Note: This doesn't represent everything that is (or could be) on the full test tomorrow. It's only a sample of things – more concepts than calculations – that might need some review to understand thoroughly. Take **twenty minutes** to work on your own, as if it were test conditions. After that, you can continue to work on your own if you like, or work with a partner or small group for the rest of the time. You'll need some extra paper to do your work.

There's a longer, more extensive verison of this review on Moodle, as well.

0.1 Tangent lines

Suppose that $f(x) = \dfrac{-7}{(2x-3)^2}$ and I computed for you $f'(x) = \dfrac{28}{(2x-3)^3}$.

1. Use the given information to find the slope of the tangent line to the graph of f at $x = 5$
2. Write an equation for the tangent line at $x = 5$.

0.2 Basic Derivative Rules

Compute the derivative of each of the following. Use the derivative rules; don't set up a limit for these.

1. $f(x) = 3x^{10}$
2. $f(x) = -\dfrac{1}{x^3}$
3. $f(x) = \sqrt[7]{x}$
4. $f(x) = \sqrt[7]{2}\,x$

0.3 Higher derivatives

1. Compute the second derivative $\dfrac{d^2}{dx^2}\left(3x^{10}\right)$
2. Compute the third derivative $\dfrac{d^3}{dx^3}\left(3x^{10}\right)$

0.4 Derivative Rules: "Rules of Combination"

For the following, suppose $f(x)$ is a differentiable function.

1. Apply one of the derivative rules rules and write down the derivative of $5\,f(x)$.
2. Apply the product rule, and write down the derivative of $x^2\,f(x)$.
3. Apply the quotient rule, and write down the derivative of $\dfrac{f(x)}{2x^5}$.

0.5 Differentiability and Continuity (True/False)

1. If a graph has a vertical tangent line at $x = 2$, then this graph is differentiable at $x = 2$.
2. If a graph has a vertical tangent line at $x = 2$, then this graph is continuous at $x = 2$.
3. If a graph has a horizontal tangent line at $x = 2$, then this graph is differentiable at $x = 2$.
4. If f is differentiable at $x = 5$, then f is continuous at $x = 5$.
5. If f is not continuous at $x = 3$, then f is not differentiable at $x = 3$.
6. If f is continuous at $x = 2$, then f is differentiable at $x = 2$.

0.6 Rolle's Theorem and Mean Value Theorem

1. Fill in the blanks so that the following becomes a statement of Rolle's Theorem:

   Suppose f is ________________________ on the interval _______, and

   $$f(a) = \_\_\_\_\_\_.$$

   Then there is at least one __ in ________ where _______________.

2. Fill in the blanks so that the following becomes a statement of the Mean Value Theorem (MVT):

   Suppose f is ________________________ on the interval _______.

   Then there is at least one ______ in ________ such that

   $$\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.$$

0.7 Mean Value Theorem Practice

Let $f(x)$ be differentiable on $[2, 5]$, with $f(2) = f(5) = -1$. True/False:

1. There must be some c between 2 and 5 such that the tangent line to the graph f at $x = c$ is horizontal.
2. There must be some c between 2 and 5 such that the tangent line to the graph f at $x = c$ is vertical.
3. There must be some c between 2 and 5 such that the tangent line to the graph f at $x = c$ has slope -1.

0.8 Functions and their Derivatives

Answer True or False (If false, give a counterexample. If true, explain):

1. The derivative of a polynomial must be a polynomial.
2. The derivative of a rational function must be a rational function.
3. The derivative of an odd-degree polynomial must be an even-degree polynomial.
4. The derivative of an odd-degree polynomial $f(x)$ must have at least one zero.

0.9 Topic: The derivative function as a limit

Given the following functions for $f(x)$, use the *definition* (limit in sec 4.1) of derivative to evaluate $f'(x)$.

1. $f(x) = \sqrt{x+1}$
2. $f(x) = 2x^3 + 1$