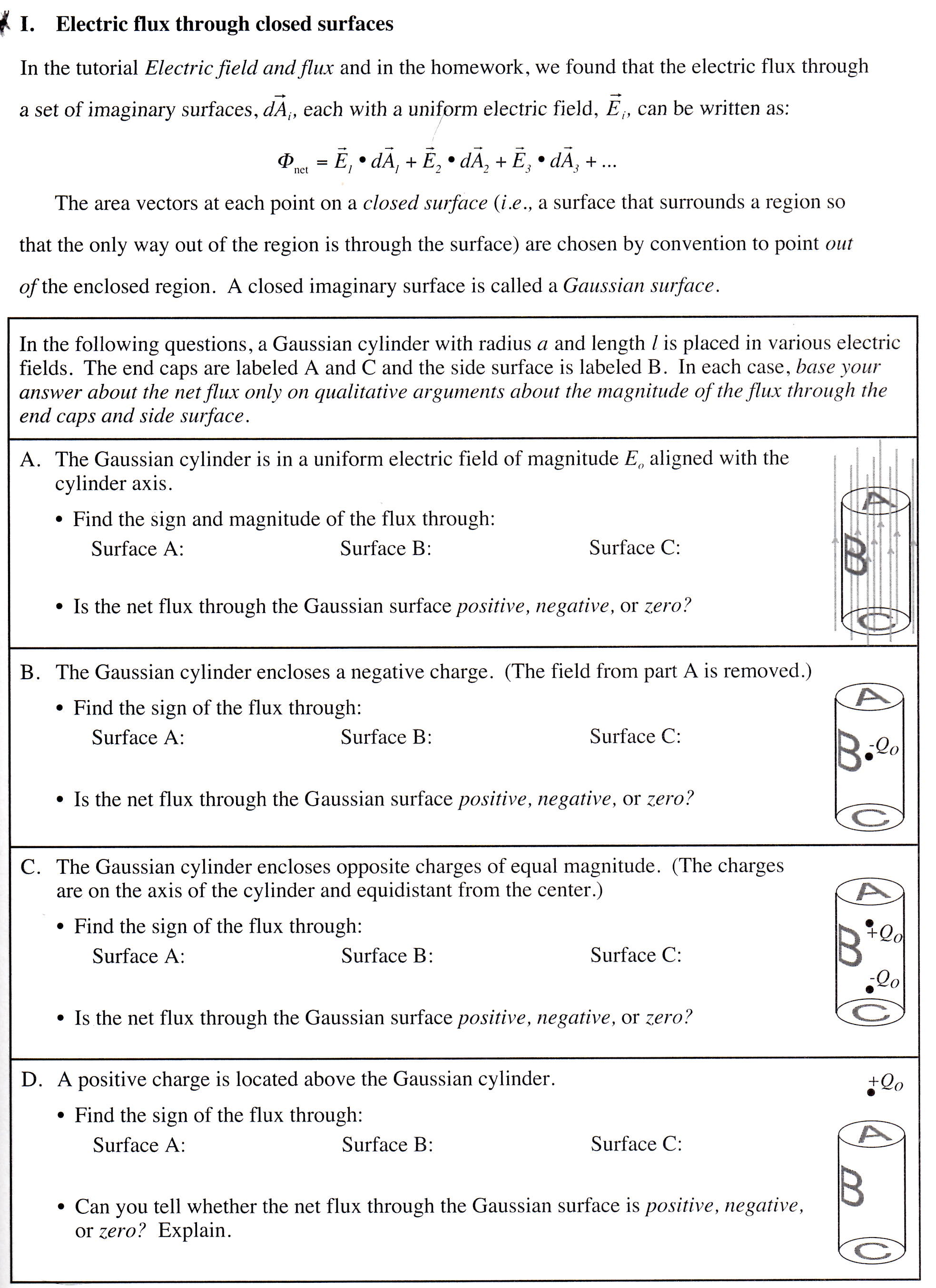
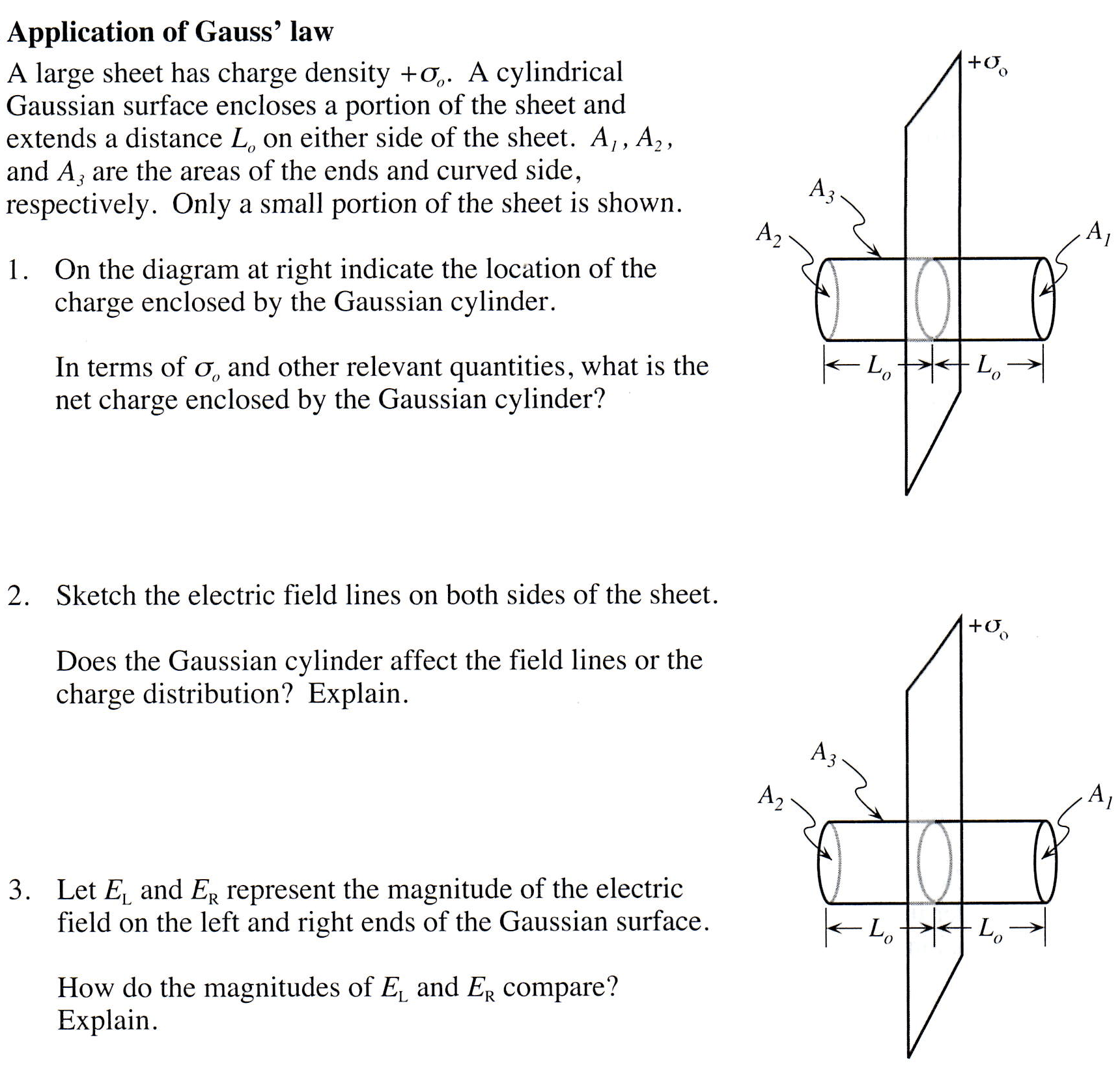
PY212

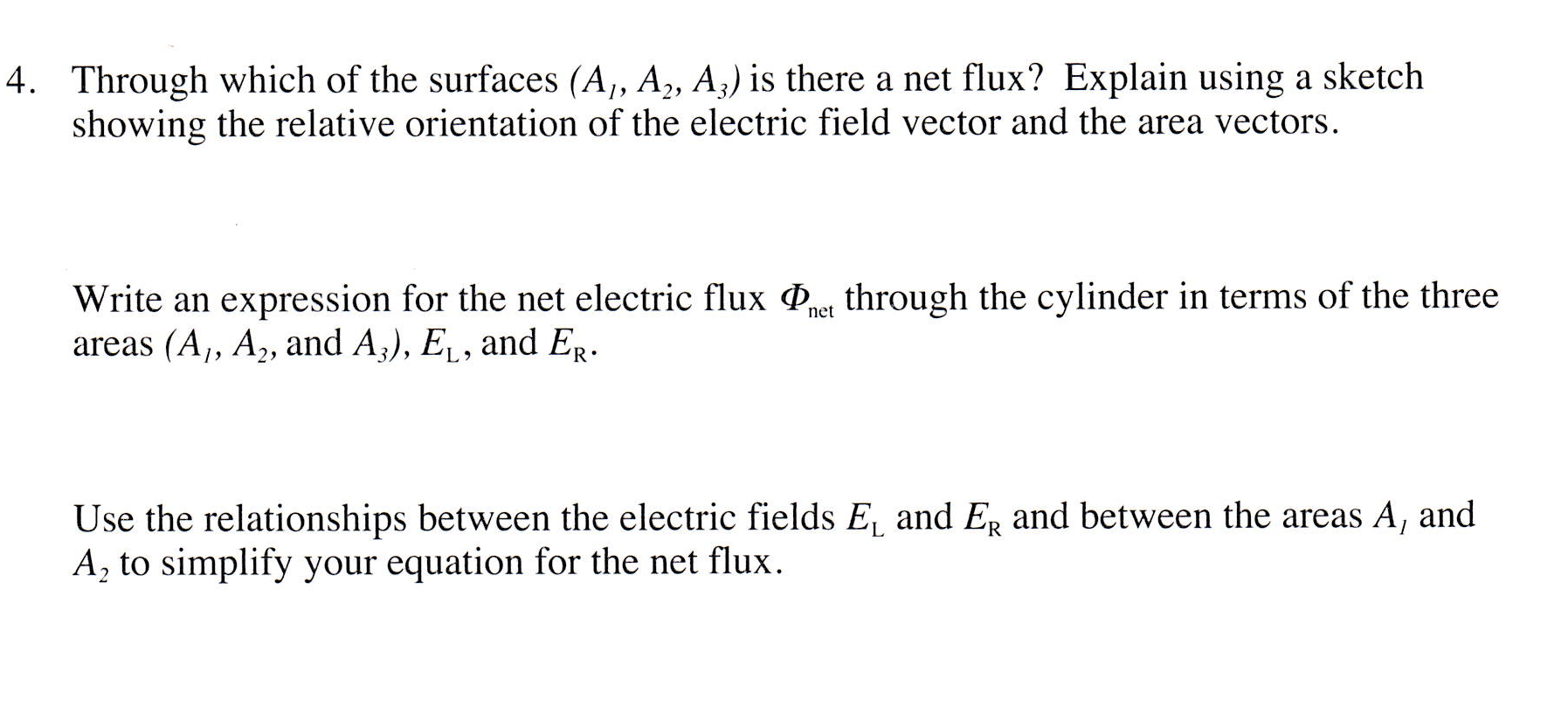
**Problem Set 2 Worksheet**

Please begin working immediately with your partners on this first page of tutorials.



1. Tutorial p. 83 leading into

**II.**

5.

Instead of a large thin sheet, suppose we had a large thick slab of insulating material with thickness 2d. Instead of a surface charge density , the slab has a uniform positive volume charge density . In comparison to the thickness 2d, the other dimensions of the slab are large and can thus be treated as essentially infinite.

Please draw a diagram of the slab in the space to the right. Is there any symmetry in the problem?

Is Gauss’s law useful in this situation? Explain.

If so, what Gaussian surface can be used? Draw it.

Indicate (by shading) the precise location of the charge enclosed by your Gaussian surface. In terms ofand other relevant quantities, what is the charge enclosed by this surface?

Please draw another diagram of the slab in the space to the right. Consider the region **inside** the slab.

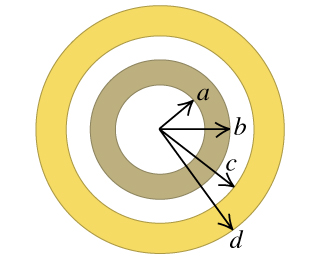
Is there a net electric field **at the center** of the slab? Why or why not?

Is there a net electric field at a point inside the slab but not at the exact center? Why or why not?

Is Gauss’s Law useful for calculating the electric field inside the slab? Explain.

If so, what Gaussian surface can be used? Draw it.

Indicate (by shading) the precise location of the charge enclosed by your Gaussian surface. In terms of  and other relevant quantities, what is the charge enclosed by this surface?

**III. Conductors and Induced Charge**

A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d (see the figure). The inner and outer shells have total charges as given below.

Given the total charges as follows, what is the charge on **each surface**?

Case 1: +2q (on inner shell) and +4q (on outer shell)

|  |  |
| --- | --- |
| Inner sphere (r=a) |  |
| Inner sphere (r=b) |  |
| Outer sphere (r=c) |  |
| Outer sphere (r=d) |  |

What is the relationship between the charge at r=a and the charge at r=b?

Between the charge at r=b and at r=c?

Between the charge at r=c and r=d?

Now consider two other cases. Specify the charge.

Case 2: +2q and 0 Case 3: +2q and -4q

|  |  |
| --- | --- |
| Inner sphere (r=a) |  |
| Inner sphere (r=b) |  |
| Outer sphere (r=c) |  |
| Outer sphere (r=d) |  |

|  |  |
| --- | --- |
| Inner sphere (r=a) |  |
| Inner sphere (r=b) |  |
| Outer sphere (r=c) |  |
| Outer sphere (r=d) |  |

Consider now Case 3. Is Gauss’s Law useful in this situation for calculating **E**? Explain.

In calculating the electric field, how many different “regions” are there for this problem? Are there any regions for which the electric field is zero? Please draw a rough sketch of the field *E* as a function of position *r*. Be sure to label your axes and important values.

Given the charges listed in your table, calculate the **charge density** on each of the surfaces for Case 3. What units would your answers have?