Tangents and Velocity

1. **Slopes**

   (a) The slope of the **secant line** of $y = f(x)$ through $(a, f(a))$ and $(b, f(b))$ is

   $$m_{sec} = \frac{\Delta y}{\Delta x} = \frac{f(b) - f(a)}{b - a}$$

   (b) The Slope of the **tangent line** of $y = f(x)$ through $(a, f(a))$ is

   $$m_{tan} = \lim_{x \to a} \frac{f(x) - f(a)}{x - a} = \lim_{h \to 0} \frac{f(a + h) - f(a)}{h}$$

2. **Velocity**

   (a) The **average velocity** of a particle with position at time t given by $s(t)$ over the time interval $[a, b]$ is

   $$v_{ave} = \frac{\Delta s}{\Delta t} = \frac{s(b) - s(a)}{b - a}$$

   (b) The **instantaneous velocity** of a particle with position at time t given by $s(t)$ at time $t = a$ is

   $$v(a) = \lim_{t \to a} \frac{v(t) - v(a)}{t - a} = \lim_{h \to 0} \frac{v(a + h) - v(a)}{h}$$