Exam 2 Circular motion and projectile motion.

$$\alpha = \frac{a_{\tan}}{r} = \frac{d\omega}{dt} \qquad \alpha = \text{ constant} \qquad v_o \text{ at } \theta \text{ above horizontal}$$

$$\omega = \frac{v_{\tan}}{r} = \frac{d\theta}{dt} = \omega_o + \int \alpha dt \qquad \omega = \omega_o + \alpha t \qquad v_{ox} = v_o \cos\theta \; ; \; v_{oy} = v_o \sin\theta$$

$$\theta = \frac{s_{\tan}}{r} = \int \omega dt \qquad \theta = \omega_o t + \frac{1}{2}\alpha t^2 \qquad a_x = 0 \qquad a_y = g$$

$$\omega_{avg} = \frac{\theta}{\Delta t} = \frac{1}{2}\left(\omega_o + \omega_f\right) \qquad x = v_{ox} t \qquad y = v_{oy} t - \frac{1}{2} g t^2$$

$$v_y = v_{oy} - gt$$

Starting from the above relations, try solving the problems below. Work out the algebra

A rock initially at rest in a sling of length **r** meters is brought to a speed of **n** rotations per second after three complete revolutions. It is then released , leaving the sling at an angle of **θ** above horizontal.

Determine the formula for the average angular acceleration during the first three revolutions.

Find the formula for the time for the first three revolutions.

determine the formulas for the tangential acceleration during the first three revolutions and the tangential speed after three revolutions.

When the rock is released, write the initial velocity and its horizontal and vertical components in terms of the variables provided above.

The rock is **h** meters above level ground when released and air resistance is negligible. Create formulas for the maximum height, the horizontal distance to the impact with the ground and the time taken.

THEN, you can use the values r = 0.8 [m], n = 2 and θ = 40° to calculate some numbers.

[B] Suppose you are given the maximum height $\mathbf{y_{max}}$ a projectile reaches and the horizontal distance $\mathbf{x_f}$ from the launching point to the impact point on level ground. Can you determine the initial velocity and angle of launch?

What would change if the launch point were some height **h** above the impact point, could you still find the initial velocity and angle? Could you find the final velocity and angle of impact?

[C] An object of mass **m** is hung from a string of negligible mass which is wound around a pulley of radius **r**. When the mass is released, it accelerates downward at $\mathbf{a \neq g}$. Create relations for the angular acceleration and the angular velocity and angular displacement after time **t**.