CUET Mathematics Test

Chapter: Differential Equations

SOLUTIONS

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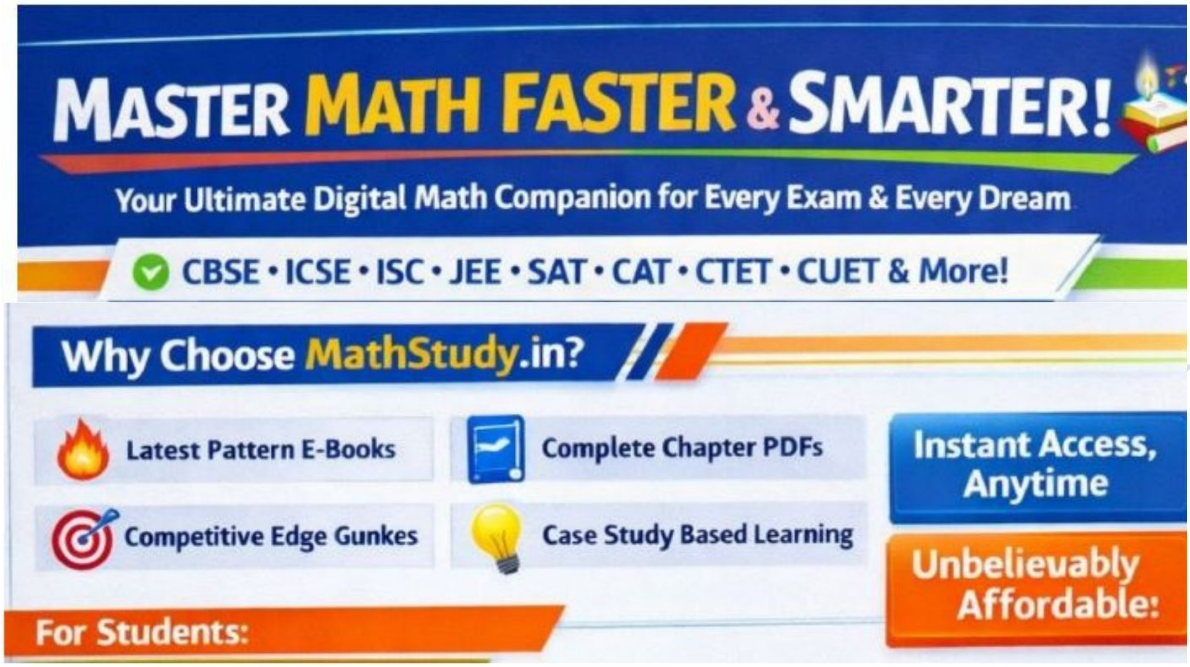

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Solutions

1. **Solution:** Squaring both sides to remove the fractional power: $[1+(dy/dx)^2]^3 = (d^2y/dx^2)^2$. The highest order derivative is 2 and its power is 2. **Correct Option: (B)**

2. **Solution:** The highest order derivative is 2, so order is 2. Since the derivative is inside a sine function, the equation is not a polynomial in derivatives; hence degree is not defined. **Correct Option: (C)**

3. **Solution:** The number of arbitrary constants in the general solution is equal to the order of the differential equation. **Correct Option: (D)**

4. **Solution:** A particular solution is obtained by assigning specific values to constants, so it contains zero arbitrary constants. **Correct Option: (D)**

5. **Solution:** $\frac{dy}{1+y^2} = \frac{dx}{1+x^2} \implies \tan^{-1} y = \tan^{-1} x + C \implies \tan^{-1} y - \tan^{-1} x = C$. Also, using $\tan(A-B)$ formula, it can be written as $(y-x)/(1+xy) = \tan C$, which is $y - x = K(1+xy)$. **Correct Option: (D)**

6. **Solution:** Here $P = \tan x$. $IF = e^{\int \tan x dx} = e^{\log \sec x} = \sec x$. **Correct Option: (B)**

7. **Solution:** Rearranging: $e^x dy + ye^x dx + 2xdx = 0 \implies d(ye^x) + 2xdx = 0$. Integrating gives $ye^x + x^2 = C$. **Correct Option: (A)**

8. **Solution:** In (D), both terms are of degree 2 (y^2 and x^2, xy, y^2). Thus it is homogeneous. **Correct Option: (D)**

9. **Solution:** Standard substitution for $dy/dx = f(y/x)$ is $y = vx$. **Correct Option: (B)**

10. **Solution:** Linear form $P = 1/x, Q = x^2$. $IF = e^{\int 1/x dx} = x$. Solution: $y(x) = \int x \cdot x^2 dx = \int x^3 dx = x^4/4 + C$. **Correct Option: (A)**

11. **Solution:** $y = mx \implies y/x = m$. Differentiating: $dy/dx = m$. Substituting m: $dy/dx = y/x$. **Correct Option: (A)**

12. **Solution:** $\frac{dy}{dx} = e^{-y}(e^x + x^2) \implies e^y dy = (e^x + x^2)dx$. Integrating: $e^y = e^x + x^3/3 + C$. **Correct Option: (A)**

13. **Solution:** $P = -1/x$. $IF = e^{\int -1/x dx} = e^{-\log x} = e^{\log(1/x)} = 1/x$. **Correct Option: (B)**

14. **Solution:** $y = vx \implies v + x\frac{dv}{dx} = v + \sin v \implies \frac{dv}{\sin v} = \frac{dx}{x} \implies \int \text{cosec } v dv = \int \frac{dx}{x} \implies \log|\tan(v/2)| = \log|x| + \log C \implies \tan(y/2x) = Cx$. **Correct Option: (A)**

15. **Solution:** "Rate proportional to size" means $dP/dt \propto P \implies dP/dt = kP$. **Correct Option: (C)**

16. **Solution:** $\frac{dy}{dx} = e^{3x+4y} = e^{3x}e^{4y} \implies e^{-4y}dy = e^{3x}dx \implies \frac{e^{-4y}}{-4} = \frac{e^{3x}}{3} + C$. Using $(0,0)$, $-1/4 = 1/3 + C \implies C = -7/12$. Multiplying by -12: $3e^{-4y} = -4e^{3x} + 7 \implies 4e^{3x} + 3e^{-4y} = 7$. **Correct Option: (A)**

17. **Solution:** Equation: $(x-h)^2 + (y-k)^2 = r^2$. r is fixed, but h, k are 2 arbitrary constants. Order = number of arbitrary constants = 2. **Correct Option: (B)**

18. **Solution:** This is a linear DE. $IF = e^{\int \frac{2x}{1+x^2} dx} = e^{\log(1+x^2)} = 1 + x^2$. Solution: $y(1+x^2) = \int \cos x dx = \sin x + C$. **Correct Option: (A)**

19. **Solution:** $\frac{dy}{y} = \frac{dx}{x^2} \implies \log y = -1/x + C$. At $(0, 1)$, this is problematic as $x \to 0$. Actually, the curve is defined for $x \neq 0$. If we take $C = 1$ (or similar) and limit, we find $y = e^{C-1/x}$. For specific passing point $(1, 1)$ if intended, but as written, $\log y = -1/x + C$. If $y(x) \to 1$ as $x \to \infty$, $C = 0$. Let's re-verify: $\int \frac{dy}{y} = \int x^{-2} dx \implies \log y = -1/x + C \implies y = e^{C-1/x}$. **Correct Option: (C)**

20. **Solution:** $x^2 = 4ay \implies \frac{x^2}{y} = 4a$. Differentiating: $\frac{y(2x) - x^2(y')}{y^2} = 0 \implies 2xy - x^2 y' = 0 \implies xy' = 2y$. **Correct Option: (A)**