NDA 1 2025

LIVE

MATHS

DIFFERENTIAL EQUATIONS

CLASS 4

NAVJYOTI SIR

Crack
EXAMS

Q) The solution of the differential equation

$$\frac{dy}{dx} = \cos(y - x) + 1 \text{ is}$$

(a) $e^x[\sec(y - x) - \tan(y - x)] = c$

(b) $e^x[\sec(y - x) + \tan(y - x)] = c$

(c) $e^x \sec(y - x) \tan(y - x) = c$

(d) $e^x = c \sec(y - x) \tan(y - x)$

$y - x = t$

$\frac{dy}{dx} - 1 = \frac{dt}{dx} \Rightarrow \frac{dy}{dx} = 1 + \frac{dt}{dx}$

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

$\frac{dt}{dx} = \cos t \Rightarrow \frac{1}{\cos t}\, dt = dx$

$$\int \frac{1}{\cos t}\, dt = \int dx$$

(left - dependent variable)

right - independent variable)

$$\int \sec t\, dt = x + c$$

$$\log(\sec t + \tan t) = x + c$$

$$\sec t + \tan t = e^{x+c}$$

$$\frac{1}{\sec t - \tan t} = e^x \cdot e^c$$

$$\frac{1}{e^c} = e^x(\sec t - \tan t)$$

$$c = e^x(\sec(y-x) - \tan(y-x))$$

$$(\sec t + \tan t) \times \frac{\sec t - \tan t}{\sec t - \tan t}$$

$$= \frac{1}{\sec t - \tan t}$$

Q) The solution of the differential equation

$$\frac{dy}{dx} = \cos(y - x) + 1 \text{ is}$$

(a) $e^x[\sec(y - x) - \tan(y - x)] = c$

(b) $e^x[\sec(y - x) + \tan(y - x)] = c$

(c) $e^x \sec(y - x) \tan(y - x) = c$

(d) $e^x = c \sec(y - x) \tan(y - x)$

Ans: (a)

Q) The degree and order of the differential equation of the family of all parabolas whose axis is x - axis, are respectively.

(a) 2, 3 (b) 2, 1 (c) 1, 2 (d) 3, 2.

$y^2 = 4a(x-h)$ — 2 arbitrary constants

$2y\frac{dy}{dx} = 4a$

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

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

order = 2

degree = 1

Q) The degree and order of the differential equation of the family of all parabolas whose axis is x - axis, are respectively.

(a) 2, 3 (b) 2, 1 (c) 1, 2 (d) 3, 2.

Ans: (c)

Q) What is the degree of the differential equation

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

(a) 1
(b) 2
(c) -1
(d) Degree does not exist.

Multiply by $\left(\frac{dy}{dx}\right)$

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

degree = 2

Q) What is the degree of the differential equation

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

(a) 1
(b) 2
(c) -1
(d) Degree does not exist.

Ans: (b)

Q) What does the differential equation $y\frac{dy}{dx}+x=a$

(where a is a constant) represent?

(a) A set of circles having centre on the Y-axis
(b) A set of circles having centre on the X-axis
(c) A set of ellipses
(d) A pair of straight lines

$$\int y\,dy = \int (a-x)\,dx$$

$$\frac{y^2}{2} = ax - \frac{x^2}{2} + c$$

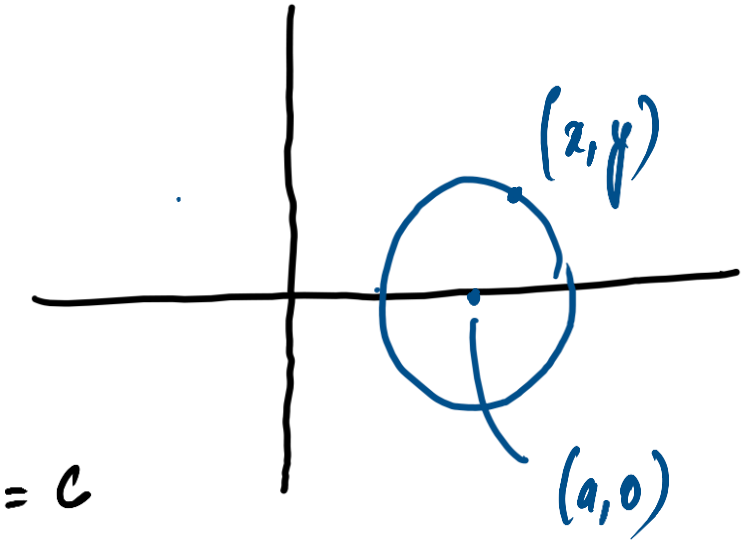
$$y^2 + x^2 - 2ax = c$$

$$(x-a)^2 - a^2 + y^2 = c$$

$$(x-a)^2 + (y-0)^2 = c + a^2$$

$\rightarrow$ (some radius)^2

eqn. of circle with centres on x-axis.



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(where a is a constant) represent?

(a) A set of circles having centre on the Y-axis
(b) A set of circles having centre on the X-axis
(c) A set of ellipses
(d) A pair of straight lines

Ans: (b)

Q) If the solution of the differential equation

$$\frac{dy}{dx} = \frac{ax+3}{2y+f}$$

represents a circle, then what is the value of a?

(a) 2 (b) 1

(c) -2 (d) -1

$\int (2y+f)\,dy = \int (ax+3)\,dx$ where a, f are constants,

$y^2 + fy = \frac{ax^2}{2} + 3x + C$] for eqn. of circle

$x^2 + y^2 + 2gx + 2fy + c = 0$

coefficient of $x^2 = 1$

$-\frac{a}{2} = 1$

$a = -2$

$-\frac{ax^2}{2} + y^2 + fy - 3x - C = 0$

Q) If the solution of the differential equation

$$\frac{dy}{dx} = \frac{ax+3}{2y+f}$$

represents a circle, then what is the value of a?

(a) 2 (b) 1

(c) -2 (d) -1

Ans: (c)

Q) What is the order of the differential equation of all ellipses whose axes are along the coordinate axes?

(a) 1 (b) 2
(c) 3 (d) 4

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ (eqn. of ellipse)

2 arbitrary constants $\Rightarrow$ order = 2

Q) What is the order of the differential equation of all ellipses whose axes are along the coordinate axes?

(a) 1 (b) 2
(c) 3 (d) 4

Ans: (b)

Q) What is the differential equation of $y = A - \frac{B}{x}$?

(a) $xy_2 + y_1 = 0$ (b) $xy_2 + 2y_1 = 0$
(c) $xy_2 - 2y_1 = 0$ (d) $2xy_2 + y_1 = 0$

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

$$x^2\frac{dy}{dx} = B$$

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

$$x(xy_2 + 2y_1) = 0$$

$$xy_2 + 2y_1 = 0$$

Q) What is the differential equation of $y = A - \frac{B}{x}$?

(a) $xy_2 + y_1 = 0$ (b) $xy_2 + 2y_1 = 0$

(c) $xy_2 - 2y_1 = 0$ (d) $2xy_2 + y_1 = 0$

Ans: (b)

Q) A particle starts from origin with a velocity (in m/s) given by the equation $\frac{dx}{dt} = x + 1$. The time (in second) taken by the particle to traverse a distance of 24 m is

(a) ln24 (b) ln5

(c) 2ln5 (d) 2ln4

$$\frac{dx}{dt} = x + 1$$

$$\int \frac{1}{x+1}\,dx = \int dt$$

$$\log(x+1) = t + c$$

When $t = 0$; $x = 0$

$$\log(0+1) = 0 + c$$

$$0 = c$$

$$\log(x+1) = t$$

$$\log(24+1) = t$$

$$\log 25 = t$$

$$\log 5^2 = t$$

$$t = 2\ln 5$$

$\log(a^m) = m\log a$

Q) A particle starts from origin with a velocity (in m/s) given by the equation $\frac{dx}{dt} = x + 1$. The time (in second) taken by the particle to traverse a distance of 24 m is

(a) $\ln 24$ (b) $\ln 5$

(c) $2\ln 5$ (d) $2\ln 4$

Ans: (c)

Q) What is the degree of the following differential equation?

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

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

(a) 1
(b) 2
(c) 3
(d) Degree is not defined

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

Q) What is the degree of the following differential equation?

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

(a) 1
(b) 2
(c) 3
(d) Degree is not defined

Ans: (a)

Q) What is the solution of the differential equation $\ln\left(\frac{dy}{dx}\right) = ax + by$?

(a) $ae^{ax} + be^{by} = C$

(b) $\frac{1}{a}e^{ax} + \frac{1}{b}e^{by} = C$

(c) $ae^{ax} + be^{-by} = C$

(d) $\frac{1}{a}e^{ax} + \frac{1}{b}e^{-by} = C$

$$\frac{dy}{dx} = e^{ax+by}$$

$$\frac{dy}{dx} = e^{ax} \cdot e^{by}$$

$$\frac{1}{e^{by}}\,dy = e^{ax}\,dx$$

$$\int e^{-by}\,dy = \int e^{ax}\,dx$$

$$\frac{e^{-by}}{(-b)} = \frac{e^{ax}}{a} + C$$

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

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

$$\frac{1}{a}e^{ax} + \frac{1}{b}e^{-by} = C$$

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(b) $\frac{1}{a}e^{ax} + \frac{1}{b}e^{by} = C$

(c) $ae^{ax} + be^{-by} = C$

(d) $\frac{1}{a}e^{ax} + \frac{1}{b}e^{-by} = C$

Ans: (d)

Q) What is the solution of the differential equation $\frac{dx}{dy} = \frac{x+y+1}{x+y-1}$?

(a) $y - x + 4\ln(x + y) = C$ (b) $y + x + 2\ln(x + y) = C$

(c) $y - x + \ln(x + y) = C$ (d) $y + x + 2\ln(x + y) = C$

$x + y = t$

$\frac{dx}{dy} + 1 = \frac{dt}{dx}$

$\frac{dt}{dx} - 1 = \frac{dx}{dy}$

$\frac{dt}{dx} - 1 = \frac{t+1}{t-1}$

$\frac{dt}{dx} = \frac{t+1}{t-1} + 1 = \frac{t+1+t-1}{t-1}$

$\frac{dt}{dx} = \frac{2t}{t-1}$

$$\frac{dt}{dx} = \frac{2t}{t-1}$$

$$\frac{t-1}{2t}\,dt = dx$$

$$\frac{1}{2}\left[\int 1\,dt - \int \frac{1}{t}\,dt\right] = \int dx$$

$$\frac{t}{2} - \log t = x + C$$

$$\frac{t}{2} - \frac{1}{2}\log t - x = C$$

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

$$C = x + y - \log(x+y) - 2x$$

$$C = y - x - \log_e(x+y)$$

$$C = y - x - \ln(x+y)$$

$\log_e x = \ln x$

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(b) $y + x + 2\ln(x + y) = C$

(c) $y - x + \ln(x + y) = C$

(d) $y + x + 2\ln(x + y) = C$

Ans: (c)

Q) Match List I (Differential equation) with List II (Its solution) and select the correct answer using the codes given below the lists.

List I	List II
A. $yy' = \sec^2 x$	1. $y \sec^2 x = \sec x + C$
B. $y' = x \sec y$	2. $xy = \sin x + C$
C. $y' + (2 \tan x)\, y = \sin x$	3. $y^2 = 2 \tan x + C$
D. $xy' + y = \cos x$	4. $x^2 = 2 \sin y + C$

Codes

	A	B	C	D
(a)	3	2	1	4
(b)	4	1	2	3
(c)	3	4	1	2
(d)	3	2	4	1

all different

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

Linear differential eqn., $\frac{dy}{dx} + Py = Q$ P, Q are constants or f(x).

$$\frac{dy}{dx} + \frac{y}{x} = \frac{\cos x}{x} \quad ; \quad P = \frac{1}{x} \quad ; \quad Q = \frac{\cos x}{x}$$

$$IF = e^{\int P\,dx} = e^{\int \frac{1}{x}\,dx} = e^{\log x} = x$$

$$y(IF) = \int \left(\frac{\cos x}{x}\right)(x)\,dx + C$$

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

$$xy = \sin x + C$$

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Codes

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(a)	3	2	1	4
(b)	4	1	2	3
(c)	3	4	1	2
(d)	3	2	4	1

Ans: (c)

Q) What does the solution of the differential equation $x\,dy - y\,dx = 0$ represent?

(a) Rectangular hyperbola
(b) Straight line passing through (0, 0)
(c) Parabola with vertex at (0, 0)
(d) Circle with centre at (0, 0)

$$x\,dy - y\,dx = 0$$

$$x\,dy = y\,dx$$

$$\frac{dy}{dx} = \frac{y}{x} \Rightarrow \int \frac{1}{y}\,dy = \int \frac{1}{x}\,dx \Rightarrow \log y = \log x + \log c$$

$$\log y = \log(cx) \Rightarrow y = cx$$

eqn. of straight line

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(a) Rectangular hyperbola

(b) Straight line passing through (0, 0)

(c) Parabola with vertex at (0, 0)

(d) Circle with centre at (0, 0)

Ans: (b)

Q) The general solution of the differential equation

$$\frac{dy}{dx} + \sin\left(\frac{x+y}{2}\right) = \sin\left(\frac{x-y}{2}\right) \text{ is}$$

(a) $\log \tan\left(\frac{y}{2}\right) = C - 2\sin x$

(b) $\log \tan\left(\frac{y}{4}\right) = C - 2\sin\left(\frac{x}{2}\right)$

(c) $\log \tan\left(\frac{y}{2} + \frac{\pi}{4}\right) = C - 2\sin x$

(d) $\log \tan\left(\frac{y}{4} + \frac{\pi}{4}\right) = C - 2\sin\left(\frac{x}{2}\right)$

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(c) $\log \tan\left(\frac{y}{2} + \frac{\pi}{4}\right) = C - 2\sin x$

(d) $\log \tan\left(\frac{y}{4} + \frac{\pi}{4}\right) = C - 2\sin\left(\frac{x}{2}\right)$

Ans: (b)

Q) Which one of the following equations represents the differential equation of circles, with centres on the x-axis and all passing through the origin?

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

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

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

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

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

Ans: (c)

Q) What is the degree of the differential equation $\frac{dy}{dx} + x = \left(y - x\frac{dy}{dx}\right)^{-4}$?

(a) 2 (b) 3 (c) 4 (d) 5

Q) What is the degree of the differential equation $\frac{dy}{dx} + x = \left(y - x\frac{dy}{dx}\right)^{-4}$?

(a) 2 (b) 3 (c) 4 (d) 5

Ans: (c)

Q) The solution of the differential equation

$$\frac{dy}{dx} + \frac{y}{x \log x} = \frac{1}{x} \text{ is}$$

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

(c) $y = \frac{1}{2} \log x + \frac{C}{(\log x)^2}$ (d) $y = \frac{1}{3} \log x - C(\log x)^{-1}$

Q) The solution of the differential equation

$$\frac{dy}{dx} + \frac{y}{x \log x} = \frac{1}{x} \text{ is}$$

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

(c) $y = \frac{1}{2} \log x + \frac{C}{(\log x)^2}$ (d) $y = \frac{1}{3} \log x - C(\log x)^{-1}$

Ans: (a)

Q) What is the equation of the curve passing through the point $\left(0, \frac{\pi}{3}\right)$ satisfying the differential equation $\sin x \cos y \, dx + \cos x \sin y \, dy = 0$?

(a) $\cos x \cos y = \frac{\sqrt{3}}{2}$

(b) $\sin x \sin y = \frac{\sqrt{3}}{2}$

(c) $\sin x \sin y = \frac{1}{2}$

(d) $\cos x \cos y = \frac{1}{2}$

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(b) $\sin x \sin y = \frac{\sqrt{3}}{2}$

(c) $\sin x \sin y = \frac{1}{2}$

(d) $\cos x \cos y = \frac{1}{2}$

Ans: (d)

Q) Which one of the following differential equations represents the system of circles touching the y-axis at the origin?

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

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

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

Ans: (c)

Q) The order and degree of the differential equation

$$\left(1+3\frac{dy}{dx}\right)^{2/3} = 4\frac{d^3y}{dx^3}$$ are

(a) $(1, \frac{2}{3})$

(b) $(3, 1)$

(c) $(3, 3)$

(d) $(1, 2)$

Q) The order and degree of the differential equation

$$\left(1+3\frac{dy}{dx}\right)^{2/3} = 4\frac{d^3y}{dx^3}$$ are

(a) $(1, \frac{2}{3})$

(b) $(3, 1)$

(c) $(3, 3)$

(d) $(1, 2)$

Ans: (c)

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PROBABILITY

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