

CUET Mathematics Test

Chapter: Differential Equations (Advanced Set)

SOLUTIONS

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Solutions

- Solution:** Raise both sides to the 6th power to remove radicals: $(\frac{d^2y}{dx^2})^3 = (\frac{dy}{dx} + 3)^2$.
Correct Answer: Order = 2, Degree = 3.
- Solution:** Rewrite as $\frac{d^2y}{dx^2} = \sin(x + y)$. This is a polynomial in derivatives. Correct Answer: Order = 2, Degree = 1.
- Solution:** Family is $y^2 = 4ax$. Differentiating: $2yy' = 4a$. Substitute $4a$ back: $y^2 = (2yy')x \Rightarrow y = 2xy'$. Correct Answer: $y - 2x\frac{dy}{dx} = 0$.
- Solution:** Highest derivative is 3. Because of $e^{y''}$, it is not a polynomial in derivatives. Correct Answer: Order = 3, Degree = Not Defined.
- Solution:** $\frac{dy}{dx} = \frac{2\sin^2(x/2)}{2\cos^2(x/2)} = \tan^2(x/2) = \sec^2(x/2) - 1$. Integrating: $y = 2\tan(x/2) - x + C$.
Correct Answer: $y = 2\tan(x/2) - x + C$.
- Solution:** $dy = \frac{e^x - e^{-x}}{e^x + e^{-x}} dx$. Let $e^x + e^{-x} = t$. Correct Answer: $y = \log|e^x + e^{-x}| + C$.
- Solution:** $\frac{dy}{y} = \tan x dx \Rightarrow \log|y| = \log|\sec x| + \log C$. $y = C \sec x$. At $(0, 1)$, $1 = C(1) \Rightarrow C = 1$. Correct Answer: $y = \sec x$.
- Solution:** $\frac{dy}{\sqrt{1-y^2}} = -\frac{dx}{\sqrt{1-x^2}}$. Integrating: $\sin^{-1} y = -\sin^{-1} x + C \Rightarrow \sin^{-1} x + \sin^{-1} y = C$.
Correct Answer: $\sin^{-1} x + \sin^{-1} y = C$.
- Solution:** $y = \int \sin^{-1} x dx$. Using integration by parts (take 1 as second function). Correct Answer: $y = x \sin^{-1} x + \sqrt{1-x^2} + C$.
- Solution:** General equation: $y = mx + c$ (where $m \neq \infty$). Two arbitrary constants. Correct Answer: Order = 2, Degree = 1.
- Solution:** $\frac{y}{\sqrt{1+y^2}} dy = -\frac{x}{\sqrt{1+x^2}} dx$. Integrating: $\sqrt{1+y^2} = -\sqrt{1+x^2} + C$. Correct Answer: $\sqrt{1+x^2} + \sqrt{1+y^2} = C$.
- Solution:** $\frac{dy}{y \log y} = \frac{dx}{x}$. Let $\log y = t \Rightarrow \frac{1}{y} dy = dt$. $\int \frac{1}{t} dt = \int \frac{1}{x} dx \Rightarrow \log(\log y) = \log x + \log C$. Correct Answer: $\log y = Cx$.
- Solution:** $\tan^{-1} y = \tan^{-1} x + C$. At $x = 1, y = \sqrt{3}$: $\pi/3 = \pi/4 + C \Rightarrow C = \pi/12$. Correct Answer: $\tan^{-1} y - \tan^{-1} x = \pi/12$.
- Solution:** Raise to power 4: $(\frac{d^2y}{dx^2})^4 = y + (\frac{dy}{dx})^2$. Correct Answer: Order = 2, Degree = 4.
- Solution:** $\frac{dy}{dx} = e^y(e^x + x) \Rightarrow e^{-y} dy = (e^x + x) dx$. Integrating: $-e^{-y} = e^x + \frac{x^2}{2} + C$.
Correct Answer: $e^x + e^{-y} + \frac{x^2}{2} = C$.
- Solution:** Given $y\frac{dy}{dx} = x \Rightarrow y dy = x dx$. Integrating: $y^2/2 = x^2/2 + C$. At $(0, -2)$: $4/2 = 0 + C \Rightarrow C = 2$. Correct Answer: $y^2 - x^2 = 4$.
- Solution:** $\frac{dy}{dx} = \frac{y(x+1)}{x(y+1)} \Rightarrow \frac{y+1}{y} dy = \frac{x+1}{x} dx$. Integrating: $\int(1 + 1/y) dy = \int(1 + 1/x) dx$.
Correct Answer: $y + \log y = x + \log x + C$.
- Solution:** Order is 2. Because of $\cos(y'')$, it is not a polynomial in derivatives. Correct Answer: Order = 2, Degree = Not Defined.
- Solution:** Let $x + y = u \Rightarrow 1 + \frac{dy}{dx} = \frac{du}{dx}$. Then $\frac{du}{dx} - 1 = \cos u + \sin u \Rightarrow \frac{du}{1 + \cos u + \sin u} = dx$.
Correct Answer: $\log|1 + \tan(\frac{x+y}{2})| = x + C$.

20. **Solution:** $\frac{dy}{(y-2)(y+1)} = \frac{dx}{x(x+2)}$. Using partial fractions on both sides. Correct Answer:
 $\frac{1}{3} \log \left| \frac{y-2}{y+1} \right| = \frac{1}{2} \log \left| \frac{x}{x+2} \right| + C$.

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