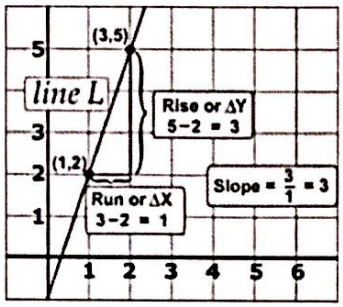
Comparing Average Rates of Change

Quick Refresher: Slopes of Linear Functions

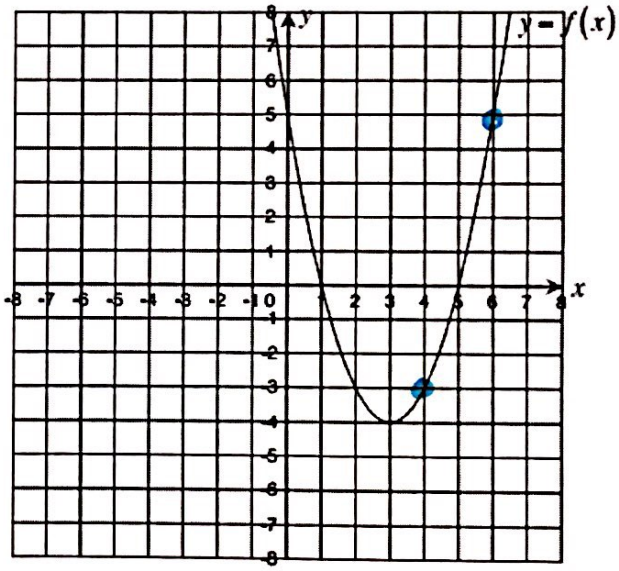
$$\text{Slope} = \frac{Y_2 - Y_1}{X_2 - X_1} = \frac{\text{Rise}}{\text{Run}} = \frac{\Delta Y}{\Delta X}$$



Slope ∇ ∘

The **average rate of change** of a function that is non-linear will not be constant. It can be positive or negative, whole number or fraction.

Consider the parabola shown to the right. To find the average rate of change between x = 1 and x = 2, you need to locate the ordered pairs that correspond to those points on the graph. The same formula used for slope can be used to find the average rate of change.



(1, 0) and (2, -3)

$$\text{Slope} = \frac{-3-0}{2-1} = \frac{-3}{1} = -3$$

If you change your x values to x = 4 and x = 6, you will see the average rate of change will not be the same as it was above.

X = 4 y = -3

X = 6 y = 5

$$\text{Slope} = \frac{5-(-3)}{6-4} = \frac{8}{2} = 4$$

You-Try!

Find the average rate of change for the following functions over the given interval. What does the average rate of change tell you about the function on the interval?

a)

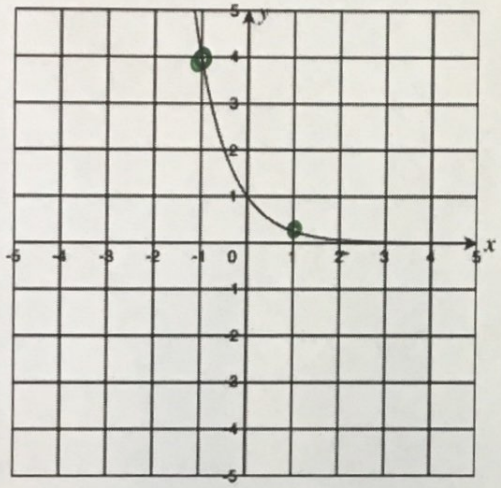
x	0	1	2	3	4
$f(x)$	3	6	12	24	48

From $x=0$ to $x=3$ (3, 24) (0, 3)

x_1 y_1 x_2 y_2

slope $= \frac{3-24}{0-3} = \frac{-21}{-3} = 7$

b)



From $x=-1$ to $x=1$

(-1, 4)

$(1, \frac{1}{4})$

$\frac{0-.25}{3-1} = \frac{-.25}{2}$ Dylan :)

$\frac{.25-4}{1-(-1)} = \frac{-3.75}{2} = -1.88$

Polynomial Functions VS Exponential Functions

x	x^3	2^x
1	1	2
2	8	4
3	27	8
4	64	16
5	125	32
6	216	64
7	343	128
8	512	256
9	729	512
10	1000	1024

Continue the table up through x = 20

11	1331	2048
12	1728	4096
13	2197	8192
14	2744	16384
15	3375	32768
16	4096	65536
17	4913	131072
18	5832	262144
19	6859	524288
20	8000	1050000

Find the average rate of change for each function given the intervals below. State which function has the bigger average rate of change.

a) x = 2 to x = 5

b) x = 6 to x = 9

c) x = 10 to x = 14

d) x = 15 to x = 20

a) 39 → $9.\overline{3}$

b) 171 → $149.\overline{3}$

c) 436 → 3840

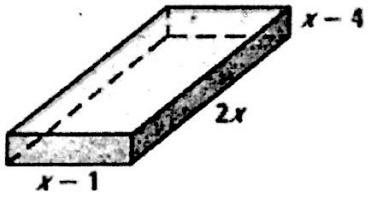
d) 925 → ~~203644~~ 203446.4

GUIDED NOTES: Polynomial Applications

EX1. For 1985 through 1996, the number, C (in millions), of videos rented each year in the United States can be modeled by $C = 0.053\left(t^3 + 2t^2 + 33t + 500\right)$, where $t = 0$ represents 1990. Using this model, estimate the number of videos rented in the United States in 1994.

EX2. The profit P (in millions of dollars) for a manufacturer of MP3 players can be modeled by $P = -4x^3 + 12x^2 + 16x$, where x is the number of MP3 players produced (in millions). Currently, the company produces 3 million MP3 players and makes a profit of $48,000,000. What lesser number of MP3 players could the company produce and still make the same profit?

EX3. Given that the volume of the box is 40 in^3, determine the dimensions of the box.



EX4. A rectangular pool has a length of $x^2 + 9x + 3$ feet and a width of $4x - 2$ feet. Determine the area of the pool.

EX5. A rectangular Tyrannosaurus Rex paddock has an area of $x^3 + x^2 - 11x + 4$ square meters, and a width of $x + 4$ meters. Find its length.

① Evaluate C at $t=4 \rightarrow 1994$

$C = 0.053(4^3 + 2(4)^2 + 33(4) + 500)$

$= 38.5$

About 38.5 million videos rented in 1994 in U.S.

② $48 = -4x^3 + 12x^2 + 16x$

$-48 \qquad\qquad -48$

$0 = -4x^3 + 12x^2 + 16x - 48$

Zeros: ~~$x=-2$~~ (doesn't make sense), $x=2$, ~~$x=3$~~ (given)

↳ If the company produces 2 million MP3 players, they'd make $48 millio

③ $2x(x-1)(x-4) = 40$

$-40 \quad -40$

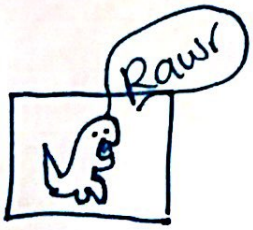
$2x(x-1)(x-4) - 40 = 0$

$x=5$

$5-1 = 4$ in

$2(5) = 10$ in

$5-4 = 1$ in ✓

⑤ 

$A = lw$

$\frac{x^3 + x^2 - 11x + 4}{x+4} = \frac{l(x+4)}{x+4}$

-4 | 1 | 1 | -11 | 4

↓ | -4 | 12 | -4

1 | -3 | 1 | 0

length: $x^2 - 3x + 1$ meters