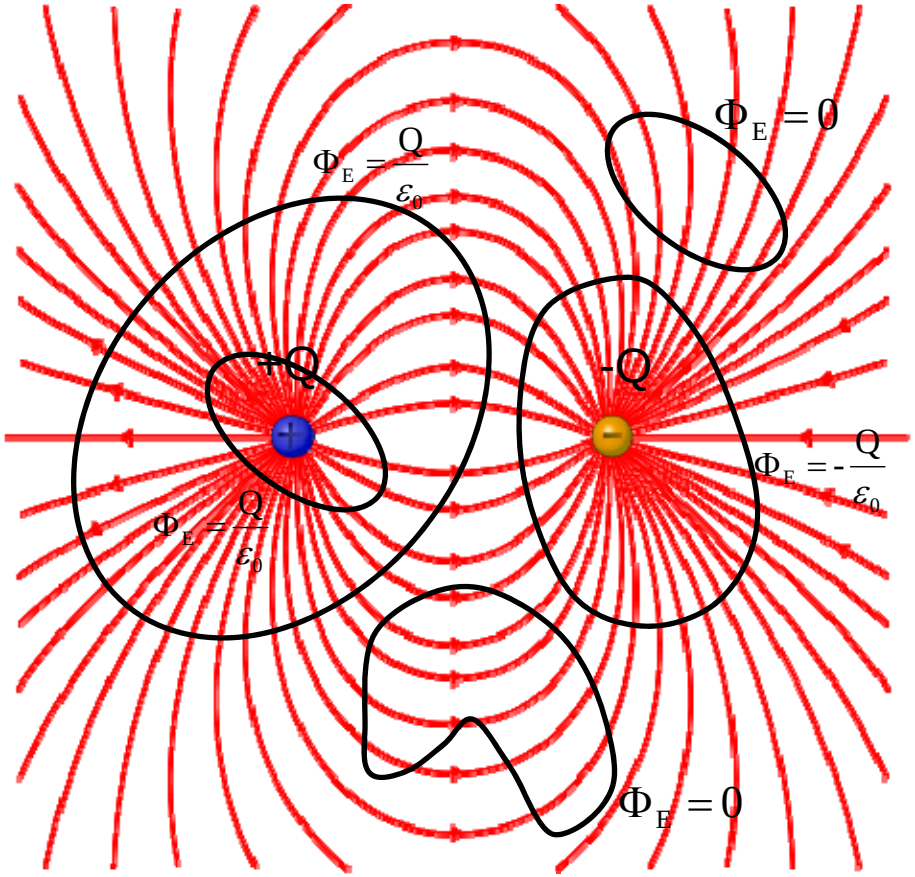
Test Next Wednesday (Sept 20)

1. Chapter 5 and 6.
2. 45 minutes sharp.
3. 4 multiple choices and 2 long problems.
4. Formula sheet provided.
5. Contact me before next Monday for prearrangement if you need special accommodation.

Gauss’s Law

Example


$\Phi_E = 0$
$\Phi_E = \frac{Q}{\varepsilon_0}$
+Q
-Q
$\Phi_E = -\frac{Q}{\varepsilon_0}$
$\Phi_E = \frac{Q}{\varepsilon_0}$
$\Phi_E = 0$

Class 9. Application of Gauss's Law I

Strategy

Step 1. Construct a Gaussian surface passing through the point you want to calculate the E field. Most likely the Gaussian surface is parallel to source charge distribution.

Step 2. For this method to work, the magnitude of the E field has to be constant on the Gaussian surface. Most likely the flux through the Gaussian surface is just Φ_E=EA, with E as the unknown. (If this is not the case, Gauss's Law is still correct, but this method just does not work.)

Step 3. Calculate the charge enclosed by the Gaussian surface, q_{in}.

Step 4. Now apply Gauss's Law:

$$\varepsilon_0 \Phi_E = q_{in} \Rightarrow \varepsilon_0 EA = q_{in}$$

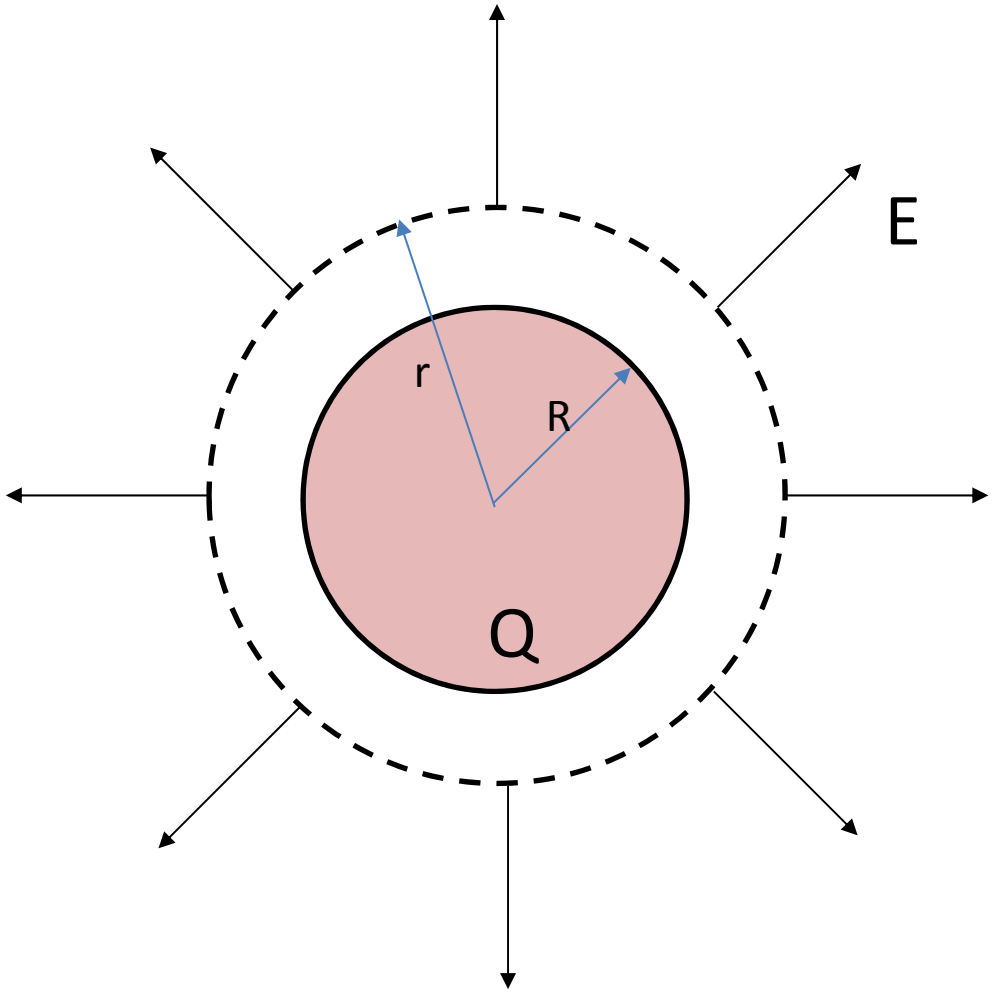
and E can be solved.

Application of Gauss's Law

Gauss's Law can be used to calculate electric field. Practically, there are three common cases in which Gauss's Law can be applied effectively for this purpose:

1) Uniform spherical distribution of source charges
2) Uniform cylindrical distribution of source charges
3) Uniform distribution of source charges in an infinite plane.

Uniform spherical distribution



For r>R

$$\varepsilon_0 \, \Phi_E = Q \;\Rightarrow\; \varepsilon_0 \cdot E \cdot 4\pi \, r^2 = Q$$

$$\Rightarrow\; E = \frac{Q}{4\pi\varepsilon_0 \, r^2}$$

Note that point charge belongs to this case.

For r<R

Depends on the actual charge distribution.