

DIFFERENTIAL CALCULUS

18

Marks	1	2	3	5	Total Marks
No. of Questions	1(U)	1(U)	1(A)	1(U)	11

1 MARK QUESTIONS

(Understanding)

Differentiate w.r.t x (1) to (41)

1. $x^2 + \frac{4}{x^2} - \frac{2}{3} \tan x + 6e$

2. $2^x - x^2 - x + 2 - 3 \log x - 4\sqrt{x}$

3. $x^e + e^x + e^e$

4. $x^9 \cdot 9^x$

5. $\sec x \tan x$

6. $\log e^e$

7. $\frac{4x^2 - 3x}{x}$

8. $\left(\sqrt{x} + \frac{1}{\sqrt{x}}\right)^2$

9. $\frac{x+1}{x}$

10. $\sin^2 x$

11. $\frac{1}{x^3} - \frac{3}{x^2}$

12. $(3x^2 + 4x + 5)^6$

13. e^{x^2}

14. $\log(x^2 - 2)$

15. $\tan^4 x$

16. $\sec(\sec x)$

17. $\log(\sec x + \tan x)$

18. $\sqrt{\tan \sqrt{x}}$

19. $\tan(\log(\sin x))$

20. $\cot\left(x^2 + \frac{1}{x^2}\right)$

21. $(a^2 - x^2)^{10}$

22. $\cos x^3$

23. $\sin^3 \sqrt{x}$

24. $[\log(\cos x)]^2$

25. $\sec\left(x + \frac{1}{x}\right)$

26. $7^{\sin \sqrt{x}}$

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27. $\sqrt{\cot \sqrt{x}}$

28. $\log \sin \sqrt{x}$

29. $\cos 3x \sin 5x$

30. $\sin x \cdot \sin 2x$

31. $e^{2x} \sin 3x$

32. $3^x \log x$

33. $\frac{x}{\sqrt{x^2-1}}$

34. $\frac{x}{\sqrt{2x-1}}$

35. Find $\frac{dy}{dx}$ if $3x^2 + 4y^2 = 10$

36. Find $\frac{dy}{dx}$ if $\sqrt{x} + \sqrt{y} = 3$

37. Find $\frac{dy}{dx}$ if $y^2 = 4ax$

38. Find $\frac{dy}{dx}$ if $x^2 = 4ay$

39. Find $\frac{dy}{dx}$ if $x - y = 0$

40. Find $\frac{dy}{dx}$ if $x^2 - y^2 = a^2$

41. Find $\frac{dy}{dx}$ if $x^2 + y^2 = a^2$

42. Find $\frac{dy}{dx}$ if $y = \frac{x^5 - \cos x}{\sin x}$

43. Find $\frac{dy}{dx}$ if $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

2 MARKS QUESTIONS**(Understanding)**

1. Differentiate w.r.t x $\frac{3x^2 + 2x + 5}{\sqrt{x}}$

2. Differentiate w.r.t x $\frac{5}{\sqrt[3]{x}} - \frac{5}{\cos x} + \frac{6}{\sin x} - \frac{2 \tan x}{\sec x} + 7$

3. Differentiate w.r.t x $(x^2 - 2x + 1)(e^x + 4)$

4. Differentiate w.r.t x $\cos x(\sqrt{3} - 4e^x)$

5. Differentiate w.r.t x $x^2 e^x (\cos x - 4)$

6. Differentiate w.r.t x $\frac{a^2 + x^2}{a^2 - x^2}$

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7. Differentiate w.r.t x $\frac{e^x - 1}{e^x + 1}$
8. Differentiate w.r.t x $\sqrt{\frac{1 - \cos 2x}{1 + \cos 2x}}$
9. Differentiate w.r.t x $\frac{e^x(x-1)}{x^2 - 1}$
10. Differentiate w.r.t x $(x - a)(x - b)$
11. Differentiate w.r.t x $\frac{x - a}{x - b}$
12. Differentiate w.r.t x $(5x^2 + 3x - 1)(x - 1)$
13. Differentiate w.r.t x $x^{-3}(5 + 3x)$
14. Differentiate w.r.t x $x^5(3 - 6x^{-9})$
15. Differentiate w.r.t x $\frac{\cos x}{1 + \sin x}$
16. Differentiate w.r.t x $(x + \cos x)(x - \tan x)$
17. If $f(x) = x^2 - 3x + 10$ find $f^1(50)$ and $f^1(11)$
18. If $f(x) = x^n$ and if $f^1(1) = 10$. Find the value of n .
19. If $y = x + \frac{1}{x}$ show that $x^2 \frac{dy}{dx} - xy + 2 = 0$.
20. If $y = \log(x + \sqrt{1 + x^2})$ prove that $\frac{dy}{dx} = \frac{1}{\sqrt{1 + x^2}}$
21. If $y = \log\left(\frac{1 + \sin x}{1 - \sin x}\right)$ find $\frac{dy}{dx}$.
22. Find $\frac{dy}{dx}$ if $x^2 + y^2 - 3xy + 2x + 3y - 5 = 0$
23. Find $\frac{dy}{dx}$ if $e^y = \sin(x + y)$

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24. Find $\frac{dy}{dx}$ if $\sin xy + \cos(x+y) = 4$

25. Find $\frac{dy}{dx}$ if $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$

26. Find $\frac{dy}{dx}$ if $x^3 + y^3 = 3xy$

27. Find $\frac{dy}{dx}$ if $x + \sqrt{xy} = x^2$

28. If $y = \sqrt{\log x + \sqrt{\log x + \sqrt{\log x + \dots \infty}}}$ show that $(2y-1)\frac{dy}{dx} = \frac{1}{x}$

29. If $y = \sqrt{\sin x + \sqrt{\sin x + \sqrt{\sin x + \dots \infty}}}$ prove that $\frac{dy}{dx} = \frac{\cos x}{2y-1}$

30. If $y = e^{x+e^{x+e^{x+\dots \infty}}}$ show that $\frac{dy}{dx} = \frac{y}{1-y}$.

31. If $y = \sqrt{x + \sqrt{x + \sqrt{x + \dots \infty}}}$ prove that $\frac{dy}{dx} = \frac{1}{2y-1}$.

32. If $y = \sqrt{\tan x + \sqrt{\tan x + \sqrt{\tan x + \dots \infty}}}$ prove that $\frac{dy}{dx} = \frac{\sec^2 x}{2y-1}$.

33. If $y = x^2$ find $\frac{dy}{dx}$.

34. Find $\frac{dy}{dx}$ if $y = (\sin x)^{\tan x}$.

35. If $y = (\log x)^{\cos x}$ find $\frac{dy}{dx}$.

36. Differentiate $x^{\sqrt{x}}$ w.r.t x

37. If $y = (\sin x)^x$ find $\frac{dy}{dx}$.

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38. $y = x^{5+\log x}$ find $\frac{dy}{dx}$.
39. Find $\frac{dy}{dx}$ if $x = a \cos \theta$, $y = a \sin \theta$.
40. Find $\frac{dy}{dx}$ if $x = at^2$, $y = 2at$.
41. Find $\frac{dy}{dx}$ if $x = \frac{1-t^2}{1+t^2}$, $y = \frac{2t}{1+t^2}$.
42. Differentiate $\sin^3 x$ w.r.t $\cos^3 x$.
43. If $x = a\theta$, $y = \frac{a}{\theta}$ prove that $\frac{dy}{dx} + \frac{y}{x} = 0$.
44. If $x = a\left(t - \frac{1}{t}\right)$, $y = a\left(t + \frac{1}{t}\right)$ find $\frac{dy}{dx}$.
45. If $x = e^{2t}$, $y = \log(2t+1)$ find $\frac{dy}{dx}$.
46. If $x = \log(1+t)$, $y = \frac{1}{1+t}$ find $\frac{dy}{dx}$.
47. If $x = \log t$, $y = \frac{1}{t}$ find $\frac{dy}{dx}$.
48. If $x = a(\theta - \sin \theta)$, $y = a(1 - \cos \theta)$ find $\frac{dy}{dx}$.
49. If $x = a \sec \theta$, $y = b(\tan \theta)$ find $\frac{dy}{dx}$.
50. If $x = a \cos(\log t)$, $y = a \log(\cos t)$ find $\frac{dy}{dx}$.
51. Differentiate $\sin^2 x$ w.r.t x^2 .
52. Differentiate $\tan \sqrt{x}$ w.r.t $\sqrt{x}$.

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53. Differentiate $\log x$ w.r.t $\frac{1}{x}$.

54. Differentiate $\log \sin x$ w.r.t $\sqrt{\cos x}$.

55. If $y = 3x^3 + 4x^2 + 7$ find $\frac{d^2y}{dx^2}$.

56. If $y = \sqrt{2x+3}$ find $\frac{d^2y}{dx^2}$.

57. If $y = e^{3x+2}$ find $\frac{d^2y}{dx^2}$.

58. If $y = x^3 \log x$ find $\frac{d^2y}{dx^2}$.

59. If $y = \log x + a^x$ find $\frac{d^2y}{dx^2}$.

60. If $y = e^{-x} \sin 2x$ find $\frac{d^2y}{dx^2}$.

61. If $y = \log (\log x)$ find $\frac{d^2y}{dx^2}$.

62. If $y = \cos 4x \cos 2x$ find $\frac{d^2y}{dx^2}$.

63. If $y = \sin 3x \sin 2x$ find $\frac{d^2y}{dx^2}$.

3 MARKS QUESTIONS**(Application)**

1. If $y = x + \tan x$ show that $\cos^2 x \cdot \frac{dy}{dx} = 2 - \sin^2 x$.

2. If $y = \left(x + \sqrt{x^2 + 1}\right)^n$ prove that $(x^2 + 1) \left(\frac{dy}{dx}\right)^2 = x^2 y^2$.

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3. If $y = \frac{\cos x + \sin x}{\cos x - \sin x}$ show that $\frac{dy}{dx} = \sec^2\left(x + \frac{\pi}{4}\right)$.
4. If $y = \log\left(\frac{1 - \cos x}{1 + \cos x}\right)$ prove that $\frac{dy}{dx} = 2 \operatorname{cosec} x$
5. Differentiate e^x w.r.t x
6. If $x\sqrt{1+y} + y\sqrt{1+x} = 0$ where $x \neq y$ S.T. $\frac{dy}{dx} = \frac{-1}{(1+x)^2}$
7. If $e^x + e^y = e^{x+y}$ show that $\frac{dy}{dx} = -e^{(y-x)}$.
8. If $\sin y = x \sin(a+y)$ P.T. $\frac{dy}{dx} = \frac{\sin^2(a+y)}{\sin a}$.
9. If $\left(\frac{x}{a}\right)^n + \left(\frac{y}{b}\right)^n = 2$ find $\frac{dy}{dx}$ at (a,b)
10. Find $\frac{dy}{dx}$ given $\log(xy) = x^2 + y^2$
11. Find $\frac{dy}{dx}$ given $2^x + 2^y = 2^{x+y}$
12. Find $\frac{dy}{dx}$ given $x^y = y^x$
13. Find $\frac{dy}{dx}$ given $\sin xy = \cos(x+y)$
14. If $x^y = e^{y-x}$ show that $\frac{dy}{dx} = \frac{2 - \log x}{(1 - \log x)^2}$
15. If $\cos y = x \cos(a+y)$ show that $\frac{dy}{dx} = \frac{\cos^2(a+y)}{\sin a}$.
16. If $e^y = y^x$ show that $\frac{dy}{dx} = \frac{(\log y)^2}{\log y - 1}$.

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17. If $e^{x+y} = xy$ show that $\frac{dy}{dx} = \frac{y(1-x)}{x(y-1)}$.
18. If $y^x = x^y$ show that $\frac{dy}{dx} = \frac{y(y-x \log y)}{x(x-y \log x)}$.
19. If $y = (e^x)^{(e^x)^{-\infty}}$ show that $\frac{dy}{dx} = \frac{y^2}{1-xy}$.
20. If $x^y = e^{x-y}$ prove that $\frac{dy}{dx} = \frac{\log x}{(1+\log x)^2}$.
21. If $x^m y^n = (x+y)^{m+n}$ show that $\frac{dy}{dx} = \frac{y}{x}$.
22. If $(xe)^y = e^x$ show that $\frac{dy}{dx} = \frac{\log x}{(1+\log x)^2}$.
23. If $x = e^{\log \cos 4\theta}$ $y = e^{\log \sin 4\theta}$ show that $\frac{dy}{dx} = \frac{-y}{x}$.
24. If $x = a \cos^4 \theta$ $y = a \sin^4 \theta$ show that $\frac{dy}{dx} = -\tan^2 \theta$.
25. If $x = e^t (\cos t + \sin t)$ $y = e^t (\cos t - \sin t)$ show that $\frac{dy}{dx} = -\tan t$.
26. If $x = a \log \sec \theta$ $y = a(\tan \theta - 1)$ show that $\frac{dy}{dx} = 2 \operatorname{cosec} 2\theta$.
27. If $x = a \cos \theta$ $y = a \sin \theta$ find $\frac{d^2 y}{dx^2}$.
28. If $x = a \cos^3 t$ $y = -a \sin^3 t$ find $\frac{d^2 y}{dx^2}$.
29. Using first principle find the derivative of $\log x$ w.r.t x .
30. Using first principle find the derivative of x^n w.r.t x .
31. Using first principle find the derivative of a constant 'k'.

5 MARK QUESTIONS**(Understanding)**

1. If $x^2 - xy + y^2 = a^2$ show that $\frac{d^2 y}{d x^2} = \frac{6a^2}{(x - 2y)^3}$.
2. if $x^2 + 2xy + 3y^2 = 1$ show that $y_2 = \frac{-2}{(x + 3y)^3}$.
3. if $x^2 + xy + y^2 = a^2$ show that $\frac{d^2 y}{d x^2} = \frac{-6a^2}{(x + 2y)^3}$.
4. If $xy + 6y = 2x$ show that $\frac{d^2 y}{dx^2} = \frac{-24}{(x + 6)^3}$.
5. If $y^2 + 2y = x^2$ show that $y_2 = \frac{1}{(1 + y)^3}$.
6. If $y = a \cos mx + b \sin mx$ show that $\frac{d^2 y}{dx^2} + m^2 y = 0$.
7. If $y = a \cos (\log x) + b \sin (\log x)$ show that $x^2 y_2 + xy_1 + y = 0$.
8. If $y = \log \left(x - \sqrt{x^2 + 1} \right)$ show that $(x^2 + 1)y_2 + xy_1 = 0$.
9. If $y = x + \sqrt{x^2 - 1}$ show that $(x^2 - 1)y_2 + xy_1 - y = 0$.
10. If $y = \left(x + \sqrt{x^2 + 1} \right)^m$ show that $(x^2 + 1)y_2 + xy_1 - m^2 y = 0$.
11. If $y = \sin (\log x)$ show that $x^2 y_2 + xy_1 + y = 0$.
12. If $y = (a^2 + x^2)^6$ show that $(x^2 + a^2)y_2 - 10xy_1 - 12y = 0$.
13. If $y = \log \left(x + \sqrt{x^2 + 1} \right)$ show that $(x^2 + 1)y_2 + xy_1 = 0$.

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14. If $y = e^x \log x$ show that $xy_2 - (2x-1)y_1 + (x-1)y = 0$.

15. If $e^y(x+1) = 1$ show that $\frac{d^2y}{dx^2} = \left(\frac{dy}{dx}\right)^2$.

16. If $y = \left[x + \sqrt{a^2 + x^2}\right]^n$ show that $(a^2 + x^2)y_2 + xy_1 - n^2y = 0$.

17. If $y = 3e^{2x} + 2e^{3x}$ prove that $\frac{d^2y}{dx^2} - \frac{5dy}{dx} + 6y = 0$.

18. If $y = A \sin x + B \cos x$ then prove that $\frac{d^2y}{dx^2} + y = 0$.
