UNIVERSITY OF COLORADO AT BOULDER **PHYS 2210**

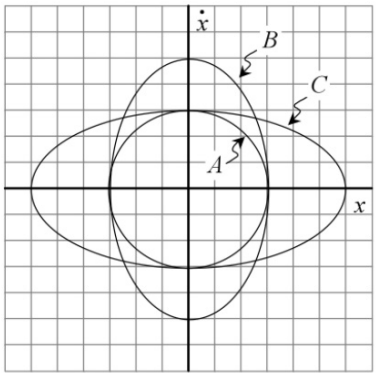
CLASSICAL MECHANICS AND MATH METHODS, SPRING, 2011

Homework 10

(Due Date: Start of class on Thurs. March 17)

NOTE: March 17 is our second in-class exam day! You may bring TWO sides of one page of paper with your own *hand written* notes, if you like. Please read the LAST homework question first, so you know it's coming. This may require some planning on your part.

1. Consider the phase space plots (A, B, and C) shown below.



(a) Could all three plots correspond to the same simple harmonic oscillator (i.e., same mass and same spring constant)? Explain why or why not.

(b) Which pair of plots could be used to show the effect of keeping the total energy constant but increasing the spring constant (while keeping the mass constant)? Clearly indicate which plot would correspond to the larger spring constant. Explain without performing any calculations.

(c) Which other pair of plots could be used to show the effect of keeping the total energy constant but decreasing the mass and keeping the spring constant fixed? Clearly indicate which plot would correspond to the smaller mass. Explain without performing any calculations.

2. *Practice, practice: We have noticed some difficulties in evaluating multi-dimensional integrals. Since this is one of our class learning goals and since you will need to master it for the coming exam, we are giving you some basic problems to practice with.*

(a) Consider a solid sphere, determined by the volume $x^2 + y^2 + z^2 \leq R^2$, with a non uniform density $\rho(x, y, z) = Az^2$. What are the units of A? Determine the total mass of the sphere in terms of A and R. (Hint: Use spherical coordinates. Can you write z^2 in terms of r, θ, and ϕ?).

(b) Consider a flat disk of radius R, with an areal mass density given in polar coordinates (it's flat, so we don't have any third "z" dimension) given by $\sigma(r, \theta) = Ar^2 \sin^2(\theta)$, where A is a given constant. Describe (in words, and a simple sketch) this mass density, what does it look like physically? Now, determine the total mass of the thin disk in terms of A and R.

CONTINUED

3. Homework review! *Note: If you have perfect scores on all homeworks so far, congratulations. Just let the grader know! Otherwise...* Go back over all your old homeworks, and look over what you missed. (Note: solutions are posted on CULearn) Pick at least one problem you didn't do well on, and redo it to your satisfaction. You don't need to turn in the resolved problem - instead, turn in a summary of what went wrong, and what you needed to do to fix it. Were you missing a concept? A math trick? Was it sloppiness, a lack of time, or something deeper? Try to articulate what you have learned by redoing the problem (For obvious reasons, the grader will not grade what you do here in *detail*, this question will be graded simply "credit/no credit").

4. Exam review! This question is similar to what we assigned you before Exam. 1. (Again you are required to turn this in. And again, for obvious reasons, the grader will not grade what you write in *detail*, each part will be graded simply "credit/no credit").

(a) Find or invent a plausible exam question covering material you expect to see on this exam. (Exams are cumulative, but focus on new material since the previous midterm) You might also think about what we have covered in Boas, too - can you hook that in? Write it down. Solve it. (Include your solution with your homework) (If it takes $<\approx$ 5 min, how could we have made it a little more interesting/richer/challenging? If it takes $>\approx$ 20 min, how could we scaffold/hint/simplify to get at the interesting physics, without making it tedious/grungy?) Write a brief (just a few words) summary which characterizes what content this problem covers (e.g, "Gauss law", or "Simple harmonic motion" or "Conservation of energy", etc) Finally, which of the course scale learning goals does your problem address (list them by number) See

http://www.colorado.edu/physics/phys2210/phys2210 sp11/course goals.html

(b) Get together with at least one other person from class, and share your made-up exam question. Do theirs, and discuss with them whether you think they got the level and coverage right. To turn in to us: Write down the name(s) of the person you worked with. To show us that you really did this activity (yes, this IS a homework problem, for credit!), write down in your homework the problem of theirs that you did. (If it's really long, paraphrase)