1.11 Transport in and out of Cells: 1-hour Pack

AQA 8464 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A biologist places two identical strips of rhubarb tissue into different solutions for one hour: strip A into distilled water, and strip B into a concentrated salt solution.

(a) Predict what would happen to the mass of strip A. Explain your answer. **(2)**

(b) Predict what would happen to the mass of strip B. Explain your answer. **(2)**

(Total for Question 1 is 4 marks)

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2 Two potato chips, cut from the same potato, are placed into distilled water for 30 minutes.

Chip 1: initial mass 2.84 g, final mass 3.20 g
Chip 2: initial mass 1.05 g, final mass 1.19 g

(a) Calculate the percentage change in mass for each chip. Give your answers to 1 decimal place. **(4)**

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(b) A student concludes: 'Chip 2 absorbed more water than Chip 1, because its percentage change in mass is higher.' Evaluate this conclusion. **(3)**

.....

(Total for Question 2 is 7 marks)

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3 A student investigates how temperature affects the rate of diffusion. They place a small crystal of purple potassium manganate(VII) at the bottom of a test tube of water, and measure how far the purple colour has spread after 10 minutes, at different water temperatures.

Temperature (°C)	Distance diffused in 10 minutes (mm)
10	4
20	9
30	15
40	22

(a) Describe the pattern shown by the results. **(2)**

(b) Explain, in terms of particles, why increasing the temperature increases the rate of diffusion. **(3)**

(c) Use the pattern in the table to predict the distance diffused in 10 minutes at 50°C. **(1)**

(Total for Question 3 is 6 marks)

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4 Root hair cells absorb mineral ions, such as nitrate ions, from the soil. The concentration of mineral ions is usually higher inside the root hair cell than in the soil around it.

(a) Name the process by which root hair cells take up mineral ions in this situation. **(1)**

(b) Explain why root hair cells need energy to take up mineral ions in this way. **(2)**

(c) Root hair cells contain a large number of mitochondria. Explain how this is an adaptation for active transport. **(2)**

(Total for Question 4 is 5 marks)

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5 Complete the table below to compare diffusion, osmosis and active transport. For each process, state (i) whether energy from respiration is required, and (ii) the direction of movement relative to the concentration gradient.

Process	(i) Energy from respiration required?	(ii) Direction relative to concentration gradient
Diffusion	?	?
Osmosis	?	?
Active transport	?	?

(Total for Question 5 is 6 marks)

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6 Required practical: a student investigates the effect of sucrose solution concentration on the mass of potato tissue.

(a) Describe a method the student could use to investigate this, including how to make the investigation a fair test. **(6)**

(b) Identify the independent variable and the dependent variable in this investigation. **(2)**

(Total for Question 6 is 8 marks)

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7 A student carrying out the potato osmosis practical did not blot the potato chips dry with a paper towel before weighing them at the start and end of the investigation.

(a) Explain the effect this could have had on the results. **(2)**

(b) Suggest one way the student could improve the reliability of the results, other than repeating the experiment. **(1)**

(c) The student's teacher suggests using several chips per concentration and calculating a mean percentage change in mass. Explain why this would improve the investigation. **(2)**

(Total for Question 7 is 5 marks)

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8 Data analysis: A student measures percentage mass change of potato cylinders after 40 minutes in different sucrose concentrations. The recorded mean percentage mass changes are: 0.0 mol per litre -> +12.0%; 0.1 mol per litre -> +6.0%; 0.2 mol per litre -> +1.0%; 0.4 mol per litre -> -8.0%; 0.6 mol per litre -> -14.0%.

(a) Plotting these points would show a line crossing the x axis where percentage change is zero. Estimate the approximate sucrose concentration of the solution that is isotonic with the potato cells (percentage change = 0%). Explain how you made your estimate. **(3)**

(b) State one limitation of using mean percentage mass change and one way to improve the experimental design to reduce the effect of that limitation. **(3)**

(Total for Question 8 is 6 marks)

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Mark scheme · 1.11 Transport in and out of Cells: 1-hour Pack

Question 1

(a) the mass increases, oe **B1**

(a) water moves into the cells by osmosis, because the surrounding water is more dilute (has a higher water concentration) than the cell contents, oe **B1**

(a) Answer: The mass increases, because water moves into the cells by osmosis from the more dilute solution outside.

(b) the mass decreases, oe **B1**

(b) water moves out of the cells by osmosis, into the more concentrated salt solution (which has a lower water concentration than the cell contents), oe **B1**

(b) Answer: The mass decreases, because water moves out of the cells by osmosis into the more concentrated salt solution.

Question 2

(a) chip 1: change in mass = 3.20 - 2.84 = +0.36 (g), oe **M1**

(a) chip 1: +12.7% awrt, cao **A1**

(a) chip 2: change in mass = 1.19 - 1.05 = +0.14 (g), oe **M1**

(a) chip 2: +13.3% awrt, cao **A1**

(a) Answer: Chip 1: +12.7%. Chip 2: +13.3%.

(b) the conclusion is incorrect in terms of the actual mass of water gained: chip 1 gained more water in total (0.36 g compared with 0.14 g for chip 2), ft from (a), oe **B1**

(b) percentage change is scaled to (accounts for) the different starting masses of the chips, so a higher percentage does not mean more water was absorbed in absolute terms, oe **B1**

(b) percentage change is still useful because it allows a fair comparison between chips of different starting sizes/masses, oe **B1**

(b) Answer: The conclusion is incorrect: chip 1 actually gained more water in total (0.36 g vs 0.14 g), even though its percentage change is smaller, because chip 1 started with a larger mass. Percentage change accounts for the different starting masses, so it is not the same as the absolute amount of water absorbed.

Question 3

(a) as temperature increases, the distance diffused (rate of diffusion) increases, oe **B1**

(a) the increase is not constant / the rate of increase itself gets bigger with each 10°C rise (e.g. the distance increases by 5 mm, then 6 mm, then 7 mm), oe with correct use of data **B1**

(a) Answer: As temperature increases, the distance diffused in 10 minutes increases. The increase is not constant: it rises by 5 mm, then 6 mm, then 7 mm as temperature increases by 10°C each time, so the rate of increase itself gets bigger.

(b) particles have more kinetic energy at a higher temperature, oe **B1**

(b) particles move faster (on average), oe **B1**

(b) so particles move from the area of higher concentration to the area of lower concentration more quickly (spread out/mix faster), oe **B1**

(b) Answer: At a higher temperature, particles have more kinetic energy, so they move faster. This means they spread out from the area of higher concentration to the area of lower concentration more quickly, increasing the rate of diffusion.

(c) an answer in the range 27-34 mm, showing correct extrapolation of the increasing difference pattern (ideally 30 mm), oe **B1**

(c) Answer: Approximately 30 mm (accept any value from 27-34 mm with correct reasoning).

Question 4

(a) active transport **B1**

(a) Answer: Active transport.

(b) mineral ions are absorbed against a concentration gradient (from a lower to a higher concentration), oe **B1**

(b) energy (from respiration) is needed to move particles against a concentration gradient, oe **B1**

(b) Answer: The ions move against a concentration gradient, from a lower concentration in the soil to a higher concentration in the cell, so energy from respiration is needed to move them.

(c) mitochondria (cso) are the site of (aerobic) respiration, oe **B1**

(c) this releases (more) energy for active transport, allowing more ions to be moved against the concentration gradient, oe **B1**

(c) Answer: Mitochondria are the site of aerobic respiration. A large number of mitochondria releases more energy, allowing more mineral ions to be actively transported against the concentration gradient.

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Question 5

diffusion: energy not required (passive process) **B1**

diffusion: down the concentration gradient (from high to low concentration) **B1**

osmosis: energy not required (passive process) **B1**

osmosis: down the (water) concentration gradient (dilute to concentrated solution) **B1**

active transport: energy required (from respiration) **B1**

active transport: against (up) the concentration gradient (from low to high concentration) **B1**

Answer: Diffusion: no energy needed, moves down the concentration gradient. Osmosis: no energy needed, moves down the water concentration gradient. Active transport: needs energy from respiration, moves against the concentration gradient.

Question 6

(a) prepare a range of at least five sucrose solutions of different, known concentrations, e.g. by serial dilution from a stock solution, oe **B1**

(a) cut potato chips of the same size using a cork borer (same diameter) and a scalpel/ruler (same length), oe **B1**

(a) blot each chip dry with paper towel to remove surface moisture, then measure and record its starting mass using a balance, oe **B1**

(a) place one chip into each concentration, using the same volume of solution for every chip, for the same fixed time and at the same temperature, oe **B1**

(a) remove each chip, blot dry again, then measure and record its final mass, oe **B1**

(a) repeat the whole investigation at least twice more for each concentration, and calculate a mean percentage change in mass, oe **B1**

(a) Answer: Prepare at least five sucrose solutions of known concentration by serial dilution. Cut identical potato chips using a cork borer. Blot and weigh each chip, then place one into each solution (same volume, time, temperature). Blot and re-weigh each chip. Repeat the whole investigation at least twice more and calculate a mean.

(b) independent variable = concentration of the sucrose solution **B1**

(b) dependent variable = (percentage) change in mass of the potato chip **B1**

(b) Answer: Independent variable: concentration of the sucrose solution. Dependent variable: percentage change in mass of the potato chip.

Question 7

(a) surface water/solution left on the chip would add to its measured mass, oe **B1**

(a) this would make the calculated percentage change in mass inaccurate/unreliable (e.g. mass could appear to increase more, or decrease less, than the true value), oe **B1**

(a) Answer: Surface water or solution left on the chip would add to its measured mass, making the calculated percentage change in mass inaccurate.

(b) any one from: use a larger sample size (more chips per concentration); use a narrower range of concentrations with smaller intervals; use a more precise balance; control temperature more closely (e.g. a water bath); ensure all chips are cut to the same size using a cork borer and template, oe **B1**

(b) Answer: Use a larger number of potato chips for each concentration.

(c) an anomalous result can be identified and excluded from the calculation, oe **B1**

(c) the mean is more representative of the true value, reducing the effect of random error and making the data more reliable, oe **B1**

(c) Answer: Using several chips allows anomalous results to be identified and excluded. The mean is then more representative of the true value, making the data more reliable.

Question 8

(a) identifies the two points bracketing zero: 0.2 mol per litre (+1.0%) and 0.4 mol per litre (-8.0%) **M1**

(a) performs linear interpolation or describes method **M1**

(a) gives approximate isotonic concentration 0.22 mol per litre (or 0.20 to 0.24 mol per litre) with explanation **A1**

(a) Answer: Approximately 0.22 mol per litre (about 0.20 to 0.24 mol per litre). Estimated by linear interpolation between 0.2 mol per litre (+1.0%) and 0.4 mol per litre (-8.0%).

(b) states limitation: variation between biological samples or measurement precision affecting means, oe **M1**

(b) gives improvement: use more replicates and report standard deviation or error bars **M1**

(b) links improvement to limitation: more replicates reduces random variation and gives a more reliable mean **A1**

(b) Answer: Limitation: biological variation between potato cylinders affects the mean. Improvement: use more replicates and calculate standard deviation or error bars so the mean is more reliable.

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