# What's Going On?

**Checking In**

**Minds on** Rate of Change Recap

**Action!** Rate of Change of Polynomial Functions

**Consolidation** Instantaneous RoC from Graph

**Learning Goal - I will be able to calculate average and instantaneous rates of change for polynomial functions.**

## Minds on

# Secant Lines and Tangent Lines

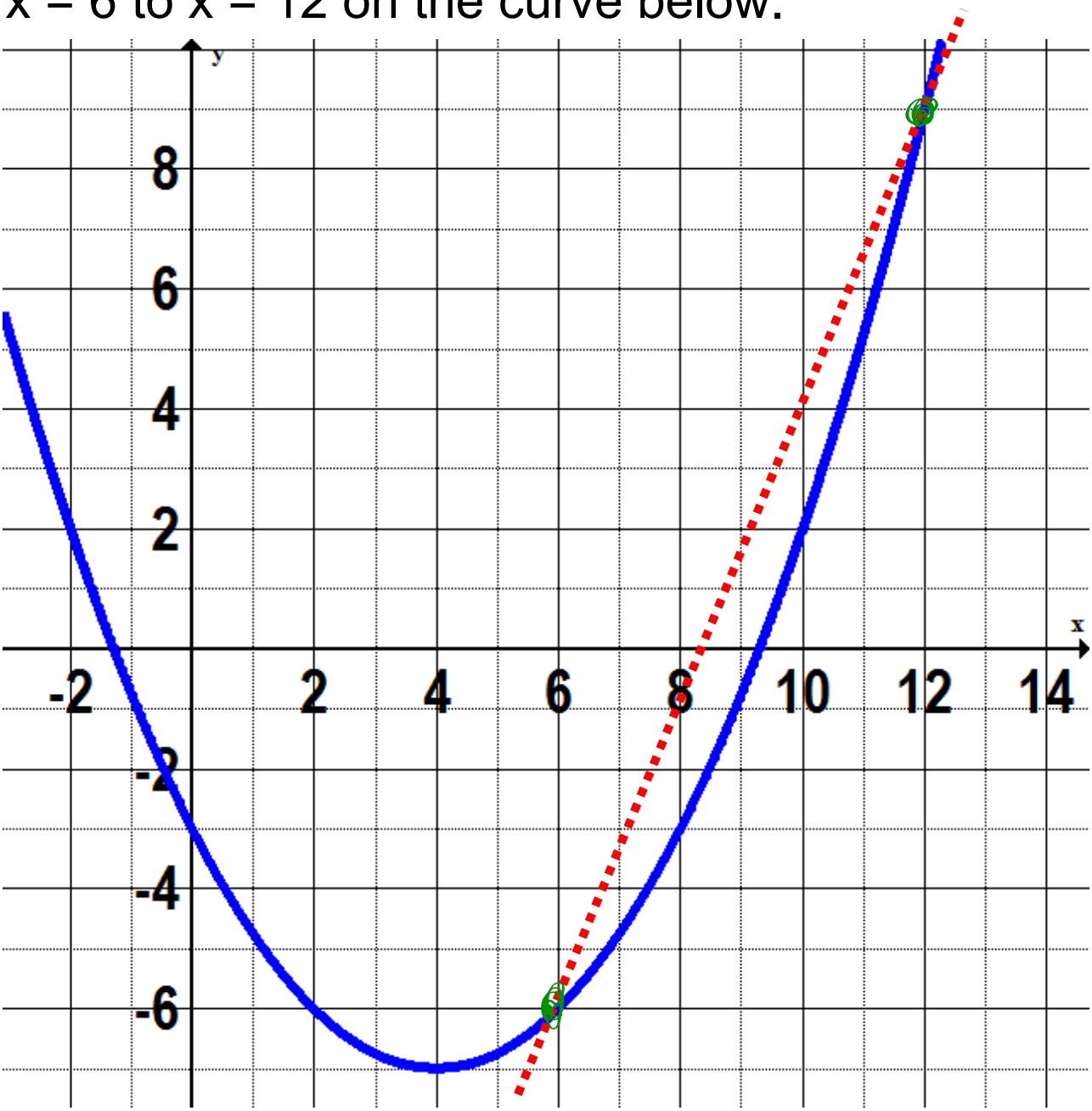
Recall from earlier in the course:

To determine the average rate of change over an interval, we find the slope of a **secant line** that passes through two points of a curve.

## Minds on

# Secant Lines and Tangent Lines

Determine the average rate of change from x = 6 to x = 12 on the curve below.



Average Rate of Change

$$= \frac{f(x_2) - f(x_1)}{x_2 - x_1}$$

$$= \frac{9 - (-6)}{12 - 6}$$

$$= \frac{15}{6} = 2.5$$

**Action!**

# Determining Rate of Change

## Average Rate of Change

To determine the average rate of change through two points $x_1$ and $x_2$, use the formula

$$\frac{f(x_2) - f(x_1)}{x_2 - x_1}$$

**Action!**

# Determining Rate of Change

## Average Rate of Change

Determine the average rate of change from x = 2 to x = 5 on the function

$$f(x) = (x - 3)^3 - 1$$

$$roc = \frac{f(5) - f(2)}{5 - 2}$$

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

$$= \frac{(7) - (-2)}{3}$$

$$= 3$$

## Minds on

# Secant Lines and Tangent Lines

Recall from earlier in the course:

To determine the instantaneous rate of change at a point, we find the slope of a **secant line** that passes through two **very close** points of a curve.

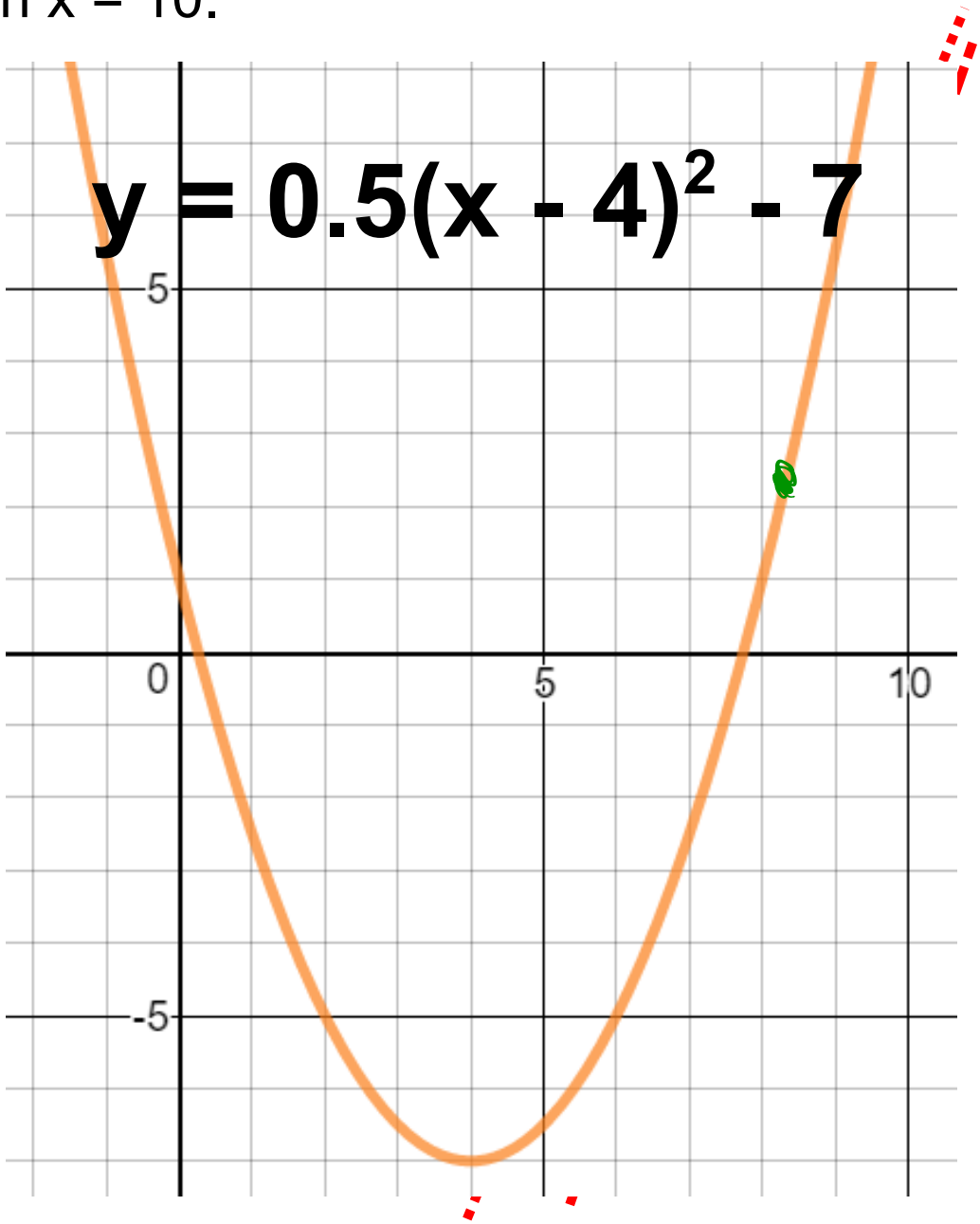
Ideally, this line would pass through our point and no other points on the curve.

This would be called a **tangent line.**

## Minds on

# Secant Lines and Tangent Lines

Determine the instantaneous rate of change when x = 10.



$$ROC = \frac{f(x+h) - f(x)}{h}$$

where $h = 0.001$

$$= \frac{f(10.001) - f(10)}{0.001}$$

$$= \frac{(0.5(10.001-4)^2 - 7) - (0.5(10-4)^2 - 7)}{0.001}$$

$$= \frac{11.006 - 11}{0.001}$$

$$= 6$$

**Action!**

# Determining Rate of Change

## Instantaneous Rate of Change

To determine the instantaneous rate of change of a function when x = a use the difference quotient

$$\frac{f(a+h)-f(a)}{h}$$

0.001

where *h* is a very small number.

**Action!**

# Determining Rate of Change

## Instantaneous Rate of Change

Determine the instantaneous rate of change when x = 4 on the function

$$f(x) = (x - 3)^3 - 1$$

$$ROC = \frac{f(4.001) - f(4)}{0.001}$$

$$= \frac{((4.001-3)^3 - 1) - ((4-3)^3 - 1)}{0.001}$$

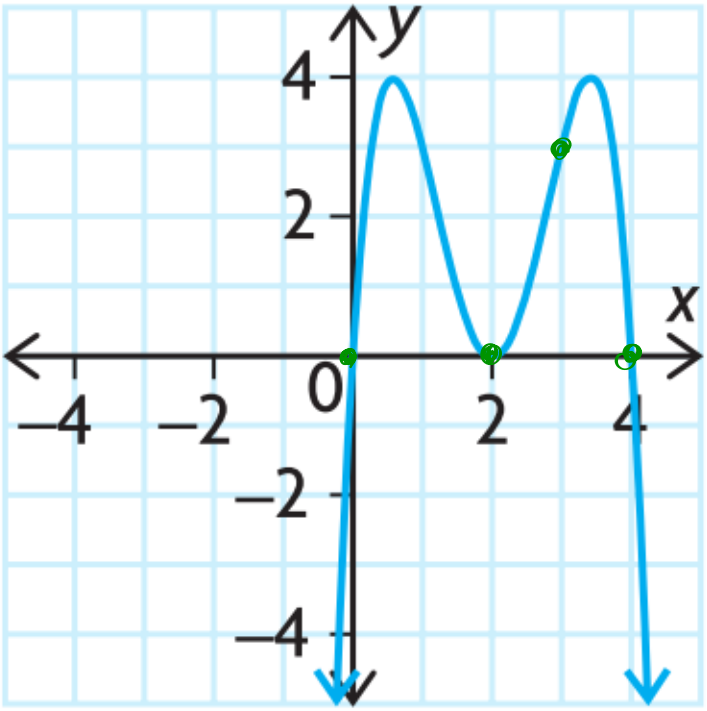
$$= \frac{0.003 - 0}{0.001}$$

$$= 3$$

**Action!**

# Determining Rate of Change

Given the graph below, estimate the instantaneous rate of change at the point (3, 3).




$y = ax(x-2)^2(x-4)$

solve for a!

$$(3) = a(3)(3-2)^2(3-4)$$

$$3 = a(3)(1)(-1)$$

$$3 = -3a$$

$$a = -1$$

$$y = -x(x-2)^2(x-4)$$

$$roc = \frac{f(a+h) + f(a)}{h}$$

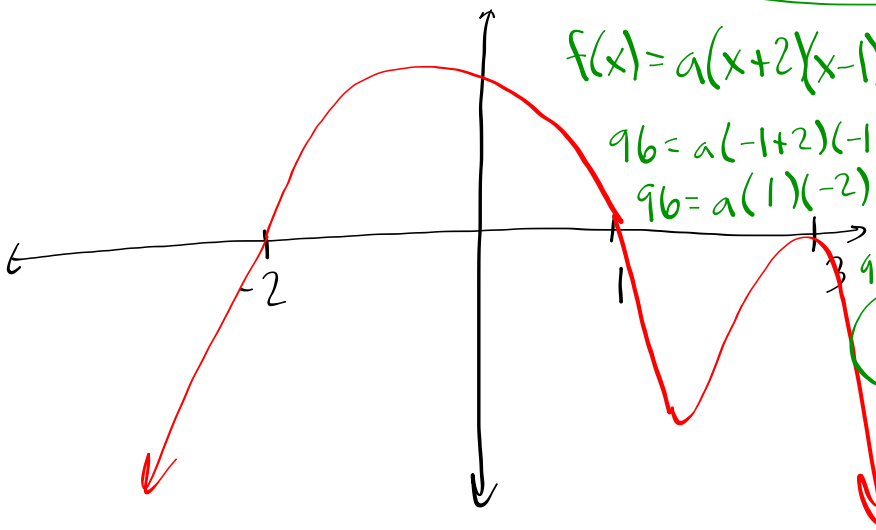
$$= \frac{(-3.001(3.001-2)^2(3.001-4)) - 3}{0.001}$$

$$= \frac{0.004}{0.001}$$

$$= 4$$

# Pg. 226 #10

Determine an expression for $f(x)$ in which $f(x)$ is a quartic function, $f(x) > 0$ when $-2 < x < 1$, $f(x) \leq 0$ when $x < -2$ or $x > 1$, $f(x)$ has a double root when $x = 3$, and $f(-1) = 96$.




$f(x) = a(x+2)(x-1)(x-3)^2$

$96 = a(-1+2)(-1-1)(-1-3)^2$

$96 = a(1)(-2)(16)$

$96 = a(-32)$

$a = -3$

e) $(x-3)(x+1)+(x-3)(x+2) \geq 0$

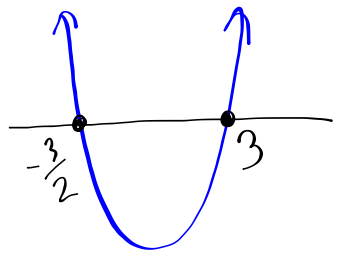
$\cancel{x^2}-2x-3+\cancel{x^2}-x-6 \geq 0$

$2x^2-3x-9 \geq 0$

$2x^2-6x+3x-9 \geq 0$

$2x(x-3)+3(x-3) \geq 0$

$(x-3)(2x+3) \geq 0$




$(x-3)(2x+3) \geq 0$ when $x \leq -\frac{3}{2}$ and $x \geq 3$

## Consolidation

Practice Questions

# Pg. 235

1, 3, 8, 11