"ELIMINATION OF ARBITRARY CONSTANTS AND FAMILIES OF CURVES"

CHAPTER 1
ELIMINATION OF ARBITRARY CONSTANTS

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

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

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

divide by $3x$,

$xdx - 2ydx - xdy = 0$

$\therefore (x+2y)dx - xdy = 0$ ans.

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

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

$y\cos x\,dx - y^2dx + \sin x\,dy - 2xydy = 0$

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

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

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

divide by dx,

$\frac{x^2dy}{dx} + 2xy = C$

Substitute,

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

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

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

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

$dx + x^3dy + x^2ydx = 0$

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

4. $Cy^2 = x^2 + y$

$\frac{x^2+y}{y^2} = C$

$\frac{y^2[2xdx + dy] - [x^2+y]2ydy}{(y^2)^2} = 0$

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

divide by y,

$2xydx + ydy - 2x^2dy - 2ydy = 0$

$\therefore 2xydx - (2x^2+y)dy = 0$ ans.

5. $x = A\sin(wt + \alpha)$; w is a parameter not to be elim.

$\frac{dx}{dt} = Aw\cos(wt + \alpha)$

$\frac{d^2x}{dt^2} = Aw[-w\sin(wt + \alpha)]$

$= -Aw^2\sin(wt + \alpha)$

but $x = A\sin(wt + \alpha)$

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

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

6. $x = C_1\cos wt + C_2\sin wt$; w is parameter.

$\frac{dx}{dt} = C_1(-w\sin wt) + C_2(w\cos wt)$

$\frac{d^2x}{dt^2} = C_1w(-w\cos wt) + C_2w(-w\sin wt)$

$= -w^2(C_1\cos wt + C_2\sin wt)$

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

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

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

$y' = C + 0 + 0$; $\therefore C = y'$

$\therefore y = y'x + (y')^2 + 1$ ans.

8. $y = mx + \frac{h}{m}$; h a parameter, m to be eliminated.

$y' = m + 0$; $\therefore m = y'$

$\therefore y = xy' + \frac{h}{y'}$ ans.

9. $y^2 = 4ax$

$2ydy = 4adx$

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

Substitute,

$y^2 = \left(\frac{2ydy}{dx}\right)x$

$y^2dx = 2xydy$

$\therefore y^2dx - 2xydy = 0$ ans.

10. $y = Ax^2 + Bx + C$

$y' = 2Ax + B + 0$

$y'' = 2A + 0$

$y'' = 0$ ans.

Rainville Solution Manual

S Ben Porath

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Table of Contents Rainville Solution Manual

1. Understanding the eBook Rainville Solution Manual
    - The Rise of Digital Reading Rainville Solution Manual
    - Advantages of eBooks Over Traditional Books
2. Identifying Rainville Solution Manual
    - Exploring Different Genres
    - Considering Fiction vs. Non-Fiction
    - Determining Your Reading Goals
3. Choosing the Right eBook Platform
    - Popular eBook Platforms
    - Features to Look for in an Rainville Solution Manual
    - User-Friendly Interface
4. Exploring eBook Recommendations from Rainville Solution Manual
    - Personalized Recommendations
    - Rainville Solution Manual User Reviews and Ratings
    - Rainville Solution Manual and Bestseller Lists
5. Accessing Rainville Solution Manual Free and Paid eBooks

- Rainville Solution Manual Public Domain eBooks
- Rainville Solution Manual eBook Subscription Services
- Rainville Solution Manual Budget-Friendly Options

6. Navigating Rainville Solution Manual eBook Formats
   - ePub, PDF, MOBI, and More
   - Rainville Solution Manual Compatibility with Devices
   - Rainville Solution Manual Enhanced eBook Features
7. Enhancing Your Reading Experience
   - Adjustable Fonts and Text Sizes of Rainville Solution Manual
   - Highlighting and Note-Taking Rainville Solution Manual
   - Interactive Elements Rainville Solution Manual
8. Staying Engaged with Rainville Solution Manual
   - Joining Online Reading Communities
   - Participating in Virtual Book Clubs
   - Following Authors and Publishers Rainville Solution Manual
9. Balancing eBooks and Physical Books Rainville Solution Manual
   - Benefits of a Digital Library
   - Creating a Diverse Reading Collection Rainville Solution Manual
10. Overcoming Reading Challenges
    - Dealing with Digital Eye Strain
    - Minimizing Distractions
    - Managing Screen Time
11. Cultivating a Reading Routine Rainville Solution Manual
    - Setting Reading Goals Rainville Solution Manual
    - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Rainville Solution Manual
    - Fact-Checking eBook Content of Rainville Solution Manual
    - Distinguishing Credible Sources
13. Promoting Lifelong Learning
    - Utilizing eBooks for Skill Development

- Exploring Educational eBooks

14. Embracing eBook Trends
    - Integration of Multimedia Elements
    - Interactive and Gamified eBooks

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