T&AM 203 - Comments on Prelim III

Problem 1

- Many of you did not read or did not understand the following portions of the problem statement:

  1. rigid, massless rod ⇒ the rod has no inertia
  2. left ball strikes the surface ⇒ no part of the rod touches the surface
  3. collision is elastic ⇒ nothing sticks to the surface (so, $\underline{v}_{LEFT} \neq \underline{0}$)

- If you used the following when using energy conservation:

  $$E_K = \frac{1}{2} m v_{CM}^2 + \frac{1}{2} I \omega^2$$

  m = total mass (not just the mass of one of the pt. masses) and $I = I_{zz}^{CM}$

  where $I_{zz}^{CM} = \sum m_i r_{i/CM}^2$ for pt. masses.

  Also, $E_K \neq \frac{1}{2} I_{zz}^{A} \omega^2$ since A not fixed.

- If you used angular momentum conservation:

  1. You must specify the pt. about which it is conserved (i.e. the contact pt.),
  2. $\underline{H}_{/A}^{+} \neq I_{zz}^{A} \omega \hat{k}$ (A not fixed)

- For part b, "subsequent motion" does not mean "just after collision". So, writing answers from a) is not sufficient. Also, the question states "Answer in terms of some or all of $\hat{\imath}, \hat{\jmath}$, v, L, and g." So, saying that the baton rotates clockwise and falls straight down is not enough to fully describe the motion.

- In part b), saying that the rotation remained constant needed to be justified (angular momentum conservation about CM).

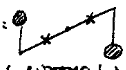
General Mistakes in Problem 2.

① It is not enough for only stating the mass is evenly distributed when answering the object is statically balanced. Instead, you should answer $\Sigma\vec{F}=m\vec{a}$, CM is on the axis, no external force needed.

② When considering whether the object is dynamically balanced, it is not enough for only saying $\Sigma\vec{M}=\vec{0}$ or saying the moment caused by each part of the object can be cancelled out. Instead, you should show $\Sigma\vec{M}=\dot{\vec{H}}=\vec{\omega}\times\vec{H}$ (coz $\vec{\omega}$ is constant). And $\vec{H}=[I]\vec{\omega}$ and why $\vec{\omega}\times\vec{H}=0$. You need to show some ~~do~~ terms of [I] to justify your answer — No external moment needed.

③ To balance 2(b), some students placed two mass on the edge of the plate or above (below) the edge

side view:



(wrong!)

It is wrong since it won't be dynamically balanced.

④ Problem 2.(d), to answer why it is not dynamically balanced, you should simply say it is not statically balanced.

⑤ To balance each ~~unbalanced~~ objects, you need state clearly what you will do. Say, how far away it is from CM, etc.

⑥ You must add 1 (m) or 2 (m/2) point mass to the object no matter it is balanced or not.

Comments on problem 3

(1) First and the most common mistake was identifying $\ddot{y} = \frac{2k}{m} y$ as a simple harmonic equation. If you are asked to find natural frequency, you should see that solution to above is an exponential growth. So SHM motion is governed by

$$\boxed{\ddot{y} = -\frac{2k}{m} y}$$

(2) In the first part note that y is measured positive downwards. So either align positive $\hat{j}$ axis down or write $\vec{a}$ in the LMB $\Sigma\vec{F} = m\vec{a}$ as $\Sigma\vec{F} = m(-\ddot{y})\hat{j}$ (in case your $\hat{j}$ is positive up).

(3). Once you have selected your $\hat{i}, \hat{j}$, note that ϕ is measured positive counterclockwise so in $I\vec{\alpha}$ take proper consideration of signs.

(4) Most of the people have forgotten the initial stretch. When you are showing "mg" in your FBD, then include the initial static stretch the springs have. If you are not showing "mg" & don't include the stretch, give a proper reasoning for that.

(5) Finding natural frequencies. Lots have done complicated research to get frequencies. Finding natural frequencies is nothing but finding equations of motion and use the idea of a simple Harmonic oscillator to compare the terms with standard equation.

$$\boxed{\ddot{x} + \frac{K}{m} x = 0}$$

(6) When you are asked to find natural frequencies of a system. There are as many natural frequencies as there are degrees of freedom. In this case - "two"