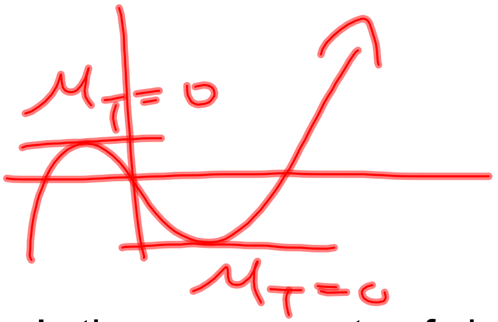
If $f(x) = x^3 + 2x^2 - x - 2$ is $x=0$ a turning point?



Calculate instantaneous rate of change at $x=0$

$$M_T \doteq \frac{f(0.01)-f(-0.01)}{0.01 - -0.01}$$

$$= \frac{-2.009799 - -1.989801}{0.02}$$

$$= \frac{-0.019998}{0.02}$$

$$\doteq -0.9999$$

$$\doteq -1$$

Is the average rate of change between x=1 and 5 positive or negative?
Demonstrate with a graph.

3

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

$$f(0+h) = h^3 + 2h^2 - h - 2$$

$f(h)$

$$f(0) = 0 + 0 - 0 - 2$$
$$= -2$$

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

$$= \lim_{h \to 0} \frac{h^3 + 2h^3 - h - 2 - -2}{h}$$

$$= \lim_{h \to 0} \frac{h^3 + 2h^2 - h}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{h}(h^2 + 2h - 1)}{\cancel{h}}$$

$$= \lim_{h \to 0} h^2 + 2h - 1$$
$$= -1$$

∴ Since $M_T = -1$ not 0, it cannot be a turning point at $x = 0$

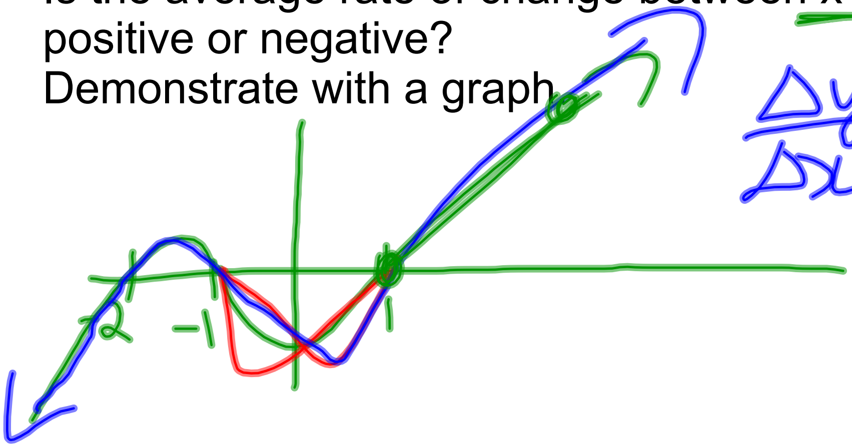
If $f(x) = x^3 + 2x^2 - x - 2$ is x=0 a turning point?

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

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

$= (x+2)(x-1)(x+1)$

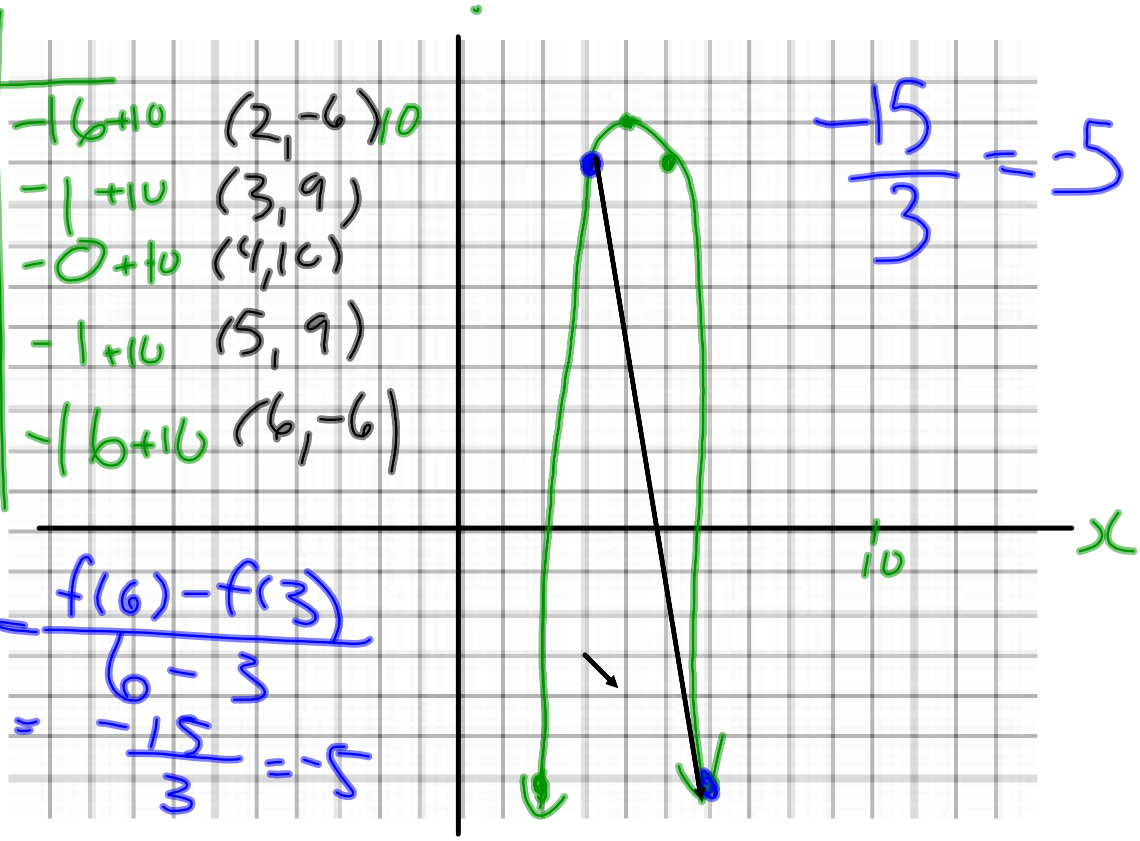
Is the average rate of change between x=1 and 5 positive or negative?
Demonstrate with a graph.



$$\frac{\Delta y}{\Delta x} = \frac{f(5)-f(1)}{5-1}$$

$$= 42$$

What is the average rate of change of f(x) = -(x-4)⁴ +10 between x=3 and x=6 ? Use a graph to show your answer is reasonable.



$-2+4$	$-16+10$	$(2,-6)$
$-1+4$	$-1+10$	$(3,9)$
$0+4$	$-0+10$	$(4,10)$
$1+4$	$-1+10$	$(5,9)$
$2+4$	$-16+10$	$(6,-6)$

$$\frac{\Delta y}{\Delta x} = \frac{f(6)-f(3)}{6-3} = \frac{-15}{3} = -5$$

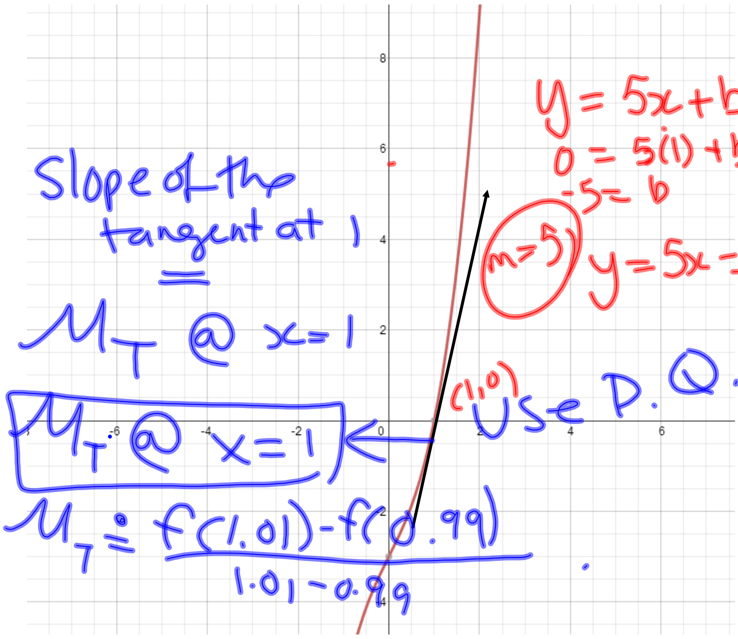
$$\frac{-15}{3} = -5$$

What is the equation of the tangent line
to the curve f(x) = $x^3 + 2x - 3$ at x = 1?

$$
\begin{array}{r|l}
 & x^2 + x + 3 \\
x-1 & x^3 + 0x^2 + 2x - 3 \\
 & x^3 - x^2 \\
\hline
 & 1x^2 + 2x \\
 & 1x^2 - x \\
\hline
 & 3x - 3 \\
 & 3x - 3 \\
\hline
 & 0
\end{array}
$$

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

What is the equation of the tangent line
to the curve $f(x) = x^3 + 2x - 3$ at $x = 1$?



$y = 5x + b$

$0 = 5(1) + b$

$-5 = b$

$m = 5$

$y = 5x - 5$

Slope of the tangent at 1

$=$

M_T @ $x = 1$

$(1,0)$ Use P.Q.

$\boxed{M_T \text{ @ } x = 1}$

$$M_T \doteq \frac{f(1.01) - f(0.99)}{1.01 - 0.99}$$

$$f(1+h) = (1+h)^3 + 2(1+h) - 3$$

$$= (1 + 2h + h^2)(1+h) + 2 + 2h - 3$$

$$= 1 + \cancel{2h} + \cancel{h^2} + \cancel{h} + \cancel{2h^2} + h^3 + 2 + \cancel{2h} - 3$$

$$= h^3 + 3h^2 + 5h$$

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

$$= 0$$

$$M_T = \lim_{h \to 0} \frac{h^3 + 3h^2 + 5h - 0}{h}$$

$$= \lim_{h \to 0} \frac{h^3 + 3h^2 + 5h}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{h}(h^2 + 3h + 5)}{\cancel{h}}$$

$$= 0 + 3(0) + 5$$

$$= 5$$

$$y = x^3 + 2x^2 - 8x$$

$f(-2.2) = 16.6$

$= x(x^2 + 2x - 8)$

$f(-2.1) = 16.4$

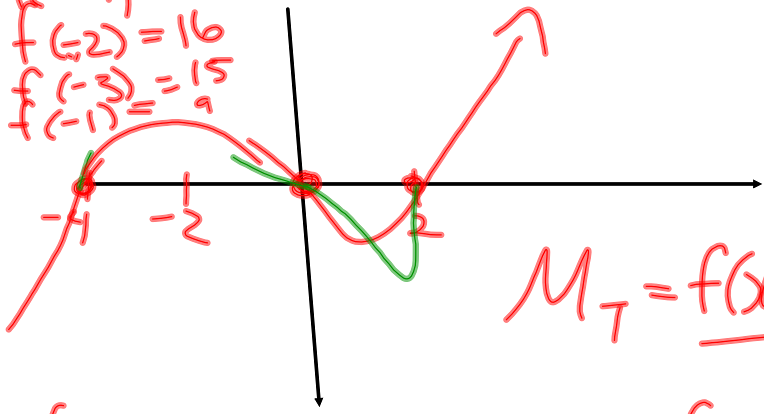
$= x(x+4)(x-2)$

$f(-1.9) = 15.56$

$f(-2) = 16$

$f(-3) = 15$

$f(-1) = 9$



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

$$f(x+h) = (x+h)^3 + 2(x+h)^2 - 8(x+h) \qquad 0 = \frac{f(x+h) - f(x)}{h}$$

$$= (x^2 + 2xh + h^2)(x+h) + 2x^2 + 4xh + 2h^2 - 8x - 8h$$

$$= x^3 + \cancel{2x^2h} + \cancel{xh^2} + \cancel{x^2h} + \cancel{2xh^2} + h^3 + 2x^2 + 4xh + 2h^2 - 8x - 8h$$

$$= x^3 + 3x^2h + 3xh^2 + h^3 + 2x^2 + 4xh + 2h^2 - 8x - 8h$$

$$f(x) = x^3 + 2x^2 - 8x$$

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

$$\lim_{h \to 0} = \frac{\cancel{x^3} + 3x^2h + 3xh^2 + h^3 + \cancel{2x^2} + 4xh + 2h^2 - \cancel{8x} - 8h - \cancel{x^3} - \cancel{2x^2} + \cancel{8x}}{h}$$

$$\lim_{h \to 0} = \frac{3x^2h + 3xh^2 + h^3 + 4xh + 2h^2 - 8h}{h}$$

$$\lim_{h \to 0} = \frac{\cancel{h}(3x^2 + 3xh + h^2 + 4x + 2h - 8)}{\cancel{h}}$$

$$0 = 3x^2 + 4x - 8$$