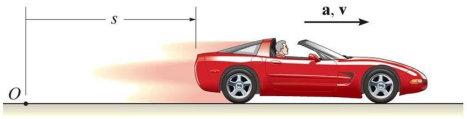
Chapter 12: Particle Kinematics

- "particle" means the object can be modeled as a point
  - cannot rotate, only translate
  - often just following on point on an extended body



- "Rectilinear": motion along a straight line
  - only need one vector component
- s, v, and a may be changing

12.2-3 Rectilinear Kinematics

Fundamental definitions: $v = \dfrac{ds}{dt}$ $a = \dfrac{dv}{dt}$

Differential relations (must be integrated): $v\,dt = ds$ $a\,dt = dv$

Solving each for dt and eliminating time: $a\,ds = v\,dv$

Average quantities: $v_{\text{ave}} = \dfrac{\Delta s}{\Delta t}$ $a_{\text{ave}} = \dfrac{\Delta v}{\Delta t}$

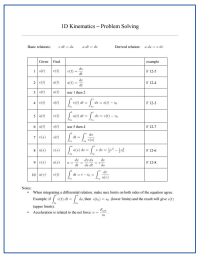
12.2-3 Rectilinear Kinematics

To use the differential relations, you must integrate them.
The initial conditions will provide the integration limits.

Example:
A bird in a tree drops to the ground from rest. It's speed is $v = \sqrt{20s}$ where s is it's distance from it's tree branch. What is it's speed at time t after it starts to fall?

Solution:
- Use the differential relation $v\,dt = ds$
- initial conditions are $t_0 = 0$ $s_0 = 0$ $v_0 = 0$
- need to evaluate $\displaystyle\int dt = \int \frac{ds}{v(s)} \longrightarrow \int_0^t dt = \int_0^s \frac{ds}{\sqrt{20s}}$

12.2-3 Rectilinear Kinematics

problem solving:

- establish a coordinate axis along with the positive direction
- identify initial conditions – these will provide the integration limits
- solve the kinematic equations
- see tips in problem solving notes (in workbook)