

# Higher Derivatives

## Reading

- Sections 3.5

## Practice problems

- Section 3.5: 3, 9, 13, 23
- To turn in (together with 3.3): 3.5 12, 14

## Notes

### Higher Derivatives

Since the first derivative is a function itself, we can take *its* derivative. We call this the second derivative:

#### Second Derivative

$$\frac{d^2 f}{dx^2} = f''(x) = \frac{d}{dx} (f'(x))$$

Example: Let  $f(x) = 3x^3 - x^2 + 1$ . Then  $f'(x) = 9x^2 - 2x$ . Then the derivative of that is  $f''(x) = 18x - 2$ .

We can similarly take *higher-order derivatives*:

#### Higher Order Derivatives

$$f^{(3)}(x) = \frac{d}{dx} (f''(x))$$

$$f^{(4)}(x) = \frac{d}{dx} (f^{(3)}(x))$$

and so on.

## Practice

- Calculate the first four derivatives of  $f(x) = \frac{1}{x}$ .
- Calculate the first four derivatives of  $2x^3 - 2x^2 + x - 1$ .
- Calculate the first four derivatives of  $\sin(x)$ .