2023 Fall Math 191 Formula Sheet for Final Examination

- Newton's Method: $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$
- Differential: $y = f(x) \Longrightarrow dy = f'(x)\,dx$
- Linear Approximation: $f(x) \approx L(x) = f(a) + f'(a)(x-a)$
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Differentiation	$\frac{d}{dx}(\tan u) = \sec^2 u \cdot \frac{du}{dx}$
$\frac{d}{dx}(\cot u) = -\csc^2 u \cdot \frac{du}{dx}$	$\frac{d}{dx}(\sec u) = \sec u \tan u \cdot \frac{du}{dx}$
$\frac{d}{dx}(\csc u) = -\csc u \cot u \cdot \frac{du}{dx}$	$\frac{d}{dx}(\sin^{-1} u) = \frac{1}{\sqrt{1-u^2}} \cdot \frac{du}{dx}$
$\frac{d}{dx}(\cos^{-1} u) = -\frac{1}{\sqrt{1-u^2}} \cdot \frac{du}{dx}$	$\frac{d}{dx}(\tan^{-1} u) = \frac{1}{1+u^2} \cdot \frac{du}{dx}$
$\frac{d}{dx}(\log_a u) = \frac{1}{u \ln a} \cdot \frac{du}{dx}$	$\frac{d}{dx}(\ln u) = \frac{1}{u} \cdot \frac{du}{dx}$
$\frac{d}{dx}(a^u) = a^u \ln a \cdot \frac{du}{dx}$	$\frac{d}{dx}(e^u) = e^u \cdot \frac{du}{dx}$

- Trapezoidal Rule:

$$\int_a^b f(x)\,dx \approx \frac{\Delta x}{2}[f(x_0) + 2f(x_1) + 2f(x_2) + \cdots + 2f(x_{n-1}) + f(x_n)]$$

- Simpson's Rule:

$$\int_a^b f(x)\,dx \approx \frac{\Delta x}{3}[f(x_0) + 4f(x_1) + 2f(x_2) + 4f(x_3) + 2f(x_4) + \cdots + 4f(x_{n-1}) + f(x_n)]$$

- Area: $A = \int_a^b [y_{\text{top}}(x) - y_{\text{bottom}}(x)]\,dx$ $A = \int_c^d [x_{\text{right}}(y) - x_{\text{left}}(y)]\,dy$
- Volume of Revolution:
- Disk: $dV = \pi(\text{radius})^2 \times \text{thickness}$
- Shell: $dV = 2\pi(\text{radius}) \times (\text{height}) \times (\text{thickness})$
- Centroid of a Flat Plate: $\begin{Bmatrix} \bar{x} = \frac{1}{A}\int_A x_e\,dA \\ \bar{y} = \frac{1}{A}\int_A y_e\,dA \end{Bmatrix}$ or $\begin{Bmatrix} \bar{x} = \frac{\int_a^b x(y_{\text{top}} - y_{\text{bottom}})\,dx}{\int_a^b (y_{\text{top}} - y_{\text{bottom}})\,dx} \\ \bar{y} = \frac{\int_c^d y(x_{\text{right}} - x_{\text{left}})\,dy}{\int_c^d (x_{\text{right}} - x_{\text{left}})\,dy} \end{Bmatrix}$
- Average Value: $y_{av} = \frac{1}{b-a}\int_a^b y(x)\,dx$
- Arc Length of a Curve: $s = \int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\,dx$
- Surface Area of a Solid of Revolution Rotating around the *x*-axis:

$$SA = 2\pi \int_a^b y\sqrt{1 + \left(\frac{dy}{dx}\right)^2}\,dx$$