Name: KEY

Date:

Section C D F

The Masters School
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Physics

Rotational Motion II

1. A drill starts from rest. After 3.8 s of constant angular acceleration, the drill turns at a rate of 2640 rad/s.
   a. Find the drill's angular acceleration. (Your answer should be between 600 – 700 rad/s^2)

Given
~~$\Delta\theta =$~~
$\omega_i = 0$
$\omega_f = 2640$ rad/s
$\alpha = ?$
$\Delta t = 3.8$ s

$\omega_f = \omega_i + \alpha \Delta t$

$2640 = \alpha(3.8)$

$\boxed{\alpha = 694.7 \text{ rad/s}^2}$

   b. Determine the angle through which the drill rotates during this period. (Your answer should be between 4000 – 7000 radians)

$\Delta\theta = \frac{1}{2}(\omega_i + \omega_f)\Delta t$

$\Delta\theta = \frac{1}{2}(2640)(3.8)$

$\boxed{\Delta\theta = 5016 \text{ rad}}$

2. A potter's wheel moves from rest to an angular speed of 0.20 rev/s in 34.0 s. Assuming constant angular acceleration, what is its angular acceleration in rad/s^2? (Your answer should be between 0.01 and 0.1 rad/s^2)

$\frac{.2 \cancel{rev}}{s} \times \frac{2\pi \text{ rad}}{1 \cancel{rev}} = 1.257$ rad/s

Given
~~$\Delta\theta =$~~
$\omega_i = 0$
$\omega_f = .2$ rev/s
$\alpha = ?$
$\Delta t = 34$

$\omega_f = \omega_i + \alpha \Delta t$

$1.257 = 0 + \alpha(34)$

$\boxed{.0370 \text{ rad/s}^2 = \alpha}$

3. The Emerald Suite, a revolving restaurant at the top of the Space Needle in Seattle, Washington, makes a complete turn once every hour. What is the tangential speed of a customer sitting 16.5 m from the restaurant's center? (Your answer should be between 0.01 and 0.1 m/s)

$\omega = \frac{1 \cancel{rev}}{1 \cancel{hr}} \times \frac{2\pi \text{ rad}}{1 \cancel{rev}} \times \frac{1 \cancel{hr}}{3600 \text{ s}} = 1.75 \times 10^{-3}$ rad/s

$V_t = r\omega = (16.5)(1.75 \times 10^{-3})$

$\boxed{V_t = .0288 \text{ m/s}}$

4. Find the centripetal accelerations of a point on the equator of Earth. (Your answer should be between .01 and .1 m/s^2)

$r_{earth} = 6.378 \times 10^6$ m

$\omega_{earth} = \frac{1\ \cancel{rev}}{24\ \cancel{hr}} \times \frac{1\ \cancel{hr}}{3600\ s} \times \frac{2\pi\ \cancel{rad}}{1\ \cancel{rev}} =$

$\omega_{earth} = 7.27 \times 10^{-5}$ rad/s

$a_c = r\omega^2$

$\boxed{a_c = .0337\ m/s^2}$

a. Find the centripetal accelerations of a point at the North Pole of Earth. (Your answer should be between 0 and 1.2 m/s^2)

radius at North Pole is zero, so

$\boxed{0\ m/s^2}$

5. A 12500 N car traveling at 59.0 km/h rounds a curve of radius 2.50 x 10^2 m.

a. Find the centripetal acceleration of the car. (Your answer should be between 1.0 and 2.0 m/s^2)

$r = 2.5 \times 10^2$ m

$F_g = 12{,}500$ N

$V_t = 59$ km/h

$V_t = \frac{59\ \cancel{km}}{1\ \cancel{hr}} \times \frac{1\ \cancel{hr}}{3600\ s} \times \frac{1000\ m}{1\ \cancel{km}} = 16.39\ m/s$

$a_c = \frac{V_t^2}{r} = \frac{(16.39)^2}{250} = \boxed{1.074\ m/s^2}$

b. Find the force that maintains centripetal acceleration. (Your answer should be between 1000 – 1500 N)

$F_c = m a_c$

$F_c = \left(\frac{F_g}{g}\right) a_c$

$F_c = \left(\frac{12500}{9.81}\right)(1.074)$

$\boxed{F_c = 1369\ N}$