1.1 Cell Biology: 1-hour Pack

AQA 8461 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Bacterial cells are prokaryotic. Animal cells are eukaryotic.

(a) State two ways the structure of a bacterial cell is different from the structure of an animal cell. **(2)**

(b) A bacterial cell has a diameter of about 2 µm. An animal cell has a diameter of about 20 µm. How many times larger is the diameter of the animal cell? **(1)**

.....

(Total for Question 1 is 3 marks)

2 Cells can be specialised for their function.

(a) A sperm cell is adapted to reach and fertilise an egg. Describe one adaptation of a sperm cell and explain how it helps the cell carry out its function. **(2)**

(b) State one way a root hair cell is adapted for absorbing water from the soil. **(1)**

(Total for Question 2 is 3 marks)

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3 Differentiation produces specialised cells.

(a) What is meant by differentiation? **(1)**

(b) At what stage of development do most animal cells become specialised and lose the ability to differentiate into other cell types? **(1)**

(c) Name the plant tissue in which cells keep the ability to differentiate throughout the plant's life. **(1)**

(Total for Question 3 is 3 marks)

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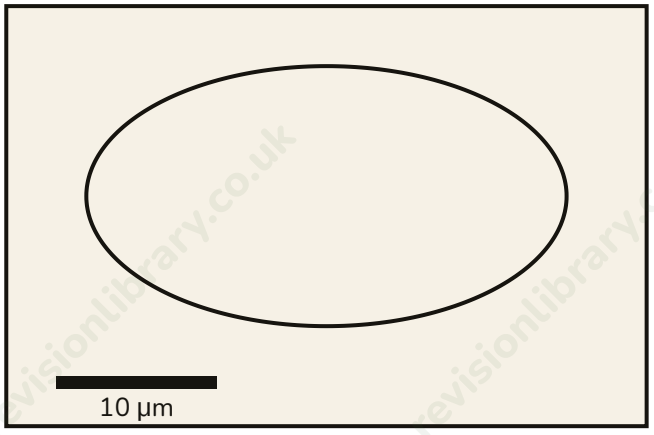
4 Scientists use light microscopes and electron microscopes to study cells.

(a) Give one advantage of using an electron microscope instead of a light microscope to study cells. **(1)**

(b) A student uses a light microscope with a x10 eyepiece lens and a x40 objective lens. Calculate the total magnification. **(1)**

(Total for Question 4 is 2 marks)

5 A micrograph of a cell has a scale bar. The scale bar is 20 mm long and represents an actual length of 10 µm.



(a) On the same micrograph the image of a cell measures 60 mm across. Calculate the actual width of the cell. Give your answer in micrometres (µm). **(3)**

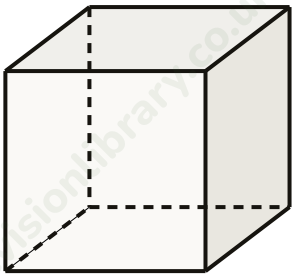
(Total for Question 5 is 3 marks)

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6 Substances move in and out of cells by diffusion.

(a) Define diffusion. **(2)**

(b) A cube-shaped model cell has sides of length 2 cm. Calculate the surface area to volume ratio of the cube. Give your answer in the form n : 1. **(2)**



2 cm

(c) Explain why large multicellular organisms need specialised exchange surfaces, but a single-celled organism does not. **(2)**

(Total for Question 6 is 6 marks)

7 Organisms are made of different types of cells organised into tissues and organs. Consider a leaf: it contains tissues such as palisade mesophyll, spongy mesophyll and epidermis.

(a) Describe three features of palisade mesophyll cells that make them adapted for photosynthesis and explain how each feature helps. **(6)**

(Total for Question 7 is 6 marks)

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8 Explain, in simple terms, why cell division by mitosis is important for growth and repair in multicellular organisms. Give two linked points: what happens during the division and why it matters for the organism.

(Total for Question 8 is 6 marks)

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9 Diffusion is the movement of particles from an area of higher concentration to an area of lower concentration. Consider a setup where a cube of agar jelly contains a pH indicator and is placed in acid solution; the indicator changes colour as acid diffuses into the jelly.

(a) Describe what you would observe in the agar jelly over time as the acid diffuses in, and explain why the change spreads from the surface towards the centre. **(4)**

(b) Give one variable that should be controlled in this practical to make the results fair, and say how to control it. **(2)**

(Total for Question 9 is 6 marks)

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10 Bacteria are prokaryotic cells. Animal cells are eukaryotic cells.

(a) Describe three differences between a typical prokaryotic cell and a typical animal eukaryotic cell. **(3)**

(Total for Question 10 is 3 marks)

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11 A cultured population of yeast cells was grown for a respiration experiment. The number of cells was counted at 0, 2 and 5 hours. A student recorded the results in the table.

Time (hours)	Number of cells
0	1.0×10^5
2	2.0×10^5
5	8.0×10^5

(a) Calculate the factor by which the population increased between 2 hours and 5 hours. **(2)**

(b) Suggest one biological reason why the population growth increased faster after 2 hours than in the first 2 hours. **(2)**

(Total for Question 11 is 4 marks)

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Mark scheme · 1.1 Cell Biology: 1-hour Pack

Question 1

(a) any one correct structural difference, for example: bacteria have no nucleus whereas animal cells have a nucleus; bacterial main DNA is a single circular loop free in the cytoplasm whereas animal nuclear DNA is in chromosomes inside a nucleus; bacteria have a cell wall whereas animal cells do not; bacteria may have plasmids whereas animal cells do not; bacterial cells are typically much smaller; bacteria lack mitochondria whereas animal cells usually have them; bacteria have smaller cytoplasmic ribosomes (70S rather than 80S in animal cells) **B1**

(a) a second, different, correct structural comparison; examples are not exhaustive: accept any other valid structural difference for either mark; do not credit the same DNA-location/nucleus comparison twice **B1**

(a) Answer: Any two distinct structural differences, e.g. bacteria have no nucleus whereas animal cells have a nucleus, and bacteria have smaller cytoplasmic ribosomes (70S rather than 80S in animal cells). Other valid comparisons include a cell wall, possible plasmids, circular main DNA rather than nuclear chromosomes, typically smaller size, or absence of mitochondria. Accept other valid structural differences. Count the nucleus/DNA-location comparison only once.

(b) 10 (times) **B1**

(b) Answer: 10

Question 2

(a) one adaptation, e.g. has a tail / flagellum (allow: many mitochondria; acrosome/enzymes in head; streamlined) **B1**

(a) linked function, e.g. tail allows it to swim to the egg; mitochondria release energy by respiration for swimming; acrosome enzymes help digest the outer coat surrounding the egg, allowing the sperm to reach the egg cell membrane **B1**

(a) Answer: A tail allows the sperm to swim to the egg. Alternatively, many mitochondria release energy by respiration for swimming, or acrosome enzymes help digest the outer coat surrounding the egg.

(b) any one valid adaptation, e.g. large surface area due to a long projection; thin cell wall providing a short path for water to enter by osmosis; a large vacuole containing concentrated cell sap gives the cell a lower water potential than the soil, so water enters by osmosis **B1**

(b) Answer: Large surface area due to a long projection into the soil. Alternatively, a thin cell wall provides a short path for water entry, or a large vacuole containing concentrated cell sap gives the cell a lower water potential than the soil so water enters by osmosis.

Question 3

(a) the process by which a cell becomes specialised (for a particular function/job) **B1**

(a) Answer: A cell becoming specialised for a particular function

(b) at an early stage of development (allow: during embryonic development) **B1**

(b) Answer: At an early stage of development, during embryonic development

(c) meristem (allow: meristem tissue) **B1**

(c) Answer: Meristem

Question 4

(a) higher magnification OR higher resolution / resolving power (oe: can see smaller sub-cellular structures) **B1**

(a) Answer: Higher resolution (and magnification), so smaller structures can be seen

(b) 400 (from 10 x 40) **B1**

(b) Answer: 400

Question 5

(a) uses scale: 20 mm represents 10 µm, so 1 mm represents 0.5 µm (oe, e.g. magnification = 20000/10 = 2000) **M1**

(a) 60 x 0.5 (oe: 60 mm = 60000 µm, /2000) **M1**

(a) 30 µm cao **A1**

(a) Answer: 30 µm

Question 6

(a) net movement of particles (or molecules); movement alone without net is insufficient for this mark **B1**

(a) from a region of higher concentration to a region of lower concentration (or down a concentration gradient); these are alternative descriptions of one direction mark, not two separate marks **B1**

(a) Answer: Net movement of particles from a region of higher concentration to a region of lower concentration

(b) surface area = 6 x (2 x 2) = 24 cm^2 AND volume = 2 x 2 x 2 = 8 cm^3 **M1**

(b) 3 : 1 (from 24 : 8) **A1**

(b) Answer: 3 : 1

(c) large organisms have a small(er) surface area to volume ratio **B1**

(c) so diffusion (across the outer surface) is too slow / distances too great to supply all cells, so an exchange surface (with a large surface area) is needed **B1**

(c) Answer: Large organisms have a small SA:V ratio, so diffusion alone is too slow to meet their needs

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Question 7

(a) states feature 1: many chloroplasts **M1**

(a) explains feature 1: many chloroplasts absorb more light so more photosynthesis **A1**

(a) states feature 2: tall, column-shaped cells packed near the upper surface **M1**

(a) explains feature 2: packing increases number of cells in region receiving light so increases light capture **A1**

(a) states feature 3, e.g. thin cell walls or large vacuole **M1**

(a) explains feature 3: thin walls reduce diffusion distance or large vacuole positions chloroplasts nearer periphery, oe **A1**

(a) Answer: Three explained features: many chloroplasts so more light absorbed; tall, column-shaped cells packed near the top so many cells absorb light; and thin walls/large vacuole reducing diffusion distance or positioning chloroplasts.

Question 8

Level 3 Detailed explanation that links the process of mitosis (replication of genetic material and division to produce two identical cells) to growth or repair, with clear reasoning and at least two correct points. **5-6**

Level 2 Partial explanation describing either the steps (replication and division) or the consequence (growth or repair) with some linkage between process and function. **3-4**

Level 1 Simple statements about cell division or that it makes more cells, without clear link to growth or repair. **1-2**

Indicative content:

- mitosis copies the chromosomes so each daughter cell has the same genetic information
- the cell divides to produce two identical cells
- this increases the number of cells for growth
- this replaces damaged or dead cells during repair
- ensures daughter cells can perform the same functions as the original cell

Question 9

(a) describes colour change starting at the outside surface and moving inwards (observation) **M1**

(a) states particles move from higher to lower concentration (definition of diffusion) or acid particles move into jelly **M1**

(a) explains gradient causes net movement from outside to inside, so outer regions change first **A1**

(a) explains over time indicator changes nearer the centre as acid diffuses further in, oe **A1**

(a) Answer: The colour change starts at the surface and spreads inward because acid particles diffuse from the higher concentration outside the jelly into the lower concentration inside; the outer regions change first and, over time, the acid reaches nearer the centre so the colour change progresses inward.

(b) identifies a variable e.g. temperature, concentration of acid, size of agar cube, or volume of solution **B1**

(b) gives how to control it e.g. keep temperature constant using a water bath, use same acid concentration, cut cubes the same size, use same volume of solution for each test, oe **B1**

(b) Answer: Control the size of the agar cube by cutting all cubes to the same dimensions; also use the same acid concentration for each trial.

Question 10

(a) prokaryote has no nucleus; eukaryote has a nucleus **B1**

(a) prokaryote lacks membrane-bound organelles (eg mitochondria); eukaryote has membrane-bound organelles **B1**

(a) prokaryote has circular DNA and plasmids or is smaller / simpler in structure; eukaryote has linear DNA in nucleus. Accept any other correct difference, eg prokaryote has a cell wall and an animal cell does not **B1**

(a) Answer: Three differences: prokaryotes have no nucleus while eukaryotes do; prokaryotes lack membrane-bound organelles such as mitochondria; prokaryotes have circular DNA and plasmids while eukaryotes have linear DNA in a nucleus.

Question 11

(a) method: divides 8.0×10^5 by 2.0×10^5 **M1**

(a) 4 cao **A1**

(a) Answer: 4

(b) gives a valid reason: cells were in a lag phase, adjusting to the culture (eg making the enzymes they need), and then entered exponential growth; or cells began dividing more often (shorter generation time), oe **B1**

(b) linked explanation: with more cells dividing at the same time, more new cells are made each hour, so the population grows faster, oe **B1**

(b) Answer: At first the cells were adjusting to the culture (a lag phase). Once they entered exponential growth they divided more often, and with more cells dividing at once more new cells were made each hour, so the population grew faster.

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