

Differential Equations

Practice Problems

Determine the order and degree of each of the following differential equations.

(i) $y \sec^2 x \, dx + \tan x \, dy = 0$

(ii) $\left(\frac{dy}{dx}\right)^4 + y^5 = \frac{d^3y}{dx^3}$

(iii) $a \frac{d^2y}{dx^2} = \left\{ 1 + \left(\frac{dy}{dx}\right)^2 \right\}^{\frac{3}{2}}$

(iv) $\tan^{-1} \sqrt{\frac{dy}{dx}} = x$ (v) $\log \left(\frac{d^2y}{dx^2}\right) = y$

(vi) $\frac{\frac{dy}{dt}}{y + \frac{dy}{dt}} = \frac{yt}{\frac{dy}{dt}}$ (vii) $\frac{d^2y}{du^2} = \frac{3y + \frac{dy}{du}}{\sqrt{\frac{d^2y}{du^2}}}$

(viii) $e^{dy} = x^2$

Order **Degree**

Ans. (i)	1	1
(ii)	3	1
(iii)	2	2
(iv)	1	1
(v)	2	1
(vi)	1	2
(vii)	2	3
(viii)	1	1

Form the differential equation by eliminating the arbitrary constants in each of the following cases.

(i) $y = A \sec x$ (ii) $y = C \tan^{-1} x$

(iii) $y = Ae^t + Be^{2t}$ (iv) $y = Ax^2 + Bx$

(v) $y = a \cos x + b \sin x$

(vi) $y = a \sin^{-1} x + b \cos^{-1} x$

(vii) $y = at + be^t$

(viii) $y = a \sin t + be^t$

(ix) $ax^2 + by = 1$

Ans. (i) $y = A \sec x$

Then $\frac{dy}{dx} = A \sec x \tan x = y \tan x$

(ii) $y = C \tan^{-1} x \Rightarrow \frac{y}{\tan^{-1} x} = C$

$\Rightarrow \frac{d}{dx} \left(\frac{y}{\tan^{-1} x} \right) = 0$

$\Rightarrow \frac{\frac{dy}{dx} \cdot \tan^{-1} x - y \cdot \frac{1}{1+x^2}}{\left(\tan^{-1} x\right)^2} = 0$

$\Rightarrow \tan^{-1} x \frac{dy}{dx} - \frac{y}{1+x^2} = 0$

(iii) $y = Ae^t + Be^{2t}$... (1)

$\frac{dy}{dt} = Ae^t + 2Be^{2t}$... (2)

Subtracting (1) from (2) we get

$\frac{dy}{dt} - y = Be^{2t} \Rightarrow \left(\frac{dy}{dt} - y\right) \cdot e^{-2t} = B$

Differentiating again we get

$\left(\frac{d^2y}{dt^2} - \frac{dy}{dt}\right) \cdot e^{-2t} + \left(\frac{dy}{dt} - y\right) (-2e^{-2t}) = 0$

$\Rightarrow \frac{d^2y}{dt^2} - \frac{dy}{dt} - 2 \frac{dy}{dt} + 2y = 0$

$\Rightarrow \frac{d^2y}{dt^2} - 3 \frac{dy}{dt} + 2y = 0$

Differential Equations Problems And Solutions

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