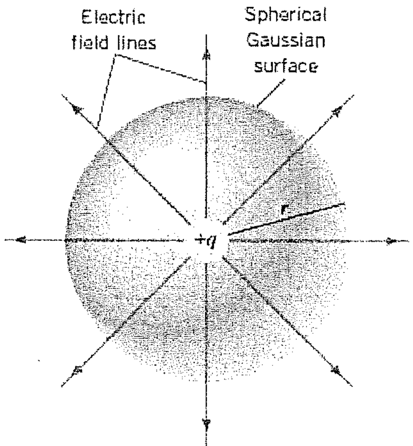
6/6

n-class problems, Thu Feb 27, 2020

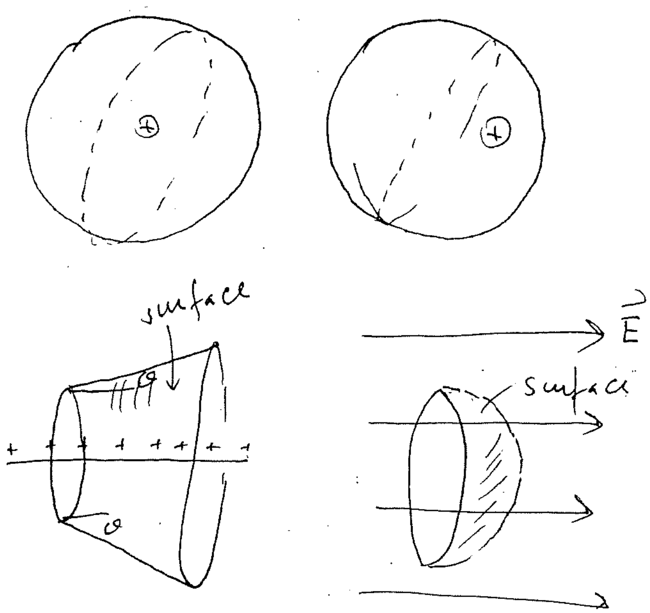
23.1 23.2 Electric flux, Gauss's law

1. Point charge $+q$ is at the center of a sphere of radius r.



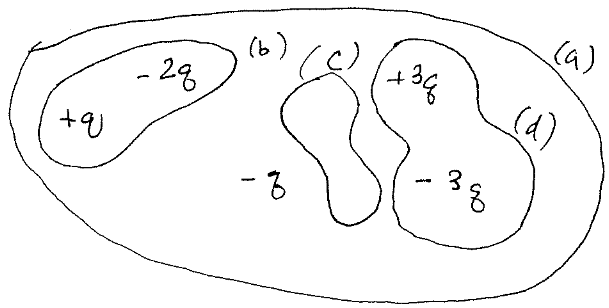
(a) Sketch four dA's and their vectors ($d\vec{A}$'s) on the surface (they're vectors, so include the arrowheads).
(b) Write down an expression for $\vec{E}$ for a point charge. Include the fact that its direction is $+\hat{r}$.
(c) Write down an expression for $d\vec{A}$. Its magnitude is dA. Add the appropriate unit vector to it.
(c) Calculate $\oint \vec{E} \cdot d\vec{A}$. (Don't use Gauss's law. Do the integral.)

2. Sometimes the integral $\int \vec{E} \cdot d\vec{A} = \int EA\cos\theta$ can be easily evaluated because E and/or θ doesn't depend on dA. That is, it's the same for every dA, and can be pulled out of the integral. For each of the following surfaces, identify whether E, θ, both, or neither is a constant with respect to the integral.

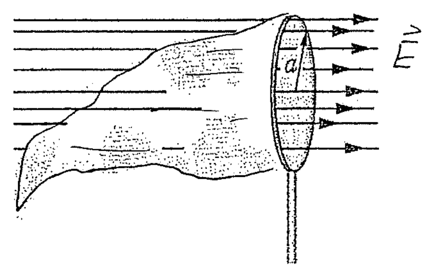


3. A sock comes out of the dryer with a trillion (10^{12}) excess electrons. Calculate the electric flux through a surface surrounding the sock. *(Wolfson 21-26)*

4. Calculate the net electric flux through the closed surfaces marked (a), (b), (c), and (d).



5. A butterfly net is in a uniform electric field of magnitude 3.0 N/C. The rim has a radius of 11cm. The net contains no net charge. Calculate the electric flux through just the netting. *(HRW 24-3)*



Due Mon Mar 2, 2020, beginning of class

23.4, 23.5, 23.6

Skim 23.4, 23.5, 23.6

1. (a) Sketch an infinite line charge and its electric field.
   (b) Write the equation for its $\vec{E}$
2. (a) Sketch sheet of charge and its electric field.
   (b) Write the equation for its $\vec{E}$
3. (a) Sketch a spherical shell of charge and its electric field.
   (b) Write the equation for $\vec{E}$ outside the shell; write $\vec{E}$ for inside the shell.
4. These sections use symmetry. Write a description (definition, or example) and give a sketch for each of the following:
   (a) rotational symmetry
   (b) translational symmetry
   (c) reflection symmetry.