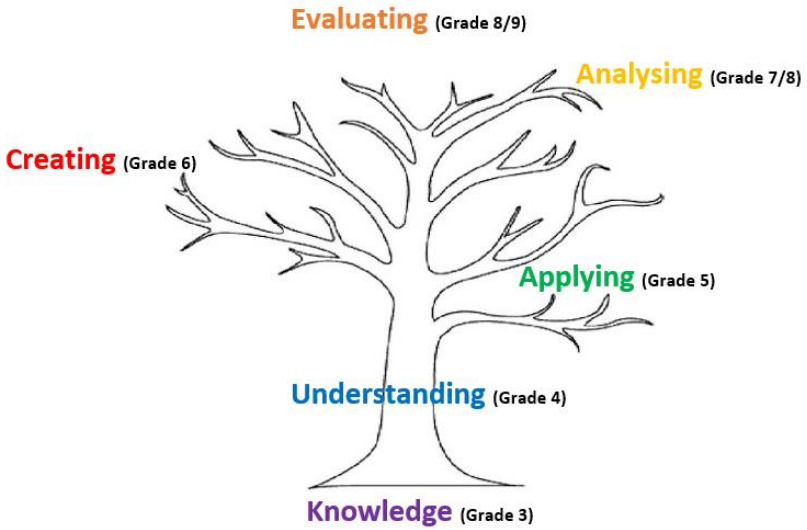
Grow Your Own GCSE Science Grade



GCSE Science/Biology: *Key Concepts in Biology*

Covers GCSE Biology/Combined Science Topics:

Cells & Microscopy
Food & Enzymes
Transport into & out of the Cell

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Cell Structure

Cells are the basic unit of all forms of life.

The structural differences between types of cells enables them to perform specific functions within the organism.

These differences in cells are controlled by genes in the nucleus.

Plant and animal cells (**eukaryotic cells**) have:

- a cell membrane, cytoplasm and genetic material enclosed in a nucleus.

Bacterial cells (**prokaryotic cells**) are much smaller in comparison.

They have:

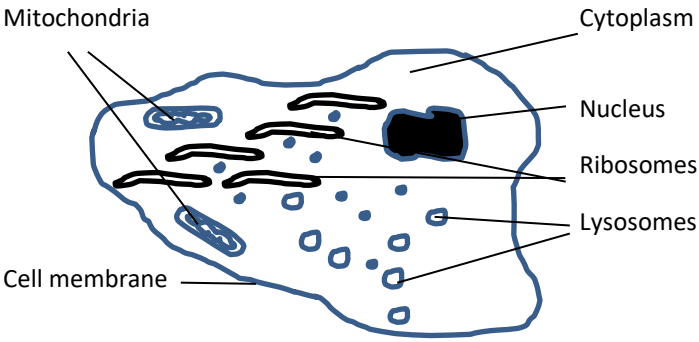
- a cytoplasm and a cell membrane surrounded by a cell wall.
- The genetic material is not enclosed in a nucleus. It is a single **DNA loop** and there may be one or more small rings of DNA called **plasmids**.

Animal Cells

CELLS build the body.

There are millions of them and lots of different types that are specific to their function.

They all have a general structure.



Cells contain **ORGANELLES**. These are tiny cellular structures that perform specific functions within a cell.

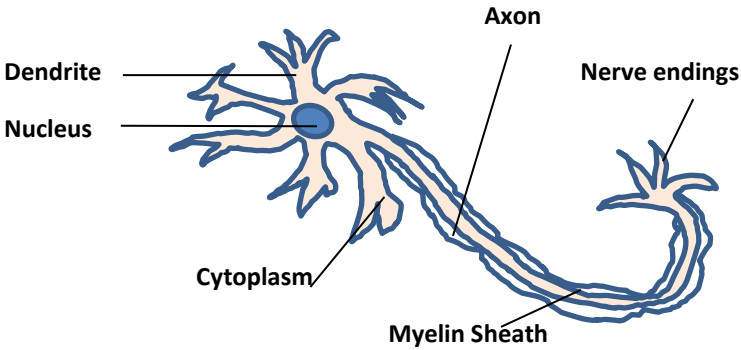
Organelle	**Function**
Nucleus	The 'brains' of the cell. The nucleus directs cell activities and contains genetic material called chromosomes made up of DNA.
Cell membrane	Controls the substances entering and leaving the cell.
Mitochondria	Make energy out of food.
Ribosomes	Make protein.
Lysosomes	Contain digestive enzymes.
Cytoplasm	A jelly like substance. Contains the organelles and many of the chemical reactions take place here.

Different cells of the body have different functions.

Their structure allows them to be **adapted** to their role.

They become **specialised**. We call this cell **differentiation**.

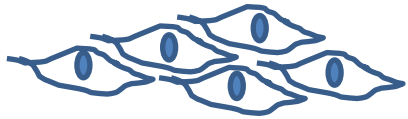
Nerve cells



The long **axon** allows messages in the form of **electrical impulses** to travel all over the body.

The axon is covered with a fatty sheath called the **myelin sheath**. This insulates the nerve cell and speeds up the nerve impulses.

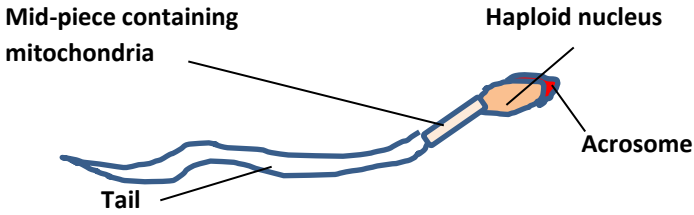
Muscle Cells



Muscle cells contain **filaments of protein that slide over each other** to cause muscle contraction.

They also contain many well-developed **mitochondria** to provide energy for muscle contraction.

Sperm Cells

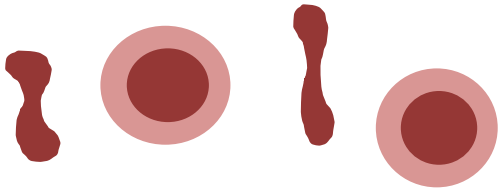


Sperm cells have a tail, enabling the sperm to swim.

The middle piece is packed with **mitochondria** to release the **energy for the swim**.

The **acrosome** contains **enzymes** so that the sperm can penetrate the egg.

Red Blood cells

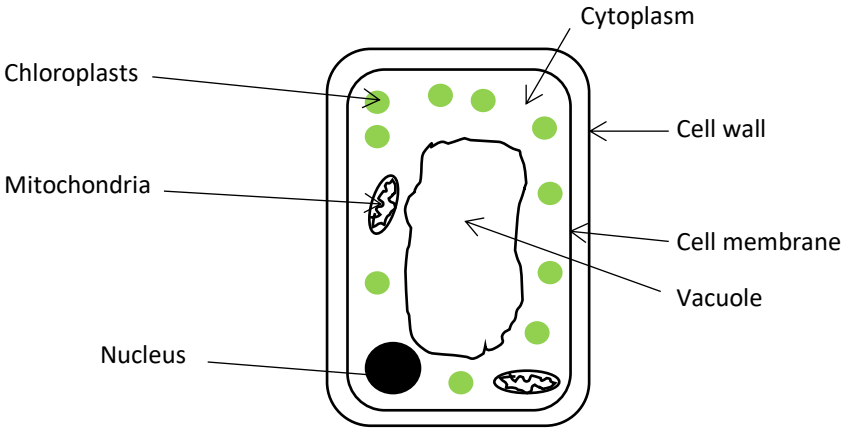


Red blood cells do not contain a nucleus, but they do contain **haemoglobin**.

Haemoglobin can combine with oxygen.

Red blood cells have a thin membrane and are biconcave in shape. This enables quick diffusion of oxygen into and out of the cell.

Plant cells



A plant cell contains similar organelles to the animal cell.

In addition, there are three unique to the plant cell.

Organelle	**Function**
Chloroplasts	Contains the green pigment chlorophyll which absorbs light energy for photosynthesis. Contains the enzymes needed for photosynthesis.
Vacuole	Filled with cell sap to keep the cell **turgid**.
Cell wall	Made from **cellulose** fibres. Strengthens the cell and supports the plant.

Microscopy

Cells are the fundamental units of living organisms.

Cells contain many sub-cellular structures that are essential for the functioning of the cell as a whole.

Microscopy is used to examine cells and subcellular structures.

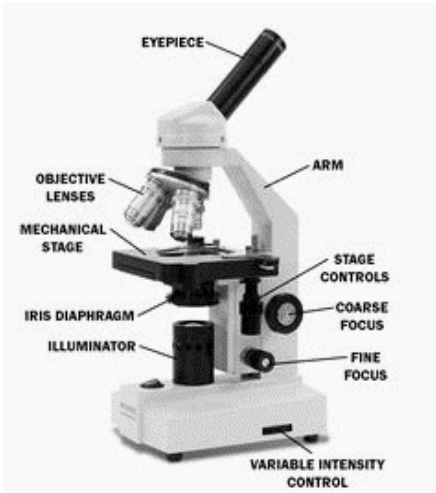
Microscopy allows objects to be **magnified** within the **resolution** range of the normal eye.

Magnification is the process of enlarging the apparent size of something.

Resolution is the ability to distinguish in detail. It is the minimum distance at which two distinct points of a specimen can still be seen.

There are two main types of microscope:

a. **Light microscope:** Used to study living cells and for regular use when relatively low **magnification** and **resolution** is enough.



Two lenses are used to magnify the specimen:

- the **eyepiece** and
- the **objective lens**.

There is a choice of objectives and these can be accessed by simply rotating them to the lens of choice.

This means that magnification can be varied to suite the level of detail required.

Below are examples of the objective lenses.

The numbers show how much each lens will magnify the image.

To calculate the total magnification the following formula is applied:

Magnification of Microscope = Magnification of Eyepiece x Magnification of Objective

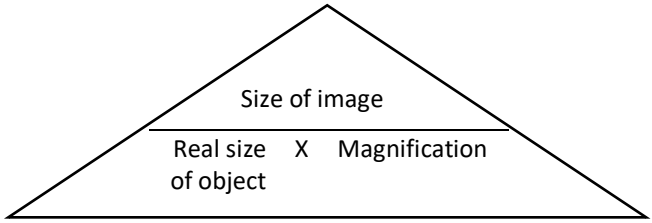
For example:

The total magnification for a microscope with an eyepiece magnification of x10 and an objective magnification of x10 is:

10 x 10 = **100**

The purpose of a microscope is to magnify the image of a specimen to see more detail.

The following formula triangle can be used to calculate this magnification:



For example:

The real size of a dividing cell is 0.03 mm.

The size of the image in a book is 90 mm.

What is the magnification of this image?

Magnification = size of image ÷ real size of object

Magnification = 90 mm ÷ 0.03 mm

*Magnification = **3000***

Note: make sure you work in the same units.

b. **Electron microscope:** Use a beam of electrons instead of beams of light. This allows not only a higher magnification but also a far greater resolution allowing more detail to be observed.

   There are two types of electron microscopes:

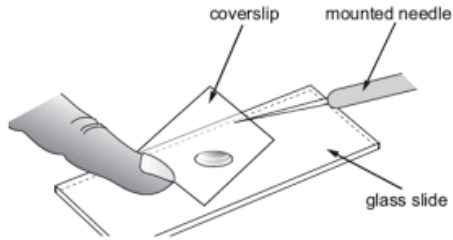
   - Transmission Electron Microscope (**TEM**): Used to examine thin slices/sections of cells or tissues.
   - Scanning Electron Microscope (**SEM**): Used to examine the surface structure of specimens.

TEMs have higher magnification and resolution than SEMs.

Making Slides for Microscopy

To examine objects under the microscope we use a thin piece of glass called a **slide**.

This is prepared as shown below.



Chemical stains are used to make some cell parts more obvious.

For GCSE, you need to prepare an animal cell slide and a plant cell slide.

The **animal cell** slide involves you scraping the inside of your cheek with a cotton bud to remove the cells.

This process is then followed:

- Smear the cotton bud onto a microscope slide.
- Add a drop of **methylene blue** (a chemical stain).
- Gently lower a coverslip (avoid trapping air bubbles) onto the cheek cells using forceps.

Epidermal cells of an onion are used to prepare a **plant cell** slide.

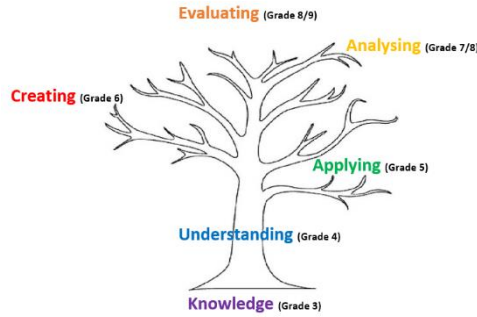
This process is followed:

- Peel a thin, transparent layer of epidermal cells from the inside of an onion.
- Place cells on a microscope slide.
- Add a drop of **iodine** (a chemical stain).
- Gently lower a coverslip (avoid trapping air bubbles) onto the onion cells using forceps.

AQA

GCSE
BIOLOGY
Foundation Tier Paper 1F

Tuesday 12 May 2020 Afternoon



Knowledge

1. This question is about cells.

a. **Figure 1** shows a cell.

Figure 1

What type of cell is shown in **Figure 1**?

[1 mark]

Tick one box.

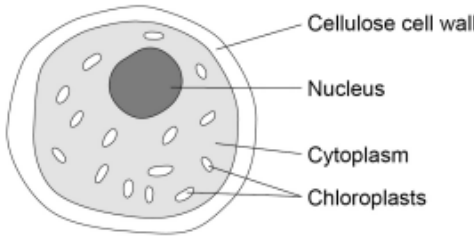
Animal ☐

Bacterium ☐

Plant ☐

Figure 2 shows an algal cell.

Figure 2



b. What is the function of the cell wall?

[1 mark]

Tick **one** box

To contain the genetic material	☐
To stop the chloroplasts leaking out	☐
To strengthen the cell	☐

c. The algal cell is green.

Which part of the algal cell makes it green in colour?

[1 mark]

Tick **one** box

- Cellulose ☐
- Chloroplast ☐
- Cytoplasm ☐
- Nucleus ☐

d. Cells contain sub-cellular structures.

Draw **one** line from each structure to its function.

[3 marks]

Structure	Function
	Controls transport of substances into the cell
Cell membrane	Where energy is released
Mitochondria	Where glucose is made
Ribosomes	Where photosynthesis takes place
	Where proteins are made

Understanding

A student prepared a microscope slide of cheek cells.

The student looked at one cell using a microscope.

Figure 3 shows the image the student saw.

Figure 3

e. What should the student do to get a clear image?

[1 mark]

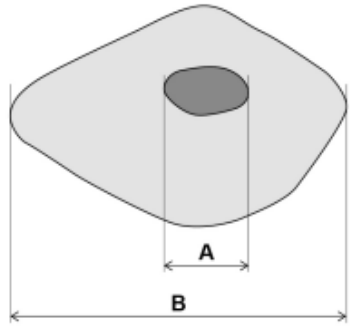
Tick **one** box

Adjust the focus knob	☐
Make the light dimmer	☐
Put water on the slide	☐

The student then obtained a clear image.

Figure 4 shows the clear image.

Figure 4



f. Measure the length of the nucleus (**A**) and the length of the cell (**B**) in millimetres (mm).

[2 marks]

A = _____ mm

B = _____ mm

g. How many times longer is the cell (B) than the nucleus (A)?

[1 mark]

Number of times longer = _____

h. The student looked at another cell.

The image width of the cell was 40 mm
The real width of the cell was 0.1 mm

Calculate the magnification of the cell.

[2 marks]

Use the equation:

$$\text{magnification} = \frac{\text{size of image}}{\text{size of real object}}$$

Magnification = ×

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

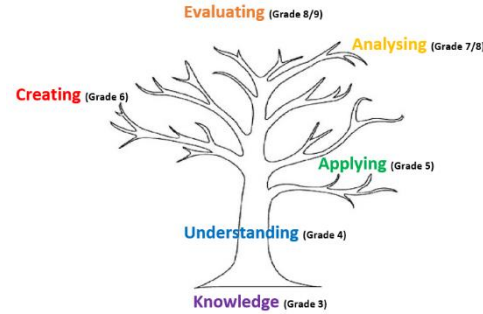
Centre Number | Candidate Number

Tuesday 12 May 2020

Afternoon (Time: 1 hour 45 minutes) | Paper Reference **1BI0/1F**

Biology
Paper 1

Foundation Tier



Knowledge

2. Figure 4 shows three cells.

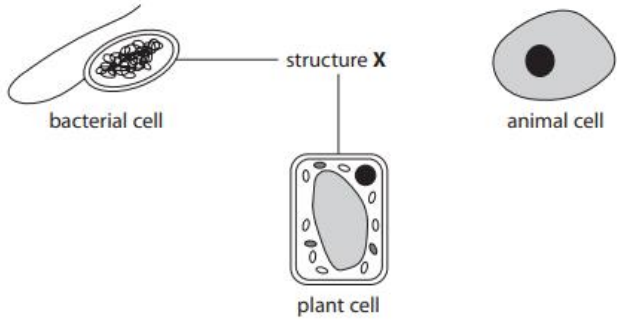


Figure 4

(i) What is structure **X**?

(1)

- ☐ **A** cell membrane
- ☐ **B** cell wall
- ☐ **C** cytoplasm
- ☐ **D** nucleus

(ii) The bacterial cell in Figure 4 has a flagellum.

State the function of a flagellum.

(1)

.....

.....

(iii) Give **one** other difference between the bacterial cell and the animal cell shown in Figure 4.

(1)

.....

.....

b. Substances move into and out of cells.

How does oxygen move into and out of cells?

(1)

- ☐ **A** transpiration
- ☐ **B** active transport
- ☐ **C** diffusion
- ☐ **D** osmosis

c. A plant leaf cell is 0.04mm long.

Calculate the length of the image after this cell has been magnified 500 times.

(2)

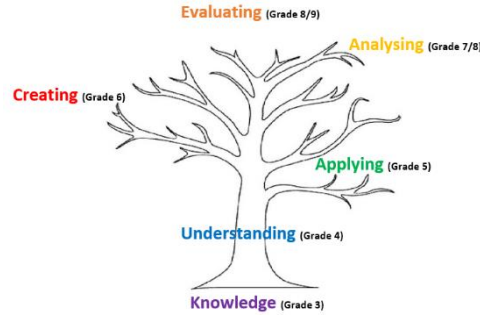
length of image = ...mm

AQA

GCSE
BIOLOGY

Foundation Tier Paper 1F

Tuesday 14 May 2019 Afternoon



Knowledge

7. **Figure 12** shows an animal cell viewed using a microscope.

Figure 12

a. The cell contains a nucleus.

What is the function of the nucleus?

[1 mark]

b. Name **one** type of cell that does **not** contain a nucleus.

[1 mark]

Understanding

c. Draw a simple diagram of the cell in **Figure 12.**

Label two parts of the cell.

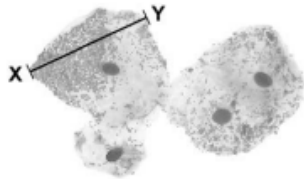
[2 marks]

d. Name **one** structure found in a plant cell but not found in an animal cell.

[1 mark]

Figure 13 shows some different cells.

Figure 13



e. The real length from point X to point Y is 0.06 mm

Calculate the magnification.

Use the equation:

$$\text{magnification} = \frac{\text{size of image}}{\text{real size of object}}$$

[3 marks]

Magnification = ×

Core Practical: Microscope Technique

Investigate different magnification techniques to draw scientific diagrams from several biological specimens.

This is an *example* of using a light microscope to examine animal/plant cells and make observations to draw scientific diagrams.

To focus the microscope:

- Rotate the **objectives** until the low power lens (x10) is in line with the **stage**.
- Place the **microscope slide** onto the stage and line it up so that the **specimen** is in the centre of the stage where the light passes through.

  Care must be taken when looking down the microscope that the illumination is not too bright to prevent eye damage.

- **'Rack**' the **course focus** down to the microscope slide and then very gradually turn it upwards until the image comes into focus.
- Adjust focus accordingly with **fine focus**.

Draw the **low power image**. This is used to show the arrangement of cells in a tissue.

Rotate the objectives so that the high-power objective (x40) is in line with the stage. Use fine focus adjustment to focus

Draw the **high-power image**. This will be a detailed image of individual cells.

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Level 1/Level 2 GCSE (9–1)

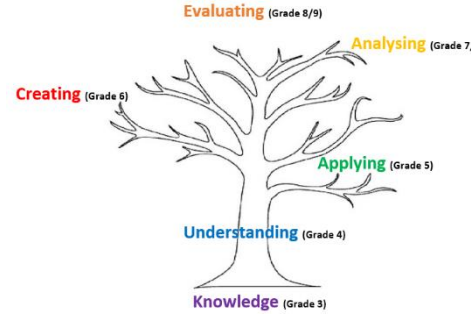
Centre Number | Candidate Number

Tuesday 12 May 2020

Afternoon (Time: 1 hour 45 minutes) | Paper Reference **1BI0/1H**

Biology
Paper 1

Higher Tier



Understanding

3. Figure 2 shows a banana plantation.

© warmer/Shutterstock

Figure 2

a. After the bananas have been harvested, the old plants are cut down.

The suckers then develop into mature plants producing the next crop of bananas.

The tip of each sucker contains a group of cells called a meristem.

(i) Describe the function of a meristem in the growth of a plant.

(2)

(ii) A student took a sample of cells from a meristem to view under a light microscope.

Describe how the student would prepare a microscope slide using these cells.

(3)

b. Figure 3 is a drawing of a eukaryotic cell.

Structure **Z** is found in plant leaf cells.

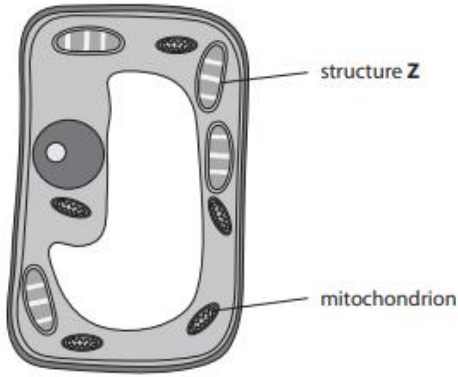


Figure 3

(i) Name structure **Z**.

(1)

(ii) Give **one** function of the mitochondrion.

(1)

(iii) Describe how a prokaryotic cell is different from the cell in Figure 3.

(2)

Food

Food is made up of **MACROMOLECULES** and **MICROMOLECULES**.

Macromolecules are large insoluble food molecules that need to be digested in order to be absorbed into the body's system.

The macromolecules are

- **fats**,
- **carbohydrates,** and
- **proteins**.

The body requires these nutrients for various reasons.

- **Fats** are needed for energy and warmth.
- **Proteins** are needed for growth and repair and
- **carbohydrates** for energy.

The **micro molecules** are

- **vitamins** and
- **minerals**.

These are needed for general health.

Core Practical: Testing for Biological Molecules

The testing of foods for presence of biological molecules in a range of foods.

These **food tests** will identify the presence of…

- **carbohydrates,**
- **protein, and**
- **fats**

…in food substances.

CARBOHYDRATES

Starch is detected using **iodine solution** (*beware: iodine is an irritant so wash it off skin straight away*).

Iodine solution is red/brown in colour.

- Using a pipette add a drop of iodine solution to the food substance to be tested and observe.
- The presence of starch will turn the iodine a **blue/black** colour.

Reducing sugars, such as glucose, are detected using **Benedict's solution**.

Benedict's solution is blue.

- Place the food substance into a boiling tube and add Benedict's solution to it.
- Place the boiling tube into a beaker of hot water and observe.
- If reducing sugars are present the Benedict's solution gradually turns from blue to **yellow, green, a cloud orange or brick red**.
- The yellow/green colouring suggests low levels of reducing sugars whilst the brick red colour shows high levels of reducing sugars.

PROTEIN

Protein is detected using **Biuret Reagent**.

This consists of a solution of *sodium hydroxide* and a solution of *copper sulphate*. Combined, these two solutions give a blue colour (*beware: both of these substances are corrosive so wash off skin straight away*).

- Place the food substance to be tested into a test tube.
- Add the biuret reagent and observe.
- Presence of protein in the food will change the colour of the biuret reagent from blue to **purple**.

LIPIDS

Lipids are detected using the **emulsion test**.

- Place the food substance to be tested into a test tube.
- Add 2cm^3 of **ethanol** and 2cm^3 of **distilled water**.
- Presence of lipids in the food will result in a **milky-white emulsion** forming.

For your information there are lots of enzyme reactivity experiments on YouTube. A good one to check out is the action of salivary amylase on starch.

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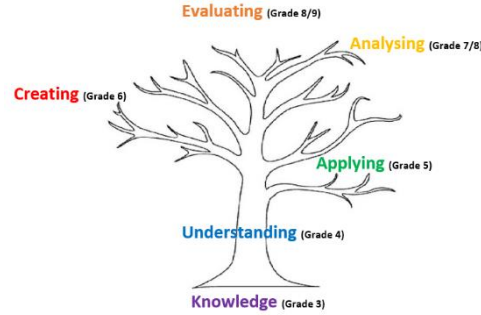
Biology
Paper 1

Foundation Tier



Knowledge

1. Some foods contain starch.

a. Which chemical is used to test for starch?

(1)

- ☒ **A** amylase
- ☒ **B** ethanol
- ☒ **C** iodine solution
- ☒ **D** hydrochloric acid

b. Benedict's solution is used to test for reducing sugars in food.

Figure 1 shows part of the method for this test.

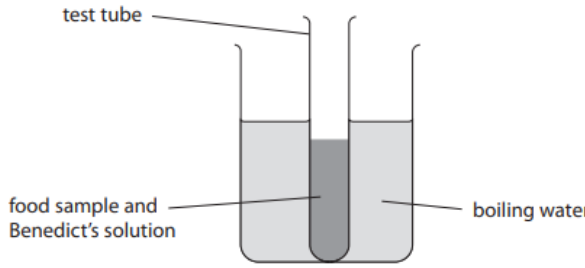


Figure 1

(i) Give **two** safety precautions needed when doing this test.

(2)

1 .....

.....

2 .....

.....

(ii) Give **one** reason for placing the test tube in boiling water.

(1)

.....

.....

Understanding

c. Figure 2 shows some information about the results of the test for reducing sugar.

colour of Benedict's solution after testing food sample	concentration of reducing sugar
blue	zero
green	low
yellow	↓
orange	
brick red	high

Figure 2

A student wanted to compare the amount of reducing sugar in three types of biscuit.

(i) Give **one** variable the student should control.

(1)

.....

.....

Figure 3 shows the student's results.

type of biscuit	colour with *Benedict's solution*
A	green
B	brick red
C	orange

Figure 3

(ii) State **two** conclusions that can be made from the data in Figure 3.

(2)

1 .....

.....

2 .....

.....

Enzymes

Macromolecules will be broken down (**digested**) into smaller soluble food molecules by **ENZYMES**.

Enzymes are **biological catalysts**. They speed up the chemical digestion of food.

Each **enzyme is specific** to the food substance it works on. In other words, only a particular type of enzyme will act on carbohydrates. This enzyme will NOT act on any other substance.

Enzymes work by the **LOCK & KEY THEORY**.

The **enzyme is the key** and the substance it acts on (called the **substrate) is the lock**.

For example, in the mouth, the carbohydrate macromolecule, **starch** is digested by the **carbohydrase** enzyme **salivary amylase**.

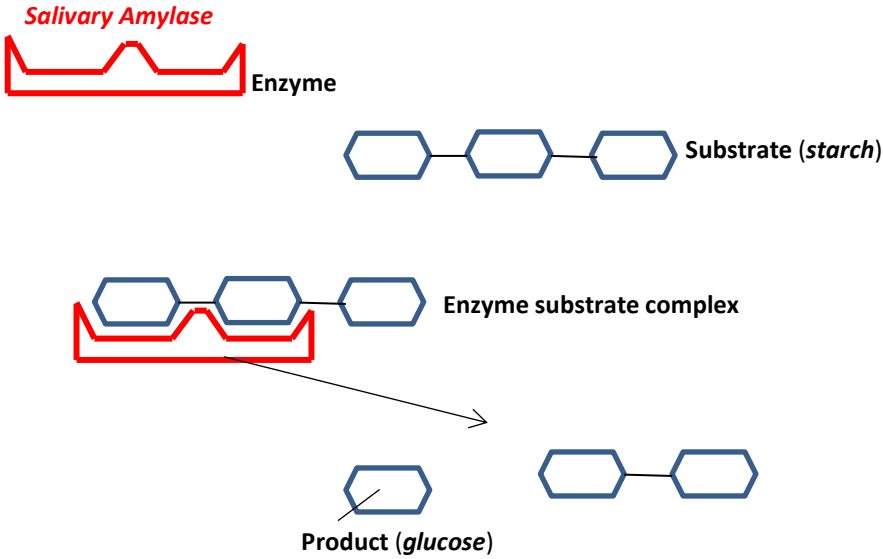
The **product** of this chemical digestion is the smaller, soluble carbohydrate **glucose**.

So, in this case the:

Substrate = Starch

Enzyme = Salivary Amylase

Product = Glucose

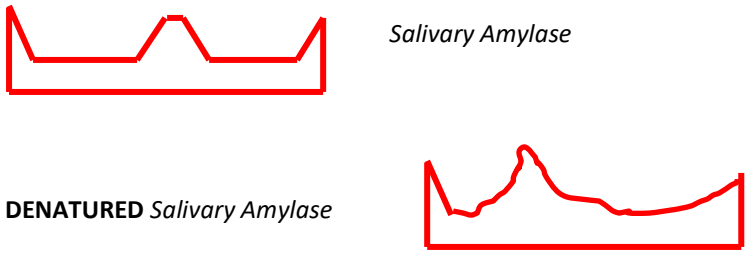


The **ACTIVE SITE** of the enzyme is the key to this process.

The shape of the ***active site is what gives the enzyme its specificity***.

It can, however, be easily damaged by high temperatures and the wrong pH.

The body temperature is approximately 37^{o}C and any temperature above this will start to warp the active site and make it ineffective

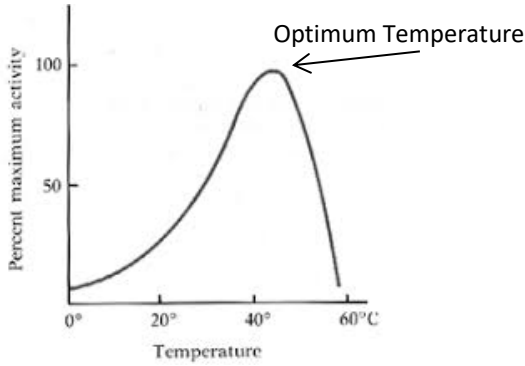


Note that the active site has become damaged and the key will no longer fit the lock.

The heat has **DENATURED** the enzyme.

Like any chemical reaction, heat will speed up enzymes BUT only to a point.

Once the temperature goes too high, the active site becomes damaged and the enzyme reaction stops working.

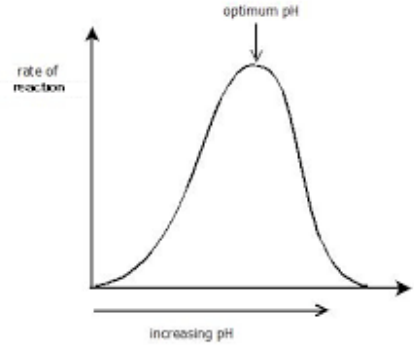


The temperature at which the enzyme functions best is called the **OPTIMUM TEMPERATURE**.

Similarly, the wrong pH will also damage the active site of the enzyme.

Salivary amylase is found in the saliva of the mouth. The mouth has a pH of 7 (neutral) so salivary amylase works best in neutral conditions.

Too acidic or too alkaline conditions will damage the active site of the enzyme and the amylase will stop working.



Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

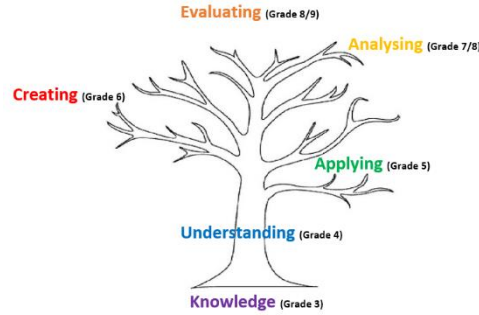
Centre Number | Candidate Number

Tuesday 12 May 2020

Afternoon (Time: 1 hour 45 minutes) | Paper Reference **1BI0/1F**

Biology
Paper 1

Foundation Tier



Understanding

6. A student investigated the activity of a human enzyme at different temperatures.

a. The student measured the mass of product formed after 10 minutes at different temperatures.

Figure 10 shows the results of this investigation.

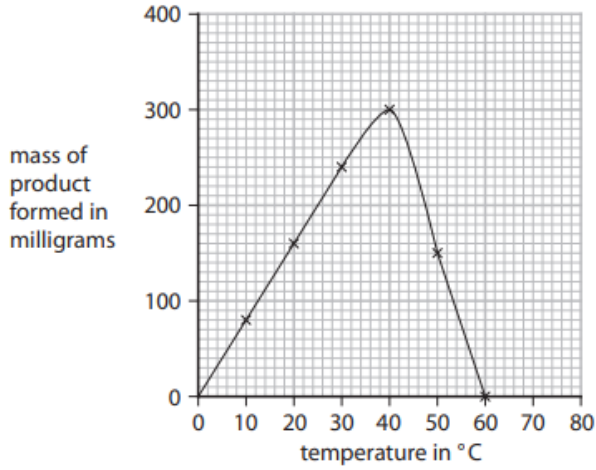


Figure 10

(i) Describe the trends shown in Figure 10.

(2)

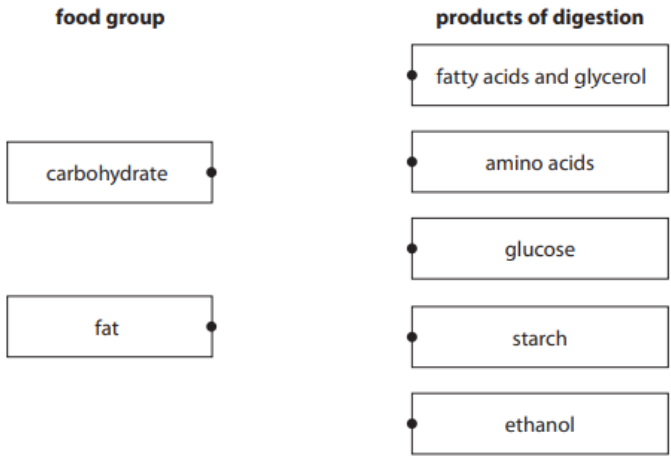
(ii) Explain the results obtained for temperatures from 40°C to 60°C.

(2)

b. Some enzymes are involved in the breakdown of food substances.

(i) Draw **one** straight line from each food group to the products of digestion for that food group.

(2)



(ii) Which enzyme breaks down fat?

(1)

- ☒ **A** carbohydrase
- ☒ **B** amylase
- ☒ **C** protease
- ☒ **D** lipase

Applying

c. Figure 11 shows an enzyme and two substrates, **P** and **Q**.

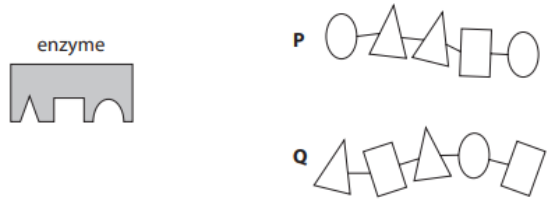


Figure 11

Explain the reason why no product will be formed if the enzyme is mixed with substrate **Q.**

(3)

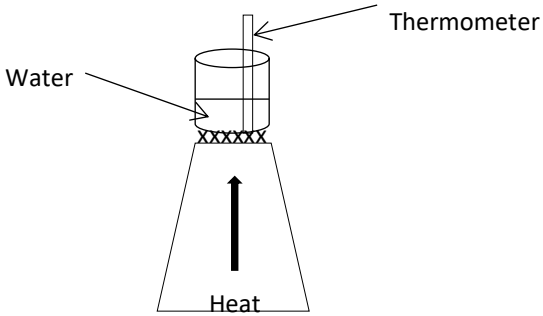
Core Practical: Enzyme controlled Reactions

Investigate the factors that can affect the rate of enzyme activity.

This experiment will allow you to determine the **optimum** pH for the enzyme ***amylase***.

First of all, put on your **safety goggles**.

Then set up the following equipment:



Adjust the Bunsen burner flame to keep the water at 35^{o}C. This is close to body temperature.

Warmer temperatures may **denature** the enzyme.

Next:

- Add 2 drops of **iodine solution** to each spot of a **spotting tile** (*beware: iodine solution is an irritant so wash of your skin straight away*)
- In a test tube add 2 cm^3 **amylase enzyme**, 2 cm^3 **starch solution** and 1 cm^3 **pH solution**.

- Mix and then place the test tube into the beaker of water on the Bunsen burner.
- Use a pipette to remove a few drops of solution every 20 seconds from the test tube and put them into different spots of the spotting tile.
- Repeat until the iodine solution stops turning black.

  The enzyme amylase breaks down starch into glucose. The iodine solution will stop turning black when this happens. If the enzyme is working effectively this will happen quickly.

- Record the time this takes.
- Repeat with different pH solutions.

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

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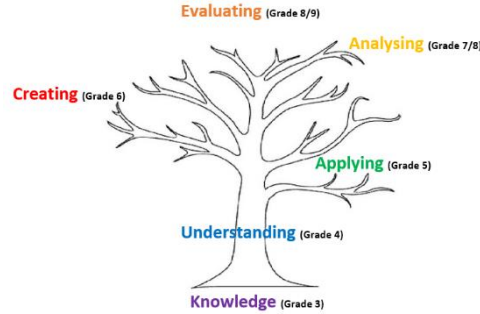
Tuesday 12 May 2020

Afternoon (Time: 1 hour 45 minutes) | Paper Reference **1BI0/1H**

Biology
Paper 1

Higher Tier



Understanding

6. A student mixed 10cm^3 of starch solution with 5cm^3 of amylase solution and kept the tube in a water bath at 25°C.

a. The student tested the solution for starch and for glucose every 30 seconds.

Figure 6 shows the results.

time in seconds	starch detected	glucose detected
0	Yes	No
30	Yes	No
60	Yes	Yes
90	Yes	Yes
120	Yes	Yes
150	No	Yes
180	No	Yes

Figure 6

(i) Give **one** reason for the result at 150 seconds.

(1)

.....

.....

(ii) Another student repeated the investigation with the same volumes of solutions and at the same temperature of 25°C.

Give **two** other variables that would need to be controlled in the investigation.

(2)

1 .....

.....

2 .....

.....

Applying

(iii) Both students also included a tube containing 10cm^3 of starch solution with 5cm^3 of distilled water instead of 5cm3 of amylase solution.

They tested the solution for starch and for glucose every 30 seconds.

Give one reason why this tube was included in their investigations.

(1)

.....

.....

b. Amylase has an optimum pH of 6.8.

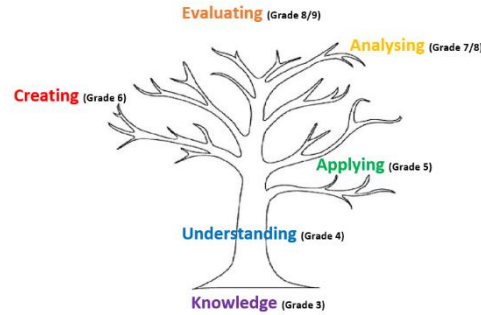
Devise a method the students could use to confirm the optimum pH for amylase.

(3)

c. Amylase is produced by salivary glands and the pancreas.

Explain why amylase is not produced in the stomach.

(3)



Applying

16. The fat in milk is broken down by the enzyme lipase.
A group of students investigate the effect of temperature on this breakdown of fat.

In their investigation they use an indicator called phenolphthalein.
Phenolphthalein is pink in alkali conditions but colourless in pH values below 8.

Step 1 One student puts 5 drops of phenolphthalein and 5 ml of full fat milk into a test tube.
Step 2 She adds 1 ml of lipase and stirs the mixture.
Step 3 She measures the time for the pink indicator colour to disappear.

The other students repeat these three steps but at different temperatures.

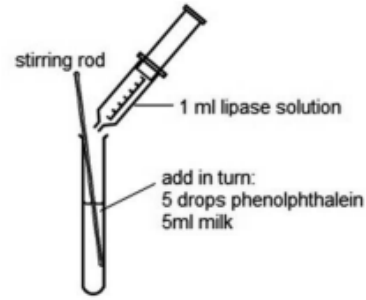


Table 16.1 shows the results of the group.

Temperature (°C)	Time for pink colour to disappear (s)
20	480
40	240
60	270
80	960

Table 16.1

a. The pH falls as the fat in milk breaks down.

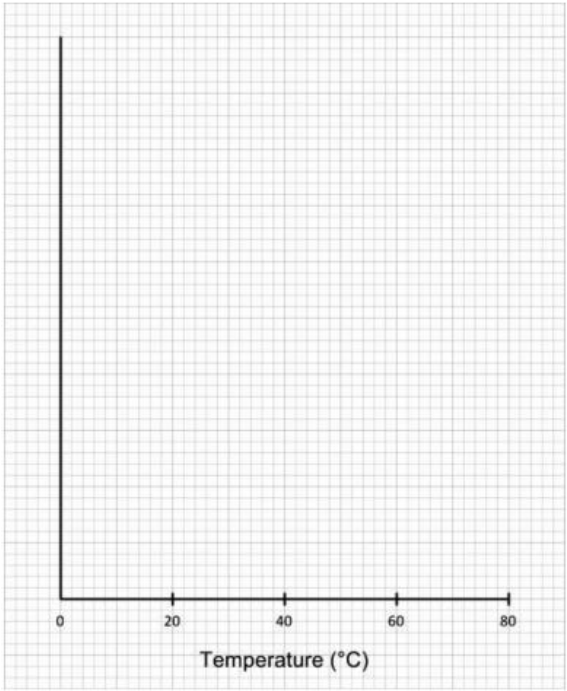
Explain why.

.....

.....

..... **[2]**

b. Plot a graph of the results from **Table 16.1** and draw a line of best fit.



[5]

c. Explain why the results at 20 °C and 40 °C are different.

.....

.....

.....

.....

..... **[3]**

d. Explain why the results at 40 °C and 80 °C are different.

.....

.....

.....

.....

..... [3]

e. One student says that the results show that the optimum temperature for the lipase is 40°C.

The teacher says that she cannot say for certain that it is 40°C.

(i) Explain why.

.....

..... [1]

(ii) Give **two** modifications that the students could make to their method to find a more accurate value for the optimum temperature.

.....

..... [2]

(iii) The students rounded each time they measured to the nearest 10 seconds.

They rounded the times because they found it difficult to judge exactly when the pink colour had disappeared.

Describe and explain two ways the method could be improved to give a more accurate measurement.

1 .....

.....

2 .....

..... **[2]**

Movement In, and Out of Cells - Diffusion

CELLS are the building blocks of life.

They are little factories performing all the vital chemical reactions and processes that your body needs to maintain life.

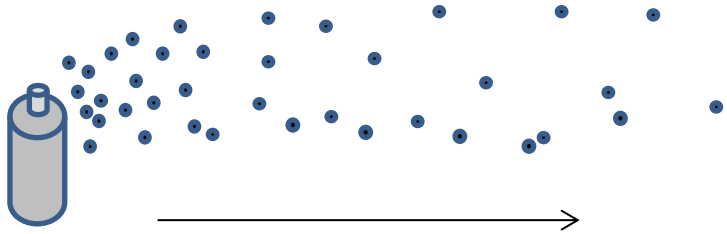
Many substances have to enter and leave cells for all these processes to take place.

There are a few ways they can do this.

Some substances enter and leave cells by a process called **DIFFUSION**.

Diffusion is the movement of particles from an area of high concentration to an area of low concentration so that they evenly spread out.

A good e*xample* of this is spraying air freshener into a room.



High Concentration Low Concentration

When you press the nozzle, the substance around the nozzle will have a high concentration.

Gradually the particles will spread throughout the room to the areas of low concentration until the particles balance out and the smell of the air freshener can be smelt throughout the room.

This is diffusion.

Red blood cells carry oxygen around the body: They pick the oxygen up from the alveoli (air sacs) of the lungs.

- Because you have just breathed in (inhaled) the concentration of the oxygen in the alveoli is high.
- The red blood cells have just returned from the body having released all their oxygen to the body's cells, so they have a low oxygen concentration.
- The oxygen diffuses from the alveoli into the red blood cells.
- Now saturated with oxygen the red blood cells commence their oxygen distribution journey around the body.

Different factors can affect the rate of diffusion. These are:

- The difference in concentrations (concentration gradient)
- The temperature
- The surface area of the membrane

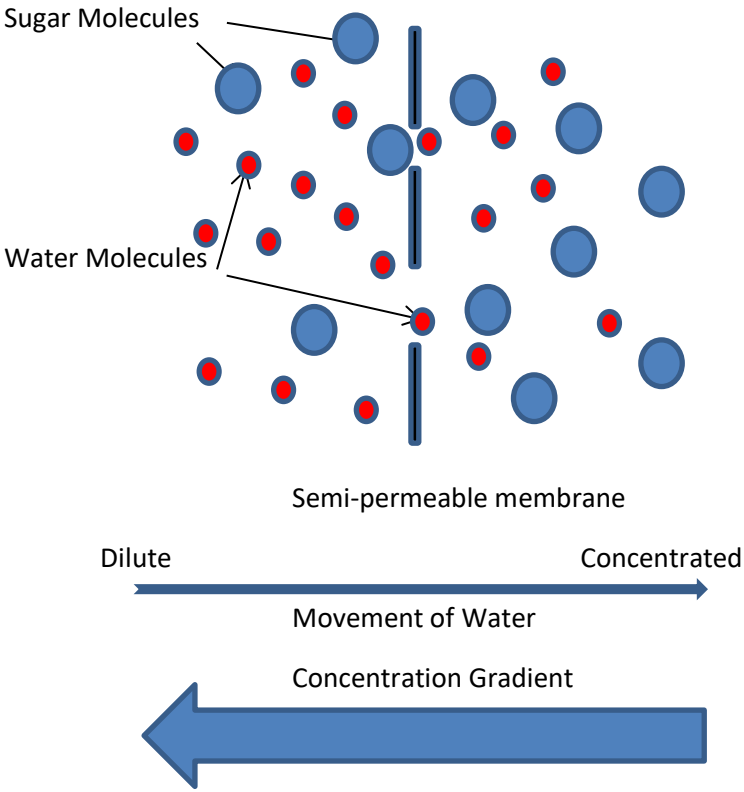
A single-celled organism has relatively large surface area to volume ratio. This allows sufficient transport of molecules into and out of the cell to meet the needs of the organism.

Movement In, and Out of Cells - Osmosis

Water is essential to life. All cells need it and are required to remove excess amounts.

Water enters and leaves cells by a process called **OSMOSIS**.

OSMOSIS *is the movement of water against the concentration gradient through a semi-permeable membrane.*



The water particles are moving from an area where there are lots of them to where there are fewer.

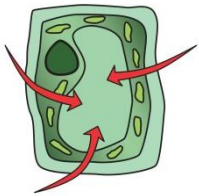
High water content means the solute is dilute (low concentration). So, ***osmosis goes against the concentration gradient.***

The results of osmosis are different in plant and animal cells.

Plant cells have a strong cellulose cell wall on the outside of the cell membrane. This stops the cell bursting when it becomes full of water.

If the water concentration outside the cell is greater than inside the cell the water will enter the plant cell by osmosis.

The cytoplasm pushes against the cell wall and the cell becomes **TURGID**.

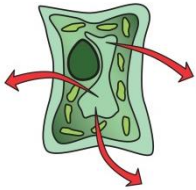


A turgid cell is swollen and hard. It plays an important part in supporting the plant.

If the water concentration outside the cell is lower than inside the cell the water will leave the cell by osmosis.

The cytoplasm pulls away from the cell wall and the cell becomes **FLACCID**.

This is called **PLASMOLYSIS**.



A flaccid cell wilts.

Animal cells do not have a cell wall.

Water gain, *for example* a red blood, will cause the cell to swell and burst. This is called **HAEMOLYSIS**.

Water loss would cause the cell to shrink making then wrinkled or **CRENATED**.

OSMOREGULATION in the body prevents this from happening.

Osmoregulation ensures that the water concentration of the blood balances that in the cell content.

Core Practical: Transport in and out of Cells

Investigate the effect of different water potentials on the length and mass of potato chips.

This experiment looks at the effect of salt concentration on potato tissue.

First:

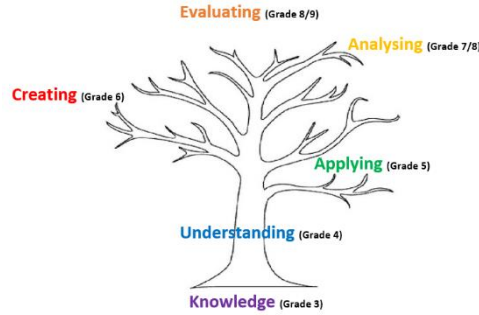
- prepare a range of salt solutions; 0%, 25%, 50%, 75% & 100%.

Next:

- collect five boiling tubes and add 20 cm^3 of the salt solutions. Make sure each tube is labelled with their concentrations. *O% acts as a **control***.
- Collect a **potato strip** and dry using a paper towel.
- Weigh the potato strip and record the mass.
- Place the potato strip into the boiling tube containing 0% salt solution.
- Leave for 20 minutes.
- Then remove, dry, and weigh again. Record your results.
- Repeat this for all of the salt solutions.

Make a series of repeat experiments to identify **anomalous results**. Ignore these anomalous results when calculating a mean.

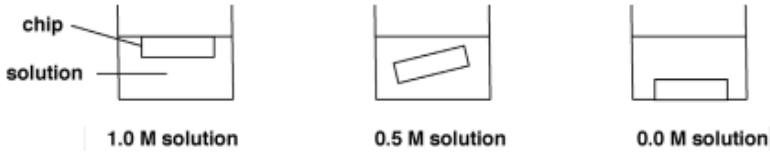
This experiment shows the effect of **osmosis** on plant tissue. The potato strips will increase or decrease in mass if they gain or lose water.



Applying

20. A student investigates how different concentrations of sucrose solutions affect potatoes.

- Three chips are cut from a potato.
- Each chip is 5.0 cm long.
- Each chip is left in a different concentration of sucrose solution for two hours.



These are the results.

Concentration of sucrose solution	Length of potato chip	
	Start (cm)	After two hours (cm)
1.0 M	5.0	4.5
0.5 M	5.0	5.0
0.0 M	5.0	5.5

a. Explain why the length of the chip increases in the 0.0 M solution.

.....

.....

..... **[2]**

b. Explain why the length of the chip stays the same in the 0.5 M solution.

.....

.....

..... **[2]**

c. Calculate the percentage change in the length of the chip in the **1.0 M solution**.

Answer = ... % [2]

(ii) In experiments like this, what is the advantage of calculating percentage change, rather than just the actual change?

.....

.....

..... [1]

d. Measuring the length of the chips is a quick and easy way to get results. However, it does not measure the total change to the chips.

(i) Explain why

.....

..... [1]

(ii) What could the students measure to see the total change to the chips?

.....

..... [1]

Movement In, and Out of Cells – Active Transport

Sometimes dissolved molecules are at a higher concentration inside the cell than outside.

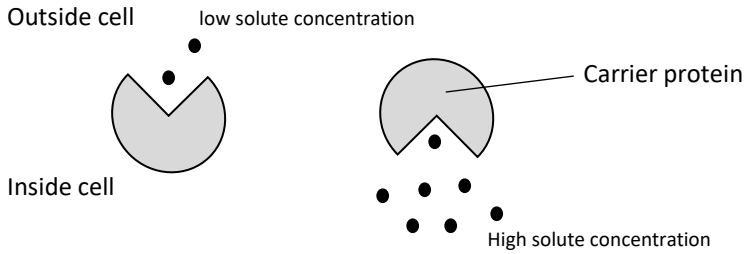
The organism needs these molecules, they still have to be absorbed.

ACTIVE TRANSPORT is the movement of dissolved molecules into or out of a cell through the cell membrane, from a region of lower to a region of higher solute concentration.

Because they are moving against a concentration gradient, **energy from respiration is required**.

Carrier proteins are used to pick up the molecules and deposit them at their correct location.

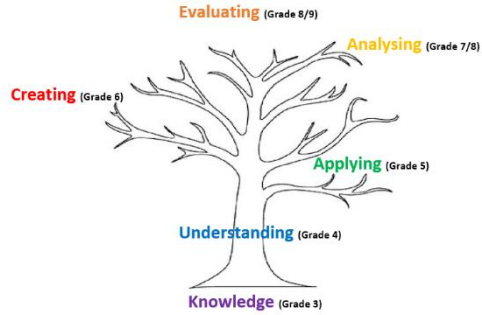
Examples of active transport include the uptake of glucose from the intestines in humans and the uptake of mineral ions into root hair cells of plants.



AQA

GCSE
BIOLOGY
Foundation Tier Paper 1F

Tuesday 12 May 2020 Afternoon



Understanding

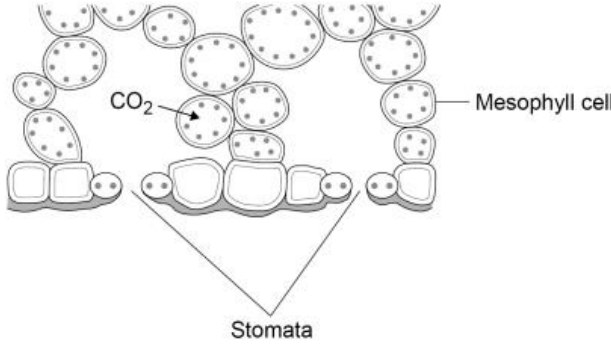
8. Diffusion is an important process in animals and plants.

a. What is meant by the term diffusion?

[2 marks]

b. **Figure 11** shows part of a leaf.

Figure 11



Molecules of carbon dioxide diffuse from the air into the mesophyll cells.

Which **two** changes will increase the rate at which carbon dioxide diffuses into the mesophyll cells?

[2 marks]

Tick **two** boxes

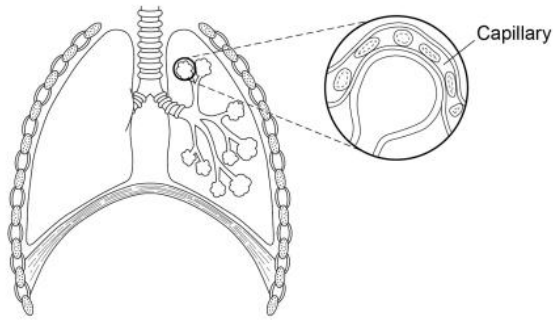
Decreased number of chloroplasts in the cells	☐
Decreased surface area of cells in contact with the air	☐
Increased carbon dioxide concentration in the air	☐
Increased number of stomata that are open	☐
Increased oxygen concentration in the air	☐

Applying

c. Diffusion also happens in the human lungs.

Figure 12 shows the human breathing system.

Figure 12

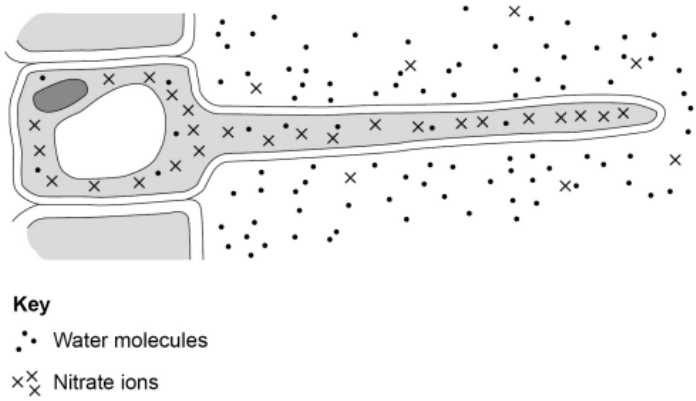


Explain how the human lungs are adapted for efficient exchange of gases by diffusion.

[6 marks]

Figure 13 shows a root hair cell.

Figure 13



d. Name the process by which water molecules enter the root hair cell.

[1 mark]

_____

e. Nitrate ions need a different method of transport into the root hair cell.

Explain how the nitrate ions in **Figure 13** are transported into the root hair cell.

Use information from **Figure 13** in your answer.

[3 marks]

Name of process _____

Explanation _____

_____

_____

Pearson Edexcel
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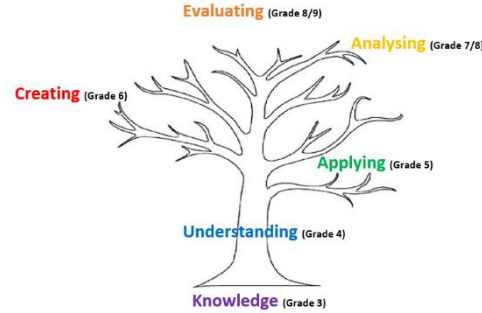
Biology
Paper 1

Foundation Tier



Applying

4. A student placed three different sized cubes of agar jelly into separate beakers containing the same concentration of hydrochloric acid.

The cubes contained a pink indicator.

This indicator becomes clear when in contact with an acid.

Figure 7 shows the results of the investigation after the cubes had been in the acid for 120 seconds.

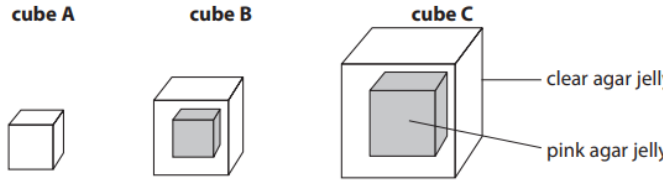


Figure 7

a. The distance from the outside of cube B to the pink area was 3 mm.

(i) Calculate the distance diffused by hydrochloric acid in one second.

(2)

..... mm

(ii) The student wanted to confirm their results.

Give one improvement the student should make to this investigation to confirm their results.

(1)

b. Devise a method, using cubes of agar jelly, to investigate how temperature affects the rate of diffusion.

(3)

c. Some substances move into and out of cells by active transport.

Which is the correct description of the movement of a substance by active transport?

(1)

- ☐ **A** against a concentration gradient using energy
- ☐ **B** down a concentration gradient using energy
- ☐ **C** against a concentration gradient without using energy
- ☐ **D** down a concentration gradient without using energy

d. Some drugs used to treat cancer are taken into cells by active transport.

Figure 8 shows some causes of preventable cases of cancer in 2015.

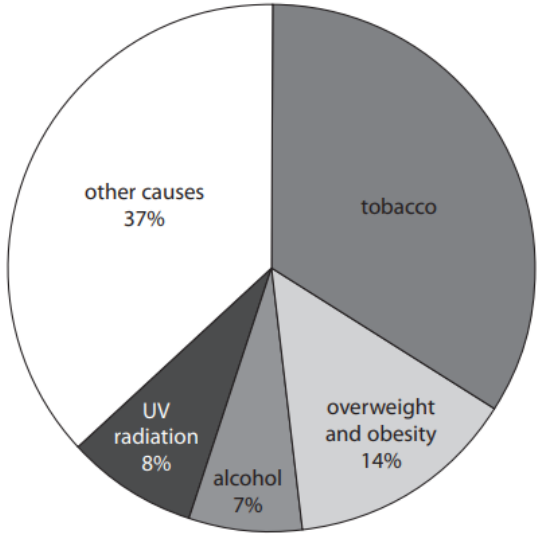


Figure 8

(i) What is the percentage of preventable cases of cancer that are caused by tobacco?

(1)

- ☒ **A** 41%
- ☒ **B** 37%
- ☒ **C** 34%
- ☒ **D** 26%

(ii) In 2015, data from Cancer Research UK suggested that 163440 cases of cancer could have been prevented.

Calculate the number of preventable cases of cancer caused by alcohol.

Give your answer to the nearest whole number.

(2)

number of preventable cases of cancer caused by alcohol .....

Exam Question Answers

Page 14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	bacterium		1	AO2 4.1.1.1
01.2	to strengthen the cell		1	AO1 4.1.1.1 4.1.1.2
01.3	chloroplast		1	AO2 4.1.1.2 4.2.3.1
01.4	**Structure** — **Function** Cell membrane → Controls transport of substances into the cell Mitochondria → Where energy is released Mitochondria → Where glucose is made Ribosomes → Where photosynthesis takes place Ribosomes → Where proteins are made additional line from a box on the left negates the mark for that box		3	AO1 4.1.1.2 4.1.3.1
01.5	adjust the focus knob		1	AO3 4.1.1.2 RPA1
01.6	(A =) 15 (mm) (B =) 60 (mm)	allow a tolerance of ± 1mm	1 1	AO2 4.1.1.2 RPA 1
01.7	$\frac{60}{15} = 4(.0)$	allow ecf from question **01.6**	1	AO2 4.1.1.2 RPA 1

01.8	$\frac{40}{0.1}$ 400	 do **not** accept if a unit is given	1 1	AO2 4.1.1.5 RPA 1
Total			**12**	

Page 20

Question number	Answer	Mark
2(a)(i)	B cell wall **The only correct answer is B** ***A is not correct because X is not the cell membrane*** ***C is not correct because X is not the cytoplasm*** ***D is not correct because X is not the nucleus***	**(1)**

Question number	Answer	Mark
2(a)(ii)	(allows) movement / swim / motility	**(1)**

Question number	Answer	Additional guidance	Mark
2(a)(iii)	• (bacteria) have no nucleus / have chromosomal DNA / have a cell wall	accept converse for all differences	**(1)**

Question number	Answer	Mark
2(b)	C diffusion **The only correct answer is C** ***A is not correct because oxygen does not move into and out of cells by transpiration*** ***B is not correct because oxygen does not move into and out of cells by active transport*** ***D is not correct because oxygen does not move into and out of cells by osmosis***	**(1)**

Question number	Answer	Additional guidance	Mark
2(c)	Substitution 500 x 0.04 (1) Evaluation 20 (mm)	 award two marks for correct answer with no working	**(2)**

(Total for question 2 = 6 marks)

Page 23

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	controls the (activities of the) cell	allow contains genetic information / genes / DNA / chromosomes do **not** accept brain do **not** accept controls substances entering / leaving the cell	1	4.1.1.2 AO1
07.2	red blood cell / RBC **or** bacteria / prokaryote **or** xylem (cell)	allow erythrocyte ignore blood cell unqualified ignore platelets allow named examples of bacteria do **not** accept virus	1	4.2.2.3 4.1.1.1 AO1
07.3	cell shape is similar to cell in **Figure 12 and** nucleus present any **two** features correctly identified and labelled: • nucleus • (cell) membrane • cytoplasm • mitochondria / mitochondrion • ribosome(s)	ignore shading do **not** accept a cell wall drawn allow cell wall if drawn and correctly labelled do **not** accept other plant sub-cellular structures	1 1	4.1.1.2 AO2 8.2.1 AO1
07.4	any **one** from: • (cellulose cell) wall • chloroplast • (permanent) vacuole	ignore chlorophyll allow starch grain	1	4.1.1.2 AO1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5		an answer of (×) 400 scores **3** marks an answer of (×) 40 scores **2** marks		4.1.1.5 AO2
	24 (mm) **or** 2.4 (cm)	allow in range 23 to 25 (mm) **or** in range 2.3 to 2.5 (cm)	1	
	$\frac{24}{0.06}$ **or** $\frac{2.4}{0.06}$	allow correct calculation from their measurement of **X** to **Y** in the range 2.3 cm to 3.5 cm **or** 23 mm to 35 mm	1	
	(×) 400	allow correct magnification derived from their measurement in **mm** ignore rounding errors	1	
07.6	high(er) magnification	ignore bigger / zoom	1	4.1.1.5 AO1
	high(er) resolution **or** high(er) resolving power	allow see more detail	1	
		if neither mark awarded allow **1** mark for see smaller objects **or** see smaller sub-cellular structures		
		allow 3D image		
Total			**10**	

(Total for question 2 = 9 marks)

Question number	Answer	Additional guidance	Mark
3(a)(i)	Two from: • (meristem cells) are undifferentiated • (meristem cells) divide / produce more cells (1) • by mitosis (1)	accept are stem cells accept (the cells produced) can differentiate /become specialised/elongate (1)	(2)

Question number	Answer	Additional guidance	Mark
3(a)(ii)	An answer including: • use a thin section of {cells/meristem} (1) • add a stain / named stain (1) • place a cover slip on top of the sample (1)	accept add a sample of the cells to the microscope slide accept a description of a coverslip	(3)

Question number	Answer	Mark
3(b)(i)	chloroplast / chloroplasts accept phonetically correct misspellings	(1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	(aerobic) respiration / release energy	ignore make / produce energy accept word equation for respiration accept to produce ATP	(1)

Question number	Answer	Additional guidance	Mark
3(b)(iii)	Any two from: • no nucleus/ chromosomal DNA (in the cytoplasm) (1) • no membrane-bound organelles (1) • circular/plasmid DNA (1) • no mitochondria (1) • no chloroplasts (1) • no vacuole (1)	accept: presence of flagellum (1) presence of a slime coat (1) presence of pili (1) accept cell wall not made of cellulose (1)	(2)

(Total for question 3 = 9 marks)

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Question number	Answer	Mark
1(a)	C iodine solution **The only correct answer is C** ***A is not correct because amylase is not used to test for starch*** ***B is not correct because ethanol is not used to test for starch*** ***D is not correct because hydrochloric acid is not used to test for starch***	**(1)**

Question number	Answer	Additional guidance	Mark
1(b)(i)	Two from: • wear goggles (1) • wear gloves (Benedict's solution is an irritant to skin) (1) • use tongs to handle test tube (1)	accept other relevant safety precautions (1) ignore PPE without additional detail	**(2)**

Question number	Answer	Additional guidance	Mark
1(b)(ii)	heat up contents of the tube / allow a reaction to take place (between food sample and Benedict's solution)	accept speed up the reaction / safer than using a Bunsen burner	**(1)**

Question number	Answer	Additional guidance	Mark
1(c)(i)	One from: • mass of biscuit • volume of Benedict's solution • temperature of water (bath) • time left in water (bath)	 accept weight of biscuit. ignore references to 'amount' ignore references to 'amount'	(1)

Question number	Answer	Additional guidance	Mark
1(c)(ii)	Two from: • all biscuits contain (reducing) sugar /glucose (1) • most in biscuit B (1) • least in biscuit A (1)	 accept high in B accept low in A accept B is greater than C is greater than A for 2 marks	(2)

(Total for question 1 = 7 marks)

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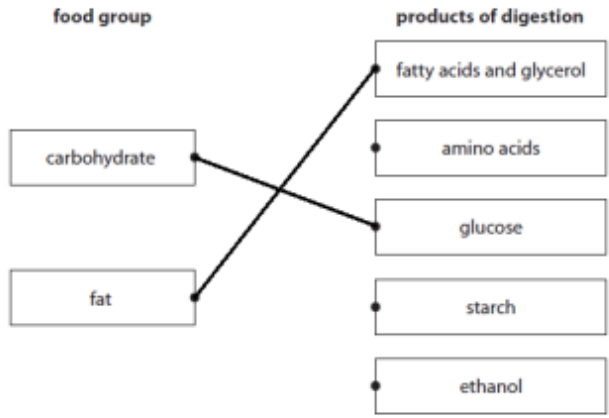
Question number	Answer	Additional guidance	Mark
6(a)(i)	Any two from: • mass of product increases up to 40ºC /300mg (1) • mass of product decreases after 40ºC /300mg (1) • mass of product decreases faster than it increases (1)	accept maximum mass is 300mg / 40ºC is the optimum temperature (1) accept increases then decreases for 1 mark	(2)

Question number	Answer	Mark
6(a)(ii)	An explanation linking two from: • (maximum product at 40ºC) because the enzyme is at its optimum temperature (1) • (between 40ºC and 60ºC the amount of product decreases) because the enzyme is becoming less active/ is being denatured /at 60ºC the enzyme is denatured (1) • (because) the active site is changing shape / substrate can't bind to the active site / fewer enzyme-substrate complexes formed (1)	(2)

Question number	Answer	Mark
6(b)(i)	Two lines drawn correctly as shown.  Reject more than one line from each food group	(2)

Question number	Answer	Mark
6(b)(ii)	D lipase **The only correct answer is D** ***A is not correct because carbohydrase does not break down fat*** ***B is not correct because amylase does not break down fat*** ***C is not correct because protease does not break down fat***	(1)

Question number	Answer	Additional guidance	Mark
6(c)	An explanation linking: • (shape of) active site of enzyme (1) • not complementary to / will not fit substrate Q (1) • (therefore) the enzyme cannot cause the reaction to occur (so no product is formed) (1)	accept lock and key are not complementary/ enzyme and substrate don't fit together	(3)

(Total for question 6 = 10 marks)

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Question number	Answer	Mark
6(a)(i)	all the starch has been converted into glucose / all the starch has reacted with the amylase / all the starch is digested (1)	(1)

Question number	Answer	Mark
6(a)(ii)	Any two from: • pH of the solution (1) • concentration of amylase (1) • concentration of starch (1) • amount of mixing (1) • size of the tube used (1) • time interval must be the same (1)	(2)

Question number	Answer	Additional guidance	Mark
6(a)(iii)	it is a control/to check that starch doesn't breakdown into glucose without amylase (1)	ignore control variable ignore allow results to be compared	(1)

Question number	Answer		Mark
6(b)	A plan including three of the following: • mix starch solution with amylase (1) • use different pH values (1) • using buffers / test at pH solutions between pH 6.5 and 7.5 (1) • control named variables (1) • a method of testing for glucose/a method of testing for starch • the sample that produces glucose in the shortest time is closest to the **optimum** (1)	ignore mix the solutions accept ranges around 5 to 8 accept **test** the sample for starch/glucose	**(3)**

Question number	Answer	Mark
6(c)	An explanation linking: • the stomach is {acidic/low pH/pH 2}(1) • which will denature the {amylase/enzyme} (1) • changes the shape of the active site/substrate will not {bind/fit} into the active site (1)	**(3)**

(Total for question 6 = 10 marks)

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Question			Answer	Marks	AO element	Guidance
16	(a)		produces acids = (1) but produces fatty acids = (2)	2	2.2	
	(b)		Y axes correctly labelled, including units (1) Y axis even scales occupying more than half of the page (1) all points correctly plotted = (2) but at least 3 points correctly plotted = (1) line of best fit (1)	1 1 2 1	2.2 2.2 2 x 2.2 2.2	
	(c)		at 20°C: slower reaction (1) particles moving more slowly (1) less frequent collisions (1)	1 1 1	3.1a 2.1 2.1	**allow** reverse argument referring to 40°C
	(d)		At 80°C: slower reaction (1) enzyme denatured (1) shape of active site changed / cannot bind to substrate (1)	1 1 1	3.1a 2.1 2.1	**allow** reverse argument referring to 40°C

Question			Answer	Marks	AO element	Guidance
	(e)	(i)	(optimum) could be either side of 40°C / could be anywhere between 40°C and 60°C (1)	1	3.1a	
		(ii)	do more repeats (1) idea of narrower intervals around 40°C (1)	1 1	3.3b 3.3b	 **allow** 30-50°C
	(f)		**any two from** use a colorimeter – so it's objective / AW (1) have the same student doing all observations – so there is a consistent judgement / AW (1) repeat the experiment at each temperature – can take mean/average (1)	2	2 x 3.3b	**allow** light meter **allow** colour chart / serial dilution

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20	(a)		absorbed water (1) higher water potential/water concentration outside ora (1)	1 1	2.1 3.1a	**allow** (movement) from higher to lower water potential / from higher to low water concentration
	(b)		(potato has) same water potential / water concentration (as solution) (1) no (net) water loss or gain (1)	1 1	3.1a 2.1	

Question			Answer	Marks	AO element	Guidance
	(c)	(i)	-10 (%)(2) but 10 (%) (1)	2	2 x 2.1	
		(ii)	can still compare even if original sizes are different (1)	1	2.2	
	(d)	(i)	ignores changes to width / mass (1)	1	3.3a	
		(ii)	measure (changes to) volume / mass (1)	1	3.3b	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	movement / spreading out of molecules / particles	allow movement / spreading out of (named) substances / chemicals / gases / liquids ignore reference to membranes / cells	1	AO1 4.1.3.1
	from (an area of) high(er) concentration to (an area of) low(er) concentration	allow down / with the concentration gradient ignore along / across the concentration gradient do **not** accept movement from / to a concentration gradient	1	
08.2	increased carbon dioxide concentration in the air		1	AO2 4.1.3.1 4.2.3.2
	increased number of stomata that are open		1	

08.3	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1 4.1.3.1 4.2.2.2 4.2.2.3
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	

	Indicative content
	• (many) alveoli
	  • provide a large(r) surface area (: volume)
	
	• capillaries are thin
	  or alveoli / capillary walls are thin **or** one cell thick
	  or capillaries are close to the alveoli
	  • which provides short diffusion path (for oxygen / carbon dioxide)
	
	• breathing (mechanism) moves air in and out
	  or lungs are ventilated
	  • to bring in (fresh) oxygen
	  • to remove carbon dioxide
	  • to maintain a concentration / diffusion gradient`
	
	• large capillary network (around alveoli)
	  or good blood supply
	  • to remove oxygen(ated blood) quickly
	  • to bring carbon dioxide to the lungs quickly
	  • to maintain a concentration / diffusion gradient		

08.4	Osmosis	allow diffusion	1	AO1 4.1.3.1 4.2.3.2 4.1.3.2
08.5	active transport (because) energy is needed (to move nitrate ions) from a low(er) concentration (in the soil) to a high(er) concentration (in the root / cell)	 allow (to move nitrate ions) against / up the concentration gradient allow (because) there is a lower concentration (of nitrate ions) in the soil **or** (because) there is a higher concentration (of nitrate ions) in the root / cell ignore reference to amount / number of nitrate ions ignore along / across the concentration gradient do **not** accept if reference to molecules / atoms moving	1 1 1	AO3 AO2 AO2 4.1.1.3 4.2.3.2 4.1.3.3
Total			**14**	

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Question number	Answer	Additional guidance	Mark
4(a)(i)	Substitution 3 ÷ 120 (1) 0.025 (mm)	 award two marks for correct answer with no working	(2)

Question number	Answer	Additional guidance	Mark
4(a)(ii)	Repeat (the investigation)	accept compare with results from other groups	(1)

Question number	Answer	Additional guidance	Mark
4(b)	A logical plan including three from the following: • heat (hydrochloric) acid to different temperatures (1) • use same size agar jelly cubes (1) • use same volume/ concentration of acid (1) • for same amount of time (1) • measure clear distance (from outside of cube) at each temperature (1)	 accept heat agar jelly cubes to different temperatures ignore amount of acid accept for 2 marks time how long for agar jelly to go clear (mp 4 and 5)	(3)

Question number	Answer	Mark
4(c)	A against a concentration gradient using energy **The only correct answer is A** ***B is not correct because active transport is not down a concentration gradient using energy*** ***C is not correct because active transport is not against a concentration gradient without using energy*** ***D is not correct because active transport is not down a concentration gradient without using energy***	**(1)**

Question number	Answer	Mark
4(d)(i)	C 34% **The only correct answer is C** ***A is not correct because the percentage of preventable cases of cancer caused by tobacco is not 41%*** ***B is not correct because percentage of preventable cases of cancer caused by tobacco is not 37%*** ***D is not correct because percentage of preventable cases of cancer caused by tobacco is not 26%***	**(1)**

Question number	Answer	Additional guidance	Mark
4(d)(ii)	Substitution (7 x 163440) ÷ 100 / 163440 x 7% / 163440 x 0.07 (1) Correctly rounded to 11441	 accept 11440.8 (1) award two marks for correct answer with no working	**(2)**

(Total for question 4 = 10 marks)