Name: _____

Class: _____

Due Date: _____

Physics Topic 20A – Rotational Kinematics

Answer the following questions. The solutions to this worksheet can be found on the YouTube channel Go Physics Go.

1. C: Define, state the equation, and give the units of *angular position* θ.

2. C: Define, state the equation, and give the units of *angular speed* ω.

3. C: Define, state the equation, and give the units of *angular acceleration* α.

4. C: Convert the *suvat* equations from linear motion to circular motion.

5. Convert the following to S.I. units.

   a. $120°$

   b. $4\ \text{Hz}$

   c. $15°/\text{hour}$

   d. $\frac{4\times10^5\ \text{rpm}}{\text{hr}}$

6. A helicopter prop accelerates from 800 rpm to 2000 rpm in five minutes.

   a. Calculate the average rotational frequency in rpm.

   b. Calculate the total rotations executed.

7. KC's potter's wheel accelerates from $45\ \text{s}^{-1}$ to $75\ \text{s}^{-1}$ over an angular displacement of 72 radians. Find its angular acceleration.

8. A saw blade, whose initial velocity is $4\ \text{s}^{-1}$, accelerates at $2\ \text{s}^{-2}$. During this interval, the blade rotates 165 radians. Find the time of this interval.

9. Given: $\omega = 30t^4 + 24t^2 + 20t$. Also: At $t = 1$, $\theta = 36$.

a. Find equations for α and θ.

b. At $t = 4$, calculate the values of θ, ω, and α.

c. Calculate $\bar{\omega}$ for the interval $t = 1$ to $t = 4$.

d. Calculate $\bar{\alpha}$ for $t = 1$ to $t = 4$.

10. The Earth spins on its axis once every 24 hours and orbits the sun once every 365.25 days. Looking down on the solar system, the Earth both spins on its axis and orbits the sun counterclockwise. Finally, the spin axis of the Earth is tilted $23.5°$ from the plane of its orbit.

    a. Calculate the angular speed of the Earth's spin ω_s.

    b. Calculate the angular speed of the Earth's orbit ω_o.

    c. Calculate the ratio of $\frac{\omega_s}{\omega_o}$.

    d. Calculate the magnitude of the total angular velocity of the Earth's motion.

11. The equatorial radius of the Earth is 3963 miles, where one mile equals 5280 feet. Find the length, along the equator, of one minute of longitude, where sixty minutes equals one degree. For our own edification, this distance is called a nautical mile as opposed to a statute mile. Please note that a nautical mile is defined as 6076 feet because the olden navigators incorrectly measured the radius of the Earth.

12. The blade of Vahid's power saw, whose radius is 3 m, takes 0.26667 seconds to slow from angular speed $32\ \text{sec}^{-1}$ to rest.

a. Calculate its angular acceleration α.

b. Calculate its tangential acceleration $a_{\tan}$.

We look at the blade 0.6667 seconds before it stops.

c. Calculate its angular speed ω.

d. Calculate its tangential speed v.

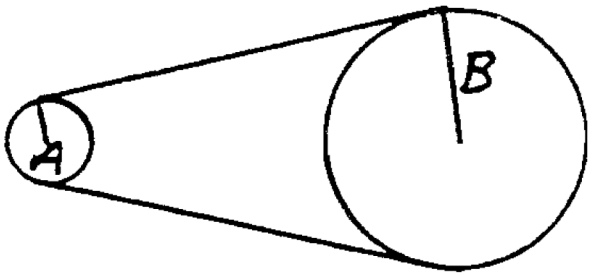
e. Calculate its radial acceleration a_{r}.

f. Calculate its total acceleration a_{total}.

g. Calculate φ of a_{total}.

h. Sketch a_{T}, a_{r}, a_{total}, and φ. The blade was spinning counterclockwise.

13. Two wheels connected by a recording tape are spinning as shown below.



$r_A = 1.5$ cm
$r_B = 7.5$ cm
$f_B = 40$ rpm

a. Calculate the frequency of the smaller wheel in revolutions per minute.

b. Calculate the speed of the tape and the rim of each wheel.