MATHS

BOOKS - VIKRAM PUBLICATION (ANDHRA PUBLICATION)

DIFFERENTIAL EQUATIONS

Solved Problems

1. Find the order and degree of the differential equation $\frac{d^2y}{dx^2} = -p^2y$.

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2. Find the order and degree of

$$\left(\frac{d^3y}{dx^3}\right)^2 - 3\left(\frac{dy}{dx}\right)^2 - e^x = 4.$$

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3. $x^{\frac{1}{2}}\left(\frac{d^2y}{dx^2}\right)^{\frac{1}{3}} + x.\frac{dy}{dx} + y = 0$ has order 2 and degree 1. Prove.

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4. Find the order and degree of

$$\left(\frac{d^2y}{dx^2}+\left(\frac{dy}{dx}\right)^3\right)^{\frac{6}{5}}=6y$$

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5. Find the order of the differential equation corresponding to $y=c(x-c)^2$, where c is an arbitrary constant.

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6. Find the order of the differential equation corresponding to $y = Ae^x + Be^{3x} + Ce^{5x}$ (A, B, C being parameters) is a solution.

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7. Form the differential equation corresponding to $y = cx - 2c^2$, where c is a parameter.

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8. Form the differential equation corresponding to $y = A\cos 3x + B\sin 3x$, where A and B are

parameters.

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9. Form the differential equation corresponding to the family of circles of radius r given by $(x-a)^2+(y-b)^2=r^2$, where a and b are parameters.

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10. Form the differential equation corresponding to the family of circles passing through the origin and having centres on Y-axis.

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11. Express the following differential equation in the form $f(x)dx + g(y)dy = 0$.

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

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12. Express the following differential equation in the form $f(x)dx + g(y)dy = 0$.

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

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13. Express the following differential equation in the form $f(x)dx + g(y)dy = 0$.

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

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14. Express the following differential equation in the form $f(x)dx + g(y)dy = 0$.

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

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15. Find the general solution of $x + y\frac{dy}{dx} = 0$.

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16. Find the general solution of $\frac{dy}{dx} = e^{x+y}$.

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

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18. Solve $\frac{dy}{dx} = \frac{y^2 + 2y}{x - 1}$

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

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20. Find the equation of the curve whose slope, at any point, (x, y) is $\frac{y}{x^2}$ and which stisfies the conditon y=1 when x=3.

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21. Solve $y(1+x)dx + x(1+y)dy = 0$

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22. Solve $\frac{dy}{dx} = \sin(x+y) + \cos(x+y)$

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23. Solve $(x-y)^2 \frac{dy}{dx} = a^2$

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24. Solve $\sqrt{1+x^2}\sqrt{1+y^2}dx + xydy = 0$

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25. Solve $\frac{dy}{dx} = \frac{x - 2y + 1}{2x - 4y}$

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26. Solve $\frac{dy}{dx} = \sqrt{y - x}$

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27. Solve $\frac{dy}{dx} + 1 = e^{x+y}$

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28. Solve $\frac{dy}{dx} = (3x + y + 4)^2$

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29. Solve $\frac{dy}{dx} - x\tan(y-x) = 1$

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30. Show that $f(x, y) = 1 + e^{x/y}$ is a homogeneous function of x and y.

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31. Show that $f(x, y) = x\sqrt{x^2 + y^2} - y^2$ is a homogeneous function of x and y.

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32. Show that $f(x, y) = x - y\log y + y\log x$ is a homogeneous function of x and y.

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33. Express $\left(1 + e^{x/y}\right)dx + e^{x/y}\left(1 - \frac{x}{y}\right)dy = 0$ in the form $\frac{dx}{dy} = F\left(\frac{x}{y}\right)$.

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34. Express $\left(x\sqrt{x^2+y^2}-y^2\right)dx+xydy=0$ in the form $\frac{dy}{dx}=F\left(\frac{y}{x}\right)$.

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35. Express $\frac{dy}{dx}=\frac{y}{x+ye^{\frac{-2x}{y}}}$ in the form $\frac{dx}{dy}=F\left(\frac{x}{y}\right)$.

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36. Solve $\frac{dy}{dx}=\frac{y^2-2xy}{x^2-xy}$

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37. Solve $\left(x^2+y^2\right)dx = 2xydy$

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

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

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40. Solve

$$x \sec\left(\frac{y}{x}\right) \cdot (ydx + xdy) = y \ \operatorname{cosec}\left(\frac{y}{x}\right) \cdot (xdy - ydx)$$

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41. Give the solution of $x \ \sin^2 \frac{y}{x} dx = ydx - xdy$ which passes through the point $\left(1, \frac{\pi}{4}\right)$.

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

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43. Transform the following two differen-tial equations into linear form.

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

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44. Solve the following differential equations.

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

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45. $(\cos x) \frac{dy}{dx} + y \sin x = \tan x$

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46. Solve $\left(2x - 10y^3\right)\frac{dy}{dx} + y = 0$

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47. Solve $\left(1 + x^2 y\right)\frac{dy}{dx} + 2xy - 4x^2 = 0$

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48. Solve $\frac{1}{x}\frac{dy}{dx} + y.\, e^x = e^{(1-x)e^x}$

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49. Solve $\sin^2 x . \frac{dy}{dx} + y = \cot x$

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50. Find the solution of the equation

$$x(x-2)\frac{dy}{dx} - 2(x-1)y = x^3(x-2)$$

which satisfies the condition that y = 9 when x = 3.

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51. Solve the following differential equation:

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

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Exercise 8 A

1. Find the order of the differential equation obtained by eliminatiing the arbitrary constant b and c from $xy = ce^{x} + be^{-x} + x^{2}$.

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2. Find the order of the differential equation of the family of all circles with their centres at the origin.

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3. Find the order of the differential equation of the following faimily of curves where parameters are given in brackets .

$y = c(x - c)^2, (c)$

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4. Find the order of the differential equation of the following faimily of curves where parameters are given in brackets .

$xy = ae^x + be^{-x}, (a, b)$

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5. Find the order of the differential equation of the following faimily of curves where parameters are given in brackets .

$y = (a + bx)e^{kx}, (a, b)$

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6. Find the order of the differential equation of the following faimily of curves where parameters are given in brackets .

$y = a\cos(nx + b), (a, b)$

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7. Obtain the differential equation which corresponds to each of the following family of curves.

The rectangular hyperbolas which have the co-ordinate axes as asymptotes.

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8. Obtain the differential equation which corresponds to each of the following family of curves.

The ellipses with centress at the origin and having co-ordinate axes as axes

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9. Form the differential equations of the following family of curves where parameters are given in brackets :

$y = ae^{3x} + be^{4x}, (a, b)$

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10. Form the differential equations of the following family of curves where parameters are given in brackets :

$y = ax^2 + bx, (a, b)$

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11. Form the differential equations of the following family of curves where parameters are given in brackets :

$ax^2 + by^2 = 1, (a, b)$

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12. Form the differential equations of the following family of curves where parameters are given in brackets :

$xy = ax^2 + \frac{b}{x}, (a, b)$

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13. Obtain the differential equation which corresponds to each of the following family of curves. The circles which touch the Y - axis at the origin.

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14. Obtain the differential equation which corresponds to each of the following family of curves. The parabolas each of which has a latus rectum 4a and whose axes are parallel to X-axis .

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15. Obtain the differential equation which corresponds to each of the following family of curves. The parabolas having their foci at the origin and axis along the X - axis .

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Exercise 8 B

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

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2. Find the general solution of $\frac{dy}{dx} = \frac{2y}{x}$.

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3. Solve the following differential equations.

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

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4. Solve the following differential equations.

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

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5. Solve the following differential equations.

$(e^x + 1)ydy + (y + 1)dx = 0$

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6. Solve the following differential equations.

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

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7. Solve the following differential equations.

$\tan ydx + \tan xdy = 0$

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8. Solve the following differential equations.

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

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9. Solve the following differential equations.

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

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10. Solve the following differential equations.

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

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11. Solve the following differential equations.

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

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12. Solve the following differential equations.

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

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13. Solve the following differential equations.

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


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14. Solve the following differential equations.

$$\frac{dy}{dx} = 2y \tan hx$$


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15. Solve the following differential equations.

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

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16. Solve the following differential equations.

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

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17. Solve the following differential equations.

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

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Exercise 8 C

1. Express $xdy - ydx = \sqrt{x^2 + y^2}dx$ in the form $F\left(\frac{y}{x}\right) = \frac{dy}{dx}$.

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2. Express $\left(x - y\tan^{-1}\frac{y}{x}\right)dx + x\tan^{-1}\frac{y}{x}dy = 0$ in the form $F\left(\frac{y}{x}\right) = \frac{dy}{dx}$.

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3. Express $x\frac{dy}{dx} = y(\log y - \log x + 1)$ in the form $F\left(\frac{y}{x}\right) = \frac{dy}{dx}$

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4. Solve the following differential equations.

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

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5. Solve the following differential equations.

$$\left(x^2 + y^2\right)dy = 2xydx$$

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6. Solve the following differential equations.

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

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7. Solve the following differential equations.

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

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8. Solve the following differential equations.

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

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9. Solve the following differential equations.

$$(x^2 - y^2)dx - xydy = 0$$

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10. Solve the following differential equations.

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

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11. Solve the following differential equations.

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

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12. Solve the following differential equations.

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

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13. Solve the following differential equations.

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

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14. Solve the following differential equations.

$$xdy - ydx = \sqrt{x^2 + y^2}dx$$

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15. Solve the following differential equations.

$$(2x - y)dy = (2y - x)dx$$

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16. Solve the following differential equations.

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

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17. Solve the following differential equations.

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

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18. Solve $\left(1 + e^{\frac{x}{y}}\right)dx + e^{\frac{x}{y}}\left(1 - \frac{x}{y}\right)dy = 0$

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19. Solve : $x \sin\frac{y}{x}.\frac{dy}{dx} = y \sin\frac{y}{x} - x$

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20. Solve : $xdy = \left(y + x \cos^2\frac{y}{x}\right)dx$

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21. Solve :

$(x - y\log y + y\log x)dx + x(\log y - \log x)dy = 0$

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22. Solve :

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

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23. Find the equation of a curve whoise gradient is $\frac{dy}{dx} = \frac{y}{x} - \cos^2\frac{y}{x}$, where $x > 0, y > 0$ and which passes through the point $\left(1, \frac{\pi}{4}\right)$.

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Exercise 8 D

1. Solve the following differential equations.

$$\frac{dy}{dx} = -\frac{(12x + 5y - 9)}{5x + 2y - 4}$$

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2. Solve the following differential equations.

$$\frac{dy}{dx} = \frac{-3x - 2y + 5}{2x + 3y + 5}$$

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3. Solve the following differential equations.

$$\frac{dy}{dx} = \frac{-3x - 2y + 5}{2x + 3y - 5}$$

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4. Solve the following differential equations.

$$2(x-3y+1)\frac{dy}{dx} = 4x - 2y + 1$$

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5. Solve the following differential equations.

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

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6. Solve the following differential equations.

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

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7. Solve the following differential equations.

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

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8. Solve the following differential equations.

$$\frac{dy}{dx} = \frac{4x + 6y + 5}{3y + 2x + 4}$$

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9. Solve the following differential equations.

$$(2x + y + 1)dx + (4x + 2y - 1)dy = 0$$

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10. Solve the following differential equations.

$$\frac{dy}{dx} = \frac{2y + x + 1}{2x + 4y + 3}$$

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11. Solve the following differential equations.

$$(x + y - 1)dy = (x + y + 1)dx$$

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12. Solve the following differential equations.

$$\frac{dy}{dx} = \frac{3y - 7x + 7}{3x - 7y - 3}$$

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13. Solve the following differential equations.

$$\frac{dy}{dx} = \frac{6x + 5y - 7}{2x + 18y - 14}$$

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14. Solve the following differential equations.

$$\frac{dy}{dx} + \frac{10x + 8y - 12}{7x + 5y - 9} = 0$$

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15. Solve the following differential equations.

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

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16. Solve the following differential equations.

$$(x-y)dy=(x+y+1)dx$$

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17. Solve the following differential equations.

$$(2x+3y-8)dx=(x+y-3)dy$$

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18. Solve the following differential equations.

$$\frac{dy}{dx}=\frac{x+2y+3}{2x+3y+4}$$

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19. Solve the following differential equations.

$$\frac{dy}{dx} = \frac{2x + 9y - 20}{6x + 2y - 10}$$

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Exercise 8 E

1. Find the I.F. of the following differential equations by transforming them into linear form.

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

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2. Find the I.F. of the following differential equations by transforming them into linear form.

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

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3. Solve the following differential equations.

$$\frac{dy}{dx} + y\tan x = \cos^3 x$$

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4. Solve the following differential equations.

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

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5. Solve the following differential equations.

$$\frac{dy}{dx} - y\tan x = e^x \sec x.$$

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6. Solve the following differential equations.

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

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7. Solve the following differential equations.

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

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8. Solve the following differential equations.

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

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9. Solve the following differential equations.

$$\frac{dy}{dx}+\frac{4x}{1+x^2}y=\frac{1}{\left(1+x^2\right)^2}$$

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10. Solve the following differential equations.

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

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11. Solve the following differential equations.

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

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12. Solve the following differential equations.

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

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13. Solve the following differential equations.

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

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14. Solve the following differential equations.

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

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15. Solve the following differential equations.

$$\cos x.\ \frac{dy}{dx} + y \sin x = \sec^2 x$$

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16. Solve the following differential equations.

$$\sec x.\ dy = (y + \sin x)dx$$

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17. Solve the following differential equations.

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

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18. Solve the following differential equations.

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

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19. Solve the following differential equations.

$$x(x - 1) \frac{dy}{dx} - y = x^3 (x - 1)^3$$

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20. Solve the following differential equations.

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

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21. Solve the following differential equations.

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

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22. Solve the following differential equations.

$$x(x-1)\frac{dy}{dx} - (x-2)y = x^3(2x-1)$$

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23. Solve the following differential equations.

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

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24. Solve the following differential equations.

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

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25. Solve the following differential equations.

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

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