



# MATHS

BOOKS - JEEVITH PUBLICATIONS

MATHS (KANNADA ENGLISH)

CONTINUITY AND DIFFERENTIABILITY

One Marks Questions With Answers

1. Find the derivative of  $\cos(x^2)$  with respect to  $x$ .



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2. If  $\tan(2x + 3)$ , find  $\frac{dy}{dx}$ .



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3. The function  $f(x) = \frac{1}{x - 5}$  is not continuous at  $x = 5$ . Justify the statement.



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4. if  $y = \sin(x^2 + 5)$  then find  $\frac{dy}{dx}$



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5.  $\cos(\sin x)$



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6.  $\sin(ax + b)$ .



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7.  $\sec(\tan \sqrt{x})$ .



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8. If  $y = \cos(\sqrt{x})$  then find  $\frac{dy}{dx}$



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9. Prove that the function  $f(x) = 5x - 3$  is continuous at  $x = 0$ , at  $x = -3$  and at  $x = 5$ .



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**10.** Examine the continuity of the function

$$f(x) = 2x^2 - 1 \text{ at } x=3.$$



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**11.** Examine the following functions for continuity:

(a)  $f(x) = x - 5$



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**12.** Examine the following functions for continuity:

$$(b) f(x) = \frac{1}{x - 1}, x \neq 5$$



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**13.** Examine the following functions for continuity:

$$(c) f(x) = \frac{x^2 - 25}{x + 5}, x \neq -5$$



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**14.** Examine the following functions for continuity:

(d)  $f(x) = |x - 5|$ .



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**15.** Prove that the function  $f(x) = x^n$  is continuous at  $x = n$ , where  $n$  is a positive integer.



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**16.** Differentiate  $\sin(\cos(x^2))$  with respect to  $x$ .



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**17.** Differentiate  $\sin(x^2)$  with respect to  $x$ .



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**18.** Differentiate  $\cos(x^3) \cdot \sin^2(x^5)$  with respect to  $x$ .





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19. If  $2x + 3y = \sin x$  find  $\frac{dy}{dx}$ .



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20. If  $2x + 3y = \sin y$  find  $\frac{dy}{dx}$ .



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21. If  $ax + by^2 = \cos y$  find  $\frac{dy}{dx}$ .



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22. If  $xy + y^2 = \tan x + y$  find  $\frac{dy}{dx}$ .



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23. Differentiate  $x^2 + xy + y^2 = 100$  with respect to  $x$ .



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24. If  $x^3 + x^2y + xy^2 + y^3 = 81$  find  $\frac{dy}{dx}$ .



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25. If  $\sin^2 x + \cos xy = k$  find  $\frac{dy}{dx}$ .



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



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27. Differentiate w.r.to  $x$  :  $x^x + a^x + x^a + a^a$



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28. Differentiate  $x^x$  w.r.to  $x$ .



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29. Differentiate  $a^x$  w.r.to  $x$ .



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30. If  $y = x^5 5^x$  find  $\frac{dy}{dx}$ .



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31. If  $y = x^3 \cdot 2^x$  find  $\frac{dy}{dx}$



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



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33. If  $y = \cos x \cdot \cos 2x \cdot \cos 3x$  find  $\frac{dy}{dx}$



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## Two Marks Questions With Answers

1. Check the continuity of the function  $f$  given by  $f(x) = 2x + 3atx = 1$ .



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2. Find the derivative of  $(3x^2 - 7x + 3)^{5/2}$  with respect to  $x$ .



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3. If  $y = (\sin^{-1} x)^x$  find  $\frac{dy}{dx}$



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4. If  $\sqrt{x} + \sqrt{y} = \sqrt{a}$ , prove that

$$\frac{dy}{dx} = -\sqrt{\frac{y}{x}}$$



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5. If  $y = \sin(\log_e x)$  prove that

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



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6. Find the derivative of  $y = x^x - 2^{\sin x}$  with respect to  $x$ .



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7. Find the derivative of  $\frac{e^x}{\sin x}$  w.r.t.  $x$ .



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8. Find the derivative of  $e^{\sin^{-1} x}$  w.r.t.  $x$ .



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9. Differentiate  $\left(x + \frac{1}{x}\right)^x$  w.r.to  $x$ .



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10. If  $y = \sqrt{\frac{(x-1)(x-2)}{(x-3)(x-4)(x-5)}}$  find  $\frac{dy}{dx}$



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11. Differentiate  $(x+3)^2(x+4)^3(x+5)^4$

w.r.to x.



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12. If  $y = \log_7(\log x)$  find  $\frac{dy}{dx}$ .



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13. Differentiate w.r.to x:

$$\sqrt{3x + 2} + \frac{1}{\sqrt{2x^3 + 4}}$$



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14. If  $y = \cos^{-1}(\sin x)$  find  $\frac{dy}{dx}$ .



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15. If  $y = \tan^{-1} \left( \frac{\sin x}{1 + \cos x} \right)$  find  $\frac{dy}{dx}$ .



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16. If  $y = \sin^{-1} \left[ \frac{2^{x+1}}{1 + 4^x} \right]$  find  $\frac{dy}{dx}$ .



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17. Differentiate  $\sin^2 x$  w.r.t  $e^{\cos x}$



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18. If  $y = (3x^2 - 9x + 5)^9$  find  $\frac{dy}{dx}$ .



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19. If  $y = \sin^3 x + \cos^6 x$  find  $\frac{dy}{dx}$ .



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20. If  $y = (5x)^{3 \cos 2x}$  find  $\frac{dy}{dx}$ .



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21. Differentiate w.r.to  $x$ .  $(\log x)^x$ .



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22. Differentiate w.r.to  $x$  :  $x^{\log x}$



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23. Differentiate  $(\log x)^{\log x}$  w.r.t  $x$ .



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24. If  $y = \sin^{-1}(x\sqrt{x})$  find  $\frac{dy}{dx}$



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



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26. Differentiate :  $x^{\sin x}$  with respect to  $x$ .



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## Three Marks Questions With Answers

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

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



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



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



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$$4. y = \cos^{-1} \left( \frac{1 - x^2}{1 + x^2} \right), 0 < x < 1.$$



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$$5. y = \sin^{-1} \left( \frac{1 - x^2}{1 + x^2} \right), 0 < x < 1.$$



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6.  $y = \cos^{-1}\left(\frac{2x}{1+x^2}\right), -1 < x < 1.$



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7.

$$y = \sin^{-1}\left(2x\sqrt{1-x^2}\right), -\frac{1}{\sqrt{2}} < x < \frac{1}{\sqrt{2}}$$



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8.

Find

$$\frac{dy}{dx}, \text{ if } y = \sec^{-1}\left(\frac{1}{2x^2-1}\right), 0 < x < \frac{1}{\sqrt{2}}$$



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9. Find  $\frac{dy}{dx}$ , if  $x = at^2$ ,  $y = 2at$ .



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10.  $x = 2at^2$ ,  $y = at^4$ .



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11.  $x = a \cos \theta$ ,  $y = b \sin \theta$ .



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12.  $x = \sin t, y = \cos 2t.$



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13.  $x = 4t, y = \frac{4}{t}$  then find  $\frac{dy}{dx}$



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14.  $x = \cos \theta - \cos 2\theta, y = \sin \theta - \sin 2\theta.$

then find  $\frac{dy}{dx}$



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15. If  $x = a(\theta - \sin \theta)$  and  $y = a(1 + \cos \theta),$

then prove that  $\frac{dy}{dx} = -\cot \left( \frac{\theta}{2} \right).$



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16.  $x = \frac{\sin^3 t}{\sqrt{\cos 2t}}, y = \frac{\cos^3 t}{\sqrt{\cos 2t}}.$



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17.

Find

$$\frac{dy}{dx}, \quad \text{if } x = a \left( \cos t + \log \tan \frac{t}{2} \right), \quad y = a \sin t$$

.



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18.  $x = a \sec \theta, y = b \tan \theta.$



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**19.**

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

then find  $\frac{dy}{dx}$



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**20.** If  $x = a(\theta + \sin \theta)$ ,  $y = a(1 - \cos \theta)$  then

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



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21. If a function  $f(x)$  is differentiable at  $x = c$

prove that it is continuous at  $x = c$ .



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22. Differentiate with respect to  $x$ :

$$(\sin x)^x + \sin^{-1} \sqrt{x}$$



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23. Find  $\frac{dy}{dx}$  given  $x^y + y^x = 1$





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24. If  $x\sqrt{1+y} + y\sqrt{1+x} = 0$ ,  $x \neq y$  prove

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



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25.  $y = \sin^{-1} x + \sin^{-1} \sqrt{1-x^2}$ ,  $0 < x < 1$

find 
$$\frac{dy}{dx}.$$



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26. If  $\cos y = x \cos(a + y)$  with  $\cos a \neq \pm 1$ .

Prove that  $\frac{dy}{dx} = \frac{\cos^2(x + a)}{\sin a}$



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27.

if

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

find  $\frac{d^2y}{dx^2}$ .



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28. If  $x^y = e^{x-y}$  prove that

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



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## Four Marks Questions With Answers

1. Determine the value of  $k$ , if

$$f(x) = \begin{cases} \frac{k \cos x}{\pi - 2x} & \text{if } x \neq \frac{\pi}{2} \\ 3 & \text{if } x = \frac{\pi}{2} \end{cases}$$



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2. Find the values of  $a$  and  $b$  such that the function defined by

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

continuous function.



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3. The function is defined by

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



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4. The function is defined by

$$f(x) = \begin{cases} kx + 1 & \text{if } x \leq 5 \\ 3x - 5 & \text{if } x > 5 \end{cases} \quad \text{is}$$

continuous at  $x = 5$ . Find  $k$ .



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5. The function is defined by

$$f(x) = \begin{cases} kx^3 & \text{if } x \leq 2 \\ 3 & \text{if } x > 2 \end{cases} \quad \text{at } x = 2.$$



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6. Define a continuity of a function at a point.

Find all the points of discontinuity of  $f$  defined

$$\text{by } f(x) = |x| - |x - 1|.$$



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

$$f(x) = \begin{cases} ax + 1 & \text{if } x \leq 3 \\ bx + 3 & \text{if } x > 3 \end{cases} \quad \text{is}$$

continuous at  $x = 3$ .



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8. Find the points of discontinuity of the function  $f(x) = x - [x]$  where  $[x]$  indicates the greatest integer not greater than  $x$ . Also write the set of value of  $x$  where the function is continuous.



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9. Find all points of discontinuity of  $f(x)$  where  $f$  is defined by

$$f(x) = \begin{cases} x^3 - 3 & \text{if } x \leq 2 \\ x^3 + 1 & \text{if } x > 2 \end{cases}.$$



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**10.** Define a continuity of a function at a point.

Find all the points of discontinuity of  $f$  defined

by  $f(x) = |x| - |x - 1|$ .



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**Five Marks Questions With Answers**



1. If  $y = A \sin x + B \cos x$ , then prove that

$$\frac{d^2y}{dx^2} + y = 0$$



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

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



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3. If  $y = (\sin^{-1} x)$ . Show that

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



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4. 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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5. If  $y = 5 \cos x - 3 \sin x$ , Prove that

$$\frac{d^2y}{dx^2} + y = 0.$$



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6. If  $y = Ae^{mx} + Be^{nx}$ , prove that

$$\frac{d^2y}{dx^2} - (m + n) \frac{dy}{dx} + mny = 0.$$



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

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



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



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9.  $y = 500e^{7x} + 600e^{-7x}$  prove that

$$\frac{d^2y}{dx^2} = 49y.$$



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

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



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11. If  $\sqrt{1-x^2} + \sqrt{1-y^2} = a(x-y)$  prove

that 
$$\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{\sqrt{1-x^2}}.$$



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12. If  $x = e^{\frac{x}{y}}$ , prove that 
$$\frac{dy}{dx} = \frac{x-y}{x \log x}.$$



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13. If  $y^x = e^{y-x}$ , prove that

$$\frac{dy}{dx} = \frac{(1 + \log y)^2}{\log y}.$$



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14. If  $y = (\cos x)^{(\cos x)^{(\cos x)^{-\infty}}}$  show that

$$\frac{dy}{dx} = \frac{y^2 \tan x}{y \log \cos x - 1}.$$



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15. If  $y = \tan^{-1} x$  find  $\frac{d^2y}{dx^2}$  in terms of  $y$  alone.



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## Try Yourself

1. Find  $\frac{dy}{dx}$  given  $2x + 3y = \sin x$ .



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2. Find  $\frac{dy}{dx}$  given  $x^2 + xy + y^2 = 100$ .



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3. If  $y = 3 \sin x + 2 \cos x$  then prove that

$$\frac{d^2y}{dx^2} + y = 0$$



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4. If  $y = a \cos(\log x) + b \sin(\log x)$ , show that

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



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5. If  $y = \cos^{-1} x$ , show that

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



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6. If  $y = \cos^{-1} x$  then find  $\frac{d^2 y}{dx^2}$  in terms of  $y$  alone.



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