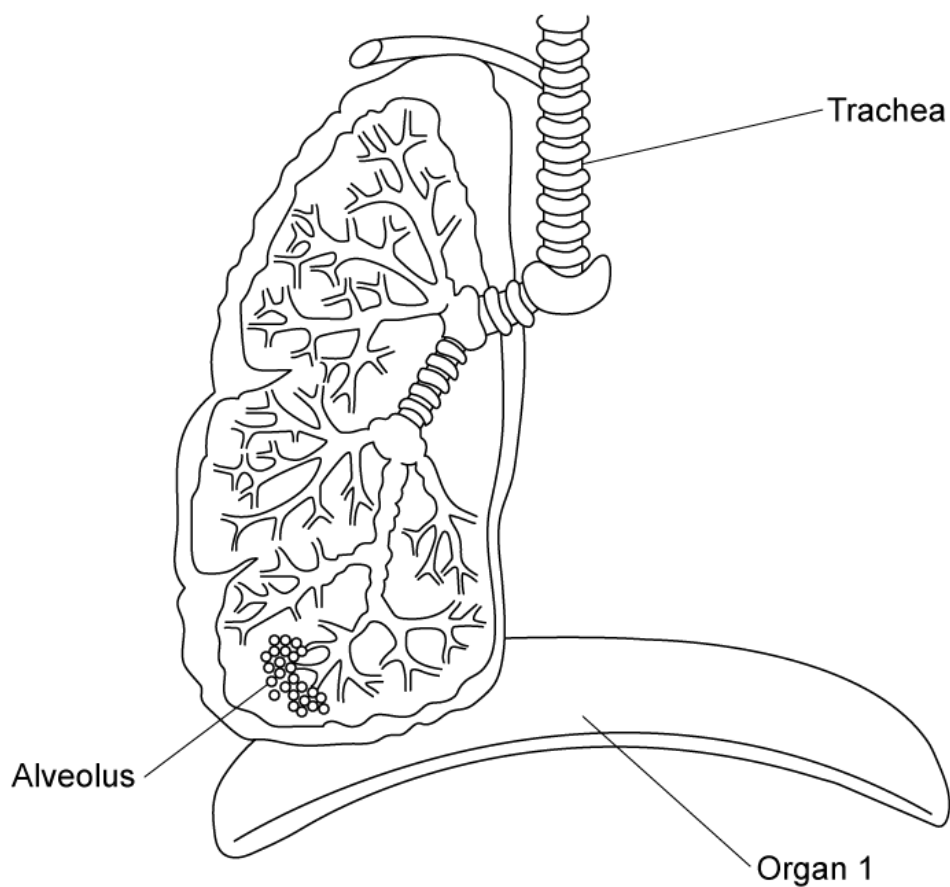
- Chloroplasts are prevented from forming / no chloroplasts are present; [1 mark]
- Discolouration of the leaves / a mosaic pattern on the leaves (due to lack of green pigment found in chloroplasts); [1 mark]
- Reduced growth (due to lack of photosynthesis); [1 mark]

[Total: 2 marks]

TMV is an example of a virus that is listed in your specification, alongside influenza and HIV. Make sure you have a basic knowledge of all these examples.

(2 marks)

- 13 (a)** The diagram below shows some of the structures in the human body involved with the ventilation process.



Identify **Organ 1** in the diagram above.

Answer

Organ 1 is the...

- Diaphragm; [1 mark]

[Total: 1 mark]

(1 mark)

(b) Describe how the contraction of **Organ 1** in part (a) aids the inhalation process.

Answer

Contraction of the diaphragm aids inhalation as follows...

Any **two** of the following:

- (Organ 1/diaphragm) flattens / moves downwards; [1 mark]
- The thorax/chest/lung volume increases; [1 mark]
- The pressure in the thorax/chest/lung decreases; [1 mark]
- Air moves/is drawn into the thorax/chest/lungs from high to low pressure / down a pressure gradient; [1 mark]

[Total: 2 marks]

(2 marks)

(c) Other than Organ 1, identify **one** set of muscles involved with ventilation.

Answer

One other antagonistic pair of muscles involved with ventilation is...

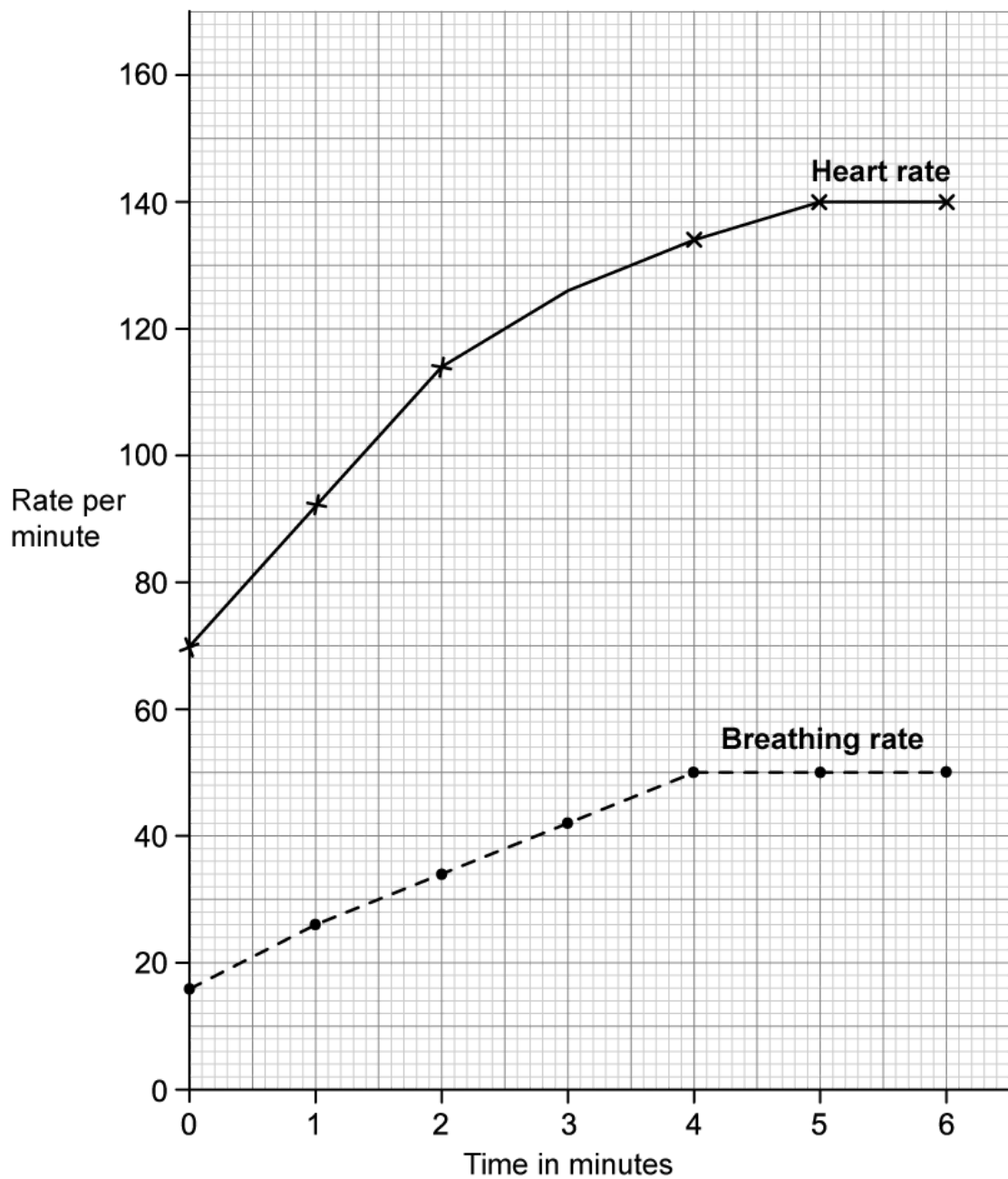
- The internal / external intercostal muscles; [1 mark]

[Total: 1 mark]

(1 mark)

(d) The graph below shows the effect of exercise on heart rate and breathing, or ventilation,

rate. Exercise started at 0 minutes during the investigation.



(i) Calculate the change in breathing rate between 0 and 4 minutes.

(2)

(ii) Explain the change in breathing rate that occurs during exercise.

(2)

(iii) The individual in the investigation stopped exercising after 6 minutes.

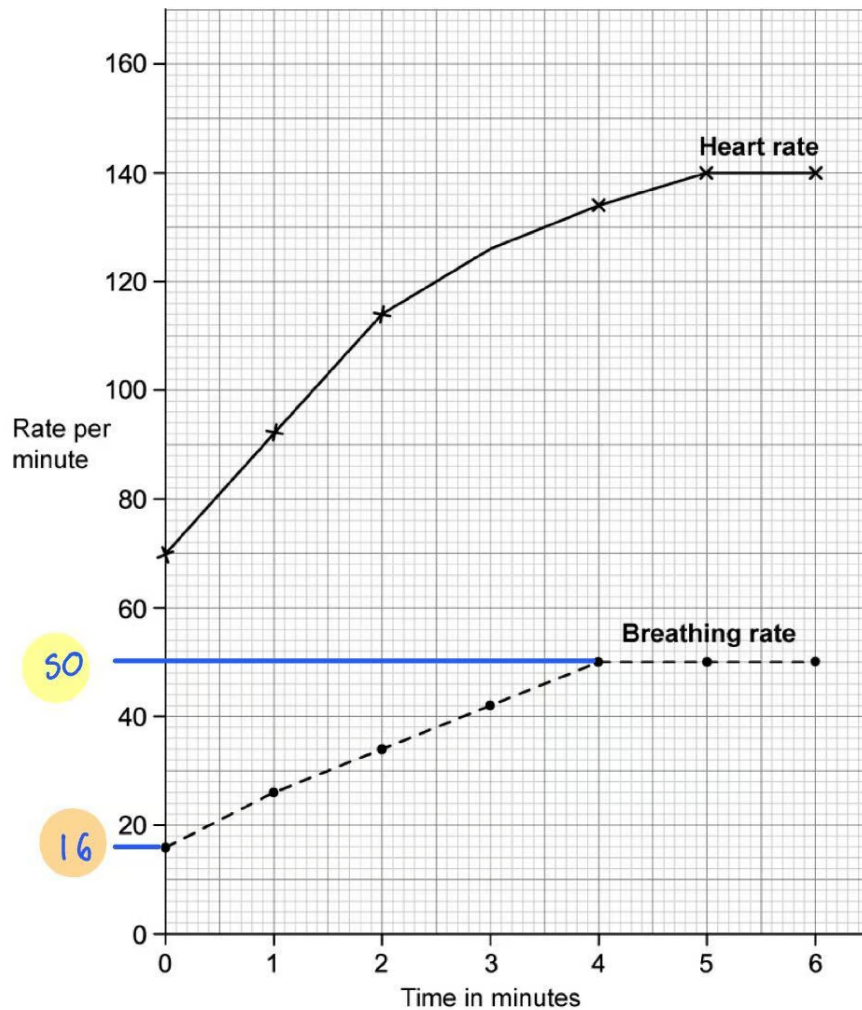
Predict how this would affect the breathing rate line shown on the graph.

(2)

Answer

(i) The change in breathing rate between 0 and 4 minutes is...

- 50 - 16; [1 mark]
- 34; [1 mark]



calculate the change in
breathing rate:

[1 mark]

$$50 - 16 = \underline{34} \quad [1 \text{ mark}]$$

(ii) The change in breathing rate that occurs during exercise is due to...

Any **two** of the following:

- The muscles are respiring more; [1 mark]
- More oxygen is required / more carbon dioxide needs to be removed; [1 mark]
- Respiration requires oxygen / produces carbon dioxide; [1 mark]

(iii) Stopping exercise would affect the line on the graph as follows...

- The line would remain at a higher/elevated level / would initially decrease slowly; [1 mark]
- The line will (eventually) return to the original level/breathing rate; [1 mark]

When exercise stops it takes time for the breathing rate to return to normal. This is because more oxygen is needed to pay off the 'oxygen debt' that has occurred, and because excess carbon dioxide still needs to be removed from the blood. Breathing rate will eventually return to normal once recovery has taken place.

[Total: 6 marks]

(6 marks)

14 (a) In respiration energy is released from glucose.

State **two** uses, in an animal cell, of the energy released from glucose.

Answer

Two uses of energy from respiration include....

Any **two** of the following:

- Active transport; [1 mark]
- Muscle contraction/movement; [1 mark]
- (Generating/sending) nerve impulses; [1 mark]
- Cell growth / division; [1 mark]
- Protein synthesis / building proteins/enzymes **OR** building large molecules from small molecules; [1 mark]
- Chemical reactions / e.g. breaking down/digesting large molecules into small molecules; [1 mark]
- Maintaining a constant temperature / body temperature of 37 °C / thermoregulation; [1 mark]

Accept other correct examples of energy use in animal cells.

[Total: 2 marks]

(2 marks)

(b) Earthworms are known as detritivores; they break down dead plant and animal material in the soil.

Which statement best describes how oxygen from the soil move into the body fluids of the earthworm to be used in respiration.

☐	A	By diffusion down a concentration gradient
☐	B	By diffusion from a low concentration to a high concentration
☐	C	By osmosis down the concentration gradient
☐	D	By active transport from a low concentration to a high concentration

Answer

The correct answer is A because...

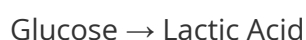
Gas exchange involves the passive movement of gases (oxygen and carbon dioxide) by **diffusion** from a **high concentration to a low concentration** (down a concentration gradient).

C and **D** are incorrect because osmosis refers to the movement of **water** molecules and active transport **requires energy** to move molecules **against** a concentration gradient.

[Total: 1 mark]

(1 mark)

- (c) If the ground becomes waterlogged then less oxygen will be available in the soil and the earthworm will need to respire anaerobically. This process is represented by the equation below.



State why this process is described as anaerobic.

Answer

The process is anaerobic because...

- There is no oxygen used / oxygen is not a reactant; [1 mark]

[Total: 1 mark]

(1 mark)

(d) Earthworms cannot survive for very long in heavily waterlogged soil.

Suggest why this is the case.

Answer

Earthworms cannot survive for very long in heavily waterlogged soil because...

Any **one** of the following:

- They cannot respire anaerobically (for very long); [1 mark]
- Lactic acid lowers the pH of their cells/makes the cells acidic / causes enzymes in their cells to denature; [1 mark]
- Anaerobic respiration releases less energy / does not release enough energy; [1 mark]

[Total: 1 mark]

This is a straightforward example of a 'suggest' question, meaning that you are not expected to *know* about respiration in earthworms, but that you should be able to use the information provided in the question and your knowledge of anaerobic respiration to come up with a sensible answer. Here you need to consider the impacts of anaerobic respiration on organisms.

(1 mark)

(e) An oxygen debt is often associated with anaerobic respiration.

Describe the process that occurs in the human body during an oxygen debt.

Answer

The process that occurs in the body during an oxygen debt is...

Any **two** of the following:

- Deeper/faster/harder breathing to supply oxygen; [1 mark]
- Oxygen is used to break down lactic acid; [1 mark]
- Lactic acid is converted to glucose; [1 mark]
- Carbon dioxide / water released as a waste product; [1 mark]

[Total: 2 marks]

(2 marks)

15 (a) Blood consists of cells and plasma.

Plasma transports various substances to and from different parts of the body.

Describe the function of plasma in transporting named substances in the body.

Answer

The function of plasma in transporting substances is as follows...

Any **four** of the following:

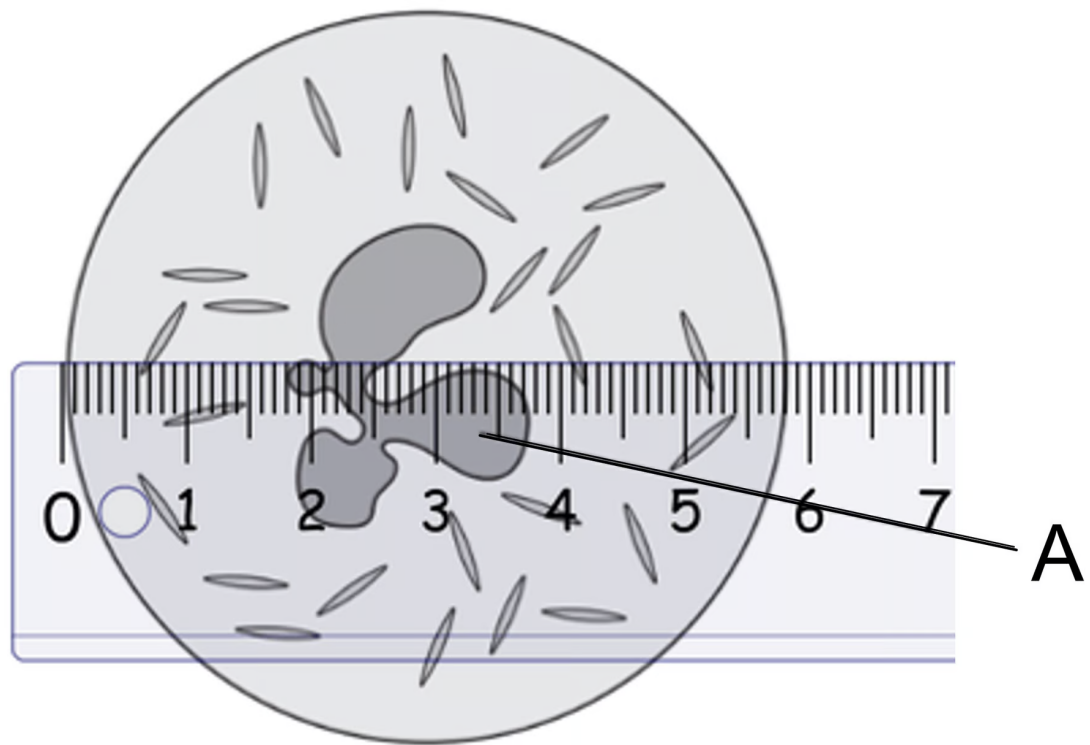
- Glucose (transported) from intestine / ileum / liver **OR** Glucose (transported) to body cells / to liver; [1 mark]
- Amino acids (transported) from ileum / liver **OR** amino acids (transported) to body cells / liver; [1 mark]
- Fatty acids / vitamins / minerals / other named product of digestion (transported) from intestine **OR** fatty acids / vitamins / minerals / other product of digestion (transported) to cells; [1 mark]
- Hormones (transported) from (endocrine) glands **OR** hormones (transported) to organs / tissues; [1 mark]
- Urea (transported) from liver **OR** urea (transported) to the kidney
- Carbon dioxide (transported) from cells **OR** carbon dioxide (transported) to lungs; [1 mark]
- Antibodies (transported) to the site of infection / to combat pathogens; [1 mark]
- Fibrinogen / clotting proteins (transported) to wound / damaged tissue; [1 mark]

[Total: 4 marks]

To gain full marks in this question you must do a bit more than just name substances carried in the plasma. The function of the plasma is to carry these substances from A to B, so you should ensure that you have described where the substances are carried from or to gain full marks.

(4 marks)

(b) The diagram shows a white blood cell called a phagocyte.



(i) The magnification of the cell is calculated using this formula.

$$\text{magnification} = \frac{\text{diameter of cell in diagram}}{\text{actual diameter of cell}}$$

The actual diameter of the cell is 0.013 mm.

Calculate the magnification of the cell. A ruler has been added to the diagram to help your calculations.

(2)

(ii) Name the structure labelled **A** in the diagram.

(1)

(iii) Describe the function of this cell in defending the body from infection.

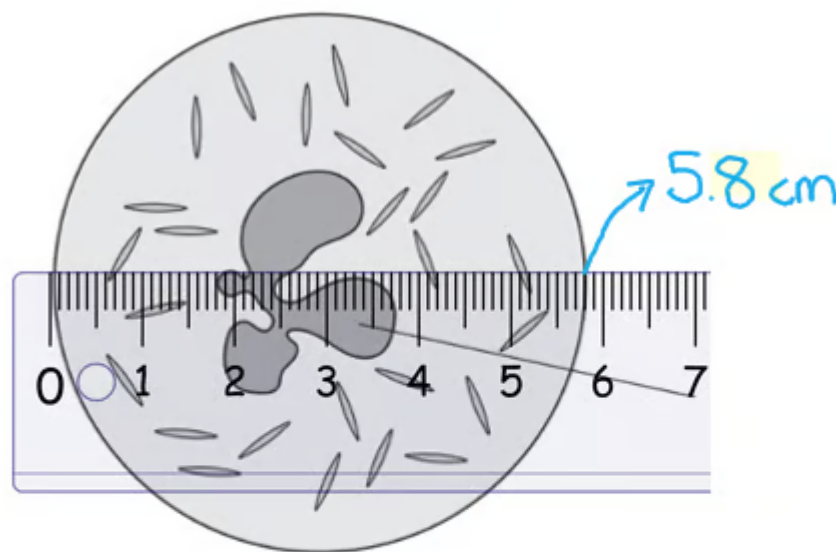
Answer

(i) The calculation should be completed as follows...

- $58 \div 0.013$; [1 mark]
- $= 4462$; [1 mark]

Full marks should be awarded for the correct answer in the absence of any calculations

Award 1 mark for dividing an incorrect cell measurement by 0.013



$$\begin{aligned}
 1. \text{ Conversion to mm} &= 5.8 \times 10 = 58 \text{ mm} \\
 2. \text{ Image} \div \text{actual} &= 58 \div 0.013 = 4462 \\
 &= \underline{4462} \times [1 \text{ mark}]
 \end{aligned}$$

Note that **all of the units within the equation need to be the same**. You have been given the actual size of the cell in mm, so you need to convert the size of the cell in the image into mm to match this.

A ruler has been added to the diagram here to account for the differences experienced when viewing the question on different screens or printing, which may

alter the sizing. In the exam, you would be expected to bring a ruler and take measurements by hand to use in your calculations.

(ii) Structure A is...

- The nucleus; [1 mark]

(iii) The function of this cell is...

Any **two** from the following:

- To engulf/ingest bacteria/pathogen/microbe; [1 mark]
- (Then) digests / breaks down (the pathogen); [1 mark]
- (Using) (digestive/hydrolytic) enzymes; [1 mark]

[Total: 5 marks]

(5 marks)

(c) Other white blood cells produce proteins called antibodies.

State how you could test a sample of plasma for protein.

Answer

You could test the plasma for protein as follows...

- Add biuret (reagent) / NaOH **AND** CuSO₄ / albustix; [1 mark]

[Total: 1 mark]

In this test, the reagent would change from blue to lilac in the presence of protein. You learn this in the context of food tests but the biuret test can also detect proteins in non-food samples like blood plasma.

(1 mark)

16 (a) Define the term **tissue**.

Answer

The term tissue can be defined as follows...

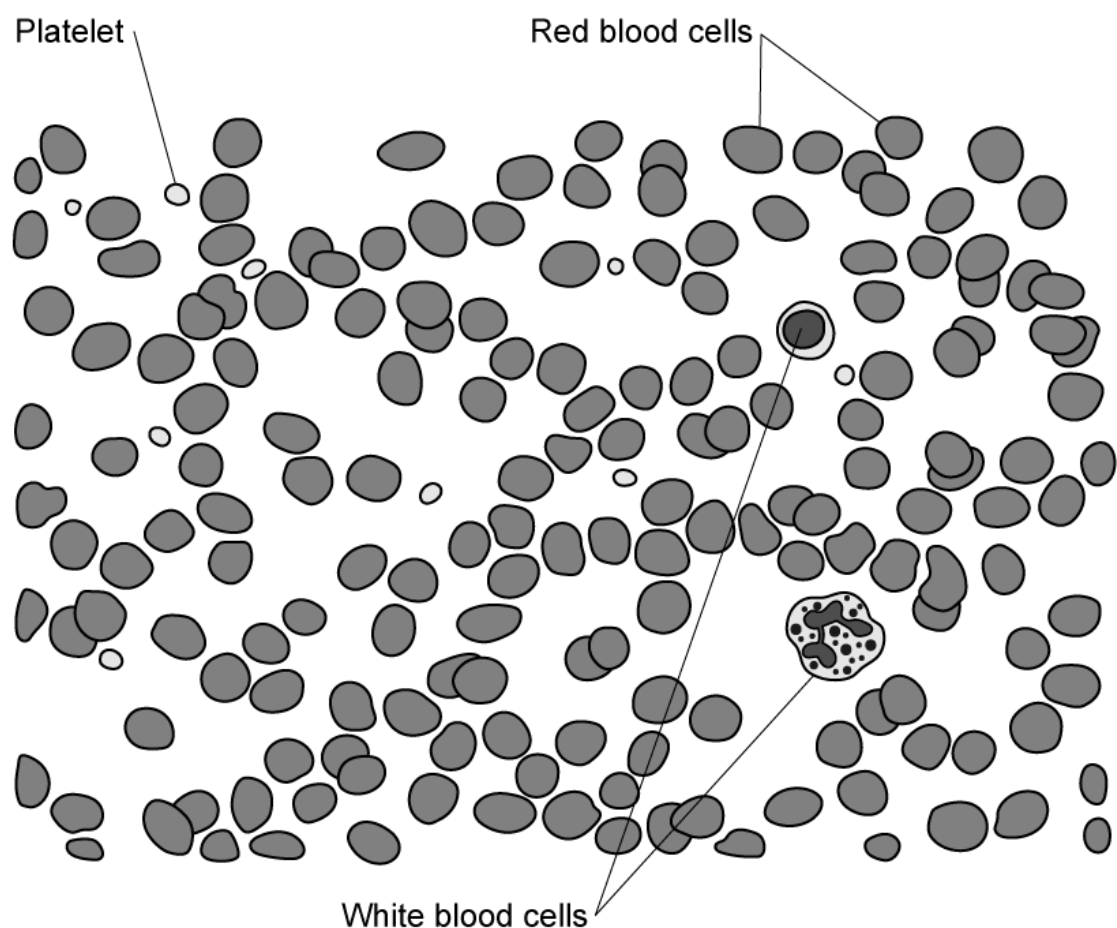
- A group/collection of similar cells...; [1 mark]
- ...working together to carry out a particular function; [1 mark]

[Total: 2 marks]

The term *tissue* is one that we use frequently in biology, but many students struggle to define it. Make sure that you are confident about giving a definition for this term.

(2 marks)

(b) The diagram below shows an example of an animal tissue.



(i) Name the tissue shown in the image.

(1)

(ii) Name the organ system associated with this tissue.

(1)

Answer

(i) The tissue in the image is...

- Blood; [1 mark]

The cells visible in the image work together to carry out the function of transport, so they can be described as tissue. The cells of the blood are suspended with a liquid (the blood plasma), so blood is an unusual example of a tissue.

(ii) The organ system associated with blood is...

- The circulatory/circulation system; [1 mark]

The blood is transported within blood vessels and pumped by the heart; these are the organs of the circulatory system.

[Total: 2 marks]

(2 marks)

(c) Other than the tissue given in part (b), name two examples of tissues found in an animal.

Answer

Two examples of tissues found in animals include...

Any **two** of the following:

- Muscle / a named example, e.g. smooth muscle / cardiac muscle / skeletal muscle; [1 mark]
- Epithelial / a named example, e.g. ciliated epithelium / the epidermis / the lining of the small intestine; [1 mark]
- Connective / a named example, e.g. adipose / cartilage / elastic / bone; [1 mark]
- Nerve/nervous / a named example, e.g. the retina; [1 mark]

Reject 'blood' for marking point 3 as this was covered in part (b).

[Total: 2 marks]

Note that blood (covered in part (b)) is technically a type of connective tissue, but you would not be expected to know this, so *connective* is an acceptable answer here.

(2 marks)

(d) State why it is not possible for prokaryotic organisms to have tissues.

Answer

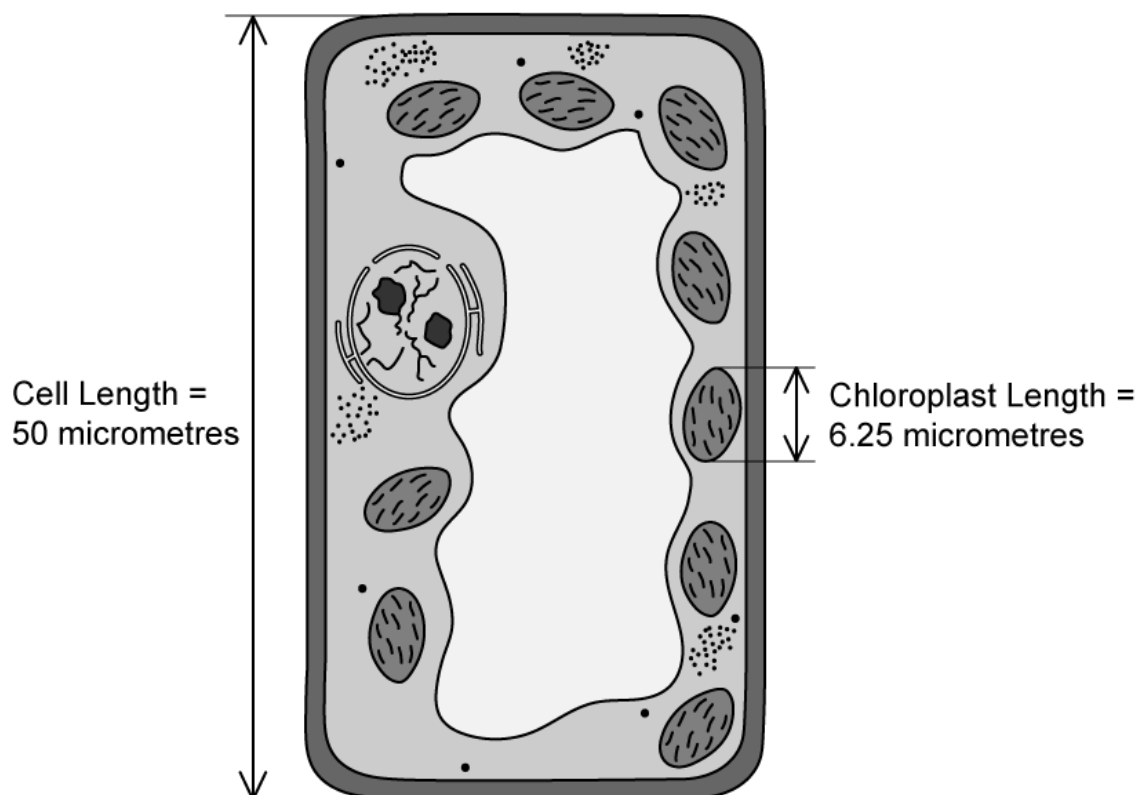
It is not possible for prokaryotes to have tissues because...

- Prokaryotes are single-celled organisms (and tissues are made up of many cells); [1 mark]

[Total: 1 mark]

(1 mark)

17 (a) The diagram below shows a plant cell drawn to scale.



Calculate how many times longer the cell length is than the chloroplast length.

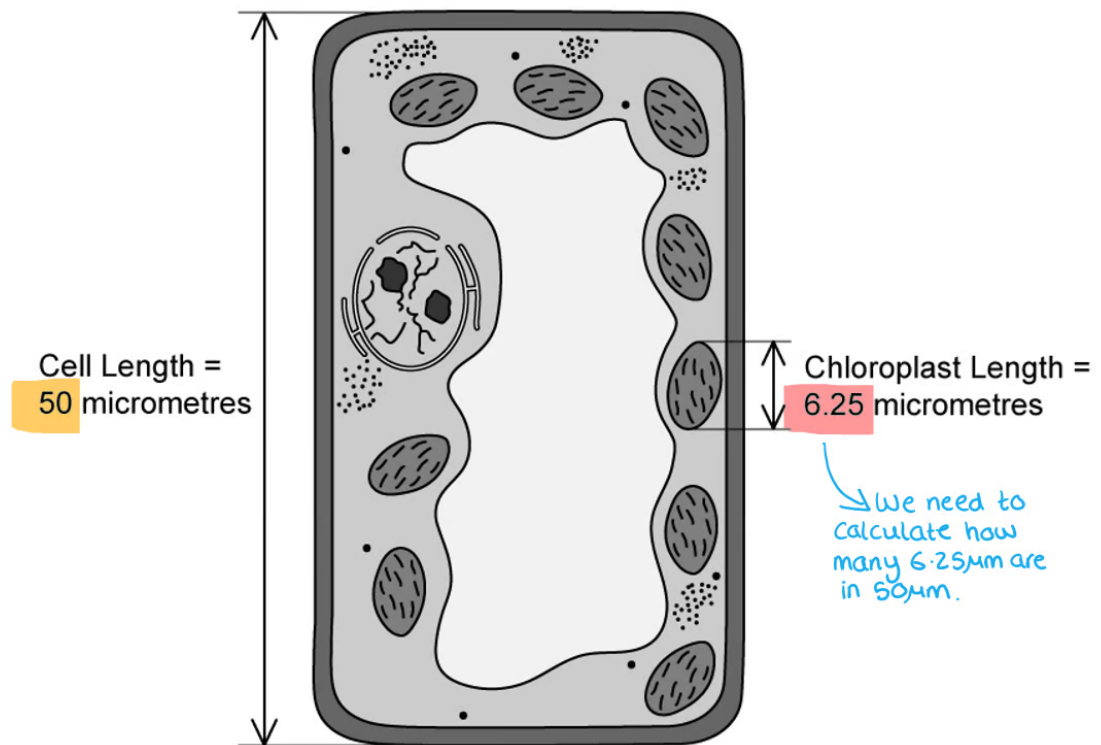
Answer

The following calculation shows how much longer the cell length is compared to the chloroplast...

- $50 \div 6.25$; [1 mark]
- 8 (times longer); [1 mark]

Full marks to be awarded for correct answer without calculation

[Total: 2 marks]



$$\underset{[1 \text{ mark}]}{50} \div \underset{[1 \text{ mark}]}{6.25} = \underline{8} \quad [1 \text{ mark}]$$

→ 8 times bigger

(2 marks)

(b) State two ways in which an animal cell would be different to the cell shown in part (a).

Answer

An animal cell would be different to the cell shown in part (a) as follows...

Any **two** of the following:

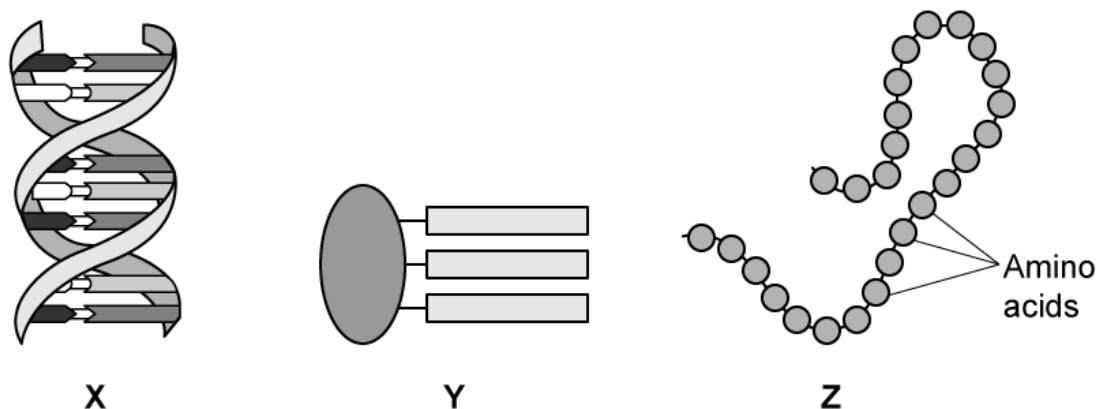
- It would not contain chloroplasts; [1 mark]
- It would not contain a (permanent) vacuole; [1 mark]
- It would not have a cell wall; [1 mark]

Ignore references to mitochondria.

[Total: 2 marks]

(2 marks)

18 (a) The image shows three different biological molecules.



Name the biological molecules represented by **X**, **Y** and **Z**.

Answer

The molecules can be identified as follows...

- X = DNA; [1 mark]
- Y = lipid/triglyceride; [1 mark]
- Z = protein/polypeptide; [1 mark]

[Total: 3 marks]

The DNA molecule can be identified by its double helix shape and base pairs; this is a structure you should be familiar with from key stage 3. The DNA double helix is also covered briefly later on in the combined science course and in more detail as part of the "Separate Science: Biology Only" section.

Y shows one molecule attached to 3 other identical molecules; this represents glycerol attached to 3 fatty acids.

Z shows amino acids joined in a long chain to make a protein.

(3 marks)

(b) Name one element found in all three of the biological molecules shown in part (a).

Answer

An element found in all of the biological molecules could be...

- Carbon / hydrogen / oxygen; [1 mark]

[Total: 1 mark]

(1 mark)

(c) With reference to molecule **Z** from part (a):

(i) Outline the test used to identify the molecule in a sample of food.

(2)

(ii) Explain the effect of very high temperature on the shape of this molecule.

(2)

Answer

(i) The test used to identify this molecule in a sample of food is...

- Add biuret reagent/solution (to prepared food sample); [1 mark]
- Colour change from blue to violet/purple **OR** a positive result appears violet/purple; [1 mark]

(ii) The effect of a high temperature on a protein molecule is as follows...

Any **two** of the following:

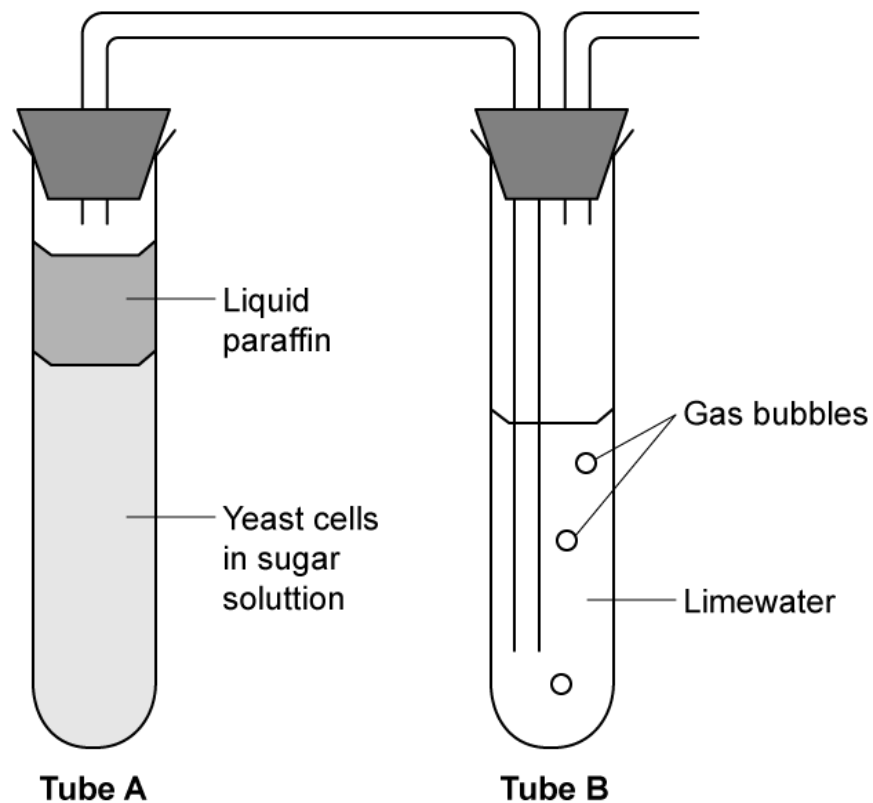
- The bonds (that hold the protein together) will break; [1 mark]
- The shape (of the active site) will change; [1 mark]
- The protein/enzyme will denature; [1 mark]
- The protein will no longer function **OR** the enzyme will no longer fit with its substrate / catalyse its reaction; [1 mark]

You should be aware that **enzymes are made of protein**, so high temperatures will affect other proteins in the same way that they affect enzymes. Marks are available here for answers relating to proteins in general or to enzymes specifically.

[Total: 4 marks]

(4 marks)

- 19 (a)** The diagram shows some apparatus set up to investigate respiration in yeast cells. Note that paraffin is impermeable to oxygen.



(i) State the type of respiration being investigated in this experiment.

(1)

(ii) State how you reached your answer to part (i).

(1)

Answer

(i) The type of respiration being investigated is...

- Anaerobic; [1 mark]

(ii) We know this because...

- The paraffin will prevent oxygen reaching the yeast/solution / keeps oxygen out (so forcing the yeast to respire anaerobically); [1 mark]

[Total: 2 marks]

Ensure that you study a diagram carefully and that you read all of the information provided before attempting to answer a question. Here the question stem tells us that paraffin is impermeable to oxygen, and the diagram shows that the yeast solution has been covered by a layer of paraffin. This means that the yeast cells will soon use up any oxygen in the solution and be forced to respire anaerobically.

Note that while this is a practical that investigates respiration, it actually doesn't appear in the specification until the food production topic which is usually taught towards the end of the GCSE course. This doesn't mean that you shouldn't be able to answer these questions relating to the practical earlier on in your studies, but if you want to find out more about it then you will need to jump ahead in the course to read about it.

(2 marks)

(b) Identify the gas in the bubbles produced by the yeast in part (a).

Answer

The gas in the bubbles produced is...

- Carbon dioxide; [1 mark]

[Total: 1 mark]

Yeast is classified as a fungus, and you should be aware that anaerobic respiration in fungi produces carbon dioxide gas.

The fact that limewater becomes cloudy when carbon dioxide is bubbled through it should also be a clue here!

(1 mark)

- (c) A group of students wanted to use the apparatus in part (a) to investigate the effect of temperature on respiration in yeast.

They set up the test tubes containing the yeast and sugar solution in water baths at a range of temperatures and counted the number of bubbles produced to give a measure of the rate of respiration.

Give two factors that the students would need to control in their investigation.

Answer

The student would need to control the following factors...

Any **two** of the following...

- The volume of yeast solution / the number of yeast cells in the solution; [1 mark]
- The concentration of sugar in the solution; [1 mark]
- The type of sugar in the solution; [1 mark]
- The depth of the paraffin layer; [1 mark]
- The length of time for which bubbles are counted; [1 mark]
- The time that the test tubes spend in the water bath before starting the bubble count; [1 mark]
- The depth at which the bubble/delivery tube is submerged in the limewater solution; [1 mark]

[Total: 2 marks]

Remember that a control variable is a factor that needs to be kept the same throughout an experiment so that it doesn't affect the results. Here there are lots of factors that can be determined by looking at the diagram and reading the method description.

(2 marks)

- (d) Complete the table to indicate whether the statements apply to **aerobic respiration**, **anaerobic respiration** or **both**.

The first statement has been completed for you.

Statement	Respiration Type
Produces lactic acid as a waste product	Anaerobic respiration
Produces ethanol when it occurs in yeast	
Produces lots of ATP	
Releases energy from glucose	
Increases during intense exercise	

Answer

The table should be completed as follows...

Statement	Respiration Type
Produces lactic acid as a waste product	Anaerobic respiration
Produces ethanol when it occurs in yeast	Anaerobic respiration; [1 mark]
Produces lots of ATP	Aerobic respiration; [1 mark]
Releases energy from glucose	Both; [1 mark]
Increases during intense exercise	Anaerobic respiration; [1 mark]

[Total: 4 marks]

(4 marks)

20 (a) The pancreas produces a range of enzymes involved in the digestion of food.

Define the term **enzyme**.

Answer

The term enzyme can be defined as follows...

Any **two** of the following:

- A protein; [1 mark]
- A biological catalyst; [1 mark]
- That helps to increase/speed up the rate of chemical reactions (in living organisms); [1 mark]

Ignore 'catalyst' on its own

[Total: 2 marks]

(2 marks)

(b) In which of the following locations does digestion by the enzyme amylase take place?

☐	A	Mouth and pancreas
☐	B	Mouth and stomach
☐	C	Small intestine and pancreas
☐	D	Mouth and small intestine

Answer

The correct answer is D because...

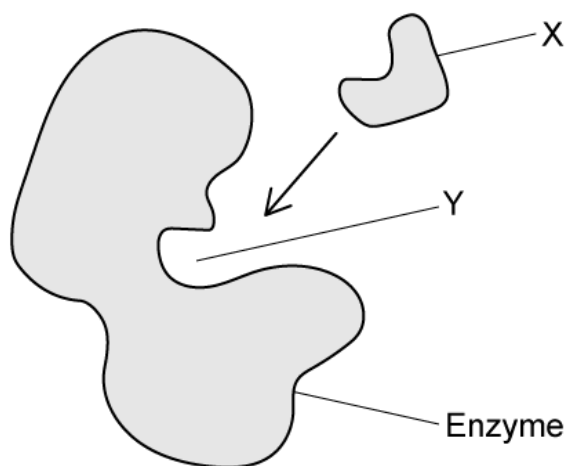
Starch digestion begins in the mouth due to the action of amylase produced by the salivary glands, and is completed in the small intestine due to the action of amylase released from the pancreas.

A and **C** are incorrect because while the pancreas produces and secretes amylase, digestion does not actually take place in the pancreas.

B is incorrect because amylase is not present in the stomach, and in fact, cannot function at the low pH of the stomach acid.

(1 mark)

- (c)** The diagram below shows an enzyme and an associated molecule labelled **X** that can bind with the enzyme at location **Y**.



Name molecule **X** and location **Y**.

Answer

Molecule **X** is the...

- Substrate; [1 mark]

Location **Y** is the...

- Active site; [1 mark]

[Total: 2 marks]

A **substrate** is a molecule that an enzyme acts on. It binds to a region of the enzyme known as the **active site** in order for the enzyme to act on it.

(2 marks)

(d) The 'lock and key hypothesis' is often used as a model to describe the action of enzymes.

Use your knowledge of the lock and key hypothesis and the diagram in part (c) to explain how enzymes function in digestion.

Answer

Enzymes work as follows...

Any **three** of the following:

- The substrate and active site are complementary / the active site is specific to one substrate; [1 mark]
- An enzyme-substrate complex forms; [1 mark]
- (The substrate is) converted/broken down into products; [1 mark]
- The products are released from the active site; [1 mark]
- The enzyme acts on more substrate molecules / is unchanged; [1 mark]

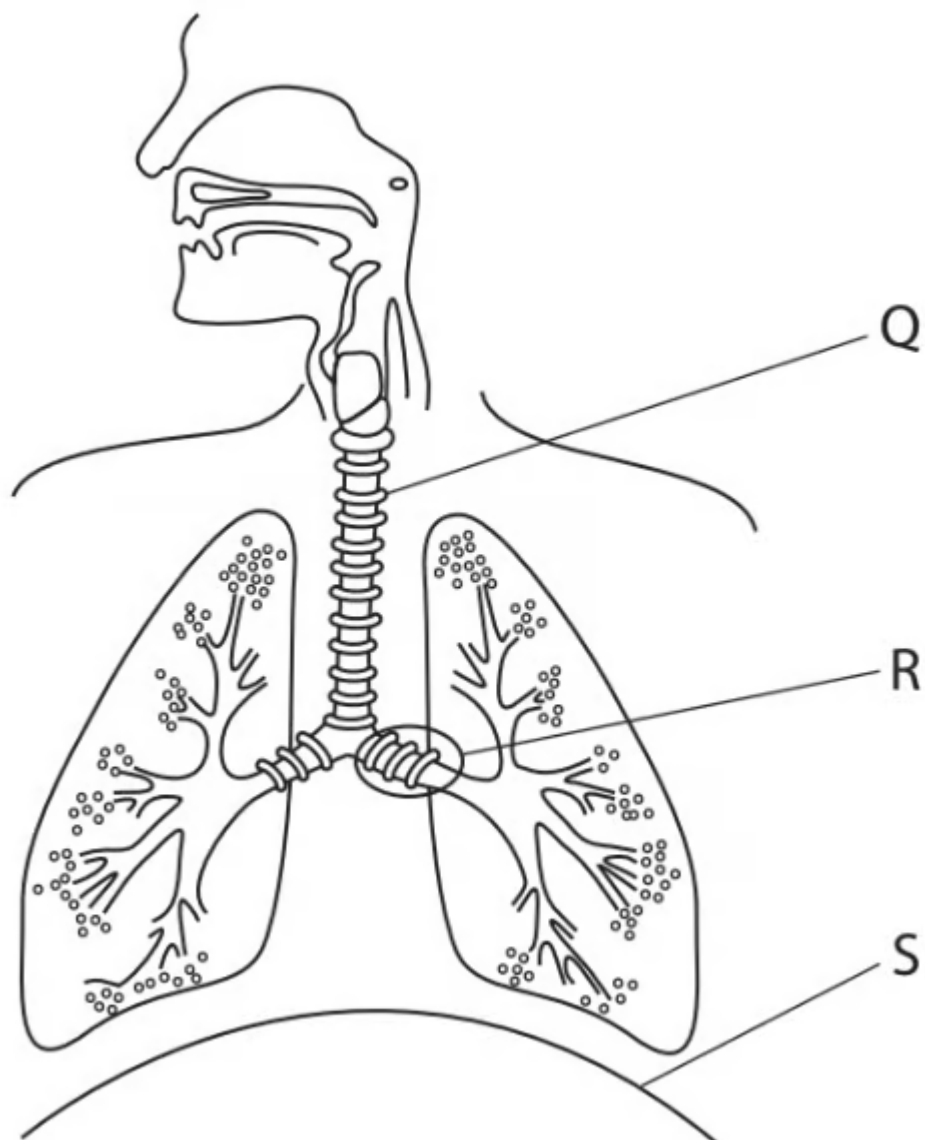
[Total: 3 marks]

In this question you should be able to explain enzyme/substrate specificity by explaining how the substrate and active site are complementary in shape and fit together like a key in a lock. To get full marks you need to use the correct keywords (substrate and active site) and mention how a product is produced which is then released from the enzyme.

It is important to remember that the enzyme and substrate are not the 'same' shape, but 'complementary' which means the opposite.

(3 marks)

21 (a) The diagram shows the human thorax.



(i) Which of these are structures Q and R?

(1)

		Q	R
☐	A	bronchiole	trachea
☐	B	bronchus	trachea
☐	C	trachea	bronchiole
☐	D	trachea	bronchus

(ii) Explain how structure S helps a person to exhale.

(3)

Answer

(i) **The correct answer is D because...**

Structure Q is the trachea and structure R is the bronchus.

Bronchioles are the smaller tubes that the bronchi divide into to reach the alveoli.

(ii) Structure S helps a person to exhale by...

Any **three** of the following:

- S/diaphragm/muscle relaxes;
- S/diaphragm moves up / becomes dome shaped;
- Volume (of the chest cavity) decreases;
- Pressure (in the chest cavity) increases;

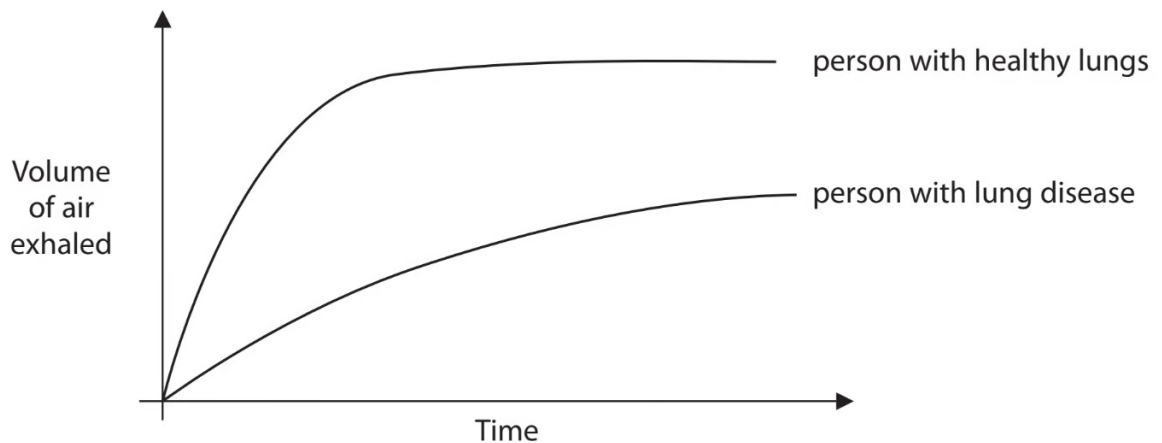
[Total: 4 marks]

Remember to read the question carefully; if the question asks about exhalation make sure to only focus on this because any reference to inhalation would not gain any marks.

(4 marks)

(b) The graph shows how the volume of air exhaled varies with time during one breath.

This is shown for a person with lung disease and a person with healthy lungs.



Explain why a person with lung disease is often breathless and unable to exercise.

Answer

The person with lung disease is often breathless and unable to exercise because...

Any **three** of the following:

- The (maximum) lung volume of people with lung disease is lower / less volume can be exhaled / less air exhaled; [1 mark]
- People with lung disease cannot exhale as rapidly; [1 mark]
- Less carbon dioxide removed / less oxygen taken in; [1 mark]
- Diffusion gradient (into the blood) is less steep; [1 mark]
- Less respiration (in cells) / more anaerobic respiration (needs to occur) / more lactic acid accumulation (as a product of anaerobic respiration); [1 mark]

Accept reverse statement for marking point 1, e.g. "the maximum lung volume of people with healthy lungs is higher" / "a larger volume can be exhaled" etc.

[Total: 3 marks]

(3 marks)

22 (a) A student made the following statement:

"Excretion is when the body gets rid of waste materials, like urine and faeces".

Explain whether the student's statement is correct.

Answer

An explanation of the accuracy of the statement is...

Any **two** of the following:

- Excretion is the removal of metabolic waste / the waste products of metabolic reactions; [1 mark]
- Faeces are not a product of metabolism / removal of faeces is not excretion (so the student is incorrect); [1 mark]
- There are other types of excretion, e.g. exhaling / sweating; [1 mark]

[Total: 2 marks]

Excretion is the removal of **metabolic waste** from the body; this refers to waste that is produced during **chemical reactions** that occur inside the cells. Faeces are made up of the undigested food that remains after digestion, so they are not the product of metabolism, and are therefore not removed from the body during *excretion*.

Referring to the loss of faeces as the excretion is a really common mistake made by many students; make sure you do not fall into the same trap. The removal of faeces can instead be referred to as egestion; the removal of solid waste from the body.

(2 marks)

(b) All living organisms carry out excretion, including plants.

(i) List two examples of excretory waste produced by plants.

(2)

(ii) Name the processes that produce the excretory waste products named in part (i). You should make it clear which process produces each product.

(2)

Answer

(i) Two excretory products produced by plants are...

Any **two** of the following:

- Carbon dioxide; [1 mark]
- Oxygen; [1 mark]
- Water (vapour); [1 mark]

(ii) The processes that produce these products are...

The **relevant two** answers from the following:

- (Carbon dioxide =) respiration; [1 mark]
- (Oxygen =) photosynthesis; [1 mark]
- (Water =) respiration/metabolism; [1 mark]

The processes must match the waste products for marks to be awarded in part (b) (ii).

Ignore references to transpiration in marking point 3 here, as water lost in this way does not come from metabolism.

[Total: 4 marks]

(4 marks)

(c) The passage describes some features of plants.

Complete the passage by writing a suitable word in each blank space.

Plant cells contain a nucleus and can therefore be classified as

The cells are supported by a cell wall made of

In order to carry out to release energy, plants require glucose. They get this glucose by carrying out a process called Any excess glucose can be stored in the plant cells in the form of

Answer

The completed passage is as follows...

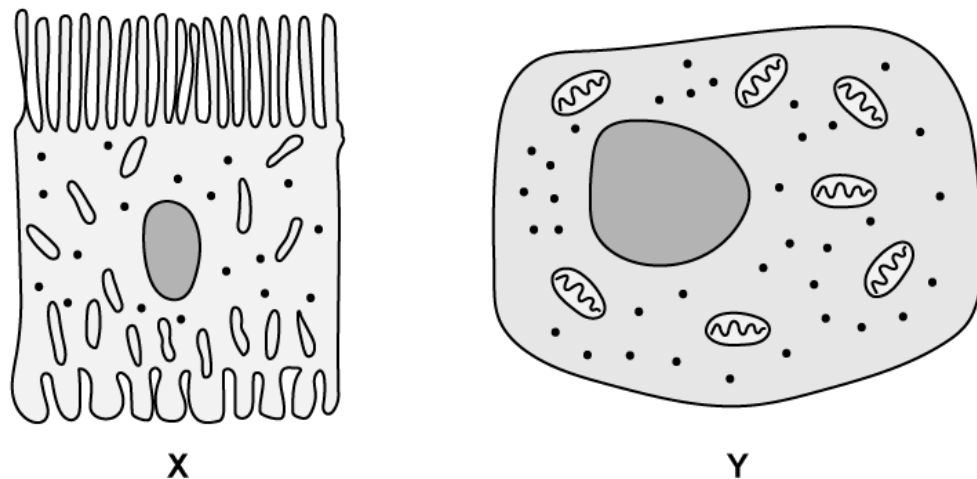
Award 1 mark for each correct answer:

- Plant cells contain a nucleus and can therefore be classified as **eukaryotic/eukaryotes**; [1 mark]
- The cells are supported by a cell wall made of **cellulose**; [1 mark]
- In order to carry out **respiration**; [1 mark] to release energy, plants require glucose. They get this glucose by carrying out a process called **photosynthesis**; [1 mark] Any excess glucose can be stored in the plant cells in the form of **sucrose/starch**; [1 mark]

[Total: 5 marks]

(5 marks)

23 (a) The diagram shows two cells.



Suggest which cell (**X** or **Y**) is better adapted to carry out diffusion and give a reason for your choice.

Answer

The cell better adapted for diffusion is...

- Cell X; [1 mark]
- (Because) it has a larger surface area to volume ratio / a folded membrane which gives a bigger surface for diffusion; [1 mark]

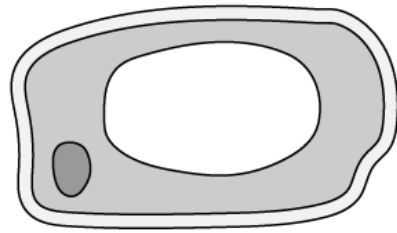
Allow any description of the folded membrane

Do not allow 'X has villi'

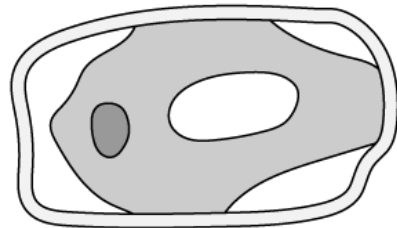
[Total: 2 marks]

(2 marks)

(b) The diagram shows two cells after the effects of osmosis.



A plant cell in
distilled water



An animal cell in highly
concentrated sugar solution

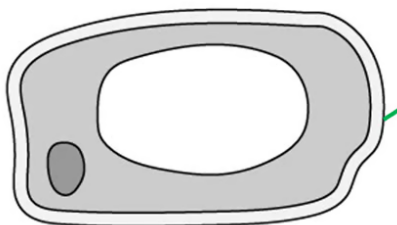
An animal cell in
distilled water

A plant cell in highly
concentrated sugar solution

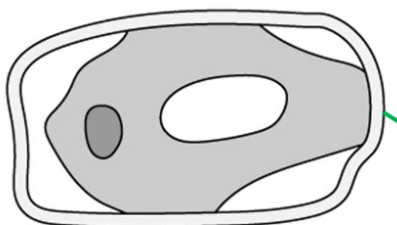
Draw a line from each cell to the correct description.

Answer

The lines should be drawn as follows:



A plant cell in
distilled water



An animal cell in highly
concentrated sugar solution

An animal cell in
distilled water

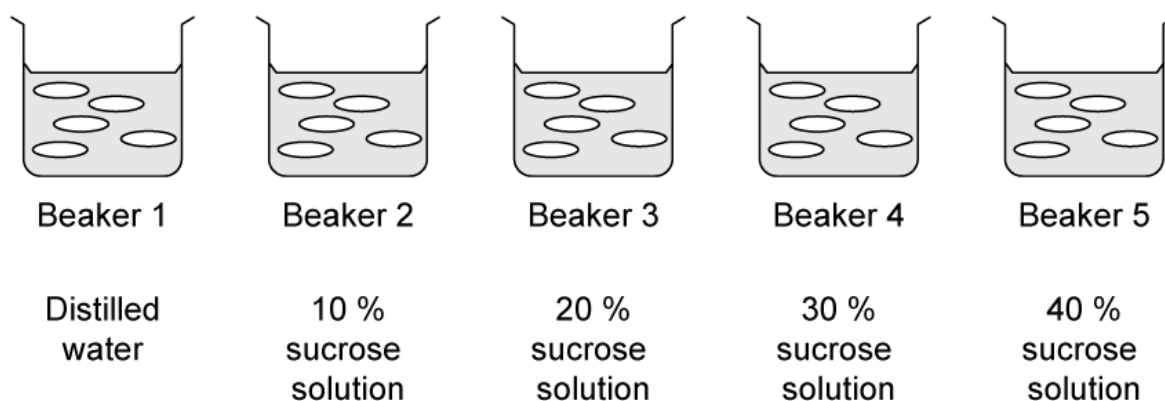
A plant cell in highly
concentrated sugar solution

Award [1 mark] for each correct line

[Total: 2 marks]

(2 marks)

- (c) A student carried out an experiment into osmosis in plant tissue. They set up their investigation as shown below.



Each beaker contained potato discs in a solution of sugar (sucrose) or distilled water.

The student found that the potato discs in Beaker 5 decreased in mass.

With reference to osmosis, explain why this is.

Answer

The potato disks in Beaker 5 decreased in mass because...

Any **two** from the following:

- Water moved out of the potato; [1 mark]
- By osmosis; [1 mark]
- From a high water potential (in the potato) to a low water potential (in the sucrose solution); [1 mark]

[Total: 2 marks]

(2 marks)

- (d) Which of the following is a suitable control variable for the investigation carried out by the student in part (c)?

☐	A	Maintain the same sugar concentration in each beaker
☐	B	Repeat the experiment 3 times
☐	C	Use the same size potato pieces in each beaker
☐	D	Calculate an average of the results

Answer

The correct answer is C because..

Keeping the potato pieces the same size (and the same total mass) makes this a fair test, which is what a control variable should do.

A is incorrect because the sugar concentration is the independent variable, the thing that the student is deliberately changing to examine the effects of changing it.

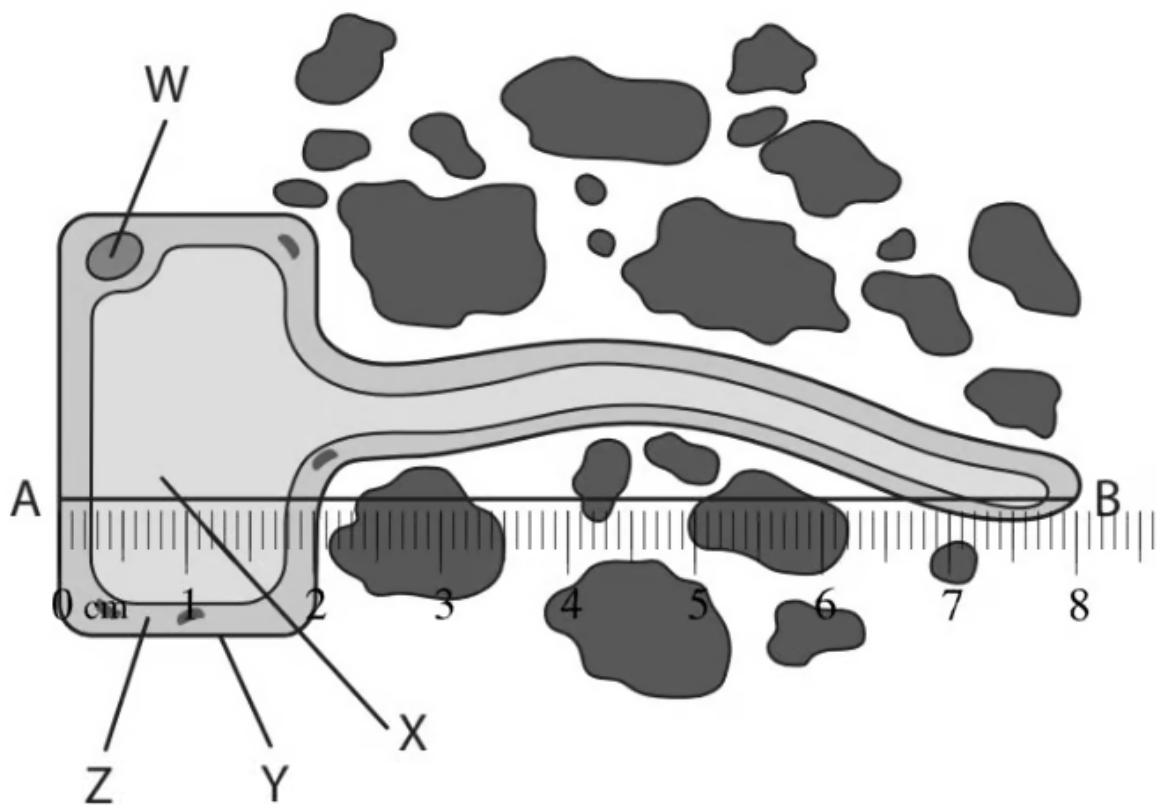
B is incorrect because repeating the experiment will add reliability but does not control any of the variables of the experiment.

D is incorrect because calculating an average (the mean) does not control the variables that might affect the results.

[Total: 1 mark]

(1 mark)

24 (a) The diagram shows a magnified image of a root hair cell from a young plant.



Give the names of structures labelled **W**, **X**, **Y** and **Z**.

Answer

The names of structures labelled W, X, Y and Z are...

- W = nucleus; [1 mark]
- X = cell sap/vacuole; [1 mark]
- Y = (cellulose) cell wall; [1 mark]
- Z = cytoplasm; [1 mark]

[Total: 4 marks]

(4 marks)

(b) The actual length of the cell, along the line between A and B, is 1000 μm .

Calculate the magnification of this drawing.

Answer

The magnification of this drawing is...

- (A-B =) $8 \text{ cm} / 80 \text{ mm} / 80\,000 \mu\text{m} / 80 \text{ (mm)} \times 1000 / 8 \text{ (cm)} \times 10000$ **OR**
(magnification =) $80\,000 \div 1000$; [1 mark]
- (Magnification = $\times$) 80; [1 mark]

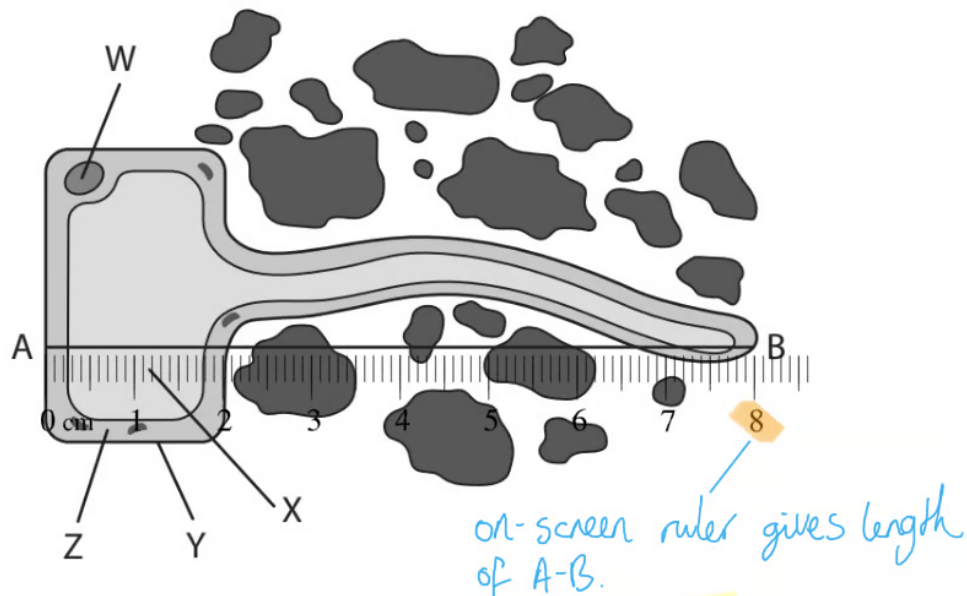
For length A-B allow answers in the range of 7.9-8.2 cm / 79-82 mm.

For the final answer allow answers in the range of 79-82 (this will depend on the measurement of line A-B).

Full marks can be awarded for the correct answer of 79-82 in the absence of other calculations.

[Total: 2 marks]

As ever it is always a good idea to show your workings in calculation questions; marks are often available for correct steps in the process even if your final answer is incorrect.



(b) The actual length of the cell, along the line between A and B, is $1000 \mu\text{m}$.

Calculate the magnification of this drawing.

The length of line A-B in the image is 8 cm
 The actual length of the cell between A-B is $1000 \mu\text{m}$.

convert units so that they match

- cm need to be in μm .

- Note that there are $1000 \mu\text{m}$ in a mm.

$$\left[\begin{array}{l} 8 \text{ cm} = 80 \text{ mm} \\ 80 \times 1000 = 80\,000 \mu\text{m} \end{array} \right] \begin{array}{l} \text{Any of these} \\ = [1 \text{ mark}] \end{array}$$

Calculate how many times bigger the line in the image is than the actual length of line AB.

$$\begin{array}{l} \text{OR} \\ [1 \text{ mark}] \end{array} 80\,000 \div 1000 = 80 \text{ (x bigger)} \quad [1 \text{ mark}]$$

(2 marks)

25 (a) Starch is a carbohydrate which contains glucose.

(i) Give the chemical formula for glucose

(1)

(ii) Starch is a polysaccharide, while some other carbohydrates are disaccharides.

Name the disaccharide which contains glucose and fructose

(1)

Answer

(i) The chemical formula for glucose is...

- $C_6H_{12}O_6$; [1 mark]

(ii) The disaccharide formed from glucose and fructose is...

- Sucrose; [1 mark]

It can be tricky to remember which disaccharide is which; maltose contains two molecules of glucose while **sucrose** contains a molecule of **glucose** and a molecule of **fructose**.

[Total: 2 marks]

(2 marks)

(b) The pancreas, small intestines and salivary glands produce the enzymes involved in the digestion starch.

(i) Describe what an enzyme is.

(2)

(ii) State the name of the enzyme responsible for the digestion of starch.

(1)

Answer

(i) An enzyme is...

Any **two** of the following:

- A protein; [1 mark]
- A biological catalyst; [1 mark]
- Functions to increase the rate of chemical reactions in living organisms **OR** speed up chemical reactions in cells; [1 mark]
- Without being used up / changed (during the reaction); [1 mark]

Ignore 'catalyst' on its own.

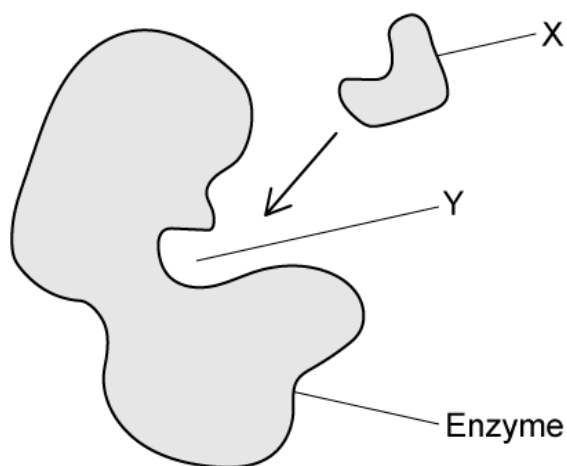
(ii) The enzyme responsible for the digestion of starch is...

- Amylase; [1 mark]

[Total: 3 marks]

(3 marks)

(c) The diagram below shows the mechanism of enzyme action.



State the name given to molecule **X** and location **Y** in a chemical reaction.

Answer

Molecule **X** is known as the...

- Substrate; [1 mark]

Location **Y** is known as the...

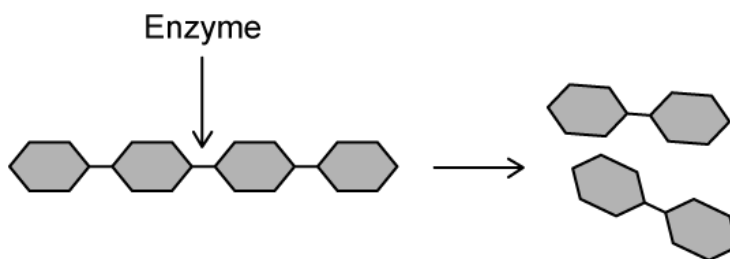
- Active site; [1 mark]

[Total: 2 marks]

A substrate is any substance that an enzyme acts on and the active site is specifically complementary to one substrate.

(2 marks)

(d) The image shows the action of an enzyme on a molecule of starch.



(i) State the name of the product of starch digestion **as shown in the diagram**.

(1)

(ii) Some students used iodine solution to show the rate of the above reaction at different temperatures.

They mixed a starch solution with the enzyme at a range of different temperatures between 20 °C and 60 °C, then added 2 drops of iodine. They timed how long it took for the solution to change from black to brown.

Identify the independent variable and dependent variable in this investigation.

(2)

Answer

(i) The name of the product is...

- Maltose; [1 mark]

You should be aware that starch is made up of **a long chain of glucose molecules**, so when starch is fully broken down, glucose is produced. However, the diagram here shows incomplete digestion; the molecules produced are **disaccharides**. The disaccharide that contains **two molecules of glucose** is **maltose**.

(ii) The variables are....

- Independent = temperature; [1 mark]
- Dependent = time taken for the solution to change from brown to black; [1 mark]

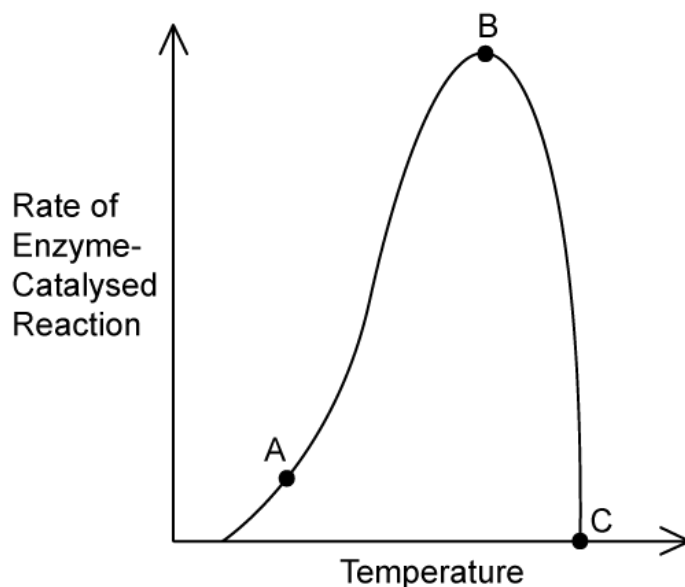
You need to be confident in identifying variables in an experiment. Remember that:

- The independent variable is the one **that we change** on purpose.
- The dependent variable is the one **that we measure** (the dependent variable *depends* on the independent variable).

[Total: 3 marks]

(3 marks)

26 (a) The graph below shows the effect of temperature on the rate of an enzyme-catalysed reaction.



Explain why the rate of an enzyme-catalysed reaction decreases after point **B**.

Answer

The rate of the enzyme catalysed reaction decreases after point **B** because...

Any **two** of the following:

- The enzyme denatures / the bonds holding the active site together are broken; [1 mark]
- The shape of the active site changes / is destroyed/lost; [1 mark]
- The substrate no longer fits into the active site; [1 mark]
- Enzyme-substrate complexes cannot form; [1 mark]

[Total: 2 marks]

Note that this is an 'explain' question, so you need to state **why** the graph has the shape that it does after point B. No marks will be awarded for *describing* the shape of the graph.

It is important you use the key term 'denatured' and not 'killed' as enzymes have never been alive!

(2 marks)

- (b) A scientist investigated how the digestive enzyme amylase breaks down starch into sugar maltose.

He added the enzyme to a solution of starch and measured the concentration of starch every 10 minutes.

The results are shown in the table below.

Time / min	Concentration of starch / mg cm^{-3}
0	17.2
10	11.1
20	7.2
30	5.3
40	4.2

Rate of reaction can be calculated using the following equation:

$$\text{Rate of reaction} = \frac{\text{mass of starch broken down}}{\text{time taken}}$$

Calculate the average rate of the reaction between 0 and 20 minutes.

Answer

The rate of reaction between 0 and 20 minutes was...

- $17.2 - 7.2 / 10$ (mg) **OR** $10 \div 20$; [1 mark]

- $0.5 \text{ (mg cm}^{-3} \text{ min}^{-1}\text{)}$; [1 mark]

[Total: 2 marks]

Time / min	Concentration of starch / mg cm^{-3}
0	17.2
10	11.1
20	7.2
30	5.3
40	4.2

Rate of reaction can be calculated using the following equation:

$$\text{Rate of reaction} = \frac{\text{mass of starch broken down}}{\text{time taken}}$$

Calculate the average rate of the reaction between 0 and 20 minutes.

Calculate the mass of starch broken down between 0-20 minutes:

$$17.2 - 7.2 = 10 \text{ (mg)} \quad [1 \text{ mark}]$$

Substitute numbers into the equation:

$$\text{Rate of reaction} = \frac{10}{20}$$

$$= 0.5 \text{ mg cm}^{-3} \text{ min}^{-1} \quad [1 \text{ mark}]$$

(2 marks)

(c) Bile is a secretion that helps with digestion.

State one way in which bile aids digestion.

Answer

Bile aids digestion as follows...

Any **one** of the following:

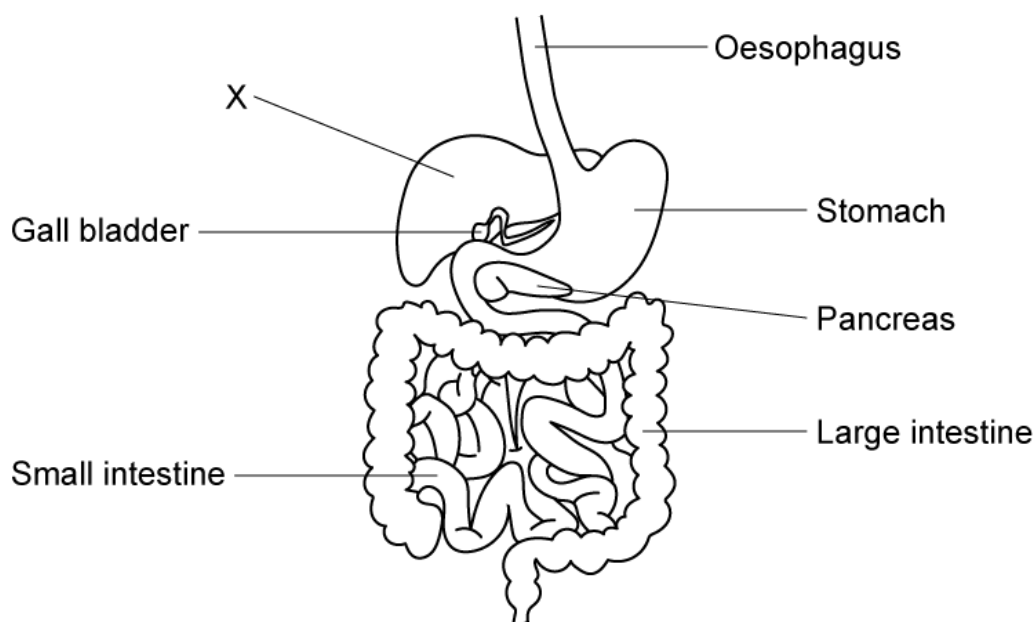
- It neutralises stomach acid / provides the optimum pH for enzymes/named enzymes (of the small intestine); [1 mark]
- It emulsifies fat / breaks large fat droplets into smaller droplets / increases the surface area of fat droplets; [1 mark]

[Total: 1 mark]

Be sure to avoid the misconception that bile contains enzymes, or that it aids in the breakdown of fat molecules; neither of these ideas is correct.

(1 mark)

(d) The diagram below shows the organs of the human digestive system.



(i) Bile is produced by organ X

Name organ **X**.

(1)

(ii) Identify the organ in which bile is stored after it is produced.

(1)

Answer

(i) Organ **X** is the...

- Liver; [1 mark]

(ii) Bile is stored in the...

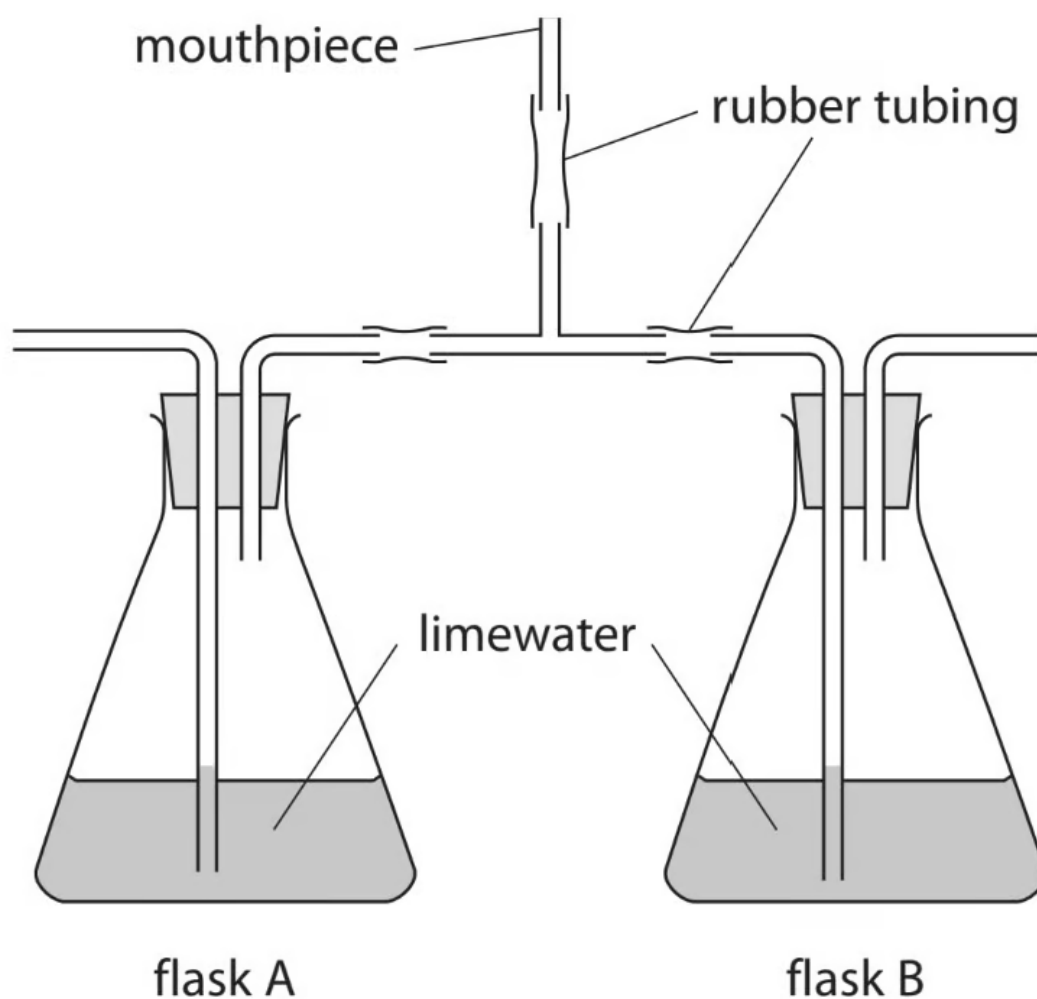
- Gall bladder; [1 mark]

[Total: 2 marks]

Remember, bile is produced in the liver and stored in the gall bladder.

(2 marks)

27 (a) The diagram shows apparatus a student uses to compare inhaled and exhaled air.



The student breathes into and out of the mouthpiece for one minute.

(i) Explain which flask exhaled air passes through.

(2)

(ii) Explain the changes that will happen in the limewater in flask A and in flask B.

(2)

(iii) The student uses limewater to compare the composition of exhaled and inhaled air.

Suggest an alternative substance that they could use.

(1)

Answer

(i) The flask exhaled air passes through is...

Any **two** of the following:

- (Flask B) as (mouthpiece is) connected to the long tube in flask B / (mouthpiece is) connected to flask A is shorter; [1 mark]
- (In flask B the) tube (from the mouthpiece is) in limewater / the tube is in liquid in flask B / causes bubbles (in limewater) in B / (the tube is) not in liquid / draws air in flask A; [1 mark]
- (The student) cannot inhale in flask B as the limewater would be sucked in / (they) would get a mouthful of liquid / Flask A is for inhalation as no liquid is drawn up; [1 mark]

No marks awarded if Flask A was identified at marking point 1.

(ii) The changes that will happen in the limewater in flask A and B are...

Any **two** of the following:

- (Limewater in) flask A stays clear / no change / less cloudy / goes cloudy slowly; [1 mark]
- (Limewater in) flask B goes (more) cloudy / milky / cloudy quicker; [1 mark]
- (Because there is) less carbon dioxide in inhaled/atmospheric air **OR** (more) carbon dioxide in exhaled (air); [1 mark]
- (There is more carbon dioxide in exhaled air) due to respiration; [1 mark]

Allow 1 mark if it is stated that the limewater goes cloudy in both flasks (due to the presence of CO₂).

Ignore reference to no CO₂ in inhaled air.

(iii) An alternative substance they could use to test the composition of inhaled and exhaled air is...

- Sodium hydrogen-carbonate / sodium bicarbonate (solution)/ hydrogen-carbonate / bicarbonate indicator; [1 mark]

[Total: 5 marks]

(5 marks)

(b) Describe the role of the diaphragm and the intercostal muscles in inhalation.

Answer

The role of the diaphragm and the intercostal muscles in inhalation is...

Any **four** of the following:

- Diaphragm contracts; [1 mark]
- Diaphragm flattens / moves down; [1 mark]
- (External) intercostal muscles contract; [1 mark]
- Rib cage is raised / moves out; [1 mark]
- Volume (of chest cavity/thorax) increases; [1 mark]
- Pressure in (chest cavity/thorax) decreases/reduces; [1 mark]
- Air drawn into lungs / lungs inflate; [1 mark]

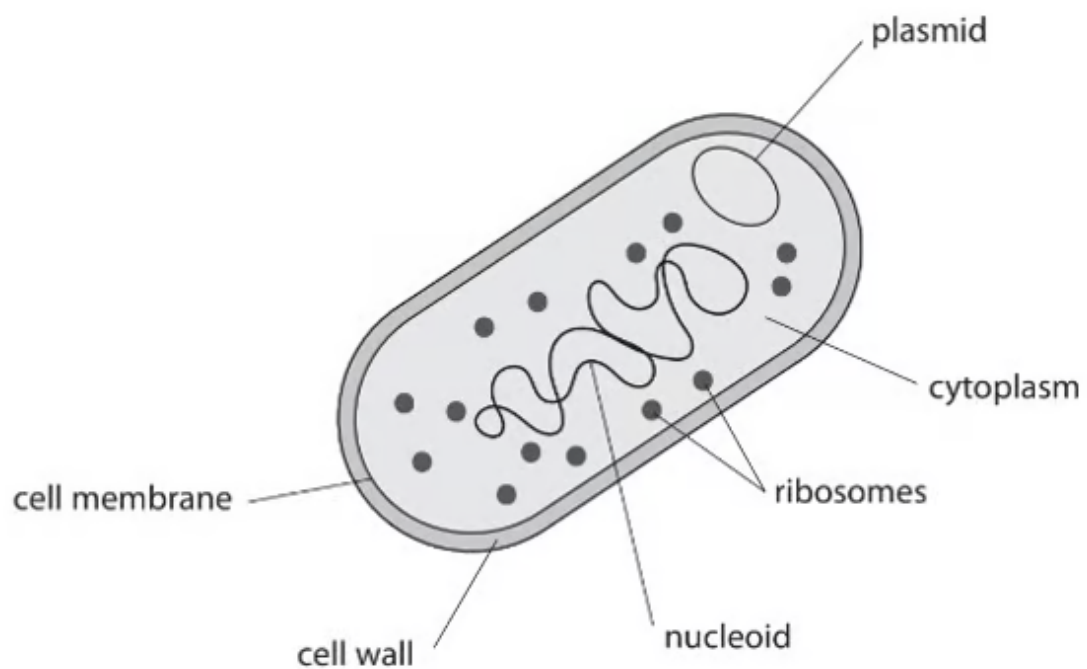
Ignore reference to the volume of the lungs increasing at marking point 5.

[Total: 4 marks]

(4 marks)

28 *P. multocida* is a bacterium that causes cholera in chickens.

The diagram shows the bacterium.



Give **two** structures in this bacterium that are also found in all eukaryotic cells.

Answer

Structures in the bacterium that are also found in eukaryotic cells include...

Any **two** of the following:

- Cytoplasm; [1 mark]
- Ribosomes; [1 mark]
- Cell membrane; [1 mark]
- DNA; [1 mark]

[Total: 2 marks]

You should be able to compare the basic structure of a prokaryotic cell with a eukaryotic cell. Remember that prokaryotes (such as bacteria) do not have membrane-bound organelles such as mitochondria, chloroplasts or a nucleus.

(2 marks)

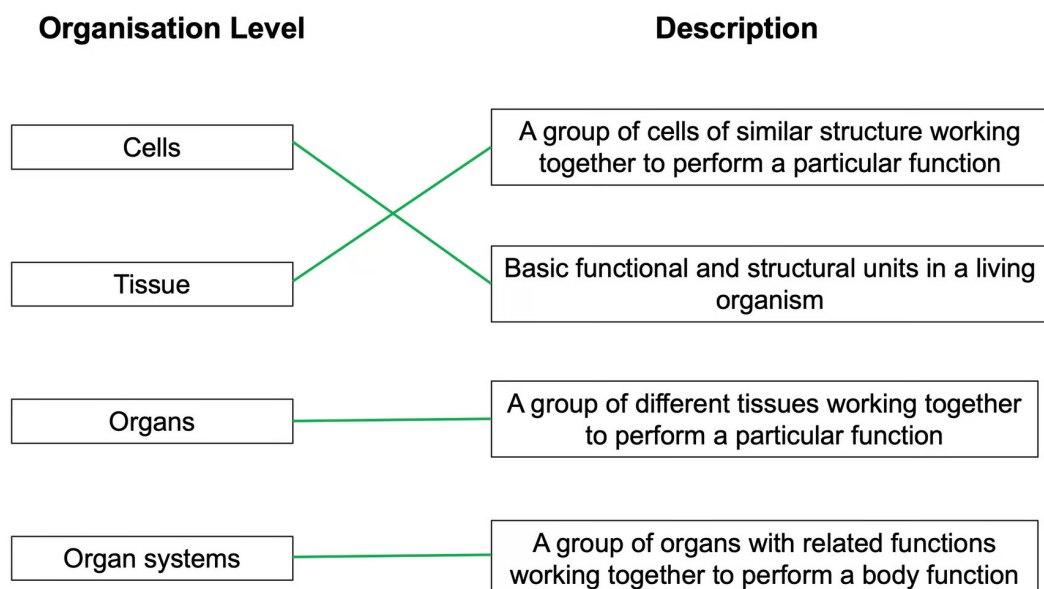
- 29 (a)** The diagram below shows four different levels of organisation and a number of descriptions.

Organisation level	Description
Cells	A group of cells of similar structure working together to perform a particular function
Tissue	Basic functional and structural units in a living organism
Organs	A group of different tissues working together to perform a particular function
Organ systems	A group of organs with related functions working together to perform a body function

Draw **one** line from each organisation level to the correct description.

Answer

The completed lines should be as follows...



- 3 or 4 lines correct; [2 marks]
- 1 or 2 lines correct; [1 mark]

Reject any mark when more than one line has been drawn from an organisation level.

[Total: 2 marks]

(2 marks)

(b) Below are some statements about organelles.

Identify the **incorrect** statement.

☐	A	Organelles are found within cells.
☐	B	Bacteria contain fewer different organelles than plant cells.
☐	C	The nucleus is an organelle.
☐	D	Organelles are small organs.

Answer

The correct answer is D.

Organelles are structures within cells that carry out specific roles, such as the nucleus and chloroplasts.

Bacterial cells are prokaryotic so do not contain any internal membrane-bound organelles. This means that they have fewer types of organelle than eukaryotic plant cells.

[Total: 1 mark]

(1 mark)

(c) The table below lists some organ systems found in the human body.

Complete the table by naming an organ from each organ system.

Organ System	Organ
Digestive system	
Circulatory system	
Respiratory system	

Answer

The correct completed table is as follows...

Organ System	Organ
Digestive system	Oesophagus / stomach / pancreas / small intestine / gall bladder / large intestine; [1 mark]
Circulatory system	Heart / arteries / veins / blood vessels; [1 mark]
Respiratory system	Lung / diaphragm / trachea / bronchi / bronchioles; [1 mark]

[Total: 3 marks]

(3 marks)

30 (a) Which of these is the balanced chemical symbol equation for aerobic respiration?

☐	A	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2$
☐	B	$\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$
☐	C	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{CO}_2 \rightarrow 6\text{O}_2 + 6\text{H}_2\text{O}$
☐	D	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$

Answer

The correct answer is D because...

Oxygen and glucose react together to release energy. Carbon dioxide and water are the products.

A is incorrect because the equation is not balanced therefore cannot happen in reality.

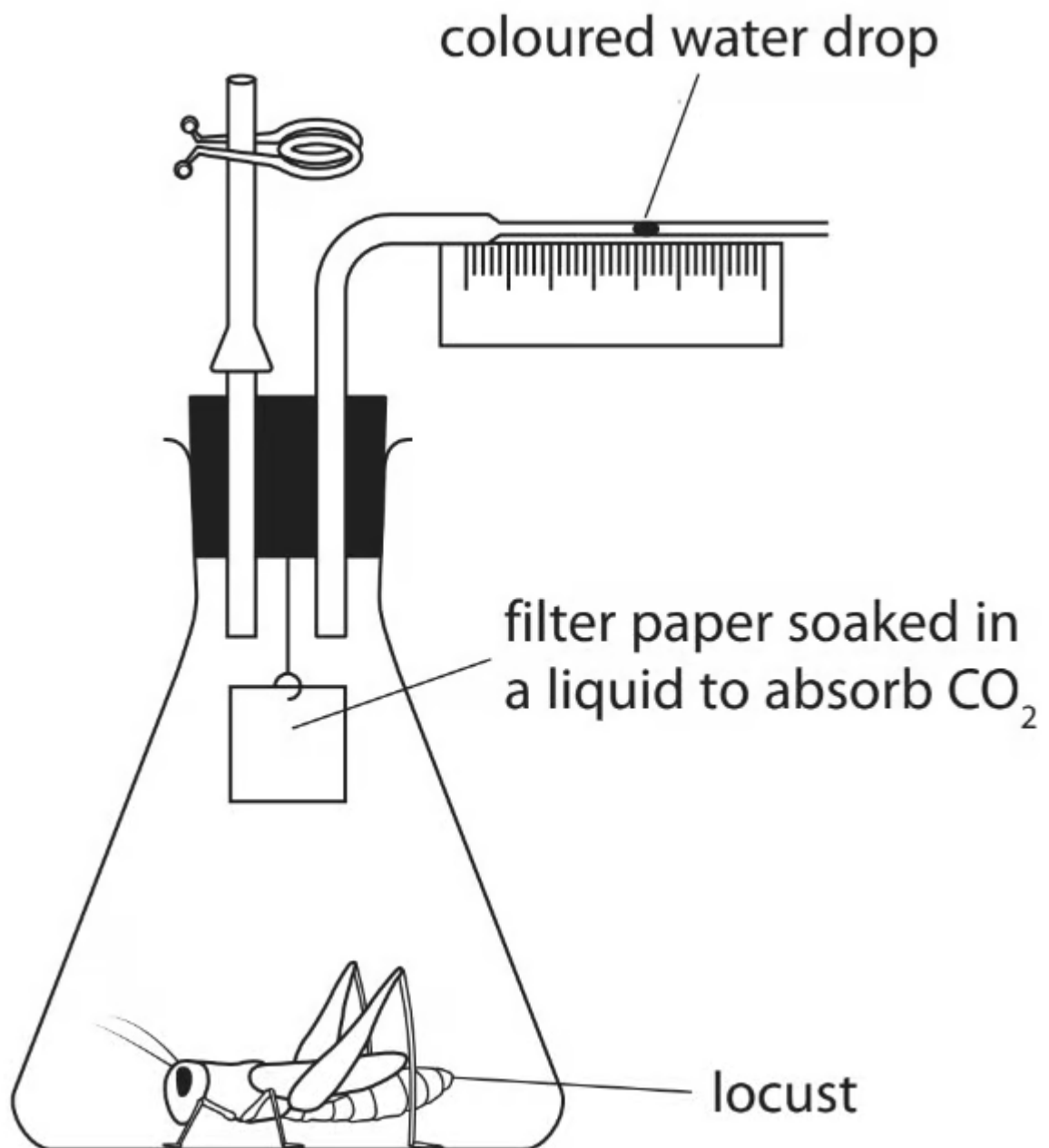
B is the equation for a form of *anaerobic* respiration.

C is incorrect because the reactant (O_2) and product (CO_2) are on the wrong sides of the equation.

[Total: 1 mark]

(1 mark)

(b) A student uses this apparatus to investigate aerobic respiration in a locust.



(i) The coloured water drop moves during the investigation.

Explain why the coloured water drop moves during the investigation.

(2)

(ii) The student compares the aerobic respiration of male and female locusts.

He uses three male locusts and three female locusts.

He uses locusts of the same age and the same species.

Explain **three** other variables that the student needs to control.

(6)

Answer

(i) The coloured water drop moves during the investigation because...

Any **two** of the following:

- (The bubble moves) left / towards the locust; [1 mark]
- Carbon dioxide produced by insect is absorbed by potassium hydroxide/KOH / filter paper; [1 mark]
- Oxygen (is used by insect); [1 mark]
- In the process of respiration; [1 mark]

Even though there is no mark awarded for mentioning pressure changes, it is changes in gas pressure that cause the movement of the bubble. Because oxygen is used up and the carbon dioxide that replaces it in the air gets absorbed by the potassium hydroxide, this will cause an overall decrease in gas pressure because all gases occupy the same amount of volume. With effectively less gas in the system, the bubble moves left as higher-pressure air on the outside pushes it towards the locust.

(ii) Three other variables that the student needs to control are...

Any **three** of the following pairs of points:

- The size / mass / (of locusts); [1 mark]
- Because more cells means more respiration; [1 mark]

OR

- Movement allowed for the locust / the size of the flask; [1 mark]
- Because more room for movement means more respiration; [1 mark]

OR

- Volume* / concentration of KOH / size of filter paper; [1 mark]
- Because that affects the amount of carbon dioxide absorbed; [1 mark]

OR

- Temperature; [1 mark]
- Because it affects enzymes / increase kinetic energy / particle movement; [1 mark]

OR

- Time / duration of the experiment; [1 mark]
- Because with more time to respire / more oxygen will be absorbed by the locust; [1 mark]

**Ignore the word 'amount' when volume can be used.*

Ignore time of day / light / oxygen / humidity etc.

[Total: 8 marks]

(8 marks)

(c) The table shows the student's results.

	Distance moved by coloured water drop in mm	
	Male	Female
Trial 1	5.0	5.4
Trial 2	4.9	5.2
Trial 3	2.0	5.2
Mean	5.0	

(i) Complete the table by giving the missing mean value.

(1)

(ii) Comment on the reliability of the data in the table.

(3)

Answer

(i) The missing mean value is calculated as follows...

$$\bullet \frac{5.4 + 5.2 + 5.2}{3} = \frac{15.8}{3} = 5.3; [1 \text{ mark}]$$

	Distance moved by coloured water drop in mm	
	Male	Female
Trial 1	5.0	5.4
Trial 2	4.9	5.2
Trial 3	2.0	5.2
Mean	5.0	

Step 1: Look at how the male mean has been calculated

Trial 3 is an anomaly so should not be included.

Step 2: Take a mean $\frac{4.9 + 5.0}{2} = 5.0$

Step 3: Look for anomalies in the female data. There are no anomalies, the data all fits a pattern.

Step 4: Take a mean of 3 values

$$\frac{5.4 + 5.2 + 5.2}{3} = 5.3$$

[1 mark]

(ii) Comments on the reliability of the data are as follows...

Any **three** of the following...

- The data is not reliable / reliability can be increased; [1 mark]
- There are not enough repeats / only three results / needs to be repeated more times; [1 mark]
- One result is anomalous / male 3 result is anomalous; [1 mark]
- There is more variation within sex than between sexes; [1 mark]

[Total: 4 marks]

(4 marks)

- 31 (a)** The table shows a list of positive and negative results for some tests that can be used to detect the presence of food substances.

Test reagent	Substance being tested	Result if positive	Result if negative
		Purple	Blue
		Blue/black	Orange/brown
		Green/orange/red	Blue

Complete the table to identify the test reagent and substance being tested.

Answer

The completed table is as follows...

Award **1 mark** for each correct **row**:

Test reagent	Substance being tested	Result if positive	Result if negative
Biuret solution	Protein	Purple	Blue
Iodine solution	Starch	Blue/black	Orange/brown
Benedict's solution	Glucose	Green/orange/red	Blue

Accept 'reducing sugars' for the substance tested for by Benedict's solution.

[Total: 3 marks]

(3 marks)

- (b) A balanced diet should contain a variety of different biological molecules, each of which is digested by a specific set of enzymes.

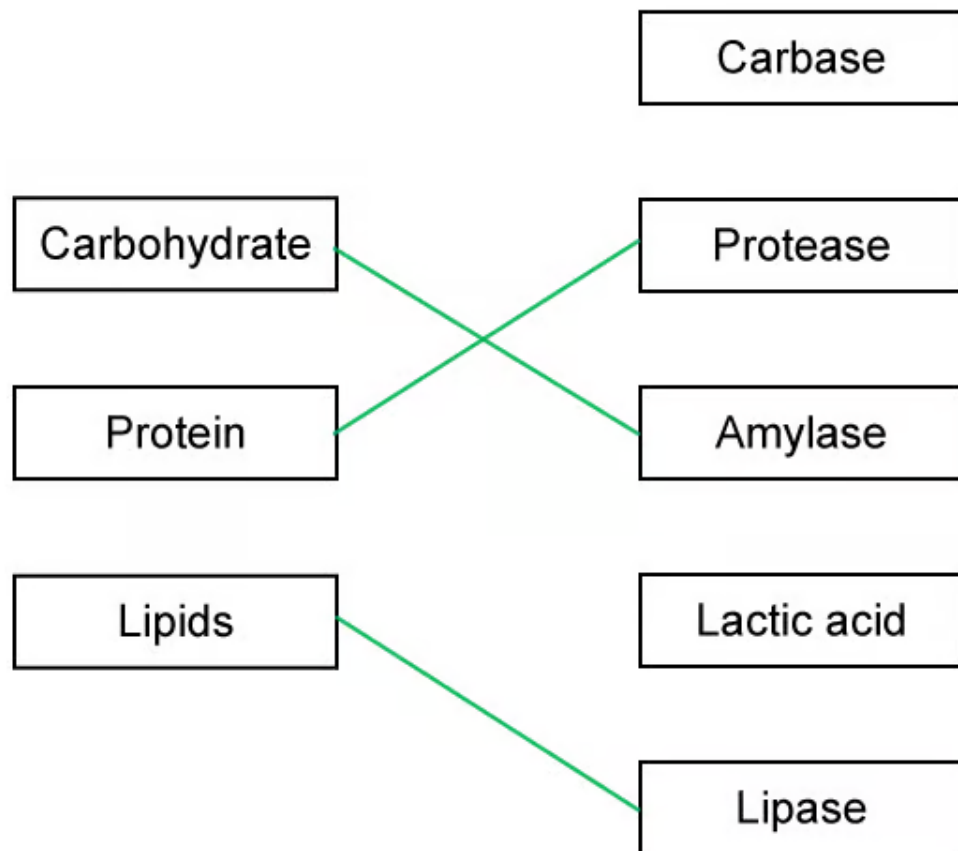
Using a straight line, match up the molecule to the specific enzyme involved in its digestion.

	Carbbase
Carbohydrate	Protease
Protein	Amylase
Lipids	Lactic acid
	Lipase

Answer

The lines should match up the enzymes and molecules as follows...

Award 1 mark for each correctly drawn line:

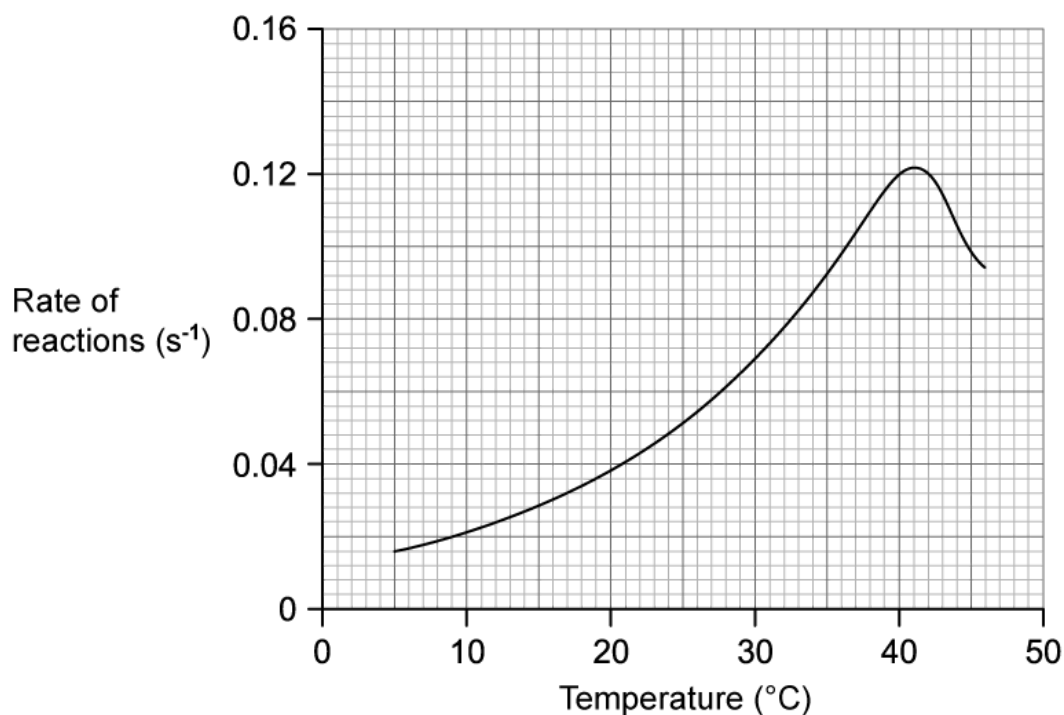


Reject any biological molecules for which more than one line has been drawn.

[Total: 3 marks]

(3 marks)

(c) The graph below shows the effect of temperature on an enzyme controlled reaction.



Explain the rate of reaction at 41 °C.

Answer

This rate of reaction can be explained as follows...

Any **one** of the following:

- This is the optimum temperature for enzyme activity; [1 mark]
- Enzymes are catalysing the reaction at the fastest rate possible / enzyme-substrate complexes are forming as fast as possible; [1 mark]

[Total: 1 mark]

(1 mark)

(d) Enzymes are examples of proteins.

Which of the following combinations of chemical elements shows the correct four elements found in proteins?

☐	A	Carbon, hydrogen, oxygen and amino acids
☐	B	Carbon, hydrogen, oxygen and nitrogen
☐	C	Carbon, oxygen, calcium and nitrogen
☐	D	Hydrogen, oxygen, nitrogen and sulfur

Answer

The correct answer is B.

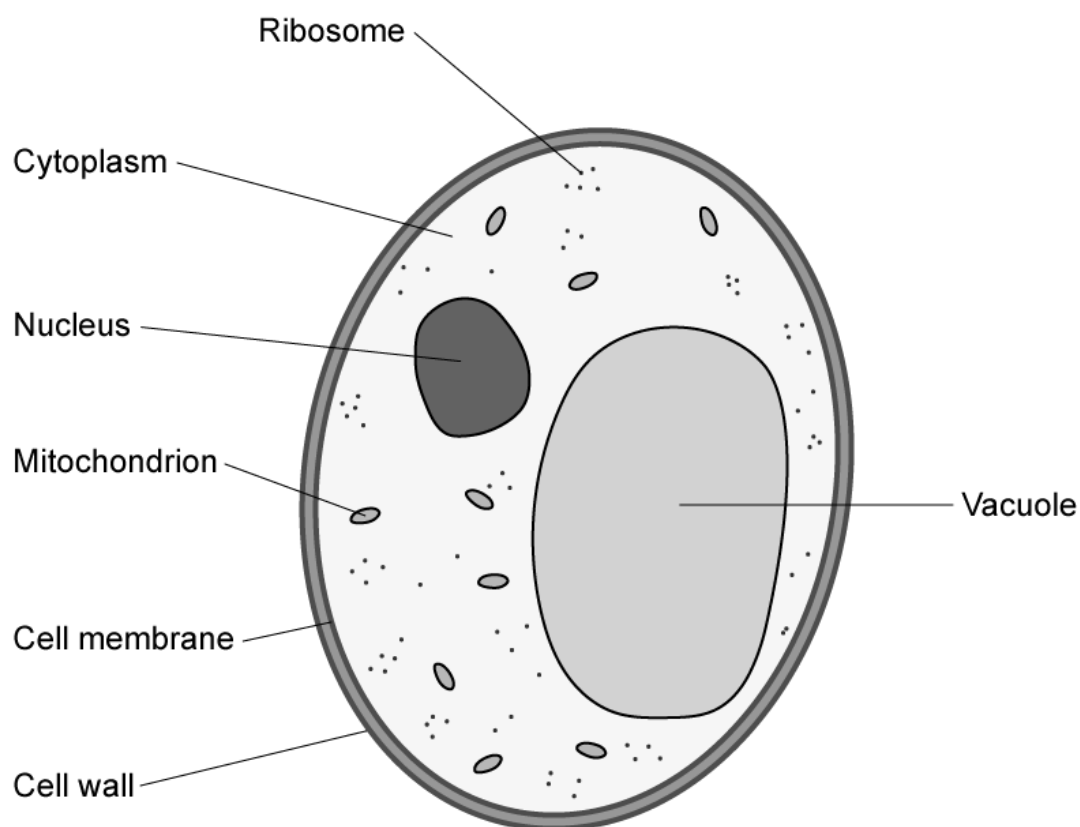
All biological molecules contain H, O and C. Proteins also have nitrogen.

The other answers are incorrect because they contain the wrong combination of molecules. Amino acids are not chemical elements and calcium and sulfur are elements which are not part of the main four elements that build proteins.

[Total: 1 mark]

(1 mark)

32 (a) The diagram shows a yeast cell.



(i) Which substance makes up the composition of the yeast cell wall?

(1)

☐	A	Cellulose
☐	B	Chitin
☐	C	Glycogen
☐	D	Starch

(ii) Which of these structures found in the yeast cell would also be present in a prokaryotic cell?

☐	A	Cell membrane
☐	B	Mitochondrion
☐	C	Nucleus
☐	D	Vacuole

Answer

(i) **The correct answer is B because...**

Yeast are fungi, and fungal cell walls are made of chitin.

A is incorrect because **plant** cells walls are made of cellulose.

C and **D** are incorrect because these are both forms of carbohydrate storage and do not form part of cell walls.

(ii) **The correct answer is A because...**

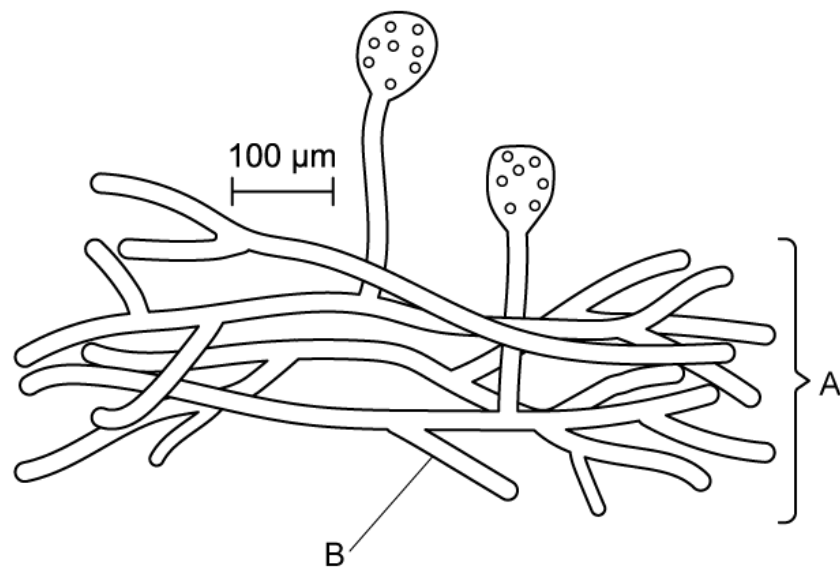
All cells are surrounded by a cell membrane; both eukaryotic and prokaryotic.

B, **C** and **D** are all incorrect because they are membrane-bound (surrounded by their own membranes), meaning that they are not present in prokaryotic cells.

[Total: 2 marks]

(2 marks)

(b) The diagram below shows a species of multicellular fungi.



Name the structures labelled **A** and **B** on the diagram.

Answer

The parts in the diagram are...

- A = mycelium; [1 mark]
- B = hyphae; [1 mark]

[Total: 2 marks]

Fungal hyphae have a long, thread-like structure. Mycelium is the name given to a large network of hyphae.

(2 marks)

- (c) Fungi were once classified as plants because they grow out of the soil, but they are now considered to be a separate kingdom of organisms.

One difference between plant and fungal cells is that plant cells contain chloroplasts and gain their nutrition through the process of photosynthesis, while fungal cells do not. Describe how fungi gain their nutrients.

Answer

Fungi get their nutrition by...

- Saprotrophic nutrition; [1 mark]
- (Fungi) secrete enzymes extracellularly / out of their cells; [1 mark]
- The cells absorb the products/nutrients from their environment; [1 mark]

[Total: 3 marks]

(3 marks)

- 33 (a)** Pre-cut potato chips can be stored in salt solution before being cooked in restaurants. To avoid the chips becoming too salty, it is important to make sure that water does not move in or out of the chips as they are stored.

A scientist wanted to collect some data about the salt content of potato chips to inform the restaurants of the best storage concentration.

The steps in the table refer to the method that the scientist used to collect his results.

1	Measure out 100ml of each salt solution into 5 different test tubes
	Remove the chips, pat dry and reweigh
	Cut 5 potato chips of similar size and dimensions
	Place 1 chip into each concentration of salt solution and leave for 1 hour
	Record the mass of the potato chips

Place the steps in the correct order by adding numbers **2** to **5** into the left hand column of the table. The first stage has been labelled for you.

Answer

The table should be completed as follows:

1	Measure out 100ml of each salt solution into 5 different test tubes
5	Remove the chips, pat dry and reweigh
2	Cut 5 potato chips of similar size and dimensions
4	Place 1 chip into each concentration of salt solution and leave for 1 hour
3	Record the mass of the potato chips

Allow [2 marks] for a correct order as shown above.

Allow [1 mark] for answers with 1 step out of place

No marks should be awarded for answers with more than 1 step in the wrong order

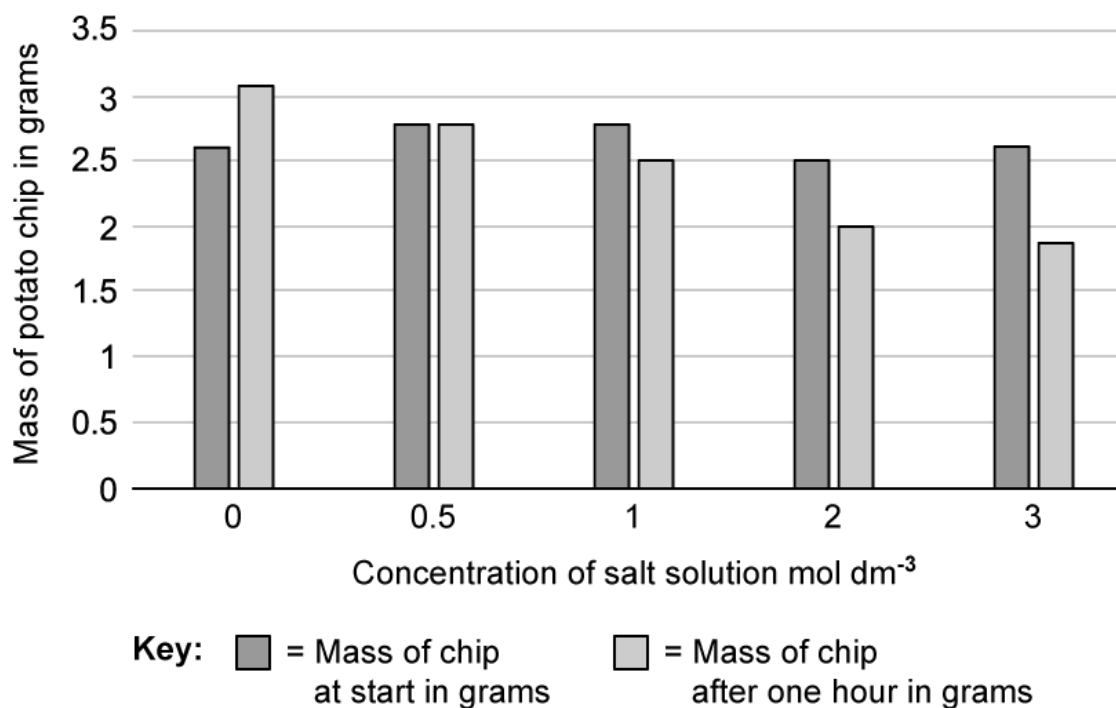
[Total: 2 marks]

You don't necessarily need to be familiar with the practical method to answer this question, but you should be careful to ensure that the steps are in a logical order.

(2 marks)

(b) The graph shows the results obtained by the scientist when completing the investigation

from part (a).



In which salt solution did the mass of the chip increase after one hour?

Answer

The mass of the chip increased in

- 0 mol dm^{-3} / distilled water; [1 mark]

[Total: 1 mark]

(1 mark)

(c) Explain what led to this increase in mass of the chip identified in part (b).

☐	A	Water moved out of the chip by osmosis
☐	B	Salt moved into the chip by diffusion
☐	C	Water moved into the chip by osmosis
☐	D	The chip reacted with the salt in the solution

Answer

The correct answer is C because...

The water moved from a high water concentration (distilled water is pure water) to a low water concentration (in the potato).

The mass gained comes from the water that moves into the potato, therefore **A** cannot be correct.

The salt does not move so **B** is not correct.

There is no reaction so **D** is not correct.

[Total: 1 mark]

(1 mark)

- (d) The scientist concluded that the best solution for storing chips in would be 0.5 mol dm^{-3} salt solution because there would be no net (overall) movement of water into or out of the potato chips.

Suggest how the scientist can tell this from the results in the graph in part (b).

Answer

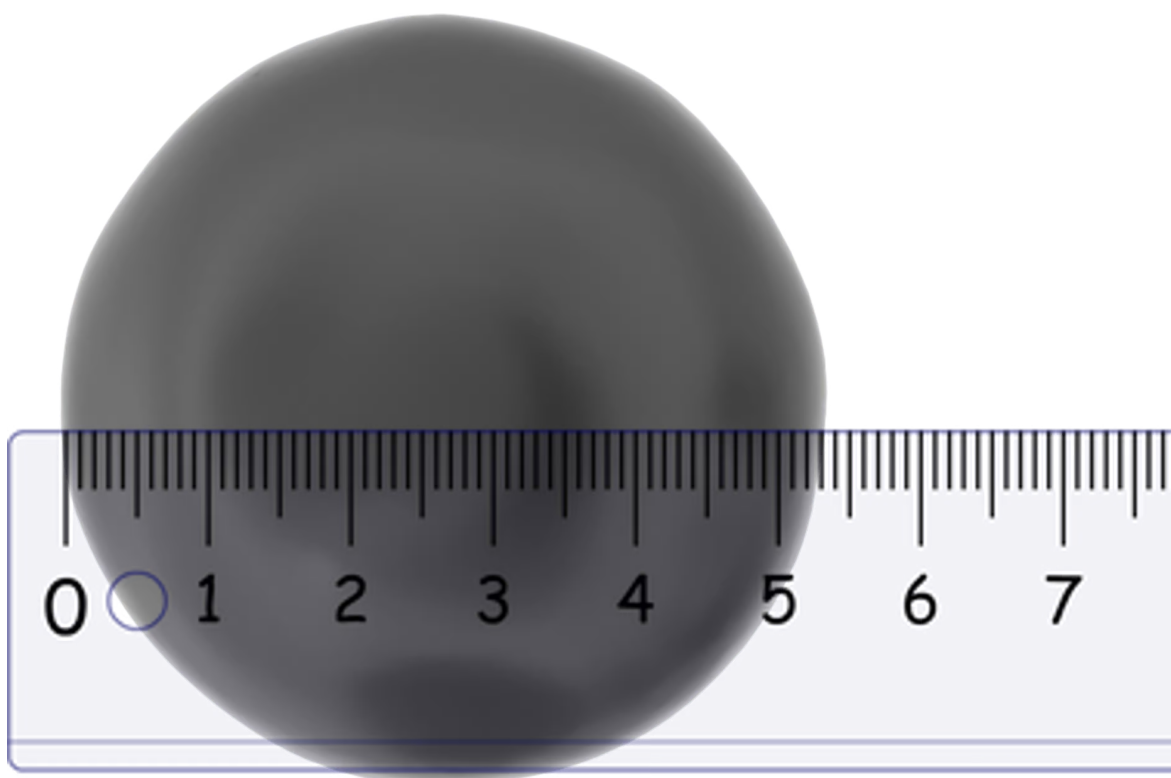
The scientist could tell this from the results in the graph because...

- The mass (of the chip in 0.5 mol dm^{-3} salt solution) remained the same after 1 hour;
[1 mark]

[Total: 1 mark]

(1 mark)

- 34 The image below shows a red blood cell viewed under a microscope using a magnification of $\times 6000$



Use the formula provided to calculate the actual diameter of the red blood cell. Give your answer in mm.

$$\text{Actual diameter of cell in mm} = \frac{\text{diameter shown in the image in mm}}{\text{magnification}}$$

Answer

The actual diameter of the cell is...

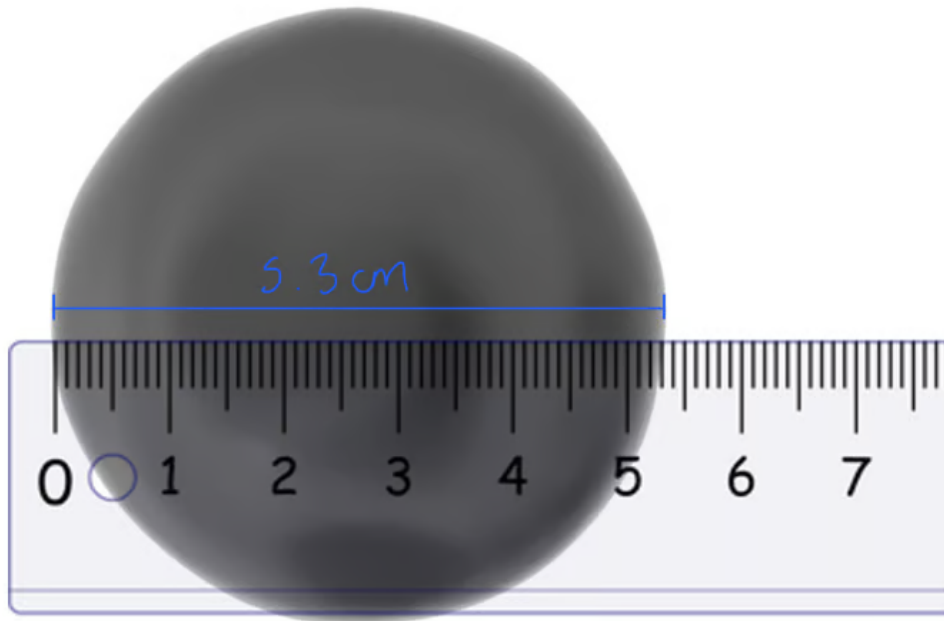
- $53 \div 6000$; [1 mark]
- 0.008 (mm); [1 mark]

Allow 1 mark for $8 \mu\text{m}$.

[Total: 2 marks]

The question asks you to give the answer in mm, and the formula states that the values should be in mm, so be sure to convert the measurement on the diagram (which is in cm) into mm before completing the calculation.

The image below shows a red blood cell viewed under a microscope under a magnification of $\times 6000$



Use the formula provided to calculate the actual diameter of the red blood cell. Give your answer in mm.

Measured on image as 5.3 cm (2)

$$\text{Actual diameter of cell in mm} = \frac{\text{diameter shown in the image in mm}}{\text{magnification}}$$

Substitute values into formula:

$$\begin{aligned} \text{Actual diameter} &= \frac{53}{6000} \quad [1 \text{ mark}] \\ &= 0.008 \quad [1 \text{ mark}] \end{aligned}$$

Handwritten notes: 53 mm in 5.3 cm (10 mm in a cm)

(2 marks)

35 (a) A student decided to investigate the effect of different salt solutions on the mass of chicken eggs.

They used the following method:

1. 5 eggs were placed in acid for 24 hours to dissolve the eggshell.
2. The mass of each egg was measured and recorded.
3. Five beakers were set up; four with 200 cm^3 of a salt solution of a particular concentration and one with water (0.0 mol dm^{-3}).
4. An egg was placed in each of the beakers.
5. After 1 hour, the eggs were removed and dried with a paper towel.
6. The mass of each egg was measured and recorded.

Their results are shown in the table below:

Concentration of salt solution (mol dm^{-3})	Mass of egg without shell in grams	Mass of egg after 1 hour in solution in grams
0.0	74.5	79.2
0.2	73.0	75.8
0.4	74.2	75.5
0.6	73.6	72.0
0.8	75.8	71.5

Calculate the percentage change of the egg placed in the 0.4 mol dm^{-3} salt solution.

Give your answer to **two** significant figures.

Answer

The percentage change of the egg placed in the 0.4 mol dm^{-3} salt solution is:

- $(1.3 / 74.2) \times 100 = 1.75$; [1 mark]
- $= 1.8\%$; [1 mark]

Full marks awarded for the correct answer only

[Total: 2 marks]

Concentration of salt solution (mol dm^{-3})	Mass of egg without shell in grams	Mass of egg after 1 hour in solution in grams
0.0	74.5	79.2
0.2	73.0	75.8
0.4	74.2	75.5
0.6	73.6	72.0
0.8	75.8	71.5

Calculate the percentage change of the egg placed in the 0.4 mol dm^{-3} salt solution.

Give your answer to **two** significant figures.

$$\% \text{ change} = \frac{\text{Difference}}{\text{Start}} \times 100$$

$$= \frac{75.5 - 74.2}{74.2} \times 100 \quad [1 \text{ mark}]$$

$$= 1.75\% \quad 2 \text{ sig figs}$$

$$= \underline{1.8\%} \quad [1 \text{ mark}]$$

↑ 2 marks for the correct answer with no working shown

(2 marks)

(b) Explain why in some of the solutions the mass of the eggs decreased.

Answer

The mass of the eggs in some solutions decreased because:

- The mass decreased when water moved out of the egg by osmosis; [1 mark]
- Through a partially permeable membrane; [1 mark]
- Because the solution it was in was more concentrated (and the solution in the egg was more dilute); [1 mark]

[Total: 3 marks]

(3 marks)

(c) Explain what the student would need to do to determine an estimate of the concentration of the solution inside an egg.

Answer

In order to determine an estimate of the concentration of the solution inside an egg, the student will need to:

Any **three** of the following:

- Calculate the percentage change of each egg placed in a salt solution; [1 mark]
- Plot the percentage change in mass on a (scatter) graph; [1 mark]
- Draw a line of best fit; [1 mark]
- Determine the concentration where the line crosses the zero percentage change (in mass); [1 mark]

[Total: 3 marks]

You may be asked to plot a graph and work this out for yourself. Make sure you feel confident with your understanding of this process.

(3 marks)

(d) State **one** safety precaution the student would need to carry out during this experiment.

Answer

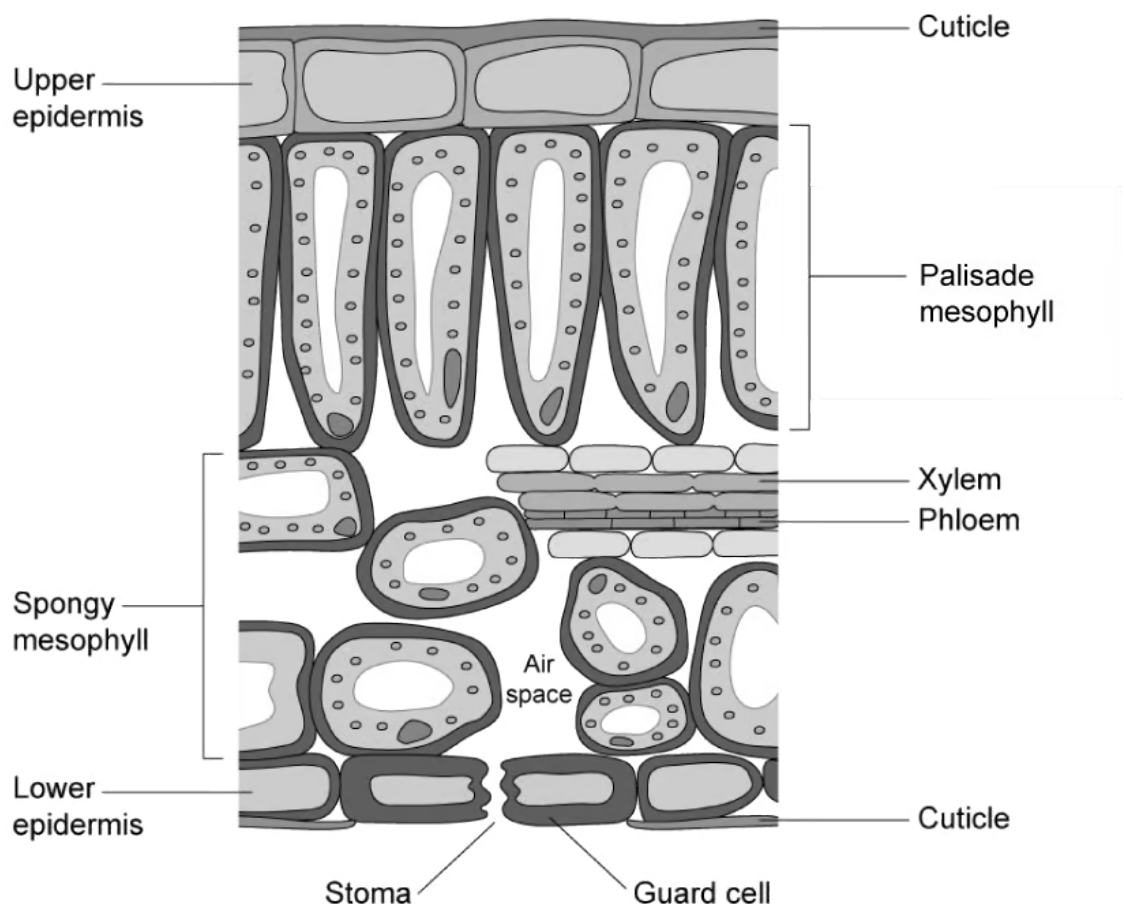
One safety precaution would be...

- Goggles / lab coat / tongs / tie hair / tuck tie away / gloves; [1 mark]

[Total: 1 mark]

(1 mark)

36 (a) The image below shows the structure of a leaf in a green plant magnified 220 times.



For the image above:

(i) Name **one** type of organelle visible.

(1)

(ii) Name **two** types of cell visible.

(2)

(iii) Name **two** types of tissue present.

(2)

Answer

(i) One type of organelle visible is...

Any **one** of the following:

- Nucleus; [1 mark]
- Chloroplast; [1 mark]
- Vacuole; [1 mark]

Ignore cell wall, cell membrane and cytoplasm.

An organelle is a cellular structure found within a cell. Here the **visible** internal structures are the nucleus, chloroplasts, and vacuoles; other organelles that you may have come across are not visible here.

Note that structures such as the cell wall and the cell membrane are not organelles, as they are not structures *within* the cells. The cytoplasm is not a *structure* so this is also not an organelle.

(ii) Types of cell visible include...

Any **two** of the following:

- Palisade (mesophyll) cell; [1 mark]
- Guard cell; [1 mark]
- Epidermis cell; [1 mark]
- Spongy mesophyll cell; [1 mark]
- Xylem cell/vessel; [1 mark]

Ignore phloem as this is not a cell type.

Any cell type visible in the diagram is an acceptable answer. You must make it clear that you are referring to the **individual cells** rather than the tissue type to which the cells belong.

(iii) Types of tissue visible include...

Any **two** of the following:

- Epidermis/dermal (tissue); [1 mark]

- Palisade mesophyll (tissue); [1 mark]
- Spongy mesophyll (tissue); [1 mark]

[Total: 5 marks]

(5 marks)

(b) Explain why the leaf shown in part (a) is an example of an organ.

Answer

The leaf is an example of an organ because...

- It contains a group/collection of / several tissues; [1 mark]
- Which work together to carry out photosynthesis; [1 mark]

[Total: 2 marks]

Here you need to apply your knowledge of the term 'organ' to the specific example of a leaf.

Leaves are the organs of the plant that are adapted to maximise photosynthesis. They contain **several tissues** which **work together** to carry out this particular function.

(2 marks)

(c) The leaf image in part (a) measures 6 cm from top to bottom.

Use the formula below to calculate the actual thickness of the leaf. Give your answer in mm.

$$\text{Actual thickness} = \frac{\text{Image thickness}}{\text{Magnification}}$$

Answer

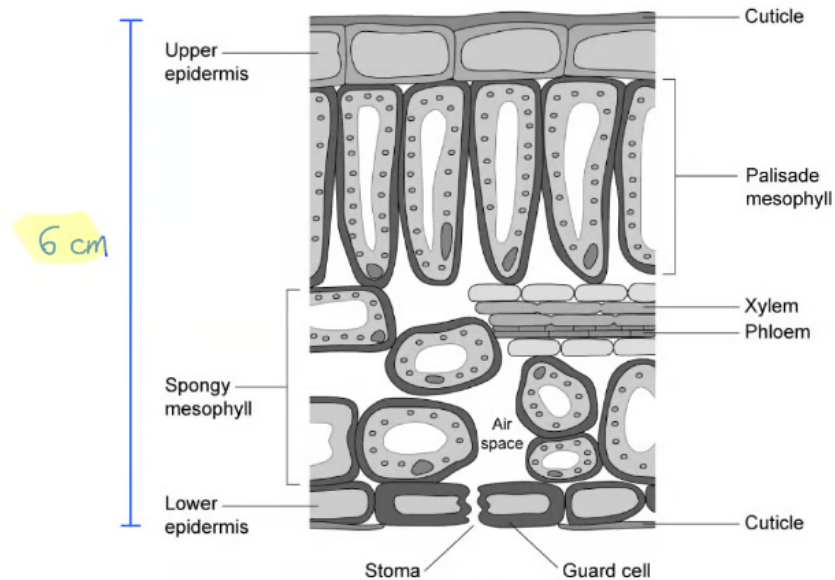
The actual leaf thickness is...

- $60 \div 220$; [1 mark]
- 0.27 (mm); [1 mark]

Full marks can be awarded for the correct answer in the absence of other calculations.

[Total: 2 marks]

- (a) The image below shows the structure of a leaf in a green plant magnified 220 times.



- (c) The leaf image in part (a) measures 6 cm from top to bottom.

Use the formula below to calculate the actual thickness of the leaf. Give your answer in mm.

$$\text{Actual thickness} = \frac{\text{Image thickness}}{\text{Magnification}}$$

Convert measurement into mm:

$$6 \text{ cm} = 60 \text{ mm}$$

There are 10 mm in a cm.

Enter numbers into formula:

$$\text{Actual width} = \frac{60}{220} \quad [1 \text{ mark}]$$

$$= 0.27 \text{ mm} \quad [1 \text{ mark}]$$

(2 marks)

37 Enzyme activity is affected by environmental factors such as pH. Sometimes environmental extremes lead to denaturing of enzymes.

(i) Name another factor, other than pH which may result in denaturing of enzymes.

(1)

(ii) Describe what is meant by 'denaturing' of enzymes.

(2)

Answer

(i) Another environmental factor which may lead to denaturing of enzymes is...

- High temperature/heat; [1 mark]

(ii) When an enzyme becomes denatured, it means that...

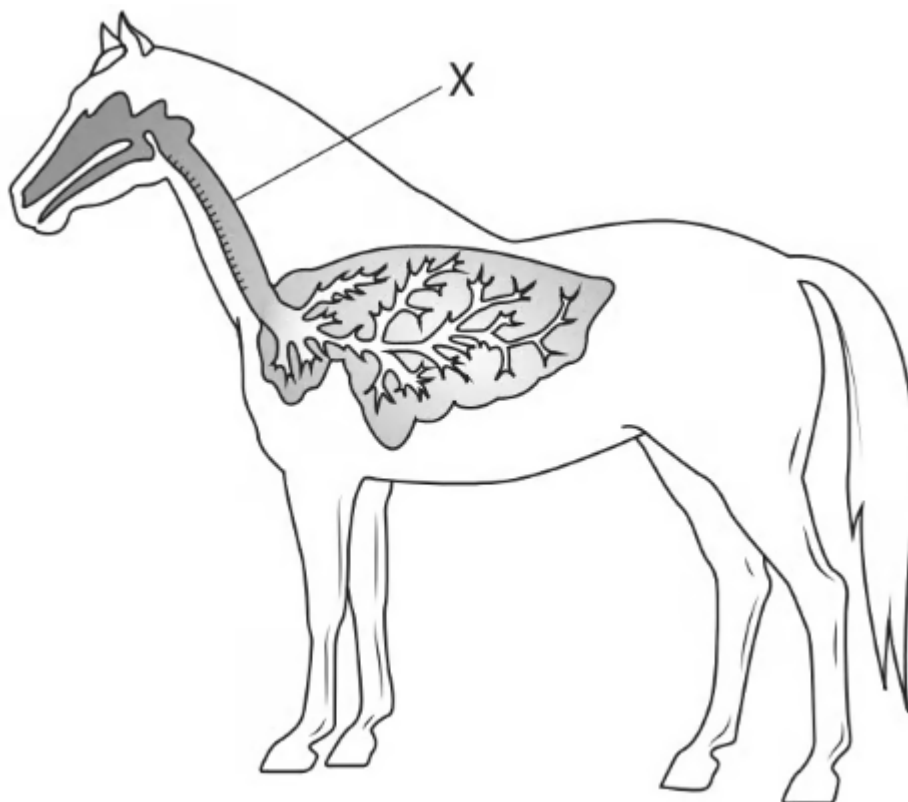
Any **two** of the following:

- Bonds (that hold the enzyme together) are broken; [1 mark]
- The active site changes shape; [1 mark]
- The enzyme can no longer form enzyme-substrate complexes **OR** the substrate can no longer fit into the active site; [1 mark]

[Total: 3 marks]

(3 marks)

38 (a) The diagram shows the location of the lungs in a horse.



(i) The part labelled **X** is the:

(1)

☐	A	bronchiole
☐	B	bronchus
☐	C	oesophagus
☐	D	trachea

(ii) Which blood vessel transports blood to the horse's lungs?

(1)

☐	A	aorta
☐	B	pulmonary artery
☐	C	pulmonary vein
☐	D	vena cava

(iii) Which row of the table describes what happens when the horse breathes in?

(1)

		Diaphragm	External intercostal muscles
☐	A	contracts	contract
☐	B	contracts	relax
☐	C	relaxes	contract
☐	D	relaxes	relax

Answer

(i) **The correct answer is D because...**

The trachea is the main windpipe through which all inhaled and exhaled air flows during breathing.

A and **B** are incorrect because the bronchi and bronchioles are smaller-diameter branches of the airway that channel air into and out of the lungs.

C is incorrect because the oesophagus carries food to the stomach, so is not a part of the animal's breathing system.

(ii) **The correct answer is B because...**

The pulmonary artery is an **a**rtery, so carries blood **a**way from the heart. Pulmonary means 'concerning the lungs'.

A is incorrect because the aorta is the main artery to the rest of the body

C is incorrect because the pulmonary vein carries blood back from the lungs. As a **vein**, it carries blood **in**to the heart.

D is incorrect because the vena cava is the main vein carrying blood back to the heart from the rest of the body.

(iii) **The correct answer is A because...**

Both sets of muscles **contract**, which both have the effect of enlarging the thorax. This causes a drop in pressure within the thorax, so air is then forced in from outside due to the pressure difference between the outside air and the thorax.

When the diaphragm relaxes it moves back upwards into its dome shape, and in doing so pushes air *out* of the lungs. Similarly, the external intercostal muscles relax and that causes the ribcage to drop by gravity, again having the effect of pushing air *out*.

(3 marks)

- (b) The table shows the percentage of total blood flow in different body parts of a horse at rest and when running.

Body part	Percentage of total blood flow (%)	
	At rest	When running
leg muscle	15	82
intestine	30	3

Comment on the changes in the percentage of total blood flow in these body parts.

Answer

The changes in the percentage of total blood flow in these body parts is...

Any **four** of the following...

- There is more blood supplied to muscles / less blood supplied to the intestine (during exercise) / blood is diverted to the muscles from the intestine; [1 mark]
- (Blood flow) supplies oxygen / oxygenated blood / glucose to organs/tissues/cells; [1 mark]
- (For aerobic) respiration / to avoid/prevent anaerobic respiration; [1 mark]
- To release energy / ATP; [1 mark]
- (So that) muscle contraction (can take place for running); [1 mark]
- (So there is) less absorption of food in the intestine when running / during exercise; [1 mark]

*Accept converse statements for marking point 1, e.g. "while **at rest** there is less blood supplied to muscles / more blood supplied to the intestine / blood is diverted to the intestine from the muscles".*

*Accept converse statements for marking point 6, e.g. "so that while **at rest** there is a high blood flow to the intestine to absorb food / maintain concentration gradient"*

[Total: 4 marks]

(4 marks)

(c) The horse breathes faster and deeper when running.

Explain why the horse continues to breathe faster and deeper for a period of time after it has stopped running.

Answer

The horse continues to breathe faster and deeper for a period of time after it has stopped running because...

Any **two** of the following:

- To supply (more) oxygen / there was a shortage of oxygen; [1 mark]
- To allow the breakdown of / remove lactic acid; [1 mark]
- To repay oxygen debt; [1 mark]
- Because anaerobic respiration had occurred; [1 mark]

[Total: 2 marks]

(2 marks)

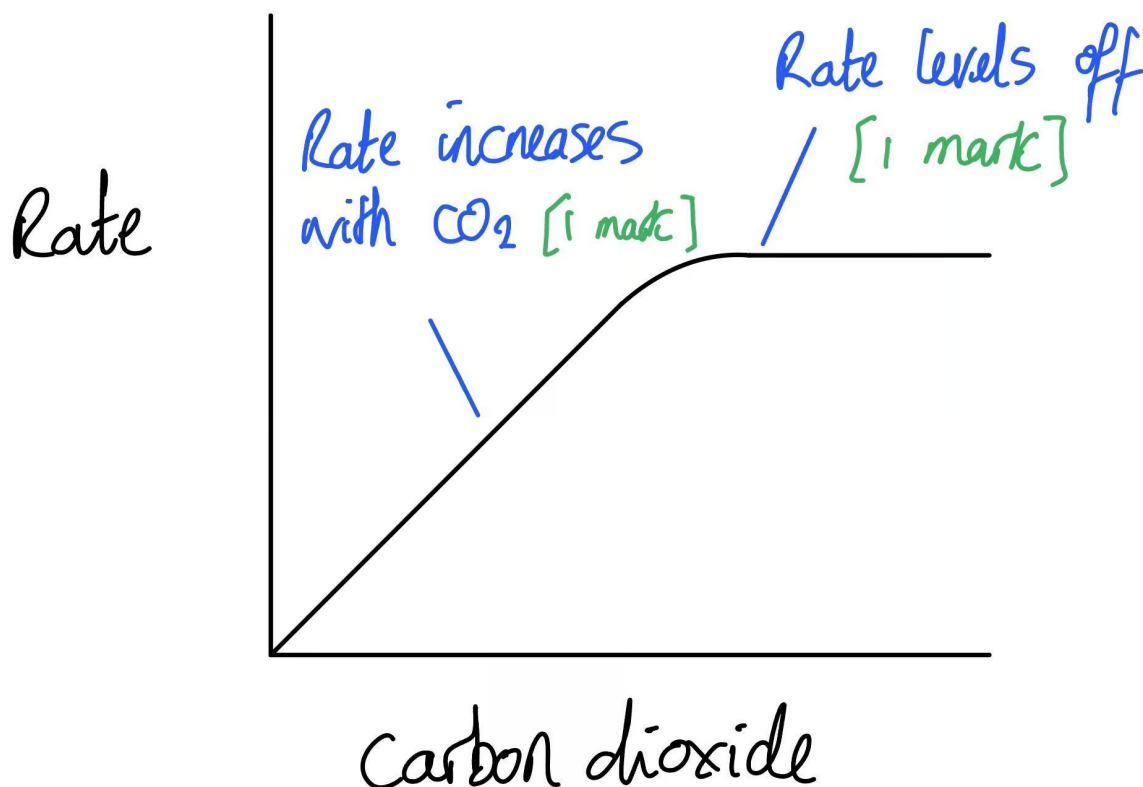
39 Carbon dioxide concentration is one of several factors that can limit the rate at which photosynthesis occurs.

Sketch a graph that shows how carbon dioxide concentration affects the rate of photosynthesis. You should label your axes with carbon dioxide concentration on the X axis and the rate of photosynthesis on the Y axis.

Answer

A sketch graph that shows the effect of carbon dioxide concentration on the rate of photosynthesis should have the following appearance...

- The rate of photosynthesis increases with carbon dioxide concentration; [1 mark]
- The rate of photosynthesis levels off; [1 mark]



The use of the term 'sketch' in the question tells you that a detailed graph with a scale and units are not required here; you just need to show the shape of the line that you would expect to see.

The rate of reaction would increase with CO_2 initially, as photosynthesis requires CO_2 as a reactant, but would then level off as other factors, such as light or temperature, become limiting.

[Total: 2 marks]

(2 marks)

- 40 (a)** Complete the table by placing a tick (✓) in the correct boxes to indicate which cell features can be found in eukaryotic cells only, prokaryotic cells only, or both types of cell.

Feature	Eukaryotic cells only	Prokaryotic cells only	Both cell types
Cell membrane			
Cell wall			
Nucleus			
Plasmid			
Chloroplast			
Cytoplasm			
Mitochondria			

Answer

The correctly completed table is as follows...

Award 1 mark per correct **column**:

Feature	Eukaryotic cells only	Prokaryotic cells only	Both cell types
Cell membrane			✓
Cell wall			✓
Nucleus	✓		
Plasmid		✓	
Chloroplast	✓		
Cytoplasm			✓
Mitochondria	✓		

[Total: 3 marks]

Remember that although not all eukaryotic cells have cell walls, plants, fungi and some protocists do have them.

(3 marks)

(b) The table below shows the average size of different types of cells and organelles.

Cell / Organelle	Average Size (μm)
Animal cell	25
Plant cell	50
Bacterium	2
Mitochondria	1
Nucleus	6

(i) Calculate how many times bigger a plant cell is compared to a bacterium.

(1)

(ii) Using evidence from the table, suggest why prokaryotic cells cannot contain a nucleus.

(2)

(iii) One scientific theory suggests that mitochondria used to be a type of bacteria that entered a eukaryotic cell and became mitochondria over time.

Identify evidence from the table that suggests this could be possible.

(1)

Answer

(i) A comparison between the size of a plant cell and a bacterium is...

- $(50 \div 2 =) 25$; [1 mark]

One mark is given for the correct answer in the absence of working shown.

Cell / Organelle	Average Size (μm)
Animal cell	25
Plant cell	50
Bacterium	2
Mitochondria	1
Nucleus	6

- (i) Calculate how many times bigger a plant cell is compared to a bacterium.

calculate how many times 2 fits into 50:

$$\frac{50}{2} = 25 \quad [1 \text{ mark}]$$

- (ii) Prokaryotic cells cannot contain a nucleus because...

- Nucleus is too big / would not fit inside bacteria/prokaryotic cell **OR** bacteria/prokaryotic cell is too small; [1 mark]
- Quoted data from the table to support the above point, e.g. $6 \mu\text{m}$ is bigger than $2 \mu\text{m}$; [1 mark]

- (iii) Evidence that mitochondria could have evolved from bacteria is...

- Mitochondria and bacteria are very similar in size / $1 \mu\text{m}$ and $2 \mu\text{m}$ are very similar; [1 mark]

Ignore references to other evidence for theory e.g. DNA in mitochondria

This theory is called endosymbiotic theory and there are lots of really interesting pieces of evidence associated with it. However, the question specially asks for evidence **from the table**, so marks will not be awarded for references to other evidence.

[Total: 4 marks]

(4 marks)

- (c) For each of the following examples, name the group of organisms to which the species belongs.

Species	Group of organisms
<i>Mucor</i>	
<i>Amoeba</i>	
Yeast	
<i>Lactobacillus</i>	
<i>Plasmodium</i>	

Answer

The correct groups are...

Species	Group of organisms
<i>Mucor</i>	Fungi; [1 mark]
<i>Amoeba</i>	Protoctist(s); [1 mark]
Yeast	Fungi; [1 mark]
<i>Lactobacillus</i>	Bacteria; [1 mark]
<i>Plasmodium</i>	Protoctist(s); [1 mark]

[Total: 5 marks]

These are all examples that are specifically listed in your specification, so you should be able to identify the groups to which they all belong. The most common mistakes are thinking that yeast and plasmodium are types of bacteria.

(5 marks)

41 (a) A student reads the following statement in a textbook:

'Respiration and metabolic reactions are intrinsically linked to temperature.'

Explain why this statement is true.

Answer

The statement that '*respiration and metabolic reactions are intrinsically linked to temperature*' is true because...

Any **four** of the following:

- Metabolic reactions are the chemical reactions in a cell / the body; [1 mark]
- Respiration is an example of a metabolic reaction; [1 mark]
- Respiration is controlled by enzymes **OR** metabolic reactions are controlled by enzymes; [1 mark]
- Enzyme controlled reactions are affected by temperature **OR** higher temperatures allow faster enzyme activity **OR** extremely high temperatures cause enzymes to denature; [1 mark]
- Respiration/some metabolic reactions release energy in the form of heat; [1 mark]

[Total: 4 marks]

All enzyme controlled reactions are dependent on temperature, and this includes metabolic reactions inside the cells, such as respiration. The rate of respiration is affected by body temperature; if the body gets too cold then respiration will slow down (e.g. during hypothermia) and if the body gets too hot then the enzymes will denature (e.g. heat stroke, or a high fever).

(4 marks)

(b) Identify **three** different ways in which animals use the energy released by aerobic respiration.

Answer

Three ways that animals use the energy from aerobic respiration are...

Any **three** of the following:

- Maintaining (core) body temperature / keeping warm / thermoregulation; [1 mark]
- Movement / muscle contraction / named example of muscle movement, e.g. heart beating / peristalsis; [1 mark]
- Synthesis of new molecules / chemical reactions to build large molecules (e.g. proteins); [1 mark]
- Cell growth / division; [1 mark]
- Active transport / transporting molecules across cell membranes against their concentration gradient; [1 mark]
- generating/transmitting nerve impulses; [1 mark]

Accept other correct examples of energy use in animals.

[Total: 3 marks]

Answers that state 'growth, repair or reproduction' would be insufficient here; you need to be specific.

(3 marks)

(c) Compare the processes of aerobic and anaerobic respiration in animals.

Answer

Aerobic and anaerobic respiration can be compared as follows...

Any **three** of the following:

- Aerobic respiration occurs in the presence of oxygen **WHEREAS** anaerobic respiration occurs in the absence of oxygen; [1 mark]
- Aerobic respiration produces more energy than anaerobic respiration; [1 mark]
- The products of aerobic respiration are carbon dioxide and water **WHEREAS** the product of anaerobic respiration is lactic acid; [1 mark]
- Glucose is completely broken down in aerobic respiration **WHEREAS** it is only partially broken down in anaerobic respiration; [1 mark]

[Total: 3 marks]

This is a **compare** question so it is important that you make direct comparisons or use language which is comparative in some way, e.g. aerobic respiration produces *more* energy than anaerobic respiration.

(3 marks)

(d) In animals exercise cannot be sustained for long periods by anaerobic respiration.

Explain why this is the case.

Answer

Exercise cannot be sustained for long periods using anaerobic respiration because...

Any **three** of the following:

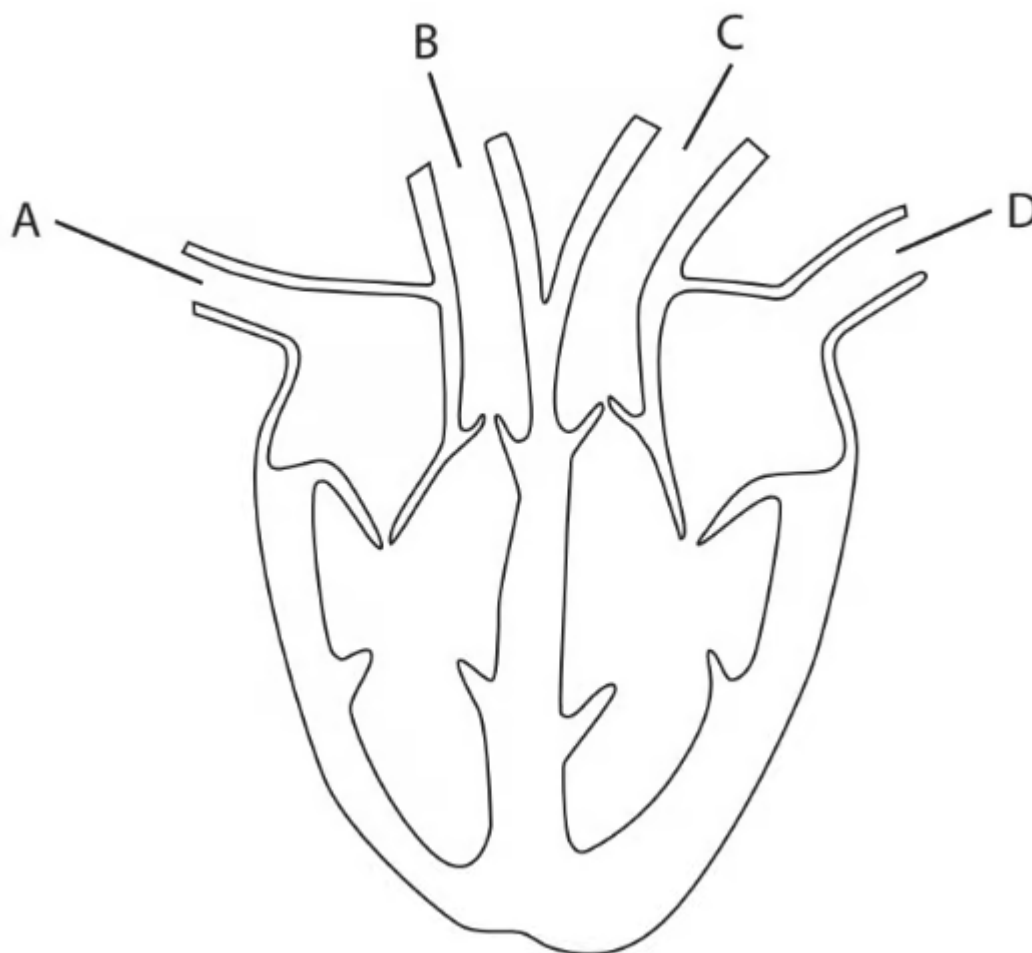
- Not enough energy is transferred/released (for muscle contraction); [1 mark]
- Lactic acid causes the pH of cells to decrease / cells to become acidic; [1 mark]
- Enzymes (of the body cells) cannot function well at low pH (slowing down chemical reactions); [1 mark]
- Muscles become fatigued quickly (due to lack of energy); [1 mark]

[Total: 3 marks]

While anaerobic respiration can support short bursts of intense exercise, such as lifting a heavy weight, or running 100 m, anaerobic respiration cannot sustain long periods of activity. **Less energy is released** in anaerobic respiration and **lactic acid is produced** as a by-product. During long periods of anaerobic activity the lactic acids accumulates in the muscles causing them to become fatigued and stop contracting efficiently. This is why our legs feel so heavy and tired after sprinting for a long time.

(3 marks)

42 (a) The diagram shows the human heart with four blood vessels labelled **A**, **B**, **C** and **D**.



(i) Which blood vessel brings oxygenated blood to the heart?

(1)

☐	A
☐	B
☐	C
☐	D

(ii) Which blood vessel contains blood at the highest pressure?

(1)

☐	A
☐	B
☐	C
☐	D

Answer

(i) **The correct answer is D because...**

Oxygenated blood from the lungs is returned to the heart by the pulmonary vein, indicated here by the letter D.

A is incorrect as it indicates the vena cava which brings deoxygenated blood from the body cells back to the heart.

B is incorrect as it indicates the pulmonary artery which transports deoxygenated blood from the heart to the lungs.

C is incorrect as it indicates the aorta which transports oxygenated blood away from the heart towards the body cells.

(ii) **The correct answer is C because...**

Blood enters the aorta at a very high pressure (generated by the thick muscular wall of the left ventricle) because it needs to travel around the entire body.

A is incorrect as the vena cava returns blood to the heart at low pressure.

B is incorrect as the pulmonary arteries will transport blood at relatively low pressure to avoid damage to the delicate capillaries of the lungs.

D is incorrect as blood is transported back to the heart via the pulmonary veins at low pressure.

[Total: 2 marks]

(2 marks)

(b) (i) Draw a label line on the diagram to show the position of a semi-lunar valve.

(1)

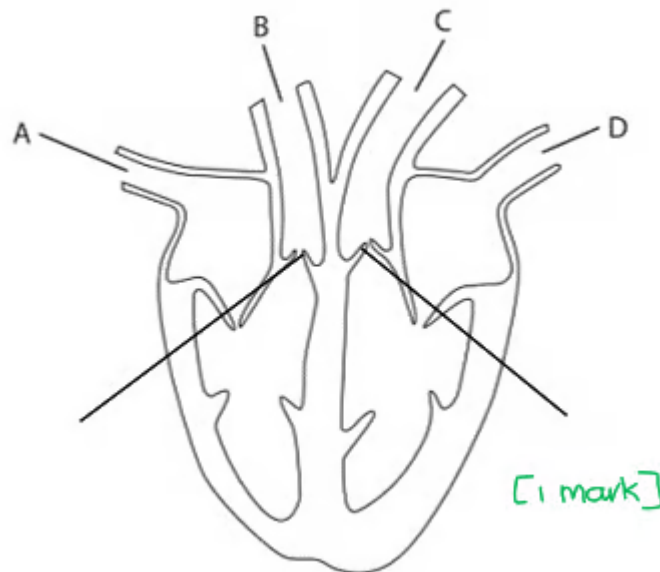
(ii) Describe the function of the semi-lunar valves.

(2)

Answer

(i) The semi-lunar valves are located as follows...

- A line drawn on the diagram to indicate a set of valves located between the ventricles and the arteries; [1 mark]



Allow other forms of indication of location.

(ii) The function of the semi-lunar valves includes...

- Preventing the backflow of blood / flow of blood back into heart / ensures one-way flow (of blood); [1 mark]

- (from arteries) into ventricle/ventricles; [1 mark]

[Total: 3 marks]

(3 marks)

(c) In the heart of a foetus, the two upper chambers (atria) are linked by a hole so that blood can pass between them.

(i) Explain why this hole is normally closed before the baby is born.

(2)

(ii) Sometimes the hole does not close.

Explain what effect this will have on the baby.

(3)

Answer

(i) The hole would normally close before the baby is born so that...

- Oxygenated and deoxygenated blood do not mix / as the left hand side (of the heart) now contains oxygenated blood from the lungs; [1 mark]
- Oxygenated blood can be pumped around the body / so that deoxygenated blood does not go round the body / so that oxygenated blood does not go to the lungs; [1 mark]

(ii) The effect of a hole in the wall separating the two atria on the baby would be...

Any **three** of the following:

- (The baby) may appear blue / lack colour / may not survive / (may experience) shortness of breath; [1 mark]
- (This is due to) less oxygen (being transported from the heart to the body) / deoxygenated blood goes/is transported to the body; [1 mark]
- (This results in) less/lower rate of (aerobic) respiration; [1 mark]
- (Which delivers) less energy/ATP (to the cells); [1 mark]

[Total: 5 marks]

It is very important that oxygenated blood from the left side of the heart does not mix with deoxygenated blood from the right side of the heart as this would decrease the overall oxygen content of the blood reaching the body cells. Oxygen is required

for aerobic respiration to occur, releasing energy in the form of ATP that is needed for various processes in the cells. Low levels of oxygen in the blood will impair these processes.

(5 marks)

43 (a) In the absence of sufficient oxygen, cells respire anaerobically.

Compare anaerobic respiration in the muscle cell of an animal with anaerobic respiration in a yeast cell.

Answer

We can compare anaerobic respiration in animal muscle cells and yeast cells as follows...

- Both release/transfer (relatively) small amounts of energy; [1 mark]
- Lactic acid is produced in animal muscle cells **WHILE** ethanol is produced in yeast cells; [1 mark]
- Carbon dioxide is produced in yeast **WHILE** it is not in animal muscle cells; [1 mark]

Award marking points 2 and 3 for word equations for anaerobic respiration in animal and yeast cells, e.g.

- *Animals: Glucose → lactic acid; [1 mark]*
- *Yeast: Glucose → ethanol + carbon dioxide; [1 mark]*

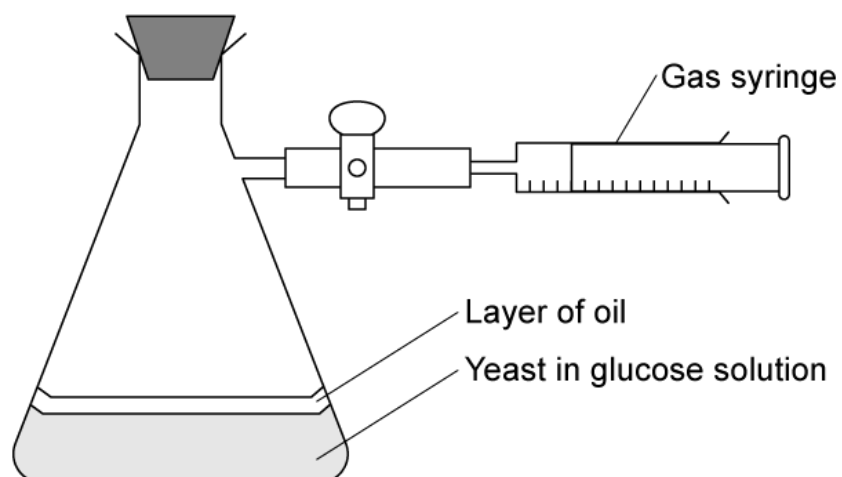
[Total: 3 marks]

Pay close attention to the specifics of the question here; you are not being asked to compare aerobic and anaerobic respiration, but to compare anaerobic respiration in two cell types.

(3 marks)

(b) A student used the equipment shown in the diagram to investigate the rate of anaerobic

respiration in yeast.



The student measured the volume of carbon dioxide produced by 5 g of yeast over a 60 minute period. His results are shown in the table below.

Time / minutes	Total volume of gas collected / cm ³
10	0.5
20	0.7
30	1.6
40	2.8
50	5.9
60	6.3

Rate can be calculated using the following equation:

$$\text{Rate} = \frac{\text{Volume of product produced}}{\text{Time}}$$

Use the equation to calculate the average rate of carbon dioxide production per minute between 30 and 60 minutes in the investigation.

Answer

The rate of carbon dioxide production can be calculated as follows...

- $4.7 \div 30$; [1 mark]
- $0.16 \text{ (cm}^3 \text{ min}^{-1}\text{)}$; [1 mark]

[Total: 2 marks]

Time / minutes	Total volume of gas collected / cm^3
10	0.5
20	0.7
30	1.6
40	2.8
50	5.9
60	6.3

Rate can be calculated using the following equation:

$$\text{Rate} = \frac{\text{Volume of product produced}}{\text{Time}}$$

Use the equation to calculate the average rate of carbon dioxide production per minute between 30 and 60 minutes in the investigation.

calculate the volume of product produced between 30-60 minutes:

$$6.3 - 1.6 = 4.7$$

calculate the amount of time that has passed between 30-60 minutes:

$$60 - 30 = 30$$

substitute numbers into equation:

$$\text{rate} = \frac{4.7}{30} \quad [1 \text{ mark}]$$

$$= \underline{0.16 \text{ cm}^3 \text{ per minute}} \quad [1 \text{ mark}]$$

(2 marks)

- (c) Suggest why the rate of carbon dioxide production shown in part (b) decreased between 50 and 60 minutes.

Answer

The rate of carbon dioxide production decreased because...

Any **three** of the following:

- There is no more glucose / the glucose is used up; [1 mark]
- Respiration slows down/stops; [1 mark]
- Ethanol / toxins have built up; [1 mark]
- Yeast cells are killed; [1 mark]

[Total: 3 marks]

(3 marks)

- (d) Explain how the student could have ensured the reliability of the results.

Answer

The student could have ensured the reliability of the results by...

- Repeating the experiment (while keeping every factor within the experiment the same); [1 mark]
- Ensuring that the results are similar/consistent **OR** identifying/removing/repeating any anomalous results; [1 mark]

[Total: 2 marks]

(2 marks)

- 44** Some cosmetic companies claim that adding argan oil to their shampoo increases the strength of human hair.

Design an investigation to find out if argan oil shampoo does increase the strength of human hair.

Include experimental details in your answer and write in full sentences.

Answer

An investigation to find out if argan oil shampoo does increase the strength of human hair would include the following...

Any **six** of the following:

- **C** - Have a shampoo with oil and one without oil; [1 mark]
- **O** - Hair from the same person / same hair length / width / age / sex / same hair type / dry hair by the same method; [1 mark]
- **R** - Test many different hairs / repeat; [1 mark]
- **M1** - Add weights / masses to hairs; [1 mark]
- **M2** - Measure mass / g / pressure / weight / force /N that causes hair to break; [1 mark]
- **S1** - Same volume / concentration of shampoo / same type of shampoo with and without oil; [1 mark]
- **S2** - Wash for same time / frequency / same temperature of water; [1 mark]

[Total: 6 marks]

Remember that with **CORMS** questions you will not be expected to know anything about the experiment you're presented with. You just have to apply your knowledge of experimental design to a new scenario.

Remember that **CORMS** stands for: **C**hange, **O**rganism, **R**epeat, **M**easure, **S**ame. There are always two marks available for **Measure** and two for **Same**.

The most difficult mark to get is the **Organism** because you need to remember to include the word **same** in your answer, eg. "same species". The point for **Organism**

needs to be different to the two points in **Same**.

Remember to write your answers in full sentences, as stated in the question stem, but you are welcome to make a quick bullet point plan in a blank space somewhere else on your page. Use your plan to tick off and make sure you've hit all the marking points.

(6 marks)

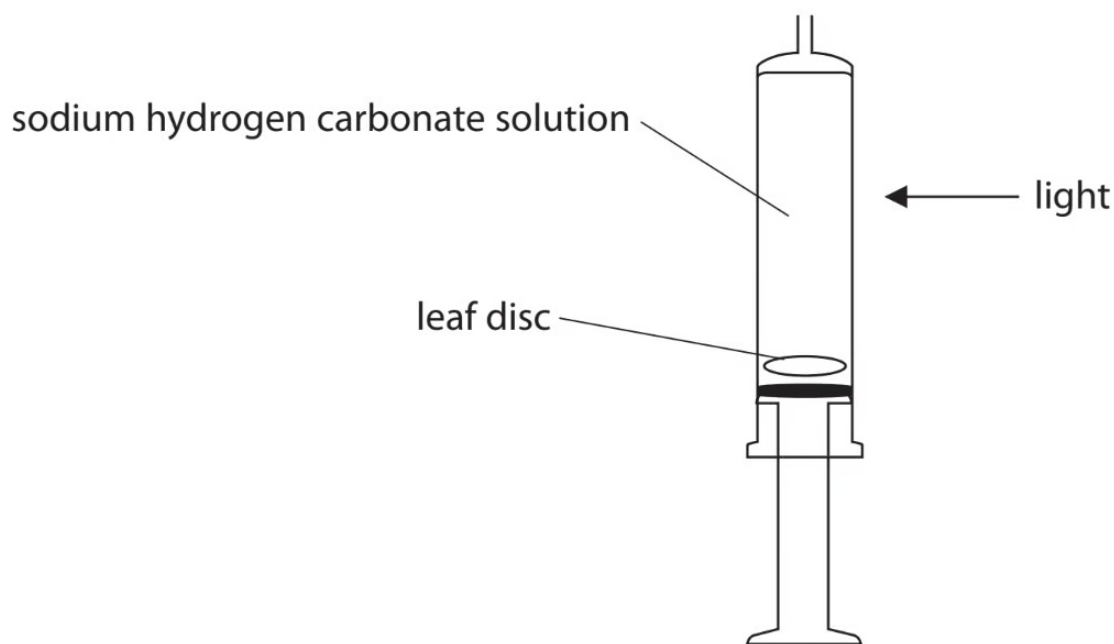
45 (a) A student investigates the effect of light intensity on photosynthesis in leaf discs.

This is the student's method.

- Cut equal sized discs from a leaf
- Remove the plunger from a 20 cm³ syringe and place a disc into the syringe
- Replace the plunger in the syringe and fill the syringe with 2 % sodium hydrogen carbonate solution, which provides carbon dioxide
- Place your thumb over the end of the syringe and pull the plunger back until the disc sinks
- Position the syringe vertically
- Place a lamp five centimetres from the syringe
- Record the time taken for the leaf disc to rise to the top of the syringe
- Repeat the experiment with the lamp at increasing distances from the syringe

The leaf discs rise in the solution due to the production of gas during photosynthesis.

The diagram shows some of the apparatus used.



Give the balanced chemical symbol equation for photosynthesis.

Answer

The balanced symbol equation for photosynthesis is...

- $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$ (correct symbols given in the correct order regardless of whether or not the equation is balanced); [1 mark]
- 6 molecules of CO_2 **AND** 6 molecules of H_2O **AND** $\text{C}_6\text{H}_{12}\text{O}_6$ **AND** 6 molecules of O_2 (equation correctly balanced); [1 mark]

[Total: 2 marks]

Remember not to use words if asked to give a **symbol** equation.

(2 marks)

(b) (i) State how the student could improve the reliability of their results.

(1)

(ii) Give the dependent variable in the investigation.

(1)

Answer

(i) The student could improve the reliability of their results by...

- (Carrying out three or more) repeats / finding the mean (of the repeat results); [1 mark]

(ii) The dependent variable in the investigation is...

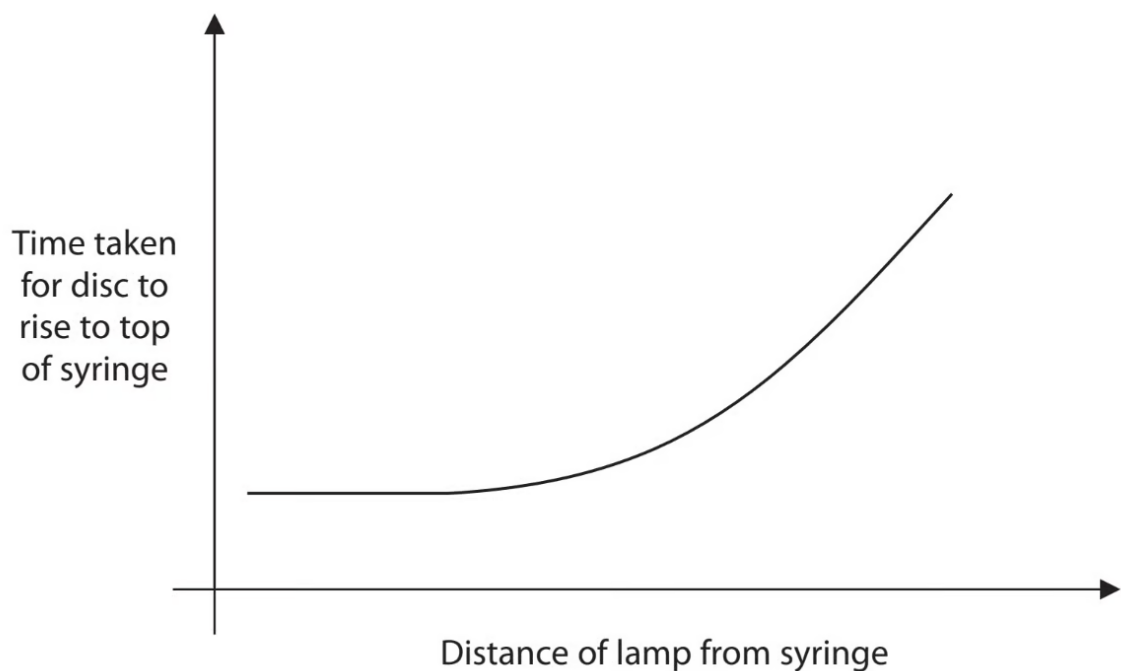
- Time taken (for leaf to rise); [1 mark]

[Total: 2 marks]

Remember that the independent variable is the thing in an experiment that you **change** and the dependent variable is the thing you **measure**.

(2 marks)

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



Explain the effect of increasing the distance of the lamp on the time taken for the leaf disc to rise to the top of the syringe.

Answer

The effect of increasing the distance of the lamp on the time taken for the leaf disc to rise to the top of the syringe is...

Any **four** of the following:

- As distance increases light intensity decreases; [1 mark]
- (As distance increases / as light intensity decreases) the rate of photosynthesis decreases/is slower; [1 mark]
- (the decrease in photosynthesis rate means that) less oxygen is produced; [1 mark]
- Oxygen (bubbles are) trapped in leaf and cause leaf discs to rise; [1 mark]
- When the leaf discs are close to the lamp another factor is limiting / light intensity is not limiting; [1 mark]

- Limiting factor (when light level is high) could be temperature / carbon dioxide concentration; [1 mark]

Accept reverse statement for marking point 1, e.g. "as distance decreases light intensity increases".

[Total: 4 marks]

Remember that when asked to **explain** you must use your scientific knowledge to say **why** the data is the way it is. Do not just describe the graph as no credit will be available for this.

(4 marks)

(d) Describe how the student could test the leaf discs for the presence of starch.

Answer

The student could test the leaf discs for the presence of starch by...

Any **three** of the following:

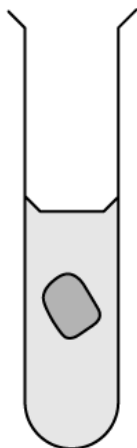
- Place leaf disc in boiling water; [1 mark]
- Heat/boil leaf in ethanol; [1 mark]
- Stain with iodine; [1 mark]
- Iodine stain will turn blue-black with / in the presence of starch; [1 mark]

[Total: 3 marks]

(3 marks)

46 (a) A student carried out an experiment to study diffusion.

A cube of beetroot was placed in a test tube of distilled water at room temperature as shown in the diagram.



The beetroot was left in the water for ten minutes.

Describe what the student should expect to see.

Answer

The expected result would be...

- The colour/pigment of the beetroot would diffuse out into the water (changing it to purple/red/pink); [1 mark]

[Total: 1 mark]

(1 mark)

- (b) Give **one** variable that must be controlled and explain why this control is necessary to provide valid results.

Answer

One variable that must be controlled to make the results comparable is...

Any **two** of the following:

- The cubes/pieces of beetroot must have the same dimensions / be the same size (and shape) / have the same length on each side of the cube; [1 mark]
- (So that they all have) equal surface areas and volumes / surface area to volume ratio; [1 mark]
- (Because) this could affect the rate at which the pigment diffuses out into the water; [1 mark]

[Total: 2 marks]

Remember that control variables are factors that must be kept the same in an experiment in order to make sure that only the independent variable causes the results to vary.

(2 marks)

(c) The student found that more of the beetroot pigment leaked out at higher temperatures.

Explain why this result was different at higher temperatures compared to room temperature.

Answer

The result was different at higher temperatures compared to room temperature because...

Any **three** of the following:

- At higher temperatures particles have more (kinetic) energy; [1 mark]
- This results in the faster movement of particles (compared to when they have less energy); [1 mark]
- The pigment particles diffuse across the membrane faster at higher temperatures; [1 mark]
- The cell membrane of the beetroot cells may become damaged at higher temperatures (so more pigment can diffuse out); [1 mark]

[Total: 3 marks]

(3 marks)

47 (a) Plant and animal cells have some features in common and some differences.

(i) Which of these structures is not found in animal cells?

(1)

☐	A	cell membrane
☐	B	cell wall
☐	C	mitochondrion
☐	D	nucleus

(ii) Which of these substances is a carbohydrate stored in plant cells?

(1)

☐	A	chlorophyll
☐	B	glucose
☐	C	glycogen
☐	D	starch

Answer

(i) **The correct answer is B because...**

A cell wall is only found in plant cells and some microorganisms.

Structures A, C and D are found in all animal (and plant) cells.

(ii) **The correct answer is D because...**

Starch is the storage compound used by plants; starch is stored in small granules inside chloroplasts.

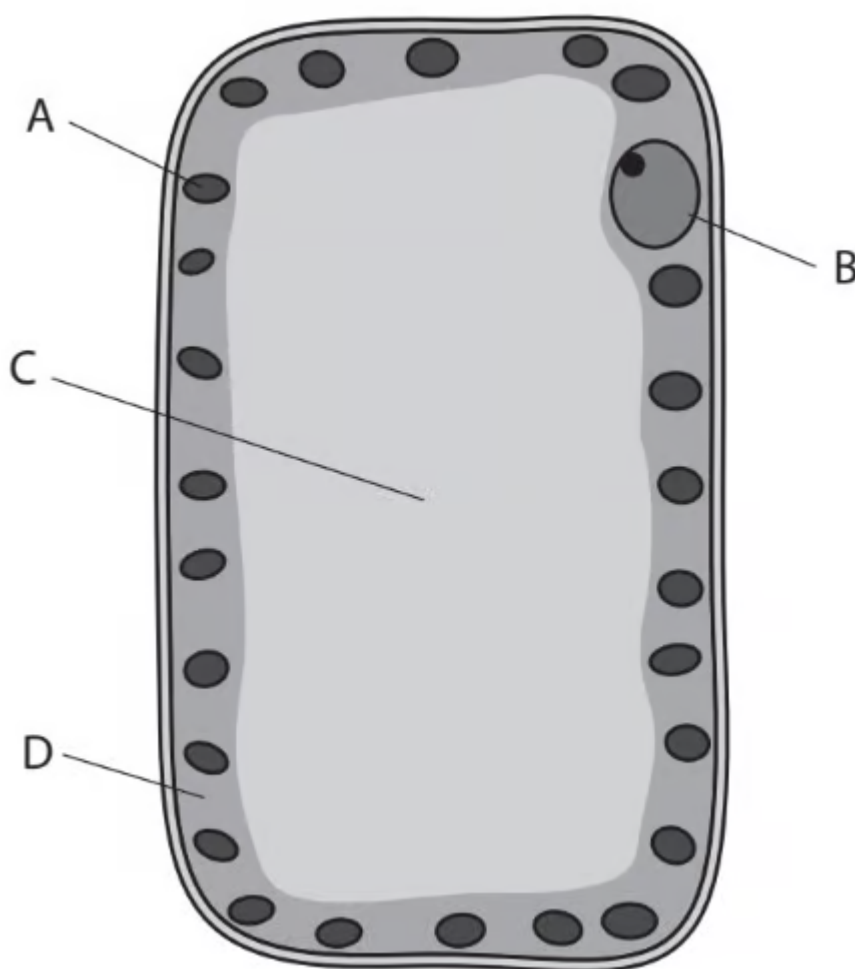
A is incorrect because chlorophyll is not a storage compound, it is the pigment that captures light energy for photosynthesis.

B is incorrect because glucose is very soluble so cannot easily be stored in plant cells

C is incorrect because glycogen is a storage compound, but in animals, not plants.

(2 marks)

(b) The diagram shows a leaf palisade mesophyll cell.



Describe the function of the parts labelled **A**, **B**, **C** and **D**.

Answer

The functions of parts labelled **A**, **B**, **C** and **D** are as follows...

- A = (chloroplasts) absorb light for photosynthesis / to make carbohydrate/starch/glucose/sugar / store starch granules; [1 mark]
- B = (nucleus) controls protein synthesis / contains DNA/genes / controls cell; [1 mark]
- C = (vacuole) contains cell sap / maintains turgor / stores water/salts/pigments/toxins; [1 mark]
- D = (cytoplasm) where chemical reactions occur / protein synthesis occurs / respiration occurs / provides a medium for chemical reactions (within the cell); [1 mark]

[Total: 4 marks]

When answering questions about structure and function be sure to explain exactly how each structure aids overall function.

(4 marks)

48 Human populations are at risk from infectious disease.

Describe the different types of pathogen.

Refer to a disease that each type of pathogen causes in your answer.

Answer

The different types of pathogen are...

Any **six** of the following:

- **Viruses** are non-living organisms / small particles / protein coat / capsid **OR** viruses rely on other organisms for reproduction; [1 mark]
- (An example of a disease viruses cause is) AIDS / TMV / any other correct example; [1 mark]
- **Bacteria** are microscopic single-celled organism / prokaryotic **OR** have no nucleus / have nucleoid / contain plasmids; [1 mark]
- (An example of a disease bacteria cause is) Pneumonia / any other correct example; [1 mark]
- **Fungus** are not able to carry out photosynthesis / (use) saprotrophic nutrition **OR** are single-celled / have a structure of hyphae / their cell wall is made of chitin; [1 mark]
- (An example of a disease fungi cause is) Athlete's foot / any other correct example; [1 mark]
- **Protoctist** / **protozoa** *Plasmodium* / are microscopic single-celled organism; [1 mark]
- (An example of a disease prototists cause is) Malaria / any other correct example; [1 mark]

[Total: 6 marks]

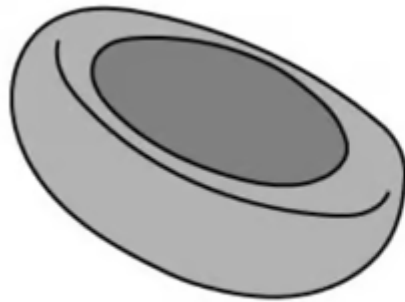
Remember that there is a difference between the name of the disease and the pathogen that causes the disease, for example, HIV is a virus that causes the disease AIDS, and *Plasmodium* is a protoctist that causes the disease malaria. These terms are

not interchangeable. The pathogen is the organism that causes the disease, but the disease is the symptoms and the effect the pathogen has on the person's body.

(6 marks)

- 49 (a)** Sickle cell anaemia is a condition in which some of the person's red blood cells develop abnormally.

The diagram shows red blood cells from a healthy person and red blood cells from a person with sickle cell anaemia.



Cells from a healthy person



Cells from a person with sickle cell anaemia

- (i) A person with sickle cell anaemia often suffers pain as some of their blood vessels become blocked by the sickle cells.

Suggest why the person's blood vessels may become blocked.

(1)

- (ii) People with sickle cell anaemia have symptoms of tiredness and joint pain that get worse if they are exposed to cold temperatures and high altitudes.

Suggest why these symptoms get worse.

(3)

Answer

- (i) Blood vessels may become blocked because...

- Sickle shaped red blood cells get caught/trapped / stick to each other **OR** Sickle shaped red blood cells get caught/trapped / stick to the walls of blood vessels; [1 mark]

(ii) Symptoms may get worse because...

Any **three** of the following:

- Cold temperatures reduce blood flow / cause more sickling (of cells); [1 mark]
- There is also less oxygen (at high altitude); [1 mark]
- Therefore less (aerobic) respiration / (more) anaerobic respiration; [1 mark]
- (Anaerobic respiration releases) more lactic acid (leading to joint pain); [1 mark]
- (Less) energy / ATP (leading to feelings of tiredness); [1 mark]

[Total: 4 marks]

(4 marks)

(b) Sickle cell anaemia is caused by a single recessive allele.

(i) State what is meant by the term **recessive**.

(1)

(ii) A man and a woman who are both heterozygous for the sickle cell allele have a child.

Calculate the probability that the child will be female and **not** have sickle cell anaemia.

(2)

Answer

(i) Recessive means...

- (The allele is) only expressed when homozygous / there are two copies (of the recessive allele) **OR** (The allele is) only expressed when no dominant allele present **OR** (The allele is) not expressed in heterozygote; [1 mark]

(ii) The probability can be calculated as follows...

- 0.75×0.5 **OR** $\frac{3}{4} \times \frac{1}{2}$; [1 mark]
- 0.375 **OR** $\frac{3}{8}$ **OR** 37.5%; [1 mark]

If the answer is incorrect, allow a maximum of [1 mark] for any of the following shown in the calculations:

$\frac{3}{4}$ / 0.75 / 75% OR $\frac{1}{2}$ / 0.5 / 50%

[Total: 3 marks]

Heterozygous parents

	A	a
A	*AA	*Aa
a	*Aa	aa

$= 0.75 \times 0.5$
 $= 0.375$ → 50% chance of a girl

* $\frac{3}{4}$ have healthy dominant allele
 $= 75\%$ OR 0.75

Note that this is a *synoptic* question, meaning that this question part addresses content that is not directly related to the transport topic and that is covered later in the specification in the inheritance topic.

(3 marks)

- (c) Sickle cell anaemia is more common in countries where malaria is found. This is because having an allele for sickle cell anaemia can reduce the likelihood of developing malaria.

Which type of organism causes malaria?

☐	A	Bacterium
☐	B	Fungus
☐	C	Plant
☐	D	Protoctist

Answer

The correct answer is D.

Malaria is caused by a parasitic protist which is carried and spread by mosquitoes.

A and **B** are incorrect as they are not pathogens which cause malaria.

C is incorrect as it is not a pathogen.

(1 mark)

(d) What is the name of the pigment found in red blood cells?

☐	A	chlorophyll
☐	B	haemoglobin
☐	C	iron
☐	D	magnesium

Answer

The correct answer is B.

A is the pigment found in plants which is responsible for absorbing sunlight

C and **D** are mineral ions

(1 mark)

(e) Give two differences in structure between red blood cells and white blood cells.

Answer

Differences between red and white blood cells include...

Any **two** of the following:

- Red (blood) cells are smaller; [1 mark]
- Red cells have no nucleus; [1 mark]
- Red cells are biconcave / flattened disk; [1 mark]

Allow converse statements for white blood cells

Ignore references to haemoglobin

[Total: 2 marks]

Note that any reference to haemoglobin is ignored as this has been given to you in the thread of an early question subpart (9d).

(2 marks)

50 (a) The data in the table were collected in Japan during a seven-year study.

Scientists collected data on the age of mothers and whether they smoked during pregnancy.

They also recorded the percentage of the babies that had a low birth mass.

Age of mother in years	Data for mothers who did not smoke during pregnancy		Data for mothers who did smoke during pregnancy	
	Number of mothers	Percentage of babies with low birth mass	Number of mothers	Percentage of babies with low birth mass
19 and under	1331	11.5	356	16.0
20-24	11243	9.8	1677	13.2
25-29	24099	9.0	2211	13.3
30-34	28695	9.2	1847	14.5
35-39	16537	10.5	934	21.1
40 and over	3242	12.3	181	22.1

(i) Calculate the percentage of mothers aged 19 years and under who smoked during pregnancy.

(2)

(ii) Determine the ratio of non-smokers to smokers used in the study.

Give the ratio as the nearest whole number (n) in the form n:1

Answer

(i) The percentage of mothers aged 19 years and under who smoked during pregnancy was...

- $356 / (356 + 1331) \times 100$; [1 mark]
- 21(.1)%; [1 mark]

Allow full marks for the correct answer in the absence of calculations.

(ii) The ratio of non-smokers to smokers used in the study was...

- 85147 **AND** 7206; [1 mark]
- 12:1; [1 mark]

Allow full marks for the correct answer in the absence of calculations.

[Total: 4 marks]

Age of mother in years	Data for mothers who did not smoke during pregnancy		Data for mothers who did smoke during pregnancy	
	Number of mothers	Percentage of babies with low birth mass	Number of mothers	Percentage of babies with low birth mass
19 and under	1331	11.5	356	16.0
20-24	11243	9.8	1677	13.2
25-29	24099	9.0	2211	13.3
30-34	28695	9.2	1847	14.5
35-39	16537	10.5	934	21.1
40 and over	3242	12.3	181	22.1
Total	85147		7206	

i) % of mothers age 19 and under who smoke = $\frac{\text{Number who smoke}}{\text{Total number of mothers}} \times 100$

$$= \frac{356}{356 + 1331} \times 100 \quad [1 \text{ mark}]$$

$$= 21.1\% \quad [1 \text{ mark}]$$

2 marks for the correct answer with no working shown

ii) Ratio of smokers : non-smokers

Total number of non-smokers = 85147

Total number of smokers = 7206

$$\text{Ratio} = 85147 : 7206$$

Divide both sides by 7206 [1 mark]

$$11.82 : 1$$

Round to whole number

$$12 : 1 \quad [1 \text{ mark}]$$

2 marks for the correct answer with no working shown

(4 marks)

- (b) A student examines this data and concludes that smoking is the main factor that causes low birth mass.

Use the data and your own biological knowledge to comment on this conclusion.

Answer

A comment on the conclusion is that...

Any **six** of the following:

The conclusion is correct because...

- (Smokers have a) higher % of low birth mass (at every age) / smokers have more low mass babies **OR** (there is a) correlation between smoking and low birth mass; [1 mark]
- Large numbers (of participants were used) in the study; [1 mark]

The conclusion is incorrect because...

- (There is a) big age effect / (there are) more (babies) with low birth mass (for mothers) at under 19; [1 mark]
- More (babies) with low birth mass (for mothers) over 35; [1 mark]
- (There is a) greater effect of smoking at older ages above 35; [1 mark]
- As older mothers may have smoked for many years / no information on the number of years mothers have smoked for; [1 mark]
- No information on mothers' mass / weight; [1 mark]
- No information on mothers' health care / medical condition / alcohol / diet / drugs; [1 mark]
- No information on premature birth; [1 mark]
- No information on frequency of smoking or when during pregnancy; [1 mark]

Use of own knowledge is...

- Smoking reduces oxygen (supply to baby/foetus); [1 mark]

- (This leads to) less respiration (in foetal cells); [1 mark]

Ignore mention of mother's lifestyle at marking point 8.

[Total: 6 marks]

Whenever you get asked to "comment on a conclusion" you must always discuss points that both agree and disagree with the conclusion.

Always make sure to refer to the data as well as your own knowledge.

(6 marks)