PHYS 21: Problems for Recitation 2

Due on Jan 18 2013

Prof. Oh

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Hints for Assignment 2

- For 6.7, find equation for each side of triangle. Can you integrate over "strips" of the triangle?
- Your method for 6.10 should be very similar to 6.5
- For 6.12, balance the forces on the small pulley first. What is the relationship between the tensions?
- For 6.9, the book's diagram can help you write down the frictional forces.
- For 6.15, can you set up a differntial equation using the torque?
- For 6.16, the rod is not moving!

Assignment 1 Retrospective

- Several people wrote that they had no idea how to approach the problem. If this happens to you, please send me an email! I would be very happy to help you if you have no idea where to start.
- In problem 6.1, many of you misunderstood the question. The question is asking about a system of N particles such that $\sum_i p_i = 0$. Keep in mind that $\sum_i(\vec{r}_i \times \vec{p}_i)$ DOES NOT EQUAL $\sum_i \vec{r}_i \times \sum_i \vec{p}_i$!
- In problem 6.2, many of you used M_S where you meant λt
- In problem 6.3, ω is in the opposite direction to v_{bug}! Many of you didn't explain your answer to part (b) sufficiently - it's enough to say that $\vec{r} = \vec{0}$ at the pivot.
- For 6.4, the module has a potential energy when it leaves the spaceship! If you forget this term, you whole answer is off by several factors.
- Many people got the expression for the centripetal force in 6.6 incorrect - the radius of turning is just R, NOT $R + d/2$.
- You need to explain why the quanitity is conserved in 6.13. Many of you had unclear/fallacious reasoning for part (b).

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Moment of inertia fun! Using the parallel axis theorem and the perpendicular axis theorem, find these moments of inertia:

- The vertical axis touching the side of a horizontal coin of mass m radius r
- The horizontal axis through the centre of a horizonal coin of mass m radius r
- The vertical axis through the centre of an annulus - a "donut ring" of inner radius r_1 and outer radius r_2
- A "cage" of 3x3 rods, each of mass m, radius r, and length ℓ, through the centre of middle hole
- A "cage" of 3x3 rods, each of mass m, radius r, and length ℓ, a distance R from the edge.
- Stacked spheres, each of mass m, one of radius r and one of radius $2R$, a distance ℓ away from their centreline.

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(a) was covered in lecture.
(b) - $I_z = I_x + I_y = 2 \cdot \frac{1}{2} mr^2 = mr^2$
(c) - $I_{longline} = \frac{mr^2}{2}$
(d) -

$$\begin{aligned} I_{tang,middle} =& 2 \cdot \frac{mL^2}{12} + 4 \cdot \left(\frac{mL^2}{12} + m \left(\frac{L}{2} \right)^2 \right) \\ =& \frac{mL^2}{6} + \frac{mL^2}{3} + mL^2 \\ =& \frac{9mL^2}{6} = \frac{3}{2} mL^2 \end{aligned}$$

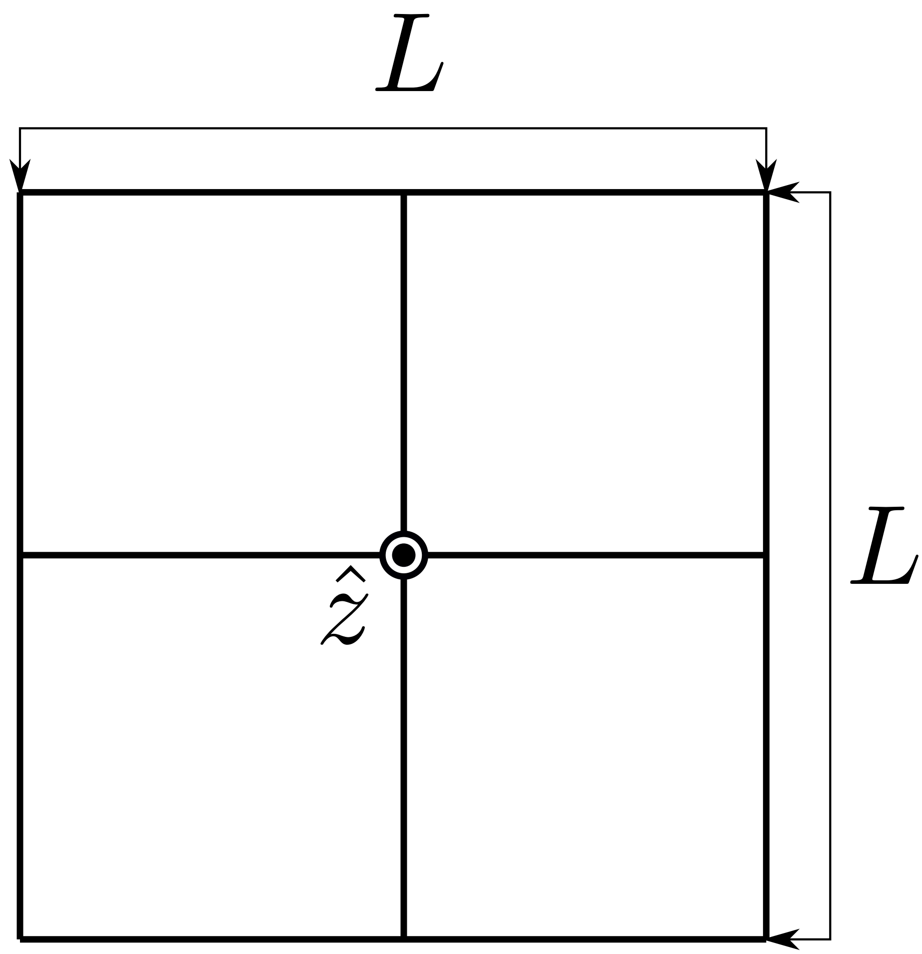
(e) -

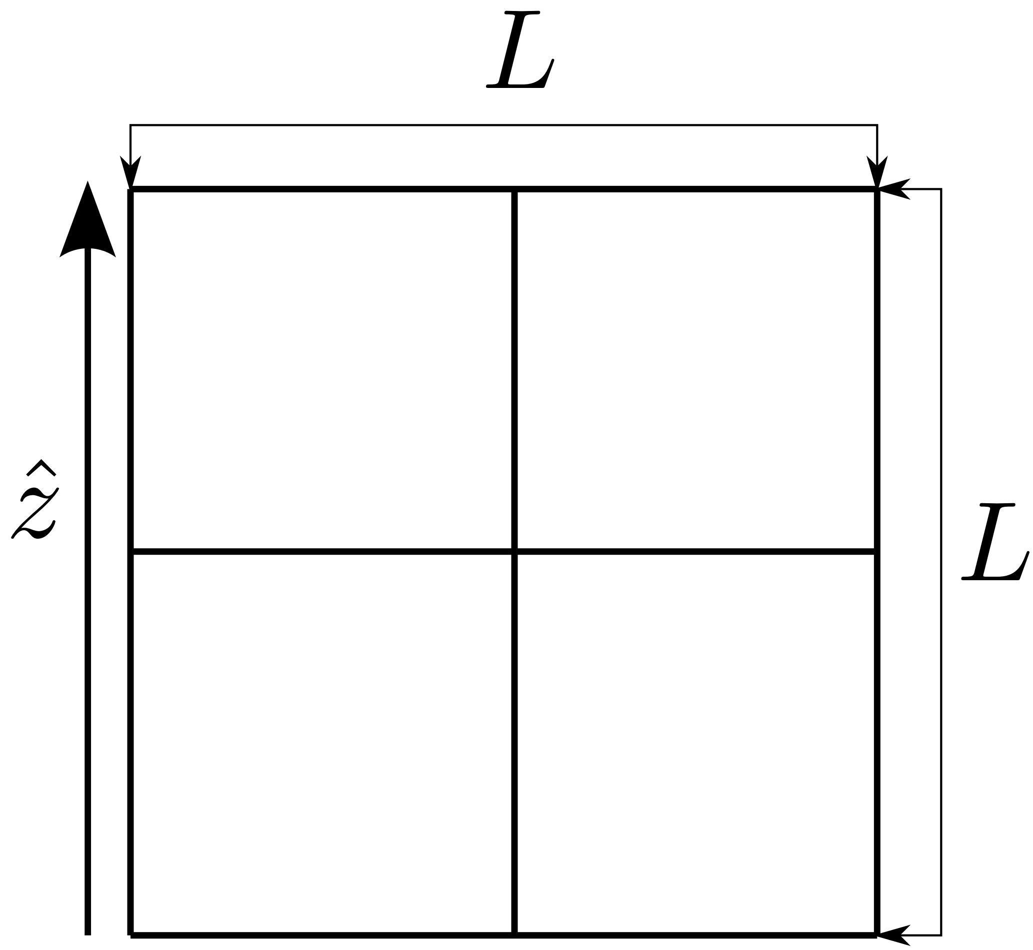
$$\begin{aligned} I =& 3 \cdot \left(\frac{mL^2}{3} \right) + \frac{mL^2}{12} + \frac{mL^2}{12} + m(L/2)^2 + \frac{mL^2}{12} + m(L)^2 \\ =& mL^2 + \frac{mL^2}{4} + \frac{mL^2}{4} + mL^2 \\ =& 2mL^2 + \frac{mL^2}{2} \\ =& \frac{5mL^2}{2} \end{aligned}$$

(f) -

$$\begin{aligned} I =& \frac{2mR^2}{5} + \frac{2m(2R)^2}{5} + 2mL^2 \\ =& 2mR^2 + 2mL^2 \end{aligned}$$

Pictures for Moments of Inertia

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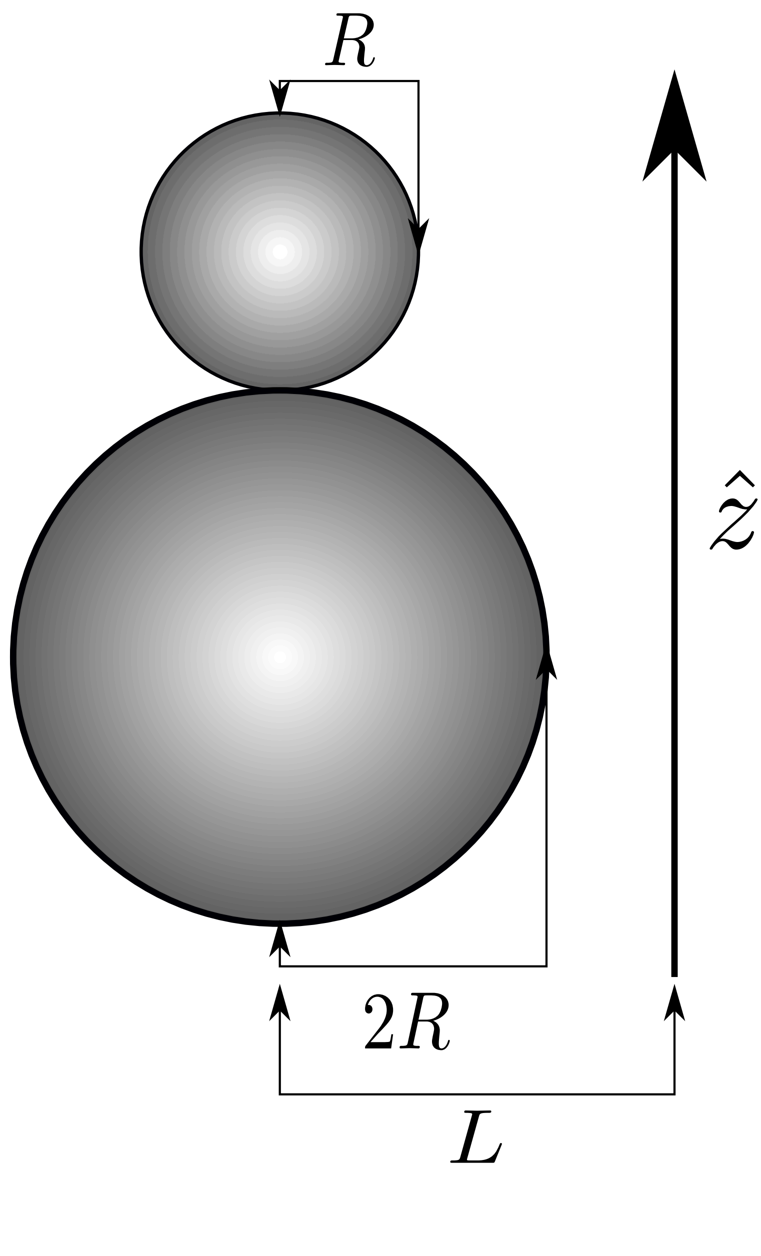
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