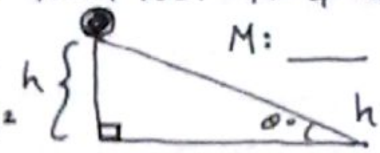
Rotational Kinetic Energy Activity 1 Name: ______

A ball of mass 'M' and radius 'R' starts from rest at a height 'h' and rolls down a slope of angle 'θ'. Assume the ball rolls without slipping. $g = 10 m/s^2$



M: ____ R: ____

h: ____ θ: ____

① What is the linear speed of the ball when it leaves the incline? Solve for linear speed using translational and rotational energy.

a.) List the forms of energy when the ball leaves the incline.

b.) Use $KE_{rot} = \frac{1}{2} I \omega^2$ and $KE_{trans.} = \frac{1}{2} mv^2$ and $PE_g = mgh$ to derive an equation for linear velocity leaving the incline.

$I = \frac{2}{5} mr^2$ for a sphere.

$V = r\omega$ or $\omega = V/r$

c.) Calculate V:

② What is the linear speed of the ball when it is at $\frac{1}{2}h$?

a.) List the forms of energy when it is at $\frac{1}{2}h$.

b.) Use KE_{rot}, $KE_{trans.}$ and PE_g to derive an equation for V.

c.) Calculate V:

③ If instead of a sphere, the same mass was a disk of mass 'M', radius 'R', and $I = \frac{1}{2} mr^2$, what would be the linear velocity after leaving the ramp?

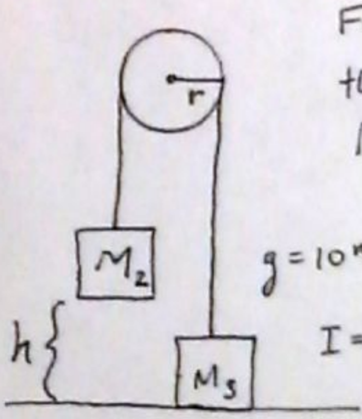
④ Which has the greater velocity at the bottom of the ramp? sphere or disk?

⑤ Why?

Rot. Kinetic Energy Activity 2 Name:

For a pulley of mass M_1, find the velocity of the block of mass M_2 when it hits the floor.

M_1: ____ M_2: ____ M_3: ____ h: ____ r: ____



$g = 10\, m/s^2$

$I = \frac{1}{2} m r^2$

a.) Create an equation of the beginning and ending forms of energy.

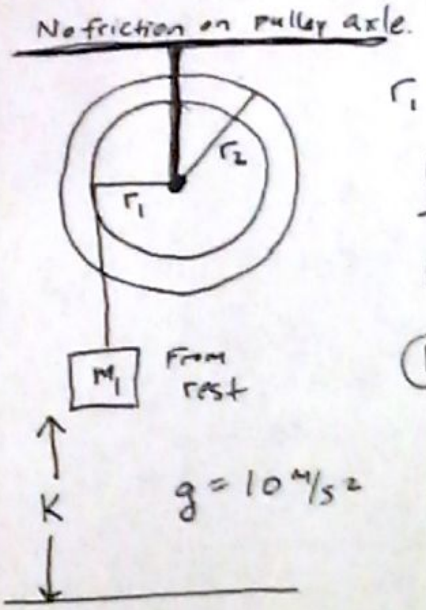
b.) Solve for velocity. Use energy concepts olly.

$\omega = \frac{v}{r}$

c.) Solve for velocity <u>not</u> using energy concepts.

d.) which method do you prefer? why?

Rotational Energy Activity 3 Name:



r_1: ____ r_2: ____ m_1: ____ K: ____ t: ____

Use rotational energy concepts only → unless stated otherwise. The box of mass 'M_1' takes 't' seconds to hit the floor. What is a_{box} and I_{pulley}?

$g = 10\ m/s^2$

(1.) Draw force and torque free body diagrams.

(2) Use the kinematic equations to solve for a.

(3) Use $\Sigma F = m \cdot a$ and $\tau = I\alpha$ and $a_T = r\alpha$ to solve for I.

Using 'conservation of energy' find the landing speed of box 'M_1' and the I_{pulley}. The string does not slip. The pulley axle has no friction.

(4) Use the kinematic equations to solve for landing velocity.

(5) Create an equation where initial energy equals final energy. (remember to include rotational energy on the final energy side)

(6) Solve for I. Remember that $\omega \cdot r = v$ where v is landing speed.

ROTATIONAL ENERGY

A solid block slides down a frictionless incline. A solid disk of the same mass rolls down an identical incline. Decide which object reaches the bottom of the incline first or if they tie. Provide your reason. Next, complete the work-energy bar charts for the block system and for the disk system, starting with the objects at the top of the incline and ending when one or both reach the bottom. The kinetic energy can be in the form of translational kinetic energy (Kt) and/or rotational kinetic energy (Kr). Can you now understand why the race ends as it does?

Question 1: Your Choice of Winner and Reason

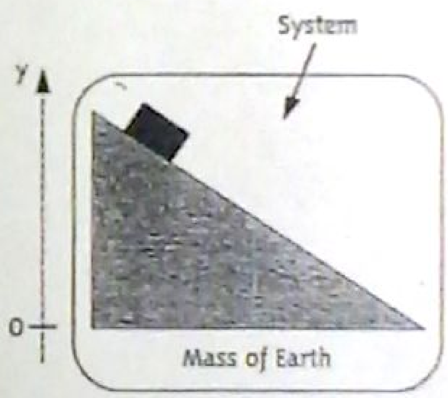
Question 2: Predicted Energy Changes

Block System:

Initial Energy + Work = Final Energy

$U_{gi} + K_{ti} + K_{ri} + W = U_{gf} + K_{tf} + K_{rf} + \Delta U_{int}$

0

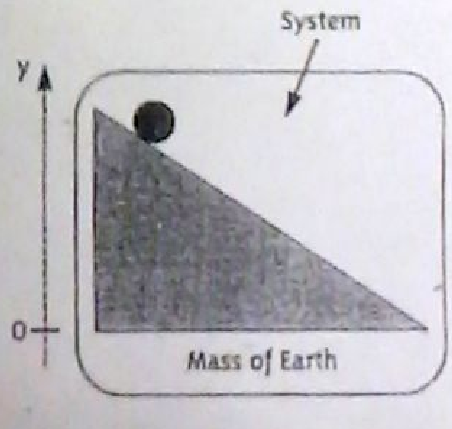


Disk System:

Initial Energy + Work = Final Energy

$U_{gi} + K_{ti} + K_{ri} + W = U_{gf} + K_{tf} + K_{rf} + \Delta U_{int}$

0



ROTATIONAL ENERGY — **7.14 Woman and Flywheel Elevator — Energy Approach**

$r_{wheel} =$

$m_{wheel} =$

A 60-kg student hangs on a trapeze held by a rope wrapped around a m-radius flywheel with a rotational inertia of kg·m². The student starts at rest. Determine her speed after falling 5.0 m towards the ground. Assume that the gravitational constant is 10 N/kg. Ug is the gravitational potential energy. Ks is the student's kinetic energy. K_f is the flywheel's kinetic energy, and Ui is the internal energy due to friction (zero in this problem).

Question 1 — Work-Energy Bar Chart