

# Cell Biology part 2 AQA Combined Science

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Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

Time: **70 minutes**

Marks: **65 marks**

Comments:

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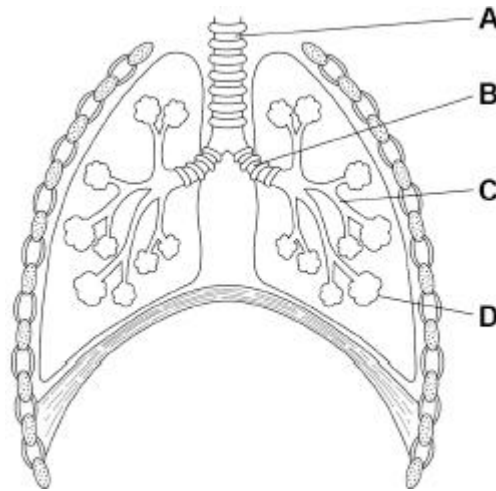
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**Q1.**

The figure below shows the human breathing system.



(a) Name parts **A** and **B**.

Choose answers from the box.

alveolus	bronchus	capillary	trachea
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**A** \_\_\_\_\_

**B** \_\_\_\_\_

(2)

(b) Where does gas exchange happen in the breathing system?

Tick (✓) **one** box.

**A**

**B**

**C**

**D**

(1)

(c) Give **two** ways that the lungs are adapted for efficient gas exchange.

1 \_\_\_\_\_  
\_\_\_\_\_

2 \_\_\_\_\_  
\_\_\_\_\_

(2)

The table below shows the percentage of gases in air breathed into the lungs and air breathed out of the lungs.

Gas	Percentage (%) in air breathed in	Percentage (%) in air breathed out
Oxygen	21	16
Carbon dioxide	0.04	4
Nitrogen	78	78

- (d) Explain the **differences** in the air breathed into the lungs and the air breathed out of the lungs.

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(4)

- (e) The percentages given in each column of the table above do **not** add up to 100%.

Suggest **one** reason why.

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(1)

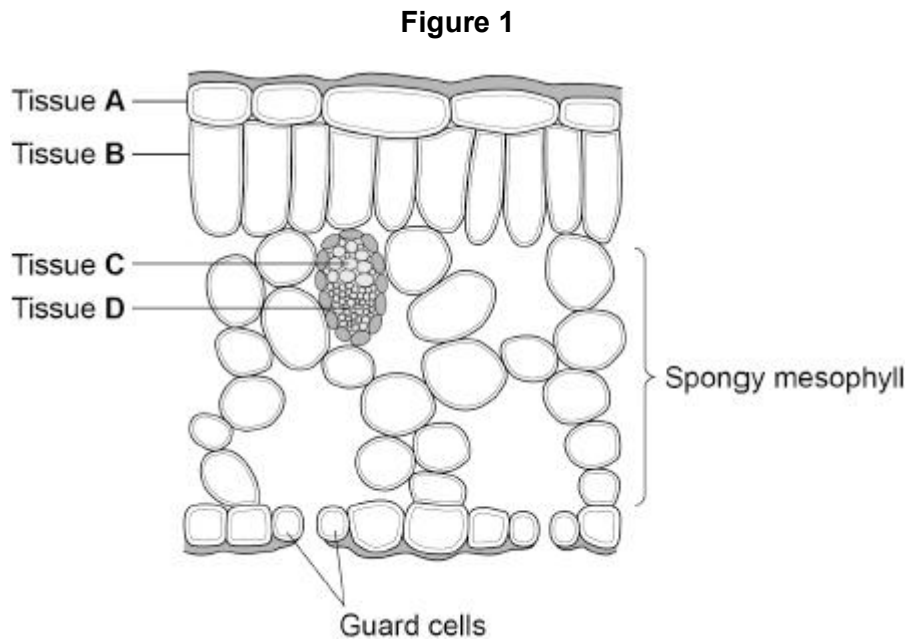
(Total 10 marks)



**Q3.**

A leaf is a plant organ.

**Figure 1** shows tissues in a leaf.



(a) Which tissue is the epidermis?

Tick (✓) **one** box.

A       B       C       D

(1)

(b) Explain how the spongy mesophyll is adapted for its function.

Use **Figure 1**.

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(3)

(c) The xylem is adapted to transport water through a plant.

Explain **one** way that xylem is adapted for its function.

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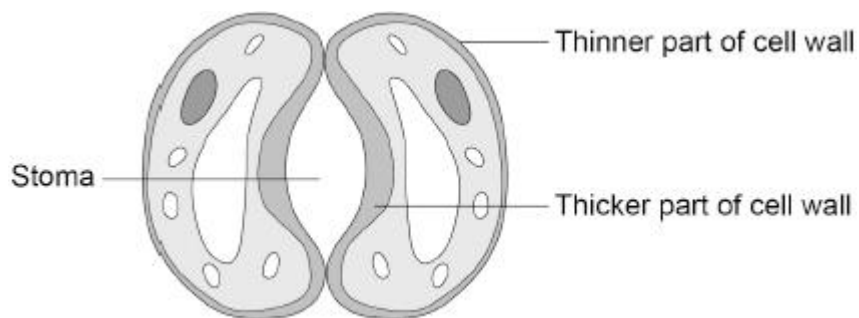
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(2)

(d) **Figure 2** shows a pair of guard cells around a stoma.

**Figure 2**



During the day, glucose is made in the guard cells.

Describe how an increase in glucose concentration in the guard cells causes the stoma to open.

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(2)

(Total 8 marks)

**Q4.**

Antibiotics are drugs used to treat bacterial infections.

Mutations in bacteria produce new strains.

Some strains of bacteria are resistant to antibiotics.

(a) Where do mutations happen in a **bacterial** cell?

(1)

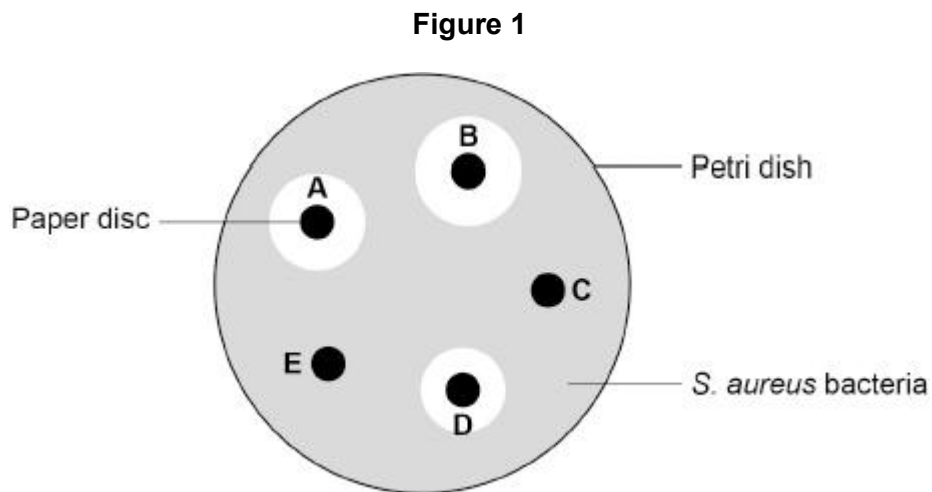
A scientist investigated which antibiotics (**A**, **B**, **C**, **D** and **E**) killed *Staphylococcus aureus* (*S. aureus*) bacteria.

This is the method used.

1. Grow *S. aureus* bacteria in a Petri dish.
2. Cut five small discs of paper.
3. Soak each paper disc in a different antibiotic solution.
4. Put the five paper discs into the Petri dish.
5. Keep the Petri dish at 37 °C for 24 hours.

**Figure 1** shows the results.

A clear area around a disc shows where the bacteria have been killed.



(b) The scientist concluded:

'*S. aureus* is resistant to antibiotics **C** and **E**'.

Explain the evidence for this conclusion.

Use **Figure 1**.

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(2)

(c) The scientist later discovered that *S. aureus* is **not** resistant to antibiotic **E**.

Suggest how the method was developed and showed that *S. aureus* is **not** resistant to antibiotic **E**.

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(2)

Broken bones are sometimes repaired using a metal implant.

The area around an implant can become infected with *S. aureus* bacteria. The infection is usually treated with a long-term course of antibiotics.

Long-term use of antibiotics has led to the development of antibiotic resistant bacteria. Research is being carried out into alternative treatments.

Stem cells from bone marrow and from fat tissue have antimicrobial properties.

A scientist investigated the effect of four treatments on the area of infection around metal implants. Each treatment was injected into the area around the implant.

The four treatments were:

- unreactive solution
- antibiotic solution
- stem cells from fat tissue
- stem cells from fat tissue containing antibiotic.

Each treatment was tested on 5 patients where an infection had developed around their metal implant.

After 7 days of treatment, the scientist calculated the ratio:

area of infection : total tissue area

(d) What was the independent variable in this investigation?

Tick (✓) **one** box.

The ratio of area of infection : total tissue area

The treatment injected around the implant

The type of antibiotic used

The type of bacterial infection

(1)

(e) Suggest **one** advantage of using stem cells from fat tissue, rather than using stem cells from bone marrow.

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(1)

- (f) Stem cells containing antibiotic were produced by growing the cells for 24 hours in a solution containing the antibiotic.

How did the antibiotic enter the stem cells from the solution?

Give a reason for your answer.

Tick (✓) **one** box.

By active transport

By diffusion

By osmosis

By translocation

Reason \_\_\_\_\_

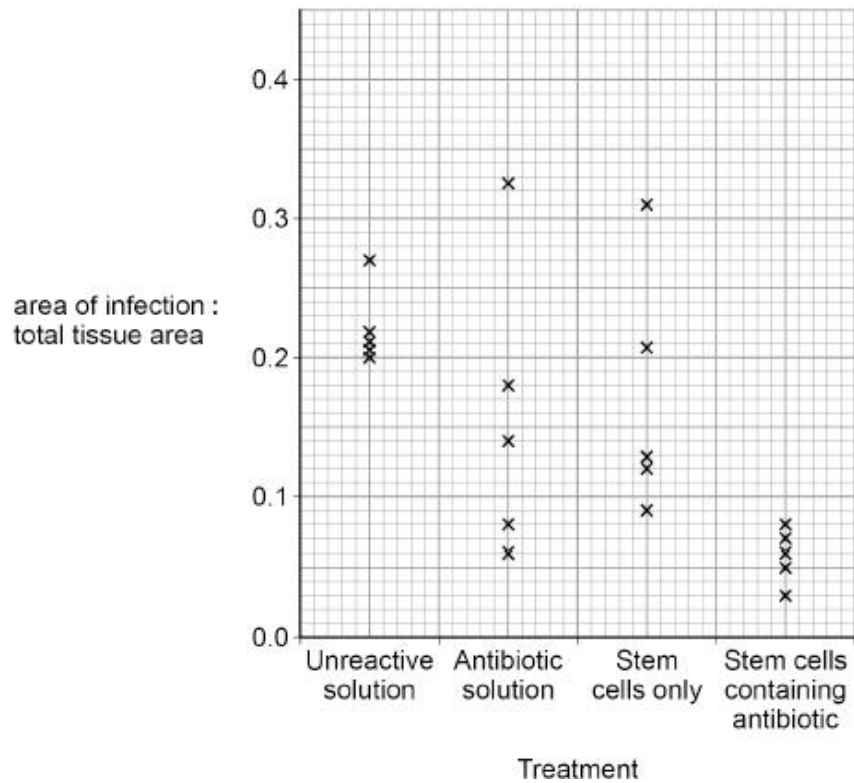
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\_\_\_\_\_

(2)

Figure 2 shows the results.

Figure 2



(g) What is the range of results for the treatment with stem cells only?

From \_\_\_\_\_ to \_\_\_\_\_

(1)

(h) A student looked at the results and concluded:

‘Injections of stem cells containing antibiotic should be used to treat **all** implant-related infections’.

Evaluate the student’s conclusion.

Use **Figure 2**.

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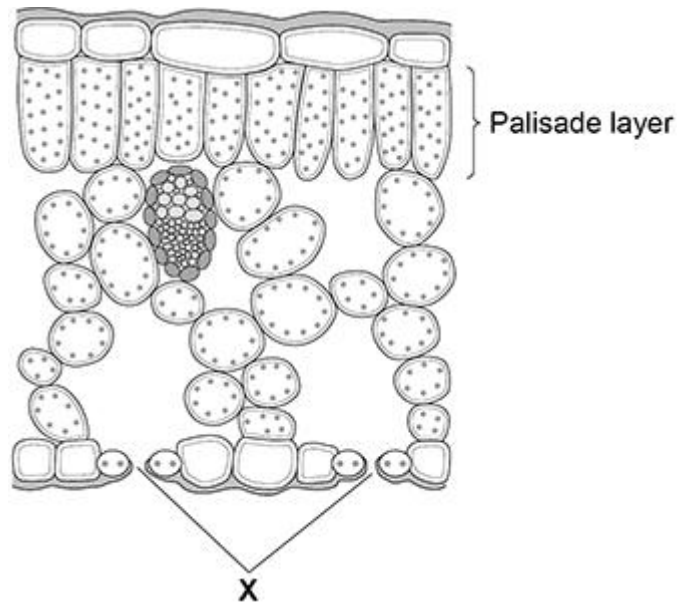
(4)

(Total 14 marks)

**Q5.**

**Figure 1** shows a section through a leaf.

**Figure 1**



- (a) Give **one** way that the palisade layer is adapted for photosynthesis.

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(1)

- (b) Gases pass into and out of the leaf through small pores in the surface of the leaf.

What are the small pores labelled **X** called?

Tick (✓) **one** box.

Guard cells

Stomata

Xylem vessels

(1)

(c) A student viewed a section of a leaf using a microscope.

The student measured the length of one of the palisade cells.

The cell image measured 28 mm in length when viewed at a magnification of  $\times 400$

Calculate the real length of the palisade cell in millimetres (mm).

Use the equation:

$$\text{real length} = \frac{\text{image length}}{\text{magnification}}$$

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Real length = \_\_\_\_\_ mm

Convert the real length of the cell from millimetres to micrometres ( $\mu\text{m}$ ).

1 mm = 1000  $\mu\text{m}$

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Real length = \_\_\_\_\_  $\mu\text{m}$

(3)

(d) Carbon dioxide can move into and out of cells.

What is the process by which carbon dioxide can move into and out of cells?

Tick ( $\checkmark$ ) **one** box.

Active transport

Diffusion

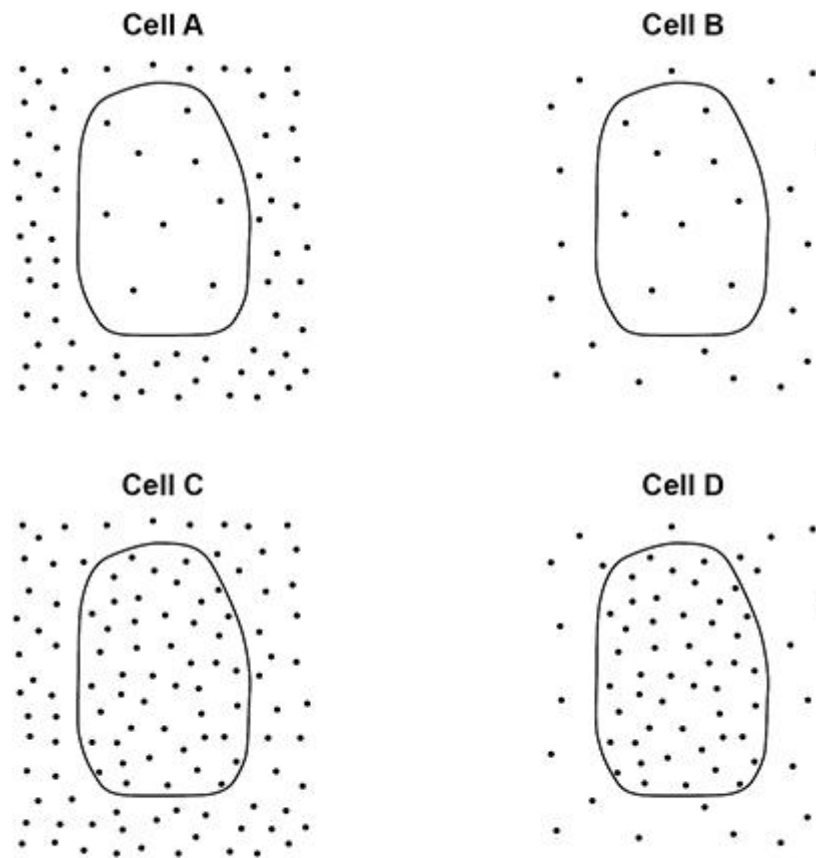
Osmosis

(1)

Figure 2 shows a diagram of four cells.

Each cell is surrounded by carbon dioxide molecules.

Figure 2



**Key**

• Carbon dioxide molecule

(e) Which cell will carbon dioxide move into at the fastest rate?

Give a reason for your answer.

Tick (✓) **one** box.

**A**

**B**

**C**

**D**

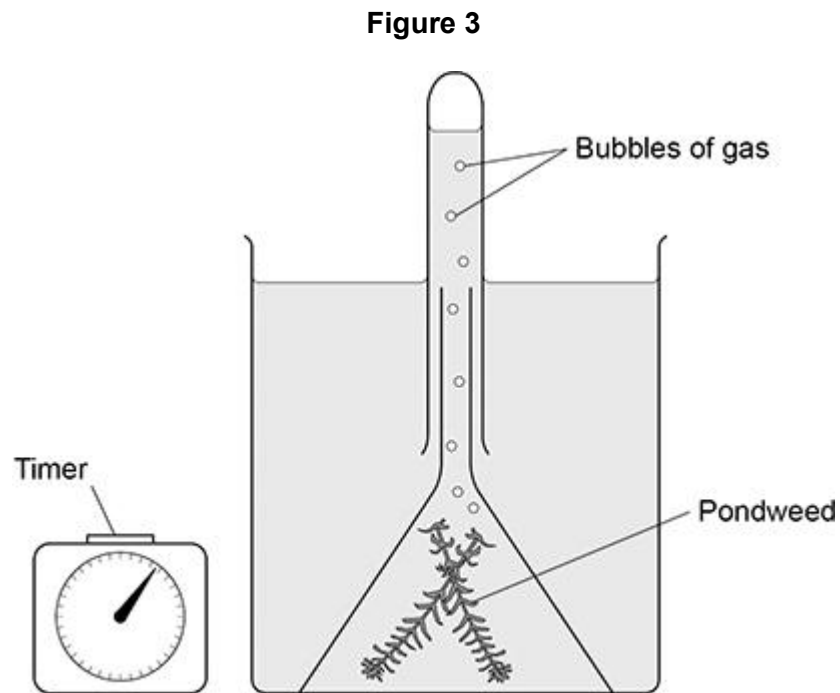
Reason \_\_\_\_\_

\_\_\_\_\_

(2)

A student investigated the effect of different colours of light on the rate of photosynthesis.

**Figure 3** shows some of the apparatus the student used.



The student placed the apparatus in blue light, then in green light and then in red light.

The student measured the rate of photosynthesis in each colour of light.

(f) What **two** measurements should the student make to calculate the **rate** of photosynthesis?

- 1 \_\_\_\_\_  
—  
2 \_\_\_\_\_  
—

(2)

(g) Give **two** variables the student should keep the same in this investigation.

- 1 \_\_\_\_\_  
—  
\_\_\_\_\_
- 2 \_\_\_\_\_  
—  
\_\_\_\_\_

(2)

The table below shows the results.

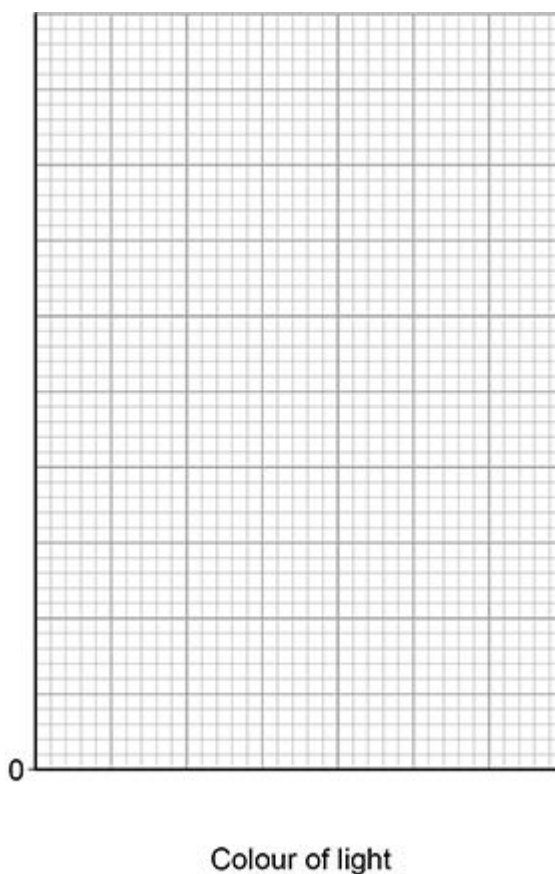
Colour of light	Rate of photosynthesis in arbitrary units
Blue	9
Green	1
Red	8

(h) Complete **Figure 4**.

You should:

- label the y-axis
- use a suitable scale
- plot the data from the table above as a bar chart
- label each bar.

**Figure 4**



(4)

(i) Look at the table above.

What colour of light should be used to grow plants in a greenhouse?

Tick (✓) **one** box.

Blue

Green

Red

(1)  
(Total 17 marks)

**Q6.**

Cigarette smoking is the main cause of cancer in the UK.

(a) Mutations in cells cause cancer.

Where in a cell do mutations happen?

Tick (✓) **one** box.

Cell membrane

Cytoplasm

Nucleus

(1)

(b) Why do some cancers develop into large tumours?

Tick (✓) **one** box.

Cells never stop dividing

Cell respiration is slowed down

Enzyme activity is stopped

(1)

Cigarette smoking has been linked to many different types of cancer.

- (c) Lung cancer is the most common type of cancer caused by smoking.

Suggest **one** reason why.

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(1)

- (d) A person with lung cancer can develop secondary cancers in other parts of the body.

Describe how this can happen.

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(1)

- (e) Sometimes a person may need a lung transplant.

The National Health Service (NHS) will **not** offer a lung transplant to a person who smokes.

Suggest **one** reason why.

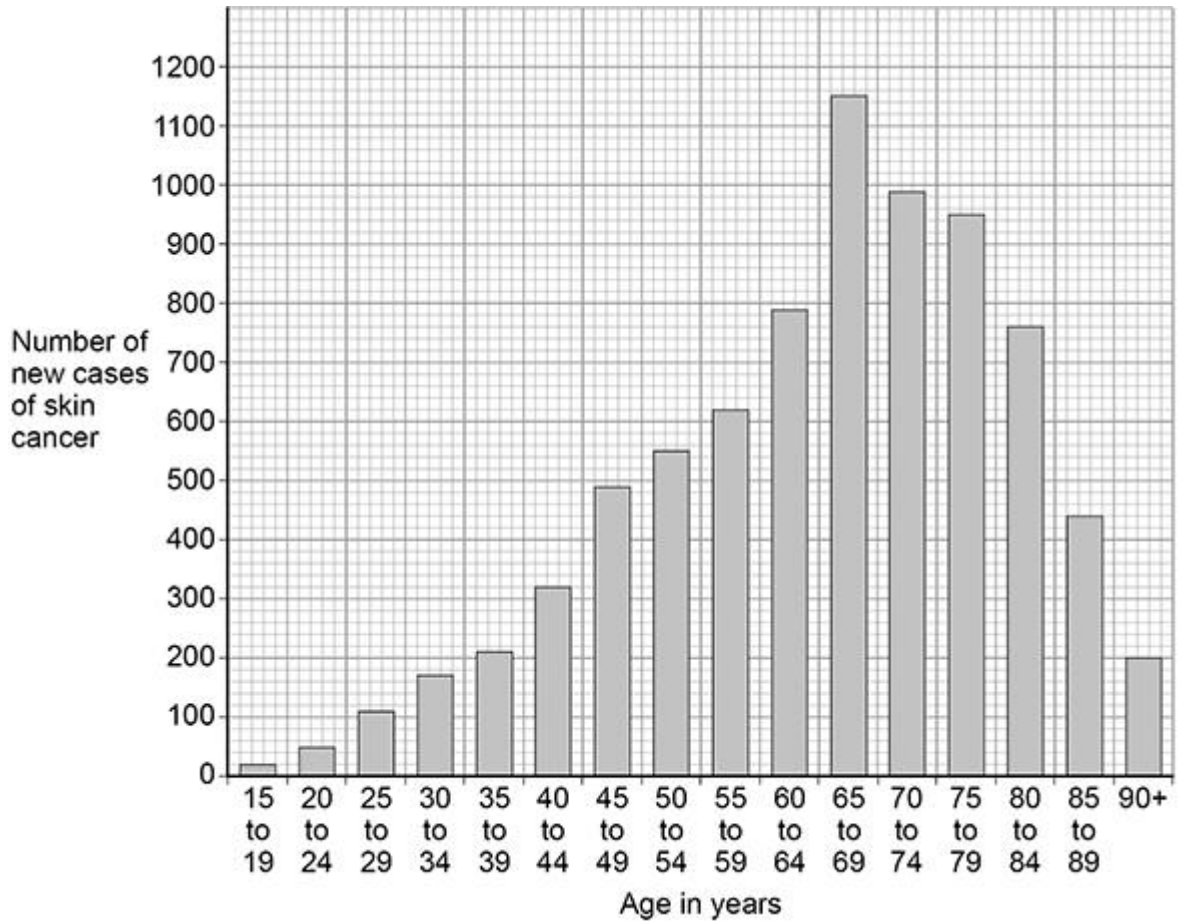
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(1)

The figure below shows data about skin cancer in males for different age groups in the UK.

The data shows the number of new cases of skin cancer in one year.



- (f) How many more new cases of skin cancer are there in males aged 40 to 44 than in males aged 15 to 19?

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Number of new cases = \_\_\_\_\_

(1)

- (g) There are no new cases of skin cancer diagnosed in males younger than 15 years of age.

Suggest **one** reason why.

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(1)

(h) Give **one** conclusion from the data in the figure above.

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(1)

(i) Survival rates for all types of cancers have improved over the last 20 years.

Suggest **two** reasons why.

1 \_\_\_\_\_

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2 \_\_\_\_\_

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(2)

(Total 10 marks)

## Mark schemes

### Q1.

- (a) (A) trachea 1
- (B) bronchus 1  
*must be in this order*
- (b) D 1
- (c) any **two** from: 2
- many alveoli
  - large surface area
  - short diffusion distance  
*allow short distance for gas to travel across*
  - wall of alveolus only one cell thick  
*allow (wall of) alveolus is thin*  
*do not accept cell wall*
  - wall of blood capillaries only one cell thick  
*allow thin (wall of) blood capillary*  
*do not accept cell wall*
  - good blood supply
  - well ventilated  
*ignore moist*
- (d) **Level 2:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account. 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**
- less oxygen in exhaled air (than inhaled air)
    - (because) the body has used some oxygen
    - for respiration
  - more carbon dioxide in exhaled air (than inhaled air)
    - (because) carbon dioxide is produced in respiration
    - carbon dioxide can cause poisoning (in high concentration)
    - (so) needs to be removed from the body
  - no difference in the percentage of nitrogen in inhaled and exhaled air
    - (because) nitrogen is not used by the body
  - more water vapour / moisture in air breathed out

- (because) water is produced in respiration
- exhaled air is warmer (than inhaled air)
  - (because) energy is transferred during respiration
  - thermal energy of body warms the exhaled air

For **Level 2**, explanation(s) and difference(s) must be given

- (e) any **one** from:
- there are other gases present  
*allow named gas eg argon*
  - water (vapour) is present
  - the numbers are rounded

1

[10]

## Q2.

**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5-6

**Level 2:** The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.

3-4

**Level 1:** The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1-2

**No relevant content**

0

### Indicative content

#### Method 1

- place ruler on (microscope) stage
- focus on (scale on) ruler
- measure diameter / width of field of view
- in millimetres
- replace ruler with slide
- focus on cells
- use same magnification
- estimate / count number of cells that fit (lengthwise) across field of view
- (to calculate mean length of onion cells):  
divide diameter / width of field of view by (estimated) number of cells
- or**  
divide diameter / width of field of view by 3 cells

#### Method 2

- focus on cells
- note magnification
- take a photograph of the image
- calculate a mean:
  - measure length of several cells (3 or more) cells on the photograph
  - add all image lengths together and divide total by number of cells (to calculate mean cell image length)

OR

- measure the length of one cell
- calculate the real size
- repeat for other cells (3 or more)
- calculate the mean real size
- (mean) size of real cell = (mean cell) image size / magnification

General points

- focus under low power first
- using focusing knob
- then focus at ×100 magnification
- reference to how total magnification is calculated
- equation:

(mean) size of real cell = (mean cell) image size / magnification

For **Level 2** attempt at a method to measure cells plus an indication of how to calculate mean length

For **Level 3** suitable method and calculation of mean length.

[6]

**Q3.**

(a) A

1

(b) has (large) air spaces (between cells)

*allow has (large) gaps (between cells)*

1

(so) gases can diffuse / move through the leaf

*allow carbon dioxide or oxygen or water vapour  
for gases*

1

to / from the photosynthetic / palisade / B layer

*allow to / from the upper mesophyll  
if named gas given for mp 2 direction of  
movement must be correct*

1

*if no other marks awarded allow 1 mark for cells  
have chloroplasts for photosynthesis*

(c) composed of hollow tubes / cells

*allow cells are empty  
allow no cytoplasm / nucleus / sub-cellular  
structures*

1

(so) no obstruction to water flow

*allow (so) water flows easily if linked to hollow  
tubes*

*allow to maintain the transpiration stream*

OR

has lignin (1)

*ignore has thick walls*

(to) hold tubes open (1)

**or**

(to) strengthen the tubes

*allow (to) keep water inside xylem*

*allow (to) make tubes rigid*

**OR**

no end walls (1)

(so) water flows easily (1)

**or**

(so) water flows continuously

*must be linked to an adaptation*

*allow (so) maintains a constant water flow*

*allow to maintain the transpiration stream*

1

*reason must correctly match the structure*

(d) water enters (guard) cells by osmosis

*allow water enters (guard) cells because the concentration of water is higher outside the cell than inside the cell*

1

cells swell and curve (to open the stoma)

*allow cells become turgid and curve (to open the stoma)*

*allow inner wall of (guard) cell is thicker / stronger  
or less flexible than outer wall so cells curve (to open stoma)*

1

[8]

#### Q4.

(a) any **one** from:

- plasmid

*do **not** accept nucleus*

- chromosome
- DNA / genes

*allow alleles*

*allow genetic material*

1

(b) no clear area (around C and E)

1

(so) no bacteria killed (by antibiotic)

*allow (so) antibiotic did not work*

1

*if no letters are given assume they are referring to antibiotics C and E*

- (c) increased the concentration of antibiotic  
*allow increased the dose of antibiotic*  
*ignore increased the volume of antibiotic*  
*ignore left it longer*  
*ignore used a different temperature*  
*ignore used a different sized disc* 1
- clear area seen (around disc)  
**or**  
bacteria (around disc) killed  
*mark dependent on describing a change to the method* 1
- (d) the treatment injected around the implant 1
- (e) any **one** from:  
*ignore reference to cost*  
  
(stem cells from fat tissue)  
• easier to obtain  
*allow quicker to obtain*  
• less invasive  
*allow fewer side effects*  
*allow less painful*  
*ignore reference to rejection* 1
- (f) by diffusion  
*no marks if incorrect process selected* 1
- concentration of antibiotic lower inside cells than in solution  
**or**  
concentration of antibiotic higher in solution than inside cells  
*allow 'it' for antibiotic*  
*allow correct reference to concentration gradient* 1
- (g) 0.09 to 0.31  
*allow 0.31 to 0.09* 1
- (h) any **two** from:  
**Pros:**  
stem cells containing antibiotic had:  
• smallest area of infection (: total tissue area)  
• small(est) range of results  
• no overlap with unreactive solution (suggesting significant effect) 2

any **two** from:

**Cons:**

- only tested on 5 patients  
*allow small sample size*
- some results for antibiotic treatment similar to stem cells containing antibiotic
- some results for stem cell treatment similar to stem cells containing antibiotic
- age / health of patients not controlled
- only tested on one type of bacterium  
*ignore only tested on one infection*
- only tested on one type of implant
- only collected results after 7 days
- may lead to antibiotic resistance (in *S. aureus* bacteria)
- rejection of stem cells
- need donors for stem cells
- allergic reaction to antibiotic  
*ignore cost*  
*ignore religion*  
*ignore use of embryonic stem cells*  
*ignore references to viruses*  
*ignore side effects unqualified*

2

[14]

**Q5.**

- (a) cells contain (many) chloroplasts

*allow positioned nearest to the light*

**or**

*at the top of the leaf*

*allow cells are closely packed*

**or**

*no gaps between cells*

*allow chlorophyll for chloroplast*

1

- (b) stomata

1

- (c) (real length) =  $\frac{28}{400}$

1

(real length in mm =) 0.07

1

(real length in  $\mu\text{m}$  =) 70

*allow answer given for length in mm correctly multiplied by 1000*

1

- (d) diffusion

		1
(e)	A	
	<i>no marks if wrong cell chosen</i>	1
	Reason any <b>one</b> from:	
	<ul style="list-style-type: none"> <li>• steeper (diffusion) gradient</li> <li>• bigger difference in concentration of carbon dioxide inside and outside the cell</li> </ul>	
	<i>allow higher concentration of carbon dioxide outside the cell than inside the cell</i>	
	<i>allow particles / molecules for carbon dioxide</i>	1
(f)	(number / amount of) bubbles	
	<i>allow volume of gas / oxygen</i>	1
	time	
	<i>allow suitable time eg 1 / 5 / 10 minutes</i>	1
(g)	any <b>two</b> from:	
	<ul style="list-style-type: none"> <li>• temperature (of water)</li> <li>• light intensity</li> </ul>	
	<i>allow amount of light</i>	
	<i>ignore light unqualified</i>	
	<b>or</b>	
	<ul style="list-style-type: none"> <li>• distance of light (from pondweed)</li> <li>• concentration of carbon dioxide (in water)</li> </ul>	
	<i>allow amount / mass of sodium hydrogen carbonate (in water)</i>	
	<i>allow type / size of plant</i>	
	<i>ignore volume of water / solution</i>	
	<i>do <b>not</b> accept colour of light</i>	
	<i>ignore time</i>	2
(h)	y-axis labelled: rate of photosynthesis in arbitrary units	1
	suitable scale	1
	all <b>bars</b> plotted correctly	
	<i>allow <math>\pm \frac{1}{2}</math> a small square the bars can be in any order</i>	1
	all bars labelled correctly	1
(i)	blue	1

[17]

**Q6.**

- (a) nucleus 1
- (b) cells never stop dividing 1
- (c) any **one** from:  
• chemicals enter the lungs (first)  
• chemicals are inhaled  
• chemicals are more concentrated in the lungs  
*allow smoke / tar / carcinogens for chemicals*  
*ignore nicotine unqualified* 1
- (d) (cancer cells transported) in the blood 1
- (e) any **one** from:  
• (smoking) will damage the new lung  
*allow poor chance of success*  
*allow (smoking) will increase the risk of cancer developing in the new lung*  
*allow wastes a healthy lung*  
• (NHS has) limited financial resources  
• the lung could be used for someone else (who does not smoke)  
• illness is self-inflicted **or** person is not attempting to help themselves 1
- (f) 300  
*answer line takes precedence* 1
- (g) any **one** from:  
• little exposure to ionising radiation  
*allow do not use sunbeds*  
• little exposure to the sunlight / UV (light)  
• more use of sunscreen  
*allow better sunscreen*  
• little exposure to carcinogens  
*allow named carcinogen*  
• little cell / DNA / gene damage  
*allow skin cancer takes a long time to develop*  
*ignore references to smoking* 1
- (h) any **one** from:  
• most new cases each year are in males / people aged 65-69 (years)  
• new cases per year increases (from age 15) up to 69 (years)  
*allow any upper age of 65-69*  
• new cases per year decreases from age 69 to 90 (+ years)

- (i) any **two** from:
- improved treatment / drugs
  - earlier diagnosis
  - improved cancer screening  
*allow improved technology / machinery*
  
  - improved patient / doctor knowledge (of dangers / treatments)  
*allow improved patient diet / lifestyle*