# FUNCTION VALUES

## Function Values

To represent the value of a function $f(x)$ at $x = a$,

$$\boldsymbol{f(a)}$$

It denotes the value obtained when $f$ is applied to a number $a$.

To evaluate the function, we simply substitute $a$ to all the $x'$s in the function.

Example 1: If $f(x) = x^2 - 5x + 6$, then $f(3) = ?$

(a) $f(3) = (3)^2 - 5(3) + 6$

$= 9 - 15 + 6$

$f(3) = 0$

Function Values

Example 1: If $f(x) = x^2 - 5x + 6$, find

(b) $f\left(\frac{1}{2}\right) = \left(\frac{1}{2}\right)^2 - 5\left(\frac{1}{2}\right) + 6$

$= \frac{1}{4} - \frac{5}{2} + 6$

$= \frac{1 - 10 + 24}{4}$

$f\left(\frac{1}{2}\right) = \frac{15}{4}$

(c) $f(x-1) = (x-1)^2 - 5(x-1) + 6$

$= x^2 - 2x + 1 - 5x + 5 + 6$

$f(x-1) = x^2 - 7x + 12$

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Example 1: If $f(x) = x^2 - 5x + 6$, find

(d) $$\frac{f(x+h) - f(x)}{h} = \frac{[(x+h)^2 - 5(x+h) + 6] - [x^2 - 5x + 6]}{h}$$

$$= \frac{[x^2 + 2xh + h^2 - 5x - 5h + 6] - [x^2 - 5x + 6]}{h}$$

$$= \frac{x^2 + 2xh + h^2 - 5x - 5h + 6 - x^2 + 5x - 6}{h}$$

$$= \frac{2xh + h^2 - 5h}{h}$$

$$= \frac{h(2x + h - 5)}{h}$$

$$\frac{f(x+h) - f(x)}{h} = 2x + h - 5$$

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Example 2: If $g(r) = \frac{r}{r+3}$, find

(a) $g(-2) = \dfrac{-2}{-2+3} = \dfrac{-2}{1} = \mathbf{-2}$

(b) $g(2a-3) = \dfrac{2a-3}{(2a-3)+3} = \dfrac{2a-3}{2a-3+3} = \dfrac{\mathbf{2a-3}}{\mathbf{2a}}$

(c) $g\left(\dfrac{1}{a}\right) = \dfrac{\frac{1}{a}}{\frac{1}{a}+3} = \dfrac{\frac{1}{a}}{\frac{1+3a}{a}} = \dfrac{1}{a} \cdot \dfrac{a}{1+3a} = \dfrac{\mathbf{1}}{\mathbf{1+3a}}$

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Example 2: If $g(r) = \frac{r}{r+3}$, find

(d) $$\frac{g(x+h)-g(x)}{h} = \frac{\frac{x+h}{(x+h)+3} - \frac{x}{x+3}}{h}$$

$$= \frac{1}{h} \cdot \frac{(x+h)(x+3) - x(x+h+3)}{(x+h+3)(x+3)}$$

$$= \frac{1}{h} \cdot \frac{x^2 + 3x + hx + 3h - x^2 - hx - 3x}{(x+h+3)(x+3)}$$

$$= \frac{1}{h} \cdot \frac{3h}{(x+h+3)(x+3)}$$

$$\frac{g(x+h)-g(x)}{h} = \boldsymbol{\frac{3}{(x+h+3)(x+3)}}$$

# Function Values

Example 3: Given: $h(w) = 2\cot w - \csc w$, find $h\left(\frac{2}{3}\pi\right)$

$$h\left(\frac{2}{3}\pi\right) = 2cot\left(\frac{2}{3}\pi\right) - \csc\left(\frac{2}{3}\pi\right)$$

$$= 2\left(-\frac{1}{\sqrt{3}}\right) - \frac{2}{\sqrt{3}}$$

$$= -\frac{2}{\sqrt{3}} - \frac{2}{\sqrt{3}}$$

$$= -\frac{\mathbf{4}}{\sqrt{\mathbf{3}}}$$

$$h\left(\frac{2}{3}\pi\right) = -\frac{\mathbf{4}\sqrt{\mathbf{3}}}{\mathbf{3}}$$

Function Values

Example 4: If $h(x) = \sin\frac{x}{2}$, then

(a) $h(\pi) = \sin\frac{\pi}{2}$

$= \sin 90°$

$h(\pi) = \mathbf{1}$

(b) $h\left(\frac{\pi}{2}\right) = \sin\frac{\pi/2}{2}$

$= \sin\frac{\pi}{4}$

$= \sin 45°$

$h\left(\frac{\pi}{2}\right) = \frac{\sqrt{2}}{2}$

(c) $h(\pi + x) = \sin\left(\frac{\pi + x}{2}\right)$

$= \sin\left(\frac{\pi}{2} + \frac{x}{2}\right)$

$= \sin\frac{\pi}{2}\cos\frac{x}{2} + \cos\frac{\pi}{2}\sin\frac{x}{2}$

$= (1)\cos\frac{x}{2} + (0)\sin\frac{x}{2}$

$h(\pi + x) = \boldsymbol{\cos\frac{x}{2}}$

Example 4: If $h(x) = \sin\frac{x}{2}$, then

(d) $h(2\pi - \theta) = \sin\left(\frac{2\pi - \theta}{2}\right)$

$$= \sin\left(\pi - \frac{\theta}{2}\right)$$

$$= \sin\pi\cos\frac{\theta}{2} - \cos\pi\sin\frac{\theta}{2}$$

$$= (0)\cos\frac{\theta}{2} - (-1)\sin\frac{\theta}{2}$$

$$h(2\pi - \theta) = \boldsymbol{\sin\frac{\theta}{2}}$$

Function Values

Example 5: If $R(t) = \cos(2t)$, find

(a) $R(0) = \cos(2)(0) = \cos 0° = \mathbf{1}$

(b) $R\left(\frac{2\pi}{3}\right) = \cos\left(2 \cdot \frac{2\pi}{3}\right) = \cos\left(\frac{4\pi}{3}\right) = \cos\ 240° = -\frac{\mathbf{1}}{\mathbf{2}}$

(c) $R(\pi + \beta) = \cos(2[\pi + \beta])$

$= \cos(2\pi + 2\beta)$

$= \cos 2\pi \cos 2\beta - \sin 2\pi \sin 2\beta$

$= (1) \cos 2\beta - (0) \sin 2\beta$

$R(\pi + \beta) = \boldsymbol{\cos 2\beta}$

FUNCTIONS

## ODD AND EVEN FUNCTIONS

*i*. A function $f$ is said to be an **EVEN** function if for every $x$ in the domain of $f$,

$$\boldsymbol{f(-x) = f(x)}$$

*ii*. A function $f$ is said to be an **ODD** function if for every $x$ in the domain of $f$,

$$\boldsymbol{f(-x) = -f(x)}$$

Example 1: $f(x) = x^2 - 1$

$$f(-x) = (-x)^2 - 1$$

$$= x^2 - 1$$

$f(-x) = \boldsymbol{f(x)}$ $\quad\therefore f(x)$ is even

FUNCTIONS

## Example 2:

$$g(x) = 3x^5 - 4x^3 - 9x$$

$$\begin{aligned} g(-x) &= 3(-x)^5 - 4(-x)^3 - 9(-x) \\ &= -3x^5 + 4x^3 + 9x \\ &= -(3x^5 - 4x^3 - 9x) \end{aligned}$$

$$g(-x) = -\boldsymbol{g}(\boldsymbol{x})$$

$\therefore g(x)$ is odd

## Example 3:

$$h(x) = x^3 + 2x^2 + 1$$

$$\begin{aligned} h(-x) &= (-x)^3 + 2(-x)^2 + 1 \\ &= -x^3 + 2x^2 + 1 \end{aligned}$$

$$h(-x) \neq h(x) \neq -h(x)$$

$\therefore h(x)$ is neither odd nor even

Functions

# Practice Task (Lesson 2)

1. Given: $f(x) = 2x - 7$, find

   $a.\ f(4)$

   $b.\ f(-2)$

   c. $f(2a)$

   d. $f(2x - 7)$

   e. $f(x + h)$

2. Given: $g(x) = \frac{x-2}{2x+3}$, find

   a. $g(-2)$

   b. $g(2p)$

   $c.\ g(a + 1)$

   $d.\ g\left(\frac{1}{2}\right)$

   $e.\ g\left(\frac{1}{x}\right)$

3. Given: $\mathrm{R(q)} = \tan\frac{q}{8}$, find

   $a.\ R(2\pi)$

   $b.\ g\ (6\pi)$

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## Home Work #2

A.

1. Given: $f(x) = x^2 - 3x + 2$, find:

   $a.\ f(3)$

   $b.\ f(-x)$

   c. $f(x+2)$

2. Given: $g(y) = \frac{y-1}{y+1}$, find:

   $a.\ g(2m)$

   $b.\ g(a+1)$

   $c.\ g\left(\frac{1}{x}\right)$

3. Given: $J(y) = \cos 3y$, find:

   $a.\ J\left(\frac{\pi}{9}\right)$ $\quad b.\ \left(\frac{\pi + x}{12}\right)$

4. If $h(w) = \frac{1}{w}$, find $h(m) - h(n)$.

B. Evaluate the expression $\frac{g(x+h)-g(x)}{h}$ for the following functions:

1. $g(x) = 3x^2 - 2x$
2. $g(x) = \sqrt{4x - 3}$

C. Determine whether the function is odd, even or neither.

1. $g(r) = r^2 - 1$
2. $y = \dfrac{4x^2 - 5}{2x^3 + x}$
3. $f(x) = \sqrt[3]{x}$
4. $f(z) = (z-1)^2$
5. $H(m) = 4m^5 - 3m^3 - 2m$