MATHS

BOOKS - NAGEEN PRAKASHAN ENGLISH

DIFFERENTIAL EQUATIONS

Solved Example

1. Find the order and degree of the differential equation.

$$\frac{d^3y}{dx^3} = \sqrt{x + \left(\frac{dy}{dx}\right)^3}$$

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2. Find the order and degree of the differential equation .

$$\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right)^3 - 1 = 0$$

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3. The slope of a curve at point (x, y) is equal to sum of coordinate of that point. Represent it in form of a differential equation.

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4. The rate of decreasing the radium is directly proportional to the amount $'Q'$ present in it. Represent it in the form of a differential equation.

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5. If A and B are arbitrary constants, then find the differential equation corresponding to $y = A\cos(x + B)$.

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6. Find the differential equation corresponding to the equation $y = A \cdot e^x + B$.

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7. Find the differential equation corresponding to the equation $y = Ae^{2x} + Be^{-x}$.

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8. Find the differential equation from the equation $(x-h)^2 + (y-k)^2 = a^2$ by eliminating h and k.

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9. The differential equation of family of curves $x^2 + y^2 - 2ax = 0$, is

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10. Find the differential equations corresponding to $v = \frac{A}{r} + B$.

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11. Show that $y = x \sin x$ is a solution of the differential equation $\frac{d^2y}{Dx^2} + y - 2\cos x = 0$.

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12. Prove that $y = e^x + m$ is a solution of the differential equation $\frac{d^2y}{dx^2} - \frac{dy}{dx} = 0$, where m is a constant.

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13. Show that $y = ae^{2x} + be^{-x}$ is a solution of the differential equation $\frac{d^2y}{dx^2} - 2y = 0$.

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14. Verify that $y = ce^{tan^{-1}x}$ is a solution of differential equation $(1+x^2)\frac{d^2y}{dx^2} + x\frac{dy}{dx} = 0.$

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15. Solve the differential equation $\frac{dy}{dx} = \sec^2 x.$

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16. Solve the differential equation $\frac{dy}{dx} = \frac{1}{x}.$

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17. Solve the differential equation $\frac{dy}{dx} = \sin(2x+5).$

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18. Solve the differential equation $\frac{dy}{dx} = \sin^4 x \cdot \cos x.$

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19. Solve the differential equation $\left(1 + x^2\right)\frac{dy}{dx} = x.$

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20. Find the solution of the differential equation $\cos y dy + \cos x \sin y dx = 0$ given that $y = \pi/2$, when $x = \pi/2.$

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21. Solve the differential equation $\frac{dy}{dx} = \frac{1 - \cos 2y}{1 + \cos 2y}.$

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22. Solve the differential equation $\frac{dy}{dx} = \frac{x(2\log x + 1)}{(\sin y + y\cos y)}$.

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23. The solution of the differential equation $3e^x \tan y dx + (1 + e^x)\sec^2 y dy = 0$ is

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24. Solution of the differential equation $(1 + x)ydx + (1 - y)xdy = 0$ is

A. $\log(x \cdot y) + x - y = c.$

B. $\log\left(\frac{x}{y}\right) + x - y = c.$

C. $\log(x \cdot y) + x = c.$

D. none of these

Answer: A

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25. Solve the differential equation $\frac{dy}{dx} = e^{2x-y} + x^2 \cdot e^{-y}$.

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26. Solve the differential equation : $\left(1-x^2\right)(1-y)\,dx = xy(1+y)dy$

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27. Solve the differential equation $4x\frac{dy}{dx} = 5y$, given that $y(1) = 3$.

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28. Solve the differential equation $y - x\frac{dy}{dx} = a\left(y^2 + \frac{dy}{dx}\right)$.

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29. In a bank, principal increases continuously at the rate of 5% per year. In how many years Rs 1000 double itself?

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30. Solve the differential equation : $\frac{dy}{dx} = \frac{x^2 - y^2}{xy}$.

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31. Solve the following differential equation: $x\frac{dy}{dx} = y - x\cos^2\left(\frac{y}{x}\right)$

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32. Show that the differential equation $\frac{(x-y)dy}{dx} = x + 2y,$ is homogeneous and solve it.

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33. Solve the following differential equation:

$y\,dx + x\log\left(\frac{y}{x}\right)dy = 2x\,dy$

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34. Solve the differential equation $x \cdot \frac{dy}{dx} - y = \log x.$

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35. Find the general solution of the differential equation $ydx - \left(x + 2y^2\right)dy = 0.$

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Exercise 9 A

1. Find the order and degree, if defined, of each of the following differential equations: (i) $\frac{dy}{dx} - \cos x = 0$ (ii)

$xy\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right)^2 - y\frac{dy}{dx} = 0$ (iii) $y^m + y^2 + e^{y'} = 0$

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2. Find the order and degree, if defined, of each of the following differential equations: (i) $\frac{dy}{dx} - \cos x = 0$ (ii) $xy\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right)^2 - y\frac{dy}{dx} = 0$ (iii) $y^m + y^2 + e^{y'} = 0$

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3. Determine order and degree (if defined) of differential equations given $\left(\frac{d^2y}{dx^2}\right)^2 + \cos\left(\frac{dy}{dx}\right) = 0$

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4. Find the order and degree of the following differential equations.

$\frac{d^2y}{dx^2} + 1 = 0$

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5. Find the order and degree of the following differential equations.

$$\frac{dy}{dx} + y = \log x$$

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6. Find the order and degree of the following differential equations.

$$2x \cdot \frac{d^2y}{dx^2} - \frac{dy}{dx} + 5 = 0$$

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7. Find the order and degree of the following differential equations.

$$\frac{d^3y}{dx^3} + 2\left(\frac{dy}{dx}\right)^4 + 3x = 0$$

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8. Find the order and degree of the following differential equations.

$$\left(\frac{d^2y}{dx^2}\right)^3 + x\left(\frac{dy}{dx}\right)^2 - 5 = 0$$

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9. Find the order and degree of the following differential equations.

$$\frac{d^2y}{dx^2} = 4\sqrt{x + \left(\frac{dy}{dx}\right)^2}$$

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10. Find the order and degree of the following differential equations.

$$\frac{d^2z}{dy^2} + 3\left(\frac{dz}{dy}\right)^3 + 1 = 0$$

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Exercise 9 B

1. If A and B are arbitrary constants, then find the differential equation corresponding to the equation $y = Ax + B$.

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2. Find the equation of a curve passing thorugh origin, if the slope of a tangent to the curve at any point (x,y) is equal to the square of the difference of the abcissa and ordinate of the point.

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3. If a and b are arbitrary constants, then find the differential equation corresponding to $y = a\cos(x + b)$.

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4. Find the differential equation corresponding to $y = cx^3$, where c is arbitrary constant.

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5. Find the differential equation corresponding to $y = cx + c - c^3$, where c is arbitrary constant.

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6. Write the differential equation obtained eliminating the arbitrary constant C in the equation $xy = C^2$.

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7. Find the differential equation of $xy = ae^x + be^{-x}$.

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8. For all values of A and B, find the differential equation of $y = A\sin x + B\cos x$.

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9. For all values of A and B, find the differential equation of $y = A\cos px + B\sin px$.

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10. Form the differential equation representing the family of curves $y = a\sin x + b\cos x$, where a, b are the arbitrary constants.

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11. For all values of A and B, find the differential equation of $y = Ae^{3x} + Be^{4x}$.

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12. Find the differential equation corresponding to j $y = ae^{2x} + be^{-3x} + ce^{x}$ where $a,\ b,\ c$ are arbitrary constants.

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13. Find the differential equation of the circles represented by $y = k(x + k)^2$ where k is an arbitrary constant.

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14. Find the differential equation of those circles whose centres lie on X-axis and whose radii are variable $'r'$.

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15. Form the differential equation of the family of circles in the first quadrant which touch the coordinate axes.

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16. From the differential equation of the family of parabolas with focus at the origin and axis of symmetry along the x-axis. Find the order and degree of the differential equation.

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17. Form the differential equation of the family of circles touching the y-axis at origin.

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Exercise 9 C

1. Show that $y = A\cos x + B\sin x$ is a solution of differential equation $\frac{d^2y}{dx^2} + y = 0.$

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2. Show that $y = e^{2x}$ is a solution of differential equation $\frac{d^2y}{dx^2} + \frac{dy}{dx} - 6y = 0$

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3. Show that $y = c \cdot e^{-x}$ is a solution of differential equation $\frac{dy}{dx} + y = 0.$

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4. Verify that $y = 4\sin 3x$ is a solution of the differential equation $\frac{d^2y}{dx^2} + 9y = 0.$

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5. Show that $y = A\cos mx + B\sin mx$ is a solution of differential equation $\frac{d^2y}{dx^2} + m^2y = 0$

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6. Show that $y = a\cos(\log x) + b\sin(\log x)$ is a solution of the differential equation $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$

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7. If $y = e^{m\sin^{-1}x}$ prove that $(1-x^2)\left(\frac{d^2y}{dx^2}\right) - x\frac{dy}{dx} = m^2y$

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8. Verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation:$y = \sqrt{1+x^2} : y' = \dfrac{xy}{1+x^2}$

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9. Verity that $y^2 = 4a\,(x+a)$ is a solution of the differential equation $y\left\{1 - \left(\dfrac{dy}{dx}\right)^2\right\} = 2x\dfrac{dy}{dx}$.

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10. Show that $y = e^x(A\cos x + B\sin x)$ is the solution of the differential equation $\dfrac{d^2y}{dx^2} - 2\dfrac{dy}{dx} + 2y = 0.$

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11. Show that $Ax^2 + By^2 = 1$ is a solution of the differential equation $x\left\{y\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2\right\} = y\frac{dy}{dx}$.

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12. Show that $x = y - \cos y$, is a solution of differential equation $(y\sin y + \cos y + x)\frac{dy}{dx} - y = 0.$

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13. Show that $y = Ax + \frac{B}{x}, x \neq 0$ is a solution of the differential equation $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} - y = 0$

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Exercise 9 D

1. Solve the following differential equations

$$\frac{dy}{dx} = e^x$$

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2. Solve the following differential equations

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

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3. Solve the following differential equations $\frac{dy}{dx} = x^2 + \sin 4x$

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4. Solve the following differential equations

$$\frac{dy}{dx} = x^3 + x^2 + 8x + 1$$

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5. Solve the following differential equations

$$\frac{dy}{dx} = \cos x$$

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6. Solve the following differential equations

$$\frac{dy}{dx} = \cos ec^2 x + 3x^2$$

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7. Solve the following differential equations $\frac{dy}{dx} + \frac{1+x^2}{x} = 0$

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8. Solve the following differential equations

$$\frac{dy}{dx} = \sec x(2\sec x + \tan x)$$

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9. Solve the following differential equations

$$\frac{dy}{dx} = \sin^8 x \cdot \cos x$$

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10. Solution of differential equation $dy - \sin x \sin y dx = 0$ is

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11. Solve the following differential equations

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

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12. Solve the following differential equations

$$\frac{dy}{dx} + \frac{1+y^2}{y} = 0$$

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13. Solve the following differential equations

$$\frac{dy}{dx} = \frac{1}{y + \sin y}$$

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14. Solve the following differential equations

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

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15. Solve the following differential equations

$$\frac{dy}{dx} = \frac{xy+y}{xy+x}$$

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16. Solve the following differential equations

$$x^2(1-y)\frac{dy}{dx}+y^2(1+x)=0$$

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17. Solve the following differential equations

$$\frac{dy}{dx}=-\frac{y}{x}$$

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18. Solve the following differential equations

$$\frac{dy}{dx}=-\sqrt{\frac{1-y^2}{1-x^2}}$$

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19. Solve the following differential equations

$$\frac{dy}{dx} = e^{x-y} + x^3 \cdot e^{-y}$$

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20. Solve the following differential equations

$$(1+x^2)xydy = (1+y^2)dx$$

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21. Solve the following differential equations

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

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22. Solve the following differential equations

$$\frac{dy}{dx} = \sqrt{4-y^2}$$

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23. Solve the following differential equations

$$\sqrt{a+x}\frac{dy}{dx}+x=0$$

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24. Solve the following differential equations: $x\cos^{2y}dx-y\cos^{2}xdy$

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25. Solve the following differential equations

$$\frac{dy}{dx}\cdot xy^{2}\left(1+x^{2}\right)+\left(1+y^{3}\right)=0$$

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26. Solve the following differential equations

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

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27. Solve the following differential equations

$$\log\left(\frac{dy}{dx}\right) = ax + by$$

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28. Solve the differential equation $\left(xy^2 + x\right)dx + \left(yx^2 + y\right)dy = 0$

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29. Solve the following differential equations

$$y\sec^2 x dx + (y+7)\tan x dy = 0$$

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30. Solve the following differential equation: $\frac{dy}{dx} = \tan^{-1} x$

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31. Solve the following differential equations

$\frac{dy}{dx} = x \cdot e^x$

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32. Find the particular solution of the differential equation $(1 + x^2)\sec^2 y dy + 2x \tan y dx = 0$, it is given that at $x = 1, y = \pi/4$.

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33. Find the particular solution of the differential equation

$(1 + e^{2x})dy + (1 + y^2)e^x dx = 0$, given that y=1 when x=0.

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34. Find the particular solution of the differential equation $\left(1+y^2\right)(1+\log x)dx+xdy=0$, it is given that at $x=1, y=1$.

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35. Find the equation of a curve, passes through $(-2, 3)$ at which the slope of tangent at any point (x, y) is $\frac{2x}{y^2}$.

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36. Find the equation of a curve, passes through $(0, -2)$, for which the product of the slope of tangent and the y-coordinate of that point is equal to the x-coordinate.

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37. In a bank principal increases at the rate of r% per year. Find the value of r if Rs. 100 double itself in 10 years $\left((\log)_e 2 = 0.6931.\right)$

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Exercise 9 E

1. Solve the following differential equations

$\left(x^2 - xy\right)dy + y^2 dx = 0$

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2. Solve the following differential equations

$\frac{dy}{dx} = \frac{x + y}{x}$

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3. Solve the differential equations $x^2 dy - \left(x^2 + xy - 2y^2\right)dx = 0$`

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4. Solve the following differential equations

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

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5. Solve the following differential equations

$$y^2 dx + \left(x^2 - xy + y^2\right) dy = 0$$

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6. Solve the differential equations $x^2 dy + \left(xy + y^2\right) dx = 0$

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7. Solve the following differential equations

$2xydy = \left(y^2 - x^2\right)dx$

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8. Solve the following differential equations

$\left(x\cos\frac{y}{x} + y\sin\frac{y}{x}\right)y\,dx = \left(y\sin\frac{y}{x} - x\cos\frac{y}{x}\right)x\,dy$

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9. Solve the following differential equation: $x\frac{dy}{dx} - y + x\sin\left(\frac{y}{x}\right) = 0$

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10. $ydx + x\log\left(\frac{y}{x}\right)dy - 2xdy = 0$

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11. Solve the differential equations $(i)\dfrac{dy}{dx}+\dfrac{3xy+y^2}{x^2+xy}=0$

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12. Solve the following differential equations

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

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13. Solve the following differential equations

$\dfrac{dy}{dx}=\dfrac{y^2+2xy}{2x^2}$, it is given that at $x=1, y=2$.

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14. Solve the following differential equations $\dfrac{dy}{dx}=\dfrac{y}{x}-\left(\sin\dfrac{y}{x}\right)\Big),$

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15. Show that the differential equation $x\cos\left(\frac{y}{x}\right)\frac{dy}{dx} = y\cos\left(\frac{y}{x}\right) + x$ is homogeneous and solve it.

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16. Show that the differential equation $2ye^{\frac{x}{y}}\,dx + \left(y - 2xe^{\frac{x}{y}}\right)dy = 0$ is homogeneous. Find the particular solution of this differential equation, given that $x = 0$ when $y = 1$.

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Exercise 9 F

1. Find the general solution of the following differential equations

$$x\frac{dy}{dx} - y = x^2$$

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2. Find the general solution of the following differential equations

$(i) x\frac{dy}{dx} + y = x^3$

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3. Find the general solution of the following differential equations

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

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4. Find the general solution of the following differential equations

$\left(1 + x^2\right)\frac{dy}{dx} + y = \tan^{-1} x$

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5. Solve the following differential equation :

$\left(\mathrm{x}^2 - 1\right)\frac{\mathrm{dy}}{\mathrm{dx}} + 2\mathrm{xy} = \frac{2}{\left(\mathrm{x}^2 - 1\right)}$

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6. Find the general solution of the differential equations

$(i)\dfrac{dy}{dx} - y = x^3 e^x$

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7. Find the general solution of the differential equations

$(i)\dfrac{dy}{dx} + y\sec x = \tan x$ `

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8. Find the general solution of the following differential equations

$(x + y)\dfrac{dy}{dx} = 1$

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9. Find the general solution of the differential equations: $\left(x+3y^2\right)\frac{dx}{dy}=y(y>0)$

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10. Find the general solution of the differential equations $(i)ydx+\left(x-y^2\right)dy=0$

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12. Find the general solution of the differential equations: $\left(1+x^2\right)dy+2xydx=\cot xdx(x\neq 0)$

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13. Find the particular solution of the differential equation $\frac{dy}{dx} + 2y \tan x = \sin x$, it is given that at $x = \frac{\pi}{3}, y = 0$.

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14. Find the particular solution of the differential equation $\frac{dy}{dx} + y \cot x = 2x + x^2 \cot x (x \neq 0)$ given that $y = 0$ when $x = \frac{\pi}{2}$.

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15. Find the equation of a curve passing through the origin given that the slope of the tangent to the curve at any point (x, y) is equal to the sum of the coordinates of the point.

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16. Find the equation of a curve passing through the point (0, 2) given that the sum of the coordinates of any point on the curve exceeds the magnitude of the slope of the tangent to the curve at that point by 5.

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17. Solve the differential equation :

$$x\frac{dy}{dx} + y - x + xy\cot x = 0, x \neq 0.$$

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18. Find the particular solution of the differential equation $\left(1+x^2\right)\frac{dy}{dx} + 2xy = \frac{1}{1+x^2}$ given that at $x = 1, y = 0.$

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Exercise 9 G

1. The degree of differential equation $\frac{d^3y}{dx^3} + \sin(y + x) = 0$ is :

A. 3

B. 1

C. 2

D. not defined

Answer:

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2. The solution of differential equation $y'\left(1 + x^2\right) = 2xy$ is :

A. $y = c\left(1 + x^2\right)$

B. $y\left(1 + x^2\right) = c$

C. $y = c\sqrt{1 + x^2}$

D. $y\sqrt{1 + x^2} = c$

Answer:

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3. Solve $x\frac{dy}{dx} = y(\log y - \log x + 1)$

A. $y = k \cdot e^x$

B. $y = xe^{kx}$

C. $y = e^{kx}$

D. None of these

Answer:

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4. The solution of differential equation $x\frac{dy}{dx} = y$ is :

A. $x \cdot y = k$

B. $x + y = k$

C. $y = kx$

D. $x - y = k$

Answer:

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5. The solution of differential equation $\sec^2 x dx + \sec^2 y dy = 0$ is :

A. $\tan x = \tan y + k$

B. $\tan x + \tan y = k$

C. $\tan x \cdot \tan y = k$

D. None of these

Answer:

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6. The equation of differential equation $2xy\frac{dy}{dx} = y^2 - x^2$ is :

A. $x^2 - y^2 = kx$

B. $x^2 + y^2 = kx$

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

D. $x^2 + y^2 = ky$

Answer:

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7. The differential equation corresponding to curve $y = a\cos(x + b)$ is :

A. $y + y = 0$

B. $y - y = 0$

C. $y' + y = 0$

D. $y' - y = 0$

Answer:

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8. The differential equation corresponding to curve $y^2 = 4ax$ is :

A. $3x\frac{dy}{dx} = y$

B. $2x\frac{dy}{dx} = y$

C. $x\frac{dy}{dx} = y$

D. $\frac{dy}{dx} = y$

Answer:

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9. The solution of $\left(1 + x^2\right)\frac{dy}{dx} + y = e^{\tan - 1x}$, is given by

A. $2ye^{\tan^{-1}x} = e^{2\tan^{-1}x} + c$

B. $ye^{\tan^{-1}x} = e^{2\tan^{-1}x} + c$

C. $2y = e^{\tan^{-1}x} + c$

D. None of the above

Answer:

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10. Find one parameter families of solution curves of the following differential equations: (or solve the following differential equations): $\frac{dy}{dx} - y = \cos 2x \; x\frac{dy}{dx} + y = x^3$

A. $\frac{1}{x^2}$

B. $\frac{1}{x^3}$

C. $\frac{1}{x^6}$

D. $\frac{1}{x^4}$

Answer:

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Exercise 9 H

1. Obtain the differential equation of all circles of radius r.

A. $\left\{1+(y_1)^2\right\}^3=r^2(y_2)^2$

B. $(1+y_1)^3=r^2y_2$

C. $(1+y_2)^3=r^2(y_1)^2$

D. None of the above

Answer:

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2. The solution of differential equation $\left(\sin^4 x+\cos^4 x\right)\frac{dy}{dx}=1$ is :

A. $y=\frac{1}{\sqrt{2}}\tan^{-1}\left(\frac{\sin x-\cos x}{\sqrt{2}}\right)+c$

B. $y = \frac{1}{\sqrt{2}} \tan^{-1}\left(\frac{\tan x - \cot x}{\sqrt{2}}\right) + c$

C. $y = \frac{1}{\sqrt{2}} \tan^{-1}\left(\frac{\sin x + \cos x}{\sqrt{2}}\right) + c$

D. None of the above

Answer:

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3. The solution of the differential equation $\frac{dy}{dx} = \sin(x + y) + \cos(x + y)$ is:

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4. Solve: $\left(x^3 - 3xy^2\right)dx = \left(y^3 - 3x^2y\right)dy$.

A. $x^2 - y^2 = \left(x^2 + y^2\right)c$

B. $x^2 + y^2 = \left(x^2 - y^2\right)c$

C. $x^2 - y^2 = \left(x^2 + y^2\right)^2 c$

D. None of the above

Answer:

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A. $y = x \tan^{-1} \log \frac{e}{x}$

B. $y = \tan^{-1} \log \frac{e}{x}$

C. $y = x \tan^{-1} \log \frac{x}{e}$

D. None of the above

Answer:

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6. The differential equation of all parabolas whose axis are parallel to the y-axis is (a) $(b)(c)(d)\frac{(e)(f)d^{(g)3(h)}(i)y}{j}\Big((k)d(l)x^{(m)3(n)}(o)\Big)(p)(q)=0(r)$ (s) (b) $(t)(u)(v)\frac{(w)(x)d^{(y)2(z)}(aa)x}{bb}\Big((cc)d(dd)y^{(ee)2(ff)}(gg)\Big)(hh)(ii)=C(jj$ (kk) (c) *[Math Processing Error]* (ii) (d) *[Math Processing Error]* (ggg)

A. $\frac{d^3y}{dx^3}=0$

B. $\frac{d^2y}{dx^2}+y=0$

C. $\frac{d^3y}{dx^3}+\frac{d^2y}{dx^2}=0$

D. None of these

Answer:

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7. The solution of differential equation $\left(1+x^2\right)y'+2xy=4x^2$

A. $3y\left(1+x^2\right)=2x^3+C$

B. $3y(1+x^2) = x^3 + C$

C. $3y(1+x^2) = 4x^3 + C$

D. None of these

Answer: C

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8. The solution of differential equation $ydx = (y^3 - x)dy$ is :

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9. The solution of differential equation $\frac{dy}{dx} = \cos(x+y)$ is :

A. $\tan(x+y) = x + c$

B. $\tan\left(\frac{x+y}{2}\right) = x + c$

C. $\tan(x+y) = y + c$

D. None of the above

Answer:

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10. The solution of differential equation `x(dy)/(dx)+y=x^(3) is :

A. $x^5 y^{-5} = \frac{5}{2}x^2 + c$

B. $x^{-5} y^5 = 5x^{-2} + c$

C. $x^5 y^{-5} = \frac{5}{2}x^{-2} + c$

D. None of the above

Answer:

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Exercise 9 1

1. Determine order and degree (if defined) of differential equations given

$$\frac{d^4y}{dx^4} + \sin(y'') = 0$$

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2. Determine order and degree (if defined) of differential equations given

$$y' + 5y = 0$$

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3. Determine order and degree (if defined) of differential equations given

$$\left(\frac{ds}{dt}\right)^4 + 3s\frac{d^2s}{dt^2} = 0$$

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4. Determine order and degree (if defined) of differential equations given

$$\left(\frac{d^2y}{dx^2}\right)^2 + \cos\left(\frac{dy}{dx}\right) = 0$$

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5. Determine order and degree (if defined) of differential equations given

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

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6. Determine order and degree (if defined) of differential equations given

$$(y^m)^2 + (y'')^3 + (y')^4 + y^5 = 0$$

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7. Determine order and degree (if defined) of differential equations given

$$y^m + 2y'' + y' = 0$$

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8. Determine order and degree (if defined) of differential equations given

$y' + y = e^x$

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9. Determine order and degree (if defined) of differential equations given

$y'' + (y')^2 + 2y = 0$

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10. Determine order and degree (if defined) of differential equations given

$y'' + 2y' + \sin y = 0$

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11. The degree of the differential equation

$$\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^2 + \sin\left(\frac{dy}{dx}\right) + 1 = 0$$

A. 3

B. 2

C. 1

D. not defined

Answer: D

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12. The order of the differential equation $2x^2\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + y = 0$ is (A) 2 (B) 1 (C) 0 (D) not defined

A. 2

B. 1

C. 0

D. not defined

Answer:

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Exercise 9 2

1. Verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation:$y = e^x + 1 : y'' - y' = 0$

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2. Verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation: $y = x^2 + 2x + C$: $y' - 2x - 2 = 0$

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3. Verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation:$y = \cos x + C : y' + \sin x = 0$

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4. Verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation:$y = \sqrt{1 + x^2} : y' = \frac{xy}{1 + x^2}$

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5. Verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation :

$y = Ax : xy' = y(x \neq 0)$

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6. In each of the following verify that the given function (explicit or implicit) is a solution of the corresponding differentia equation: $y = x \sin x$ ii. $y = \sqrt{a^2 - x^2}$

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7. Verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation: $xy = \log y + C$:

$y' = \frac{y^2}{1 - xy}(xy \neq 1)$

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8. Verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation: $y - \cos y = x$:

$(y \sin y + \cos y + x)y' = y$

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9. Verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation: $x + y = \tan^{-1} y$:

$y^2 y' + y^2 + 1 = 0$

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10. Verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation:$y = \sqrt{a^2 - x^2} x \in (-x, a)$: $x + y\frac{dy}{dx} = 0 (y \neq 0)$

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11. The number of arbitrary constants in the general solution of a differential equation of fourth order are: (A) 0 (B) 2 (C) 3 (D) 4

A. 0

B. 2

C. 3

D. 4

Answer: D

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12. The number of arbitrary constants in the particular solution of a differential equation of third order are: (A) 3 (B) 2 (C) 1 (D) 0

A. 3

B. 2

C. 1

D. 0

Answer: D

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Exercise 9 3

1. Form a differential equation representing the given family of curves by eliminating arbitrary constants a and b. $\frac{x}{a} + \frac{y}{b} = 1$

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2. Form a differential equation representing the given family of curves by eliminating arbitrary constants a and b.$y^2 = a\left(b^2 - x^2\right)$

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3. Form a differential equation representing the given family of curves by eliminating arbitrary constants a and b.$y = ae^{3x} + be^{-2x}$

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4. Form a differential equation representing the given family of curves by eliminating arbitrary constants a and b.$y = e^{2x}(a + bx)$

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5. Form a differential equation representing the given family of curves by eliminating arbitrary constants a and b. y = ex (a cos x + b sin x)

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6. Form the differential equation of the family of circles touching the y-axis at origin.

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7. Form the differential equation of the family of parabolas having vertex at origin and axis along positive y-axis.

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8. Form the differential equation of the family of ellipses having foci on y-axis and centre at origin.

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9. Form the differential equation of the family of hyperbolas having foci on x-axis and centre at origin.

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10. Form the differential equation of the family of circles having centre on y-axis and radius 3 units.

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11. Which of the following differential equations has $y = c_1 e^x + c_2 e^{-x}$ as the general solution ?

A. $\frac{d^2y}{dx^2} + y = 0$

B. $\frac{d^2y}{dx^2} - y = 0$

C. $\frac{d^2y}{dx^2} + 1 = 0$

D. $\frac{d^2y}{dx^2} - 1 = 0$

Answer:

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12. Which of the following differential equations has y = x as one of its particular solution?

(A) $\frac{d^2y}{dx^2} - x^2\frac{dy}{dx} + xy = x$

(B) $\frac{d^2y}{dx^2} + x\frac{dy}{dx} + xy = x$

(C) $\frac{d^2y}{dx^2} - x^2\frac{dy}{dx} + xy = 0$

(D) $\frac{d^2y}{dx^2} + x\frac{dy}{dx} + xy = 0$

A. $\frac{d^2y}{dx^2} - x^2\frac{dy}{dx} + xy = x$

B. $\frac{d^2y}{dx^2} - x\frac{dy}{dx} + xy = x$

C. $\frac{d^2y}{dx^2} - x^2\frac{dy}{dx} + xy = 0$

D. $\frac{d^2y}{dx^2} + x\frac{dy}{dx} + xy = 0$

Answer:

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Exercise 9 4

1. Find the general solution of the differential equations $\frac{dy}{dx} = \frac{1 - \cos x}{1 + \cos x}$

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2. Find the general solution of differential equations (dy)/(dx)=sqrt(4-y^2)

(-2

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3. Find the general solution of the differential equations $\frac{dy}{dx} + y = 1 (y \neq 1)$

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4. Find the general solution of the differential equations $\sec^2 x \tan y dx + \sec^2 y \tan x dy = 0$

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5. The solution of the differential equation $\left(e^x + e^{-x}\right)dy - \left(e^x - e^{-x}\right)dx$=0 is

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6. Find the general solution of the differential equations $\frac{dy}{dx} = \left(1 + x^2\right)\left(1 + y^2\right)$

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7. Find the general solution of the differential equations y log y dx x dy = 0

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8. Find the general solution of the differential equations $x^5 \frac{dy}{dx} = -y^5$

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9. Find the general solution of the differential equations $\frac{dy}{dx} = \sin^{-1} x$

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10. Find the general solution of the differential equations $e^x \tan y dx + (1 - e^x)\sec^2 y dy = 0$

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11. The differential equations, find a particular solution satisfying the given condition: $\left(x^3 + x^2 + x + 1\right) \frac{dy}{dx} = 2x^2 + x; y = 1$when $x = 0$

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12. For the differential equation, find a particular solution satisfying the given condition: $x\left(x^2-1\right)\frac{dy}{dx}=1; y=0$ when $x=2$

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13. The differential equations, find a particular solution satisfying the given condition: $\cos\left(\frac{dy}{dx}\right)=a(a\in R); y=1$

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14. The differential equations, find a particular solution satisfying the given condition: $\frac{dy}{dx}=y\tan x; y=1$when x = 0

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15. Find the equation of a curve passing through the point (0, 0) and whose differential equation is $y' = ex \sin x$

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16. For the differential equation $xy\frac{dy}{dx} = (x+2)(y+2)$, find the solution curve passing through the point $(1, 1)$.

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17. Find the equation of the curve passing through the point (0, -2) given that at any point (x, y) on the curve the product of the slope of its tangent and y coordinate of the point is equal to the x-coordinate of the point.

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18. At any point (x, y) of a curve, the slope of the tangent is twice the slope of the line segment joining the point of contact to the point $(\quad 4, \quad 3)$. Find the equation of the curve given that it passes through $(2, \quad 1)$.

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19. The volume of spherical balloon being inflated changes at a constant rate. If initially its radius is 3 units and after 3 seconds it is 6 units. Find the radius of balloon after t seconds.

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20. In a bank principal increases at the rate of r% per year. Find the value of r if Rs. 100 double itself in 10 years $\left((\log)_e 2 = 0.6931.\right)$

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21. In a bank, principal increases continuously at the rate of 5% per year. An amountof Rs 1000 is deposited with this bank, how much will it worth after 10 years $\left(e^{0.5} = 1.648\right)$

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22. In a culture, the bacteria count is 1,00,000. The number is increased by 10% in 2 hours. In how many hours will the count reach 2,00,000, if the rate of growth of bacteria is proportional to the number present?

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23. The general solution of the differential equation $\frac{dy}{dx} = e^{x+y}$is (A) $e^x + e^{-y} = C$ (B) $e^x + e^y = C$ (C) $e^{-x} + e^y = C$ (D) $e^{-x} + e^{-y} = C$

A. $e^x + e^{-y} = C$

B. $e^x + e^y = C$

C. $e^{-x} + e^y = C$

D. $e^{-x} + e^{-y} = C$

Answer:

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Exercise 9 5

1. Show that the given differential equation is homogeneous and solve each of them.$\left(x^2 + xy\right)dy = \left(x^2 + y^2\right)dx$

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2. Show that the given differential equation is homogeneous and solve each of them.$y' = \frac{x + y}{x}$

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3. Show that the given differential equation is homogeneous and solve each of them. (x y) dy (x + y) dx = 0

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4. Show that the given differential equation is homogeneous and solve each of them. $\left(x^2 - y^2\right)dx + 2xydy = 0$

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5. Show that the given differential equation is homogeneous and solve each of them. $x^2 \frac{dy}{dx} = x^2 - 2y^2 + xy$

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6. Show that the given differential equation is homogeneous and solve each of them. $xdy - ydx = \sqrt{x^2 + y^2}dx$

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7. Solve the differential equation $(xdy - ydx)y\sin\left(\frac{y}{x}\right) = (ydx + xdy)x\cos\left(\frac{y}{x}\right)$.

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8. Show that the given differential equation is homogeneous and solve it.

$$x\frac{dy}{dx} - y + x\sin\left(\frac{y}{x}\right) = 0$$

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9. Show that the given differential equation is homogeneous and solve each of them. $ydx + x\log\left(\frac{y}{x}\right)dy - 2xdy = 0$

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10. Show that the given differential equation is homogeneous and solve each of them. $\left(1+e^{\frac{x}{y}}\right)dx+e^{\frac{x}{y}}\left(1-\frac{x}{y}\right)dy=0$

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11. The differential equations , find the particular solution satisfying the given condition: (x + y) dy + (x - y) dx = 0; y = 1 when x = 1

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12. Find the particular solution of the differential equation satisfying the given conditions: $x^2dy+\left(xy+y^2\right)dx=0;\ y=1$ when $x=1.$

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13. The differential equations , find the particular solution satisfying the given condition: $\left[x\sin^2\left(\frac{y}{x}\right)-y\right]dx+xdy=0;\ y=\frac{\pi}{4}$ when x = 1

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14. Find the particular solution, satisfying the given condition, for the following differential equation: $\frac{dy}{dx} - \frac{y}{x} + \cos ec\left(\frac{y}{x}\right) = 0; y = 0$ when $x = 1$

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15. For the given differential equation , find the particular solution satisfying the given condition: $2xy + y^2 - 2x^2\frac{dy}{dx} = 0; y = 2$when x = 1

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16. A homogeneous differential equation of the from $\frac{dx}{dy} = h\left(\frac{x}{y}\right)$can be solved by making the substitution.(A) $y = vx$ (B) $v = yx$ (C) $x = vy$ (D) $x = v$

A. $y = vx$

B. $v = yx$

C. $x = vy$

D. $x = v$

Answer: C

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17. Which of the following is a homogenous differential equation ?

A. $(4x + 6y + 5)dy - (3y + 2x + 4)dx = 0$

B. $(xy)dx - \left(x^3 + y^3\right)dy = 0$

C. $\left(x^3 + 2y^2\right)dx + 2xydy = 0$

D. $y^2dx + \left(x^2 - xy - y^2\right)dy = 0$

Answer: D

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Exercise 9 6

1. Find the general solution of the differential equations:

$$\frac{dy}{dx} + 2y = \sin x$$

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2. Find the general solution of the differential equations:

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

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3. Find the general solution of the differential equations: $\frac{dx}{dy} + \frac{y}{x} = x^2$

A. $xy = \frac{x^4}{4} + c$

B. $xy = x^4 + c$

C. $xy = \frac{x^2}{2} + c$

D. none of these

Answer: A

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4. Find the general solution of the differential equations: $\frac{dy}{dx} + (\sec x)y = \tan x \left(0 \leq x < \frac{\pi}{2}\right)$

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5. Solve the following differential equation: $\cos^2 x \frac{dy}{dx} + y = \tan x$

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6. Find the general solution of the differential equation : $x\frac{dy}{dx} + 2y = x^2 \log x$

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7. Find the general solution of the differential equations: $x \log x \frac{dy}{dx} + y = \frac{2}{x} \log x$

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8. Find the general solution of the differential equations: $\left(1 + x^2\right) dy + 2xy dx = \cot x dx (x \neq 0)$

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9. Find the general solution of the differential equations: $x \frac{dx}{dy} + y - x + xy \cot x = 0 (x \neq 0)$

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10. Find the general solution of the differential equations: $(x+y)\frac{dx}{dy}=1$

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11. Find the general solution of the differential equation $ydx-\left(x+2y^2\right)dy=0.$

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12. Find the general solution of the differential equations: $\left(x+3y^2\right)\frac{dx}{dy}=y(y>0)$

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13. For the differential equation, find a particular solution satisfying the given condition: $\frac{dy}{dx}+2y\tan x=\sin x; y=0$ when $x=\frac{\pi}{3}$

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14. The differential equations, find a particular solution satisfying the given condition: $\left(1+x^2\right)\frac{dy}{dx}+2xy=\frac{1}{1+x^2}; y=0$when $x=1$

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15. The differential equations, find a particular solution satisfying the given condition: $\frac{dy}{dx}-3y\cot x=\sin 2x; y=2$when $x=\frac{\pi}{2}$

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16. Find the equation of a curve passing through the origin given that the slope of the tangent to the curve at any point (x, y) is equal to the sum of the coordinates of the point.

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17. Find the equation of a curve passing through the point (0, 2) given that the sum of the coordinates of any point on the curve exceeds the magnitude of the slope of the tangent to the curve at that point by 5.

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18. The Integrating Factor of the differential equation $x\frac{dy}{dx} - y = 2x^2$ is(A) e^{-x} (B) e^{-y} (C) $\frac{1}{x}$ (D) x

A. e^{-x}

B. e^{-y}

C. $\frac{1}{x}$

D. x

Answer:

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19. What is the integrating factor of the differential equation $(1-y^2)\frac{dx}{dy}+\frac{y}{x}=ay(-1<y<1)$

A. $\frac{1}{y^2-1}$

B. $\frac{1}{\sqrt{y^2-1}}$

C. $\frac{1}{1-y^2}$

D. $\frac{1}{\sqrt{1-y^2}}$

Answer:

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Miscellaneous Exercise

1. For each of the differential equations given below, indicate its order and degree (if defined).(i) $\frac{d^2y}{dx^2}+5x\left(\frac{dy}{dx}\right)^2-6xy=\log x$ (ii) $\left(\frac{dy}{dx}\right)^3-4\left(\frac{dy}{dx}\right)^2+7y=\sin x$(iii) $\frac{d^4y}{dx^4}-\sin\left(\frac{d^3y}{dx^3}\right)=0$

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2. For each of the exercises given below, verify that the given function (implicit or explicit) is a solution of the corresponding differential equation.(i) $y = ae^{x} + be^{-x} + x^{2} : x\frac{d^{2}y}{dx^{2}} + 2y\frac{dy}{dx} - xy + x^{2} - 2 = 0$

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3. Form the differential equation representing the family of curves given by $(x - a)^{2} + 2y^{2} = a^{2}$, where a is an arbitrary constant.

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4. Prove that $x^{2} - y^{2} = c\left(x^{2} + y^{2}\right)^{2}$ is the general solution of differential equation $\left(x^{3} - 3xy^{2}\right)dx = \left(y^{3} - 3x^{2}y\right)dy$, where c is a parameter.

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5. Form the differential equation of the family of circles in the first quadrant which touch the coordinate axes.

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6. Find the general solution of the differential equation $\frac{dy}{dx} + \sqrt{\frac{1-y^2}{1-x^2}} = 0.$

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7. Show that the general solution of the differentia equation $\frac{dy}{dx} + \frac{y^2y+1}{x^2+x+1} = 0$ is given by $x + y + 1 = A(1 - x - y - 2xy)$ where A is a parameter.

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8. Find the equation of the curve passing through the point $\left(0, \frac{\pi}{4}\right)$ whose differential equation is $\sin x \cos y dx + \cos x \sin y dy = 0$.

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9. Find the particular solution of the differential equation: $\left(1 + e^{2x}\right) dy + \left(1 + y^2\right) e^x dx = 0$, given that $y = 1$, when $x = 0$.

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10. Solve the differential equation $ye^{\frac{x}{y}} dx = \left(xe^{\frac{x}{y}} + y^2\right) dy (y \neq 0)$

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11. Find a particular solution of the differential equation $(x - y)(dx + dy) = dx - dy$, given that $y = -1$, when $x = 0$. (Hint: put $x - y = t$).

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12. Solve the differential equation $\left[\frac{e^{-2\sqrt{x}}}{\sqrt{x}} - \frac{y}{\sqrt{x}}\right]\frac{dx}{dy} = 1(x \neq 0)$

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13. Find the particular solution of the differential equation. $\frac{dy}{dx} + y\cot x = 4x \ \operatorname{cosec} x, \ (x \neq 0),$ given that $y = 0$ when $x = \frac{\pi}{2}$.

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14. find the particular solution satisfying the given condition, for the following differential equation: $(x+1)\frac{dy}{dx} = 2e^{-y} - 1$ given that $y = 0$ when $x = 0$

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15. The population of a village increases continuously at the rate proportional to the number of its inhabitants present at any time. If the population of the village was 20, 000 in 1999 and 25000 in the year 2004, what will be the population of the

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16. The general solution of the differential equation $\frac{ydx - xdy}{y} = 0$ is

(A) $xy = C$ (B) $x = Cy^2$ (C) $y = Cx$ (D) $y = Cx^2$

A. $xy = C$

B. $x = Cy^2$

C. $y = Cx$

D. $y = Cx^2$

Answer:

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17. The general solution of a differential equation of the type $\frac{dx}{dy} + P_1 x = Q_1$ is

(A) $ye^{\int P_1 dy} = \int \left(Q_1 e^{\int P_1 dy}\right) dy + C$ (B) $ye^{\int P_1 dx} = \int \left(Q_1 e^{\int P_1 dx}\right) dx + C$

(C) $xe^{\int P_1 dy} = \int \left(Q_1 e^{\int P_1 dy}\right) dy + C$ (D) $xe^{\int p_1 dx} = \int Q_1 e^{\int p_1 dx} dx + C$

A. $y \cdot e^{\int P_1 dy} = \int \left(Q_1 e^{\int P_1 dy}\right) dy + C$

B. $y \cdot e^{\int P_1 dx} = \int \left(Q_1 e^{\int P_1 dx}\right) dx + C$

C. $x \cdot e^{\int P_1 dy} = \int \left(Q_1 e^{\int P_1 dy}\right) dy + C$

D. $x \cdot e^{\int P_1 dx} = \int \left(Q_1 e^{\int P_1 dx}\right) dx + C$

Answer:

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18. Solve: $e^x(x+1)dx + (ye^y - xe^x)dy = 0$, such that f(0)=0

A. $xe^y + x^2 = C$

B. $xe^y + Y^2 = C$

C. $ye^x + x^2 = C$

D. $ye^y + x^2 = C$

Answer:

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