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NCERT Class 12- Mathematics: Chapter – 9 Differential Equations Part 8

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Question 17:

Find the general solution of the differential equation $(1 + y^2) + (x - e^{\tan^{-1}y}) \frac{dy}{dx} = 0$

Answer:

$$2xe^{\tan^{-1}y} = e^{2\tan^{-1}y} + c$$

Question 18:

Find the general solution of $y^2 dx + (x^2 - xy + y^2) dy = 0$.

Answer:

Given, differential equation is

$$\begin{aligned} y^2 dx + (x^2 - xy + y^2) dy &= 0 \\ \Rightarrow y^2 dx &= -(x^2 - xy + y^2) dy \\ \Rightarrow y^2 \frac{dx}{dy} &= -(x^2 - xy + y^2) \end{aligned}$$

Dividing both sides by y^2 , we get

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

Which is a homogeneous differential equation

$$\begin{aligned} \text{Put } \frac{x}{y} &= vx \text{ or } x = vy \\ \Rightarrow \frac{dx}{dy} &= v + y \frac{dv}{dy} \end{aligned}$$

On substituting these value in Eq. (i) , we get

$$\begin{aligned} v + y \frac{dv}{dy} &= -[v^2 - v + 1] \\ \Rightarrow y \frac{dv}{dy} &= -v^2 - 1 \Rightarrow \frac{dv}{v^2 + 1} = -\frac{dy}{y} \end{aligned}$$

On integrating both sides, we get

$$\int \frac{dv}{v^2 + 1} \int -\frac{dy}{y}$$

$$\tan^{-1}(v) = -\log y + C$$

$$\Rightarrow \tan^{-1}\left(\frac{x}{y}\right) + \log y = C \left[\because v = \frac{x}{y} \right]$$

Question 19:

Solve: $(x + y)(dx - dy) = dx + dy$. [**Hint:** Substitute $x + y = z$ after separating dx and dy]

Answer:

$$\Rightarrow x + y = Ke^{z-y} \left[\because K = \frac{1}{C} \right]$$

Question 20:

Solve: $2(y + 3) - xy \frac{dy}{dx} = 0$, given that $y(1) = -2$

Answer:

$$x^2(y + 3)^3 = e^{y+2}$$

Question 21:

Solve the differential equation $dy = \cos x (2 - y \operatorname{cosec} x) dx$ given that $y = 2$ when $x = \frac{\pi}{2}$.

Answer:

$$y \sin x = \frac{-\cos 2x}{2} + \frac{3}{2}$$

Question 22:

Form the differential equation by eliminating A and B in $Ax^2 + By^2 = 1$.

Answer:

$$xy y'' + x(y')^2 - yy' = 0$$

Question 23:

Solve the differential equation $(1 + y^2) \tan^{-1} x dx + 2y(1 + x^2) dy = 0$.

Answer:

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

Question 24:

Find the differential equation of system of concentric circles with centre $(1, 2)$.

Answer:

$$(x - 1)^2 + (y - 2)^2 = a^2$$

$$\Rightarrow x^2 + 1 - 2x + y^2 + 4 - 4y = a^2$$

$$\Rightarrow x^2 + y^2 - 2x - 4y + 5 = a^2 \dots (i)$$

On differentiating Eq. (i) w.r.t.x , we get

$$2x + 2y \frac{dy}{dx} - 2 - 4 \frac{dy}{dx} = 0$$

$$\Rightarrow (2x - 4) \frac{dy}{dx} + 2x - 2 = 0$$

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