MATHS

BOOKS - SHARAM PUBLICATION

CONTINUITY AND DIFFERENTIABILITY

Example

1. If a function $f(x) = \dfrac{x^2 - 4}{x - 2}$ is continuous at x = 2, then what is the value of f (2) ?

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2. If $f(x) = \dfrac{x^3 + x^2 - 16x + 20}{(x - 2)^2}$ if $x \neq 2 = k$ if $x = 2$ is continuous at for all x, then what is the value of k.

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3. If $f(x) = (1 + 2x)^{\frac{1}{x}}$, $x \neq 0$ is continuous at x=0, then what is the value of f(0) ?

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4. The function $f(x) = \begin{cases} 6.5 & f \text{ or } x \leq 0 \\ 2a + x & f \text{ or } x > 0 \end{cases}$ continuous at x = 0. Then what is value of a ?

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5. The function $f(x) = \begin{cases} \left[\dfrac{x^3 - 3x + 2}{x^2 - 10^2}, \quad \text{if } x \neq 1 \right], [K, \quad \text{if } x = 1] \end{cases}$ is continuous for all x then what is value of k.

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6. If the function $f(x) = \dfrac{\sin 10x}{x}$ is continuous at x = 0 then what is f(0)?

7. If $f(x) = \left\{ \left(\dfrac{x^3 - 8}{x - 2} \right), whenx \neq 2 \right), (k, whenx = 2) :\}$ is continuous at x = 2, then what is the value of k.

8. Discuss the continuity of `f(x)={((x^2-25)/(x-5),when x!=5),(9,when x=5):}

9. Discuss the continuity of the function $f(x) = \left\{ \dfrac{\sin 3x}{2x}, whenx \neq 0 \right), \left(\dfrac{3}{2}, whenx = 0 \right) :\}$ .at x=0

10. Show that the function $f(x) = \begin{cases} \frac{e^{1/x}-1}{e^{1/x}+1}, & \text{when } x \neq 0 \\ 0, & \text{when } x = 0 \end{cases}$ is

discontinuous at $x = 0$.

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11. Examine the continuity of the function $f(x) = \begin{cases} \frac{1}{x+[x]} & \text{if } x < 0 \\ -1 & \text{if } x \geq 0 \end{cases}$

at x=0.

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12. Discuss the continuity of the function

$f(x) = \begin{cases} \frac{|x|}{x}, & \text{if } x \neq 0 \\ 0, & \text{if } x = 0 \end{cases}$ at $x = 0$.

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13. If a function is continuous at x=a, then find

$$\lim_{h \to 0} \quad + \frac{1}{2}\{f(a+h) + f(a-h)\}$$

14. Examine the continuity of $f(x) = \dfrac{\sin(\pi(x))}{2}$ at x = 0.

15. Find the value of a such that the function f defined by

$$f(x) = \begin{cases} \frac{\sin ax}{\sin x} & \text{if } x \neq 0 \\ \frac{1}{a} & \text{if } x = 0 \end{cases}$$

is continuous at x=0.

16. If $f(x) = \begin{cases} ax^2 + b & \text{if } x < 1 \\ 1 & \text{if } x = 1 \\ 2ax - b & \text{if } x > 1 \end{cases}$

is continuous at x=1, then find a and b.

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17. Show that sinx is continuous for every real x.

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18. For what value of k is the function defined by $\begin{cases} k(x^2 + 2) & when x \leq 0 \\ 3x + 1 & when x > 0 \end{cases}$ .Continuous at x = 0. Also write whether the function is continuous at x = 1.

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19. Find the value of k if the function f(x) defined by

$$f(x) = \begin{cases} 2x - 1 & when\,x < 2 \\ k & when\,x = 2 \\ x + 1 & when\,x > 2 \end{cases}$$ is continous at x=2.

20. For what value of λ is the function

$$f(x) = \begin{cases} \lambda(x^2 - 2x), & \text{if } x \leq 0 \\ 4x + 1, & \text{if } x > 0 \end{cases}$$ continuous at x=0 ?

What about continuity at x=1 ?

21. Find the value of k, so that the function defined by

$$f(x) = \begin{cases} kx + 1, & \text{if } x \leq \pi \\ \cos x, & \text{if } x > \pi \end{cases}$$ is continuous at $x = \pi$.

22. Examine the contiunity of the following functions at the indicated points . $f(x)=\begin{cases} 2x+1 & \text{if } x \leq 0 \\ x & \text{if } 0 < x < 1 \\ 2x-1 & \text{if } x \geq 1 \end{cases}$ at $x = 0, 1$.

23. Examine the continuity of the function f defined by $f(x)=\begin{cases} 2x+1 & \text{if } x < 1 \\ 0 & \text{if } x = 1 \\ x^2-1 & \text{if } x > 1 \end{cases}$.

24. If $f(x) = \begin{cases} ax^2+b & \text{if } x < 1 \\ 1 & \text{if } x = 1 \\ 2ax-b & \text{if } x > 1 \end{cases}$ is continuous at x=1, then find a and b.

25. Find the relationship between a and b so that the function defined by

$$f(x) = \begin{cases} ax + b & \text{if} & x \leq 3 \\ bx + 3 & \text{if} & x > 3 \end{cases}$$ s continuous at x = 3.

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26. Find the value of a and b if the function given below is continuous.

$$f(x) = \begin{cases} 5 & \text{if} \;\; x \leq 2 \\ ax + b & \text{if} \;\; 2 < x < 10 \\ 21 & \text{if} \;\; x \geq 10 \end{cases}$$

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27. For what value of k the following function is continuous at $x = 0$?

$$f(x) = \begin{cases} \frac{1 - \cos 4x}{8x^2}, & x \neq 0 \\ k, & x = 0 \end{cases}$$

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28. If $f(x) = \begin{cases} ax^2 + b & \text{if } x < 1 \\ 1 & \text{if } x = 1 \\ 2ax - b & \text{if } x > 1 \end{cases}$

is continuous at x=1, then find a and b.

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29. Show that : $\sin^2 x$ is continuous for everyreal value of x.

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30. $f(x) = \begin{cases} x^2 \sin\left(\frac{1}{x}\right) & x \neq 0 \\ 0 & x = 0 \end{cases}$ $atx = 0$

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31. If 'f(x)= {((1-cos4x)/(x^2)),whenx<0),(k,whenx=0),(sqrtx/(sqrt(16+sqrtx))-4)

,when x>0):}`, and f is continuous at x=0, then find the value of k.

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32. Find the value of k so that the function f defined by $f(x) = \left\{\left(\dfrac{k\cos x}{\pi - 2x}\right), whenx \neq \dfrac{\pi}{2}\right), \left(0, atx = \dfrac{\pi}{2}\right) :\right\}$ is continuous at$x = \dfrac{\pi}{2}$.

33. If the function $f(x) = \begin{cases} 3ax + b, & \text{if } x > 1 \\ 11, & \text{if } x = 1 \\ 5ax - 2b, & \text{if } x < 1 \end{cases}$ is continuous at $x = 1$, then find the values of a and b

34. Find all points of discontinuity of f, where f is defined by
$f(x) = \begin{cases} |x| + 3, & \text{if } x \leq -3 \\ -2x, & \text{if } -3 < x < 3 \\ 6x + 2, & \text{if } x \geq 3 \end{cases}$

35. Find the derivative of $\tan^{-1}\left(\dfrac{\cos x + \sin x}{\cos x - \sin x}\right)$ w.r.t. x.

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36. What is the derivative of $e^{3\log x}$ w.r.t.x?

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37. If $u = t^2$ and $v = \sin t^2$ then dv/du=_____.

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38. If $y = \dfrac{\sec^{-1}\left(\sqrt{x}+1\right)}{\sqrt{x}} + \sin^{-1}\dfrac{\sqrt{x}}{\sqrt{x}+1}$ then $\dfrac{dy}{dx} =$ ____

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39. Write the derivative of sinx with respect to cosx.

40. If $y = \sin^{-1}\left[x\sqrt{1-x} - \sqrt{x}\sqrt{1-x^2}\right]$ then find $\dfrac{dy}{dx}$

41. if $e^x + e^y = e^{x+y}$ then show that $\dfrac{dy}{dx} + e^{y-x} = 0.$

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

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

44. Differentiate $\tan^{-1}\left(\dfrac{\sqrt{1+x^2}-1}{x}\right)$ w.r.t $\sin^{-1}\left(\dfrac{2x}{1+x^2}\right)$ when $x \neq 0$.

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45. Write that condition of Rolle's theorem which is violated by the function $f(x) = |x - 1|$ in $[0, 2]$.

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46. If $f(0) = 0, f'(0) = 2$ then what is the derivative of $y = f(f(f(f(x))))$ at x=0.

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47. If

$$y = \tan^{-1}\left(\frac{1}{1 + x + x^2}\right) + \tan^{-1}\left(\frac{1}{x^2 + 3x + 3}\right) + \tan^{-1}\left(\frac{1}{x^2 + 5x + 7}\right)$$

.... Up to n terms then find y'(0).

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48. If $x = a\left(\cos t + \log\tan\left(\frac{t}{2}\right)\right)$, $y = a\sin t$, then what is $\dfrac{d^2y}{dx^2}$ at $t = \dfrac{\pi}{3}$.

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49. What is the first derivative of $\cos^{-1}\left(\sin\left(\dfrac{\sqrt{1 + x}}{2}\right)\right) + x^x$ w.r.t x at x=1.

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50. If $f(x) = |\log x|$ then for $x \neq 1$, then what is $f'(x)$?

51. If $y = |\cos x| + |\sin x|$ then what is $\dfrac{dy}{dx}$ at $x = \dfrac{2\pi}{3}$?

52. If $f(x) = \log_x^2 (\log x)$, then $f(e)$

53. If $y = \tan^{-1} \left[\left(\dfrac{x}{\log e} x^3 \right) \right] + \tan^{-1} \left[\dfrac{5 + 3\log x}{1 - 15 \log x} \right]$ then find $\dfrac{dy}{dx}$.

54. If $f(x) = a|\sin x| + b.\, e^{|x|} + c|x|^3$ and f(x) is differentiable at x = 0, then what are the values of a,b, c.?

55. What is the value ofthe derivative of $f(x) = |x - 1| + |x - 3|$ at x=2?

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56. If f(x+y) = f(x) f(y) for all x,y and if f(5) = 2 and f(0) = 3, then what is the value of f '(5)?

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57. Write the derivative of $e^{3\log x}$ w.r.t.x^2

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58. Differentiate$a^{\ln x}$ w. r. tx^2.

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59. If $x = \int_0^y \left(\dfrac{1}{\sqrt{1+4t}} \right) dt$ then what is the value of $\dfrac{d^2y}{dx^2}$.

60. If x andy are variables related by the equation $x = \int_0^y \left(\dfrac{1}{\sqrt{1+9u^2}} dx \right)$, then what is the value of $\dfrac{dy}{dx}$?

61. What is the derivative of $\sec^{-1}\left(\dfrac{1}{2x^2 - 1} \right)$, with respect to $\left(\sqrt{1 - x^2} \right)$?

62. If $y = \sec^{-1}\left(\dfrac{x+1}{x-1} \right) + \sin^{-1}\left(\dfrac{x-1}{x+1} \right)$, then find $\dfrac{dy}{dx}$.

63. Differentiate $\sin^{-1}(\cos x)$ w.r.t.x

64. Differentiate $\cos^{-1}(\sin x)$ w.r.t.x.

65. What is the derivative of $\sec^{-1}x$ w.r.t.x, if $x < -1$?

66. What is the derivative of $\sin^{-1}(3x - 4x^3)$ w.r.t $\sin^{-1}x$?

67. What is the derivative of $\sin^{-1}\left(\dfrac{2x}{1+x^2}\right)$ w.r.t $\tan^{-1}\left(\dfrac{2x}{1-x^2}\right)$?

68. Find $\dfrac{d}{dx}\cot^{-1}\tan\left(\dfrac{\pi}{2}-x\right)$.

69. If $y = \dfrac{\sec^{-1}\left(\sqrt{x}+1\right)}{\sqrt{x}} + \sin^{-1}\dfrac{\sqrt{x}}{\sqrt{x}+1}$ then $\dfrac{dy}{dx} = $ ____

70. What is the first derivative of $\cos^{-1}\left(\sin\left(\dfrac{\sqrt{1+x}}{2}\right)\right) + x^x$ w.r.t x at x=1.

71. If $f(x) = |\log x|$ then for $x \neq 1$, then what is $f'(x)$?

72. What is the derivative of $\tan^{-1}(\cos\sqrt{x})$.

73. If $y = \cot^{-1}\left(\dfrac{\sqrt{1+x^2}}{x}\right)$ then(dy)/(dx)=?

74. Find the derivative of $\cos^{-1}\left(\dfrac{\sqrt{1+x}}{2}\right)$.

75. Differentiate $\cos^{-1}(4x^3 - 3x)$.

76. Differentiate $\tan^{-1}\left(\dfrac{\sqrt{x}-x}{1+x\sqrt{x}}\right)$.

77. If $y = 10^x$ and $z = 100^{\frac{x}{2}}$ then find $\dfrac{d}{dx}\left(\dfrac{y^2}{z}\right)$.

78. What is the derivative of $\cos\left(\sin^{-1}x\right)$ w.r.t $\cos^{-1}x$?

79. What is the derivative of $\cos ec^{-1}x$ $w.r.tx when |x| > 1$.

80. Find $\dfrac{dy}{dx}$ when $y = \log|x|$.

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81. Find $\dfrac{dy}{dx}$ at $t = \dfrac{1}{2}$ when $x = (at^2)$, y=2at.

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82. Find $\dfrac{d}{dx}$ In $\sin^{-1} \cos\left(\dfrac{\pi - 2e^x}{2}\right)$.

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83. If $y = \tan^{-1}\left(\dfrac{a}{x}\right) + \log\sqrt{\dfrac{x-a}{x+a}}$, then prove that $\dfrac{dy}{dx} = \dfrac{2a^3}{x^4 - a^4}$.

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84. If $\left(\tan^{-1} x\right)^y + y^{\cot x} = 1$ then find $\dfrac{dy}{dx}$.

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

86. If $y = x\log\left(\dfrac{x}{a+bx}\right)$ then prove that $x^3\dfrac{d^2y}{dx^2} = \left(x\dfrac{dy}{dx} - y\right)^2$.

87. If $y = (\sin x)^x + \sin^{-1}\sqrt{x}$, then find $\dfrac{dy}{dx}$.

88. If $x = 2\cos\theta - \cos 2\theta$ and $y = 2\sin\theta - \sin 2\theta$, then prove that $\dfrac{dy}{dx} = \tan\left(\dfrac{3\theta}{2}\right)$

89. Differentiate the following function w.r.t. x,

$(\log x)^x + x^{\log x}$.

90. If $y = \log\left[x + \sqrt{x^2 + 1}\right]$, then prove that $(x^2 + 1)\dfrac{d^2y}{dx^2} + x\dfrac{dy}{dx} = 0$

.

91. If $x = a\cos^3\theta, y = a\sin^3\theta$,then find $\dfrac{d^2y}{dx^2}$

92. If sin y = x sin (a + y) then show that $\dfrac{dy}{dx} = \dfrac{\sin^2(a + y)}{\sin a}$

93. Find dy/dx if

$$x^m y^n = \left(\frac{x}{y}\right)^{m+n}$$

94. Find $\dfrac{dy}{dt}$, when $y = \sin^{-1}\left(2\dfrac{\sqrt{t^2 - 1}}{t^2}\right)$

95. If $x = a \sec\theta$, $y = b\tan\theta$, then prove that $\dfrac{d^2y}{dx^2} = -\dfrac{b^4}{a^2 y^3}$

96. IF $x^y = e^{x-y}$ then show that $\dfrac{dy}{dx} = \dfrac{\log x}{[\log(xe)]^2}$.

97. If sin y = x sin (a + y) then show that $\dfrac{dy}{dx} = \dfrac{\sin^2(a+y)}{\sin a}$

98. If $x = a(\cos t + t \sin t)$ and $y = a(\sin t - t \cos t)$, then find $\dfrac{d^2y}{dx^2}$ at $t = \dfrac{\pi}{4}$.

99. If $\cos x = \sqrt{\dfrac{1}{1+t^2}}$, $\sin y = \dfrac{2t}{1+t^2}$ then show that $\dfrac{dy}{dx}$ is independent of t.

100. Find $\dfrac{dy}{dx}$, when $y^x = x^{\sin y}$

101. If $y^2 \cot x = x^2 \cot y$ then find $\dfrac{dy}{dx}$.

102. Find the derivative of $x^{\sin x}$ w.r.t.x.

103. Differentiate $\sin^{-1}\left(\dfrac{2X}{1+X^2}\right)$ with respect to $\cos^{-1}\left(\dfrac{1-X^2}{1+X^2}\right)$.

104. Differentiate $y = \tan^{-1} \cdot \dfrac{\sqrt{1+x^2} + \sqrt{1-x^2}}{\sqrt{1+x^2} - \sqrt{1-x^2}}$

105. Differentiate $y = (\sin y)^{\sin 2x}$

106. Test the differentiability and continuity of the following function at

x=0: $f(x) = \begin{cases} \frac{1-e^{-x}}{x} & x \neq 0 \\ 1 & x = 0 \end{cases}$

107. What is the derivative of $\sec^{-1}\left(\frac{1}{2x^2 - 1}\right)$, with respect to $\left(\sqrt{1 - x^2}\right)$?

108. If $y = \left(x + \cfrac{1}{x + \cfrac{1}{x + \ldots \infty}}\right)$ find $\frac{dy}{dx}$, the rhs being a valid expression.

109. If $y = e^{\sin^{-1} x}$ and u=logx then what is $\dfrac{dy}{du}$?

110. Find the slope of the tangent to the curve $x = 2(\theta - \sin 2\theta)$, y= $2(1 - \cos \theta) at \theta = \dfrac{\pi}{4}$.

111. If cos y = x cos(a+y) then prove that

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

112. Differentiate $\sec^{-1}\left(\dfrac{x + x^{-1}}{x - x^{-1}}\right)$ w.r.tx.

113. Prove that $y = \tan(x + y)$, then $\dfrac{dy}{dx} = \dfrac{1 + y^2}{-y^2}$

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114. Find $\dfrac{dy}{dx}$, if $y = \log_{x^2} 3$.

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115. Find $\dfrac{dy}{dx}$ when $y = 10^{\sin x}$.

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116. If $F(x) = \displaystyle\int_{x}^{x^2} e^{-t^4}\, dt$ then find $F^1(x)$.

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117. If

$$f(x) = \sin x \text{ and } g(x) = x^3 then f \in d the value of [f(x). g(x)]^I II at x = \frac{\pi}{2}$$

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118. Find the derivative of $\sin^{-1}\left(\dfrac{2x^3}{1+x^6}\right)$.

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119. Find the derivative of $\tan^{-1}\left(\cos^2 x\right)$.

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120. Examine the differentiability of $\ln x^2$ for all real values of x.

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121. Find $\dfrac{dy}{dx}$ when $y = \tan^{-1}\left(\dfrac{4x}{1+5x^2}\right) + \tan^{-1}\left(\dfrac{2+3x}{3-2x}\right)$.

122. Differentiate $\sin^{-1}\left(\dfrac{2X}{1+X^2}\right)$ with respect to $\cos^{-1}\left(\dfrac{1-X^2}{1+X^2}\right)$.

123. Find $\dfrac{dy}{dx}$ when $y = x^y$.

124. If $2z = x\left(2 + \dfrac{dz}{dx}\right)$, then prove that $\dfrac{d^2z}{dx^2}$ is a constant.

125. If sin (x + y) = y cos (x + y) then prove that
$$\frac{dy}{dx} = -\frac{1 + y^2}{y^2}$$

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126. If $e^{y/x} = \frac{x}{a + bx}$ then show that $x^3 \frac{d}{dx}\left(\frac{dy}{dx}\right) = \left(x\frac{dy}{dx} - y\right)^2$

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

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128. If $x = \sqrt{a^{\sin^{-1}t}}$, $y = \sqrt{a^{\cos^{-1}t}}$, then show that $\frac{dy}{dx} = -\frac{y}{x}$.

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129. Differentiate $\tan^{-1}\left(\dfrac{\sqrt{1+x^2}-1}{x}\right)$ w. r. tx.

130. If $y = \left(\tan^{-1}x\right)^2$ then show that

$$\left(x^2+1\right)^2\dfrac{d^2y}{dx^2} + 2x\left(x^2+1\right)\left(\dfrac{dy}{dx}\right) = 2.$$

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

132. If $x = a(\cos t + t\sin t)$ and $y = a(\sin t - t\cos t)$, then find $\dfrac{d^2y}{dx^2}$ at $t = \dfrac{\pi}{4}$.

133. If x= cos t+ log tan t/2 and y = sin t, then find the value of $\dfrac{d^2y}{dt^2}$ and $\dfrac{d^2y}{dx^2}$ $att = \dfrac{\pi}{4}$.

134. If $x\sqrt{1+y} + y\sqrt{1+x} = 0$ for $-1 < x, y < 1$ then prove that $\dfrac{dy}{dx} = \dfrac{-1}{(x+1)^2}$

135. If x=tan(1/a logy), show that (1+x^2)d^2y/dx^2+(2x-a)dy/dx=0.

136. Differentiate the following function w.r.tx $\tan^{-1}\left(\dfrac{\sqrt{1+x} - \sqrt{1-x}}{\sqrt{1+x} + \sqrt{1-x}}\right)$.

137. If $y = \sin^{-1}\left[\left(\dfrac{5x + 12\left(\sqrt{1 - x^2}\right)}{13}\right)\right]$ then $f \in d\dfrac{dy}{dx}$.

138. If $y = \tan(x + y)$, then find $\dfrac{dy}{dx}$.

139. If $y = x^{\cot x} + (\sin x)^x$ then find $\dfrac{dy}{dx}$.

140. If $y = \dfrac{\sin^{-1} x}{\sqrt{1 - x^2}}$, the prove that $(1 - x^2)\dfrac{d^2y}{dx^2} - 3x\dfrac{dy}{dx} - y = 0$.

141. If $x = \dfrac{1 - \cos^2 \theta}{\cos \theta}$, $y = \dfrac{1 - \cos^{2n} \theta}{\cos^n \theta}$ then show that

$$\left(\dfrac{dy}{dx} \right)^2 = n^2 \left(\dfrac{y^2 + 4}{x^2 + 4} \right)$$

142. If $y = (\log x)^{\cos x} + \dfrac{x^2 + 1}{x^2 - 1}$ find $\dfrac{dy}{dx}$.

143. If $y = \cos^{-1} \left[\dfrac{3x + 4\sqrt{1 - x^2}}{5} \right]$ then find $\dfrac{dy}{dx}$.

144. Prove that

$\cot^{-1} \left(\dfrac{\sqrt{1 + \sin x} + \sqrt{1 - \sin x}}{\sqrt{1 + \sin x} - \sqrt{1 - \sin x}} \right) = \dfrac{x}{2}, \ 0 < x < \dfrac{\pi}{2}, \ \text{or } x \in \left(0, \dfrac{\pi}{4} \right)$

.

145. Differentiate $\sin^{-1}\left(2ax\sqrt{1-a^2x^2}\right)$ wth respect to $\sqrt{1-a^2x^2}$.

146. If sin (x + y) = y cos (x + y) then prove that

$$\frac{dy}{dx} = -\frac{1+y^2}{y^2}$$

147. Find $\dfrac{dy}{dx}$ when $y = \cot^{-1}(\cos ecx) + \dfrac{x\sin^{-1}x}{\sqrt{1-x^2}}$.

148. Find the derivative of $\left(\dfrac{x-1}{x^2+5}\right)^{-4}\cos^{-1}\left(\dfrac{1-x^2}{1+x^2}\right)$

149. Find $\dfrac{dy}{dx}$ when $y = \tan^{-1}\sqrt{\dfrac{1+\sin x}{\sin x}}$.

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150. Find $\dfrac{dy}{dx}$ when (x+y)^(p+q) = x^py^q.

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151. If $xe^{xy} + y = \sin^2 x$, then find $\dfrac{dy}{dx}$ at x=0.

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152. If sin y = x sin (a + y) then show that $\dfrac{dy}{dx} = \dfrac{\sin^2(a+y)}{\sin a}$

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153. If $x = a\cos^3\theta, y = a\sin^3\theta$, then find $\dfrac{d^2y}{dx^2}$

154. Differentiate $\tan^{-1}\left(\dfrac{1+\sin x}{1-\sin x}\right)^{\frac{1}{2}}$ with respect to $\left(\dfrac{1+\cos x}{1-\cos x}\right)$.

155. Find $\dfrac{dy}{dx}$ when $x = e^{\tan^{-1}\left(\frac{y-x^2}{x^2}\right)}$.

156. If $y = x^{\sin^{-1}x} + x^3\left(\dfrac{\sqrt{x^2+4}}{\sqrt{x^3+3}}\right)$ then find $\dfrac{dy}{dx}$.