

**AS Level Biology A**  
**H020/02** Depth in biology

**Question Set 17**

1. *Paramecium caudatum* is a protocist. The structure of this organism is shown in Fig. 1.

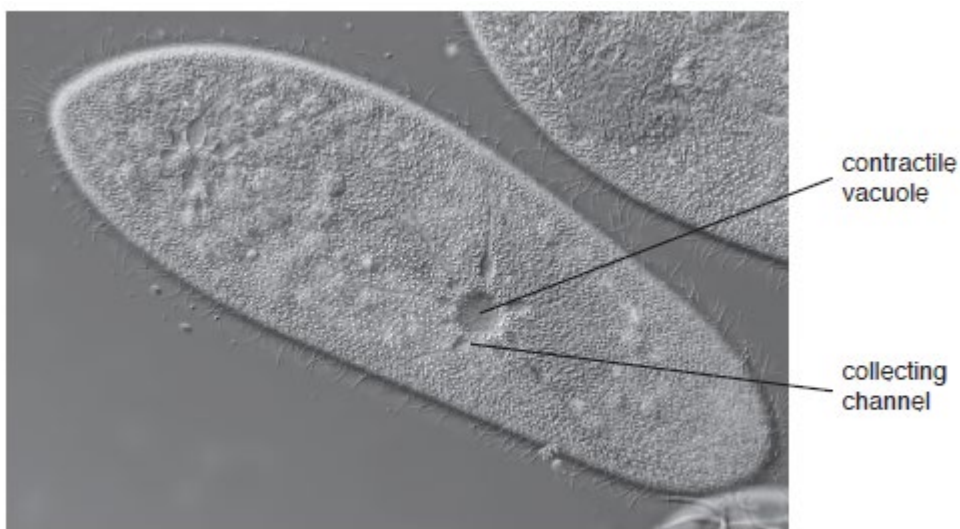


Fig. 1

Most species of *Paramecium* are freshwater organisms. Over a period of time water from the cytoplasm is collected by the collecting channels. They pass the water into the contractile vacuole. Once the contractile vacuole is full, it contracts, expelling the contents from the cell.

- (a) Explain why *Paramecium* needs to expel water when in fresh water.

**When in freshwater, the water potential outside of the organism is higher than inside. Therefore water will enter *Paramecium* down the water potential gradient via osmosis. Water must be expelled to maintain the cell's optimum water potential and prevent it bursting.**

[2]

- (b) An experiment was carried out in which the frequency of vacuole contraction was observed when *Paramecium* was bathed in different concentrations of sodium chloride solution. The results are shown in Table 1.

| Concentration of sodium chloride solution (mol dm <sup>-3</sup> ) | Mean number of contractions (min <sup>-1</sup> ) |
|---|--|
| 0.00  | 6.5  |
| 0.01  | 6.2  |
| 0.03  | 5.7  |
| 0.05  | 4.9  |
| 0.10  | 4.4  |
| 0.15  | 3.9  |
| 0.20  | 1.2  |

Table 1

- (i) Calculate the percentage decrease in the mean number of contractions as the concentration of sodium chloride solution increases from  $0.00 \text{ mol dm}^{-3}$  to  $0.15 \text{ mol dm}^{-3}$ .

$$\frac{6.5 - 3.9}{6.5} \times 100 = 40\%$$

percentage decrease = .....40..... % [2]

- (ii) Explain why there is a decrease in the activity of the contractile vacuole as the concentration of sodium chloride increases. [2]

**As the concentration of NaCl increases, the water potential of the external environment decreases. The water potential gradient between the inside and outside of the cell decreases so less water will enter the cell via osmosis. Less water must be expelled, thus, the rate of vacuolar contraction will decrease.**

- (iii) The cytoplasm of *Paramecium* contains salt crystals. These salt crystals can be used to alter the water potential of the cytoplasm.

Suggest and explain how the water potential can be altered **and** how this could benefit the *Paramecium* living in freshwater. [3]

**Production of salt crystals decreases the solute potential and increases the water potential of the cytoplasm. This decreases the water potential gradient between the inside and outside of the cell so less water will enter the cell via osmosis. Less water must be expelled so the rate of vacuolar contraction can decrease. This saves energy, so it can be used for survival**

- (iv) The experiment described in **Table 1** was extended to find out the effect of reducing the dissolved oxygen concentration on the mean number of contractions at each concentration of sodium chloride. [2]

When the dissolved oxygen concentration of the solution was reduced, the mean number of contractions was lower at each concentration of sodium chloride.

Suggest an explanation for these findings.

**As dissolved  $O_2$  concentration decreases, there is less  $O_2$  available for aerobic respiration. Less ATP will be produced via the electron transport chain so less energy will be available for vacuolar contractions.**

**Total Marks for Question Set 17: 11**

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