Particle Kinematics: x-y Coordinates

Current unit: Particle Kinematics

Last class: Curvilinear, Circular, Projectile Motion

Today:

- (a) Math Preliminaries: Dot notation, chain rule
- (b) "Path Known" x-y Problem
- (c) "Parametric Equations" x-y Problem

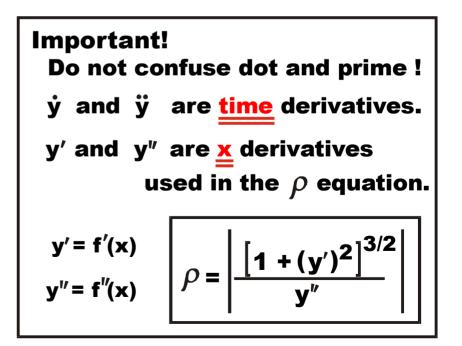
Math Preliminaries:

1. Dot Notation

Dot Notation

$$\dot{\mathbf{x}} = \frac{d\mathbf{x}}{dt} = \mathbf{v}_{\mathbf{x}} \qquad \dot{\mathbf{y}} = \frac{d\mathbf{y}}{dt} = \mathbf{v}_{\mathbf{y}}$$
$$\ddot{\mathbf{x}} = \frac{d^{2}\mathbf{x}}{dt^{2}} = \mathbf{a}_{\mathbf{x}} \qquad \ddot{\mathbf{y}} = \frac{d^{2}\mathbf{y}}{dt^{2}} = \mathbf{a}_{\mathbf{y}}$$

A convenient, shorthand notation for time derivatives.



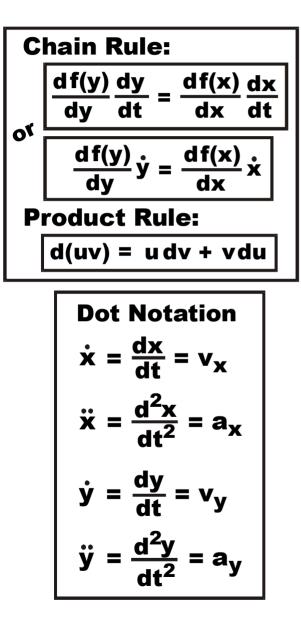
Math Preliminaries (cont'd)

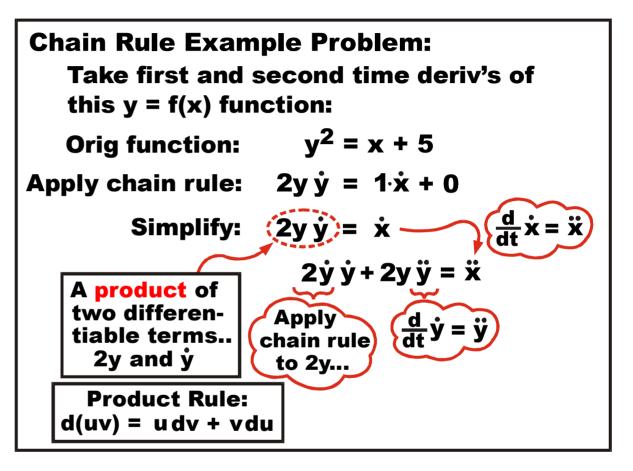
2. Chain Rule: Used to introduce time derivatives into a y = f(x) function which does not contain time (t) terms.

Chain Rule Given a function: f(y) = f(x)Introduce time derivatives by: Take y deriv's of f(y) terms, then multiply by $\frac{dy}{dt} = \dot{y}$. $\frac{d f(y)}{dy} \frac{dy}{dt} = \frac{d f(x)}{dx} \frac{dx}{dt}$ Similarly, take x deriv's of f(x) terms, then multiply by $\frac{dx}{dt} = \dot{x}$.

See the course web page for practice chain rule problems. Learn this well! We'll use the chain rule often in dynamics.

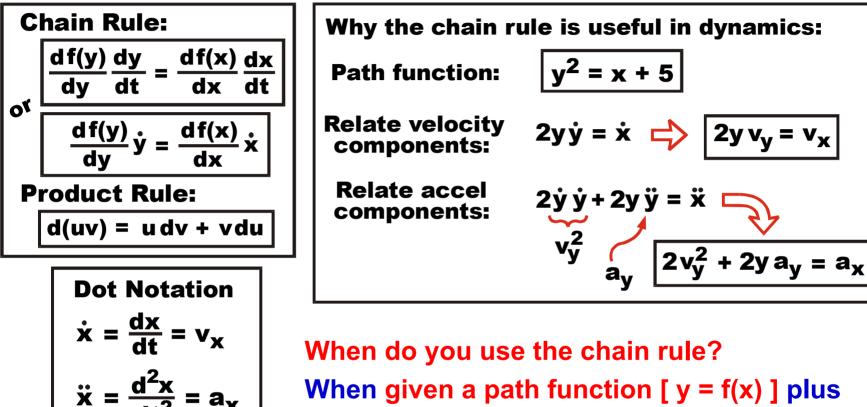
2. Chain Rule (Applied to an example problem):





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3. Chain Rule Example (Why is it useful in dynamics?):



some derivative information [y = I(x)] plus some derivative information [$(v_y \text{ and } a_y)$ or v_x and a_x)], use the chain rule to get a velocity and an accel equation. Plug in the comp's you have to get the ones you seek.