Homework No. 10A (Spring 2023)

PHYS 205A-001: UNIVERSITY PHYSICS

School of Physics and Applied Physics, Southern Illinois University–Carbondale

Due date: Friday, 2023 Apr 14, Noon, on D2L

Instructions

- You are encouraged to use any of the resources to complete this homework. However, the extent to which you depend on resources while doing this homework is a measure of how much extra work you need to put in to master the associated concepts. Solutions should be the last resource.
- Describe your thought process in detail and organize it clearly. Make sure your answer has units and the right number of significant digits.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (under Assesments → Assignments).

Problems

1. (**10 points.**) A circular disc in the xy plane rotates about the z axis. Then, we have

$$\boldsymbol{\omega} = \hat{\mathbf{z}}\,\omega, \tag{1}$$

where $\omega = 75\,\text{radians/s}$ is the magnitude of the vector $\boldsymbol{\omega}$, and represents the angular speed and angular velocity, respectively. Given the relation,

$$\mathbf{v} = \boldsymbol{\omega} \times \mathbf{r}, \tag{2}$$

where $\mathbf{r}$ is the position and $\mathbf{v}$ is the linear velocity of a point on the disc, find the linear velocity of a point on the disc at

$$\mathbf{r} = \hat{\mathbf{x}}\,0.20\,\text{m}, \tag{3}$$

Solution

2. (**10 points.**) Starting from rest a wheel rotates with uniform angular acceleration $3.0\,\text{rad/s}^2$. Determine the instantaneous angular velocity of the wheel after $3.0\,\text{s}$.

Solution

3. (**10 points.**) The angular position of a point on the rim of a rotating wheel is given by $\theta = 4.0\,t - 2.0\,t^2 + t^3$, where θ is in radians and t is in seconds.

(a) Determine the angular velocity at $t = 6.0\,\text{s}$.

(b) Determine the instantaneous angular acceleration at $t = 6.0\,\text{s}$.

Solution

4. (**10 points.**) A motorcycle accelerates uniformly from rest and reaches a linear speed of $24.0\,\text{m/s}$ in a time of $8.00\,\text{s}$. The radius of each tire is $0.300\,\text{m}$. What is the magnitude of the angular acceleration of each tire?

Solution