

## Formulas for Exam 1

1. **Average and instantaneous rate of change.**

(a) The average rate of change of  $f(x)$  over  $[a, b]$  :

$$\frac{f(b) - f(a)}{b - a}$$

(b) The instantaneous rate of change of  $f(x)$  at  $x = a$  :  $f'(a)$ .

2. **Definition of Derivative.** Derivative of  $y = f(x)$  at  $x = a$  is

$$f'(a) = \lim_{h \rightarrow 0} \frac{f(a+h) - f(a)}{h} \quad \text{or} \quad \lim_{x \rightarrow a} \frac{f(x) - f(a)}{x - a}.$$

In Leibniz notation,  $\left. \frac{dy}{dx} \right|_{x=a} = \lim_{\Delta x \rightarrow 0} \frac{\Delta y}{\Delta x}$ .

3. **Power Rule.**

$$y = x^n \quad \Rightarrow \quad y' = nx^{n-1}$$

4. **Tangent Line.**  $y_0 = f(x_0)$ ,  $m = f'(x_0)$

$$y - y_0 = m(x - x_0)$$

5. **Applications.** The velocity  $v(t) = s'(t) = \frac{ds}{dt}$  and the acceleration  $a(t) = v'(t) = \frac{dv}{dt} = s''(t) = \frac{d^2s}{dt^2}$ .