1.9 Cell Structure and Microscopy: Test Pack

AQA 8464 · Calculator allowed · about 35 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State one part of the cell theory.

(a) Give one of the three parts of the cell theory. **(1)**

(Total for Question 1 is 1 mark)

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2 A student uses a light microscope to view a plant cell. Name two parts of the microscope the student adjusts to bring the cell into focus and to increase magnification.

(a) Name the adjustment used to bring the image into sharp focus. **(1)**

(b) Name the part the student changes to increase magnification of the specimen. **(1)**

(Total for Question 2 is 2 marks)

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3 State two differences between prokaryotic and eukaryotic cells. Give one difference in internal structure and one difference in size.

(a) Give one internal structural difference. **(1)**

(b) Give one size difference, using typical size ranges. **(2)**

(Total for Question 3 is 3 marks)

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4 A student measures the scale bar on a printed micrograph of a pollen grain. The scale bar is labelled 5 micrometres and measures 2.0 mm. Calculate the magnification of the image. Show your working and give the magnification followed by the symbol x.

(a) Convert the image measurement to micrometres and set up the magnification ratio (image size / actual size). **(1)**

(b) Calculate the magnification and give the final answer with the unit x. **(3)**

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(Total for Question 4 is 4 marks)

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5 Required practical: a student investigates how cell size affects the time taken for substances to diffuse across a sheet of agar jelly. The student uses cubes of agar containing sodium hydroxide and phenolphthalein, so the agar is pink. Each cube is placed in acid and the time for the pink colour to disappear throughout the cube is measured. The results are shown in the table.

Edge length of cube (mm)	Time for pink colour to disappear (s)
1.0	12
2.0	48
4.0	192

Explain whether the results support a relationship between cube size and diffusion time, and state one improvement to make the experiment fair.

(a) Explain how the results support or contradict a proportional relationship between linear size and diffusion time. Use the data in your answer. **(3)**

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(b) State one improvement to make the experiment fair and reduce random error. **(1)**

(Total for Question 5 is 4 marks)

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6 A student is calibrating a light microscope using a stage micrometer. The stage micrometer line spacing is 0.01 mm. Using an objective lens, the student prints an image of the stage micrometer scale and measures 50 of its divisions as 25.0 mm on the printout. Calculate the image scale factor in micrometres per mm on the printout, then calculate how many micrometres correspond to 1.5 mm on the printout. Show working and give the final answer with units.

(a) Calculate the actual length that corresponds to the 50 stage divisions, in micrometres, and find the scale factor in micrometres per mm on the printout. **(3)**

(b) Using the scale factor, calculate the actual size that corresponds to 1.5 mm on the printout. **(3)**

(Total for Question 6 is 6 marks)

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7 Error analysis: A student reports that their measured diameter of a cell is larger than the accepted value. Suggest two plausible sources of error or bias in the microscopy method that could explain the larger measured diameter, and for each suggest a way to reduce or check the error.

(a) Source of error 1, explanation and way to reduce it. **(3)**

(b) Source of error 2, explanation and way to reduce it. **(3)**

(Total for Question 7 is 6 marks)

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Mark scheme · 1.9 Cell Structure and Microscopy: Test Pack

Question 1

(a) one correct statement: eg all living things are made of cells, or cells are the basic unit of life, or all cells come from pre-existing cells, oe **B1**

(a) Answer: Example: All living things are made of cells.

Question 2

(a) coarse focus knob or fine focus knob **B1**

(a) Answer: Coarse focus knob (or fine focus knob).

(b) objective lens (eg rotate to a higher power objective) or changing to a higher-power eyepiece **B1**

(b) Answer: Rotate to a higher power objective lens.

Question 3

(a) eukaryotes have membrane-bound organelles, including a nucleus; prokaryotes do not, oe **B1**

(a) Answer: Eukaryotes have membrane-bound organelles such as a nucleus; prokaryotes do not.

(b) prokaryotic cells are smaller, typically 0.5 to 5 micrometres **B1**

(b) eukaryotic cells are larger, typically 10 to 100 micrometres, oe **B1**

(b) Answer: Prokaryotes about 0.5 to 5 micrometres; eukaryotes about 10 to 100 micrometres.

Question 4

(a) converts 2.0 mm to 2000 micrometres and sets up magnification = 2000 / 5 **M1**

(a) Answer: Image size = 2.0 mm = 2000 micrometres; magnification = 2000 / 5

(b) performs division: 2000 / 5 **M1**

(b) gives 400 as the calculated magnification **A1**

(b) gives answer with the unit: 400x cao **A1**

(b) Answer: 400x

Question 5

(a) uses the data to show time increases with cube size, eg 1.0 mm -> 12 s, 2.0 mm -> 48 s, 4.0 mm -> 192 s **M1**

(a) identifies relationship: when linear size doubles (1.0 to 2.0 mm) time quadruples (12 to 48), and when size doubles again (2.0 to 4.0 mm) time quadruples (48 to 192), oe **M1**

(a) concludes that diffusion time is proportional to the square of the size, i.e. time scales as size^2 (doubling the edge length quadruples the time), with evidence provided (accept explanation that time increases as area or volume increases; accept a conclusion that time is not directly proportional to edge length because doubling the edge length quadruples the time) cao **A1**

(a) Answer: The data show that doubling edge length from 1.0 to 2.0 mm increases time from 12 s to 48 s (4x) and doubling again to 4.0 mm increases time to 192 s (4x again), so diffusion time increases faster than linear size and is proportional to the square of linear dimension in this data set; therefore the results do not show direct proportionality between edge length and time, but support a strong, non-linear relationship between cube size and diffusion time.

(b) one valid improvement: repeat each measurement and take an average, use more precise timing, ensure same concentration and temperature of acid, cut cubes to exact sizes, or use automated detection of colour change, oe **B1**

(b) Answer: Repeat each timing several times and use the average to reduce random error.

Question 6

(a) converts stage micrometer divisions: 50 x 0.01 mm = 0.50 mm actual **M1**

(a) converts 0.50 mm to micrometres: 0.50 x 1000 = 500 micrometres **M1**

(a) calculates scale factor: 500 micrometres corresponds to 25.0 mm on printout so 500 / 25.0 = 20 micrometres per mm cao **A1**

(a) Answer: Scale factor = 20 micrometres per mm on the printout

(b) multiplies 1.5 mm by scale factor 20 micrometres per mm **M1**

(b) gives 30 cao **A1**

(b) gives correct units: micrometres cao **A1**

(b) Answer: 30 micrometres

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Question 7

(a) identifies a plausible source of error: poor focus making edges appear blurred and larger, or another valid source that makes the measured diameter larger, oe **M1**

(a) explains how this increases measured diameter: eg blurred edges reduce precision and lead to overestimation **M1**

(a) suggests reduction: improve focusing, use fine focus and calibration, or use higher magnification and repeat measurement, oe **A1**

(a) Answer: Poor focus could blur the cell edges and make diameter appear larger; reduce by refocusing carefully with fine focus, use higher magnification and repeat measurements.

(b) identifies a plausible source, different from part a: incorrect calibration or parallax in reading the scale on the image, or another valid source, oe **M1**

(b) explains how this leads to larger value: eg wrong conversion factor will scale up measured mm to micrometres **M1**

(b) suggests reduction: recalibrate using stage micrometer, check scale consistency, or have a second person measure independently, oe **A1**

(b) Answer: Incorrect calibration of the image scale could cause a systematic overestimate; reduce by recalibrating with a stage micrometer and checking measurements independently.

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