



## MATHS

### BOOKS - SAI MATHS (TELUGU ENGLISH)

### DIFFERENTIATION

#### Problems

1. If  $x = \frac{1 - \sqrt{y}}{1 + \sqrt{y}}$ , then  $(x + 1) \frac{d^2y}{dx^2} + \left( \frac{3\sqrt{y} + 1}{\sqrt{y}} \right) \frac{dy}{dx} =$

A.  $-2y$

B. 0

C.  $-y$

D.  $y$

**Answer: B**

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2. If  $x^2 + y^2 = t + \frac{2}{t}$  and  $x^4 + y^4 = t^2 + \frac{4}{t^2}$ , then  $x^3 y \frac{dy}{dx} =$

A. -1

B. -2

C.  $\frac{y}{x}$

D.  $xy$

**Answer: B**

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3. If  $y = \tan^{-1}\left(\frac{3x - x^3}{1 - 3x^2}\right) + \tan^{-1}\left(\frac{4x - 4x^3}{1 - 6x^2 + 4x^4}\right)$  then  $\frac{dy}{dx} =$

A.  $\frac{2}{1 + x^2}$

B.  $\frac{4}{1 + x^2}$

C.  $\frac{6}{1 + x^2}$

D.  $\frac{7}{1+x^2}$

Answer: D



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4. If  $x^2 + y^2 = t + \frac{1}{t}$  and  $x^4 + y^4 = t^2 + \frac{1}{t^2}$  then  $\frac{dy}{dx} =$

A.  $\frac{-x}{y}$

B.  $\frac{-y}{x}$

C.  $\frac{x^2}{y^2}$

D.  $\frac{y^2}{x^2}$

Answer: B



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5. If  $x = at^2$  and  $y = 2at$ , then  $\frac{d^2y}{dx^2}$  at  $t = \frac{1}{2}$  is

A.  $\frac{-2}{a}$

B.  $\frac{4}{a}$

C.  $\frac{8}{a}$

D.  $\frac{-4}{a}$

**Answer: D**



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6. If  $y = \tan^{-1}\left(\frac{\sqrt{1+a^2x^2}-1}{ax}\right)$ , then  $(1+a^2x^2)y^n + 2a^2xy$  is equal

to

A.  $-2a^2$

B.  $a^2$

C.  $2a^2$

D. 0

**Answer: D**



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7. If  $f(x) = \frac{x}{1+x}$  and  $g(x) = f(f(x))$ , then  $g(x)$  is equal to

A.  $\frac{1}{(2x+3)^2}$

B.  $\frac{1}{(x+1)^2}$

C.  $\frac{1}{x^2}$

D.  $\frac{1}{(2x+1)^2}$

**Answer: D**



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8.  $f(x) = \frac{1}{1+\frac{1}{x}}g(x) = \frac{1}{1+\frac{1}{f(x)}} \Rightarrow g'(2) =$

A.  $\frac{1}{5}$

B.  $\frac{1}{25}$

C. 5

D.  $\frac{1}{16}$

**Answer: B**

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9.  $\sqrt{\frac{y}{x}} + \sqrt{\frac{x}{y}} = 2 \Rightarrow \frac{dy}{dx} =$

A.  $\frac{x^2 + y^2}{x + y}$

B.  $\frac{x^2 - y^2}{x + y}$

C. 1

D. 2

**Answer: C**

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10.

$$\frac{d}{dx} [(x + 1)(x^2 + 1)(x^4 + 1)(x^8 + 1)] = (15x^p - 16x^q + 1)(x - 1)^{-2} \Rightarrow$$

A. (12, 16)

B. (15, 14)

C. (16, 14)

D. (16, 15)

**Answer: D**



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$$11. \cos^{-1}\left(\frac{y}{b}\right) = 2 \log\left(\frac{x}{2}\right), x > 0 \Rightarrow x^2 \frac{a^2 y}{dx^2} + x \frac{dy}{dx} =$$

A.  $4y$

B.  $-4y$

C. 0

D.  $-8y$

**Answer: B**



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12. If  $u = \log(x^3 + y^3 + z^3 - 3xyz)$ , then  $(x + y + z)(u_x + u_y + u_z)$  is equal to

A. 0

B.  $x + y + z$

C. 2

D. 3

**Answer: D**



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13.  $f(x) = \log\left(e^x \left(\frac{x-2}{x+2}\right)^{3/4}\right) \Rightarrow f'(0) =$

A.  $\frac{1}{4}$

B. 4

C.  $\frac{-3}{4}$

D. 1

**Answer: A**



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14. If  $xy \neq 0$ ,  $x + y \neq 0$  and  $x^m y^n = (x + y)^{m+n}$ , where,  $m, n \in \mathbb{N}$ ,

then  $\frac{dy}{dx}$  is equal to

A.  $\frac{y}{x}$

B.  $\frac{x+y}{xy}$

C.  $xy$

D.  $\frac{x}{y}$

**Answer: A**



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15.  $x^2 + y^2 = t + \frac{1}{t}$ ,  $x^4 + y^4 = t^2 + \frac{1}{t^2} \Rightarrow x^3 y \frac{dy}{dx} =$

A. -1

B. 1

C. 0

D. t

**Answer: A**



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16. If  $f(x) = (X^2 - 1)^7$ , then  $f^{(14)}(x)$  is equal to

A. 0

B. 2!

C. 7!

D. 14!

**Answer: D**



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17. If  $y = (1 + x)(1 + x^2) \dots (1 + x^{2n})$ , then  $\left(\frac{dy}{dx}\right)_{x=0}$  is equal to

A. 0

B.  $\frac{1}{2}$

C. 1

D. 2

**Answer: C**



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18. If  $\cos^{-1}\left(\frac{x^2 - y^2}{x^2 + y^2}\right) = k$  (a constant), then  $\frac{dy}{dx} =$

A.  $\frac{y}{x}$

B.  $\frac{x}{y}$

C.  $-2$

D.  $-3$

**Answer: A**



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19. If  $f(x) = |x| + |\sin x|$  for  $x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ , then its left hand derivative at  $x = 0$  is

A. 0

B.  $-1$

C.  $-2$

D.  $-3$

**Answer: C**

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20. If  $y = \frac{\log_e x}{x}$  and  $z = \log_e x$ , then  $\frac{d^2y}{dz^2} + \frac{dy}{dz} =$

A.  $e^{-z}$

B.  $2e^{-z}$

C.  $ze^{-z}$

D.  $-e^{-z}$

**Answer: D**

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21. IF  $f(x) = (\cos x)(\cos 2x)\dots (\cos nx)$ , then  $f(x) + \sum_{r=1}^n (r \tan rx)f(x)$  is equal to

A.  $f(x)$

B. 0

C.  $-f(x)$

D.  $2f(x)$

**Answer: B**



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22. If  $y = \cos^{-1}\left(\frac{a^2 - x^2}{a^2 + x^2}\right) + \sin^{-1}\left(\frac{2ax}{a^2 + x^2}\right)$ , then  $\frac{dy}{dx}$  to

A.  $\frac{a}{x^2 + a^2}$

B.  $\frac{2a}{x^2 + a^2}$

C.  $\frac{4a}{x^2 + a^2}$

D.  $\frac{a^2}{x^2 + a^2}$

**Answer: C**



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23.  $f(x) = \sin x + \cos x \Rightarrow f\left(\frac{\pi}{4}\right) f^{(iv)}\left(\frac{\pi}{4}\right) =$

A. 1

B. 2

C. 3

D. 4

**Answer: B**



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24. If  $y = \sin(m \sin^{-1} x)$ , then  $(1 - x^2)y_2 - xy_1$  is equal to (Here,  $y_n$  denotes  $\frac{d^n y}{dx^n}$ )

A.  $m^2 y$

B.  $-m^2 y$

C.  $2m^2 y$

D.  $-2m^2 y$

**Answer: B**



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25.  $x = \frac{1 - \sqrt{y}}{1 + \sqrt{y}} \Rightarrow \frac{dy}{dx}$  is equal to

A.  $\frac{4}{(x + 1)^2}$

B.  $\frac{4(x - 1)}{(1 + x)^3}$

C.  $\frac{x - 1}{(1 + x)^3}$



D.  $\frac{4}{(x+1)^3}$

**Answer: B**

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26.  $x = \cos^{-1}\left(\frac{1}{\sqrt{1+t^2}}\right)$ ,  $y = \sin^{-1}\left(\frac{t}{\sqrt{1+t^2}}\right) \Rightarrow \frac{dy}{dx}$  is equal to

A. 0

B.  $\tan t$

C. 1

D.  $\sin t \cos t$

**Answer: C**

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27.  $\frac{d}{dx} \left[ a \tan^{-1} x + b \log\left(\frac{x-1}{x+1}\right) \right] = \frac{1}{x^4-1} \Rightarrow a - 2b =$

A. 1

B. -1

C. 0

D. 2

**Answer: B**



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28.  $y = e^{a \sin^{-1} x} \Rightarrow (1 - x^2)y_{n+2} - (2n + 1)xy_{n+1}$  is equal to

A.  $-(n^2 + a^2)y_n$

B.  $(n^2 - a^2)y_n$

C.  $(n^2 + a^2)y_n$

D.  $-(n^2 - a^2)y_n$

**Answer: C**



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29. If  $x = a \left\{ \cos \theta + \log \tan \left( \frac{\theta}{2} \right) \right\}$  and  $y = a \sin \theta$ , then  $\frac{dy}{dx}$  is equal to

A.  $\cot \theta$

B.  $\tan \theta$

C.  $\sin \theta$

D.  $\cos \theta$

**Answer: B**



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30. If  $y = \sin(\log_e x)$  then  $\left( x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} = \right.$

A.  $\sin(\log_e x)$

B.  $\cos(\log_e x)$

C.  $y^2$

D.  $-y$

**Answer: D**

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31. If  $2x^2 - 3xy + y^2 + x + 2y - 8 = 0$ , then  $\frac{dy}{dx}$  is equal to

A.  $\frac{3y - 4x - 1}{2y - 3x + 2}$

B.  $\frac{3y + 4x + 1}{2y + 3x + 2}$

C.  $\frac{3y - 4x + 1}{2y - 3x - 2}$

D.  $\frac{3y - 4x + 1}{2y + 3x + 2}$

**Answer: A**

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32. If  $y = \log \left\{ \left( \frac{1+x}{1-x} \right)^{1/4} \right\} - \frac{1}{2} \tan^{-1}(x)$ , then  $\frac{dy}{dx} =$

A.  $\frac{x}{1-x^2}$

B.  $\frac{x^2}{1-x^4}$

C.  $\frac{x}{1+x^4}$

D.  $\frac{x}{1-x^4}$

**Answer: B**



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33.  $x = \cos \theta, y = \sin 5\theta \Rightarrow (1-x^2) \frac{d^2y}{dx^2} - x \frac{dy}{dx} =$

A.  $-5y$

B.  $5y$

C.  $25y$

D.  $-25y$

**Answer: D**



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34.  $x^y = y^x \Rightarrow x(x - y \log x) \frac{dy}{dx} =$

A.  $y(y - x \log y)$

B.  $y(y + x \log y)$

C.  $x(x + y \log x)$

D.  $x(y - x \log y)$

**Answer: A**



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35. If  $f(x) = e^x \sin x$ , then  $f^{(6)}(x)$  is equal to

A.  $e^{6x} \sin 6x$

B.  $-8e^x \cos x$

C.  $8e^x \sin x$

D.  $8e^x \cos x$

**Answer: B**



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**36.** IF  $f: R \rightarrow R$  is an even function which is twice differentiable on  $R$  and  $f^t(-\pi)$  is equal to

A.  $-1$

B.  $0$

C.  $1$

D.  $2$

**Answer: C**



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37. Statement I :  $f(x) = ax^{41} + bx^{-40}$

$$\Rightarrow \frac{f'(x)}{f(x)} = 1640x^{-2}$$

Statement II :  $\frac{d}{dx} \tan^{-1} \left( \frac{2x}{1-x^2} \right) = \frac{1}{1+x^2}$

Which of the following is correct ?

- A. I is true, but II is false
- B. Both I and II are true
- C. Neither I nor II is true
- D. I is false, but II is true

**Answer: A**



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38.  $f(x) = 10 \cos x + (13 + 2x) \sin x \Rightarrow f''(x) + f(x) =$

- A.  $\cos x$



B.  $4 \cos x$

C.  $\sin x$

D.  $4 \sin x$

**Answer: B**



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39.  $x\sqrt{1+y} + y\sqrt{1+x} = 0 \Rightarrow \frac{dy}{dx} =$

A.  $\frac{1}{(1+x)^2}$

B.  $-\frac{1}{(1+x)^2}$

C.  $\frac{1}{1+x^2}$

D.  $\frac{1}{1-x^2}$

**Answer: B**



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40. If  $x^y = e^{x-y}$  then  $\frac{dy}{dx} =$

- A.  $\frac{1}{(1 + \log x)^2}$   
B.  $\frac{\log x}{(1 + \log x)^2}$   
C.  $\left(\frac{\log x}{1 + \log x}\right)^2$   
D.  $\frac{(\log x)^2}{1 + \log x}$

**Answer: B**



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41.  $y = \sin^{-1} x \Rightarrow (1 - x^2) \frac{d^2y}{dx^2} =$

- A.  $x \frac{dy}{dx}$   
B. 0  
C.  $x \frac{dy}{dx}$   
D.  $x \left(\frac{dy}{dx}\right)^2$

**Answer: C**



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42. If  $f(x) = \frac{1}{x^2} \int_3^x (2t - 3f'(t)) dt$ , then  $f'(3)$  is equal to

A.  $-\frac{1}{2}$

B.  $-\frac{1}{3}$

C.  $\frac{1}{2}$

D.  $\frac{1}{3}$

**Answer: C**



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43. If  $f(x) = e^x$ ,  $g(x) = \sin^{-1} x$  and  $h(x) = f(g(x))$ , then  $\frac{h'(x)}{h(x)} =$

A.  $\sin^{-1} x$

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

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

D.  $\sin^{\sin^{-1}} x$

**Answer: B**



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44. If  $y = \sqrt{ax} + \frac{a^2}{\sqrt{ax}}$  then  $y_1, y_2$  at  $x = a$  are

A. 0

B. -1

C. 1

D. a

**Answer: A**



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45. If  $y = ae^x + be^{-x} + c$ , where  $a, b, c$  are parameters, then  $y''$  is equal to

A. 0

B.  $y'$

C.  $y$

D.  $y''$

**Answer: C**



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46. If  $y = a \cos(\log x) + b \sin(\log x)$  then  $x^2 y_2 + x y_1 + y =$

A.  $y$

B.  $-y$

C.  $2y$

D.  $-2y$

**Answer: B**



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47. If  $h(x) = e^{e^x}$  then  $\frac{h'(x)}{h(x)}$

A.  $h(x)$

B.  $\frac{1}{h(x)}$

C.  $\log h(x)$

D.  $-\log h(x)$

**Answer: C**



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48.  $\frac{d}{dx} \{ \sin^{-1}(3x - 4x^3) \} =$

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

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

C.  $\frac{1}{\sqrt{4-x^2}}$

D.  $-\frac{1}{\sqrt{4-x^2}}$

**Answer: B**



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49. If  $y_k$  is the  $k$ th derivative of  $y$  with respect to  $x$ ,  $y = \cos(\sin x)$  then

$$y_1 \sin x + y_2 \cos x =$$

A.  $y \sin^3 x$

B.  $-y \sin^3 x$

C.  $y \cos^3 x$

D.  $-y \cos^3 x$

**Answer: D**



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50. If  $f(x) = \frac{x^2}{x+a}$ , then  $f''(a)$  is equal to

A.  $4a$

B.  $\frac{1}{8a}$

C.  $\frac{1}{4a}$

D.  $8a$

**Answer: C**



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