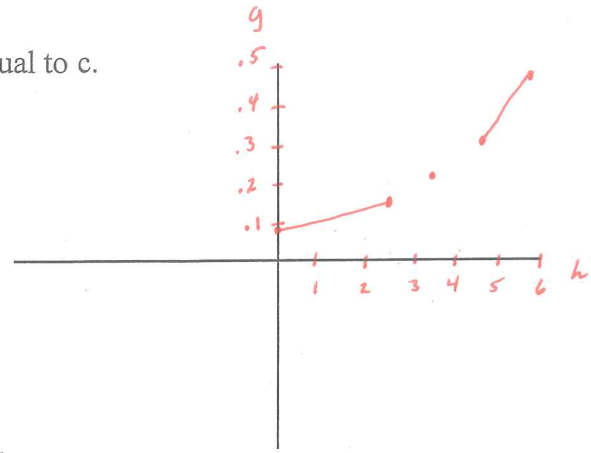
Sec 1.2 Rate of Change

Average rate of change – change in one variable with relation to the other over a given interval, can be found by finding the slope of the data

Average rate of change $= \frac{\Delta y}{\Delta x} = \frac{f(x) - f(c)}{x - c}$ for x not equal to c.



Ex.

Time (h)	Population (g)
0	0.09
2.5	0.18
3.5	0.26
4.5	0.35
6	0.50

a. Draw a scatter plot.
b. Draw a line through the first two points.
c. Find the average rate of change from 0 to 2.5 hours.
d. Draw a line through the last two points.
e. Find the average rate of change from 4.5 to 6 hours.
f. What is happening to the average rate of change as time passes? rate of change is increasing

c.) $\frac{.18-.09}{2.5-0}$ $\frac{.09}{2.5}$ .036g/hour

e.) $\frac{.50-.35}{6-4.5}$ $\frac{.15}{1.5}$ .1 g/hour

Ex. Find the average rate of change of $f(x) = 2x^2 - 3x$ from 1 to x.

$\frac{2x^2-3x-(2(1)^2-3(1))}{x-1}$ $\frac{2x^2-3x--1}{x-1}$

$\frac{2x^2-3x-(2-3)}{x-1}$ $\frac{2x^2-3x+1}{x-1}$

$$\begin{array}{r|rrr} 1 & 2 & -3 & 1 \\ & & 2 & -1 \\ \hline & 2 & -1 & 0 \end{array}$$

$\boxed{2x-1}$

Increasing and Decreasing Functions:

a. A function is increasing on an open interval I when for $x_1 < x_2$, $f(x_1) < f(x_2)$.
b. A function is decreasing on an open interval I when for $x_1 < x_2$, $f(x_1) > f(x_2)$.
c. A function is constant on an open interval I when for all x, f(x) is equal.

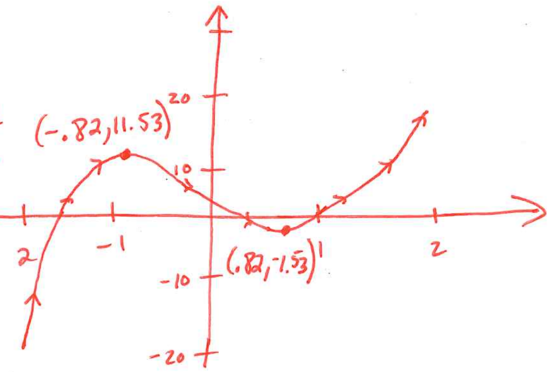
Local Maximums and Local Minimums-

a. A function has a local maximum if there exists a "crest" to the graph that is not the highest peak of the entire graph.
b. A function has a local minimum if there exists a "valley" to the graph that is not the lowest peak of the entire graph.

****To find, either graph by hand or by using your calculator and locate valleys and peaks of the graph. You may have more than one local max/min or none!**

Ex. Graph $f(x) = 6x^3 - 12x + 5$ for $-2 < x < 2$. Sketch the graph below. Then find any local maximum and local minimums. Then determine where the graph is increasing and decreasing.

local min – (.82, −1.53)
local max – (−.82, 11.53)
increasing – −2 < x < .82
.82 < x < 2
decreasing – −.82 < x < .82



Ex. Carbon 14 is a radioactive element that exists naturally in the atmosphere and is absorbed by living organisms. When an organism dies, the carbon 14 present at death begins to decay. The following table shows the quantity of Carbon 14 left in a tree t years after its death.

t, time in years	0	1000	2000	3000	4000	5000
L, quantity of carbon 14	200	177	157	139	123	109

23 20 18 16 14

a. What type of function is this? How do you know that without looking at the table? Explain. It states that the amount of carbon begins to decay

b. Now look at the table. How do you know what type of function it is by looking at the table? As time increases, the quantity of carbon decreases

c. What is f(2000)? What is f(4000)? Compare your answers. Do they make sense?

f(2000) = 157 f(4000) = 123

6000 7000 8000 9000 10000
95 85 75 67 59

d. If you were to extend the table to f(10000), what could you predict about the amount of Carbon 14 left in the tree? Explain your reasoning.
The rate of decay is approximately 11.5%. ($\frac{177}{200} = .885$)
The amount should be around 59.

e. Find the average rate of change from 1000 to 3000 years. Then find the average rate of change from 3000 to 5000 years. What do you notice happens?

$\frac{139-177}{3000-1000}$ $\frac{38}{2000} = -.019$ $\frac{109-139}{5000-3000}$ $\frac{-20}{2000} = -.01$ Rate of change (decrease) slows

Ex. Find the average rate of change for $f(x) = x^2$ between x = 1 and x = 3 and between x = -2 and x = 1. Does the function stay the same or change? Explain your answer.

$\frac{9-1}{3-1} = \frac{8}{2} = 4$ $\frac{1-4}{1--2} = \frac{-3}{3} = -1$ The function is increasing from 1 to 3 but decreases and increases from -2 to 1.

HW: pg 15 – 18, # 1, 3, 4, 5-9, 13, 15, 17, 18, 21, 22, 25
3-9