Read Section 3.2. Work the embedded problems.

1. Fill in the following rules:

   (a) $\frac{d}{dx}[c] = 0$

   (b) $\frac{d}{dx}[x^n] = n\,x^{n-1}$

   (c) $\frac{d}{dx}[c\,f(x)] = c\,f'(x)$

   (d) $\frac{d}{dx}[f(x) \mp g(x)] = f'(x) \mp g'(x)$

2. Apply the rules to find the derivative of:

   (a) $f(x) = e^3$ $\quad f'(x) = 0$

   (b) $f(x) = x^{-4}$ $\quad f'(x) = -4x^{-5}$

   (c) $H(x) = 4x^{1/2}$ $\quad H'(x) = 4 \cdot \frac{1}{2} x^{-1/2} = 2x^{-1/2}$

   (d) $j(x) = \frac{\sqrt{2}}{2} + x - x^{2.3}$

   $j'(x) = 0 + 1 - 2.3x^{1.3}$

3. Fill in the following rules:

   (a) $\frac{d}{dx}[f(x)\,g(x)] = f' \cdot g + f \cdot g'$

   (b) $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g \cdot f' - f \cdot g'}{g^2}$

4. Find the derivative of each of the following:

   (a) $H(x) = (3x^2+1)(\frac{1}{x} + x) = (3x^2+1)(x^{-1}+x)$

   $H'(x) = (6x)(\frac{1}{x} + x) + (3x^2+1)(-x^{-2}+1)$

   $= 6 + 6x^2 - 3 + 3x^2 - x^{-2} + 1$

   $= 9x^2 - x^{-2} + 4$

   (b) $G(x) = \frac{x^2}{x^2+1}$

   $$G'(x) = \frac{(x^2+1)(2x) - x^2(2x)}{(x^2+1)^2}$$

5. Notation:

$f'(x),\ y',\ y'(x),\ \frac{dy}{dx},\ \frac{df}{dx},\ \frac{d}{dx}\left[f(x)\right]$

6. Higher order derivatives

Example: $y = x^3 - 2\sqrt{x} + \pi$ $= x^3 - 2x^{1/2} + \pi$

$y' = 3x^2 - x^{-1/2} + 0$

$y'' = 6x + \frac{1}{2}x^{-3/2}$

$y''' = 6 - \frac{3}{4}x^{-5/2}$

$y^{(4)} = \frac{+15}{8}x^{-7/2}$

$\vdots$

s-feet t-seconds

7. The vertical height of an object is given by $s(t) = -16t^2 + 20t + 100$. Find $s'(t)$ and $s''(t)$. Include units.

$s'(t) = -32t + 20$ units: ft/sec

$s''(t) = -32$ units ft/sec/sec = ft/s^2

$s' = v =$ velocity

$s'' = v' = a =$ acceleration