

Differential Equations — Assignment 2

Class 12 Maths · Higher-difficulty challenge set + integrated problems · Answer key included · Narayan Gurukul Academy

Instructions: (1) Attempt all questions; start with the topic-wise challenge set, then attempt the integrated (multi-topic) problems.
(2) Give all answers with correct SI units. $g = 10 \text{ m/s}^2$ unless stated.
(3) A final answer key is provided at the end — try the full set before checking it.

Part A — Topic-wise challenge questions

Order and Degree

1. Find the order and degree of $\frac{dy}{dx} + y = x$.
2. Find the order and degree of $(\frac{d^2y}{dx^2})^2 + y = 0$.
3. Find the order and degree of $\frac{d^2y}{dx^2} + (\frac{dy}{dx})^3 + y = 0$.

Forming a Differential Equation

1. Form the differential equation from $y = mx$.
2. Form the differential equation representing $y = a \cos x + b \sin x$.
3. Form the differential equation from $y = A e^{2x} + B e^{-2x}$.

Variable-Separable Equations

1. Solve $\frac{dy}{dx} = x/y$.
2. Solve $\frac{dy}{dx} = 2x$.
3. Solve $\frac{dy}{dx} = e^{x+y}$.

Homogeneous Equations

1. Solve $\frac{dy}{dx} = y/x + 1$ using $y = vx$.
2. Show that $\frac{dy}{dx} = (x+y)/x$ is homogeneous.
3. Solve $\frac{dy}{dx} = (x+y)/(x-y)$.

Linear Differential Equations

1. Solve $\frac{dy}{dx} + y = e^{-x}$.
2. Solve $\frac{dy}{dx} + (1/x)y = x$.
3. Solve $x \frac{dy}{dx} + y = x^3$.

Part B — Integrated problems (multi-topic)

1. Find the order and degree of $(\frac{d^2y}{dx^2})^2 + y = 0$.
2. Form the differential equation from $y = A e^{2x} + B e^{-2x}$.
3. Solve $\frac{dy}{dx} = x/y$.
4. Solve $\frac{dy}{dx} = (x+y)/(x-y)$.
5. Find the integrating factor for $\frac{dy}{dx} + y = x$.

Answer Key

Order and Degree

Order 1, degree 1. Order 2, degree 2. Order 2, degree 1.

Forming a Differential Equation

$$x \, dy/dx = y. \, d^2y/dx^2 + y = 0. \, d^2y/dx^2 - 4y = 0.$$

Variable-Separable Equations

$$y^2 = x^2 + C. \, y = x^2 + C. \, e^{-y} + e^x = C.$$

Homogeneous Equations

$$y = x(\ln x + C). \, \text{Homogeneous (degree 0). } x^2 - 2xy - y^2 = C.$$

Linear Differential Equations

$$y = e^{-x}(x + C). \, y = x^2/3 + C/x. \, y = x^3/4 + C/x.$$

Integrated problems

$$1: \text{order 2, degree 2. } 2: d^2y/dx^2 - 4y = 0. \, 3: y^2 = x^2 + C. \, 4: x^2 - 2xy - y^2 = C. \, 5: e^x.$$