AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.1.1.4

Cell differentiation

Past-paper questions

Tier	**Higher**
Question groups	**5**
Available paper years	**2018–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.1.1.4 Cell differentiation

Question 01

June 2018 | 8464/B/1H | Original Q6

0 6 This question is about stem cells.

0 6 . 1 Give **one** place in a plant where stem cells are found.

[1 mark]

_____

_____

0 6 . 2 What is **one** economic use of plant stem cells?

[1 mark]

Tick **one** box.

- To create genetically modified crops ☐
- To create new species of plants ☐
- To increase variation in plants ☐
- To produce large numbers of identical plants ☐

Question 6 continues on the next page

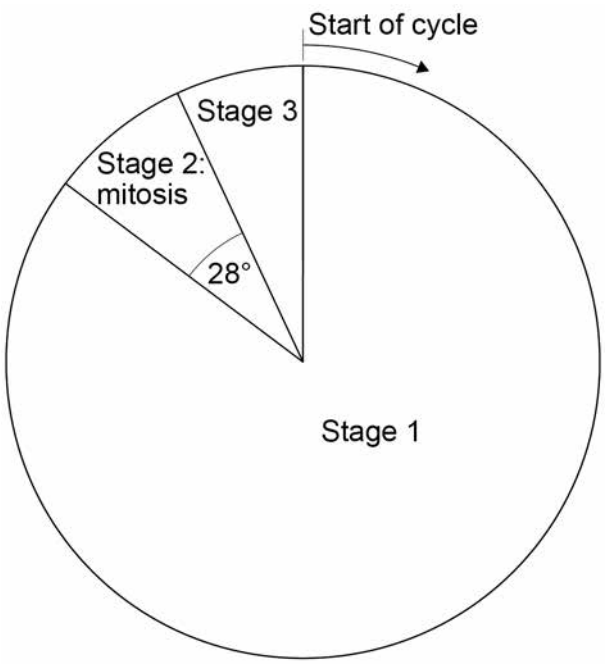
4.1.1.4 Cell differentiation

Question 01 · continued

Embryonic stem cells divide by mitosis.

Figure 9 represents a cell cycle for a human embryonic stem cell.

Figure 9



0 6 . 3 The mass of DNA in the cell at the start of the cycle is 6 picograms.

A picogram is 10^{-3} nanograms.

Convert 6 picograms to grams.

Give your answer in standard form.

[1 mark]

Mass = _____ g

4.1.1.4 Cell differentiation

Question 01 · continued

0 6 . 4 The time taken for this complete cell cycle is 15 hours.

Calculate how many hours the cell spent in mitosis.

Give your answer to 3 significant figures.

[2 marks]

Time spent in mitosis = _____ hours

0 6 . 5 Describe what happens in each of the three stages of the cell cycle.

[5 marks]

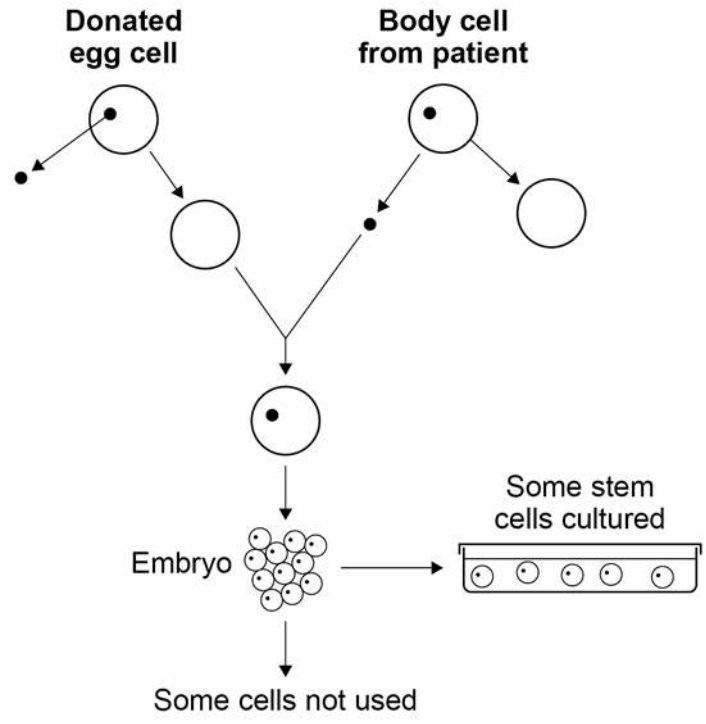
Question 6 continues on the next page

4.1.1.4 Cell differentiation

Question 01 · continued

0 6 . 6 **Figure 10** shows how embryonic stem cells are produced in therapeutic cloning for use in patients.

Figure 10



Give **two** advantages and **two** disadvantages of therapeutic cloning in medical treatments.

Use **Figure 10** to help you.

[4 marks]

Advantage 1 _____

_____

Advantage 2 _____

_____

Disadvantage 1 _____

_____

Disadvantage 2

_____

14

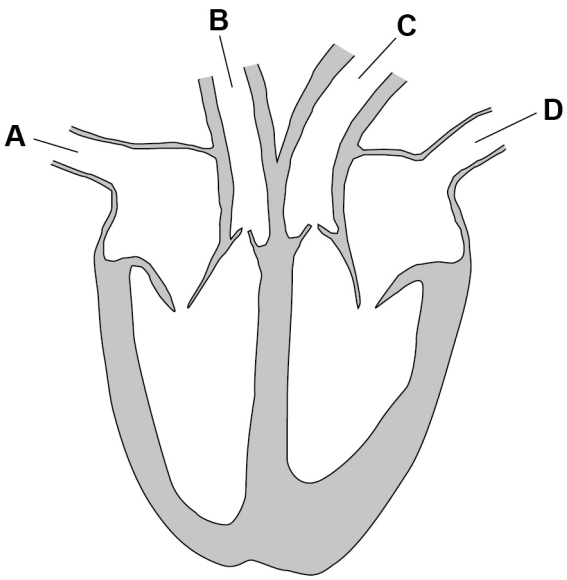
4.1.1.4 Cell differentiation

Question 02

November 2021 | 8464/B/1H | Original Q5

0 5 **Figure 5** shows the human heart.

Figure 5



0 5 . 1 Which blood vessel transports blood with the highest oxygen concentration **into** the heart?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 5 . 2 Blood pressure is a measure of the force of the blood against the walls of the blood vessels.

Which blood vessel transports blood at the highest pressure?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

4.1.1.4 Cell differentiation

Question 02 · continued

0 5 . 3 What is the correct order for blood flowing through the heart to the lungs?

[1 mark]

Tick (✓) **one** box.

- left atrium → left ventricle → pulmonary artery ☐
- left atrium → left ventricle → pulmonary vein ☐
- right atrium → right ventricle → pulmonary artery ☐
- right atrium → right ventricle → pulmonary vein ☐

Question 5 continues on the next page

4.1.1.4 Cell differentiation

Question 02 · continued

Every year thousands of people in the UK have heart attacks.

A heart attack is caused when the heart muscle cells do **not** get enough oxygen, causing the cells to die.

0 5 . 4 Statins and stents are two treatments used to reduce the risk of someone having a heart attack.

Evaluate the use of statins compared with the use of a stent to reduce the risk of a heart attack.

[6 marks]

4.1.1.4 Cell differentiation

Question 02 · continued

0 5 . 5 Many people who survive a heart attack get out of breath easily when they exercise gently.

Explain why heart attack survivors get out of breath easily.

[4 marks]

Question 5 continues on the next page

4.1.1.4 Cell differentiation

Question 02 · continued

Scientists have developed patches of beating heart cells to repair damaged heart tissue.

The patches are placed onto areas of the heart where cells have died. New cells grow to replace the dead cells.

The patches are made using a person's own cells that are converted into stem cells.

0 5 . 6 Explain why stem cells are used to make the patches.

[2 marks]

0 5 . 7 The scientists could have used human embryonic stem cells to make the patches.

Give **two** advantages of using stem cells made from the person's own cells, rather than using embryonic stem cells.

[2 marks]

1

2

17

4.1.1.4 Cell differentiation

Question 03

June 2023 | 8464/B/1H | Original Q7

0 7 Antibiotics are drugs used to treat bacterial infections.

Mutations in bacteria produce new strains.

Some strains of bacteria are resistant to antibiotics.

0 7 . 1 Where do mutations happen in a **bacterial** cell?

[1 mark]

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

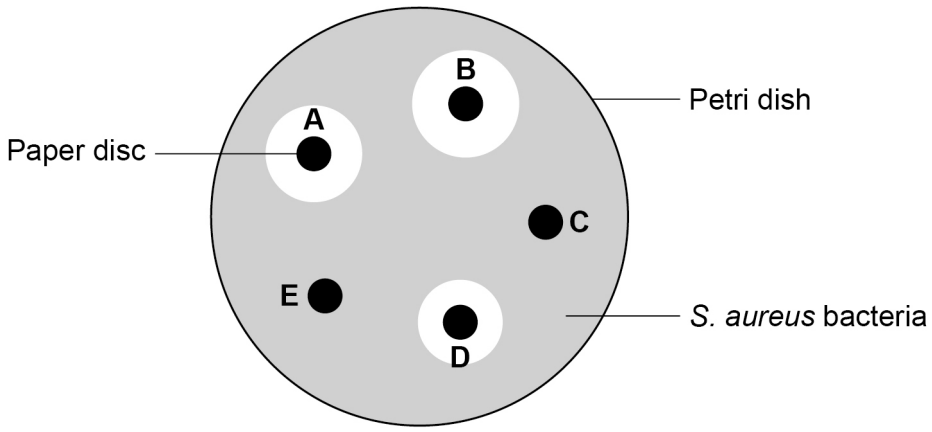
This is the method used.

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 9 shows the results.

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

Figure 9



4.1.1.4 Cell differentiation

Question 03 · continued

0 7 . 2 The scientist concluded:

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

Explain the evidence for this conclusion.

Use **Figure 9**.

[2 marks]

0 7 . 3 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**.

[2 marks]

Question 7 continues on the next page

4.1.1.4 Cell differentiation

Question 03 · continued

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

0 7 . 4 What was the independent variable in this investigation?

[1 mark]

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 ☐

4.1.1.4 Cell differentiation

Question 03 · continued

0 7 . 5 Suggest **one** advantage of using stem cells from fat tissue, rather than using stem cells from bone marrow.

[1 mark]

0 7 . 6 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.

[2 marks]

Tick (✓) **one** box.

By active transport ☐

By diffusion ☐

By osmosis ☐

By translocation ☐

Reason

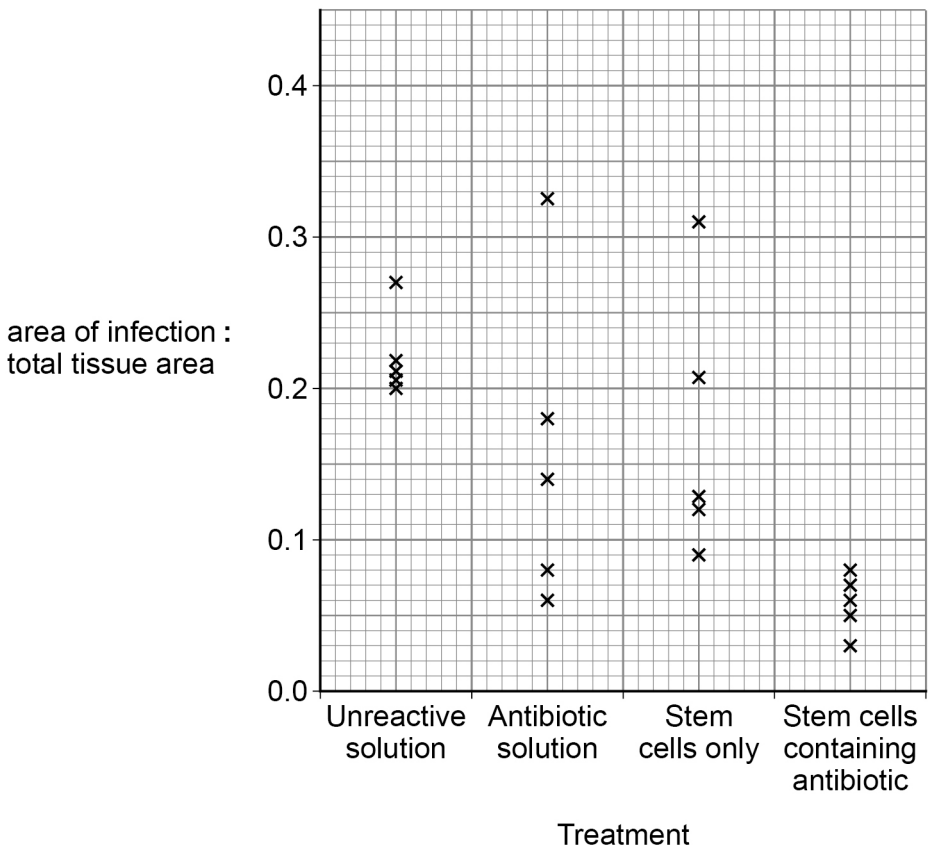
Question 7 continues on the next page

4.1.1.4 Cell differentiation

Question 03 · continued

Figure 10 shows the results.

Figure 10



0 7 . 7 What is the range of results for the treatment with stem cells only?

[1 mark]

From _____ to _____

4.1.1.4 Cell differentiation

Question 03 · continued

0 7 . 8 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 10**.

[4 marks]

14

4.1.1.4 Cell differentiation

Question 04

June 2024 | 8464/B/1H | Original Q4

0 4 This question is about photosynthesis.

0 4 . 1 What is the symbol equation for photosynthesis?

[1 mark]

Tick (✓) **one** box.

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

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

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

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

Question 4 continues on the next page

4.1.1.4 Cell differentiation

Question 04 · continued

A student investigated the relationship between temperature and the rate of photosynthesis.

The student measured the volume of gas produced by an aquatic plant in 1 hour.

The student collected the gas in a measuring cylinder.

Table 2 shows the results.

Table 2

Temperature in °C	Volume of gas produced in 1 hour in cm^3
10	1
15	2
20	4
25	8
30	16
35	16
40	2
45	0

0 4 . 2 Describe the effect of increasing temperature on the **rate** of photosynthesis.

Use data from **Table 2**.

[3 marks]

4.1.1.4 Cell differentiation

Question 04 · continued

0 4 . 3 Explain why no gas was produced by the plant at 45 °C.

[2 marks]

0 4 . 4 How could the student increase the accuracy of the results?

[1 mark]

Tick (✓) **one** box.

- Repeat the investigation, collecting the gas for 24 hours. ☐
- Repeat the investigation, measuring the volume of gas to 0.5 cm^3. ☐
- Repeat the investigation using a different aquatic plant. ☐
- Repeat the investigation, using temperatures of 5 °C and 50 °C. ☐

Question 4 continues on the next page

4.1.1.4 Cell differentiation

Question 04 · continued

A person grows tomatoes in a greenhouse.

0 4 . 5 The mean temperature of the greenhouse is 15 °C.

A heater would keep the temperature of the greenhouse at 25 °C.

Suggest **two** reasons **against** using a heater set at 25 °C in the greenhouse.

Do **not** refer to cost in your answer.

[2 marks]

1 _____

_____

2 _____

_____

0 4 . 6 The person cut a stem from one of the tomato plants.

The cut stem was placed in soil to grow new roots.

Which tissue in the cut stem will differentiate into new root cells?

[1 mark]

Tick (✓) **one** box.

- Epidermis ☐
- Meristem ☐
- Mesophyll ☐
- Phloem ☐

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4.1.1.4 Cell differentiation

Question 05

June 2025 | 8464/B/1H | Original Q6

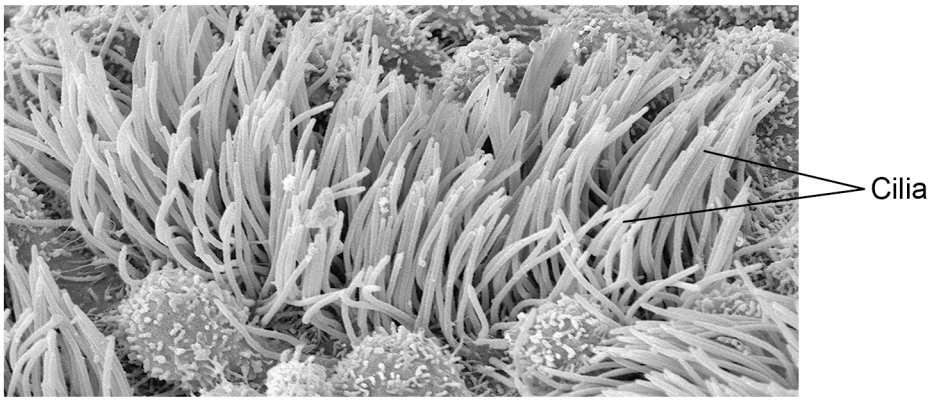
0 6 Ciliated cells have small hair-like structures called cilia on the cell surface.

Ciliated cells are found in the trachea and in the oviducts.

Oviducts are part of the female reproductive system.

Figure 7 shows cilia lining an oviduct.

Figure 7



0 6 . 1 Give **one** piece of evidence that an electron microscope was used to produce the image shown in **Figure 7**.

Do **not** refer to colour in your answer.

[1 mark]

0 6 . 2 Describe the function of ciliated cells in the **oviduct**.

[1 mark]

4.1.1.4 Cell differentiation

Question 05 · continued

0 6 . 3 The mean length of the cilia in an image was 6 mm.

The cilia were viewed at a magnification of 1.5×10^3

Calculate the real mean length of the cilia.

Give your answer in micrometres (μm).

[5 marks]

Real mean length = _____ μm

Question 6 continues on the next page

4.1.1.4 Cell differentiation

Question 05 · continued

Red blood cells are a type of cell found in humans.

People with anaemia do **not** have enough red blood cells.

0 6 . 4 Explain why a person with anaemia is likely to experience muscle fatigue.

[2 marks]

4.1.1.4 Cell differentiation

Question 05 · continued

Scientists have produced red blood cells from stem cells in a laboratory.

The scientists:

- collected a sample of blood from a donor
- extracted 5×10^5 stem cells from the sample.

Each stem cell was developed into 100 000 red blood cells.

35% of the red blood cells made from stem cells are suitable to use in a patient.

0 6 . 5 Calculate the number of red blood cells made from the donor's sample that could be used in a patient.

Give your answer in standard form.

[4 marks]

Number of red blood cells (in standard form) = _____

Question 6 continues on the next page

0 6 . 6 Patients with anaemia are sometimes given a blood transfusion.

A blood transfusion is when a patient is given blood.

The patient can be given red blood cells:

- produced from stem cells in a laboratory

  or

- from a whole blood donation.

Table 2 gives information about the two sources of red blood cells.

Table 2

Red blood cells produced from stem cells	Red blood cells from a whole blood donation
• A small sample of blood is collected from the patient. • The total cost is £15 per 10 cm^3 of cells produced. • All of the new cells can function for 120 days.	• 470 cm^3 of blood is collected from a donor. • The blood donation is separated into its different parts. • Red blood cells make up 45% of whole blood. • The total cost of a blood donation is £130. • The cells can function for between 1 and 120 days.

4.1.1.4 Cell differentiation

Question 05 · continued

Evaluate the use of red blood cells:

- produced from stem cells in a laboratory
- from a whole blood donation.

You should refer to costs in your answer.

[6 marks]

Extra Space

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