Announcements

- HW9 due on Monday
- I've finally gotten my Python grading in an ok place, so my attention is shifting back to you all here! The Midterm will be graded by the end of next week, guaranteed. So sorry for the delays.
- If you haven't filled in the Google Sheet to sign up for your prefered Final Chapter, do so by the end of today!
- Responses: `rembold-class.ddns.net`

Today's Objectives

- Reacquaint ourselves with fundamentals of rigid bodies
- Ensure we know how and why we can break up the motion of rigid bodies into distinct pieces
- Understand how the angular momentum corresponds to the moment of inertia
- Be able to work out the moments of inertia about a single axis of rotation

Q1

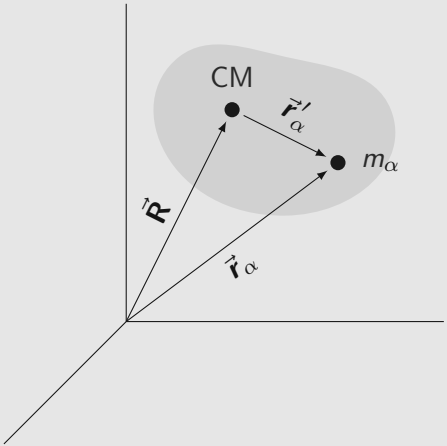
Suppose you have rigid body which has a small contribution of mass m_α located according to the image to the right. Which of the following terms is not therefore equal to 0?

A) $\sum_\alpha \vec{\mathbf{R}} \times m_\alpha \dot{\vec{r}}'_\alpha$

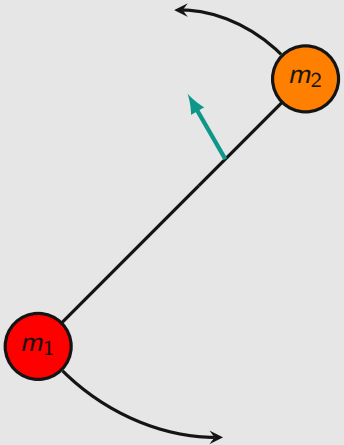
B) $\sum_\alpha m_\alpha \vec{r}'_\alpha \times \vec{\mathbf{R}}$

C) $\sum_\alpha m_\alpha \vec{r}'_\alpha \times \dot{\vec{r}}'_\alpha$

D) $\sum_\alpha m_\alpha \vec{r}_\alpha \times \vec{r}_\alpha$



Q2



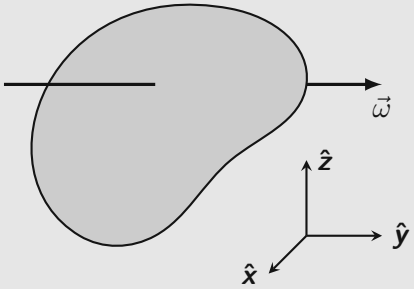
The object to the right is moving through the air at 4 m/s and tumbling about its center of mass once every π seconds. If $m_1 = 2\,\text{kg}$, $m_2 = 5\,\text{kg}$, and the distance between them in 1 m, what is the total kinetic energy of the object? You can assume the central connecting rod is of negligible mass.

A) 70.30 J
B) 63.14 J
C) 56.15 J
D) 58.85 J

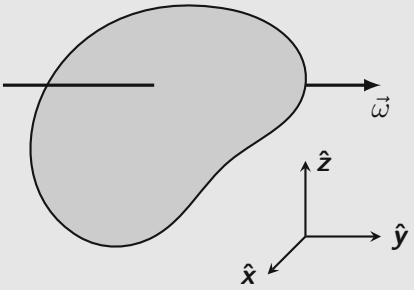
Q3

Suppose you are rotating the 3D rigid body to the right about the rotational axis shown, which pierces the rigid body's center of mass. What term would best describe the z-component of the velocity of some bit of mass m_α about the center of mass?

A) ωy_α
B) ωx_α
C) $-\omega z_\alpha$
D) $-\omega x_\alpha$



Q4



Take the same system, where we are rotating this rigid body about the y-axis. What is the y-component of the angular momentum of some bit of mass m_α as it rotates about the y-axis?

A) $m_\alpha \omega y_\alpha^2$
B) $m_\alpha \omega (x_\alpha^2 + z_\alpha^2)$
C) $m_\alpha \omega (x_\alpha^2 + y_\alpha^2)$
D) $-m_\alpha \omega x_\alpha y_\alpha$

Q5

What is the x-component of the total angular momentum of the system of masses arranged in the triangle to the right as it rotates about the z-axis (coming out of the screen)? You know that $\vec{\omega} = 10\hat{\boldsymbol{z}}$.

A) 80
B) -80
C) 0
D) 10