



FORMULAS YOU MUST KNOW

$$x \frac{dv}{dx} = f(v) - v,$$

$$x_{n+1} = x_n + h, \quad y_{n+1} = y_n + h \cdot f(x_n, y_n).$$

$$\frac{dy}{dx} = f(x) \cdot g(y)$$

$$\frac{dy}{dx} + P(x)y = Q(x)$$

$$\frac{dy}{dx} = f\left(\frac{y}{x}\right)$$

$$\text{Any } \frac{dy}{dx} = f(x, y)$$

$$P(x)$$

$$\frac{k}{x}$$

$$e^{kx}$$

$$\tan x$$

$$-\tan x$$

$$-k/x$$

KEY METHODS

- Check in this order: (1) Can I factorise the RHS as $f(x)g(y)$? → Separable. (2) Is it linear in y ? → Integrating factor. (3) Same total degree in every term? → Homogeneous. (4) None of the above? → Euler's method.
- For the logistic DE, partial fractions give $\frac{1}{P(a-P)} = \frac{1/a}{P} + \frac{1/a}{a-P}$. The factor $\frac{1}{a}$ in each term is easy to miss — write the algebra out fully.
- After multiplying by μ , verify that the LHS is $\frac{d}{dx}(\mu y)$ by expanding — this catches sign errors before you waste time integrating the wrong expression.
- After $v + x \frac{dv}{dx} = f(v)$, simplify to $x \frac{dv}{dx} = f(v) - v$ before separating — this always cancels nicely and exposes the separable form.
- Show the full table even for 2 steps — IB mark schemes award method marks for the table structure, not just the final answer.

EXAM TRAPS TO AVOID

- $y' + Py = Q$ is linear only if P and Q depend on x alone (no y^2 , $\sin y$, etc.). Check before applying the integrating factor.
- $\int \frac{1}{y} dy = \ln|y|$ — absolute value bars required. And $+C$ must appear on one side only; do not write C_1 on the LHS and C_2 on the RHS.
- Forgetting to divide to standard form first. If the DE is $2y' + 4y = 6$, divide by 2 to get $y' + 2y = 3$ before reading off $P = 2$.
- $P(x)$ is the coefficient of y , not of y' . For $y' - 2y = x$, $P = -2$ (negative), so $\mu = e^{-2x}$, not e^{2x} .
- The substitution gives $\frac{dy}{dx} = v + x \frac{dv}{dx}$ — not just $x \frac{dv}{dx}$. Forgetting the v term is the most common method-mark loss in this section.
- Back-substituting $v = y/x$ at the end is mandatory. Leaving the answer in terms of v and x is incomplete and loses the final A1.

- Number of steps from x_0 to a target x_T with step size h is $\frac{x_T - x_0}{h}$ — check this before starting so you don't run out of rows.
- In any modelling question, write the DE explicitly before solving — IB mark schemes award an M mark just for setting up the correct DE.
- Euler uses the slope at the current point (x_n, y_n) , not the next one. $y_{n+1} = y_n + h \cdot f(x_n, y_n)$ — never use $f(x_{n+1}, y_{n+1})$.