Unspringy Springs – HINTS!

Physics 204,

John Jay College of Criminal Justice, the CUNY

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The hints below are all for PROBLEM 1: finding a function that gives the force on a particle *inside* of a giant solid sphere. You must solve problem 1 to be able to solve problems 2 & 3.

HINT #1:
The *first* and *most important* hint is just a reminder:

Newton's Shell Theorem, which we discussed in class on Wednesday is about a *HOLLOW SHELL* of uniform density. *But—*

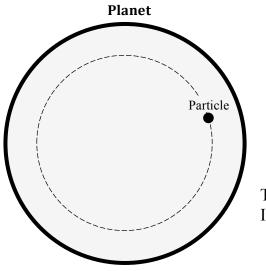### the giant sphere in this problem is *SOLID*. It is not a *SHELL*.

Did you already realize that? If yes, good! If no, read more carefully!

A solid sphere is a more complicated situation.
However, Newton's Shell Theorem will help you solve the problem.
But the answer won't be a simple zero. It'll be more complicated.

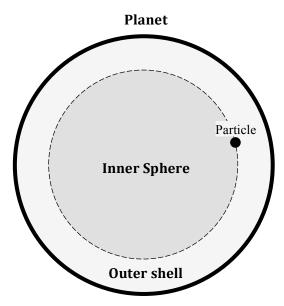Thing about this for a while on your own, before you look at the next hint.

HINT # 2:
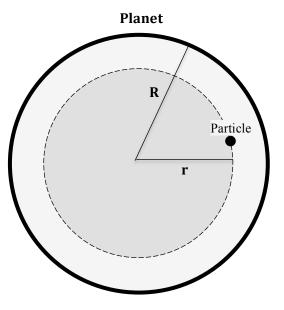The *second* hint is just a *picture*:

Planet

Particle

Thing about that for a while *on your own*.
If you're not sure what to do, look at hint # 3

Hint #3:
The *third* hint is *also* just a *picture* (but with a few more words on it):

Planet

Particle

Inner Sphere

Outer shell

Again, think this over and try to solve the problem on you rown on your own before you look at the next hint.

Hint #4:
One more picture.

Now, again, try it on your own for a while before you look at the next hint.

Planet

R

Particle

r

Hint #5:
Ok, enough pictures. The fifth hint is just a reminder of some things you already know:
1. Newton's Shell Theorem.
2. Newton's Law of Universal Gravitation
3. The ***definition of density*** ($\rho = m/v$).
4. The volume of a sphere ($V = \frac{4}{3}\pi r^3$).

You should definitely, definitely see if you can solve it on your own before you look at the sixth & final hint.

Hint #6:
Use Newton's Shell Theorem to deal with the outer shell.
Find the volume of the planet.
Use the planet's volume to find the mass of the inner sphere.
Apply Newton's Law of Universal Gravitation.