CUET (UG) – MATHEMATICS

Chapter Test - Differential Equations (Order, Degree, and Variable Separable)

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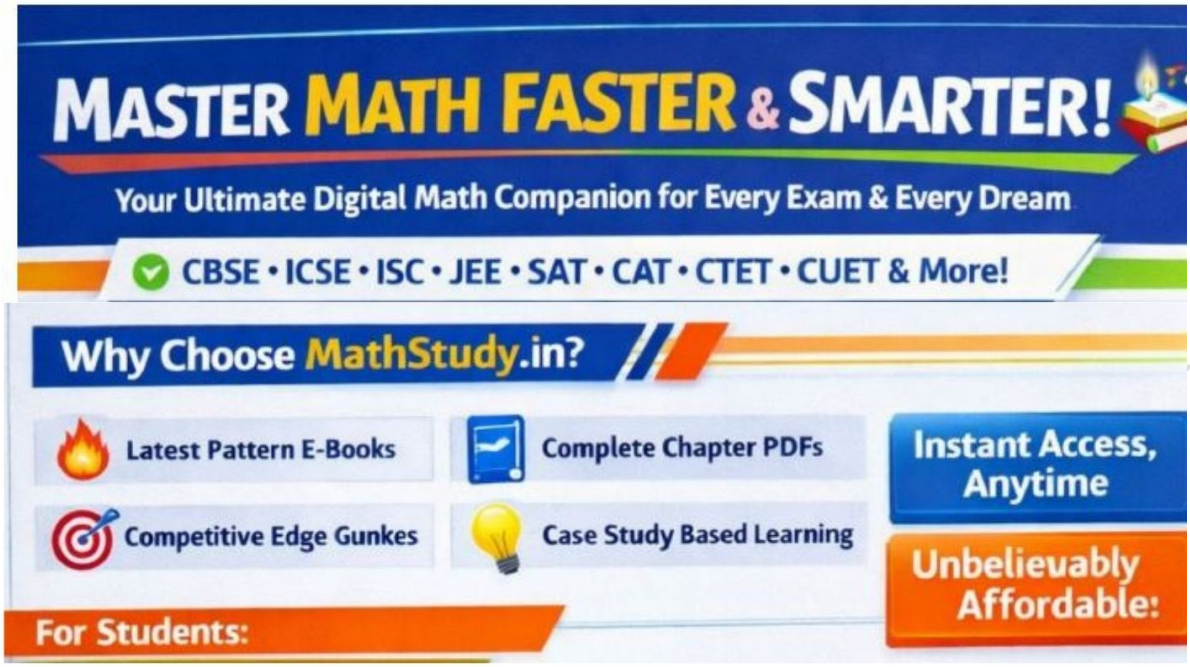

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1. To find the degree, we must remove fractional powers. Squaring both sides: $[1+(dy/dx)^2]^3 = (d^2y/dx^2)^2$. The highest order derivative is d^2y/dx^2 (order 2) and its power is 2 (degree 2). Correct Option: **(A)**

2. The highest derivative is d^2y/dx^2, so order is 2. However, since the equation is not a polynomial in its derivatives (due to $\sin(dy/dx)$), the degree is not defined. Correct Option: **(D)**

3. The equation is $(x-h)^2 + (y-k)^2 = r^2$. Since r is fixed, only h and k are arbitrary constants. Two constants imply a 2nd order differential equation. Correct Option: **(B)**

4. $\frac{dy}{dx} = e^x \cdot e^y \implies e^{-y}dy = e^x dx$. Integrating: $-e^{-y} = e^x + C'$ which can be rewritten as $e^x + e^{-y} = C$. Correct Option: **(B)**

5. $\frac{dy}{1+y^2} = \frac{dx}{1+x^2} \implies \tan^{-1} y = \tan^{-1} x + C \implies \tan^{-1} y - \tan^{-1} x = C$. Correct Option: **(B)**

6. The number of arbitrary constants in a general solution is always equal to the order of the differential equation. Correct Option: **(C)**

7. $\frac{dy}{\sqrt{1-y^2}} = dx \implies \sin^{-1} y = x + C$. Correct Option: **(A)**

8. The expression $y = e^x(A\cos x + B\sin x)$ contains two arbitrary constants A and B. Thus, the differential equation must be of order 2. Correct Option: **(B)**

9. $(\sin y + y\cos y)dy = (2x\log x + x)dx$. Integrating LHS by parts ($\int y\cos y dy$): $y\sin y - \int \sin y dy = y\sin y + \cos y$. Total LHS: $-\cos y + y\sin y + \cos y = y\sin y$. RHS integral of $2x\log x$ is $x^2\log x - x^2/2$. Result: $y\sin y = x^2\log x + C$. Correct Option: **(A)**

10. Family is $y^2 = 4ax$. Differentiating: $2yy' = 4a$. Substituting $4a = y^2/x$ gives $2yy' = y^2/x \implies 2xy' = y$. Correct Option: **(B)**

11. Raising both sides to the power of 6: $(d^2y/dx^2)^3 = (dy/dx + 3)^2$. The power of the highest derivative is 3. Correct Option: **(B)**

12. $\int \frac{dy}{1+y} = \int \frac{dx}{1-x} \implies \log(1+y) = -\log(1-x) + \log C \implies \log(1+y) + \log(1-x) = \log C \implies (1+y)(1-x) = C$. Correct Option: **(A)**

13. $\frac{\sec^2 y}{\tan y}dy = \frac{-e^x}{1-e^x}dx$. Integrating: $\log(\tan y) = \log(1-e^x) + \log C \implies \tan y = C(1-e^x)$. Correct Option: **(A)**

14. $\frac{dy}{dx} = (1+x)(1+y) \implies \int \frac{dy}{1+y} = \int (1+x)dx \implies \log(1+y) = x + x^2/2 + C$. Using $y(0) = 0 \implies C = 0$. Thus $1 + y = e^{x+x^2/2}$. Correct Option: **(A)**

15. Squaring: $(d^2y/dx^2)^2 = 1 + (dy/dx)^2$. Order = 2, Degree = 2. Correct Option: **(A)**

16. $e^{x-y} = e^x/e^y$. So $e^y dy = e^x dx$, which is separable. Correct Option: **(C)**

17. $\int \frac{dy}{\sqrt{1-y^2}} = -\int \frac{dx}{\sqrt{1-x^2}} \implies \sin^{-1} y = -\sin^{-1} x + C \implies \sin^{-1} y + \sin^{-1} x = C$. Correct Option: **(A)**

18. A particular solution has no arbitrary constants as they have been substituted with specific values. Correct Option: **(A)**

19. $\int \frac{dy}{y} = \int \frac{dx}{x} \implies \log y = \log x + \log C \implies y = Cx$. Correct Option: **(B)**

20. Highest derivative is order 3. Its power is 2. Correct Option: **(A)**