Planar viscous flow and boundary-value discretization — review sheet

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

Key ideas

- Incompressibility is a local volume constraint, not a complete velocity law.
- The reduced momentum equation plus wall values selects the profile.
- Flow per width and total flow have different units.
- A nodally exact quadratic can still have a quadrature error.

Common errors and repairs

Using a pressure drop where the equation requires a pressure gradient. Divide pressure drop by channel length to obtain G.

Reporting an order-two profile error from the trapezoidal flux plot. The plotted error belongs to integration; the quadratic nodal solution is exact to roundoff in this scheme.

Retrieve without your notes

- What changes when viscosity doubles at fixed gradient and walls?
- Which test checks nonzero boundary insertion?

Readiness check

- Explain divergence-free velocity as the local constant-density volume balance.
- Derive planar Poiseuille flow from a stated reduced momentum balance and two wall conditions.
- Check SI units, no-slip walls, flow rate and limiting cases in a finite-difference boundary-value solve.
- Distinguish algebraic residual, nodal profile error and flow-integration error.