CUET Mathematics Test - Set 20

Chapter: Differential Equations (Intermediate)

SOLUTIONS

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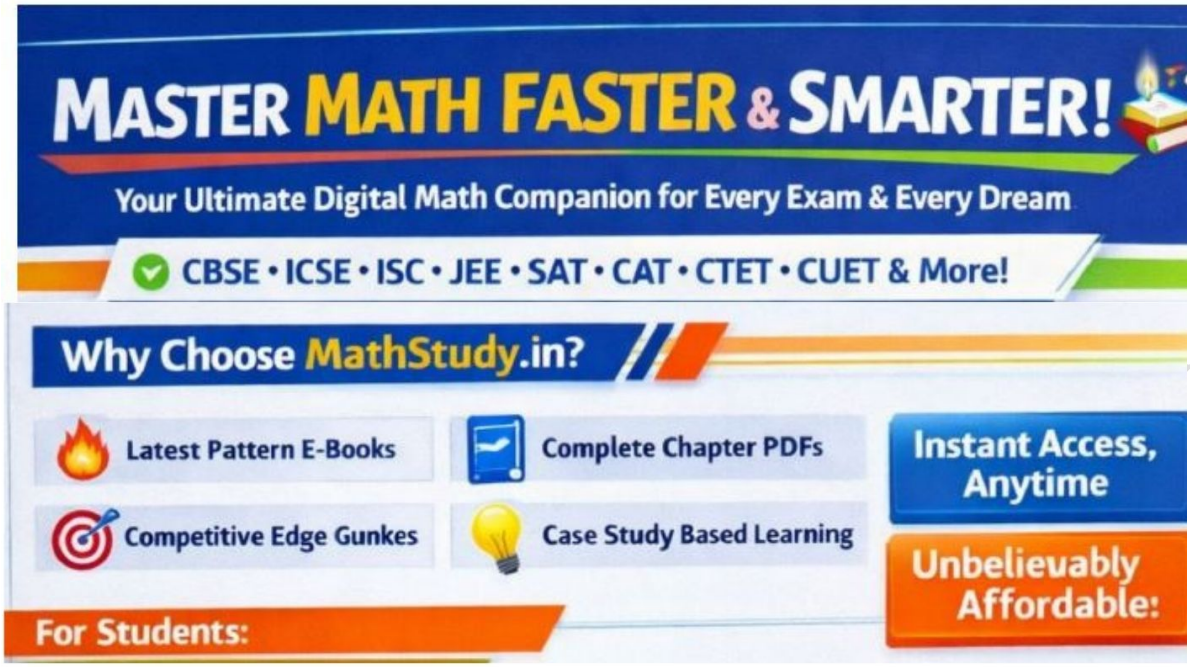

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Solutions

1. **Solution:** Let $4x+y+1=v \implies 4+dy/dx=dv/dx \implies dy/dx=dv/dx-4$. Equation becomes $dv/dx-4=v^2 \implies \int \frac{dv}{v^2+4}=\int dx \implies \frac{1}{2}\tan^{-1}(v/2)=x+C$. **Correct Option: (A)**

2. **Solution:** Divide by x: $\frac{dy}{dx}-\frac{1}{x}y=2x$. $P=-1/x$. $IF=e^{\int -1/x dx}=1/x$. **Correct Option: (C)**

3. **Solution:** $ydx+xdy+x^2ydy=0 \implies d(xy)+x^2ydy=0$. Divide by x^2y^2: $\frac{d(xy)}{(xy)^2}+\frac{1}{y}dy=0 \implies -1/xy+\log y=C$. **Correct Option: (A)**

4. **Solution:** The highest order derivative $\frac{d^2y}{dx^2}$ is inside a sine function. Thus, the equation is not a polynomial in derivatives. **Correct Option: (D)**

5. **Solution:** Homogeneous. $y=vx \implies v+x\frac{dv}{dx}=\frac{v^2x^2-x^2}{2vx^2}=\frac{v^2-1}{2v}$. $x\frac{dv}{dx}=\frac{v^2-1-2v^2}{2v}=-\frac{v^2+1}{2v}$. $\int \frac{2v}{v^2+1}dv=-\int \frac{dx}{x} \implies \log(v^2+1)=-\log x+\log C \implies x(v^2+1)=C$. $x(y^2/x^2+1)=C \implies (y^2+x^2)/x=C \implies x^2+y^2=Cx$. **Correct Option: (A)**

6. **Solution:** $\frac{dy}{y}=\tan x dx \implies \log y=\log\sec x+C$. For $x=0, y=1$, $C=0$. $y=\sec x$. **Correct Option: (B)**

7. **Solution:** $y'=-a\sin(x+b)$, $y''=-a\cos(x+b)=-y$. So $y''+y=0$. **Correct Option: (A)**

8. **Solution:** $IF=e^{\int \frac{1}{x\log x}dx}=e^{\log(\log x)}=\log x$. Solution: $y\log x=\int \frac{1}{x}\log x dx=\frac{(\log x)^2}{2}+C$. **Correct Option: (A)**

9. **Solution:** Since it is a homogeneous equation, $y=vx$ is the standard substitution. **Correct Option: (B)**

10. **Solution:** Let $x+y=v \implies 1+dy/dx=dv/dx$. $(v+1)/(v-1)=dv/dx-1 \implies dv/dx=\frac{v+1+v-1}{v-1}=\frac{2v}{v-1}$. $\int \frac{v-1}{v}dv=2\int dx \implies v-\log v=2x+C \implies x+y-\log(x+y)=2x+C \implies y-x-\log(x+y)=C$. **Correct Option: (A)**

11. **Solution:** Standard result for Linear Differential Equations. **Correct Option: (A)**

12. **Solution:** $y=C_1e^x+C_2e^{2x}+C_3e^x\cdot e^{C_4}=(C_1+C_3e^{C_4})e^x+C_2e^{2x}$. Let $A=C_1+C_3e^{C_4}$. Then $y=Ae^x+C_2e^{2x}$. Only 2 independent arbitrary constants. **Correct Option: (C)**

13. **Solution:** $\int \frac{dy}{\sqrt{4-y^2}}=\int dx \implies \sin^{-1}(y/2)=x+C$. **Correct Option: (B)**

14. **Solution:** $\frac{dx}{dy}=\frac{x+2y^3}{y}=\frac{1}{y}x+2y^2$. $\frac{dx}{dy}-\frac{1}{y}x=2y^2$. $IF=1/y$. $x/y=\int 2y^2\cdot\frac{1}{y}dy=y^2+C \implies x=y^3+Cy$. **Correct Option: (A)**

15. **Solution:** $dy/dx=x/y \implies ydy=xdx \implies y^2/2=x^2/2+C \implies y^2-x^2=2C$. This is the equation of a hyperbola. **Correct Option: (C)**