MATHS

BOOKS - RS AGGARWAL MATHS (HINGLISH)

LINEAR DIFFERENTIAL EQUATIONS

Solved Examples

1. Solve the differential equation

$$x\frac{dy}{dx} - y = 2x^3, x > 0$$

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2. Solve the following differential equation :

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

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

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

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5. Solve $\left(x^2+1\right)\frac{dy}{dx}+2xy=\sqrt{x^2+4}$

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6. Solve the differential equation: $\left(1+x^2\right)\frac{dy}{dx}+y=\tan^{-1}x$

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7. Find the general solution of the differential equation $\frac{dy}{dx} - y = \cos x$

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8. Solve the differential equation :

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

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

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10. Solve $x\frac{dy}{dx} + 2y = x\cos x$

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11. Solve: $\frac{dy}{dx} + y\sec x = \tan x$

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12. Find the general solution of the differential equation $\frac{dy}{dx} - 2y = \cos 3x..$

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13. Solve the differential equation

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

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14. Solve the differential equation

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

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15. Solve the differential equation $x\frac{dy}{dx} + y = x\cos x + \sin x,$ given $y\left(\frac{\pi}{2}\right) = 1$

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16. Find the particular solution of the differential equation $\cos x\frac{dy}{dx} + y = \sin x,$ given that $y = 2$when $x = 0.$

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

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

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

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20. Find the equation of a 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 the x coordinate (abscissa) and the product of the x coordinate and y coordinate (ordinate) of t

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21. An equation relating to the stability of an aeroplane is given by $\frac{dv}{dt}=g\cos\alpha-kv$, where v is the velocity and g, α, k are constants. Find an expression for the velocity if $v=0$ at $t=0$

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

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

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24. Find the particular solution of the differential equation $\left(\sqrt{1-y^2}dx=(\sin^{-1}y-x\right)dy,$ it being given that when $y=0,$ then $x=0.$

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

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Exercise 21

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

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

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3. $2x\frac{dy}{dx} + y = 6x^3$

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4. $x\frac{dy}{dx} + y = 3x^2 - 2, x > 0$

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

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

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

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

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

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

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11. Solve the following differential equation : $\frac{dy}{dx}+2y=6e^x$

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

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13. Solve the following differential equation: $4\frac{dy}{dx} + 8y = 5\,e^{-3x}$

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14. $x\frac{dy}{dx} - y = (x-1)e^{x}, x > 0$

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15. Solve the following differential equation: $\frac{dy}{dx} - y\tan x = e^{x}\sec x$

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

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

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

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19. $(1 + x)\frac{dy}{dx} - y = e^{3x}(1 + x)^2$

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20. Solve the following differential equations:

$$\frac{dy}{dx} + \frac{4x}{x^2+1}y + \frac{1}{(x^2+1)^2} = 0$$

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

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22. $xdy - \left(y + 2x^2\right)dx = 0$

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23. $xdy + \left(y - x^3\right)dx = 0$

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

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25. Solve: $\frac{dy}{dx} + y = \cos x = \sin x$

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26. $\sec x \frac{dy}{dx} - y = \sin x$

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27. $\left(1 + x^2\right) dy + 2xydx = \cot x dx$

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

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29. The solution of the differential equation $\frac{dy}{dx} + 2y \cot x = 3x^2 \cos ec^2 x$ is

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

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31. $\frac{dy}{dx} = y \tan x - 2 \sin x$

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

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

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34. 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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35. $x \frac{dy}{dx} + y = x^3$, given that $y = 1$ when $x = 2$

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36. 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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37. $\frac{dy}{dx} + 2xy = x$, given that $y = 1$ when $x = 0$

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38. $\frac{dy}{dx} + 2y = e^{-2x} \sin x$, given that $y = 0$ when $x = 0$

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39. $\left(1 + x^2\right) \frac{dy}{dx} + 2xy = 4x^2$, given that $y = 0$, when $x = 0$

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40. $x \frac{dy}{dx} - y = \log x,$ given that $y = 0$ when $x = 1.$

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41. $\frac{dy}{dx} + y\tan x = 2x + x^2 \tan x$, given that $y = 1$ when $x = 0$

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42. 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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43. 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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44. $ydx - \left(x + 2y^2\right)dy = 0$

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

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

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

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48. Find the general solution of the linear differential equation $(x + y)\frac{dy}{dx} = 1.$

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49. Solve the equation $(x+y+1)\left(\frac{dy}{dx}\right)=1$

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50. 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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51. Solve the differential equation: (i) $\left(1+y^2\right)+\left(x-e^{\tan^{-1}y}\right)\frac{dy}{dx}=0$

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

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Objective Questions

1. The solution of the $DE \frac{dy}{dx} = e^{x+y}$ is

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

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

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

D. none of these

Answer: C

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2. The solution of the $DE \frac{dy}{dx} = 2^{x+y}$ is

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

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

C. $2^x - 2^{-y} = C$

D. none of these

Answer: B

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3. The solution of the DE $(e^x + 1)ydy = (y + 1)e^x dx$ is

A. $e^y = C(e^x + 1)(y + 1)$

B. $e^y = e^x + y + 1$

C. $y = (e^x + 1)(y + 1)$

D. none of these

Answer: A

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4. The solution of the DE $xdy + ydx = 0$ is

A. $x + y = C$

B. $xy = C$

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

D. none of these

Answer: B

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5. The solution of the DE $x\dfrac{dy}{dx} = \cot y$ is

A. $x \cos y = C$

B. $x \tan y = C$

C. $x \sec y = C$

D. none of these

Answer: A

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6. The solution of the DE $\frac{dy}{dx} = \frac{(1+y^2)}{(1+x^2)}$ is

A. $(y+x) = C(1-yx)$

B. $(y-x) = C(1+yx)$

C. $y = (1+x)C$

D. none of these

Answer: B

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7. The solution of the DE $\frac{dy}{dx} = 1 - x + y - xy$ is

A. $\log(1+y) = x - \frac{x^2}{2} + C$

B. $e^{1+y} = x - \frac{x^2}{2} + C$

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

D. none of these

Answer: A

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8. The solution of the DE $\frac{dy}{dx} = e^{x+y} + x^2 \cdot e^y$ is

A. $e^{x-y} + \frac{x^3}{3} + C$

B. $e^x + e^{-y} + \frac{x^3}{3} = C'$

C. $e^x - e^{-y} = \frac{x^3}{3} + C$

D. none of these

Answer: B

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9. The solution of the DE $\frac{dy}{dx} + \sqrt{\frac{1-y^2}{1-x^2}} = 0$ is

A. $y + \sin^{-1} y = \sin^{-1} x + C$

B. $\sin^{-1} y - \sin^{-1} x = C$

C. $\sin^{-1} y + \sin^{-1} x = C$

D. none of these

Answer: C

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10. The solution of the DE $\frac{dy}{dx} = \frac{1 - \cos x}{1 + \cos x}$ is

A. $y = 2\tan\frac{x}{2} - x + C$

B. $y\tan\frac{x}{2} - 2x + C$

C. $y = \tan x - x + C$

D. none of these

Answer: A

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11. The solution of the DE $\frac{dy}{dx} = \frac{-2xy}{(x^2+1)}$ is

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

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

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

D. none of these

Answer: B

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12. The solution of the DE $\cos x(1+\cos y)dx - \sin y(1+\sin x)dy = 0$ is

A. $1 + \sin x \cos y = C$

B. $(1+\sin x)(1+\cos y) = C$

C. $\sin x \cos y + \cos x = C$

D. none of these

Answer: B

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13. The solution of the DE $x \cos y dy = (xe^x \log x + e^x)dx$ is

A. $\sin y = e^x + \log x + C$

B. $\sin y - e^x + \log x = C$

C. $\sin y = e^x(\log x) + C$

D. none of these

Answer: C

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14. The solution of the DE $\frac{dy}{dx} + y \log y \cot x = 0$ is

A. $\cos x \log y = C$

B. $\sin x \log y = C$

C. $\log y = C \sin x$

D. none of these

Answer: B

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15. The general solution of the DE $\left(1 + x^2\right) dy - xydx = 0$ is

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

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

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

D. none of these

Answer: B

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16. The solution of $x\sqrt{1+y^2}dx + y\sqrt{1+x^2}dy = 0$

A. $\sin^{-1}x + \sin^{-1}y = C$

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

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

D. none of these

Answer: B

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17. The solution of the equation $\log\left(\frac{dy}{dx}\right) = ax + by$ is (a) $(b)(c)(d)\frac{(e)(f)e^{(g)(h)by(i)}(j)}{k}b(l)(m) = (n)\frac{(o)(p)e^{(q)(r)ax(s)}(t)}{u}a(v)(w$

(y) (b) *[Math Processing Error]* (xx) (c) $(d)(e)(f)\frac{(g)(h)e^{(i)(j)-by(k)}(l)}{m}a(n)(o) = (p)\frac{(q)(r)e^{(s)(t)ax(u)}(v)}{w}b(x)($

(aa) (d) None of these

A. $\frac{-e^{-by}}{b} = \frac{e^{ax}}{a} + C$

B. $e^{ax} - e^{-by} = C$

C. $be^{ax} + ae^{by} = C$

D. none of these

Answer: A

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18. The general solution of the DE $\frac{dy}{dx} = \left(\sqrt{1-x^2}\right)\left(\sqrt{1-y^2}\right)$ is

A. $\sin^{-1} y - \sin^{-1} x = x\sqrt{1-x^2} + C$

B. $2\sin^{-1} y - \sin^{-1} x = x\sqrt{1-x^2} + C$

C. $2\sin^{-1} y - \sin^{-1} x = C$

D. none of these

Answer: B

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19. The general solution of the DE $\frac{dy}{dx} = \frac{y^2 - x^2}{2xy}$ is

A. $x^2 - y^2 = C_1 x$

B. $x^2 + y^2 = C_1 y$

C. $x^2 + y^2 = C_1 x$

D. none of these

Answer: C

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20. The general solution of the DE $x^2 \frac{dy}{dx} = x^2 + xy + y^2$ is

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

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

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

D. none of these

Answer: A

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21. The general solution of the DE $x\frac{dy}{dx} = y + x\tan\frac{y}{x}$ is

A. $\sin\left(\frac{y}{x}\right) = C$

B. $\sin\left(\frac{y}{x}\right) = Cx$

C. $\sin\left(\frac{y}{x}\right) = Cy$

D. none of these

Answer: B

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22. The general solution of the DE $2xydy + \left(x^2 - y^2\right)dx = 0$ is

A. $x^2 + y^2 = Cx$

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

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

D. none of these

Answer: A

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23. The general solution of the DE $(y - x)dy + (x + y)dx = 0$ is

A. $\tan^{-1}\frac{y}{x} = C\sqrt{x^2 + y^2}$

B. $e^{\tan^{-1}(y/x)} = C\sqrt{x^2 + y^2}$

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

D. none of these

Answer: B

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24. The general solution of the DE $\frac{dy}{dx} = \frac{y}{x} + \sin\frac{y}{x}$ is

A. $\tan\frac{y}{2x} = Cx$

B. $\tan\frac{y}{x} = Cx$

C. $\tan\frac{y}{2x} = C$

D. none of these

Answer: A

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25. The general solution of the DE $\frac{dy}{dx} + y\tan x = \sec x$ is

A. $y = \sin x - C\cos x$

B. $y = \sin x + C\cos x$

C. $y = \cos x - C\sin x$

D. none of these

Answer: B

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26. The general solution of the DE $\frac{dy}{dx} + y\cot x = 2\cos x$ is

A. $(y + \sin x)\sin x = C$

B. $(y + \cos x)\sin x = C$

C. $(y - \sin x)\sin x = C$

D. none of these

Answer: C

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27. The general solution of the DE $\frac{dy}{dx} + \frac{y}{x} = x^2$ is

A. $xy = x^4 + C$

B. $4xy = x^4 + C$

C. $3xy = x^3 + C$

D. none of these

Answer: B

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