Instructions. Do this worksheet with your group. After section, complete it on your own and upload it to Gradescope.

**Computing Derivatives**

1. Write out all the rules for derivatives of functions that you know:

(a) Derivative of a constant
\[ f(x) = k \quad \rightarrow \quad f'(x) = \]

(b) Derivative of a linear function
\[ f(x) = mx + b \quad \rightarrow \quad f'(x) = \]

(c) Constant Multiple Rule
\[ f(x) = k \cdot g(x) \quad \rightarrow \quad f'(x) = \]

(d) Sum and Difference Rule
\[ h(x) = f(x) \pm g(x) \quad \rightarrow \quad h'(x) = \]

(e) Power Rule
\[ f(x) = x^n \quad \rightarrow \quad f'(x) = \]

(f) Product Rule
\[ h(x) = f(x) \cdot g(x) \quad \rightarrow \quad h'(x) = \]

(g) Quotient Rule
\[ h(x) = \frac{f(x)}{g(x)} \quad \rightarrow \quad h'(x) = \]

(h) Chain Rule (Write 2 versions here)
\[ h(x) = f(g(x)) \quad \rightarrow \quad h'(x) = \]
\[ y = f(u) \text{ and } u = g(x) \quad \rightarrow \quad \frac{dy}{dx} = \]

2. Consider the following table of values of the function \( f \) and \( g \) and their derivatives at various points.

<table>
<thead>
<tr>
<th>( x )</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f(x) )</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>( f'(x) )</td>
<td>-6</td>
<td>-7</td>
<td>-8</td>
<td>-9</td>
</tr>
<tr>
<td>( g(x) )</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>( g'(x) )</td>
<td>2/7</td>
<td>3/7</td>
<td>4/7</td>
<td>5/7</td>
</tr>
</tbody>
</table>

Below is another notation for derivative. Find the derivatives of the compositions below, using the chain rule and the table above.

a) \( D_x(f[g(x)]) \) at \( x = 1 \)

b) \( D_x(f[g(x)]) \) at \( x = 2 \)
3. Zenzizenzizenzic is an obsolete word with the distinction of containing the most \( z \)'s of any word found in the Oxford English Dictionary. It was used in mathematics, before powers were written as superscript numbers, to represent the square of the square of the square of a number. In symbols, zenzizenzizenzic is written as \((x^2)^2\). The term was first suggested by Robert Recorde, a 16th-century Welsh write of popular math textbooks, where is wrote that it meant “doeth represent the square of squares squaredly”. \textit{Source: The Phrontistery}

(a) Use the chain rule twice to find the derivative (don’t simplify first with properties of exponents).

(b) Say “zenizenizenic” 3 times fast.

4. Suppose that at the beginning of the year, a Vermont syrup distributor found that the demand for maple syrup, sold at $15 a quart, was 500 quarts each month. At that time, the price was going up at a rate of $0.50 a month, but despite this, the demand was going up at a rate of 30 quarts a month due to increased advertising. How fast was the revenue increasing?

5. For the following functions, take the derivative. Use proper derivative notation and equals signs each time. The last four questions are from old quizzes.

(a) \( y = -\frac{2}{\sqrt{x} + 4} \)

(b) \( y = \sqrt{\frac{-2}{x} + 4} \)

(c) \( f(x) = \sin^2(x) \)

(d) \( h(s) = \sin(s^2) \)
(e) \( w(u) = e^{\tan(u)} \)

(f) \( y = (3x^4 + 1)^4(x^3 + 4) \)

(g) \( g(\alpha) = \frac{\sec(\alpha)}{e^{\alpha^2}} \)

(h) \( g(x) = \tan^5(\ln(t^9 + 3)) \)

(i) \( w(t) = \sqrt[3]{\sin(t^5 + 4t)} \)

(j) Find the second derivative of \( h(t) = \cos(\sqrt{t}) \).

(k) Find the second derivative of \( g(x) = \arctan(3e^{2x}) \)