Formulas for Calculus, Math 170

This is a work-in-progress. I wrote these off the top of my head.
If you find something you think should be added, please let me know.

Differentiation Formulas

<table>
<thead>
<tr>
<th>Basic Formulas</th>
<th>With the Chain Rule where u=f(x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>((x^n)' = n \cdot x^{n-1})</td>
<td>((u^n)' = n \cdot u^{n-1} \cdot \frac{du}{dx})</td>
</tr>
<tr>
<td>((u \cdot v)' = u' \cdot v + v' \cdot u)</td>
<td>(\left(\frac{u}{v}\right)' = \frac{v \cdot u' - u \cdot v'}{v^2})</td>
</tr>
<tr>
<td>((e^x)' = e^x)</td>
<td>((e^u)' = e^u \cdot \frac{du}{dx})</td>
</tr>
<tr>
<td>((b^x)' = b^x \cdot \ln b)</td>
<td>((b^u)' = b^u \cdot \ln b \cdot \frac{du}{dx})</td>
</tr>
<tr>
<td>((\ln x)' = \frac{1}{x})</td>
<td>((\ln u)' = \frac{1}{u} \cdot \frac{du}{dx})</td>
</tr>
<tr>
<td>((\log_b x)' = \frac{1}{x \ln b})</td>
<td>((\log_b u)' = \frac{1}{u \ln b} \cdot \frac{du}{dx})</td>
</tr>
</tbody>
</table>

Integration Formulas where u=f(x)

\[\int u^n \, du = \frac{1}{n+1} u^{n+1} + C \text{ for } n \neq -1\]
\[\int u^{-1} \, du = \ln |u| + C\]
\[\int e^u \, du = e^u + C\]
\[\int b^u \, du = \frac{1}{\ln b} b^u + C\]
\[\int \ln(u) \, du \text{ you will learn in Calculus II}\]
\[\int \cos u \cdot du = \sin u + C\]
\[\int \sin u \cdot du = -\cos u + C\]
\[\int \sec^2 u \cdot du = \tan u + C\]
\[\int \csc^2 u \cdot du = -\cot u + C\]
\[\int \sec u \cdot \tan u \cdot du = \sec u + C\]
\[\int \csc u \cdot \cot u \cdot du = -\csc u + C\]
\[\int \tan u \cdot du = \ln |\sec u| + C\]
\[\int \cot u \cdot du = \ln |\sin u| + C\]

Other trig. formulas/methods will be learned in Calculus II.
Other Items of Importance

\[ \lim_{x \to 0} \frac{\sin x}{x} = 1 \]

Definition of the derivative: \[ f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h} \]

\[ f(x) \text{ is continuous at } x = a \text{ if all 3 of these are true:} \]

1. \( f(a) \) is defined (or \( x = a \) is in the domain of \( f(x) \)).
2. \( \lim_{x \to a} f(x) \) exists (i.e. show that LHL = RHL)
3. \( \lim_{x \to a} f(x) = f(a) \) (i.e. the y-coordinate in #1 equals the limit in #2)

Differentials:
\[ \Delta y \approx dy = f'(x)dx, \text{ when } dx = \Delta x \]

Linearization:
\[ f(x) \approx L(x) = f(a) + f'(a)(x - a), \text{ when the } x\text{-value is near } a. \]

Newton's Method:
\[
\begin{align*}
x_2 &= x_1 - \frac{f(x_1)}{f'(x_1)} \\
x_3 &= x_2 - \frac{f(x_2)}{f'(x_2)}
\end{align*}
\]

etcetera, where \( x_i \approx \text{an } x\text{-intercept} \)

For volume of solids of rotation, see the notes sheet that we completed in class.

When force is a constant, Work, \( W = F \int_a^b \)

When force is variable, Work, \( W = \int_a^b f(x) \, dx \), where \( f(x) \) is the force function.

\[ \text{The average } y\text{-value of a function} = \frac{1}{b-a} \int_a^b f(x) \, dx \]