

# Monday Warm Up: Unit 6: Rotational Motion I

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## 1 Memory Bank

- $s = r\theta$  ... Definition of the radian.
- $\vec{s} = \vec{\theta} \times \vec{r}$  ... Vector relationship between angular displacement, arc length, and radius.
- $v = r\omega$  ... Relationship between tangential velocity, angular velocity, and radius.
- $\vec{v} = \vec{\omega} \times \vec{r}$  ... Vector relationship between tangential velocity, angular velocity, and radius.

## 2 Rotational Variables and Rotational Motion

1. Suppose the displacement of an aircraft along a curved trajectory is  $\vec{s} = 0.1\hat{j}$  km, and the radius from our origin is  $\vec{r} = 10\hat{i}$  km. What is  $\vec{\theta}$ ?
2. Suppose the displacement of an aircraft along a curved trajectory is  $\vec{s} = -0.1\hat{i}$  km, and the radius from our origin is  $\vec{r} = 1\hat{j}$  km. What is  $\vec{\theta}$ ?
3. Suppose the angular velocity of our aircraft is  $\vec{\omega} = +\pi/2\hat{k}$  radians/minute, and the radius of curvature of our trajectory is  $\vec{r} = -10\hat{i}$  km. What is our velocity vector?
4. Perform the following unit conversions:
  - 45 rpm to radians per second.
  - 100 radians per second to rpm.
  - 6000 rpm to rotations per millisecond.
5. A particle moves 3.0 m along a circle of radius 1.5 m. (a) Through what angle does it rotate? (b) If the particle makes this trip in 1.0 s at a constant speed, what is its angular velocity? (c) What is its acceleration?
6. On takeoff, the propellers on a UAV (unmanned aerial vehicle) increase their angular velocity for 3.0 s from rest at a rate of  $\omega = (25.0t)$  rad/s where  $t$  is measured in seconds. (a) What is the instantaneous angular velocity of the propellers at  $t=2.0$ s? (b) What is the angular acceleration?