**Section 2.4** (The Chain Rule)

Composite functions can be more complex and we have not yet talked about their derivatives.

Example: Find the derivative of h(x) = (2x3 – 4)2 using formulas covered to this point.

Example: Decompose the previous into 2 functions f(x) and g(x) such that h(x) = f(g(x))

Chain Rule: If y = f(u) is a differentiable function of u and u = f(x) is a differentiable function of x, then y = f(g(x)) is a differentiable function of x and $\frac{d}{dx}$ **[f(g(x))] = f `(g(x)) g`(x)** or $\frac{dy}{dx}=\frac{dy}{du}\frac{du}{dx}$

--- For composite functions, take the derivative of the outer function and multiply by the derivative of the inner function ---

Example: Find the derivative of h(x) = (2x3 – 4)2 using the chain rule

Examples: Decompose the following composite functions y = f(g(x)) into smaller functions u = g(x) and y = f(u)

y = (3x + 8)4 y = $\frac{3}{2x+5}$ y = cos(3x) y = $\sqrt{3x^{3}-x+5}$ y = sin3(x)

As a result of the chain rule we can generalize the power rule to be $\frac{d}{dx}$[un] = nun – 1 u`

Example: Find the derivative of f(x) = (3x + 8)4

Example: Find the derivative of f(x) = $\sqrt[3]{(x^{2}-1)}$

Where does f `(x) = 0 and where does it not exist?

Review examples 7,8,9 in the book and work some of the homework exercises 7-36

The chain rule also applies to derivatives of trigonometric functions…

 $\frac{d}{dx}$[sin u] = (cos u) u` $\frac{d}{dx}$[cos u] = – (sin u) u` …

Examples: Find the derivatives of the following functions…

 y = sin(4x) y = sin2(x) y = $\sqrt{sin⁡(x)}$ y = sin2(8θ)

--- Note that if a derivative involves the composition of more than 2 functions you may need to apply the chain rule more than once