

# Cell biology practice questions

25 questions • 72 marks • mark scheme at the back

For AQA GCSE Combined Science: Trilogy 8464. **Higher tier** is only on the Higher paper.

Name .....

Total ..... / 72

## Cell structure Spec 4.1.1

**1** Which structure is a small ring of DNA found in a bacterial cell? [1 mark]

- A. ☐ Cell wall
- B. ☐ Plasmid
- C. ☐ Nucleus
- D. ☐ Ribosome

**2** State two differences between a bacterial cell and an animal cell. [2 marks]

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**3** A plant cell is  $1 \times 10^{-4}$  m long. A bacterial cell is  $1 \times 10^{-6}$  m long. How many orders of magnitude longer is the plant cell? [1 mark]

- A. ☐ 1
- B. ☐ 2
- C. ☐ 4
- D. ☐ 6

**4** Describe the function of each of these sub-cellular structures: nucleus, mitochondria, ribosomes. [3 marks]

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- 5** A student draws a plant cell. The drawing is 45 mm long and the magnification is  $\times 500$ . **[3 marks]**  
Calculate the real length of the cell. Give your answer in micrometres ( $\mu\text{m}$ ).

Answer = .....

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- 6** Explain how the development of the electron microscope has increased our understanding of sub-cellular structures. **[3 marks]**

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- 7** A muscle cell contains many mitochondria and protein fibres that can shorten. Explain how these features help the muscle cell to carry out its function. **[3 marks]**

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- 8** Explain why cell differentiation is important in a multicellular organism. Describe one difference in differentiation between animals and plants. **[3 marks]**

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**13** Describe the function of stem cells in (a) human embryos, (b) adult bone marrow, (c) plant meristems. **[3 marks]**

[illegible]

**14** Why are stem cells produced by therapeutic cloning less likely to be rejected by the patient's body? **[1 mark]**

- A. ☐ The embryo is produced from bone marrow
- B. ☐ The embryo has the same genes as the patient
- C. ☐ The cells have been killed by treatment
- D. ☐ The embryo contains no DNA

**15** Give two ways in which stem cells from meristems can be used. **[2 marks]**

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**16** Stem cells from human embryos may one day be used to treat conditions such as diabetes and paralysis. Evaluate the use of stem cells in medical treatments. **[6 marks]**

[illegible]

## Transport in cells Spec 4.1.3

**17** Which statement defines osmosis? [1 mark]

- A. ☐ The movement of particles from a low to a high concentration using energy
- B. ☐ The spreading out of particles of a gas
- C. ☐ The diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane
- D. ☐ The movement of any particles from a high to a low concentration

**18** Oxygen enters a cell by diffusion. Explain how each of these changes would affect the rate of diffusion: (a) increasing the temperature, (b) increasing the concentration of oxygen outside the cell, (c) increasing the surface area of the membrane. **[3 marks]**

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**19** A cube has sides of 5 cm. Calculate its surface area to volume ratio. Give your answer in the form X : 1. **[3 marks]**

Answer = .....

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**20** A single-celled organism does not need a transport system or special exchange surfaces. A large multicellular organism does. Explain why. **[4 marks]**

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**21** Explain how the gills of a fish are adapted for exchanging materials. **[3 marks]**

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- Answer = .....

[illegible]

- | Percentage change in mass of potato cylinders          |                               |
|--------------------------------------------------------|-------------------------------|
| Concentration of sugar solution (mol/dm <sup>3</sup> ) | Percentage change in mass (%) |
| 0.0                                                    | +18                           |
| 0.2                                                    | +9                            |
| 0.4                                                    | +1                            |
| 0.6                                                    | -7                            |
| 0.8                                                    | -14                           |

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**25** Describe how substances are transported into and out of cells by diffusion, osmosis and active transport. Explain the differences between the three processes. **[6 marks]**

[illegible]

## Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

**1. [1]**

**B** B: plasmid (1)

**2. [2]**

- bacterial cell is much smaller / animal cell is larger (1)
- bacterial cell has a cell wall, animal cell does not (1)
- bacterial DNA is a single loop / not enclosed in a nucleus, animal cell DNA is in a nucleus (1)
- bacterial cell may have plasmids, animal cell does not (1)
- Max 2. Ignore references to mitochondria.

**3. [1]**

**B** B:  $2 (10^{-4} \div 10^{-6} = 10^2)$  (1)

**4. [3]**

- nucleus contains genetic material / DNA / controls the activities of the cell (1)
- mitochondria: where aerobic respiration takes place / release energy (1)
- ribosomes: where proteins are made / protein synthesis (1)

**5. [3]**

- real size = image size  $\div$  magnification (1)
- $45 \div 500 = 0.09$  mm (1)
- $0.09 \times 1000 = 90$   $\mu\text{m}$  (1)
- Correct answer of 90  $\mu\text{m}$  gains all 3 marks. Allow  $9 \times 10^1$   $\mu\text{m}$ . 0.09 mm with no conversion gains 2 marks.

**6. [3]**

- electron microscopes have a much higher magnification (than light microscopes) (1)
- and a higher resolving power / resolution (1)
- so smaller sub-cellular structures (such as ribosomes) / more detail of structures (such as the inside of mitochondria) can be seen (1)

**7. [3]**

- protein fibres shorten so the cell contracts (1)
- (contraction) causes movement (1)
- mitochondria release energy by respiration (1)
- energy is needed for contraction (1)
- Max 3.

**8. [3]**

- cells acquire different sub-cellular structures (1)
- so they can carry out specific functions / become specialised (1)
- most animal cells differentiate at an early stage, but many plant cells keep the ability to differentiate throughout life (1)

**9. [6]**

|                        |                                                                                                                                                                                                                   |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Level 3<br/>5-6</b> | A clear, logical and complete method covering preparation of the slide, focusing from low power, and drawing with labels and a magnification. Scientific terms are used correctly and there are few or no errors. |
| <b>Level 2<br/>3-4</b> | A method that covers most stages in a sensible order, but with some detail missing, such as focusing or the drawing technique.                                                                                    |
| <b>Level 1<br/>1-2</b> | Some relevant points are made, but the method is incomplete or in the wrong order.                                                                                                                                |

**Indicative content**

- thin slice of plant tissue placed on a slide with a drop of water or a stain (such as iodine)
- cover slip lowered at an angle to avoid air bubbles
- start with the lowest-power objective lens and focus using the coarse focus knob
- then use the fine focus knob to get a sharp image, moving to a higher-power lens if needed
- draw with a sharp pencil, clear lines and no shading
- label the cell structures (such as cell wall, nucleus, vacuole)
- calculate and write the magnification (size of drawing ÷ real size), or draw a scale bar

**10. [1]**

**B B (1)**

**11. [3]**

- the cell grows / increases the number of sub-cellular structures (such as ribosomes and mitochondria) (1)
- DNA replicates to form two copies of each chromosome (1)
- in mitosis, one set of chromosomes is pulled to each end of the cell and the nucleus divides (1)
- the cytoplasm and cell membranes divide to form two identical cells (1)
- Max 3.

**12. [2]**

- mitosis (1)
- for growth (of the plant) / development / production of new cells (1)

**13. [3]**

- (a) can differentiate into most types of human cell (1)
- (b) can form many types of cell, including blood cells (1)
- (c) can differentiate into any type of plant cell, throughout the life of the plant (1)

**14. [1]**

**B B (1)**

**15. [2]**

- to clone rare species to protect them from extinction (1)
- to produce clones of crop plants with special features (such as disease resistance) quickly and economically / in large numbers for farmers (1)

**16. [6]**

|                        |                                                                                                                                                                        |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Level 3<br/>5-6</b> | A balanced evaluation that considers benefits, risks and ethical or religious objections in detail, with a justified conclusion. Scientific terms are used accurately. |
| <b>Level 2<br/>3-4</b> | Some benefits and some risks or objections are described, but the evaluation is not fully balanced or there is no clear conclusion.                                    |
| <b>Level 1<br/>1-2</b> | Simple points are made on either benefits or risks only, with little or no development.                                                                                |

**Indicative content**

- stem cells can differentiate into many types of cell, so can replace damaged or lost tissue
- may help conditions such as diabetes and paralysis
- in therapeutic cloning, the embryo has the same genes as the patient, so the cells are not rejected
- risk of transfer of viral infection
- some people have ethical or religious objections to using embryos
- conclusion that weighs benefit to patients against risks and objections

**17. [1]****C C (1)****18. [3]**

- (a) rate increases because particles have more energy / move faster (1)
- (b) rate increases because the concentration gradient is steeper / difference in concentration is bigger (1)
- (c) rate increases because more particles can pass through at once (1)

**19. [3]**

- surface area =  $6 \times 5 \times 5 = 150 \text{ cm}^2$  (1)
- volume =  $5 \times 5 \times 5 = 125 \text{ cm}^3$  (1)
- $150 \div 125 = 1.2$ , so 1.2 : 1 (1)
- Correct answer gains all 3 marks.

**20. [4]**

- single-celled organism has a large surface area to volume ratio (1)
- so enough substances can diffuse in and out across the surface to meet its needs (1)
- multicellular organism has a small surface area to volume ratio (1)
- so diffusion across the outside is not enough / diffusion distance too far for inner cells (1)
- so exchange surfaces and a transport system are needed to move molecules in and out of cells (1)
- Max 4.

**21. [3]**

- many gill filaments / lamellae give a large surface area (1)
- thin (membrane) gives a short diffusion path (1)
- good blood supply to maintain the concentration gradient (1)
- water flows over the gills / ventilated, keeping the concentration gradient (1)
- Max 3.

**22. [4]**

- (a) change in mass =  $5.6 - 5.0 = 0.6$  g (1)
- (a)  $0.6 \div 5.0 \times 100$  (1)
- (a) = 12% (increase) (1) allow +12%
- (b)  $0.6 \div 30 = 0.02$  g/min (1)

**23. [3]**

- water moves into the cells by osmosis (1)
- from the dilute solution to the more concentrated solution (inside the cells) through the partially permeable membrane (1)
- estimate of 0.4 to 0.45 mol/dm<sup>3</sup> (1)

**24. [2]**

- mitochondria release energy by respiration (1)
- needed for active transport of mineral ions (against a concentration gradient) (1)

**25. [6]**

|                              |                                                                                                                                                                          |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Level 3</b><br><b>5-6</b> | A clear description of all three processes, with accurate explanation of the differences in direction, what moves and energy. Examples and key terms are used correctly. |
| <b>Level 2</b><br><b>3-4</b> | Two or three processes described correctly, with some attempt to compare them, but with some gaps.                                                                       |
| <b>Level 1</b><br><b>1-2</b> | Some correct statements about one or two processes, with little or no comparison.                                                                                        |

**Indicative content**

- diffusion: net movement of particles (gas or in solution) from a higher to a lower concentration (down a gradient)
- examples of diffusion: oxygen and carbon dioxide in gas exchange, urea from cells into blood plasma
- osmosis: diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane
- active transport: moves substances from a more dilute to a more concentrated solution (against the concentration gradient)
- active transport requires energy from respiration, whereas diffusion and osmosis do not
- examples of active transport: mineral ions into root hairs, sugar from the gut into the blood
- osmosis only involves water