

CHAPTER 1  
ELIMINATION OF ARBITRARY CONSTANTS

1.  $x^2 - 2x^2y = C$

$$2x^2 dx - 2x^2 dy - 2y(2x) dx = 0$$

$$2x^2 dx - 4xy dx - 2x^2 dy = 0$$

divide by  $2x^2$

$$dx - 2y dx - dy = 0$$

$$\therefore (1 - 2y) dx - dy = 0 \quad \text{ans.}$$

2.  $y \sin x - xy^2 = 0$

$$y(\cos x dx) + \sin x dy - dy y = 0$$

$$+ y^2 dx = 0$$

$$y(\cos x dx) - y^2 dx + \sin x dy - dy y = 0$$

$$y(\cos x - y) dx + (\sin x - 2xy) dy = 0 \quad \text{ans.}$$

3.  $x^2 y = 1 + Cx$

$$x^2 dy + 2xy dx = 0 + C dx$$

divide by  $dx$

$$\frac{d^2 y}{dx^2} + 2xy = C$$

substitute

$$x^2 y = 1 + Cx \Rightarrow \left[ x^2 \frac{d^2 y}{dx^2} + 2xy \right] x$$

$$x^3 y = 1 + x^2 \frac{d^2 y}{dx^2} + 2x^2 y$$

$$x^3 y dx = dx + x^3 dy + 2x^2 y dx$$

$$dx + x^3 dy + 2x^2 y dx - x^3 y dx = 0$$

$$\therefore dx + x^3 dy + x^2 y dx = 0$$

$$\therefore (x^3 y + 1) dx + x^2 dy = 0 \quad \text{ans.}$$

4.  $cy^3 = x^2 + y$

$$\frac{y^3 + y}{y^4} = C$$

$$\frac{y^4 (y^3 + y) - (y^4 + y^2) dy}{(y^4)^2} = 0$$

$$2xy^3 dx + y^2 dy - 2y^2 dy - 2y dy = 0$$

divide by  $y$

$$2xy^2 dx + y dy - 2y dy - 2 dy = 0$$

$$\therefore 2xy^2 dx - 2 dy = 0 \quad \text{ans.}$$

5.  $x = A \sin(\omega t + \phi)$ ;  $\omega$  is a parameter not to be elim.

$$\frac{dx}{dt} = A \omega \cos(\omega t + \phi)$$

$$\frac{d^2 x}{dt^2} = A \omega^2 [-\sin(\omega t + \phi)]$$

$$= -A \omega^2 \sin(\omega t + \phi)$$

$$\text{but } x = A \sin(\omega t + \phi)$$

$$\frac{d^2 x}{dt^2} = -\omega^2 x$$

$$\therefore \frac{d^2 x}{dt^2} + \omega^2 x = 0 \quad \text{ans.}$$

6.  $x = C_1 \cos \omega t + C_2 \sin \omega t$   
Let  $\omega$  be parameter.

$$\frac{dx}{dt} = -C_1 \omega \sin \omega t + C_2 \omega \cos \omega t$$

$$\frac{d^2 x}{dt^2} = -C_1 \omega^2 \cos \omega t - C_2 \omega^2 \sin \omega t$$

$$= -\omega^2 (C_1 \cos \omega t + C_2 \sin \omega t)$$

$$= -\omega^2 x$$

$$\frac{d^2 x}{dt^2} + \omega^2 x = 0 \quad \text{ans.}$$

7.  $y = Cx + C^2 + 1$

$$y^2 = C^2 + 2C + 1 \Rightarrow C = y^2$$

$$\therefore y = y^2 x + (y^2)^2 + 1 \quad \text{ans.}$$

8.  $y = mx + \frac{1}{m^2}$ ;  $m$  is a parameter, so to be eliminated.

$$y' = m + 0 \Rightarrow m = y'$$

$$\therefore y = y' x + \frac{1}{y'^2} \quad \text{ans.}$$

9.  $y^3 = 4ax$

$$3y^2 dy = 4a dx$$

$$\therefore dy = \frac{4a dx}{3y^2}$$

substitute,

$$y^3 = \left( \frac{4a dx}{3y^2} \right) x$$

$$y^5 dx = 4a x dy$$

$$\therefore y^5 dx - 4a x dy = 0 \quad \text{ans.}$$

10.  $y = 4x^2 + bx + c$

$$y' = 8x + b \Rightarrow b = y'$$

$$y'' = 8 \Rightarrow 0$$

$$y'' = 0 \quad \text{ans.}$$

# Rainville Solution Manual

**O García**



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