

Cell biology practice questions

29 questions • 83 marks • mark scheme at the back

For AQA GCSE Biology 8461 and Combined Science: Trilogy 8464. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Name

Total / 83

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]

3 A plant cell is 1×10^{-4} m long. A bacterial cell is 1×10^{-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]

- 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 (μm).

Answer =

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

- 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]**

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

9 Describe how you would use a light microscope to observe a plant cell and make a labelled drawing, including a magnification.

[6 marks]

[illegible]

10 Triple only

[2 marks]

A bacterium divides once every 30 minutes. Calculate the number of bacteria produced from one bacterium in 4 hours.

Answer =

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11 Triple only Higher tier

[3 marks]

A bacterium divides once every 20 minutes. Calculate the number of bacteria produced from one bacterium in 10 hours. Give your answer in standard form to 2 significant figures.

Answer =

[illegible]

12 Triple only

[3 marks]

Explain why, when preparing an uncontaminated culture of bacteria in a school laboratory: (a) the inoculating loop is passed through a flame, (b) the lid of the Petri dish is secured with adhesive tape, (c) the culture is incubated at 25 °C and not at a higher temperature.

13 Triple only

[3 marks]

A student places a disc soaked in an antibiotic on an agar plate covered in bacteria. After incubation, the clear zone around the disc has a diameter of 16 mm. Calculate the area of the clear zone. Use the equation $\text{area} = \pi \times r^2$ and $\pi = 3.14$.

Answer =

Cell division Spec 4.1.2

14 Which statement about chromosomes is correct?

[1 mark]

- A. ☐ They are small rings of DNA found in bacteria
- B. ☐ They are found in the nucleus, are made of DNA and carry many genes
- C. ☐ They are the part of the cell where respiration takes place
- D. ☐ They are made of protein and carry one gene each

15 Describe what happens during the cell cycle in a body cell, up to the formation of two daughter cells.

[3 marks]

16 A scientist looks at the tip of a growing root. Many of the cells are dividing. Name the type of cell division taking place and explain why it is important in a plant. **[2 marks]**

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

[illegible]

18 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

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

[illegible]

20 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

21 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

22 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]**

23 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 =

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

25 Explain how the gills of a fish are adapted for exchanging materials.

[3 marks]

26 A potato cylinder has a mass of 5.0 g. After 30 minutes in a sugar solution its mass is 5.6 g. (a) Calculate the percentage change in mass. (b) Calculate the mean rate of water uptake in g per minute. **[4 marks]**

Answer =

27 A student puts identical potato cylinders into sugar solutions of different concentrations. The table shows the results. Explain why the mass increased in the 0.0 mol/dm³ solution, and estimate the concentration at which there would be no change in mass. **[3 marks]**

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

28 Root hair cells contain many mitochondria. Explain how this helps the root hair cell to absorb mineral ions from the soil. **[2 marks]**

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29 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]**

This image shows a full page of primary-ruled notebook paper. It features ten sets of horizontal lines across the page. Each set consists of a solid top blue line, a dashed midline, and a solid bottom blue line, providing a guide for letter height and placement. The paper is otherwise blank, with no margins or additional markings.

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)
- $0.09 \times 1000 = 90$ μm (1)
- Correct answer of 90 μm gains all 3 marks. Allow 9×10^1 μm . 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]

Level 3 5-6	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.
Level 2 3-4	A method that covers most stages in a sensible order, but with some detail missing, such as focusing or the drawing technique.
Level 1 1-2	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 $\div$ real size), or draw a scale bar

10. [2] **Triple only**

- 8 divisions ($240 \div 30$) (1)
- $2^8 = 256$ bacteria (1)
- Correct answer of 256 gains both marks.

11. [3] **Triple only** **Higher tier**

- 10 hours = 600 minutes, so 30 divisions (1)
- $2^{30} = 1\,073\,741\,824$ (1)
- 1.1×10^9 (1)
- 1 073 741 824 not in standard form, or 1.07×10^9 (wrong number of significant figures), gains 2 marks.

12. [3] **Triple only**

- (a) to sterilise it / kill other microorganisms (1)
- (b) to stop microorganisms from the air getting in / the cultured microorganisms escaping (1)
- (c) to prevent growth of pathogens (harmful to humans) (1)

13. [3] **Triple only**

- radius = $16 \div 2 = 8$ mm (1)
- area = 3.14×8^2 (1)
- = 201 mm^2 (allow 200.96 mm^2 , 200 mm^2 or $2.0 \times 10^2 \text{ mm}^2$) (1)
- Correct answer gains all 3 marks. Using the diameter ($3.14 \times 16^2 = 804 \text{ mm}^2$) gains 1 mark only.

14. [1]

B B (1)

15. [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.

16. [2]

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

17. [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)

18. [1]**B B** (1)**19. [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)

20. [6]

Level 3 5-6	A balanced evaluation that considers benefits, risks and ethical or religious objections in detail, with a justified conclusion. Scientific terms are used accurately.
Level 2 3-4	Some benefits and some risks or objections are described, but the evaluation is not fully balanced or there is no clear conclusion.
Level 1 1-2	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

21. [1]**C C** (1)**22. [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)

23. [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.

24. [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.

25. [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.

26. [4]

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

27. [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/dm³ (1)

28. [2]

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

29. [6]

Level 3 5-6	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.
Level 2 3-4	Two or three processes described correctly, with some attempt to compare them, but with some gaps.
Level 1 1-2	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