



# BASIC DIFFERENTIATION: A BEGINNER'S GUIDE



## Application

- a) Engineering applications
- b) Economics and business application
- c) Temperature and heat flow
- d) Biology and Medicine

## Definition

Fundamental concept in calculus

## Constant Rule

$$y = k$$

$k$  is constant

$$\frac{dy}{dx} = 0$$

# DIFFERENTIATION

$f_x$

## Constant Multiple

$$a)y = x^n$$

$$\frac{dy}{dx} = nx^{n-1}$$

$$b)y = ax^n$$

$$\frac{dy}{dx} = anx^{n-1}$$

## Power Rule

$$y = (ax + b)^n$$

$$\frac{dy}{dx} = n(ax + b)^{n-1} \cdot \frac{d}{dx}(ax + b)$$

$$= an(ax + b)^{n-1}$$

Differentiate the following functions:

### Constant Rule

$$a) y = 7$$

$$\frac{dy}{dx} = 0$$

$$b) y = \pi$$

$$\frac{dy}{dx} = 0$$

### Constant Multiple

$$a) y = 7x$$

$$\frac{dy}{dx} = 7$$

$$b) y = x^3$$

$$\begin{aligned}\frac{dy}{dx} &= 3x^{3-1} \\ &= 3x^2\end{aligned}$$

$$c) y = 2x^3$$

$$\begin{aligned}\frac{dy}{dx} &= (3) \times 2x^{3-1} \\ &= 6x^2\end{aligned}$$

### Constant Multiple

$$d) y = x^{-3}$$

$$\begin{aligned}\frac{dy}{dx} &= -3x^{-3-1} \\ &= -3x^{-4}\end{aligned}$$

$$e) y = 7x^3$$

$$\begin{aligned}\frac{dy}{dx} &= 3(7)x^{3-1} \\ &= 21x^2\end{aligned}$$

$$f) y = -7x^{-3}$$

$$\begin{aligned}\frac{dy}{dx} &= (-3)(-7)x^{-3-1} \\ &= 21x^{-4}\end{aligned}$$

### Sum & Difference rules

$$a) y = 5x + x^2$$

$$\begin{aligned}\frac{dy}{dx} &= 5(1) + (2)x^{2-1} \\ &= 5 + 2x\end{aligned}$$

$$b) y = 2x^3 - 4$$

$$\begin{aligned}\frac{dy}{dx} &= (3)2x^{3-1} - 0 \\ &= 6x^2\end{aligned}$$

Differentiate the following functions:

### Power Rule

$$a) y = (2x + 3)^3$$

$$\frac{dy}{dx} = 3(2x + 3)^{3-1} \frac{d}{dx}(2x + 3)$$

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

$$= 6(2x + 3)^2$$

$$b) y = \frac{3}{(5x - 2)^3}$$

$$\frac{dy}{dx} = 3(5x - 2)^{-3}$$

$$= (-3)(3)(5x - 2)^{-3-1} \frac{d}{dx}(5x - 2)$$

$$= -9(5x - 2)^{-4} (5)$$

$$= -45(5x - 2)^{-4}$$

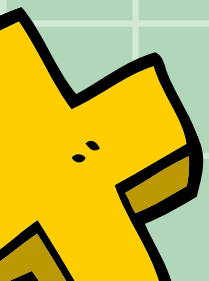
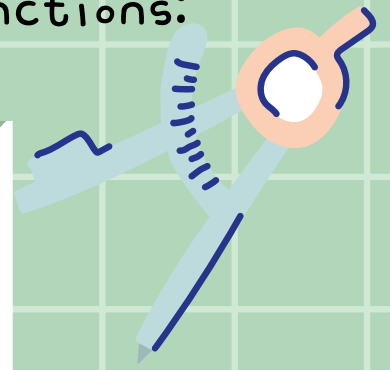
$$= -\frac{45}{(5x - 2)^4}$$

$$c) y = (x^3 - 3x)^3$$

$$\frac{dy}{dx} = 3(x^3 - 3x)^{3-1} \frac{d}{dx}(x^3 - 3x)$$

$$= 3(x^3 - 3x)^2 (3x^2 - 3)$$

$$= 3(3x^2 - 3)(x^3 - 3x)^2$$



## LET'S DO THIS!!

Differentiate for following functions:

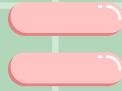
$$a) y = 3\pi$$

$$b) y = \pi x^3$$

$$c) y = (\pi x - 3)^3$$

$$d) y = 3\pi x^2 + 5\pi x$$

$$e) y = 4\pi x - 7\pi x^2$$



Answer:

$$a) \frac{dy}{dx} = 0$$

$$b) \frac{dy}{dx} = 3\pi x^2$$

$$c) \frac{dy}{dx} = 3\pi(\pi x - 3)^2$$

$$d) \frac{dy}{dx} = 6\pi x + 5\pi$$

$$e) \frac{dy}{dx} = 4\pi - 14\pi x$$

Differentiate for following functions:

$$a) y = 9$$

$$b) y = \frac{9}{x}$$

$$c) y = (9x^2 + 2)^3$$

$$d) y = 9x^4 + 2x^3$$

$$e) y = 9x^2 - 2x^{-3}$$



Answer:

$$a) \frac{dy}{dx} = 0$$

$$b) \frac{dy}{dx} = -9x^{-2}$$

$$c) \frac{dy}{dx} = 54x(9x^2 + 2)^2$$

$$d) \frac{dy}{dx} = 36x^3 + 6x^2$$

$$e) \frac{dy}{dx} = 18x + 6x^{-4}$$