

## Learning Goal Check!



Determine the instantaneous rate of change on the curve  $f(x) = 3x^2 + 6x + 9$ ,  
when  $x = -2$ .

Show all work

10)

$$10) V(r) = \frac{4}{3}\pi r^3 \quad \text{when } r=5$$

2)

worksheet  
1

$$\begin{aligned}
 m_T &= \frac{f(x+h) - f(x)}{h}, \quad h \rightarrow 0 \\
 &= \frac{\frac{4}{3}\pi(5+h)^3 - \frac{4}{3}\pi(5)^3}{h} \\
 &= \frac{\frac{4}{3}\pi(25+10h+h^2)(5+h) - \frac{4}{3}\pi(5)^3}{h}, \quad h \rightarrow 0 \\
 &= \frac{\frac{4}{3}\pi(125+50h+5h^2+25h+10h^2+h^3) - \frac{4}{3}\pi(125)}{h} \\
 &= \frac{\frac{4}{3}\pi(\cancel{125} + \underline{50h} + 5h^2 + \underline{25h} + 10h^2 + h^3 - \cancel{125})}{h} \\
 &= \frac{\frac{4}{3}\pi(75h + 15h^2 + h^3)}{h}, \quad h \rightarrow 0 \\
 &= \frac{\frac{4}{3}\pi h(75 + 15h + h^2)}{h}, \quad h \rightarrow 0 \\
 &= \frac{4}{3}\pi(75 + \cancel{15h} + \cancel{h^2}), \quad h \rightarrow 0 \\
 &= \frac{4}{3}\pi(75) \\
 &= 100\pi
 \end{aligned}$$

$$\begin{aligned}
 2) \quad & \begin{matrix} b) & f(1.5) \\ & f(2.5) \end{matrix} & m_s = \frac{f(1.5) - f(2.5)}{1.5 - 2.5} \\
 & & = \frac{26.98 - 32.38}{-1} \\
 & & = \frac{5.4}{1}
 \end{aligned}$$

$$1a) \quad f(x) = 2x^2 + x + 1$$

$$x = a$$

$$m_T = \frac{f(a+h) - f(a)}{h}, \text{ as } h \rightarrow 0$$

$$= \frac{2(a+h)^2 + (a+h) + 1 - (2a^2 + a + 1)}{h}, \quad h \rightarrow 0$$

$$= \frac{2(a^2 + 2ah + h^2) + a + h + 1 - 2a^2 - a - 1}{h}, \quad h \rightarrow 0$$

$$= \frac{\cancel{2a^2} + 4ah + 2h^2 + \cancel{a} + h + \cancel{1} - \cancel{2a^2} - \cancel{a} - \cancel{1}}{h}, \quad h \rightarrow 0$$

$$= \frac{4ah + 2h^2 + h}{h}, \quad h \rightarrow 0$$

$$= \frac{\cancel{h}(4a + 2h + 1)}{\cancel{h}}, \quad h \rightarrow 0$$

$$= 4a + 2h + 1, \quad h \rightarrow 0$$

$$= 4a + 1$$

$$f(x) = \frac{1}{x}$$

$$\frac{\frac{1}{a+h} - \frac{1}{a}}{h}, h \rightarrow 0$$

$$= \frac{a - a - h}{a(a+h)} \cdot \frac{1}{h}, h \rightarrow 0$$

$$= \frac{-h}{a^2 + ah} = \frac{\cancel{-h}}{a^2 + ah} \times \frac{1}{\cancel{h}}, h \rightarrow 0$$

$$= \frac{-1}{a^2 + \cancel{h}^0}, h \rightarrow 0$$

$$= \frac{-1}{a^2}$$

## Review questions:

pg 95 1, 2, 3 (estimate these using average rates of change)

4, 6 (use the first principles difference quotient to find the EXACT rate of change)

$$f(x) = \sin x$$

when  $x = 30^\circ$

