8.5: Dot Notation

Derivatives of quantities with respect to time are so common in mechanics that physicists often use a special shorthand notation for them. The derivative with respect to time is indicated with a dot over the quantity; a second derivative is indicated with two dots, etc. You can think of this as similar to the "prime" notation for derivatives encountered in calculus, except that the "dot" over a variable always indicates a derivative with respect to time. This dot notation is especially common in more advanced mechanics courses.

For example, velocity and acceleration in one dimension may be written in dot notation as follows:

$$\dot{x} = dx/dt \quad \text{(velocity)}$$
$$\ddot{x} = d^2x/dt^2 \quad \text{(acceleration)}$$

This dot notation for derivatives ($\dot{x}, \ddot{x}$, etc.) is due to Sir Isaac Newton. The notation $dx/dt, d^2x/dt^2$, etc. was originated by the German mathematician Gottfried Leibniz, who is believed to have been an independent co-discoverer of the calculus, along with Newton. The "prime notation" sometimes used $(x'(t), x''(t)$, etc.) is due to Italian mathematician Joseph-Louis Lagrange.