IGCSE BIOLOGY • EXERCISE SHEET

3.2 Osmosis

Name: ____________ Class: ________ Date: __________ **Total: 31 marks**

KEY WORDS solution 溶液 • osmosis 渗透 • water potential 水势 • turgid 膨胀 • flaccid 松软

Objective

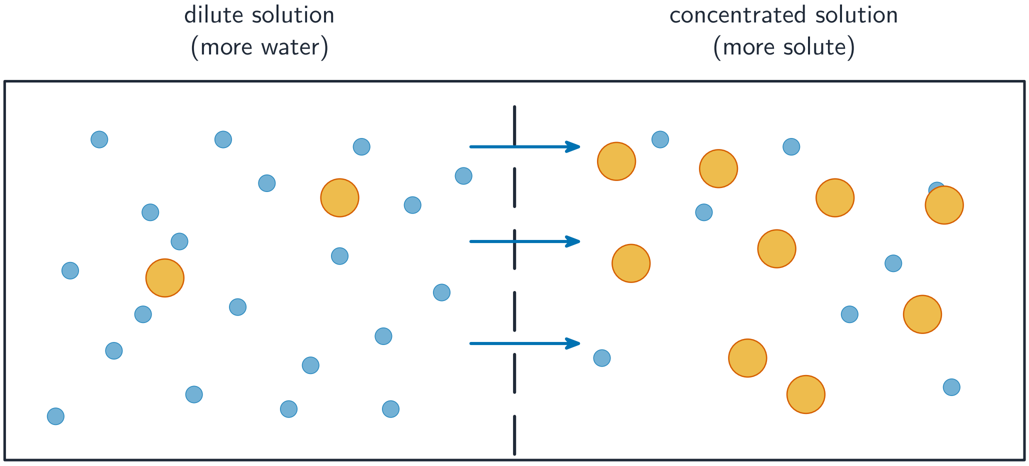
Build the skills to answer exam questions on **osmosis 渗透** — the definition, **water potential** 水势, and the effect on plant cells (**turgid** 膨胀, **flaccid** 松软, **plasmolysed** 质壁分离).

You must be able to:

- define osmosis (net water movement across a partially permeable membrane)
- describe what happens to plant cells in dilute and concentrated solutions
- interpret a potato/dialysis-tubing experiment

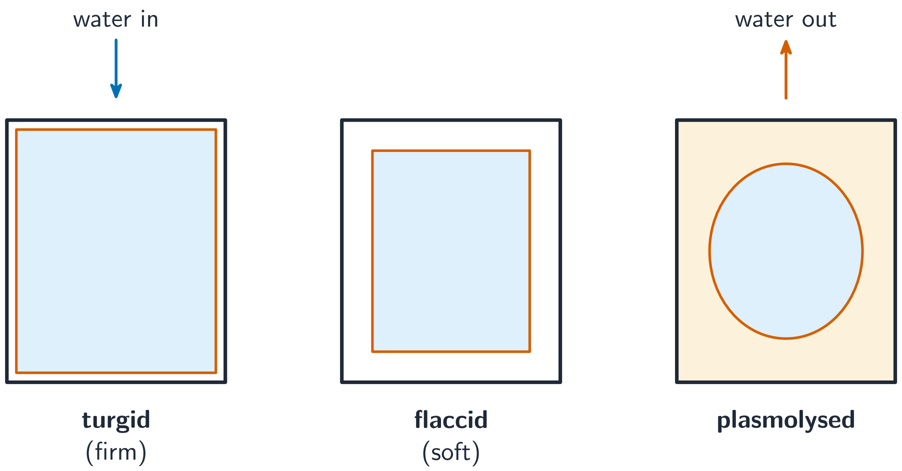
1 Worked examples

■ Osmosis and plant cells



water moves by osmosis to the concentrated side; solute is too big to cross

Osmosis: net movement of water from higher to lower water potential, through a partially permeable membrane



Dilute solution → water in → turgid; concentrated → water out → flaccid/plasmolysed

- potato in water → gains mass; in concentrated solution → loses mass.

Osmosis, in the words that earn the marks

Osmosis 渗透 is the net movement of **water molecules** from a region of **higher water potential** to a region of **lower water potential**, through a **partially permeable membrane** 半透膜.

Three phrases are marks and cannot be paraphrased away: *water molecules* (not "water"), *partially permeable* (not "semi-permeable" in current specifications), and *down the water potential gradient.* Never write that water moves "to where there is more salt" — the mark scheme wants the concentration of **water**, or the **water potential**.

Water potential 水势: pure water has the **highest** water potential; adding solute **lowers** it. So a dilute solution has a higher water potential than a concentrated one, and water moves from dilute to concentrated.

What happens to a cell — and the two words differ between plant and animal:

	in a dilute solution (higher Ψ outside)	**in a concentrated solution (lower Ψ outside)**
plant cell	water enters, the vacuole swells, the cell becomes **turgid** 膨压 — the cell wall stops it bursting	water leaves, the protoplast shrinks from the wall: **plasmolysed** 质壁分离; before that it is **flaccid**
animal cell	water enters and the cell **bursts (lysis)** — no wall to resist	water leaves and the cell shrinks and **crenates**

The presence or absence of a **cell wall** is the whole explanation for the difference, and stating it is usually the mark.

The standard experiment. Cut identical potato cylinders, blot them, measure the mass, leave each in a different sucrose concentration, blot and re-weigh. Calculate the **percentage change in mass** — always dividing by the ORIGINAL mass — and plot it against concentration. Where the line crosses **zero change**, the external solution has the same water potential as the cell sap, so there is no net movement. Blotting matters: surface water counts on the balance and is not osmosis.

Worked example. A cylinder gains mass in solution A and loses mass in solution B. What does that say about the two solutions?

1. Gaining mass means water entered, so solution A has a **higher** water potential than the cell sap — it is more dilute.
2. Losing mass means water left, so solution B has a **lower** water potential than the cell sap — it is more concentrated.

2 Practice

2.1 Define osmosis. [2]

2.2 State what happens to a plant cell placed in pure water. [1]

2.3 Define osmosis, using the term water potential. [3]

2.4 Explain why a plant cell in pure water becomes turgid but does not burst. [2]

2.5 Explain why the potato cylinders must be blotted before weighing. [2]

3 Exam-style questions

3.1 A plant cell in a concentrated sugar solution becomes: [1]

A | B
C | D

A turgid
B flaccid (loses water)
C larger
D unchanged

3.2 Potato cylinders are placed in different sugar solutions and their mass measured.

(a) State what happens to the mass of a cylinder in pure water, and why. [2]

(b) State what you would observe for a cylinder in a very concentrated solution. [1]

3.3 Explain why turgid cells help support a plant. [2]

3.4 A student places identical potato cylinders in sucrose solutions of different concentrations for one hour, then blots and re-weighs them.

Sucrose concentration / mol dm^{-3}	**0.0**	**0.2**	**0.4**	**0.6**
Initial mass / g	5.00	5.00	5.00	5.00
Final mass / g	5.55	5.20	4.75	4.40

(a) Calculate the percentage change in mass for the 0.0 and the 0.6 solutions. [3]

(b) Explain, in terms of water potential, the result for the 0.0 solution. [3]

(c) Estimate the concentration at which there would be no change in mass, and state what that tells you about the cells. [2]

(d) Describe what would be seen under a microscope in a cell from the 0.6 solution, and name the condition. [3]

(e) Explain why a red blood cell placed in pure water bursts, but a plant cell does not. [2]

(f) State two variables the student must control for the comparison to be valid. [2]