Lesson #5: Gauss's Law **Name:** _____

Read examples 2.2 and 2.3 in Griffiths, then answer the following questions.

1. Where is the "field point" in Figure 2.18?

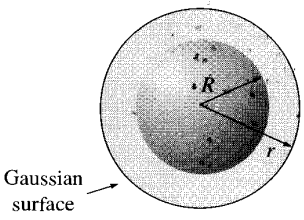


Figure 2.18

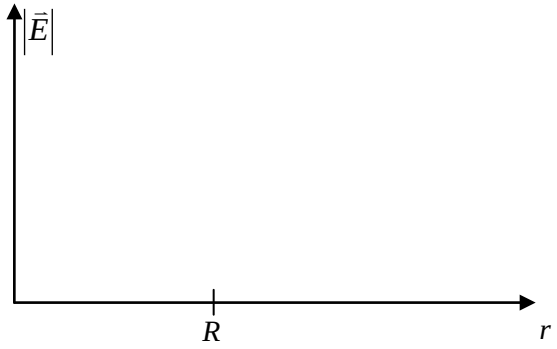
2. What, exactly, is the integration of $\oint_S \vec{E} \cdot d\vec{a}$ over?

3. In the solution for Example 2.2, the integral $\int_S \vec{E} \cdot d\vec{a}$ is replaced with $\int_S \left|\vec{E}\right| da$.

   A few lines later, the integral $\int_S \left|\vec{E}\right| da$ replaced with $\left|\vec{E}\right| \int_S da$. Explain why each of these steps is mathematically appropriate.

4. In Example 2.2, the electric field outside the sphere of charge was determined. Now use Gauss's law to find the electric field <u>inside</u> the sphere of charge as a function of *r*.

5. Using the axes provided, plot the magnitude of the electric field as a function of *r*, both inside and outside the sphere. Also, comment on why the electric field increases as a function or *r* inside the sphere, but decreases outside the sphere.



6. Devise your own problem-solving strategy for using Gauss's law. That is, outline the mathematical steps and decisions you need to make to determine the electric field of a given charge distribution.

Read examples 1.4 in Griffiths, then answer the following question.

7. Calculate the divergence of $\vec{v} = x^2\hat{\mathbf{x}} + 3xz^2\hat{\mathbf{y}} - 2xz\,\hat{\mathbf{z}}$. What does it mean that the divergence is not a constant value, as it was for the three vector fields considered in Example 1.4?