



A-Level Biology

Osmosis

Question Paper

Time available: 65 minutes

Marks available: 45 marks

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1.

An unfertilised chicken egg is a single cell surrounded by a shell.

A student investigated osmosis in chicken eggs. She dissolved the shells of two eggs without damaging the cell contained inside the shells. She then:

- measured the mass of each egg without its shell
- covered one egg with vinegar and covered the other egg with a sugar solution
- kept both eggs covered at 30 °C for 24 hours.

After 24 hours, she measured the mass of each egg.

The student designed the table below and added her results to it.

Initial mass of egg / g	Final mass of egg / g	Name of solution covering egg	Ratio of final mass to initial mass
66	85	Vinegar	1.29:1
60	43	Sugar	0.7:1

- (a) Suggest **one** improvement to the design of the table above and **one** improvement to the way she presented the data contained in the table.

Improvement to design of table _____

Improvement to presentation of data _____

(2)

- (b) Suggest and explain an advantage of carrying out this investigation at 30 °C rather than at 20 °C.

(2)

- (c) The student concluded from the information in the table above that the water potential of the solution inside the egg is higher than the water potential of the vinegar.

Is the student's conclusion correct? Justify your answer.

(3)

(d) The student wanted to determine the water potential of chicken eggs. She:

- produced a dilution series of sugar solution
- followed the procedure described above.

She calculated the final mass to initial mass ratio of the egg covered in each sugar solution.

How would you advise the student to use her calculated ratios to determine the water potential of the eggs?

In your answer state the independent variable in the student's investigation.

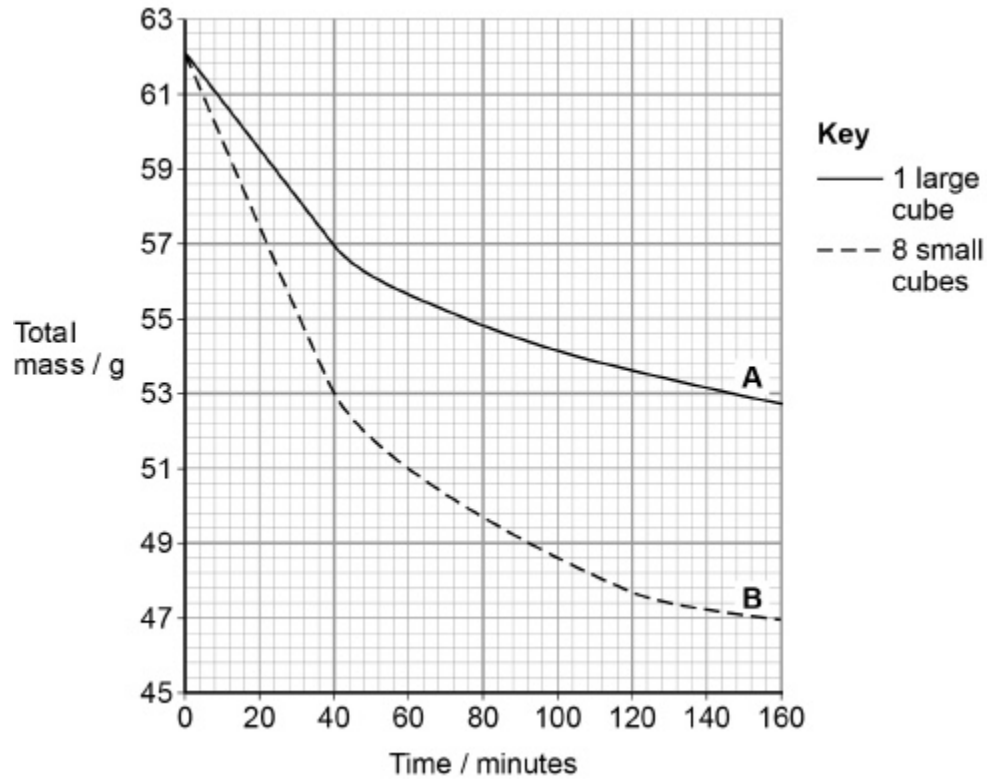
(4)
(Total 11 marks)

2.

A student investigated the effect of surface area on osmosis in cubes of potato.

- He cut two cubes of potato tissue, each with sides of 35 mm in length.
- He put one cube into a concentrated sucrose solution.
- He cut the other cube into eight equal-sized smaller cubes and put them into a sucrose solution of the same concentration as the solution used for the large cube.
- He recorded the masses of the cubes at intervals.

His results are shown in the graph.



- (a) Describe the method the student would have used to obtain the results in the graph. Start after all of the cubes of potato have been cut. Also consider variables he should have controlled.

(3)

- (b) The loss in mass shown in the graph is due to osmosis. The rate of osmosis between 0 and 40 minutes is faster in **B** (the eight small cubes) than in **A** (single large cube).

Is the rate of osmosis per mm^2 per minute different between **A** and **B** during this time?
Use appropriate calculations to support your answer.

(3)

(Total 6 marks)

3.

Strawberries may be dehydrated by removing most of the water they contain. Dehydrated strawberries have many different uses in the food industry.

Food scientists investigated the effect of using osmosis to dehydrate strawberries.

1. The scientists weighed a sample of strawberries and then cut them into 10 mm thick slices.
2. They put the strawberry slices into a 1.2 mol dm^{-3} solution of sucrose at a temperature of $25 \text{ }^\circ\text{C}$.
3. After 1 hour, they removed the slices from the sucrose solution and washed them in water. They dried the slices by blotting them and then weighed them.
4. They also measured the texture of the strawberry slices.
5. The scientists repeated steps 1 to 4, but they left the strawberry slices in the sucrose solution for different amounts of time.

The results of the investigation are shown in the table.

Length of time in sucrose solution / hours	Percentage loss in mass	Texture / arbitrary units
0	Not applicable	1.2
1	15.96	0.9
2	22.88	0.7
4	32.36	0.7
6	38.78	0.7

- (a) (i) In this investigation, the scientists cut the strawberries into slices (step 1). Explain the advantage of this.

(2)

- (ii) The scientists blotted the strawberry slices dry before weighing them (step 3). Explain why.

(2)

- (b) In the second column of the table, the percentage loss in mass for one of the values has been recorded as not applicable. Explain why.

(1)

(c) Use the table to describe how the length of time in the sucrose solution affected the strawberries.

(3)

(d) You could use the data in the table to predict the time that strawberries should be left in sucrose solution to dehydrate them fully. Describe how you could use a graph to do this.

(3)

(Total 11 marks)

4.

(a) Give **three** properties of water that are important in biology.

1. _____

2. _____

3. _____

(3)

A student investigated the effect of different concentrations of sucrose solution on “chips” cut from a potato. Each chip had the same dimensions.

The student:

- weighed each chip at the start
- placed each chip in a separate test tube, each containing 10 cm³ of sucrose solution at a different concentration
- left the chips in the sucrose solution for 24 hours
- dried the surface of the chips and then weighed them again.

The table shows the student’s results.

Concentration of sucrose solution / mol dm⁻³	Initial mass of chip / g	Final mass of chip / g	Ratio of final mass to initial mass of chips
0.0	2.79	3.82	
0.2	2.75	2.97	
0.4	2.78	2.67	
0.6	2.69	2.31	
0.8	2.72	2.20	
1.0	2.77	1.99	

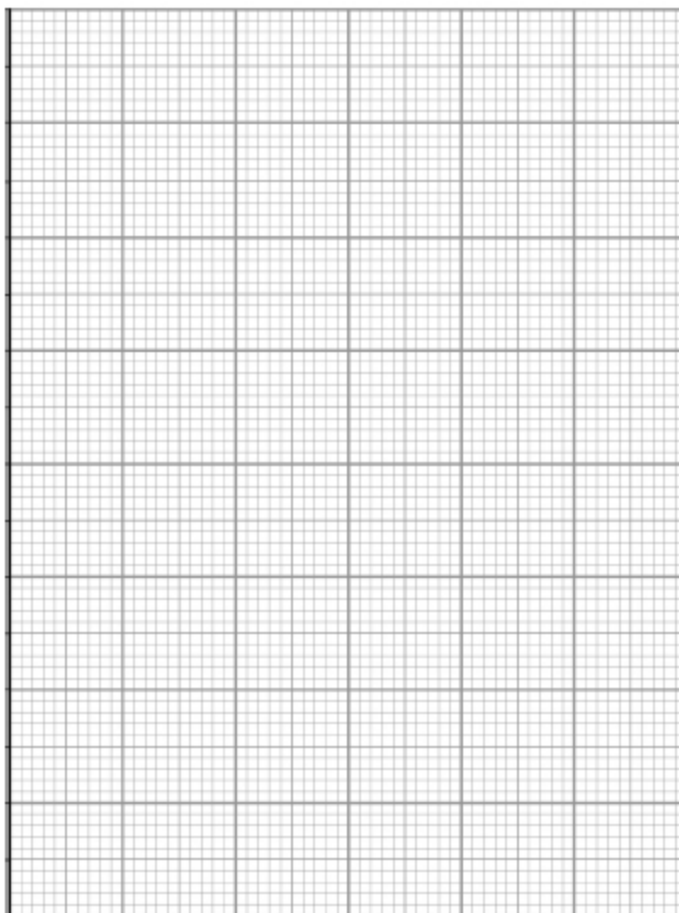
- (b) The student produced the sucrose solutions with different concentrations from a concentrated sucrose solution.

Name the method she would have used to produce these sucrose solutions.

Name of method _____

(1)

- (c) Calculate the ratio of final mass to initial mass of potato chips and plot a suitable graph of your processed data. Express the ratios in the table in part (a) as a single number (for example 5.26:1 would be expressed as 5.26).



(3)

- (d) Explain the result for the chip in 0.8 mol dm^{-3} sucrose solution.

(2)

(Total 9 marks)

5.

A group of students carried out an investigation to find the water potential of potato tissue.

The students were each given a potato and 50 cm³ of a 1.0 mol dm⁻³ solution of sucrose.

- They used the 1.0 mol dm⁻³ solution of sucrose to make a series of different concentrations.
- They cut and weighed discs of potato tissue and left them in the sucrose solutions for a set time.
- They then removed the discs of potato tissue and reweighed them.

The table below shows how one student presented his processed results.

Concentration of sucrose solution / mol dm ⁻³	Percentage change in mass of potato tissue
0.15	+4.7
0.20	+4.1
0.25	+3.0
0.30	+1.9
0.35	-0.9
0.40	-3.8

(a) Explain why the data in the table above are described as **processed** results.

(1)

(b) Describe how you would use a 1.0 mol dm⁻³ solution of sucrose to produce 30 cm³ of a 0.15 mol dm⁻³ solution of sucrose.

(2)

(c) Explain the change in mass of potato tissue in the 0.40 mol dm^{-3} solution of sucrose.

(2)

(d) Describe how you would use the student's results in the table above to find the water potential of the potato tissue.

(3)

(Total 8 marks)