

ELIMINATION OF ARBITRARY CONSTANTS AND FAMILY OF CURVES

CHAPTER 1
ELIMINATION OF ARBITRARY CONSTANTS

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

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

3. $x^2y + 1 + c$
 $x^2y + 2xy dx = 0 + c dx$
 divide by dx
 $\frac{d^2y}{dx^2} + 2xy = c$
 substitute
 $x^2y = 1 + x^2 \frac{dy}{dx} + 2xy$
 $x^2y = 1 + x^2 \frac{dy}{dx} + 2xy$
 $x^2 y dx + dx + x^2 dy + 2xy dx$
 $dx + x^2 dy + 2xy dx - x^2 y dx = 0$
 $\therefore (x^2y + 1) dx + x^2 dy = 0$ ans.

4. $cy^2 + x^2y$
 $\frac{x^2y}{y^2} = c$
 $\frac{d}{dx} \left[\frac{x^2y}{y^2} \right] = 0$
 $2xy^2 dx + x^2 dy - 2xy^2 dx - 2y^2 dy = 0$
 divide by y
 $2xy dx + x^2 dy - 2xy dx - 2y dy = 0$
 $\therefore 2xy dx - 2y dy = 0$
 ans.

5. $x = A \sin(\omega t + \phi)$; ω & ϕ are parameters not to be elim.
 $\frac{dx}{dt} = A \omega \cos(\omega t + \phi)$
 $\frac{d^2x}{dt^2} = -A \omega^2 \sin(\omega t + \phi)$
 $= -A \omega^2 x$ (wt + ϕ)
 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. $x = C_1 \cos(\omega t) + C_2 \sin(\omega t)$
 ω is a parameter.
 $\frac{dx}{dt} = -C_1 \omega \sin(\omega t) + C_2 \omega \cos(\omega t)$
 $\frac{d^2x}{dt^2} = -C_1 \omega^2 \cos(\omega t) - C_2 \omega^2 \sin(\omega t)$
 $= -\omega^2 (C_1 \cos(\omega t) + C_2 \sin(\omega t))$
 $= -\omega^2 x$
 $\frac{d^2x}{dt^2} + \omega^2 x = 0$ ans.

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

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

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

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

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Didier Musso



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Notices of the American Mathematical Society American Mathematical Society, 1981

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