Cable equations and propagation through a branch — review sheet

Use this after attempting the worked examples and practice. Explain each claim in words before calculating.

Key ideas

- Axial current couples local membrane balances.
- One edge carries one shared current; one junction has one shared voltage.
- Membrane current density must be multiplied by area when using total currents.
- A time trace fixes location; a spatial snapshot fixes time.
- Arrival speed requires a declared event and physical path distance.
- Conservation, numerical accuracy and biological validity are distinct claims.

Common errors and repairs

Creating a separate junction voltage for each branch. This connected cable uses one shared junction state and sums all incident contributions.

Calling a steady attenuating profile a traveling spike. Travel requires time-dependent observations; regenerative channel feedback must be represented for this active model.

Treating implicit stepping as proof of accuracy. Implicit coupling helps solve the discrete balance. Time and spatial errors still require assessment.

Retrieve without your notes

- For an edge with K = 0.0001 mS and V_i - V_j = 20 mV, what current leaves i?
- Where is the common junction in both snapshot panels?
- If a sealed active cable changes its mean voltage, is that automatically a conservation failure?

Readiness check

- Explain how axial current couples neighboring membrane regions.
- Distinguish a voltage trace at one place from a spatial snapshot at one time.
- Apply one shared-voltage and current-balance rule at a branch.
- Measure arrival delay using a declared threshold and physical path length.
- Explain why conservation, numerical refinement and biological validation are different tests.