

Calculus 2.4 Rates of Change

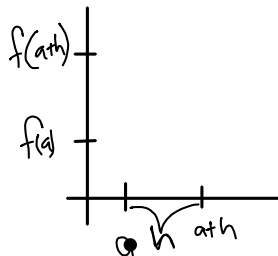
If you drop a rock on Mars it will fall according to the equation $y = 1.86t^2$ in meters per second.

- Find the average speed of the rock for the first two seconds.
- Find the average speed over $[1,4]$.
- Find the instantaneous speed at 3 sec.

Average rate of change-

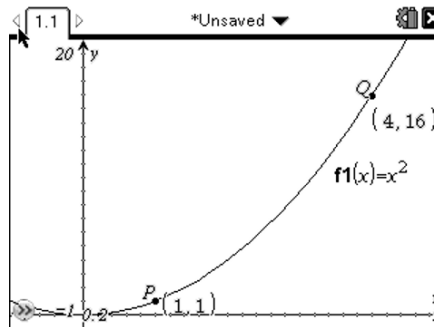
Instantaneous rate of change-

Draw a general sketch how we calculated the instantaneous rate of change.

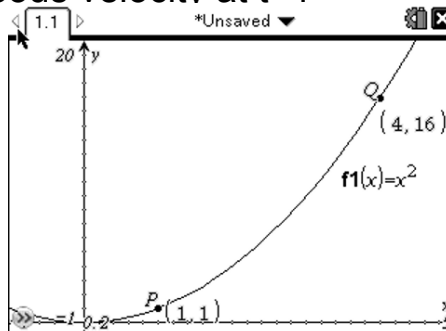


2.4

What happens as h approaches zero.



Estimate the instantaneous velocity at $t=1$



Difference Quotient Theorem-

Slope of the tangent line at $x=a$ is:

$$\lim_{h \rightarrow 0} \frac{f(a+h) - f(a)}{h}$$

*Slope will be different for different x -values

For each of the following:

- a) Find the average rate of change of the given interval.
- b) Find the instantaneous rate of change at a .
- c) Write an equation of the tangent line.
- d) Write an equation of the normal line. (perpendicular to the tangent line).

1. $f(x) = \frac{1}{4}x^2$ over $[1,3]$, $a=1$

2.4

2. $f(x) = \frac{1}{x}$ over $[-2, -1]$, $a=2$

3. $f(x) = x^2 - x$ over $[0, 4]$, $a=3$

2.4

4. Find the slope of the tangent line of

$$f(x) = -2x^2 + 1 \quad \text{at } x=a.$$

5. Find the slope of the tangent line of

$$f(x) = 9 - 3x^2 \quad \text{at } x=a.$$

Book Example pg. 92 #8 a) and b)...Lunar Data