

1. Examine the continuity of the function $f(x) = \begin{cases} 1+x; x \leq 2 \\ 5-x; x > 2 \end{cases}$ at $x=2$.

2. Show that the function $f(x) = \{2x - |x|\}$ is continuous at $x=0$.

3. Discuss the continuity of the function: $f(x) = \begin{cases} \frac{e^x - 1}{\log(1+2x)}, x \neq 0 \\ 7, x = 0 \end{cases}$

at the point $x=0$.

4. Examine the continuity of the functions at $x=0$

$$(i) f(x) = \begin{cases} \frac{x}{\sin 3x}, x \neq 0 \\ 3, x = 0 \end{cases} \quad (ii) f(x) = \begin{cases} \frac{\sin 2x}{\sin 3x}, x \neq 0 \\ 2, x = 0 \end{cases}$$

5. Determine the constants if the given functions are continuous at specified points

$$(i) f(x) = \begin{cases} ax+5; x \leq 2 \\ x-1, x > 2 \end{cases} \text{ at } x=2 \quad (ii) f(x) = \begin{cases} \frac{x^2 - 3x + 2}{x-1}, x \neq 1 \\ k, x = 1 \end{cases} \text{ at } x=1$$

6. Find the value of a,b and c for which the function is continuous at $x=0$.

$$f(x) = \begin{cases} \frac{\sin(a+1)x + \sin x}{x}, x < 0 \\ c, x = 0 \\ \frac{(x+bx^2)^{1/2} - x^{1/2}}{bx^{3/2}}, x > 0 \end{cases}$$

7. Find the derivative of the function with respect to x

$$(i) e^{\tan^{-1}(\cos \sqrt{x})} \quad (ii) \log\left(\frac{x^2+x+1}{x^2-x+1}\right) + \frac{2}{\sqrt{3}} \tan^{-1} \frac{\sqrt{3}x}{1-x^2}$$

8. If $y = x \log\left(\frac{x}{a+bx}\right)$, show that $x^3 \frac{d^2y}{dx^2} = \left(x \frac{dy}{dx} - y\right)^3$

9. If $y = 3 \cos t - \cos 3t$, $x = 3 \sin t - \sin 3t$, find $\frac{d^2y}{dx^2}$ at $t = \frac{\pi}{3}$

10. If $ax^2 + 2hxy + by^2 = 1$, show that $\frac{d^2y}{dx^2} = \frac{h^2 - ab}{(hx+by)^3}$