



MATHS

BOOKS - ACCURATE PUBLICATION

DIFFERENTIABILITY

Questions Carrying 4 Marks Examples

1. Use chain rule to find $\frac{dy}{dx}$ if $y = \left(\frac{2x - 1}{2x + 1}\right)^2$



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2. Use chain rule to find $\frac{dy}{dx}$, if $y = \left(\frac{3x - 1}{3x + 1}\right)^2$.



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3. Use chain rule to find $\frac{dy}{dx}$, if $y = \left(\frac{4x - 1}{4x + 1} \right)^2$.



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4. Differentiate $\log(x + \sqrt{a^2 + x^2})$ w.r.t.x .



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5. Differentiate $\log(x + \sqrt{a^2 + x^2})$ w.r.t.x .



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6. Differentiate the following w.r.t.x

$$y = \log\left(x + 2 + \sqrt{x^2 + 4x + 1}\right)$$

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7. Find $\frac{dy}{dx}$ if $y = \log\left(x + 3 + \sqrt{x^2 + 6x + 3}\right)$

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8. Differentiate the following w.r.t.x

$$y = \log\left(x + 4 + \sqrt{x^2 + 8x + 4}\right)$$

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9. If $y = \sqrt{2^x + \sqrt{2^x + \sqrt{2^x + \dots \infty}}}$, then prove that: $(2y - 1) \frac{dy}{dx} = 2^x \log 2$.

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10. If $y = \sqrt{3^x + \sqrt{3^x + \sqrt{3^x + \dots \infty}}}$, then prove that: $(2y - 1) \frac{dy}{dx} = 3^x \log 3$.

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11. If $y = \sqrt{5^x + \sqrt{5^x + \sqrt{5^x + \dots \infty}}}$, then prove that: $(2y - 1) \frac{dy}{dx} = 5^x \log 5$.

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12. Differentiate the following w.r.t. x :

$$\frac{(ax + b)(cx + d)}{(ax - b)(cx - d)}, x \neq \frac{b}{a}, \frac{d}{c}$$

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13. If $y = \sqrt{\frac{(x - 3)(x^2 + 4)}{(3x^2 + 4x + 5)}}$, then find $\frac{dy}{dx}$

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14. Differentiate the function w.r.t. x :

$$\frac{\sqrt{(x - 1)(x - 2)}}{(x - 3)(x - 4)(x - 5)}$$

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15. If $x^y + y^x = 10$, find $\frac{dy}{dx}$

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16. "If $y = \sqrt{\cos x + \sqrt{\cos x + \sqrt{\cos x + \dots \infty}}}$ ", prove that " $\frac{dy}{dx} = \frac{\sin x}{(1-2y)}$ ".

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

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18. $y = \sqrt{\tan x + \sqrt{\tan x + \sqrt{\tan x + \dots \text{to } \infty}}}$ prove that

$$(2y - 1) \frac{dy}{dx} = \sec^2 x.$$

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19. If $\sin y = x \sin(a + y)$, then prove that $\frac{dy}{dx} = \frac{\sin^2(a + y)}{\sin a}$.

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20. If $\sin y = x \cos(a + y)$, prove that $\frac{dy}{dx} = \frac{\cos^2(a + y)}{\cos a}$.

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21. If $\sin y = x \cos(a + y)$, prove that $\frac{dy}{dx} = \frac{\cos^2(a + y)}{\cos a}$

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22. If $x = a(\theta + \sin \theta)$, $y = a(1 - \cos \theta)$, then $\frac{dy}{dx} =$

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23. Find $\frac{dy}{dx}$ in the following

$$x = a(\theta - \sin \theta), y = a(1 + \cos \theta)$$

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24. Find $\frac{dy}{dx}$ when $x = a(\theta - \sin \theta)$, $y = b(1 - \cos \theta)$.



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25. If $y = (\sin x)^{\cos x}$, then find $\frac{dy}{dx}$.



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26. (i) If $y = (\cos x)^{\sin x}$, then find $\frac{dy}{dx}$.

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



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27. If $y = (x \tan x)^x$, then find $\frac{dy}{dx}$.



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28. (i) If $y = (\sin x)$, find $\frac{dy}{dx}$.

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

(iii) If $y = (\tan x)^x$, find $\frac{dy}{dx}$.

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29. Differentiate : $x^{\sin x} + (\sin x)^x$ w. r. to x :

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30. If $y = x^{\sin x} + (\sin x)^{\cos x}$ then find $\frac{dy}{dx}$.

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31. Differentiate : $x^{\cos x} + (\cos x)^x$ w. r. tx :

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32. If $y = x^{\tan x} + (\tan x)^x$, then find $\frac{dy}{dx}$.

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

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34. Find $\frac{dy}{dx}$ of the function : $(\cos x)^y = (\cos y)^x$

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

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36. Differentiate $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$, $0 < x < 1$. w.r.t.x

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37. Differentiate $\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ w.r.t.x .

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38. Differentiate the following w.r.t. x :

$$\sin^{-1}\left(\frac{2x}{1+x^2}\right), \quad -1 < x < 1$$

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39. Differentiate the following functions by substitution

method: $\cot^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right), \quad x \neq 0$

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40. Differentiate $\tan^{-1}\left(\frac{\sqrt{1+a^2x^2}-1}{ax}\right)$ w.r.t. x .

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41. If $y = \tan^{-1} \left\{ \frac{\sqrt{1 + \sin x} + \sqrt{1 - \sin x}}{\sqrt{1 + \sin x} - \sqrt{1 - \sin x}} \right\}$, then $\frac{dy}{dx}$ is

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42. Prove that :

$$\cot^{-1} \left[\frac{\sqrt{1 + \sin x} + \sqrt{1 - \sin x}}{\sqrt{1 + \sin x} - \sqrt{1 - \sin x}} \right] = \frac{x}{2}, x \in \left(0, \frac{\pi}{4} \right)$$

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43. Differentiate $\sin^{-1} \left(\frac{x}{\sqrt{1 + x^2}} \right)$ w.r.t. $\tan^{-1} x$.

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44. Differentiate $\cos^{-1}\left(\frac{1}{\sqrt{1+x^2}}\right)$ w.r.t. $\tan^{-1}x$.

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45. Differentiate $\tan^{-1}\left(\frac{x}{\sqrt{1-x^2}}\right)$ w.r.t. $\sin^{-1}x$.

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46. Differentiate $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$ w.r.t. $\tan^{-1}x$.

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47. Differentiate $\sin^{-1}\left(\frac{2x}{1+x^2}\right)$ w.r.t. $\tan^{-1}x$.

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48. Differentiate $\frac{\tan^{-1}(2x)}{1-x^2}$ w.r.t. $\tan^{-1} x$.

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49. If $y = e^x \sin x$, then find $\frac{dy}{dx}$

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50. If $Y = e^x \cos x$, then find $d^2 \frac{y}{dx^2}$

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51. If $y = e^x \tan x$, then find $d^2 \frac{y}{dx^2}$

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52. If $y = 3e^{2x} + 2e^{3x}$ then prove that

$$\frac{d^2 y}{dx^2} - 5 \frac{dy}{dx} + 6y = 0$$

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53. If $y = (\tan^{-1} x)^2$, then prove that

$$(1 + x^2)^2 \frac{d^2 y}{dx^2} + 2x(1 + x^2) \frac{dy}{dx} - 2 = 0$$

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54. If $y = [\sin^{-1} x]^2$, then prove that :

$$(1 - x^2)y_2 - xy_1 - 2 = 0.$$

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55. $y = e^{m \sin^{-1} x}$, prove that $(1 - x^2)y_2 - xy_1 = m^2y$

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56. If $y = e^{a \cos^{-1} x}$, $-1 \leq x \leq 1$, show that

$$(1 - x^2) \frac{d^2y}{dx^2} - x \left(\frac{dy}{dx} \right) - a^2y = 0$$

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57. If $y = e^{m \tan^{-1} x}$, then show that

$$(1 + x^2)y_2 + (2x - m)y_1 = 0.$$

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58. If $y = e^{2 \tan^{-1} x}$, then show that

$$(1 + x^2)^2 \frac{d^2 y}{dx^2} + 2x(1 + x^2) \frac{dy}{dx} = 4y$$

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59. If $y = \left[x + 3 + \sqrt{x^2 + 6x + 10} \right]^n$ then prove that

$$(x^2 + 6x + 10)y_2 + (x + 3)y_1 - n^2 y = 0.$$

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60. If $y = \left[x + 2 + \sqrt{x^2 + 4x + 10} \right]^n$ then prove that $(x^2 + 4x + 10)y_2 + (x + 2)y_1 - n^2y = 0$.

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61. If $y = \left[x + 5 + \sqrt{x^2 + 10x + 1} \right]^n$ then prove that $(x^2 + 10x + 1)y_2 + (x + 5)y_1 - n^2y = 0$.

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Questions Carrying 1 Mark Mcq S Type I

1. The derivative of $f(x) = |x|$ at $x=1$ equals :

A. 1

B. -1

C. 0

D. 2

Answer: A



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2. The derivative of $f(x) = |x|$ at $x = 2$ equals

A. 1

B. -1

C. 0

D. 2

Answer: A



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3. If $y = a^5$ then $\frac{dy}{dx}$ is equal to :

A. $5a^4$

B. $a^5 \log a$

C. $\frac{a^5}{\log a}$

D. 0

Answer: D



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4. If $y = n^x$, $n > 0$ then $\frac{dy}{dx}$ is equal to

A. xn^{x-1}

B. $\frac{x}{\log n}$

C. $n^x \log n$

D. None of these

Answer: C



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5. If $x = at$, $y = at^2$ then $\frac{dy}{dx}$ is:

A. $2t$

B. $2a$

C. 2

D. t

Answer: A



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6. If $x = 2at, y = at^2$, then $\frac{dx}{dy}$ is equal to :

A. 2

B. 2a

C. 2at

D. t

Answer: D

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7. If $x = 3at$, $y = at^3$, then $\frac{dy}{dx}$ is equal to :

A. 3

B. $3a$

C. $3at$

D. t^2

Answer: D

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8. If $y = \tan x$ then $\frac{dy}{dx}$ at $x = \frac{\pi}{4}$ is equal to:

A. 0

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

C. $\sqrt{2}$

D. 2

Answer: D



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9. If $y = \log(\tan x)$, then $\frac{dy}{dx}$ is:

A. $\frac{1}{\tan x}$

B. $\frac{\sec^2 x}{\tan x}$

C. $\sec^2 x$

D. 0

Answer: B

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10. The derivative of $\sqrt{\log(\sin x)}$ w.r.t. x is

A. $\frac{1}{2\sqrt{\tan x}}$

B. $\frac{1}{2}\sec^2 x$

C. $\frac{\cot x}{2\sqrt{\log(\sin x)}}$

D. None of these

Answer: C

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11. The derivative of $\sqrt{\log(\cos x)}$ w.r.t. x is

A. $\frac{1}{2\sqrt{\tan x}}$

B. $\frac{1}{2\sec^2 x}$

C. $\frac{-\tan x}{2\sqrt{\log(\cos x)}}$

D. None of these

Answer: C



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12. Derivative of $\sin^{-1}(\cos x)$ w.r.t. x equals

A. -1

B. 1

C. $\cos x$

D. $\sin x$

Answer: A



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13. Derivative of $\cos^{-1}(\sin x)$ w.r.t. x equals

A. -1

B. 1

C. $\cos x$

D. $\sin x$

Answer: A

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14. If $y = (\tan^{-1} x)^2$ then $\frac{dy}{dx}$ is equal to:

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

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

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

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

Answer: B

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15. Derivative of $(\sin^{-1} x + \cos^{-1} x)$ w.r.t 'x' is equal to :

A. -1

B. 0

C. 1

D. 2

Answer: B



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16. If $y = \sin(\sin^{-1} x + \cos^{-1} x)$, $x \in [-1, 1]$, then $\frac{dy}{dx}$

is:

A. $\frac{\pi}{2}$

B. $-\frac{\pi}{2}$

C. 0

D. 11

Answer: C



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17. Derivative of $(\tan^{-1} x + \cot^{-1} x)$ w.r.t 'x' is equal to :

A. -1

B. 0

C. 1

D. 2

Answer: B



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18. $\frac{d}{dx} \{ \sin^{-1}(e^x) \}$ is equal to :

A. $e^x \sin^{-1}(e^x)$

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

C. $\frac{e^x}{1 - e^x}$

D. $e^x \cos^{-1} x$

Answer: B



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19. $\frac{d}{dx} \{ \cos^{-1}(e^x) \}$ is equal to:

A. $e^x \sin^{-1}(e^x)$

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

C. $e^x \cos^{-1} x$

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

Answer: D

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20. If $y = \sin x$, then $d^2 \frac{y}{dx^2}$ at $x = \frac{\pi}{2}$ is equal to :

A. 2

B. 0

C. -1

D. 1

Answer: C



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21. If $y = \sin x$, then at $x = \frac{\pi}{2}$, y_2 is equal to

A. -1

B. 1

C. 0

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

Answer: A

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22. If $y = \tan x$ then at $x = 0$, y_2 is equal to :

A. -1

B. 1

C. 0

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

Answer: C

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23. Let $f(x) = |\cos x|$. Then,

A. f is everywhere differentiable

B. f is everywhere continuous but not differentiable at

$$x = n\pi, n \in \mathbb{Z}$$

C. f is everywhere continuous but not differentiable at

$$x = (2n + 1)\frac{\pi}{2}, n \in \mathbb{Z}$$

D. None of these

Answer: C



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24. The set of points where the functions f given by

$$f(x) = |x - 3|\cos x \text{ is differentiable is}$$

A. \mathbb{R}

B. $R - \{3\}$

C. $(0, \infty)$

D. None of these

Answer: B



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25. Differential coefficient of $\sec(\tan^{-1} x)$ w.r.t. x is

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

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

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

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

Answer: A



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26. If $u = \sin^{-1}\left(2\frac{x}{(1+x)^2}\right)$ and $v = \tan^{-1}\left(2\frac{x}{1-x^2}\right)$

, the $\frac{d}{d}v$ is

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

B. x

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

D. 1

Answer: D



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27. The set of points where the function f given by

$f(x) = |2x - 1|\sin x$ is differentiable is

A. \mathbb{R}

B. $\mathbb{R} - \left(\frac{1}{2}\right)$

C. $(0, \infty)$

D. None of these

Answer: B



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28. The function $f(x) = e^{|x|}$ is

A. continuous every where but not differentiable at $x=0$

B. continuous and differentiable everywhere

C. not continuous at $x=0$

D. None of these

Answer: A

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29. Let $f(x) = |\sin x|$. Then

A. f is everywhere differentiable

B. f is everywhere continuous but not differentiable at

$$x = n\pi, n \in \mathbb{Z}$$

C. f is everywhere continuous but not differentiable at

$$x = (2n + 1)\frac{\pi}{2}, n \in \mathbb{Z}$$

D. None of these

Answer: B

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30. If $y = \log\left(\frac{1 - x^2}{1 + x^2}\right)$, then $\frac{dy}{dx}$ is equal to

A. $\frac{4x^3}{1 - x^4}$

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

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

D. $\frac{-4x^3}{1 - x^4}$

Answer: B



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31. If $y = \sqrt{\sin x + y}$, then $\frac{dy}{dx}$ is equal to

A. $\frac{\cos x}{2y - 1}$

B. $\frac{\cos x}{1 - 2y}$

C. $\frac{\sin x}{1 - 2y}$

D. $\frac{\sin x}{2y - 1}$

Answer: A



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32. The derivative of $\cos^{-1}(2x^2 - 1)$ w.r.t. $\cos^{-1} x$ is

A. 2

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

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

D. $1 - x^2$

Answer: A



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33. If $x = t^2$, $y = t^3$, then $\frac{d^2y}{dx^2}$ is

A. $\frac{3}{2}$

B. $\frac{3}{4t}$

C. $\frac{3}{2t}$

D. $\frac{3}{4}$

Answer: B



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Questions Carrying 1 Mark Fill In The Blanks Questions Type Ii

1. The derivative of $f(x) = |x|$ at $x = 3$ equals



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2. If $y = x^a$, $a \in R$ then $\frac{dy}{dx}$ is equal to :



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3. If $x = 4at$, $y = at^4$, then $\frac{dy}{dx}$ is equal to :

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4. The derivative of $\sqrt{\log(\tan x)}$ w.r.t. x is ____

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5. Derivative of $\tan^{-1}(\cot x)$ w.r.t. x equals

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6. Derivative of $(\sec^2 x + \operatorname{cosec}^{-1} x)$ w.r.t. x is ____



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7. $\frac{d}{dx} \{ \tan^{-1}(e^x) \}$ is equal to :



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8. If $y = \cos x$, then $d^2 \frac{y}{dx^2}$ at $x = \pi$ is equal to :



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9. If $y = \cos x$ then at $x = \frac{\pi}{2}$, y_2 is equal to ____



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10. If $y = \sin 2x$, then $\frac{d^2y}{dx^2}$ at $x = \frac{\pi}{2}$ is equal to ____

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11. The derivative of $f(x) = |x|$ at $x=3$ equals ____

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12. If $y = x^a$, $a \in R$ then $\frac{dy}{dx}$ is equal to ____

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13. If $x = 4at$, $y = at^4$, then $\frac{dy}{dx}$ is equal to ____

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14. The derivative of $\sqrt{\log(\tan x)}$ w.r.t. x is ____

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15. Derivative of $\tan^{-1}(\cot x)$ w.r.t. x equals ____

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16. Derivative of $(\sec^{-1} x + \operatorname{cosec}^{-1} x)$ w.r.t. x is

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17. $\frac{d}{dx} \{ \tan^{-1}(e^x) \}$ is equal to :



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18. If $y = \cos x$, then $d^2 \frac{y}{dx^2}$ at $x = \pi$ is equal to :



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19. If $y = \cos x$ then at $x = \frac{\pi}{2}$, y_2 is equal to ____



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20. If $y = \sin 2x$, then $\frac{d^2 y}{dx^2}$ at $x = \frac{\pi}{2}$ is equal to ____



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Questions Carrying 1 Mark True Or False Questions Type Iii

1. true or false: $|\sin x|$ is a differentiable function for every value of x .

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2. true false: $\cos|x|$ is differentiable every where.

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3. All trigonometric functions have inverse over their respective domains.

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$$4. \frac{d}{dx} [(3x^2 + 2)^2] = 12(3x^2 + 2).$$

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5. If $x = f(t)$ and $y = \phi(t)$ then to prove that

$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{\phi'(t)}{f'(t)}.$$

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$$6. \frac{d}{dx} (\sec^{-1} x + \operatorname{cosec}^{-1} x) = 0$$

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

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2. If $\frac{x}{x-y} = \log \frac{a}{x-y}$, then prove that $\frac{dy}{dx} = 2 - \frac{x}{y}$.

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3. If $y = \sqrt{x+1} - \sqrt{x-1}$, prove that

$$(x^2 - 1) \frac{d^2y}{dx^2} + x \frac{dy}{dx} - \frac{1}{4}y = 0.$$

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4.

If

$$f(x) = \sqrt{x^2 + 1}, g(x) = \frac{x + 1}{x^2 + 1} \text{ and } h(x) = 2x - 3,$$

then find $f'[h'\{g'(x)\}]$.

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5. IF $\left[x = a \left\{ \frac{1 + t^2}{1 - t^2} \right\} \right]$ and $\left[y = 2 \frac{t}{1 - t^2} \right]$ find dy/dx .

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6. Differentiate $7x^5 - 11x^2$ w.r.t. $7x^2 - 15x$.

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7. If $x^2 + y^2 = t - \frac{1}{t}$ and $x^4 + y^4 = t^2 + \frac{1}{t^2}$, show that

$$\frac{dy}{dx} = \frac{1}{x^3 y}.$$

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8. If $y\sqrt{x^2 + 1} = \log(x + \sqrt{x^2 + 1})$, show that

$$(x^2 + 1) \frac{dy}{dx} + xy - 1 = 0.$$

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9. If $e^x + e^y = e^{x+y}$, prove that $\frac{dy}{dx} + e^{y-x} = 0$.

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10. If $x\sqrt{1+y} + y\sqrt{1+x} = 0$ then $\frac{dy}{dx}$ equals.

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11. If $y = x^{e^{x^2}}$, find $\frac{dy}{dx}$.

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12. If $x^y = e^{x-y}$, then prove that $\frac{dy}{dx} = \frac{\log x}{(1 + \log x)^2}$

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13. Differentiate the following w.r.t.x.

If $y^x = e^{y-x}$, prove that $\frac{dy}{dx} = \frac{(1 + \log y)^2}{\log y}$

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14. If $x^p \cdot y^q = (x + y)^{p+q}$, show that $\frac{dy}{dx} = \frac{y}{x}$

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15. If $x^{16} \cdot y^9 = (x^2 + y)^{17}$, prove that $\frac{dy}{dx} = \frac{2y}{x}$.

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16. Find $\frac{dy}{dx}$, if $y^x + x^y + x^x = a^b$.



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17. If $y = a \sin x + b \cos x$, prove that $y^2 + \left(\frac{dy}{dx}\right)^2 = a^2 + b^2$



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18. If $x \sin(a+y) + \sin a \cos(a+y) = 0$, then prove that :

$$\frac{dy}{dx} = \frac{\sin^2(a+y)}{\sin a}$$



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19. Find the value of $\frac{dy}{dx}$ at $\theta = \frac{\pi}{4}$ if $x = ae^\theta(\sin \theta - \cos \theta)$

and $y = ae^\theta(\sin \theta + \cos \theta)$.



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20. If $x = \cos t(3 - 2 \cos^2 t)$ and $y = \sin t(3 - 2 \sin^2 t)$, find the value of $\frac{dy}{dx}$ at $t = \frac{\pi}{4}$.

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21. If $x = a \sin 2t(1 + \cos 2t)$ and $y = b \cos 2t(1 - \cos 2t)$. show that $\left(\frac{dy}{dx}\right)_{t=\frac{\pi}{4}} = \frac{b}{a}$ Also find $\frac{dy}{dx}$ at $t = \frac{\pi}{3}$

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22. Find $\frac{dy}{dx}$ at $t = \frac{\pi}{4}, \frac{\pi}{3}$, when $x = a \left(\cos t + \log \tan \frac{t}{2} \right)$, $y = a \sin t$.

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23. If

$x = 2 \cos \theta - \cos 2\theta$ and $y = 2 \sin \theta - \sin 2\theta$ Prove that

$$\frac{dy}{dx} = \tan\left(\frac{3\theta}{2}\right).$$

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24. If $y = x^{\sin x - \cos x} + \frac{x^2 - 1}{x^2 + 1}$, find $\frac{dy}{dx}$.

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25. Find $\frac{dy}{dx}$ when :

$$y = x^{\cot x} + \frac{2x^2 - 3}{x^2 + x + 2}$$

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26. Find $\frac{dy}{dx}$, if $y = (\cos x)^x + (\sin x)^{\frac{1}{x}}$.

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27. If $(\cos x)^y = (\sin y)^x$, then find $\frac{dy}{dx}$.

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28. If $y = x^{\cot x} + (\sin x)^x$, find $\frac{dy}{dx}$.

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29. Differentiate $(\sin x)^x + (\cos x)^{\sin x}$ w.r.t. x .

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30. Differentiate $\sin^{-1}\left(\frac{2^{x+1}}{1+4^x}\right)$ w.r.t x

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31. Differentiate the following with respect to x :

$$\sin^{-1}\left[\frac{2^{x+1} \cdot 3^x}{1 + (36)^x}\right]$$

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

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33. If $y = \sin^{-1}\left(\frac{2x}{1+x^2}\right) + \sec^{-1}\left(\frac{1+x^2}{1-x^2}\right)$, prove that

$$\frac{dy}{dx} = \frac{4}{1+x^2}, 0 < x < 1$$

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34. If $y = \tan^{-1}\left(\frac{\sqrt{1+x^2} - \sqrt{1-x^2}}{\sqrt{1+x^2} + \sqrt{1-x^2}}\right)$, then show that

$$\frac{dy}{dx} = \frac{x}{\sqrt{1-x^4}}$$

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35. If $y = \sin^{-1} \left[x\sqrt{1-x} - \sqrt{x}(\sqrt{1-x^2}) \right]$ find $\frac{dy}{dx}$

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36. Differentiate $\tan^{-1} \left(\frac{\sqrt{1+x^2}-1}{x} \right)$ w.r.t.
 $\sin^{-1} \left(\frac{2x}{1+x^2} \right)$.

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37. Differentiate $\tan^{-1} \left(\frac{\sqrt{1-x^2}}{x} \right)$ w.r.t.
 $\cos^{-1} (2x\sqrt{1-x^2})$

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38. Differentiate $\tan^{-1}\left(\frac{x}{\sqrt{1-x^2}}\right)$ w.r.t. $\sin^{-1}(2x\sqrt{1-x^2})$.

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39. Find the derivative of $\sec^{-1}\left(\frac{1}{2x^2-1}\right)$ w.r.t. $\sqrt{1-x^2}$ at $x = \frac{1}{2}$.

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40. Find $\frac{dy}{dx}$ when $y = (\sin x)^x + \sin^{-1} \sqrt{x}$.

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41. If $y = 3 \cos(\log x) + 4 \sin(\log x)$ show that

$$x^2 y_2 + x y_1 + y = 0$$

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42. If $y = e^{ax} \cos bx$, then prove that

$$\frac{d^2 y}{dx^2} - 2a \frac{dy}{dx} + (a^2 + b^2)y = 0.$$

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43. If $(a + bx)e^{y/x} = x$, show that $x^3 y'' = (xy' - y)^2$.

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44. If $y = x^3 \log\left(\frac{1}{x}\right)$, prove that $\frac{d^2y}{dx^2} - \frac{2}{x} \frac{dy}{dx} + 3x = 0$.

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45. If $x = \tan\left(\frac{1}{2} \log y\right)$, then show that

$$(1 + x^2) \frac{d^2y}{dx^2} = (a - 2x) \frac{dy}{dx}.$$

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46. If $y = x^x$, prove that $\frac{d^2y}{dx^2} - \frac{1}{y} \left(\frac{dy}{dx}\right)^2 - \frac{y}{x} = 0$.

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47. If $x^p y^q = (x + y)^{p+q}$, find $\frac{dy}{dx}$.

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48. If

$$y = \log(x + \sqrt{x^2 + 1}), \text{ prove that } (x^2 + 1)d^2 \frac{y}{dx^2} + x \frac{dy}{dx} = 0$$

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49. Find $\frac{d^2 y}{dx^2}$ in the following

If $x = a(\theta + \sin \theta)$, $y = a(1 - \cos \theta)$, find $\frac{d^2 y}{dx^2}$ at $\theta = \frac{\pi}{2}$

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50. If $x = a \cos \theta + b \sin \theta$ and $y = a \sin \theta - b \cos \theta$, then

prove that $y^2 \frac{d^2y}{dx^2} - \frac{dy}{dx} + y = 0$



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