MATHS

BOOKS - NEW JYOTHI MATHS (TAMIL ENGLISH)

DIFFERENTIAL EQUATIONS

Example

1. Find the order and degree (if defined) of each of the following differential equations.

$i. \frac{dy}{dx} - \cos x = 0$

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

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2. Write the order and degree of the differential equation

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

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3. Determine the order and degree (if defined) of the differential equation

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

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4. If $\cos x.\ \frac{dy}{dx} + y\sin x = \tan^2 x$ is a differential equation, then find its order and degree

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5. Determine the order and degree (if defined) of the differential equation

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

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6. Verify that the function $y = e^{-3x}$ is a solution of the differential equation

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} - 6y = 0$$

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7. Verify that the function $y = b\cos x + a\sin x,$ where a and $b \in R$ is a solution of the differential equation $\frac{d^2y}{dx^2} + y = 0$

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8. From the differential equation representing the family of curves $y = nx,$ where n is an arbitrary constant.

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9. From the differential equation corresponding to the equation $xy = c^2$

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10. From the differential equation of the family of parabolas having vertex at the origin and axis along positive direction of x-axis.

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11. From the differential equation corresponding to the function $\frac{x}{a} + \frac{y}{b} = 2$.

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12. Find the differential equation of the family of circles with their centre at the origin.

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13. From the differential equation representing the family of curves $y = a\sin(x + b),$ where a, b are arbitrary constants.

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14. From the differential equation representing the family of ellipses having focion x-axis and centre at the origin.

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15. i. Form the differential equation corresponding to the function $y = ae^x + be^{2x}$.

ii. State the order and degree of the differential equation obtained.

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16. The equation of the circle touching the y-axis at the origin is $x^2 + y^2 - 2ax = 0$. Find the differential equation of all such circles.

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

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18. Find the general solution of the differential equation $\frac{dy}{dx} = \frac{x+1}{3-y}, (y \neq 3)$

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19. Consider the differential equation $x^2 \frac{dy}{dx} - 2xy = 0$

1. Write the differential equation in the form $f(y)dy = g(x)dx$:

ii. Solve the given differential equation.

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

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21. Solve the differential equation,

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

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22. Consider the differential equation $\frac{dy}{dx} = e^{x-y+}x^2e^{-y}$

i. Express the equation in the form $f(x)dx = g(y)dy$.

ii. Hence solve the equation.

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23. Consider the differential equation

$3e^x \tan y dx - (1 + e^x)\sec^2 y dy = 0$

i Order of the differential equation is ...

ii. Express the differential equation in variable separable form.

iii. Solve the differential equation

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24. Find the particular solution of the differential equation $\frac{dy}{dx} = -4xy^2$, given that $y = -1$, where $x = 0$

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25. Consider the differential equation $\frac{dy}{dx} = \frac{2a}{y}$ with $y(0) = 2$.

i. Write the given equation into variable separable form.

ii. Integrate the variable separable form (i).

iii. Get the value of the arbitrary constant using $y(0) = 2$ of (ii).

iv. Write the solution of the differential equation.

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26. Find the equation of the curve passing through the point $(1, -1)$ whose differential equation is $xdy = (2x^2 - 1)dx$, where $x \neq 0$.

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27. Find the particular solution of the following differential equation $dy = e^{2x+y}dx, y(0) = 0$.

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28. Find the equation of the curve passing through the point $(2, -3)$, given that the slope of the tangent to the curve at any point (x, y) is $\frac{2x}{y^2}$

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29. Find the equation of a 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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30. Find the solution of the differential equation $\log\left(\frac{dy}{dx}\right) = 2x + 3y$ given $y = 0$ when $x = 0$.

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31. Consider the equation $\left(x^3 + y^3\right)dx - xy^2dy = 0$

i. Express this equation in the form $\frac{dy}{dx} = \frac{f(x, y)}{g(x, y)}$

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32. Consider the differential equation $xdy - ydx = \sqrt{x^2 + y^2}dx$.

a. Express it in the form $\frac{dy}{dx} = F(x, y)$.

b. Show that it is homogeneous equation of degree zero.

c. Find its general solution.

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33. Consider the differential equation

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

i. Show that the differential equation is homogeneous.

ii. Hence find the gerenal solution

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34. Show that the family of curves for which the slope of the tangent at any point (x, y) on it is $\frac{x^2+y^2}{2xy}$, is given by $x^2 - y^2 = Cx$

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

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36. Find the general solution of the differential equation $x\frac{dy}{dx} + 3y = x^2, x \neq 0$

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37. Find $\int x \log x dx$

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38. Solve $y' + y \cot x = \cos x$

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39. Solve the differential equation $x \frac{dy}{dx} = x^2 + y$

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40. Solve the differential equation:

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

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41. 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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42. Find the equation of the curve passing through the point $(0, 1)$, if the slope of the tangent to the curve at any point (x, y), is equal to the sum of x coordinate and product of x coordinate and y coordinate of that point.

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

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Exercise 9 1

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

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

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

$y' + 6y = 0$

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

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

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

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

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

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

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

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

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

$$y''' + 2y'' + y' = 0$$

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

$y' + y = e^x$

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

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

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

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

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11. The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^2 + 1 = 0$ is

A. 3

B. 2

C. 1

D. not defined

Answer: A::B::C::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

Answer: A::B::D

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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 :

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

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

$y = x \sin x : xy' = y + x\sqrt{x^2 - y^2}$

$(x \neq 0 \text{and} x < y \text{or} x > -y)$

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

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

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

$y = \sqrt{a^2 - x^2} x \in (-a, a)$

$x + y\frac{dy}{dx} = 0 (y \neq 0)$

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9. The number of arbitrary constants in the general solution of a defferential equation of fourth order are

A. 0

B. 2

C. 3

D. `4

Answer: A::B::C::D

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10. The number of arbitrary constants in the particular solution of a defferential equation of third order are

A. 3

B. 2

C. 1

D. 0

Answer: A::B::C::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 b.

$y = be^{2x}x$

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5. Form a differential equation representing the given family of curves by eliminating arbitrary constants a and b.

y^2=a(b^2-x^2)

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

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7. Form the differential equation of the family of circles having centre on y-axis and radius 5 units.

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

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

A. d^2y/dx^2-

B.

C.

D.

Answer:

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Exercise 9 4

1. For each of the differential equations in

$$\frac{dy}{dx} = \sqrt{16 - y^2}$$

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2. For each of the differential equations in

$$\frac{dy}{dx} + y = 2(y \neq 2)$$

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3. For each of the differential equations in

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

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4. For each of the differential equations in

$$\left(e^{x}+e^{-x}\right)dy-\left(e^{x}-e^{-x}\right)dx=0$$

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5. For each of the differential equations in

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

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6. solve each of the differential equations in

$$y\log ydx-xdy=0$$

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7. solve differential equations in

$$x^5 \frac{dy}{dx} = -y^5$$

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8. For each of the differential equations in

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

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9. For each of the differential equations find solution satisfying the given condition.

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

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10. For each of the differential equations in find a particular solution satisfying the given condition.

$$x(x-1)\frac{dy}{dx}=1$$

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11. For each of the differential equations find solution satisfying the given condition.

$$\cos\left(\frac{dy}{dx}\right)=a(a\in R), y=1, \text{ when } x=0.$$

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12. For each of the differential equations find solution satisfying the given condition.

$\frac{dy}{dx} = y \tan x, y = 1,$ when $x = 0.$

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

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14. For the differential equation $xy\frac{dy}{dx} = (x + 1)(y + 1),$ find the solution.

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15. Find the equation of a curve passing through the point $(0, 2)$. Given that at any point (x, y) on the curve, the product of the slope of its tanget and y coordinate of the point is equal to the x coordinate of the point.

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16. 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 $(-4, -3)$. Find the equation of the curve, given that it passes through $(-2, 1)$.

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

Answer: A

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Exercise 9 5

1. Show that the given differential equation is homogeneous and solve each of them.

$$(x^2 + xy)dy = (x^2 + y^2)dx$$

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2. Solve the given differential equation.

$$y' = \frac{x + y}{x}$$

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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. Show that the given differential equation is homogeneous and solve each of them.

$$\left\{x\cos\left(\frac{y}{x}\right) + y\sin\left(\frac{y}{x}\right)\right\}ydx = \left\{y\sin\left(\frac{y}{x}\right) - x\cos\left(\frac{y}{x}\right)\right\}xdy$$

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8. Show that the given differential equation is homogeneous and solve each of them.

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

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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. Find the solution of the differential equation:

$$\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 3y = 0$$

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11. For each of the differential equations in 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. For each of the differential equations in find the particular solution satisfying the given condition :

$x^2dy+\left(xy+y^2\right)dx=0, y=1$ when $x=1$

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13. For each of the differential equations in find the particular solution satisfying the given condition :

$\left[x \sin^2\left(\frac{y}{x}\right) - y\right] dx + x dy = 0, y = \frac{\pi}{2}$ when $x = 1$

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14. For each of the differential equations in find the particular solution satisfying the given condition :

$\frac{dy}{dx} - \frac{y}{x} + \cos ec\left(\frac{y}{x}\right) = 0, y = 0$ when $x = 1$

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15. For each of the differential equations in 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 form $\frac{dx}{dy} = h\left(\frac{x}{y}\right)$ can be solved by making the substitution

A. $y = vx$

B. $v = yx$

C. $x = vy$

D. $x = v$

Answer: C

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17. Which of the following is a homogeneous 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. For each of the differential equations given in

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

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2. For each of the differential equations given in

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

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3. solve each of the differential equations given in

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

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4. For each of the differential equations given in

$$\frac{dy}{dx} + \sec x . y = \tan x \left(0 \leq x < \frac{\pi}{2}\right)$$

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5. For each of the differential equations given in

$$\cos^2 x \frac{dy}{dx} + y = \tan x \left(0 \leq x < \frac{\pi}{2}\right)$$

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6. For each of the differential equations given in

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

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7. solve each of the differential equations given in

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

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8. For each of the differential equations given in

$$\left(1 + x^2\right) dy + 2xy dx = \tan x dx (x \neq 0)$$

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9. For each of the differential equations given in

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

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10. For each of the differential equations given in

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

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11. solve each of the differential equations given in

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

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12. For each of the differential equations given in

$$\left(x+2y^2\right)\frac{dy}{dx}=y(y>0).$$

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13. For each of the differential equations given in find a particular solution satisfying the given condition :

$$\frac{dy}{dx} + 2y \tan x = \sin x, y = 0 \text{ when } x = \frac{\pi}{3}$$

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14. For each of the differential equations given in find a particular solution satisfying the given condition :

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

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15. For each of the differential equations given in find a particular solution satisfying the given condition :

$$\frac{dy}{dx} - 3y \cot x = \sin 2x, y = 2 \text{ when } x = \frac{\pi}{2}.$$

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16. Find the equation of a curve passing through the origin, given that the slope of the tangent of the curve at any point (x, y) is equal to tha 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 fifferential equation $x\frac{dy}{dx} - y = 2x^2$ is

A. e^{-x}

B. e^{-y}

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

D. x

Answer: C

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19. The integrating factor of the fifferential equation $\left(1 - y^2\right)\frac{dy}{dx} + yx = ay(-1 < y' < 1)$ is

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: D

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Additional Question For Practice 9 1

1. Find the order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3+\left(\frac{dy}{dx}\right)^5=0$

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2. Find the order and degree of the differential equation $\left(\frac{d^2s}{dt^2}\right)^2 + 3\left(\frac{ds}{dt}\right)^3 + 4 = 0$

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3. Find the order and degree of the differential equation $y''' + 2y'' + y' = 0.$

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4. Find the order and degree of the differential equation $y' + 1 + y + y^2.$

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5. Find the order and degree of the differential equation $\frac{dy}{dx} = 4xy.$

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6. Find the order and degree of the differential equation $\left(\frac{dy}{dx}\right)^2 - \sin^2 y = 0.$

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Additional Question For Practice 9 2

1. Verify that the function $y = \cos x - \sin x$ is a solution of the differential equation $y'' + y = 0.$

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2. Show that $y = A\cos 2x + B\sin 2x$ is a solution of the differential equation $\frac{d^2y}{dx^2} + 4y = 0$

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3. Cheak whether $y = e^{-x} + 2$ is a solution of the differential equation $y_1 + y = 2$.

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4. Show that $y = (a + bx)e^{2x}$ is a solution of the differential equation $y'' - 4y' + 4y = 0$.

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5. Verify that the function $y''' = 0$ is a solution of the differential equation $y = x^2 + 2x + 1$.

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6. Verify that the function $y'' + 4y = 0$ is a solution of the differential equation $y = 3\sin 2x$.

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Additional Question For Practice 9 3

1. By eliminating a and b from $y = a\sin x + b\cos x$ form the differential equation.

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2. Find the differential equartion of the family of curves $y = Ae^{x} + Be^{-x}$, where A and B are arbitrary constants.

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3. Find the differential equation of the family of curves $Ax^2 + By^2 = 1.$

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4. By eliminating a and b, obtain the differential equation of the family of curves $y = a\cos(\log x) + b\sin(\log x)$

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Additional Question For Practice 9 4

1. Solve the differential equations.

$y' = 3y$

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2. Solve the differential equations.

$\frac{dy}{dx} = (e^x + 1)y$

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3. Solve the differential equations.

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

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4. Find the particular solution to the following initial value problem $3xy' = 5y, y(1) = 1$

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5. Find the particular solution to the following initial value problem $y' = 2e^{2x}y^2$

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6. Find the particular solution to the following initial value problem $y' + 2y^2 = 0, y(1) = 1$

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7. Find the particular solution to the following initial value problem $\frac{dy}{dx} = 4xy, y(0) = 1$

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Additional Question For Practice 9 5

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

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2. i. Show that $\frac{dy}{dx} = \frac{x}{y} + \frac{y}{x}$ is a homogeneous equation.

ii. Hence, solve it.

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

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4. Solve the differential equation `x(dy)/(dx)=y-xtan((y)/(x)) is homogenous and solve it.

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5. Find the particular solution of the differential equation $\left(xe^{\frac{y}{x}} + y\right)dx = xdy,\ y = 1 when x = 1.$

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6. Solve the differential equation $y' - \frac{y}{x} + \cos ec\left(\frac{y}{x}\right) = 0$ when $y(1) = 0.$

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Additional Question For Practice 9 6

1. Find the general solution of the following differential equation.

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

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2. Find the general solution of the following differential equation.

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

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3. Find the general solution of the following differential equation.

$$\frac{dy}{dx} = 6e^{x}y$$

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4. Find the general solution of the following differential equation.

$xy' + y = x^4$

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Ncert Miscellaneous Exercise

1. For each of the differential equations given below, indicate its order and degree (if defined).

$$\frac{d^2y}{dx^2} + 5y\left(\frac{dy}{dx}\right)^2 - 6y = \log x$$

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2. For each of the differential equations given below, indicate its order and degree (if defined).

$$\left(\frac{dy}{dx}\right)^3 - 4\left(\frac{dy}{dx}\right)^2 - 7y = \sin x$$

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3. For each of the differential equations given below, indicate its order and degree (if defined).

$$\frac{d^4y}{dx^4} - \sin\left(\frac{d^3y}{dx^3}\right) = 0$$

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4. For each of the exercises given below, verify that the given function (implicit or explicit) is a solution of the

corresponding differential equation.

$y = ae^{x} + be^{-x} + x^{2}$:

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

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5. For each of the exercises given below, verify that the given function (implicit or explicit) is a solution of the corresponding differential equation.

$y = e^{x}(a\cos x + b\sin x)$:

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

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6. For each of the exercises given below, verify that the given function (implicit or explicit) is a solution of the corresponding differential equation.

$y = x \sin 3x : \frac{d^2y}{dx^2} + 9y - 6\cos 3x = 0$

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7. For each of the exercises given below, verify that the given function (implicit or explicit) is a solution of the corresponding differential equation. x^(2)=2y^(2)logy: (x^(2)+y^(2))(dy)/(dx)-xy=0`

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

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

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

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12. 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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13. 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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14. 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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15. Find a particular solution of the differential equation $(x - y)(dx + dy) = dx - dy.$ Given that $y = -1,$ when $x = 0.$

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16. 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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17. Find a particular solution of the differential equation $\frac{dy}{dx} + y\cot x = 4x\,\mathrm{cosec}\,x(x \neq 0).$

Given that $y = 0$ when $x = \frac{\pi}{2}.$

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18. Find a particular solution of the differential equation $(x+1)\frac{dy}{dx} = 2e^{-y} - 1,$ given that $y = 0$ when $x = 0.$

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19. The population of a village increases continuously at the rate proportional to the number of its Inhabitants present at any time. It the population of the village was $20,000$ in 1999 and $25,000$ in the year 2004, what will be the population of the village in 2009 ?

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

A. $xy = C$

B. $x = Cy^2$

C. $y = Cx$

D. $y = Cx^2$

Answer: C

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21. 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. $y.\ e^{\int p_1 dx} = \int \left(Q_1 e^{\int P_1 dx} \right) dx + C$

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

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

Answer: A::C::D

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22. The general solution of the differential equation $e^x dy + y dx = 0$ is

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

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

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

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

Answer: B::C::D

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Unit Test

1. Find the order and degree of the differential equation

$$t^2\frac{d^2s}{dt^2} - st\frac{ds}{dt} = s$$

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2. The order and degree of the differential equation

$$\sqrt{x}\frac{d^4y}{dx^4} + 5\left(\frac{dy}{dx}\right)^2 = 2y^2 + x \text{ is.....}$$

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3. The solution of the differential equation $y' + y = 0$ is .....

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4. Show that $y = A\cos nx + B\sin nx$ is the solution of the differential equation $\frac{d^2y}{dx^2} + n^2y = 0$

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5. Find the differential equation of the family of curves represented by $y^2 - 2ay + x^2 = a^2$, where a is an arbitrary constant.

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6. Solve $e^x\sqrt{1-y^2}dx + \frac{y}{x}dy = 0$

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7. Find the solution of the differential equation $x\frac{dy}{dx} = y + x^3$

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8. Consider the differential equation $\frac{dy}{dx} = \frac{y}{x} + \log x$

i. Find the integrating factor of the differential equation

ii. Evaluate $\int \frac{1}{x} \log x dx$

iii. Hence find the general solution of the given differential equation.

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Continuous Evaluation Assignment

1. Complete the following tables

i.

Differential equation	Order	Degree	Linear/Non-linear
$\left(\frac{dy}{dx}\right)^2+\frac{1}{\left(\frac{dy}{dx}\right)}=2$			
$5\frac{d^2y}{dx^2}=\left[1+\frac{dy}{dx}\right]^{\frac{3}{2}}$			
$x+y=\sqrt{1+\frac{dy}{dx}}$			

ii.

Family of curves	Cartesian Equation	Differential Equation
Family of lines with slope -1		
Family of lines passing through (0, 2)		
Family of circles with centre on x-axis and y-axis is a tangent		
Family of circles with centre on x-axis and radius 2		

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Objective Type Question

1. The degree of the differential equation $\left[5+\left(\frac{dy}{dx}\right)^2\right]^{\frac{5}{3}}=x^5\left(\frac{d^2y}{dx^2}\right)$ is

A. 4

B. 2

C. 3

D. 10

Answer: C

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2. The order and degree of the differential equation $\frac{d^2y}{dx^2} = \left(1 + \left(\frac{dy}{dx}\right)^2\right)^{\frac{3}{2}}$ are

A. $2, 2$

B. $2, 1$

C. $1, 2$

D. $2, 3$

Answer: A

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3. The degree of differential equation $\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^3 + 6y = 0$ is

A. 1

B. 3

C. 2

D. 5

Answer: A

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4. The order of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 = \left(1 + \frac{dy}{dx}\right)^{\frac{1}{2}}$ is

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

B. 2

C. 3

D. 4

Answer: B

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5. The order of the differential equation whose solution is $y = \cos x + b \sin x$ is

A. 3

B. 2

C. 1

D. None of these

Answer: A

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6. The order of differential equation of all circles with radius 'a' is.

A. 1

B. 2

C. 3

D. 4

Answer: B

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7. The degree of the differential equation $\frac{d^2y}{dx^2} + 3\left(\frac{dy}{dx}\right)^2 = x^2$ is

A. 1

B. 2

C. 3

D. not defined

Answer: D

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8. The number of arbitrary constants in the general solution of a defferential equation of order 4 is

A. 0

B. 1

C. 2

D. 4

Answer: D

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9. Which of the following is a second order differential equation ?

A. $(y')^2 + x = y^2$

B. $y'y'' + y = \sin x$

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

D. $y' = y^2$

Answer: B

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10. The differential equation of the family of all non-vertical lines in a plane is

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

B. $\frac{dy}{dx} = 0$

C. $\frac{dx}{dy} = 0$

D. $\frac{d^2x}{dy^2} = 0$

Answer: A

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11. The differential equation of the family of all non-horizontal lines in a plane is

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

B. $\frac{d^2x}{dy^2} = 0$

C. $\frac{dy}{dx} = 0$

D. $\frac{dx}{dy} = 0$

Answer: B

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12. A solution of the differential equation $y' = y$ is

A. $y = e^x$

B. $y = e^x$

C. $y = x$

D. $y = x^2$

Answer: A

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13. The differential equation $y.\frac{dy}{dx}+x=C$ represents a

A. family of hyperbolas

B. family of parabolas

C. family of ellipses

D. family of circles

Answer: D

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14. $\tan^{-1}x+\tan^{-1}y=C$ is the general solution of the differential equation

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

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

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

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

Answer: C

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15. The general solution of the differential equation $\frac{dy}{dx} = e^{x-y}$ is

A. $e^y + e^x = c$

B. $e^y - e^x = c$

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

D. $e^{-y} - e^{-x} = c$

Answer: B

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16. A homogeneous differential equation of the form $\frac{dy}{dx} = f\left(\frac{y}{x}\right)$ can be solved by using the substitution

A. family of hyperbolas

B. family of parabolas

C. family of ellipses

D. family of circles

Answer: C

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17. A homogeneous differential equation of the form $\frac{dy}{dx} = f\left(\frac{y}{x}\right)$ can be solved by using the substitution

A. $y = vx$

B. $v = yx$

C. $x = v$

D. $y = v$

Answer: A

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18. Integrating factor of the differential equation $\cos x \frac{dy}{dx} + y \sin x = 1$ is

A. $\cos x$

B. $\tan x$

C. $\sec x$

D. $\sin x$

Answer: C

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19. The integrating factor of the differential equation $\frac{dy}{dx} + y \cot x = \cos ecx$ is

A. $\log \sin x$

B. $\log \cos x$

C. $\sin x$

D. $\cos x$

Answer: C


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