



QUESTION WORKBOOK

Modelling with differential equations

Differential equations · Year FM

6 questions · 20 marks

PRINT EDITION

SECTION A · Warm-up

- A1** In the oscillator model $y'' + by' + cy = 0$, state what the y' term and the y term each represent physically. [2]

- A2** Classify the damping in $y'' + 8y' + 25y = 0$, and state the frequency and decay rate of the motion. [3]

SECTION B · Standard

- B1** A shock absorber obeys $y'' + 10y' + 25y = 0$. Classify the damping, give the general solution, and explain why this case is the design target for suspension. [4]

- B2** Classify the damping in $y'' + 5y' + 4y = 0$ and describe the long-term motion. [3]

B3 Solve the coupled system $dx/dt = 2y$, $dy/dt = -2x$ with $x(0) = 3$ and $y(0) = 0$. [5]

SECTION C · Stretch

C1 For a fixed stiffness c , describe how increasing the damping coefficient b from zero changes the behaviour of $y'' + by' + cy = 0$, naming each regime it passes through. [3]