

ELIMINATION OF ARBITRARY CONSTANTS AND FAMILY OF CURVES

**CHAPTER 1**  
**ELIMINATION OF ARBITRARY CONSTANTS**

1.  $x^2 - 2x^2y + c$   
 $2x^2y - 2x^2y - 2y(2x^2y) = c$   
 $2x^2y - 4x^2y - 4xy^2 = 2x^2y + c$   
 divide by  $2x$   
 $x - 2y^2x - 2y = c/x$   
 $\therefore (x - 2y^2)x - 2y = c/x$  ans.

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

3.  $x^2y + 1 + c$   
 $x^2y + 2xy^2 = c + c$   
 divide by  $dx$   
 $\frac{d^2y}{dx^2} + 2xy = c$   
 substitute  
 $x^2y = 1 + x^2 \frac{dy}{dx} + 2xy^2$   
 $x^2y = 1 + x^2 \frac{dy}{dx} + 2xy^2$   
 $x^2y dx = dx + x^2 dy + 2xy^2 dx$   
 $dx + x^2 dy + 2xy^2 dx = c dx$   
 $\therefore (x^2y + 1) dx + x^2 dy = c dx$  ans.

4.  $cy^2 + x^2y$   
 $\frac{x^2y}{y^2} = c$   
 $\frac{d^2y}{dx^2} + 2xy = c$   
 $2xy^2 dx + x^2 dy - cy^2 dx - cy^2 dy = c dx$   
 divide by  $y$   
 $2xy dx + x^2 dy - cy dx - cy dy = c dx$   
 $\therefore 2xy dx + x^2 dy - cy dx = c dx$  ans.

5.  $x = A \sin(\omega t + \phi)$  ;  $\omega$  &  $\phi$  are parameters not to be elim.  
 $\frac{dx}{dt} = A \omega \cos(\omega t + \phi)$   
 $\frac{d^2x}{dt^2} = -A \omega^2 \sin(\omega t + \phi)$   
 $= -A \omega^2 x$  (ans) (ans)  
 but  $x = A \sin(\omega t + \phi)$   
 $\frac{d^2x}{dt^2} = -\omega^2 x$   
 $\therefore \frac{d^2x}{dt^2} + \omega^2 x = 0$  ans.

6.  $x = C_1 \cos(\omega t) + C_2 \sin(\omega t)$   
 ;  $\omega$  a parameter.  
 $\frac{dx}{dt} = -C_1 \omega \sin(\omega t) + C_2 \omega \cos(\omega t)$   
 $\frac{d^2x}{dt^2} = -C_1 \omega^2 \cos(\omega t) - C_2 \omega^2 \sin(\omega t)$   
 $= -\omega^2 (C_1 \cos(\omega t) + C_2 \sin(\omega t))$   
 $\frac{d^2x}{dt^2} = -\omega^2 x$   
 $\therefore \frac{d^2x}{dt^2} + \omega^2 x = 0$  ans.

7.  $y = C_1 e^{2t} + C_2 e^{-2t}$   
 $y' = 2C_1 e^{2t} - 2C_2 e^{-2t}$   
 $\therefore y'' = 4C_1 e^{2t} + 4C_2 e^{-2t}$  ans.

8.  $y = C_1 e^{\frac{t}{2}} + C_2 e^{-\frac{t}{2}}$  ;  $\omega$  a parameter, to be eliminated.  
 $y' = \frac{1}{2} C_1 e^{\frac{t}{2}} - \frac{1}{2} C_2 e^{-\frac{t}{2}}$   
 $\therefore y'' = \frac{1}{4} C_1 e^{\frac{t}{2}} + \frac{1}{4} C_2 e^{-\frac{t}{2}}$  ans.

9.  $y^2 = 4ax$   
 $2y dy = 4a dx$   
 $\therefore \frac{dy}{dx} = \frac{2a}{y}$   
 substitute,  
 $y' = \left( \frac{2a}{y} \right) x$   
 $y^2 dx = 2axy$   
 $\therefore y^2 dx - 2axy = 0$  ans.

10.  $y = Ax^2 + Bx + C$   
 $y' = 2Ax + B = 0$   
 $y'' = 2A = 0$   
 $y''' = 0$  ans.

# Rainville Solution Manual

**L Darling-Hammond**



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