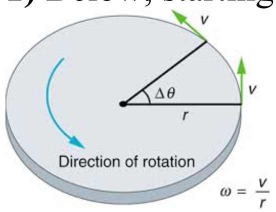
PHYS 1211, QUIZ 9, November 24, 2017 **Max Grade**: **13 out of 9**

1) Below, starting from **rest**, a disk rotates about its central axis with constant angular acceleration. In 5.0 s, it rotates 25 rad.



A) (1 point) During that time, what is the **magnitude** of the **angular acceleration**, $\vec{\alpha}$.

Use $\Delta\theta = \theta - \theta_0 = \omega_0 t + \frac{1}{2}\alpha t^2$, with $\theta_0 = 0, \omega_0 = 0, \theta = 25rad, t = 5.0s$,

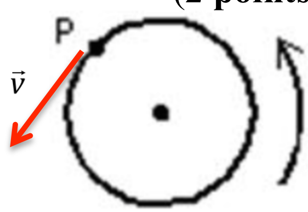
$$25rad = 0.5\alpha(5s)^2 \rightarrow \alpha = 1rad \bullet s^{-2} = 1s^{-2}$$

B) (1 point) What is the **instantaneous angular velocity**, $\vec{\omega}$, of the disk at the end of the 5.0 s?

Angular speed after 5 seconds $\omega_1 = \omega_0 + \alpha t = 5s^{-1}$, angular velocity 5 s^{-1} ccw

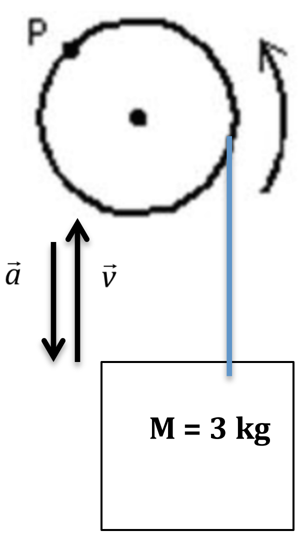
C) (1 point) With the **angular acceleration** unchanged, through what **angle**, θ, will the disk turn in the next 5 seconds.

$$\Delta\theta = \omega_1 t + \frac{1}{2}\alpha t^2 = 5rad \bullet s^{-1}(5s) + \frac{1}{2}(1rad \bullet s^{-2})(5s)^2 = 37.5rad.$$



(2 points) **2)** In the figure, a disk of radius 0.7 m **rotates ccw** at 1.2 rad•s^{-1}. Calculate the **linear speed** of point **P**. Draw the **direction** of the **linear velocity** at point **P**.

$v = \omega r = 1.2rad \bullet s^{-1} \times 0.7m = 0.84m \bullet s^{-1}$, see **red arrow** for velocity of point P.



3) In the **left figure**, a **pulley** of radius 0.7 m **rotates ccw** at angular speed of 1.2 rad•s^{-1}. As the pulley rotates it hauls up a 3kg box, attached to a **rope** that does not **slip** as the pulley **rotates**.

A) (1 point) Calculate the **velocity** of the box

$v_0 = \omega r = 1.2rad \bullet s^{-1}(0.7m) = 0.84m \bullet s^{-1}$. Velocity of box is **up**.

B) The **constant angular acceleration** is 0.5 rad•s^{-2} **cw**. Calculate the **acceleration** of **box**, and its **velocity,** and the **distance** it moves, **after 0.4 s**

(3 points)

Acceleration, $a = r\alpha = -0.7m(0.5rad \bullet s^{-2}) = -0.35m \bullet s^{-2}$, with the **negative sign** denoting that the **direction** is **down**.

Velocity after 0.4s, $v = v_0 + at = 0.84m \bullet s^{-1} - 0.35m \bullet s^{-2} \times 0.4s = 0.7m \bullet s^{-1}$, still **moving up**

C) (1 point) Calculate the **linear acceleration** of the box. Still a = – 0.35m•s^{-2}

BONUS: Calculate the **net force** on the **box**, and the **tension** on the box.

Use Newton's second law on box, the net force is **down**

$F_y^{net} = ma = 3kg \times \left(-0.35m \bullet s^{-2}\right) = -1.05N$. (**2 points**)

Second law, $F_y^{net} = T - mg = -\left(3kg\right)\left(0.35m \bullet s^{-2}\right) = -1.05N$

$T = \left(3kg\right)\left(9.8m \bullet s^{-2}\right) - 1.05N = 28.35N$, (**2 points**)