



# MATHS

## BOOKS - CHHAYA PUBLICATION

### MATHS (BENGALI ENGLISH)

### LINEAR DIFFERENTIAL EQUATION

Exampale

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



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



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



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**4. Solve :**  $(x + 1) \frac{dy}{dx} - ny = e^x(x + 1)^{n+1}$



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$$5. \text{ Solve : } (1 + y^2)dx = (\tan^{-1} y - x)dy$$



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$$6. (1 + x^2) \frac{dy}{dx} + y = e^{\tan^{-1} x}$$



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$$7. \text{ Solve : } \frac{dy}{dx} + \frac{y}{(1-x)\sqrt{x}} = 1 - \sqrt{x}$$



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$$8. \text{ Solve : } x \log x \frac{dy}{dx} + y = \frac{2}{x} \log x$$



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$$9. \text{ Solve : } (1 + x^2) \frac{dy}{dx} + 2xy = \sqrt{x^2 + 4}$$



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$$10. \text{ Solve : } \frac{dy}{dx} + y \cot x = 2x + x^2 \cot x,$$

given that  $y(0) = 0$



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



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12. Solve :  $\frac{dy}{dx} + \frac{y}{(1 - x^2)^{\frac{3}{2}}} = \frac{x + \sqrt{1 - x^2}}{(1 - x^2)^2}$



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13. Solve :  $(x + \tan y)dy = \sin 2ydx$



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



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15. Solve :  $\cos^2 x \frac{dy}{dx} - \tan 2x \cdot y = \cos^4 x,$

given  $y = \frac{3\sqrt{3}}{8}$  when  $x = \frac{\pi}{6}$



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16.

Solve

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



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17. Solve :  $(1 + \tan y)(dx - dy) + 2xdy = 0$



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18. Solve :  $(x^2 - y^2)dx + 2xydy = 0$



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## Multiple Choice Type Qusetions

1. In the linear differential equation of the

form  $\frac{dy}{dx} + Py = Q$ ,

A. Q is a constant

B. Q is a constant or function of x

C. Q is a function of y

D. Q is a function of both x and y

**Answer: B**



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2. The integrating factor of the differential

equation  $\frac{dy}{dx} + Py = Q$  is -

A.  $e^x$

B.  $e^{Px}$

C.  $e^{\int P dx}$

D. none of these

**Answer: C**



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3. To solve the differential equation  $\frac{dx}{dy} + Px = Q$  we multiply both sides of the equational by,

A.  $e^{Py}$

B.  $e^{Px}$

C.  $e^{\int P dx}$

D.  $e^{\int P dy}$

**Answer: D**



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4. The integrating factor of the differential

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

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

B.  $e^x$

C.  $e^{2 \log x}$

D.  $e^{-2 \log x}$

**Answer: A**



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5. The integrating factor of the differential equation  $(x + y + 1) \frac{dy}{dx} = 1$  is -

A.  $e^{-y}$

B.  $e^x$

C.  $e^{-x}$

D.  $e^y$

## Answer: A



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6. The integrating factor of the differential

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

A.  $x^2$

B.  $\log x$

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

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

**Answer: B**



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### Short Answer Type Questions

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



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



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$$3. \frac{dy}{dx} + y \cot x = 2 \cos x$$



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



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



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$$6. (x^2 + 1) \frac{dy}{dx} + 2xy = 4x^2$$



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$$7. x \frac{dy}{dx} + 2y = \log x$$



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$$8. \text{ Solve } \frac{dy}{dx} + 3y = e^{-2x}$$



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$$9. \cos^2 x \frac{dy}{dx} + y = \tan x \left[ 0 \leq x \leq \frac{\pi}{2} \right]$$



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$$10. \frac{dy}{dx} - \frac{n}{x}y = e^x x^n$$



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$$11. \frac{dy}{dx} - y \tan x = e^x \sec x$$



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$$12. \frac{dy}{dx} + \frac{n}{x}y = \frac{a}{x^n}$$



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$$13. \frac{dy}{dx} - 3y \cot x = \sin 2x, \quad \text{given } y = 2$$

$$\text{when } x = \frac{\pi}{2}$$



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$$14. \frac{dy}{dx} + 2y = 6e^2$$



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$$15. \frac{dy}{dx} + \frac{2x}{1+x^2}y = \frac{1}{(1+x^2)^2}$$



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$$16. 2\cos x \frac{dy}{dx} + 2y \sin x = \sin 2x$$



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$$17. \frac{dy}{dx} + \frac{4x}{x^2 + 1}y = \frac{1}{(x^2 + 1)^3}$$



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$$18. \frac{dy}{dx} + \frac{1}{x \log x}y = \frac{2}{x}$$



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



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$$20. (1 + x^2) \frac{dy}{dx} + 2xy = 4x^2, \text{ given } y = 0,$$

when  $x = 0$



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$$21. \cos t \frac{dx}{dt} + \sin t = 1$$



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$$22. \frac{dy}{dx} + y \sec x = \tan x \left(0 \leq x \leq \frac{\pi}{2}\right)$$



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$$23. (1 + x) \frac{dy}{dx} - xy = 1 - x$$



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$$24. (1 - x^2) \frac{dy}{dx} - xy = x^2, \text{ given } y = 2 \text{ when } x = 0$$



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$$25. \frac{dx}{dt} + x \cos t = \frac{1}{2} \sin 2t$$



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$$26. \frac{dy}{dx} + \left( \tan x + \frac{1}{x} \right) y = \frac{\sec x}{x}$$



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$$27. \frac{dy}{dx} + 2y \tan x = \sin x, \text{ give } y = 0 \text{ when}$$

$$x = \frac{\pi}{3}$$



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28.  $\frac{dy}{dx} = \frac{x\sqrt{x^2 - 1} - y}{\sqrt{x^2 - 1}}$ , given  $y = 1$  when  $x = 1$



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29.  $x(1 - x^2)dy + (2x^2y - y - 5x^3)dx = 0$



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



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$$31. (x + 2y^3) \frac{dy}{dx} = y$$



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$$32. ydx - (x + 2y^2)dy = 0$$



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$$33. 1 + y^2 + \left(x - e^{\tan^{-1} y}\right) \frac{dy}{dx} = 0$$



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$$34. 1 + y^2 + \left( x - e^{-\tan^{-1} y} \right) \frac{dy}{dx} = 0$$



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$$35. y^2 + \left( x - \frac{1}{y} \right) \frac{dy}{dx} = 0$$



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$$36. dx + xdy = e^{-y} \sec^2 y dy$$



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37.  $(x^2y^3 + 2xy)dy = dx$



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## Sample Question For Competitive Examination A Multiple Correct Answers Type

1. The solution of  $\frac{dy}{dx}(x^2y^3 + xy) = 1$  is -

A.  $\frac{1}{x} = 2 - y^2 + ce^{\frac{y^2}{2}}$

B. The solution of an equation which is  
reducible to linear equation

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

D.  $e^{\frac{y^2}{2}} \left( \frac{1 - 2x}{x} + y^2 \right) = c$

**Answer: A::B::C**



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2. The solution of  $\frac{dy}{dx} = \frac{x^2 + y^2 + 1}{2xy}$

satisfying  $y(1) = 1$  is given by -

A. a system of hyperbolas

B. a system of circles

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

D.  $(x - 2)^2 + (y - 3)^2 = 5$

**Answer: A::C**



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3. The solution of the equation

$$\frac{dy}{dx} - 3y = \sin 2x \text{ is -}$$



4. Which of the following equation (s) is/ are linear?

- A.  $\frac{dy}{dx} + \frac{y}{x} = \log x$
- B.  $y\left(\frac{dy}{dx}\right) + 4x = 0$
- C.  $(2x + y^3)\left(\frac{dy}{dx}\right) = 3y$
- D.  $\frac{dy}{dx} = \frac{(ax^3 - 2x^2y + y)}{x(1 - x^2)}$

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



5. A solution of the differential equation

$$(x^2y^2 - 1)dy + 2xy^3dx = 0 \text{ is-}$$

A.  $1 + x^2y^2 = cx$

B.  $1 + x^2y^2 = cy$

C.  $y = 0$

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

**Answer: A::B::D**



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# Sample Question For Competitive Examination B

## Integer Answers Type

1. The integrating factor of the differential equation  $\frac{dy}{dx} (x(\log)_e x) + y = 2(\log)_e x$  is given by (a) (b) (c) (d) (b) (e) (f) (g)  $e^{(h)x(i)}$  (j) (k) (l) (c) (m) (n) (o) ((p)  $\log_q e(r)$ ) (s)  $x(t)$  (u) (d) [Math Processing Error] (ii)



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2.  $\frac{dy}{dx} + \frac{y}{x} = x^2$  is find integrating factor.



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3. If  $(t + 1) \frac{dy}{dx} - ty = 1$  and  $y(0) = -1$  then at  $t = 1$  the solution of the differential equation is  $y(1) = \frac{-1}{k}$ , find k.



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4. If the solution of  
 $(1 + x^2) \frac{dy}{dx} + 2xy - 4x^2 = 0$  is  
 $3y(1 + x^2) = kx^3 + c$ , then the value of k is -



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5. If the integrating factor of  
 $x(1 - x^2)dy + 2(x^2y - y - ax^3)dx = 0$  is  
 $e^{\int pdx}$  where P is equal to  $\frac{kx^2 - 1}{x(1 - x^2)}$  then  
what will be the value of k ?



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## Sample Question For Competitive Examination C

### Matrix Match Type

1. Let  $x \frac{dy}{dx} + y - e^x = 0$ .

find integrating factor .



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2.  $\left( \frac{dy}{dx} \right) + 4xy = 0$  find integrating factor.



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# Sample Question For Competitive Examination D

## Comprehension Type

1. Let  $\frac{dy}{dx} = \frac{yQ'(x) - y^2}{Q}(x)$  where  $Q(x)$  is a specified function satisfying

$$Q(1) = 1 \text{ and } Q(4) = 1296.$$

Integrating factor is -

A.  $\log Q(x)$

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

C.  $Q(x)$

D.  $\frac{1}{\log Q(x)}$

**Answer: C**



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**2.** Draw the rough sketch of  $y = |x + 2|$



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**3.** Draw the rough sketch of  $y = |x^2 - 2|$



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4. Linear differential equation of the form

$\frac{dx}{dy} + Px = Q$  where P, Q are functions of y

or constants and the coefficient of  $\frac{dx}{dy} = 1$ .

Taking  $e^{\int P dy}$  as Integrating factor the above

form reduces to  $\frac{d}{dy} \left( x e^{\int P dy} \right) = Q e^{\int P dy}$ .

Solution of the equation

$dx + xdy = e^{-y} \sec^2 y dy$  is-



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5. Linear differential equation of the form

$\frac{dy}{dx} + Py = Q$  where P, Q are functions of x

or constants and the coefficient of  $\frac{dy}{dx} = 1$ .

Taking  $e^{\int P dx}$  as Integrating factor the above

form reduces to  $\frac{d}{dx} \left( ye^{\int P dx} \right) = Q e^{\int P dx}$ .

Solution of the equation

$\cos t \frac{dx}{dt} + x \sin t = 1$  is -

A.  $x = c \sin t + \cos t$

B.  $x + c + \sin t + \cos t$

C.  $x + \sin t + c \cos t$

D. none of these

**Answer: C**



6. Linear differential equation of the form

$\frac{dy}{dx} + Py = Q$  where P, Q are functions of x

or constants and the coefficient of  $\frac{dy}{dx} = 1$ .

Taking  $e^{\int P dx}$  as Integrating factor the above

form reduces to  $\frac{d}{dx} \left( ye^{\int P dx} \right) = Q e^{\int P dx}$ .

Solution of the equation

$\frac{dy}{dx} + 2y \tan x = x \sin x$  given  $y = 0$  when

$x = \frac{\pi}{3}$  is -

A.  $y = \cos x - 2 \cos^2 x$

B.  $y = \sin x - 2 \sin^2 x$

C.  $y = \cos x - 2 \sin^2 \sin^2 x$

D.  $y = \sin x - 2 \cos^2 x$

**Answer: A**



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**Sample Question For Competitive Examination E**  
**Assertion Reason Type**

1. Consider the differential equation

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

Statement - I  $xy = y^2 \log y + c$  is a solution of the given differential equation.

Statement - II : The differential equation is a linear equation in y and x.

A. Statement - I is True, Statement - II is

True , Statement - II is a correct

explanation for Statement - I

B. Statement - I is True, Statement - II is

True , Statement - II is not a correct

explanation for Statement - I

C. Statement - I is True, Statement - II is

False.

D. Statement - is Fasle, Statement - II is

True.

**Answer: A**



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2. Let  $x \frac{dy}{dx} + y - e^x = 0$ ,  $y(a) = b$ .

, The solution is given by  $xy = e^x + a$ , find true or false.



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