Assignment 4 Due: Friday, Oct. 2
33.331

1) Problem 5.9 of the text.
Don't try to do the integral exactly (you can't) and don't try to beat it into the form of a standard elliptic integral. But *do* expand the integrand in a/R (where R is the distance from the center of the ring to the point of interest). Keep whatever order you need to get a non-vanishing correction from the point-mass potential. (Keep terms consistently of the same order!)

2) Problem 5.11 of the text.
First show it to be true for a point mass external to the sphere. (You can choose a convenient set of axes for the problem.) Then it is easy to obtain the desired result without any more calculations.

3) Problem 5.16 of the text.
This is a trick question. Don't do any actual integration! You may want to think about the form of the field due to the sphere and the field due to the plane... and perhaps Newton's third law. Would your answer change if the mass M were distributed non-uniformly with a density which varied as a function of r, θ, and *phi* over the sphere?

4) Problem 6.3 of the text.
The 3-D distance element, ds, is found like the 2-D one we've done in class many times. Use Pythagoras, and then factor out dx. But now you'll have $f(y, y', z, z'; x)$ so you'll need *two* Euler's equations.

5) Problem 6.5 of the text.
This is the side-ways soap bubble which we just solved in class (with horrible differential equations). Now you can make it look easy by using the alternate form of Euler's equation. (Once you simplify it to the form of equation 4 or $4'$ that we got in class, you're done.)

6) Problem 6.7 of the text.
Consider a light ray which travels from a source at (x_0, y_0) in medium 1 to a point $(x_1, 0)$ on the boundary (at $y = 0$) and then through medium 2 to an observer at (x_2, y_2). Assuming it travels on straight lines within each medium, what x_1 allows it to make the trip in minimum time? From that you can easily find the sines of the angle of incidence and of the refracted ray.
(But *WHY* should it take the fastest path? ...because it *does*!... or see Feynman's path integral formulation.)