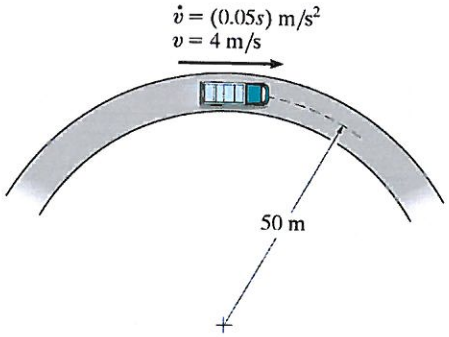
Problem 2: Particle Kinematics I

The truck travels in a circular path having a radius of 50 m at a speed of $v = 4$ m/s. For a short distance from $s = 0$, its speed is increased by $\dot{v} = (0.05s)$ m/s^2, where s is in meters. Determine its speed and the magnitude of its acceleration when it has moved $s = 10$ m.



$$a_t = \frac{dv}{dt} = \frac{dv}{ds}\frac{ds}{dt}$$

but $\frac{ds}{dt} = v$

$$a_t = v\frac{dv}{ds}$$

$$a_t\,ds = v\,dv$$

$$\int_{s_1=0}^{s_2=10\text{m}} (0.05s)\,ds = \int_{v_1=4\text{m/s}}^{v_2} v\,dv$$

$$\frac{0.05s^2}{2}\Big|_0^{10} = \frac{v^2}{2}\Big|_4^{v_2}$$

$$\frac{0.05}{2}(10)^2 = \frac{v_2^2}{2} - \frac{4^2}{2}$$

$$v_2 = 4.583\text{ m/s} = 4.58\text{ m/s}$$

$$a_n = \frac{v^2}{\rho} = \frac{(4.583)^2}{50} = 0.420\text{ m/s}^2$$

$$a_t = \frac{dv}{dt} = \dot{v} = 0.05s = 0.05(10) = 0.5\text{ m/s}^2$$

$$a = \sqrt{a_t^2 + a_n^2} = \sqrt{(0.420)^2 + (0.5)^2} = 0.653\text{ m/s}^2$$