Fall 2026 MATH 191 Final Exam Formula Sheet

- Newton's Method: $x_{n+1} = x_n - \dfrac{f(x_n)}{f'(x_n)}$
- Differential: $y = f(x) \Rightarrow dy = f'(x)dx$
- Linear Approximation: $f(x) \approx L(x) = f(x_1) + f'(x_1)(x - x_1)$
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Differentiation	$\frac{d}{dx}(\tan x) = \sec^2 x$	$\frac{d}{dx}(\log_a x) = \frac{1}{x \ln a}$
$\frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}}$	$\frac{d}{dx}(\sec x) = \sec x \tan x$	$\frac{d}{dx}(\ln x) = \frac{1}{x}$
$\frac{d}{dx}(\cos^{-1} x) = \frac{-1}{\sqrt{1-x^2}}$	$\frac{d}{dx}(\cot x) = -\csc^2 x$	$\frac{d}{dx}(a^x) = a^x \ln a$
$\frac{d}{dx}(\tan^{-1} x) = \frac{1}{1+x^2}$	$\frac{d}{dx}(\csc x) = -\csc x \cot x$	$\frac{d}{dx}(e^x) = e^x$

- Trapezoidal Rule:

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

- Simpson's Rule:

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

- 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: $\left\{ \begin{array}{l} \bar{x} = \dfrac{1}{A}\displaystyle\int_A x_e\,dA \\ \bar{y} = \dfrac{1}{A}\displaystyle\int_A y_e\,dA \end{array} \right\}$ or $\left\{ \begin{array}{l} \bar{x} = \dfrac{\int_a^b x(y_{\text{top}} - y_{\text{bottom}})\,dx}{\int_a^b (y_{\text{top}} - y_{\text{bottom}})\,dx} \\ \bar{y} = \dfrac{\int_c^d y(x_{\text{right}} - x_{\text{left}})\,dy}{\int_c^d (x_{\text{right}} - x_{\text{left}})\,dy} \end{array} \right\}$
- Work: $w = \displaystyle\int_a^b F(x)\,dx$
- Average Value: $y_{\text{av}} = \dfrac{1}{b-a}\displaystyle\int_a^b f(x)\,dx$
- Arc Length of a Curve: $s = \displaystyle\int_a^b \sqrt{1 + \left(\tfrac{dy}{dx}\right)^2}\,dx$
- Surface Area of a Solid of Revolution Rotating around the x-axis: $SA = 2\pi \displaystyle\int_a^b y\sqrt{1 + \left(\tfrac{dy}{dx}\right)^2}\,dx$