Enter group members' names: [ ]

Enter the name of the member who will submit the group report in the Canvas: [ ]

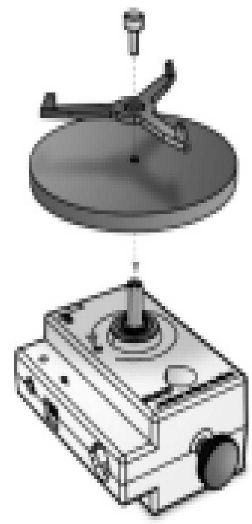
**AP Physics C: Rotational Collisions**

**Purpose:** Study rotational collisions between an object dropped onto a rotating disk by comparing theoretical predictions with experimental data on the angular speed of the disk immediately before and immediately after a collision.

Show your work for $\boldsymbol{\omega_f / \omega_i}$ **prediction below**: All rings and disks have the same outer diameter. Use $M_{disk}$ for the mass of disk 1, $M_{ring}$ for the mass of the ring, and $M_{disk2}$ for the mass of disk 2.

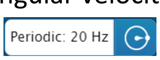
- For ring dropped onto disk 1: Show your work here:
- For disk 2 dropped onto disk 1: Show your work here:

**Materials:**



1. A flat surface
2. Wireless Rotary Motion Sensor
3. 2 disks and 1 ring
4. Rotational Inertia Accessory (alignment guide for the ring)
5. SPARKvue software

**Procedures:**

1) Measure the mass of each of the disks and ring
2) If the sensor is already set up skip to step 3, else: (image of the assembly -->)
   a. Unscrew the screw on the rotary motion sensor. **Please TAKE CARE NOT TO LOSE THE SCREW.**
   b. Place one of the disks (disk 1) onto the rotary motion sensor along with the alignment guide
   c. Carefully secure the disk and guide with the screw **without over tightening the screw**. Double check that the disk and the guide are secure before proceeding.
3) Open SPARKvue, select sensor data. Turn on your rotary motion sensor, so you can select the correct wireless rotary motion sensor to connect. Select angular velocity. Then click the Graph button under Templates. You should see an angular velocity vs. time graph.
4) Click on 

and increase the Rotary Motion Sensor's sample rate to **100 Hz** Click OK.
5) With the disk on the sensor at rest, **click the** 

**button to calibrate the rotary motion sensor**.
6) For each data collection run:
   a) While holding the ring close to and directly above the disk, click "Start", give the disk (disk 1) an initial angular velocity, and **then** carefully drop the ring onto the rotating disk. Click "Stop" soon after the collision ends. You will collect and analyze data (the angular velocity just before the collision and the angular velocity just after the collision.
   Try to **use very different initial angular velocities** for the 4 valid runs.
   b) If the ring does not land well on the disk, you will need to discard the run and try again. To discard a run, click  to manage the runs.

   – After 4 valid runs with the ring, remove the alignment guide from the assembly and secure the disk with the screw. **Please take care NOT TO LOSE THE SCREW and NOT TO OVER-TIGHTEN THE SCREW**. Double check that the disk and the guide are secure before proceeding. **Place the alignment guide in the ziplock bag.**

   – Replace the ring with the 2nd disk (disk 2) and repeat steps 6a and 6b for 4 valid runs.

   **Each group member** should do **at least two valid runs** and each group should do at least 4 valid runs for dropping the ring onto the disk and 4 valid runs for dropping disk 2 onto disk 1 .

7) For collecting data for each valid run:

   a) Click on the add coordinates tool to select the angular velocity data point just before the collision and do the same for the angular velocity data point just after the collision.

   b) Take a screenshot of graph (ctrl + shift + )or save a snapshot of these data for each run and include one image for each valid run in the lab report (see the next item). Please make sure that your images are **large enough** (should be larger than the sample image above**) so the before and after angular velocities data readings are easily readable**.

**Include a screenshot or snapshot of each valid run under an appropriate bullet below.** Clearly label each run #:

- For dropping the ring onto disk 1:

- For dropping disk 2 onto disk 1:

**Data:**

Mass of the base disk (disk 1) attached to the rotary motion sensor as measured with a balance $M_{disk}$ = [mass] kg
Mass of disk 2 as measured with a balance $M_{disk2}$ = [mass] kg
Mass of the ring which is used as a weight as measured with a balance $M_{ring}$ = [mass] kg

| **Dropped object** | **Run #** | **Member who collected and analyzed the data for the run (include all members/take turns)** | **$\omega_i$ (rad/s)** | **$\omega_f$ (rad/s)** | **Predicted $\omega_f$ /$\omega_i$** |
|---|---|---|---|---|---|
| Ring | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Disk 2 | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Graphs:**

- Plot an **$\omega_f$ vs. $\omega_i$** graph for ring colliding with disk 1: Use a software or graph paper to plot the graph. Your graph should include all data points and the line of best-fit. Include the graph here:

  Find the linear regression equation (line of best-fit) for your graph. Write the equation here: [ ].

  Compare the slope of your graph to the predicted $\omega_f$ /$\omega_i$ value. Calculate the percentage error:

- Plot an **$\omega_f$ vs. $\omega_i$** graph for disk 2 colliding with disk 1: Use a software or graph paper to plot the graph. Your graph should include all data points and the line of best-fit. Include the graph here:

Find the linear regression equation (line of best-fit) for your graph. Write the equation here: [ ].

Compare the slope of your graph to the predicted $\omega_f / \omega_i$ value. Calculate the percentage error:

Do error analysis and discuss sources of error here: