# MOMENT OF INERTIA & CONSERVATION OF ENERGY

## Objective

1. To experimentally calculate the moment of inertia of a disk ($I_{disk}$) , hoop ($I_{hoop}$) , and disk+hoop ($I_{disk+hoop}$)
2. Compare $I_{disk}$ and $I_{hoop}$ to their expected values:

$$I_{disk} = \frac{1}{2} M_{disk} R^2$$

$$I_{hoop} = \frac{1}{2} M_{hoop} (R_1^2 + R_2^2)$$

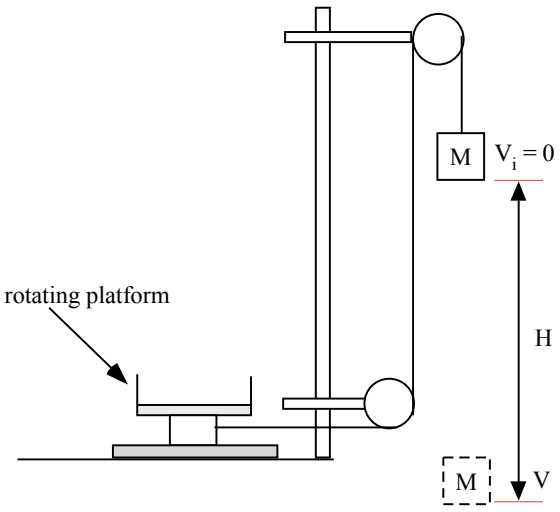
3. Show experimentally that: $I_{hoop+disk} = I_{hoop} + I_{disk}$

## Apparatus

1. large rod
2. pulleys (2)
3. moment of inertia apparatus
4. set of masses
5. triple-beam balance
6. stop watch

## Theory

1. Consider the following system shown below.



2. Use conservation of energy to derive an expression for the moment of inertia of the rotating platform assuming that the system is released from rest.
3. Using the kinematic equations of motion obtain an expression for the speed of the mass M after it has fallen a height H when released from rest.
4. Simplify your derived equation obtained in part (2) to obtain the moment of inertia in terms of the following variables/constants: I = I(m,g,r,t,H).
5. Have the instructor check the equation before proceeding.

**Procedure**

1. Setup the apparatus as shown in the Theory section.
2. Set H ≈ 1m.
3. Measure the time of fall for H ≈ 1m five times for the following:
    a) Platform only (use M ≈ 100g)
    b) Platform + Hoop (use M ≈ 550g)
    c) Platform + Disk (use M ≈ 550g)
    d) Platform + Hoop +Disk (use M ≈ 1050g)

4. Calculate the average time of fall for each set of data.
5. Calculate the moment of inertia using the derived equation obtained in the theory section for the disk, hoop, and disk+hoop.
6. Calculate the expected values of $I_{disk}$ and $I_{hoop}$.
7. Compare experimental values of $I_{disk}$ and $I_{hoop}$ with their expected values.
8. Show experimentally that: $I_{hoop+disk} = I_{hoop} + I_{disk}$