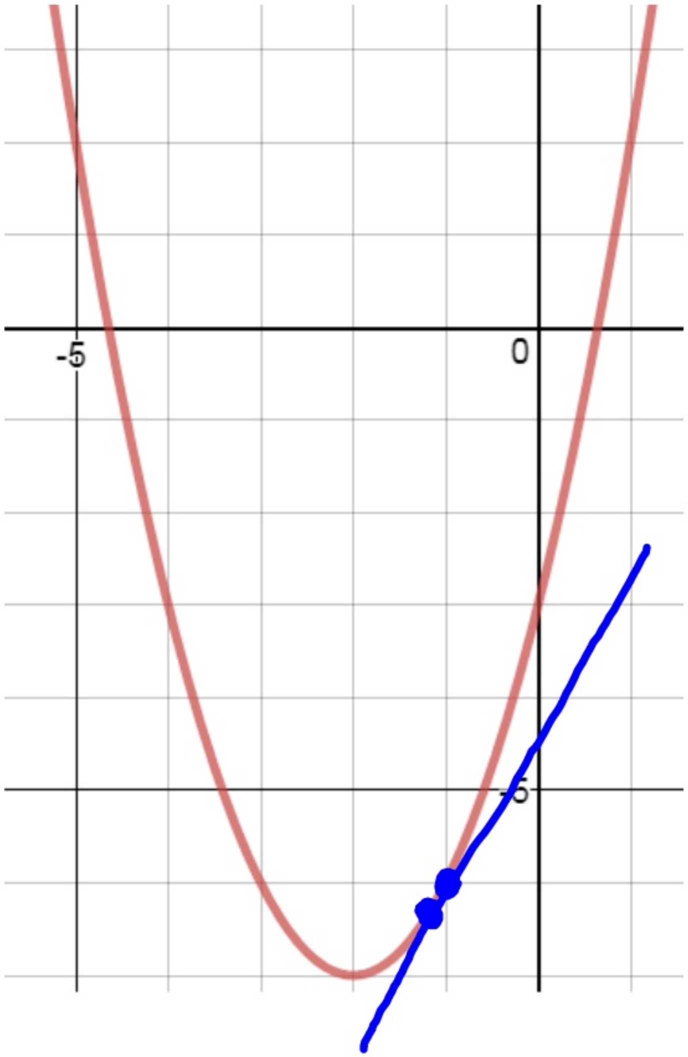
Do Now

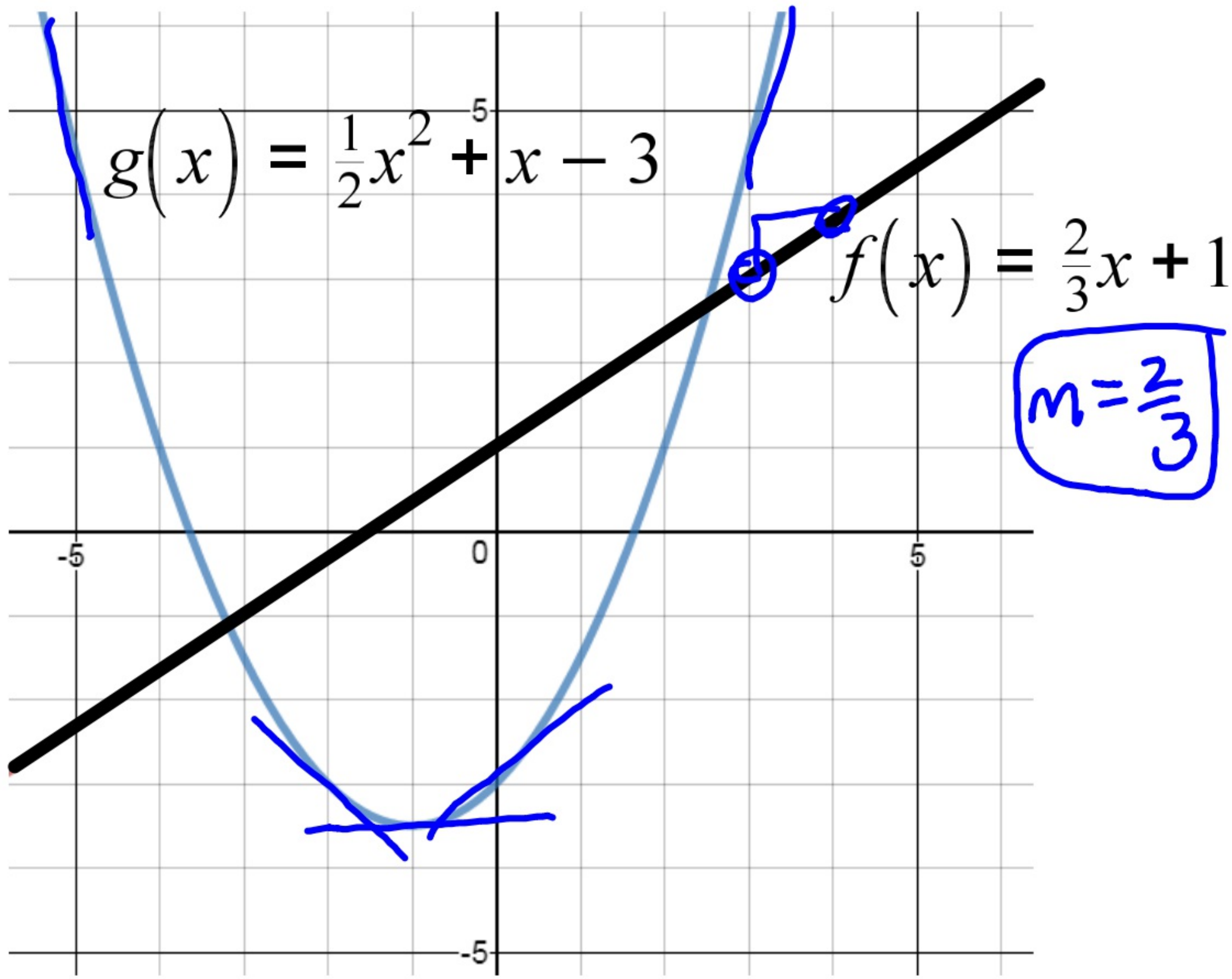
What is the slope of the line tangent to the function when x = -1?



$y = x^2 + 4x - 3$

To guess the slope of the tangent line, find the slope of the secant line when $x_1 = -1$ and $x_2 = -1.001$

$$m = \frac{f(-1) - f(-1.001)}{-1 - -1.001} = 1.999$$


$g(x) = \frac{1}{2}x^2 + x - 3$
$f(x) = \frac{2}{3}x + 1$
$m = \frac{2}{3}$
5
-5
0
5
-5

Definition:

The **Tangent Line** to the curve y = f(x) at the point P: (a,f(a)), is the line through P with slope...

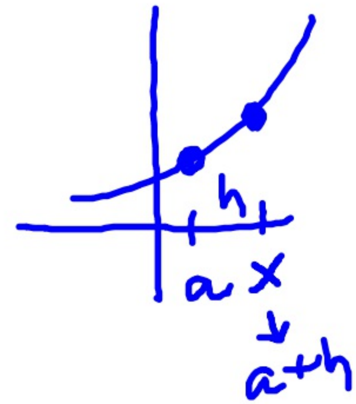
$$m = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$

provided that limit exists.

Note:

A second representation of m, instead of:

$$m = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$



is this:

$$m = \lim_{h \to 0} \frac{f(a+h) - f(a)}{h}$$

a+h − a

...and this is a **derivative.** A **derivative** is the instantaneous slope, or the slope of the tangent line, of a function at a point *a*, and is denoted by $f'(a)$ provided the limit exists.

DERIVATIVE

$$\underset{m}{f'(a)} = \lim_{h \to 0} \frac{f(a+h) - f(a)}{h}$$ means the derivative at *a*.

x

Equation of the tangent line at the point (a, f(a)):

$$y = \underbrace{f'(a)}_{m}(x - a) + \underbrace{f(a)}_{y_1}$$

Example: Use the definition of a derivative

$$f'(a) = \lim_{h \to 0} \frac{f(a+h) - f(a)}{h}$$

to find the derivative of $f(x) = \frac{2}{3}x + 1$ when x = 3

Example: Use the definition of a derivative

$$f'(a) = \lim_{h \to 0} \frac{f(a+h) - f(a)}{h}$$

to find the derivative of $f(x) = \frac{1}{2}x^2 + x - 3$ when x = -2