

CHAPTER 1
ELIMINATION OF ARBITRARY CONSTANTS

1. $y^2 - 3xy = C$

$2x^2dx - 3x^2dy - 3y(2x)dx = 0$

$2x^2dx - 6xydx - 3x^2dy = 0$

divide by $2x^2$,

$x - 3y + 6x^2 = 0$

$(x + 2y)dx - 3xydy = 0$ and

2. (1) $x = A \sin(\omega t + \phi)$; $y = B \sin(\omega t + \phi)$

(2) $x = A \cos(\omega t + \phi)$

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

$y = B \cos(\omega t + \phi)$

$\frac{dy}{dt} = -B\omega \sin(\omega t + \phi)$

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

$\frac{dy}{dt} = -B\omega \sin(\omega t + \phi)$

$\therefore \frac{dx}{dt} + \frac{dy}{dt} = -A\omega^2 \sin^2(\omega t + \phi) - B\omega^2 \cos^2(\omega t + \phi) = 0$

3. $y \ln x = x \ln y = 0$

$y(\ln x + 1) + \ln x \cdot dy - dy \cdot y = 0$

$-y^2 dy = 0$

$y \ln x + x - y^2 \ln x + 2xy - 2y^2 \ln y = 0$

$y(\ln x + y)dx + (2x - 2y^2 \ln y)dy = 0$ and

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

$x^2dy + 2xydx = 0 + Cdx$

divide by x^2 ,

$2ydx + 1 + Cx = 0$

Separately,

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

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

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

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

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

$(x^2y + 1)dx + x^2y^2dx = 0$ and

5. $y = Cx + C^2x^2$

$y' = C + 2Cx = 0 \quad \therefore C = 0$

$\therefore y = Cx + (Cx)^2 = 0$ and

$\frac{dy}{dx} = Cx$

$\therefore \frac{dy}{dx} = Cx^2 + 2Cx^3 = 0$ and

6. $y = \ln x + \frac{b}{x}$

$y' = \frac{1}{x} - \frac{b}{x^2} = 0$ $\therefore x = \sqrt{b}$

$\therefore y = \ln x + \frac{b}{x}$ and

7. $y^2 = 4ax$

$2ydy = 4adx$

$\therefore \frac{2ydy}{4a} = \frac{dx}{dx}$

Separately,

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

$y^2dx = 2ydx$

$y^2dx - 2ydx = 0$ and

8. $y = ax^2 + bx + c$

$y' = 2ax + b = 0$

$\therefore x = -\frac{b}{2a}$

$\therefore y = 0$

9. $xy^2 = x^2 + y$

$\frac{x^2 + y}{xy^2} = 0$

$\frac{x^2}{xy^2} + \frac{y}{xy^2} = 0$
 $\frac{x}{y^2} + \frac{1}{x} = 0$

$x^2y^2 + y = 0$

$x^2y^2 + y^2 = 0$

$y^2(x^2 + 1) = 0$

$y^2 = 0 \quad \therefore y = 0$

$x^2 + 1 = 0$

$x^2 = -1$ (not possible)

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Wolfram Weckwerth

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Ordinary Differential Equations and Their Solutions George Moseley Murphy, 2011-01-01 This treatment presents most of the methods for solving ordinary differential equations and systematic arrangements of more than 2 000 equations and their solutions The material is organized so that standard equations can be easily found Plus the substantial number and variety of equations promises an exact equation or a sufficiently similar one 1960 edition *The American Mathematical Monthly*

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Modeling with Differential Equations in Chemical Engineering Stanley M. Walas, 1991 Modelling with Differential Equations in Chemical Engineering covers the modelling of rate processes of engineering in terms of differential equations While it includes the purely mathematical aspects of the solution of differential equations the main emphasis is on the derivation and solution of major equations of engineering and applied science Methods of solving differential equations by analytical and numerical means are presented in detail with many solved examples and problems for solution by the reader Emphasis is placed on numerical and computer methods of solution A key chapter in the book is devoted to the principles of mathematical modelling These principles are applied to the equations in important engineering areas The major disciplines covered are thermodynamics diffusion and mass transfer heat transfer fluid dynamics chemical reactions and automatic control These topics are of particular value to chemical engineers but also are of interest to mechanical civil and environmental engineers as well as applied scientists The material is also suitable for undergraduate and beginning graduate students as well as for review by practising engineers

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