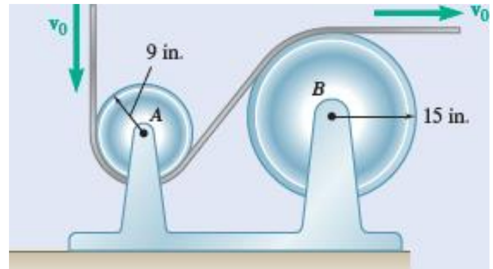
Quiz 11: Chapter 16 Due: Tuesday 28 Feb 23

Examine the solved problem below. There are four errors in the solution below. Your task is to locate and identify those errors, then correct them and calculate the proper result. If the same error occurs more than once, only count it as a single error, even if you have to correct it in more than one instance.

Each correctly identified error is worth 4 points, and the re-calculated results are worth 4 points as well. You must save your work in pdf format and submit via the Quiz 11 Assignment in the Chapter 16 folder of the Quizzes folder of the Online Classroom in Blackboard. Please do not use any other file format than pdf.

A thin belt passes over two freely-spinning drums. Starting at $t_0 = 0$, the speed of the belt is increased uniformly from $v_0 = 2\frac{\text{ft}}{\text{s}}$ to $v_1 = 4\frac{\text{ft}}{\text{s}}$ at time $t_1 = 4\text{s}$. The belt does not slip on the drums. Find the number of revolutions executed by each drum during the 4-second interval.



A) Calculate the accelerations a of the belt:

$$a = \frac{\Delta v}{\Delta t} = \frac{(4-2)\frac{\text{ft}}{\text{s}}}{4\text{s}} = 0.5\frac{\text{ft}}{\text{s}^2}$$

B) Determine the initial angular velocities ω_{0A} and ω_{0B} of each drum:

Drum A:

$$v_0 = \omega_{0A} r_A$$

$$2\frac{\text{ft}}{\text{s}} = \omega_{0A}\left(\frac{9}{12}\text{ft}\right)$$

$$\omega_{oA} = \left(2\frac{\text{ft}}{\text{s}}\right)\left(\frac{9}{12}\text{ft}\right) = 1.5\frac{\text{rad}}{\text{s}}$$

Drum B:

$$v_0 = \omega_{0B} r_B$$

$$2\frac{\text{ft}}{\text{s}} = \omega_{0B}\left(\frac{15}{12}\text{ft}\right)$$

$$\omega_{0B} = \left(2\frac{\text{ft}}{\text{s}}\right)\left(\frac{15}{12}\text{ft}\right) = 2.5\frac{\text{rad}}{\text{s}}$$

C) Calculate the angular accelerations α_A and α_B of each drum:

Drum A:

$$a = \frac{\alpha_A}{r_A}$$

$$\alpha_A = a r_A = \left(0.5\frac{\text{ft}}{\text{s}^2}\right)\left(\frac{9}{12}\text{ft}\right)$$

$$\alpha_A = 0.375\frac{\text{rad}}{\text{s}^2}$$

Drum B:

$$a = \frac{\alpha_B}{r_B}$$

$$\alpha_B = a r_B = \left(0.5\frac{\text{ft}}{\text{s}^2}\right)\left(\frac{15}{12}\text{ft}\right)$$

$$\alpha_B = 0.625\frac{\text{rad}}{\text{s}^2}$$

D) Determine the angular speeds ω_A and ω_B of each drum.

Drum A:

$$\omega_A = \omega_{0A} + \alpha_A t$$

$$\omega_A = 1.5\frac{\text{rad}}{\text{s}} + \left(0.375\frac{\text{rad}}{\text{s}^2}\right)(4\text{s}) = 3.0\frac{\text{rad}}{\text{s}}$$

Drum B:

$$\omega_B = \omega_{0B} + \alpha_B t$$

$$\omega_B = 2.5\frac{\text{rad}}{\text{s}} + \left(0.625\frac{\text{rad}}{\text{s}^2}\right)(4\text{s}) = 5.0\frac{\text{rad}}{\text{s}}$$

E) Find the number of revolutions executed by each drum during the 4-second interval.

Drum A:

$$\theta_A = \omega_{0A} t - \tfrac{1}{2}\alpha_A t^2$$

$$\theta_A = \left(1.5\frac{\text{rad}}{\text{s}}\right)(4\text{s}) - \tfrac{1}{2}\left(0.375\frac{\text{rad}}{\text{s}^2}\right)(4\text{s})^2 = 3.0\text{rad}$$

$$\theta_A = (3.0\text{rad})\left(\frac{2\pi\text{rev}}{1\text{rad}}\right) = 18.9\text{rev}$$

Drum B:

$$\theta_B = \omega_{0B} t - \tfrac{1}{2}\alpha_B t$$

$$\theta_B = \left(2.5\frac{\text{rad}}{\text{s}}\right)(4\text{s}) - \tfrac{1}{2}\left(0.625\frac{\text{rad}}{\text{s}^2}\right)(4\text{s})^2 = 5.0\text{rad}$$

$$\theta_B = (5.0\text{rad})\left(\frac{2\pi\text{rev}}{1\text{rad}}\right) = 31.4\text{rev}$$