WIND STUDY

Wind Study is intended for grades 5-8 and 8-11
Questions posted on: Monday Answers posted on: Friday
Find downloadable one pagers at www.oneenergy.com/one-energy-feed

2024 Q1

ROTATING BODIES

Hello students! Here at One Energy, we build and operate wind turbines. These turbines have a rotor with three long fiberglass blades, as the wind spins the rotor, the turbines generate energy. To maintain and operate these wind turbines, it is important to be able to monitor the rotating body's position, velocity, and acceleration. Position is where a body is located in space, velocity is how fast a body is moving, and acceleration is the rate at which the speed changes.

A rotating object's angular position is denoted with the variable Θ (theta) with units of either degrees, or radians. The object's angular velocity is denoted by the variable ω (omega) with units of radians per second. Finally, the object's angular acceleration is denoted by α (alpha) with units of radians per second^2. The linear values of position, velocity, and acceleration can be found by multiplying their angular value by the radius of rotation.

$\theta = angular\ position\ (degrees)$

$\omega = angular\ velocity\ (clockwise\ positive)(radians/\text{sec})$

$\alpha = angular\ acceleration\ (clockwise\ positive)(radians/sec^2)$

$V = linear\ velocity\ (meter/sec)$

$r = radius\ of\ rotation\ (meters)$

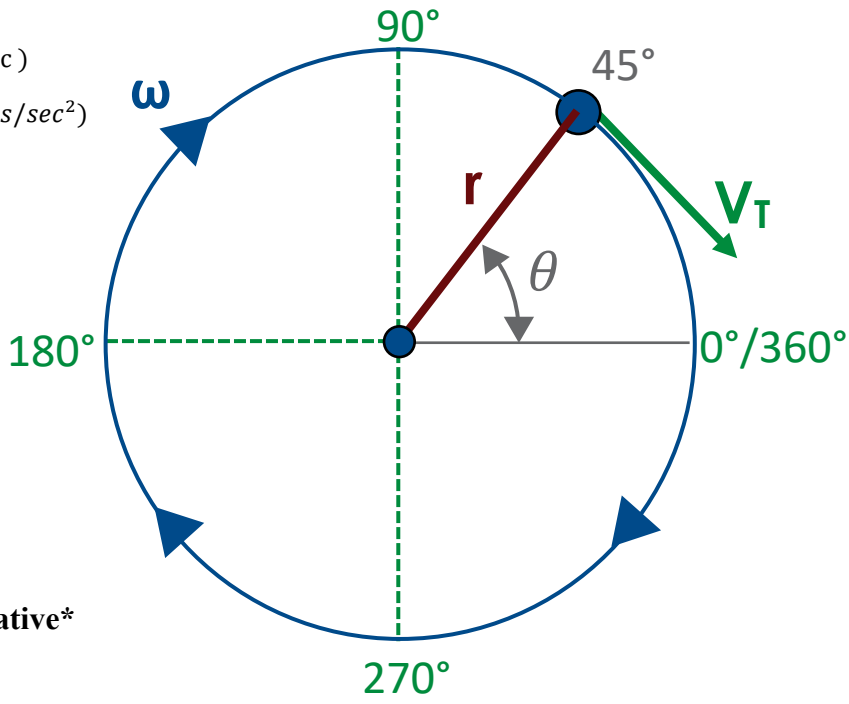
$\Delta t = change\ in\ time\ (\text{sec})$

$\theta_{radians} = \theta_{degrees} * \frac{\pi}{180}$

$V = linear\ velocity = r\omega$

$\omega_{final} = (\alpha * \Delta t) + \omega_{initial}$

$\theta_{final} = \theta_{initial} + (\omega_{initial} * \Delta t) + \frac{\alpha t^2}{2}$



Note that clockwise rotation is considered negative

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Level 1: If a turbine's rotor spins at a constant rate and completes 10 revolutions every minute, calculate the total number of revolutions a turbine's rotor experiences after 90 days? What RPM would the turbine have to spin to experience a total of 1,500,000 revolutions after 90 days?

Level 2: Assuming the following conditions:

The initial position of a given blade is **θ=45 degrees** from horizontal. The initial velocity **ω=4 rad/s clockwise**. The initial angular acceleration $\boldsymbol{\alpha}$**=0.10 rad/s²** in the same direction. Determine the position (between 0-360°) and angular velocity of the blade after 30 seconds have elapsed. If the length of the turbine blade is 52 meters long, determine the linear velocity of the tip of the blade, and remember to include direction.