Answer on Question #58417, Physics / Mechanics | Relativity |

The rate of change of speed of the belt is given by 0.06(10-t) m/s^2, where t is in seconds. The speed of the belt is 0.8m/s at t=0. When the normal acceleration of a point in contact with the pulley is 40m/s^2, determine (a) the speed of the belt; (b) the time required to reach that speed; and (c) the distance traveled by the belt. Radius is 0.2m.

Solution:

(a) For point the normal acceleration is

$$a_n = \frac{v^2}{R}$$

Hence,

$$v = \sqrt{a_n R} = \sqrt{40 \cdot 0.2} = \sqrt{8} = 2.83 \frac{\text{m}}{\text{s}} \quad \text{or} \quad -2.83 \frac{\text{m}}{\text{s}}$$

(b)

$$v = v_0 + \dot{v}t$$

$$v = v_0 + 0.06(10 - t)t = v_0 + 0.6t - 0.06t^2$$

In our case

$$v_0 = 0.8 \text{ m/s}$$

The equation for time is

$$0.06t^2 - 0.6t - 2.83 - 0.8 = 0$$
$$0.06t^2 - 0.6t - 3.63 = 0$$

Solution gives us

$$t = 14.25 \text{ s}$$

(c)

The distance is integral of velocity

$$d = \int_0^t (v_0 + 0.6t - 0.06t^2)\, dt$$

$$d = \int_0^{14.25} (0.8 + 0.6t - 0.06t^2)\, dt = 0.8t + \frac{0.6t^2}{2} - \frac{0.06t^3}{3}\Big|_0^{14.25}$$

$$d = 0.8 \cdot 14.25 + 0.6 \cdot \frac{14.25^2}{2} - 0.06 \cdot \frac{14.25^3}{3} = 14.45 \text{ m}$$