InkMaths

QUESTION WORKBOOK

Solving differential equations

Integration · Year 12–13

6 questions · 28 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 Separate the variables in $\frac{dy}{dx} = \frac{x^2}{y}$, writing the result as two integrals. [2]

A2 Solve $\frac{dy}{dx} = 3x^2y$ for $y > 0$, given that $y = 2$ when $x = 0$. [4]

SECTION B · Standard

B1 Solve $\frac{dy}{dx} = y^2$, given that $y = 1$ when $x = 0$, and state the values of x for which your solution is valid. [5]

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B2 A tank is draining, and its depth h at time t satisfies $\frac{dh}{dt} = -k\sqrt{h}$, where k is a positive constant. Given that $h = 16$ when $t = 0$, solve the equation and find, in terms of k, the time at which the tank empties. [5]

B3 Water leaks from a tank at a rate proportional to the volume present, so that $\frac{dV}{dt} = -kV$. Initially the tank holds 500 litres, and after 10 minutes it holds 250 litres. Find V as a function of t, and find the value of k to 3 significant figures. [5]

SECTION C · Stretch

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C1 A population of P thousand insects at time t years is modelled by $dP/dt = 0.1P(5 - P)$, $0 < P < 5$. Given that $P = 1$ when $t = 0$, show that $P = 5/(1 + 4e^{-0.5t})$. [7]

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