# Continuity

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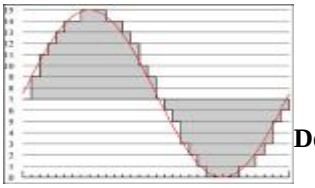
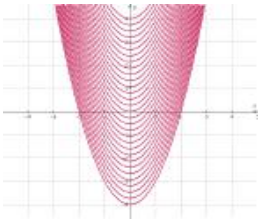
# Continuity- Introduction

A real valued function is continuous at a point in its domain if the limit of the function at that equals the value of the function at that point.



**Definition 1:-** Suppose f be a real function on a subset of the real numbers and let ‘a’ be a point in the domain of ‘f’. Then f is continuous at ‘a’ if

$$\lim_{x \to a} f(x) = f(a)$$



**Definition 2:-** A real valued function is said to be continuous if it is continuous at every point in the domain of f

A function is said to be continuous at x=a, if

$$\lim_{x \to a^-} f(x) = \lim_{x \to a^+} f(x) = f(a)$$

# Domain of a function

Let f:A — B be a function then the set of first components in the ordered pair of the function is said to be the domain. In other words, first set A is the domain of the function. B is called the co-domain of the function.

- For example: The domain of the modulus function, f(x)=|x| is R

The domain of thegreatest integer function is also R

# Real Valued Function

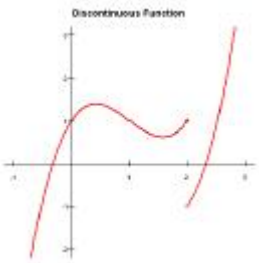
A function which has either R or one of its subsets as its range is called real valued function. Further, if its domain is also either R or a subset of R, it is called a real function.

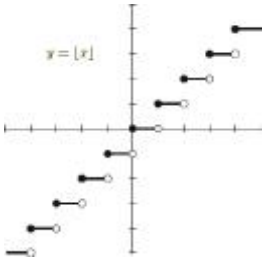
# Discontinuous function

A function which is not continuous is called discontinuous function.

For a discontinuous function, $\lim_{x \to a} f(x) \; ? \; f(a)$

## Graph of a discontinuous functions:




# Algebra of continuous function

## Theorem 1:-

Suppose f and g be two real functions continuous at a real number 'c', then

1) f + g is continuous at c
2) f - g is continuous at c
3) f. g is continuous at c
4) $\left(\frac{f}{g}\right)$ is continuous at c, provided $g(c) \neq 0$

## Theorem 2:-

Suppose f and g are real valued functions such that (f o g) is defined at c. If g is continuous at c and if f is continuous at g( c), then (f o g) is continuous at c.

For example: Let $f(x) = \sin(x^2)$

Take g(x) = sinx and h(x)=$x^2$, both the functions are continuous, so that g o h = g[h(x)]=sin($x^2$) is also continuous.

Example 2: Find all the points of discontinuity of the function f defined by

$$f(x) = \begin{cases} x+2, & \text{if } x<1 \\ 0, & \text{if } x=1 \\ x-2, & \text{if } x>1 \end{cases}$$

Solution: Left hand limit, $\lim_{x \to 1^-} f(x) = \lim_{x \to 1^-} x+2 = 1+2=3$

Right hand limit, $\lim_{x \to 1^+} f(x) = \lim_{x \to 1^+} x-2 = 1-2=-1$

Since, the left hand limit is not equal to right hand limit at x=1, the only point of discontinuity is x=1.

Now try it yourself! Should you still need any help,click here to schedule live online session with e Tutor!

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## Reference Links:


- http://en.wikipedia.org/wiki/Continuous_function
- http://en.wikipedia.org/wiki/Subset
- http://en.wikibooks.org/wiki/Algebra/Functions
- http://en.wikipedia.org/wiki/Domain_of_a_function
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