Lesson #4: Spherical Charge Distributions **Name: _____**
Electric Field Lines and Flux

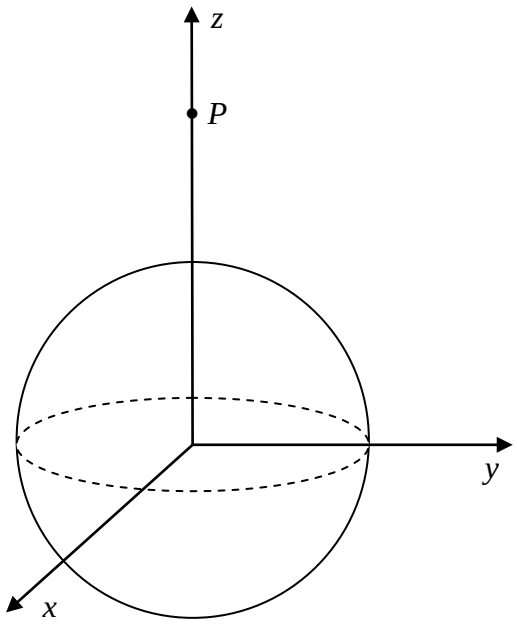
Read sections 1.4 and 2.1-2.2 in Griffiths, then answer the following questions. Note that <u>question #1 below is problem Q3 from the next homework set</u>, so it's in your best interest to work carefully through this question!

1. Suppose we wanted to find the electric field due to a spherical shell of radius R which has a uniform surface charge density σ. The total charge on the sphere is Q. Consider only the case $z > R$ (i.e., the point P is <u>outside</u> the sphere).

   a. On the figure, sketch a representative differential area element for spherical coordinates, $da' = (r')^2 \sin\theta' \, d\theta' \, d\phi'$.

   b. Also sketch the vectors $\vec{r}$, $\vec{r}'$ and $\vec{\mathscr{r}}$.

   c. Specify the magnitude of the separation vector, $|\vec{\mathscr{r}}|$, in terms of the source coordinates (r' θ' ϕ') and the distance z. (*Hint: the Law of Cosines will be useful.*)



   d. In what direction is the electric field of this shell of charge? How do you know?

   e. Specify the z component of the field $d\vec{E}$ produced by your little dq. Your answer should be only in terms of source coordinates (r' θ' ϕ') and the distance z, as well as given constants.

   f. Completely specify, but do not evaluate, the integral (Eq. 2.7 in Griffiths) required to find the electric field at point P. Your answer should be in terms of the given parameters. Include limits of integration.

2. Sketch the electric field lines for the charge arrangement shown below.

3. You already know what the electric field of a finite charge distribution looks like at large distances – is your sketch for question 2 consistent with your expectation? Explain.

4. [**TRUE / FALSE**] Electric flux is a vector quantity.