Massachusetts Institute of Technology

Physics 8.03 Spring 2003

Response to questions/comments I get by email

Question 1: Springs in series

A mass m is attached to two springs in series, with spring constants k_1 and k_2, respectively. What is the effective spring constant for two springs in series?

Each spring feels the same force, $F = -k_1 x_1 = -k_2 x_2 \Rightarrow x_2 = \frac{k_1}{k_2} x_1$.

The total extension is $x = x_1 + x_2 \Rightarrow F = -k_{eff}(x_1 + x_2)$.

So, $-k_1 x_1 = -k_{eff}(x_1 + \frac{k_1}{k_2} x_1 \Rightarrow \frac{1}{k_{eff}} = \frac{1}{k_1} + \frac{1}{k_2}$.

Question 2: The rolling ball

On Problem 1.5 of the problem set, why is the kinetic energy $K = \frac{7}{5}m(R-r)^2\dot{\theta}^2$?

The total kinetic energy is due to the rotation of the ball about the center of mass + the translation of the ball. We know that for a sphere of radius, r, in a bowl of radius, R: $I_{CM} = \frac{2}{5}mr^2$ and $v_{cm} = (R-r)\dot{\theta}$. Suppose the ball rotates with angular velocity, ω, then

$$
\begin{aligned}
K &= \frac{1}{2}I_{cm}\omega^2 + \frac{1}{2}mv_{cm}^2 \\
&= \frac{1}{5}mr^2\frac{v^2}{r^2} + \frac{1}{2}mv^2 \\
&= \frac{7}{10}mv_{cm}^2 \\
&= \frac{7}{10}m(R-r)^2\dot{\theta}^2
\end{aligned}
$$

Question 3: Keep the Math Simple

Since many students do not have Maple or MATLAB on their personal computers (and a portion of students do not own TI-89 high performance calculators), please have the problem sets utilize math that is relatively simple to calculate on paper. This way, the students can focus on the physics aspect of the material, and not be stuck with tedious error-prone hand calculations.

The purpose of physics is to quantitatively understand the physical Universe. Nature has provided us with very few systems where the mathematical description is simple. Rather than avoid the math you need to work with real physical systems, I have tried to encourage you to use mathematical tools as an aid, NOT an impediment. I appreciate that all students don't have computing resources in their immediate living space, but surely it's not too onerous to spend an hour per week in an Athena cluster?

Question 4: A Break in the Middle of Lecture

I think that it would be beneficial to pause for 3-5 minutes approximately halfway through lecture. I have seen this done in other 1.5 hour lectures and would allow us to relax for a minute or two, and run to the bathroom or to the waterfountain.

An interesting suggestion. As a lecturer, I would find it rather disruptive to do, but I'll take a vote on this one and see if other students have the same sentiment.

As well, I really find your office hours to be an effective way to learn in the smaller setting.

I'm glad to hear it. Keep on coming...

Question 5: Take Home Experiments Cause Stress

1) How can a report for a take-home experiment be 1 page long when the take-home experiment often has literally a page of QUESTIONS itself?

Questions can easily be more wordy than answers to them. You're welcome to be as brief or verbose as you like.

2) I think these take-home experiments being mandatory and requiring a one page report are counterproductive. (a) they are too tedious (b) the one page report deal is killer, it is completely stressing me out when i would like to focus on the reading material and working practice problems (c) they require us to hunt down and find all these materials (e.g. a milk carton) that kids in college dorms don't necessarily have).

No assignment in this class is designed to cause stress. I have carefully chosen the least tedious and most instructive experiments – thus you were required to do only half of the total experiments in the handbook. This is not how it's been done in past years, so I hope you see this as an improvement.

3) can you make take-home experiments optional, i would seriously still do the experiments to get a better understanding of the material. the only difference is that i wouldn't be stressed or pressured.

Every year we study student evaluations to decide if certain aspects of 8.03 are unpopular with or not useful to students. There are always a few students who intensely dislike the take-home experiments. However, many more students find them useful, so we have tried to continue them. I doubt the experiments would get done if they were not required, so to enforce a uniform standard on all students in the class, I have made them mandatory.

4) if you arent feelin it on #3 how about at least giving us the ability to "drop" two or three take-home experiments?

You may see me about that option, I will decide on a case by case basis. I will require an alternative piece of work in lieu of the experiments, e.g. a computer simulation project like the demos I show in lecture. Again to maintain a uniform standard for all students in the class.