BIOMATHEMATICS

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Functions and its derivatives

In this lecture, we will discuss the idea of "derivative"

Function

- The relation between quantities that we plot in X axis and Y axis is called a "**Function**"

We learned :

- Linear function : $Y = mX + C$
- Quadratic function : $Y = kX^2$
- Exponential function: $\exp(x)$
- Periodic functions : $\sin(x)$, $\cos(x)$

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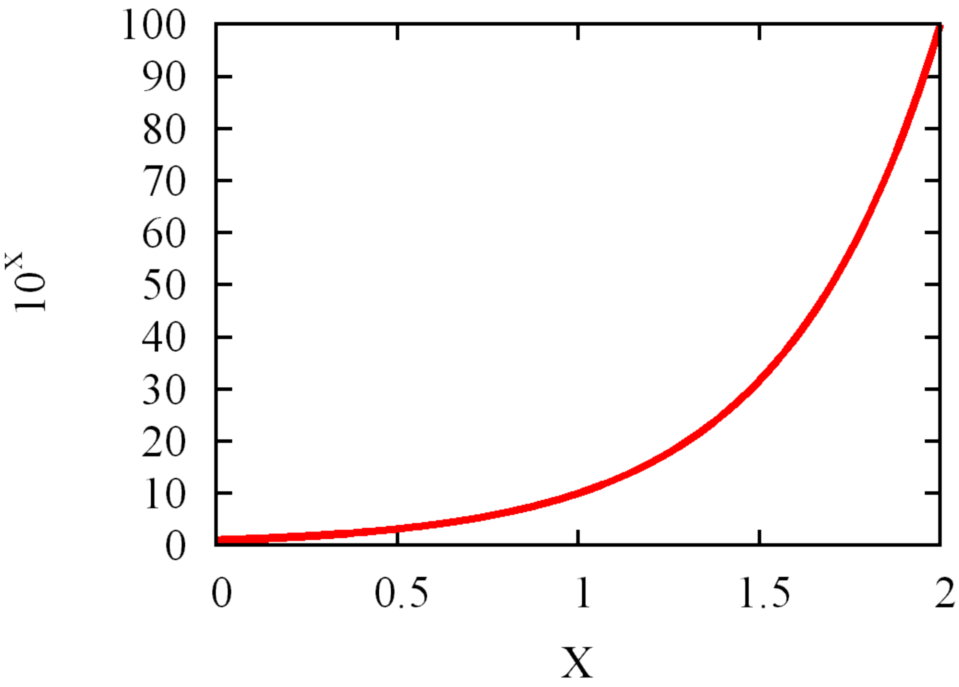
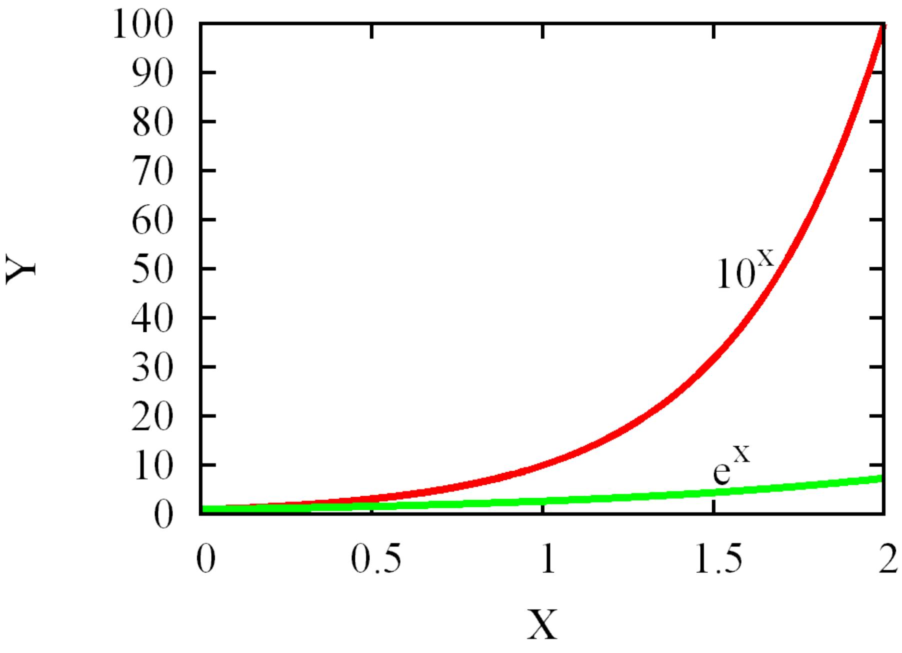
$Y=10^x$

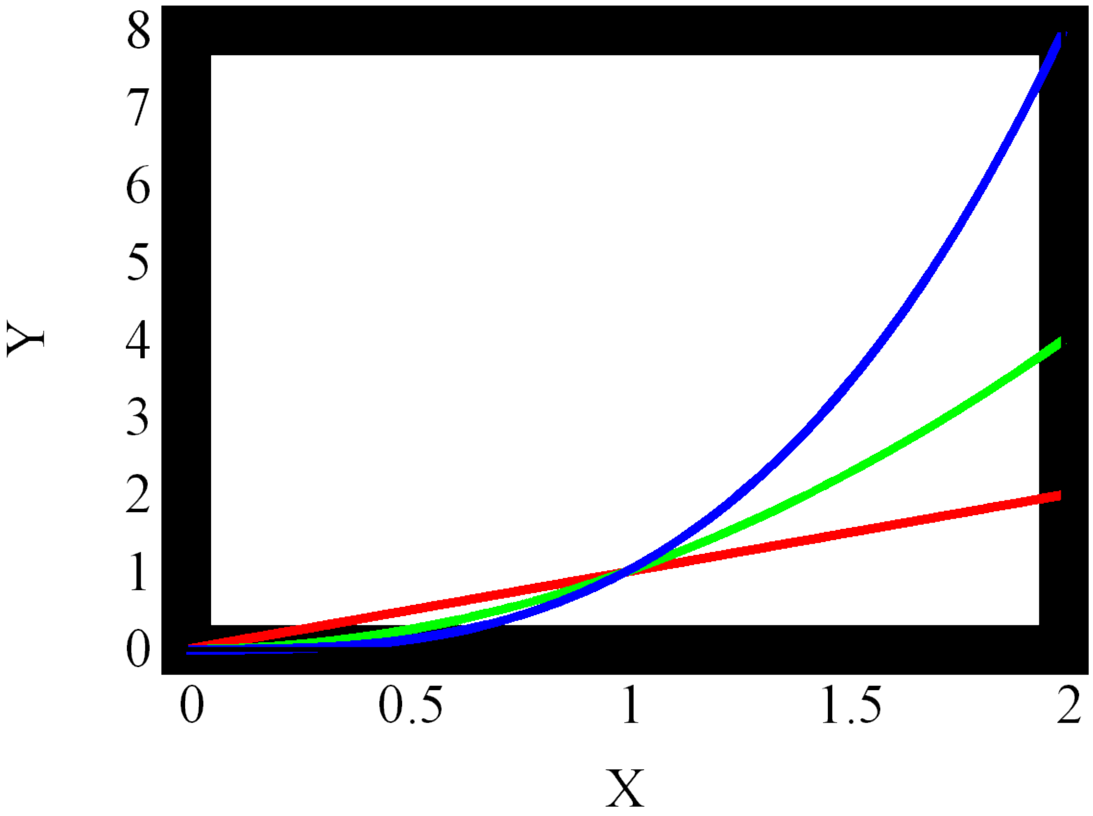


100
90
80
70
60
50
40
30
20
10
0
10^x
0
0.5
1
1.5
2
X



100
90
80
70
60
50
40
30
20
10
0
Y
10^x
e^x
0
0.5
1
1.5
2
X

Given a Y value, how to get X value ?



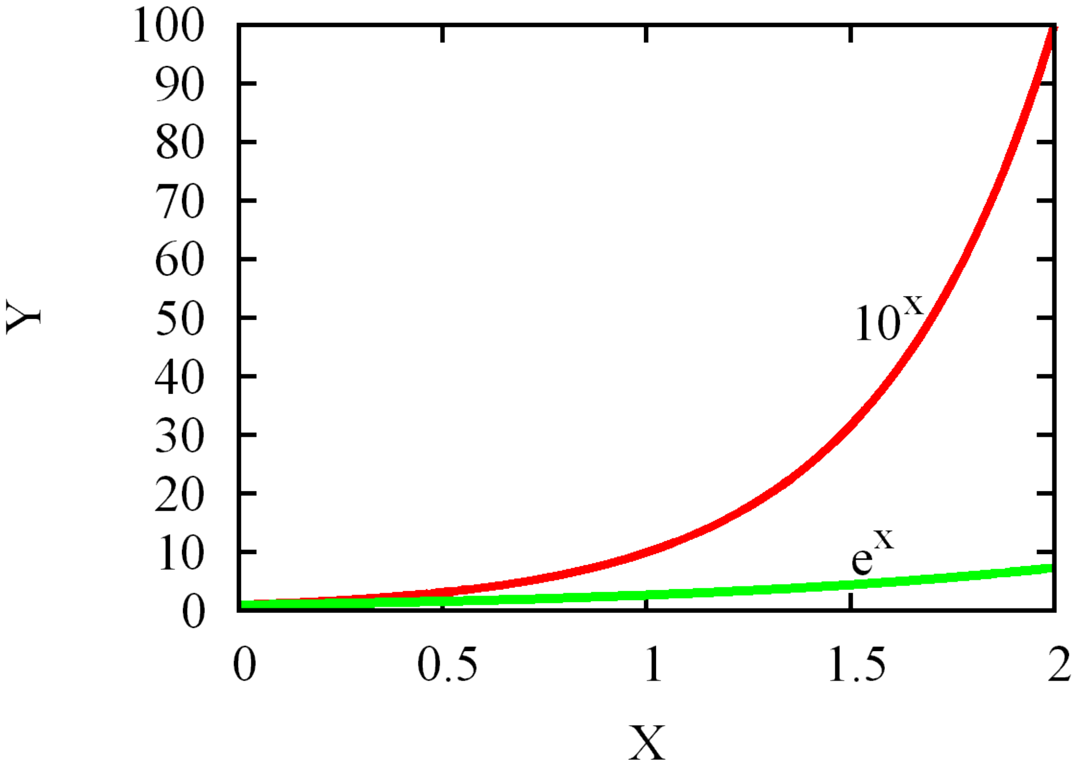
$$Y = X^2$$

$$X = \sqrt{Y} = Y^{1/2}$$

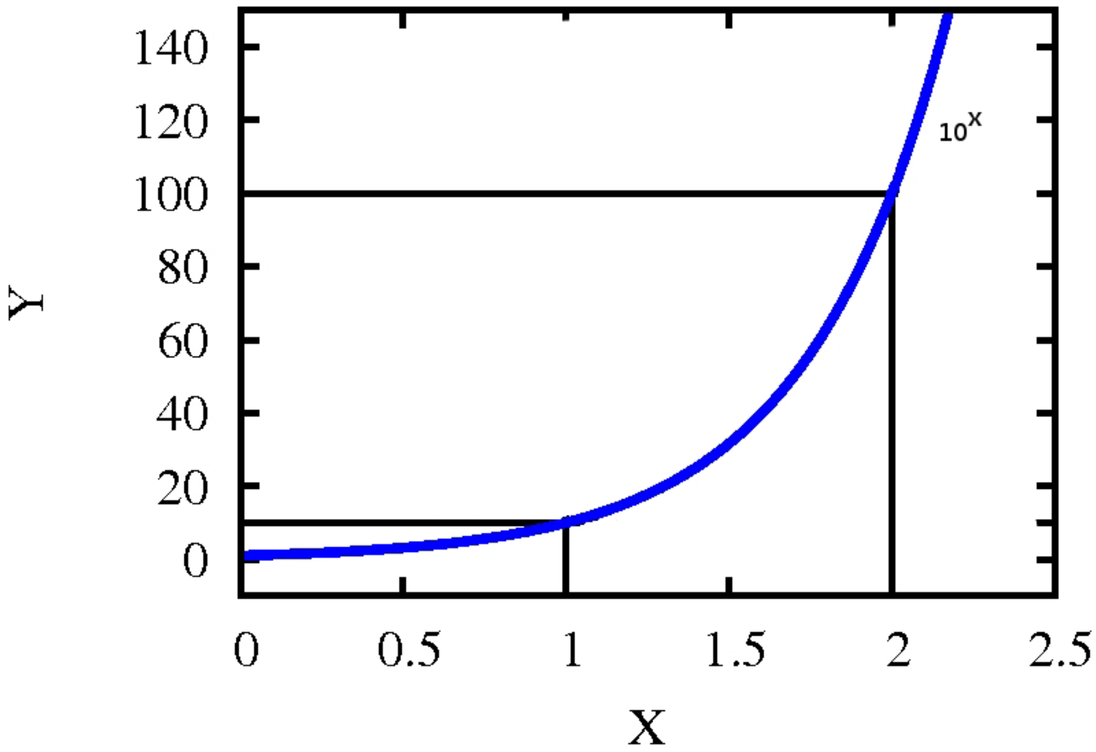
$$Y = X^3$$

$$X = \sqrt[3]{Y} = Y^{1/3}$$

Given a Y value, how to get X value ?



log (Y)



$Y = 10^x$

$\log_{10}(Y) = X$

$\log_{10}$ is often written as simply: log

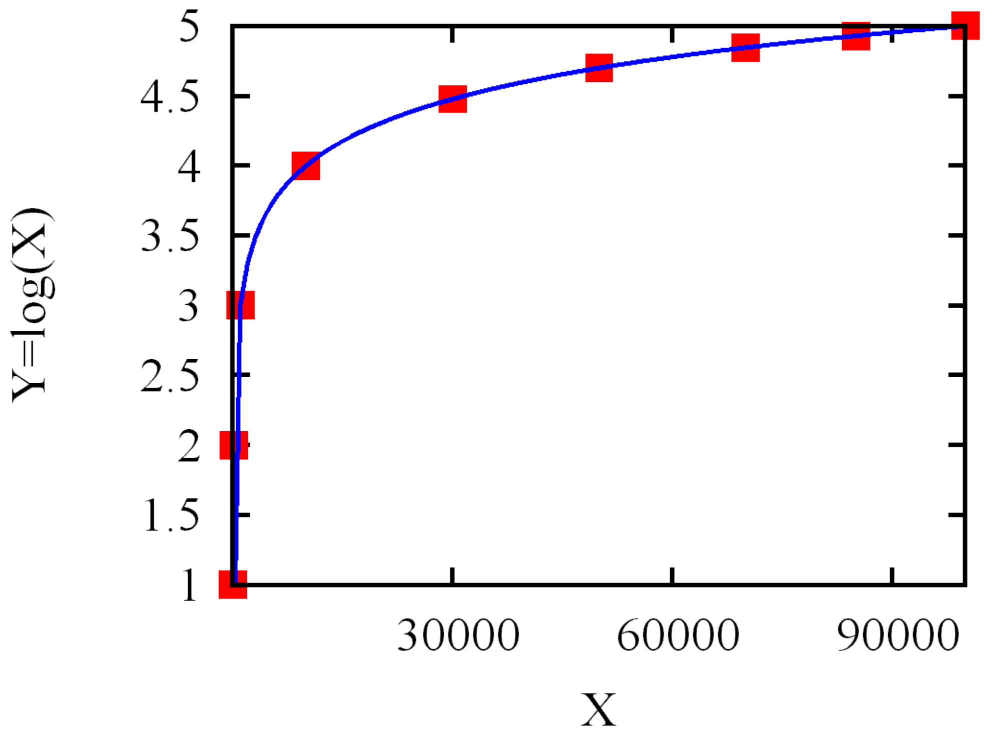
ln (Y)

$Y = e^{x}$

$\log_e(Y) = X$

$\log_e$ is often written as simply: ln

Log(x)



Example:

Beer-Lambert law

$$A = \log_{10}\left(\frac{I}{I_0}\right)$$

A: absorbance

I_0 & I : Intensity of incident and transmitted light

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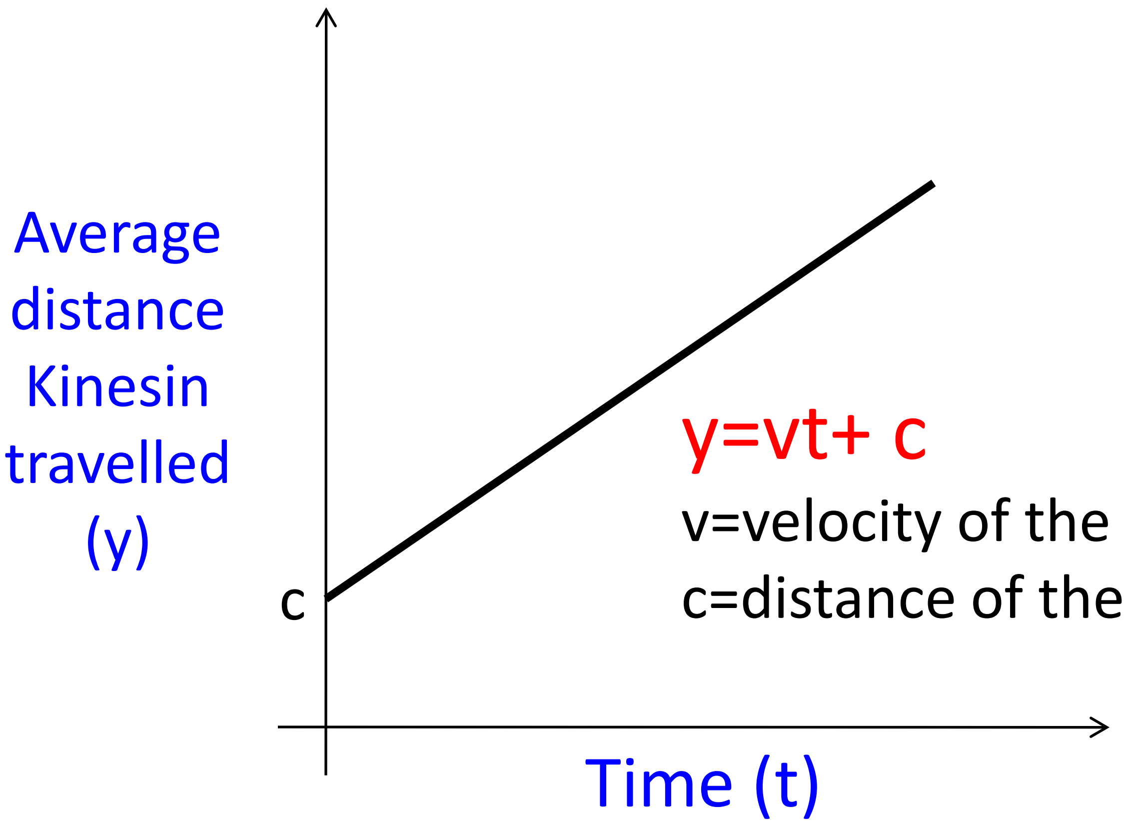
Function

- Natural phenomena – absorbance, bacterial growth etc – behave like mathematical functions

Idea of “derivatives”

Molecular motor walking along microtubule



$y = vt + c$

v=velocity of the motor

c=distance of the motor at time=0

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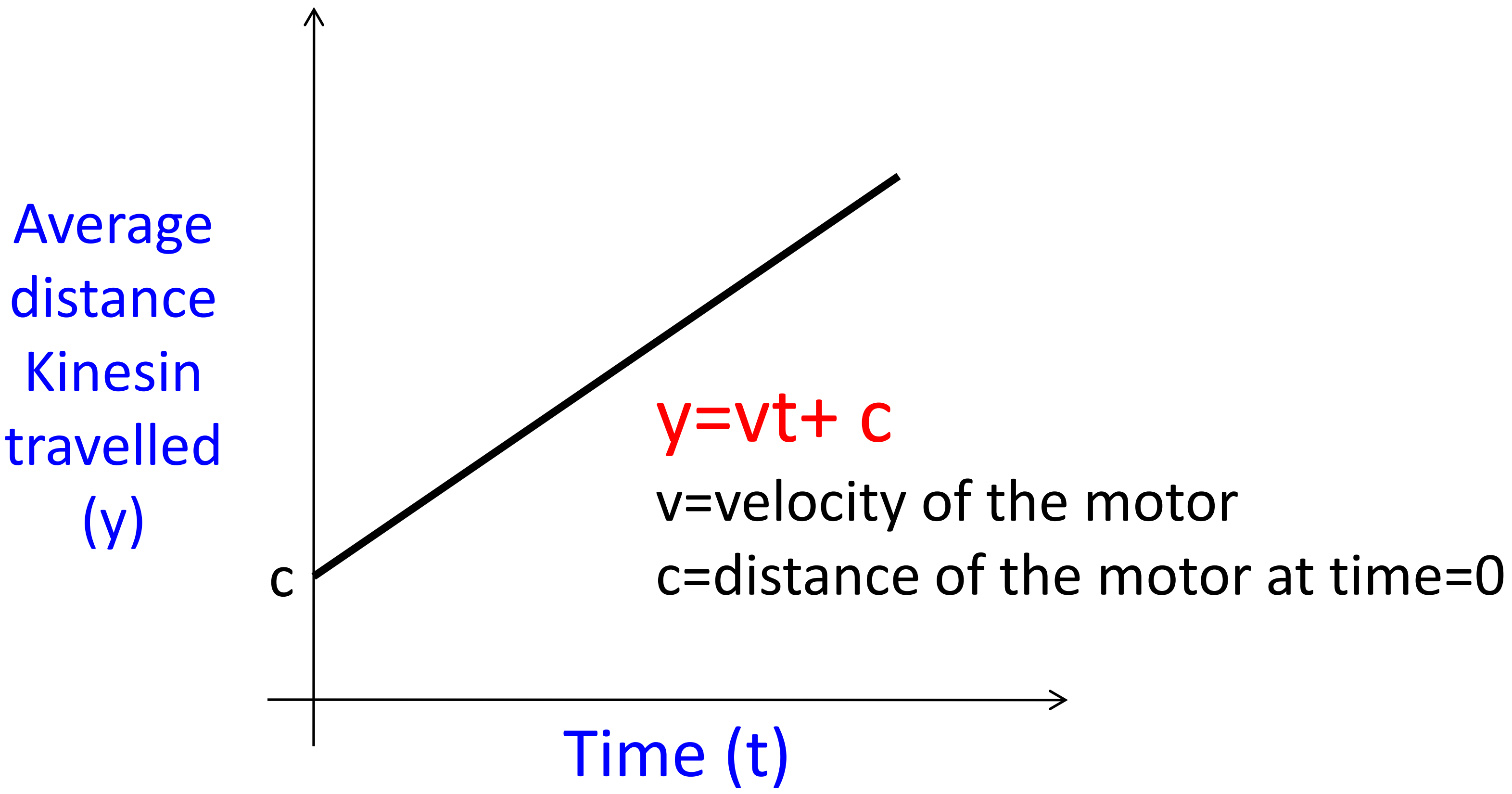
Velcotiy = (change in distance)/(change in time)

=dy/dt



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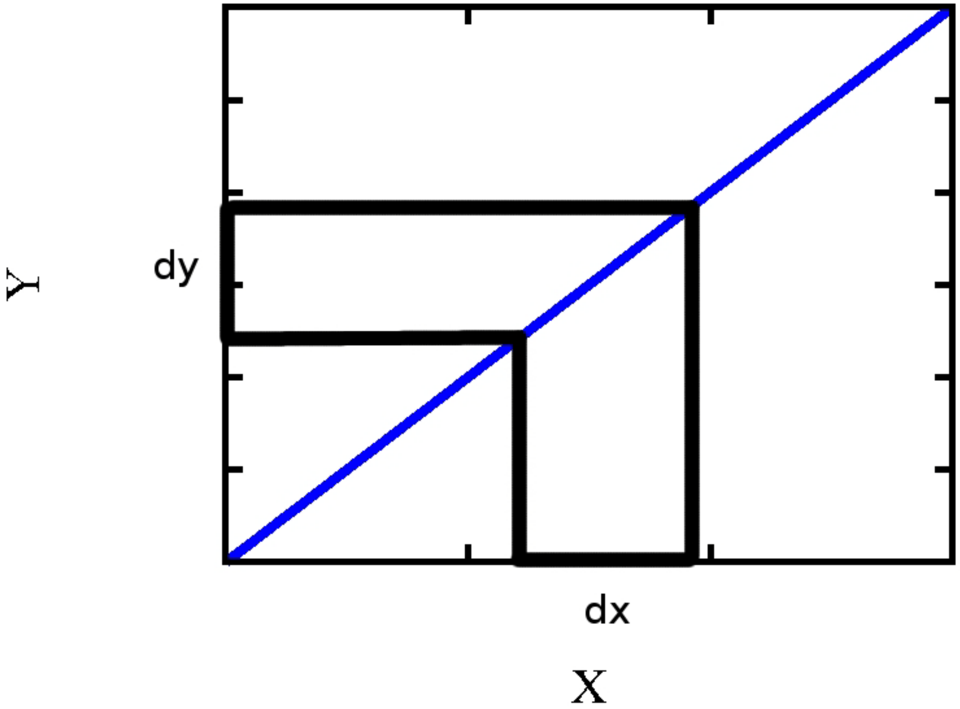
Slope=How Y changes with X

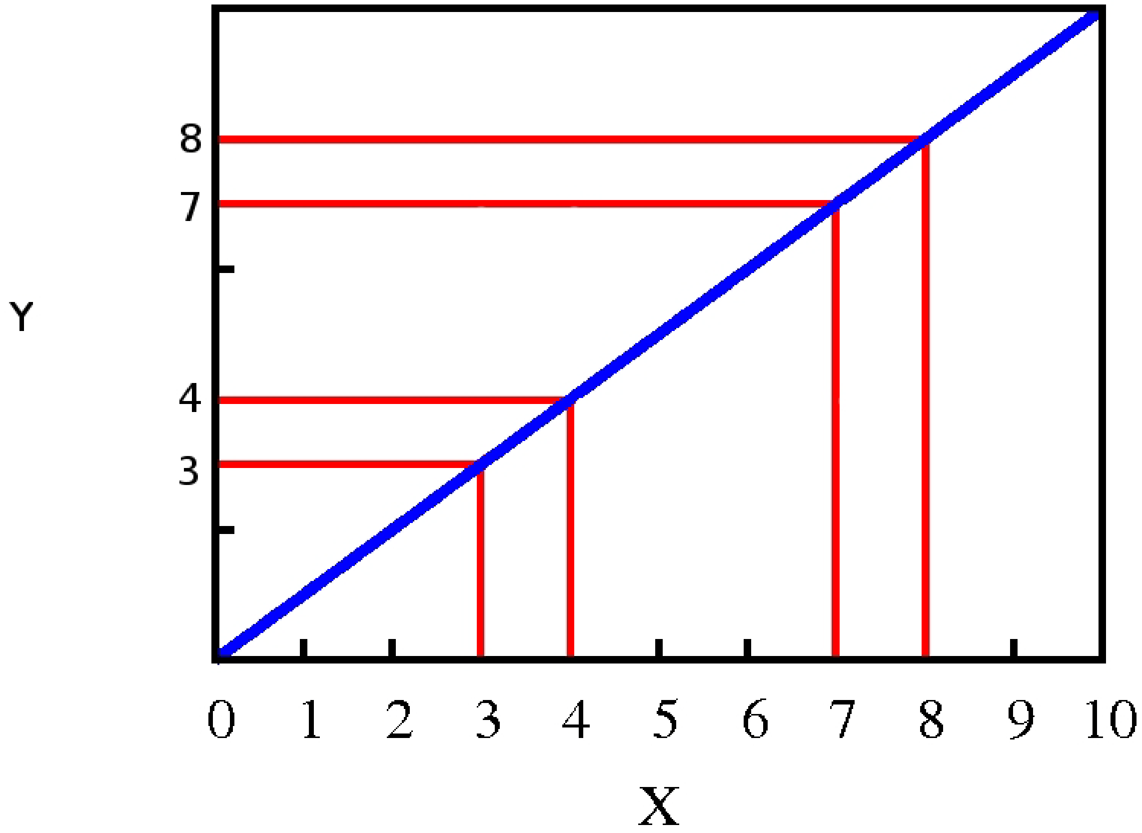


Slope = dy/dx

= derivative of y

Finding derivative of a function is nothing but calculating the slope of the function

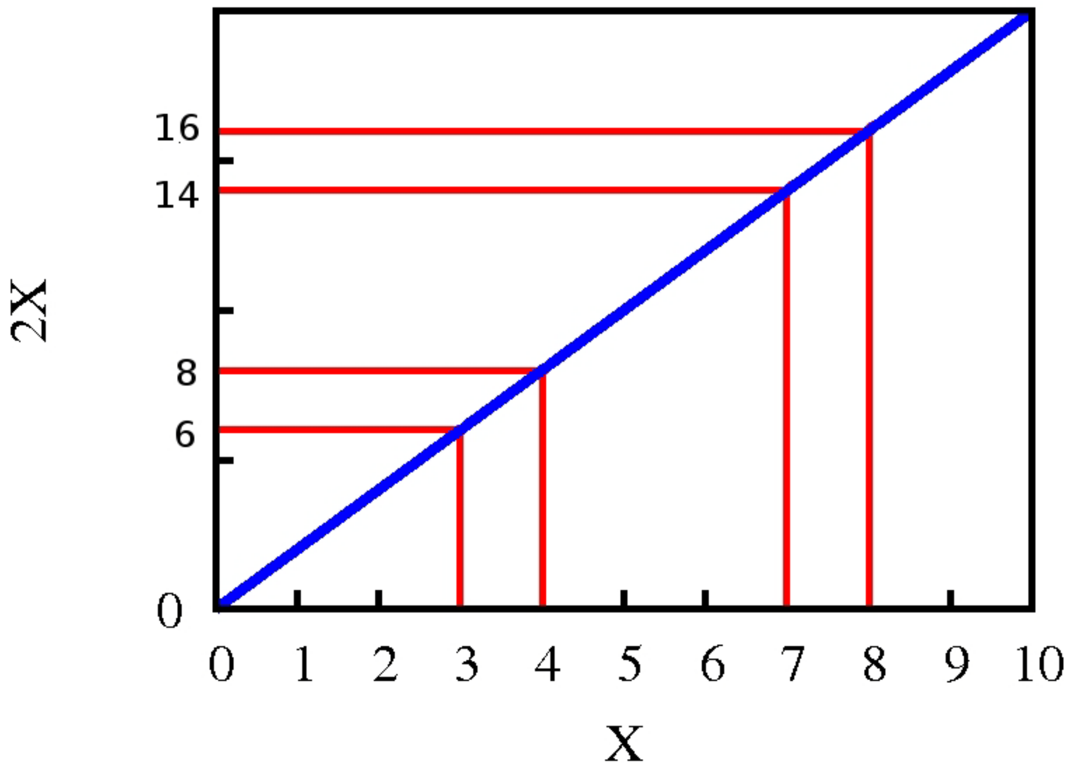
Slope of Y=X curve



Slope = dy/dx = 1.

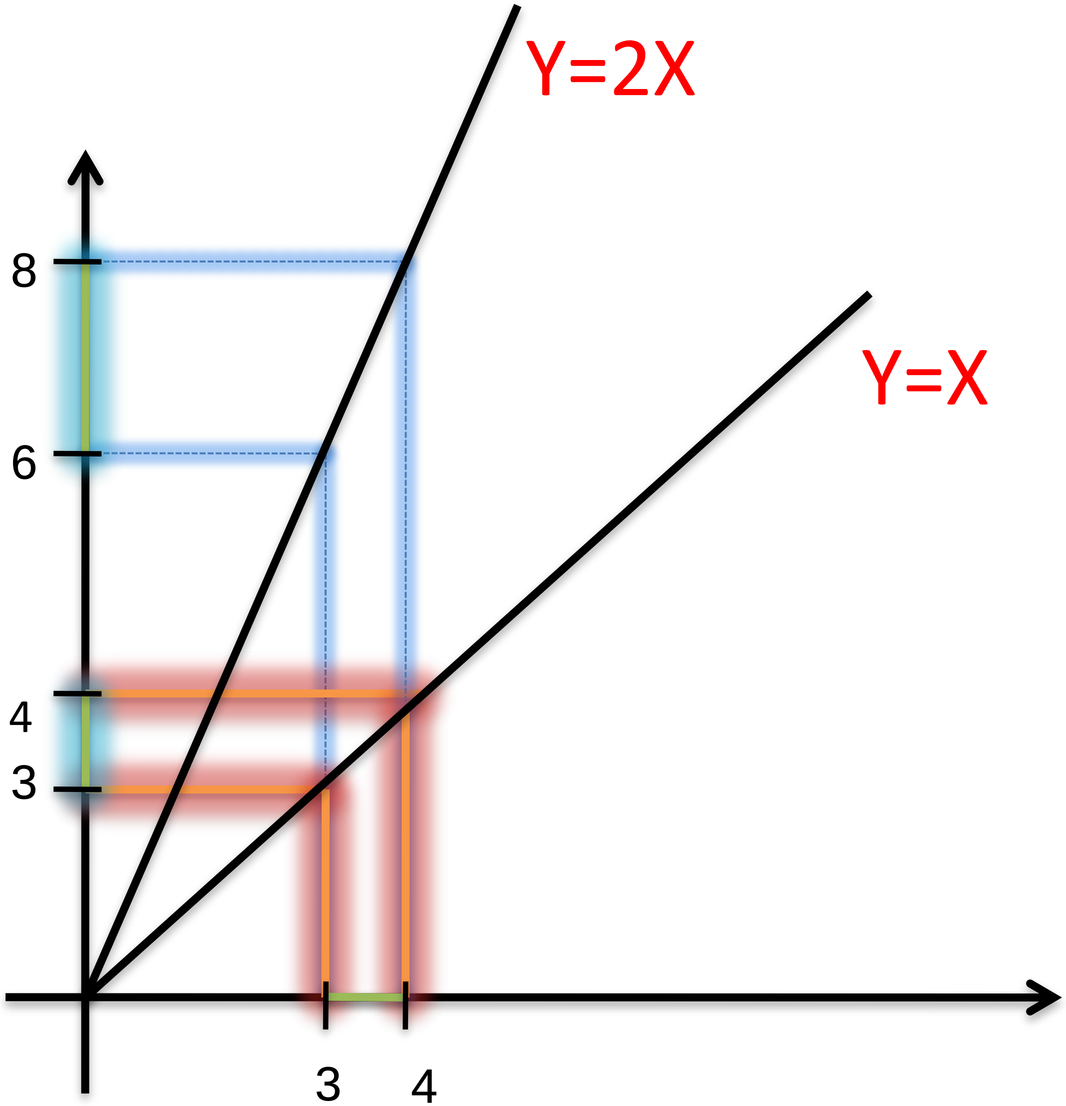
Independent of X

Slope of Y=2X curve



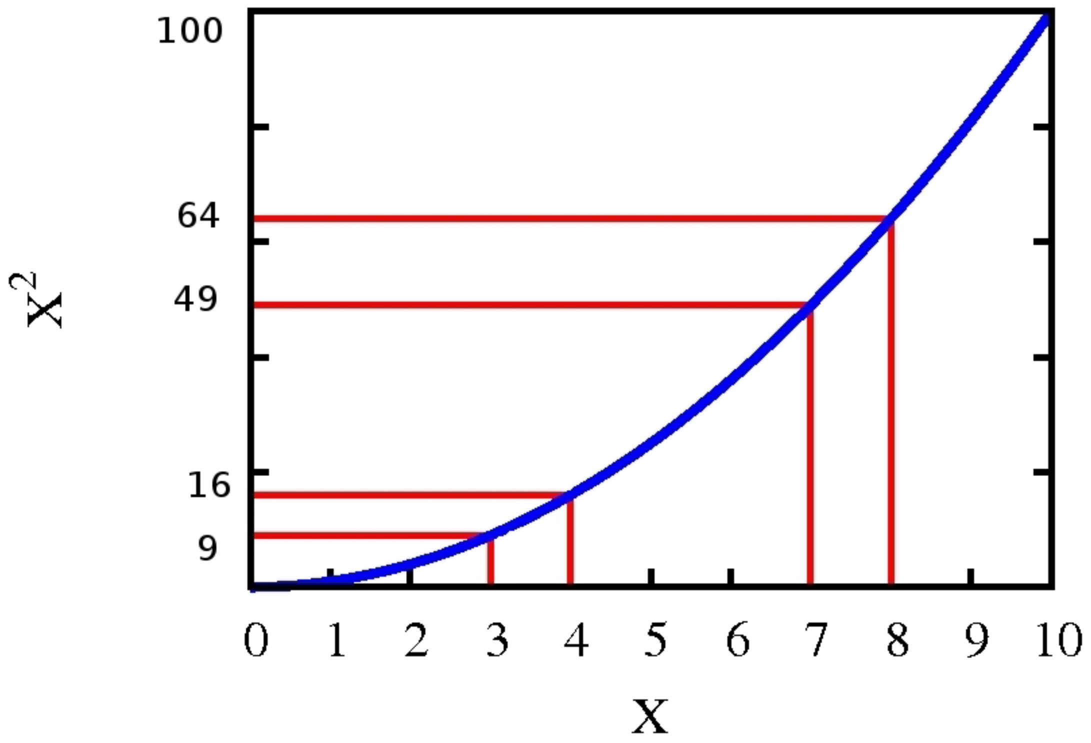
Slope = dy/dx = 2.

Independent of X



Y=2X
Y=X
8
6
4
3
3
4

Slope of $Y=X^2$ curve



Slope is not Independent of X.

Slope of X^2 is 2X.

Summary

Finding derivative of a function is nothing but calculating the how Y changes with X

Slope of a function = dy/dx

In most physical situations, slope of a function represents a physical quantity (eg. Velocity)