2.15 - 9/30/15.

Velocity $v(t)$ meters/second.

$$a(t) = \frac{dv}{dt}$$

$$= \lim_{h \to 0} \frac{v(t+h) - v(t)}{h} \quad \frac{m/s}{\text{hours}}$$

$$= (\qquad) \quad \frac{\text{meters}}{(\text{seconds} \cdot \text{hours})}$$

Suppose we knew

$\frac{d}{dx} x^5 = 5x^4$. Find

$\frac{d}{dx} x^6$.

$$x^6 = x \cdot x^5$$

$$\frac{d}{dx} x^6 = \frac{d}{dx}(x \cdot x^5)$$

$$= 1 \cdot x^5 + x \cdot (5x^4)$$

$$= \cancel{6x^6} \quad \underline{6x^5}$$

Rates of change.

— Recall that if $f(t)$ is a function, the derivative at t is the limit of a slope

$$\lim_{s \to t} \frac{f(s)-f(t)}{s-t}.$$

The slope is a rate of change or a constant of proportionality giving

$$\frac{\text{change in } f}{\text{change in } t}.$$

Velocity is

$$\frac{\text{change in position}}{\text{change in time}}$$

Acceleration is

$$\frac{\text{change in velocity}}{\text{change in time.}}$$

Marginal cost.

~~Chang~~ $C = C(n) =$ cost

of producing n ~~ipt~~ things.

Marginal cost is

$$\frac{C(n+1) - \cancel{K}C(n)}{1} \approx C'(n).$$

B If $\frac{f(a+1)-f(a)}{1} \approx f'(a)$.

Rewrite as

$$f(a+1) = f(a) + f'(a).$$

__Example__ ~~If $f(x)=\sqrt{x}$, use the~~ Use the above to estimate $\sqrt{82}$.

Know $\sqrt{81} = 9$. Let $f(x) = \sqrt{x}$, $a = 81$, then

$$f(82) = f(81) + f'(81)$$
$$= 9 + f'(81)$$

$f(x) = \sqrt{x} = x^{1/2}$.

$f'(x) = \frac{1}{2}x^{-1/2}$, so

$f'(81) = \frac{1}{18}$.

Thus $\sqrt{82} \approx 9\frac{1}{18}$

Checking $\left(9\frac{1}{18}\right)^2 \approx 82.003$.

$f(10) = 8$, $f(11) = 9$.

$$f'(10) \approx \frac{f(11) - f(10)}{1} = \frac{9-8}{}$$

$$= \frac{1}{}$$

$$p(t) = -5t + 22$$

$$p(0) = 22 \text{ and}$$

$$p'(t) = -5.$$

An object ~~follow~~ falling under gravity has acceleration $-g$.

Thus $v(t) = v_0 - gt$.

$h(t)$ is height.

$$h(t) = h_0 + v_0 t - \frac{1}{2} g t^2$$

Known $g = 9.8 \ m/s^2$

or $g = 32 \ ft/sec^2$

Example. A ball is thrown up in the air & returns to ground after 4 s. What is the initial velocity?

Find $h(t)$. Know $h(0) = 0$ then

$$h(t) = v_0 t - \frac{1}{2} g t^2$$

Know $h(4)=0$

or $v_0 \cdot 4 - 8g = 0$

$v_0 = 2g.$

what is max. height?

Know

$$h(t) = 2gt - \frac{1}{2}gt^2$$

$$= -\frac{1}{2}g(t^2 - 4t + 4 - 4)$$

$$= -\frac{1}{2}g((t-2)^2 - 4)$$

$$= -\frac{1}{2}g(t-2)^2 + 2g$$

Max is at $t=2$ & is $2g$.