

### Section 3.4: The Chain Rule

The chain rule is a rule that lets us take the derivative of a composite function.

#### Form 1 of the Chain Rule

If  $C$  is a function of  $p$ , and  $p$  is a function of  $t$ , then

$$\frac{dC}{dt} = \frac{dC}{dp} \frac{dp}{dt}$$

Example 1:

$$C(p) = 2p^2 - 1 \text{ and } p(t) = \ln t$$

Find  $\frac{dC}{dt}$

Example 2:

$A(y) = 14 + \frac{100}{y}$  is the average cost in cents to produce  $y$  Yo-Yo's.  $y(t) = 3t^2 + 100t + 5000$  represents the number of Yo-yo's produced  $t$  years after 2000.

Find  $\frac{dA}{dt}$

At what rate is the average cost changing in 2002?

**Form 2 of the Chain Rule**

If  $y = h(g(x))$ , then  $\frac{dy}{dx} = h'(g(x))g'(x)$

Example 3:

$$y = (x^4 + 3)^5$$

$$y = \frac{1}{2x^2+2}$$

$$y = e^{2.5x}$$

Example 4:(Logistic Functions)

The percentage of households with TVs that subscribed to cable  $t$  years after 1970 can be modeled by the logistic equation:

$$P(t) = \frac{68}{1+38e^{-0.258t}}$$

Find  $P'(t)$  which represents the rate of change for the percentage of households with TVs who subscribe to cable.