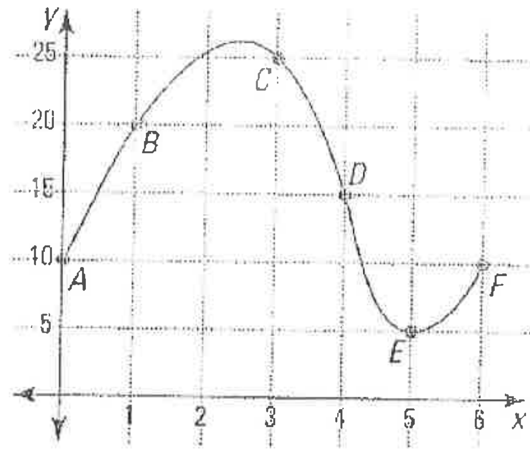
Key

Math 4 Name______________________

5-2 **Learn Check** Date________

In this investigation, you are being assessed on the following learning goals:
I can compute and interpret average rates of change in functions
I can calculate and use the difference quotient for a function



In numbers 1-4, use the graph at the right.

1. In going from B to C, find Δx and Δy.

$\Delta x =$ 2 $\Delta y =$ 5

2. Between which two named points is $\Delta y = -10$?

C to D ; D to E + B to F

3. Find the average rate of change of the function from D to F.

$$\frac{f(x_2)-f(x_1)}{x_2-x_1} = \frac{10-15}{6-4} = \boxed{-\frac{5}{2}}$$

4. Between which two named points is the average rate of change of the function zero?

A to F (same y-values)

5. Suppose P and Q are two points on the curve $f(x) = x^2 - x + 2$. If the x-coordinate of P is 1 and the x-coordinate of Q is 4, find the slope of the secant line $\overleftrightarrow{PQ}$.

$f(4) = 4^2 - 4 + 2 = 14$

Slope = AROC = $\frac{f(4)-f(1)}{4-1} = \frac{14-2}{3} = \frac{12}{3} = \boxed{4}$

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

$P(1,2)$; $Q(4,14)$

6. Find the difference quotient, $\frac{f(x+\Delta x)-f(x)}{\Delta x}$, for the function f defined by $f(x) = \frac{1}{2}x - 5$.

$$= \frac{\frac{1}{2}(x+\Delta x) - 5 - (\frac{1}{2}x - 5)}{\Delta x}$$

$$= \frac{\cancel{\frac{1}{2}x} + \frac{1}{2}\Delta x \cancel{-5} \cancel{-\frac{1}{2}x} \cancel{+5}}{\Delta x}$$

$$= \frac{\frac{1}{2}\cancel{\Delta x}}{\cancel{\Delta x}} = \boxed{\frac{1}{2}}$$

This happens because f(x) is linear!

OVER→

7. A projectile is thrown in the air and its height (in meters) is modeled by the equation:

$$h(t) = 1 + 20t - 4.9t^2$$

7a. Calculate the difference quotient $\dfrac{h(t+\Delta t) - h(t)}{\Delta t}$

$$= \frac{1 + 20(t+\Delta t) - 4.9(t+\Delta t)^2 - (1 + 20t - 4.9t^2)}{\Delta t}$$

$$= \frac{1 + 20t + 20\Delta t - 4.9(t^2 + 2t\Delta t + \Delta t^2) - 1 - 20t + 4.9t^2}{\Delta t}$$

$$= \frac{\cancel{1} + \cancel{20t} + 20\Delta t - \cancel{4.9t^2} - 9.8t\Delta t - 4.9\Delta t^2 \cancel{-1} \cancel{-20t} \cancel{+4.9t^2}}{\Delta t}$$

$$= \frac{20\Delta t - 9.8t\Delta t - 4.9\Delta t^2}{\Delta t}$$

$$= \boxed{20 - 9.8t - 4.9\Delta t}$$

7b. Explain the difference quotient tells you in the context of this problem.

The difference quotient gives you the average velocity (not speed) of the projectile over a given time interval.

7c. Find the average velocity of the projectile from 2 to 2.75 seconds. Interpret the sign of your velocity. $t = 2$; $\Delta t = 0.75$

$$= 20 - 9.8(2) - 4.9(0.75)$$

$$= \boxed{-3.275 \text{ m/s}}$$ → The projectile is traveling this speed downward.

8. The speed of a car (in miles per hour) travelling on the highway over time (in hours) is modeled by the equation $f(x) = -x^4 + 10x^3 - 27x^2 + 18x + 15$

8a. Find the average rate of change of the car's speed (the car's *acceleration*) over the interval $1 \le x \le 5$

$f(1) = -(1)^4 + 10(1)^3 - 27(1)^2 + 18(1) + 15 = 15$

$f(5) = -(5)^4 + 10(5)^3 - 27(5)^2 + 18(5) + 15 = 55$

$\text{AROC} = \dfrac{55-15}{5-1} = \dfrac{40}{4} = \boxed{10 \text{ mi/h}^2}$ or mph/h