MATHS

BOOKS - VIKRAM PUBLICATION (ANDHRA PUBLICATION)

DIFFERENTIATION

Solved Problems

1. Show that $f(x) = x^2$ is differentiable $\forall x \in R$. Hence find the derived function.

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2. Check whether the function $f(x) = \begin{cases} 3+x & \text{if } x \geq 0 \\ 3-x & \text{if } x < 0 \end{cases}$ is differentiable at $x = 0$.

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3. If $f(x) = (ax+b)^n, \left(x - > -\frac{b}{a}\right)$ then find f'(x).

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4. Find the derivative of $f(x) = e^x\left(x^2+1\right)$.

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5. If $y = \frac{a-x}{a+x}, (x \neq -a)$ then find $\frac{dy}{dx}$

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6. If $f(x) = e^{2x}.\log x, (x > 0)$ then find $f'(x)$.

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7. If $f(x) = \sqrt{\frac{1+x^2}{1-x^2}}(|x| < 1)$ then find f'(x).

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8. If $f(x) = x^2, 2^x \log x (x > 0)$, find f'(x).

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9. If $y = \begin{vmatrix} f(x)g(x) \\ \phi(x)\Psi(x) \end{vmatrix}$ then show that $\frac{dy}{dx} = \begin{vmatrix} f(x)g(x) \\ \phi(x)\Psi(x) \end{vmatrix} + \begin{vmatrix} f(x)g/(x) \\ \phi(x)\Psi(x) \end{vmatrix}$

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10. Find $f(x) = 7^{3+3x}(x > 0)$, then find $f'(x)$.

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11. If $f(x) = xe^x \sin x$ then find $f'(x)$.

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12. If $f(x) = \sin(\log x), (x > 0)$ then find f'(x)

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13. If $f(x) = \left(x^3 + 6x^2 + 12x - 15\right)^{100}$, find f(x) .

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14. Find the derivative of $f(x) = \frac{x \cos x}{\sqrt{1+x^2}}$

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15. If $f(x) = \log(\sec x + \tan x)$, find f(x).

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16. If $y = \sin^{-1}\sqrt{x}$, then find $\frac{dy}{dx}$.

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17. If $y = \sec\left(\sqrt{\tan x}\right)$, find $\frac{dy}{dx}$.

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18. Find $\int \frac{x \sin^{-1} x}{\sqrt{1-x^2}} dx$

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19. If $y = \log(\cosh 2x)$ then find $\frac{dy}{dx}$

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

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21. If $y = \left(\cot^{-1} x^3\right)^2$ then find $\frac{dy}{dx}$.

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

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23. If $y = \tan^{-1}\left(\cos\sqrt{x}\right)$ then find $\frac{dy}{dx}$

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24. If $y = \tan(-1)\left(\frac{\sqrt{(1+x^2)}+\sqrt{1-x^2}}{\sqrt{1+x^2}-\sqrt{1-x^2}}\right)$ then find $\frac{dy}{dx}$.

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

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

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27. If $x = a\left[\cos t + \log \tan\left(\frac{t}{2}\right)\right], y = a \sin t$ then find $\frac{dy}{dx}$.

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

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29. if $\sin y = x \sin(a+y)$ then show that $\frac{dy}{dx} = \frac{\sin^2(a+y)}{\sin a}$.

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30. If $y = x^4 + \tan x$ then find y".

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31. If $f(x) = \sin x, \sin 2x \sin 3x$, find $f(x)$.

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32. Show that $y = x + \tan x$ satisfies the equation $\cos^2 x \frac{dy^2}{dx^2} + 2x = 2y.$

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33. If $x = a(t - \sin t), y = a(1 + \cos t)$ find $\frac{d^2y}{dx^2}$.

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34. Find the second order derivative of $y = \tan^{-1}\left(\frac{2x}{1-x^2}\right)$

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35. If $y = \sin(\sin x)$ then show that $y'' + (\tan x)y' + y\cos^2 x = 0$.

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36. If $y = \tan^{-1}\sqrt{\frac{1-x}{1+x}}$ then $\frac{dy}{dx}$ at

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37. If $y = \tan^{-1}\left[\frac{2x}{l-x^2}\right](|x| < 1)$ then we shall $\frac{dy}{dx}$.

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38. Find $\frac{dy}{dx}$ if $x = a\cos^3 t, y = a\sin^3 t.$

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39. If $y = e^t + \cos t, x = \log t + \sin t$ then find $\frac{dy}{dx}$.

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40. To find the derivative of $f(x) = x^{\sin\frac{1}{x}}$ with respect to $g(x) = \sin^{-1} x$, we have to compute $\frac{df}{dg}$

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41. If $x^3 + y^3 = 3axy$then $\frac{dy}{dx} =$

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

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43. If $y = x^x (x > 0)$, find $\frac{dy}{dx}$

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

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Exercise 9 A

1. Find the derivatives of the following functions $f(x)$.

$\sqrt{x} + 2x^{\frac{3}{4}} + 3x^{\frac{5}{6}} (x > 0)$

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2. Find the derivatives of the following functions $f(x)$.

$\sqrt{2x-3}+\sqrt{7-3x}$

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3. Find the derivatives of the following functions $f(x)$.

$\left(x^2-3\right)\left(4x^3+1\right)$

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4. Find the derivatives of the following functions $f(x)$.

$\left(\sqrt{x}-3x\right)\left(x+\frac{l}{x}\right)$

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5. Find the derivatives of the following functions $f(x)$.

$\left(\sqrt{x+l}\right)\left(x^2-4x+2\right)(x>0)$

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6. Find the derivative of the following functions (it is to be understood that a, b, c, d, p, q, r and s are fixed non-zero constants and m and n are integers):

$(ax+b)^n(cx+d)^m$

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7. Find the derivatives of the following functions $f(x)$.

$5\sin x+e^x\log x$

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8. Find the derivatives of the following functions $f(x)$.

$5^x + \log x + x^3 e^x$

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9. Find the derivatives of the following functions $f(x)$.

$e^x + \sin x \cos x$

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10. Find the derivative of w.r.to x

$\frac{1}{ax^2 + bx + c}$(whre $|a| + |b| + |c| \neq 0$)

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11. Find the derivatives of the following functions $f(x)$.

$\log_7(\log x)(x > 0)$

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12. Find the derivative of w.r.to x

$\frac{1}{ax^2 + bx + c}$(whre $|a| + |b| + |c| \neq 0$)

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13. Find the derivatives of the following functions $f(x)$.

$e^{2x} \log(3x + 4)\left(x > \frac{-4}{3}\right)$

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14. Find the derivatives of the following functions $f(x)$.

$(4 + x^2)e^2xy$

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15. Find the derivatives of the following functions $f(x)$.

$\frac{ax + b}{ax + d}[|c| + |d| \neq 0]$

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16. Find the derivatives of the following functions $f(x)$.

$a^x . e^{x^2}$

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17. If $f(x) = 1 + x + x^2 + \ldots\ldots\ldots\ldots + x^{100}$, then find $f'(1)$.

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18. Find the derivatives of the following functions from the first principles.

x^3

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19. Find the derivatives of the following functions from the first principles.

$x^4 + 4$

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20. Find the derivatives of the following functions from the first principles.

$ax^2 + bx + c$

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21. Find the derivatives of the following functions from the first principles.

$\sqrt{x+l}$

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22. Find the derivatives of the following functions from the first principles.

$\sin 2x$

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23. Find the derivatives of the following functions from the first principles.

$\cos ax$

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24. Find the derivatives of the following functions from the first principles.

$\tan 2x$

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25. Find the derivatives of the following functions from the first principles.

$\cot x$

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26. Find the derivatives of the following functions from the first principles.

$\sec 3x$

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27. Find the derivativ of the function from first principles :

$x \sin x$

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28. Find the derivativ of the function from first principles :

$\cos^2 x$

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29. Find the derivative of $\frac{1 - x\sqrt{x}}{1 + x\sqrt{x}}, (x > 0)$

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30. Find the derivative of $x^n n^x \log(nx)$, $(x > 0, n \in N)$.

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31. Find the derivative of the w.r.t.x

$ax^{2n} \log x + bx^n e^{-x}$

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32. Find the derivatives of the following function.

$\left(\frac{1}{x} - x\right)^3 e^x$

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33. Is the following function f derivable at 2 ? Justify .

$f(x)\begin{cases} x & \text{if } 0 \leq x \leq 2 \\ 2 & \text{if } x \geq 2 \end{cases}$

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Exercise 9 B

1. Find the derivative of w.r.to x

$(\cot x)^n$

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2. Find the derivative of w.r.to x

$\cos ec^4 x$

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3. Find the derivatives of the following function.

$\tan(e^x)$

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4. Evaluate the following inegrals

$$\int \frac{1-\cos 2x}{1+\cos 2x} dx$$

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5. Find the derivatives of the following function.

$$\sin^m x \cos^n x$$

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6. Find the derivatives of the following function.

$$\sin mx . \cos nx$$

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7. Find the derivatives of the function

$x \tan^{-1} x$

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8. Find the derivatives of the function

$\sin^{-1}(\cos x)$

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9. Find the derivatives of the following function.

$\log(\tan 5x)$

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10. Find the derivatives of the following function.

$\sinh^{-1}\left(\frac{3x}{4}\right)$

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11. Find the derivatives of the function

$\tan^{-1}(\log x)$

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12. Find the derivative of $\log\left(\frac{x^2+x+2}{x^2-x+2}\right)$ w.r.to x.

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13. Find the derivatives of the following function.

$\log\left(\sin^{-1}(e^x)\right)$

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14. Find the derivative of the function

$$\sin^2 x\left(\sin^{-1} x\right)^2$$

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15. Find the derivative of $y = \dfrac{\cos x}{\sin x + \cos x}$.

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16. Find the derivatives of the following function.

$$\frac{x\left(l + x^2\right)}{\sqrt{l - x^2}}$$

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

$e^{\sin^{-1} x}$

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18. Find the derivatives of the following function.

$y = \cos(\log x + e^x)$

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19. Find the derivatives of the following function.

$y = \dfrac{\sin(x + a)}{\cos x}$

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20. Find the derivatives of the function

$\cot^{-1}(\cos ec3x)$

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21. Find the derivatives of the following functions.

$x = \sinh^2 y$

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22. Find the derivatives of the following functions.

$x = \tanh^2 y$

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23. Find the derivatives of the following functions.

$x = e^{\sinh y}$

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24. Find the derivatives of the following functions.

$x = \tan\left(e^{-y}\right)$

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25. Find the derivatives of the function

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

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26. Find the derivatives of the function

If $x = \log\left(1 + \sqrt{y}\right)$, then show that $\frac{dy}{dx} = 2\sqrt{y}e^{x}$

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27. Find the derivative of $v = \cos[\log(\cot x)]$

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28. Find derivative $y = \sinh^{-1}\left(\frac{1-x}{1+x}\right)$.

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29. Find the derivative of w.r.to x

$\log\left(\cot\left(1 - x^{2}\right)\right)$

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30. Find the derivatives of the following functions.

$y = \sin\left[\cos\left(x^2\right)\right]$

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31. Find the derivative of the function wrt x.

$\sin\left(\tan^{-1}\left(e^{-x}\right)\right)$

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32. Integrate the functions

$\sin(ax+b)\cos(ax+b)$

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33. Find the derivatives of the following functions.

$y = \tan^{-1}\left(\tanh.\ \frac{x}{2}\right)$

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34. Find the derivative of the function

$\sin x \left(\tan^{-1} x\right)^2$

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35. Find the derivative of $\sin^{-1}\left(\frac{b + a\sin x}{a + b\sin x}\right)$ w.r. to x.

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36. Find the derivatives of the function

$\cos^{-1}\left(\frac{b + a\cos x}{a + b\cos x}\right), (a > 0, b > 0)$

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37. Find the derivatives of the following functions.

$$\tan^{-1}\left[\frac{\cos x}{l+\cos x}\right]$$

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Exercise 9 C

1. Find the derivative of $\sin^{-1}\left(3x-4x^3\right)$ with respect of 'x' .

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2. $\frac{d}{dx}\left[\cos^{-1}\left(4x^3-3x\right)\right]=$

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3. Integrate the functions

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

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4. Find the derivative of $\tan^{-1}\left(\frac{a-x}{1+ax}\right)$

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5. Integrate the following functions with respect to x.

$$\tan^{-1}\sqrt{\frac{1-\cos 2x}{1+\cos 2x}}$$

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6. Find the derivatives of the following functions.

$$y = \sin\left[\cos\left(x^2\right)\right]$$

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7. Find the derivatives of the following functions.

$$\sec^{-1}\left(\frac{l}{2x^2 - l}\right)\left(0 < x < \frac{l}{\sqrt{2}}\right)$$

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8. Find the derivative of the function wrt x.

$$\sin\left(\tan^{-1}\left(e^{-x}\right)\right)$$

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9. Differentiate $f(x) = e^x$ w.r.to $g(x) = \sqrt{x}$.

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10. Differentiate $f(x) = e^{\sin x}$ w.r.to $g(x) = \sin x$.

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11. Find the derivative of $f(x) = \tan^{-1}\left(\frac{2x}{1-x^2}\right) w.r.tg(x) = \sin^{-1}\left(\frac{2x}{1+x^2}\right)$.

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12. If $y = e^{a\sin^{-1}x}$ then prove that $\frac{dy}{dx} = \frac{ay}{\sqrt{1-x^2}}$.

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13. Find the derivative of $\tan^{-1}\left(\frac{3a^2x - x^3}{a(a^2-3x^2)}\right)$.

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14. Simplify each of the following:

$\tan^{-1}(\sec x + \tan x)$

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15. Write the following function in the simplest form :

$\tan^{-1}\frac{\sqrt{1+x^2}-1}{x}, x \neq 0$

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16. Find the derivatives of the following function.

$(\log x)^{\tan x}$

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17. Find the derivatives of the following function.

$(x^x)^x = x^{x^2}$

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18. Find the derivative of $20^{\log(\tan x)}$.

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19. Find the derivative of the w.r.to x.

$x^x + e^{e^x}$

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20. Find the derivatives of the following function.

$x.\log x.\log(\log x)$

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21. Find the derivative of

$e^{-ax^2}.\sin(x\log x)$ w.r.t.x

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22. $\sin^{-1}\left(\frac{2^{x+1}}{1+4^x}\right)\left(put\ 2^x=\tan\theta\right)$

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

$x=3\cos t-2\cos^3 t,$

$y=3\sin t-2\sin^3 t$

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24. If $x = \dfrac{3at}{1+t^3}, y = \dfrac{3at^2}{1+t^3}$ then find $\dfrac{dy}{dx}$.

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25. Find $\dfrac{dy}{dx}$ if

$x = a(\cos t + t \sin t), y = a(\sin t - t \cos t)$.

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26. If $x = a\left[\dfrac{1-t^2}{1+t^2}\right], y = \dfrac{2bt}{1+t^2}$ then find $\dfrac{dy}{dx}$.

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27. Differentiate $f(x) = \log_a x$ with respect to $g(x) = a^x$.

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28. Differentiate $f(x)$ with respect to $g(x)$ for the following .

$$f(x) = \sec^{-1}\left(\frac{1}{2x^2-1}\right), g(x) = \sqrt{l-x^2}$$

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29. Find the derivative of $f(x)$ w.r.t. g(x) for the

$$f(x) = \tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right), g(x) = \tan^{-1}x$$

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30. Find the derivative of $x^4 + y^4 - a^2xy = 0$.

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31. Find the derivative of $y = x^y$.

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32. Find the derivative of the function y defined implicitly by each of the following equations.

$y^x = x^{\sin y}$

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33. If $\sqrt{1-x^2} + \sqrt{1-y^2} = a(x-y)$ then prove that $\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{\sqrt{1-x^2}}$.

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34. If $y = x\sqrt{a^2+x^2} + a^2 \log\left(x + \sqrt{a^2+x^2}\right)$, then show that $\frac{dy}{dx} = 2\sqrt{a^2+x^2}$.

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

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36. 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 $\frac{dy}{dx} =$

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37. If $x^y = y^x$ then show that $\frac{dy}{dx} = \frac{y(x\log y - y)}{x(y\log x - x)}$.

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38. If $x^3 + y^3 = 3axy$ then $\frac{dy}{dx} =$

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39. Find the derivative $\frac{dy}{dx}$ of the function $y = \frac{(1-2x)^{2/3}(1+3x)^{-3/4}}{(1-6x)^{5/6}(1+7x)^{-6/7}}$.

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40. Find the derivative $\frac{dy}{dx}$ of each of the following functions.

$$y = \frac{x^4 . \sqrt[3]{x^2+4}}{\sqrt{4x^2-7}}$$
$$= \frac{x^4(x^2+4)^{1/3}}{(4x^2-7)^{1/2}}$$

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41. Find $\frac{dy}{dx}$ for the function (using logarithms).

$$y = \frac{(a-x)^2(b-x)^2}{(c-2x)^3}$$

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42. Find $\frac{dy}{dx}$ for the function (using logarithms).

$$y = \frac{x^3\sqrt{2+3x}}{(1-x)(2+x)}$$

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43. Differentiate $\sqrt{\frac{(x-3)(x^2+4)}{(3x^2+4x+5)}}$.

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44. Find the derivative of $(\sin x)^{\log x} + x^{\sin x}$.

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45. Find the derivatives of the following functions.

x^{x^x}

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46. Find the derivative of (ii) $(\sin x)^x + x^{\sin x}$ w.r.to x.

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47. Find the derivatives of the following functions.

$x^3 + (\cot x)^x$

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48. If $x^y + y^x = a^b$ then prove that $\frac{dy}{dx} = -\left[\frac{yx^{y-1} + y^x \log y}{x^y \log x + xy^{x-1}}\right]$.

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49. If $f(x) = \sin^{-1}\sqrt{\frac{x-\beta}{\alpha-\beta}}, g(x) = \tan^{-1}\sqrt{\frac{x-\beta}{\alpha-x}}$ then prove that f'(x) = g'(x)

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50. If $f(x) = \left(a^2 - b^2\right)^{-1/2} . \cos^{-1}\left(\frac{a\cos x + b}{a + b\cos x}\right) a > b > 0$ and $0 < x < \pi$, then S.T $f'(x) = (a + b\cos x)^{-1}$.

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51. Differentiate $\left(x^2 - 5x + 8\right)\left(x^3 + 7x + 9\right)$ by

Using product rule

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52. Differentiate $\left(x^2 - 5x + 8\right)\left(x^3 + 7x + 9\right)$ by

Using product rule

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53. Differentiate $\left(x^2-5x+8\right)\left(x^3+7x+9\right)$ by

Using product rule

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Exercise 9 D

1. If $y=\dfrac{2x+3}{4x+5}$ then find y''.

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2. If $y=ae^{nx}+be^{-nx}$, then prove that $y''=n^2y$.

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3. Find the second order derivatives of the following functions of f(x)

$y = \cos^3 x$

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4. Find the second order derivatives of the following functions of f(x)

$y = \sin^4 x$

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5. Find the second order derivatives of the following functions of f(x)

$\log\left(4x^2 - 9\right)$

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6. Find the second order derivatives of the following functions of f(x)

$y = e^{-2x} \sin^3 x$

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7. Find the second order derivatives of the following functions of f(x)

$e^x \sin x \cos 2x$

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8. Find the second order derivatives of the following functions of f(x)

$\tan^{-1}\left[\frac{l+x}{l-x}\right]$

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9. $\tan^{-1}\left(\frac{3x - x^3}{1 - 3x^2}\right) =$

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10. If $y = ax^{n+1} + bx^{-n}$ then show that $x^2 y'' = n(n+1)y$.

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11. If $y = a\cos x + (b + 2x)\sin x,$ then show that $y'' + y = 4\cos x$.

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12. If $ay^4 = (x + b)^5$ then show that $5yy'' = (y')^2$.

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13. If $y = a\cos(\sin x) + b\sin(\sin x)$ then prove that $y'' + (\tan x)y' + y\cos^2 x = 0$.

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14. If $y = 128 \sin^3 x \cos^4 x$,then find $\frac{d^2y}{dx^2}$

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15. If $y = e^{-kx/2}(a \cos nx + b \sin nx)$ then $y_2 + ky_1 + \left(n^2 + k^2/4\right)y =$

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