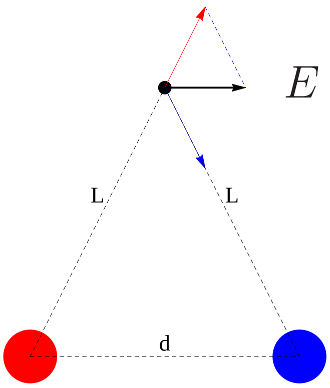
Fields And Gauss

I. Dipole. Generic:



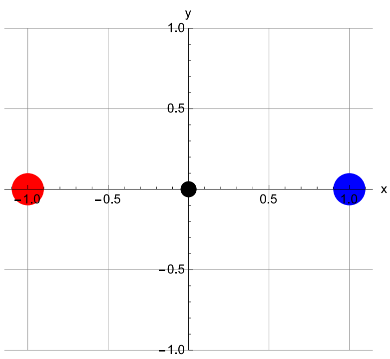
$$E = \frac{kqd}{L^3}$$

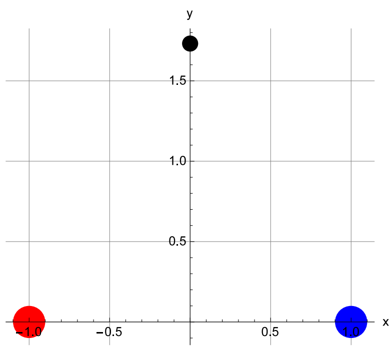
If charge Q at the observation point (black dot)

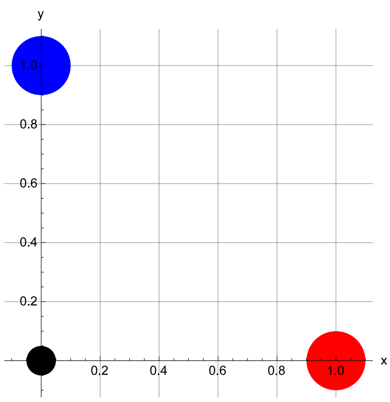
$$\vec{F} = Q\vec{E}$$

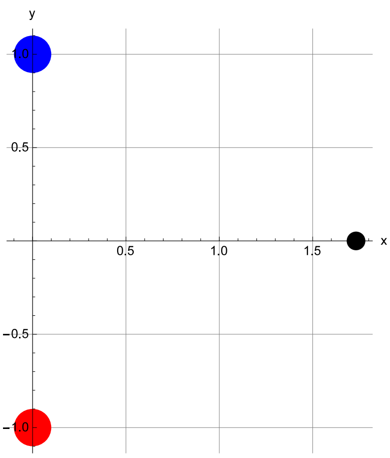
In all problems below $q = \pm 1\,\mu C$ (small red/blue circles) or $q = \pm 2\,\mu C$ (large red/blue), and $Q = 0.5\,\mu C$ (black dot). Distances are in mm.

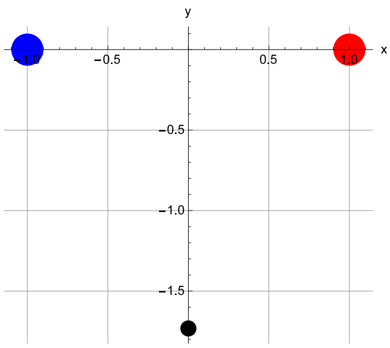
For all configurations:
a)) find the direction of the field at the black dot; show your work to instructor
b)clearly identify L and d in each picture and calculate the magnitude of the field
c) calculate the magnitude of the force on Q

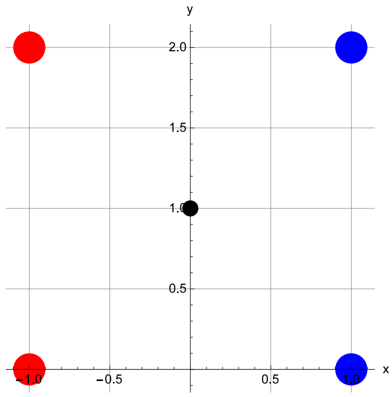


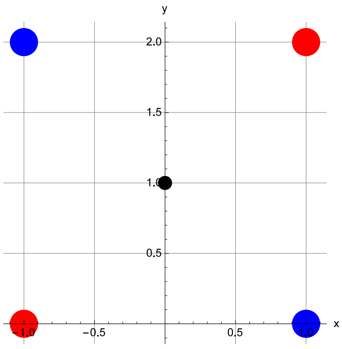


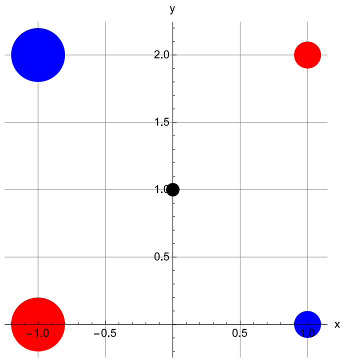


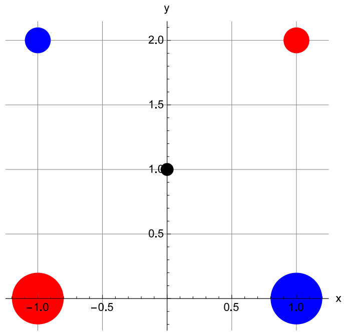












II. Zero points of field.

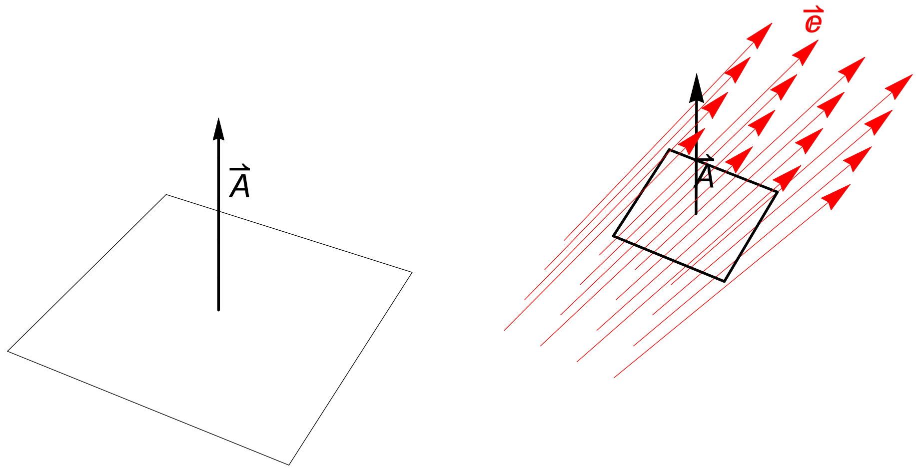
1. Charges $q = 1\,nC$ qnd $Q = -2\,nC$ are placed at $x = 0$ and $x = 3\,cm$. Identify the point with $E = 0$.

2. The same for $Q = +2\,nC$

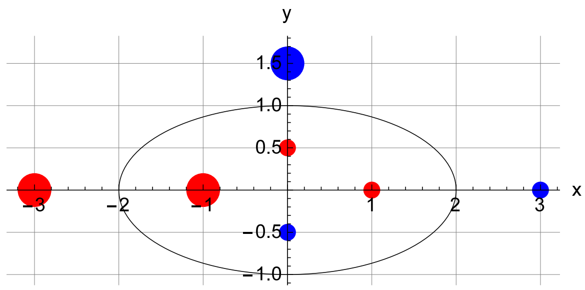
III. Gauss.

$$\Phi = q_{enc}/\epsilon_0$$

1. A square has a a side of $1\,cm$. The field $E = 10^5\,N/C$ makes an angle 30^o with the normal. Find $\Delta\Phi$.



2. Find Φ through an elliptiically shaped surface

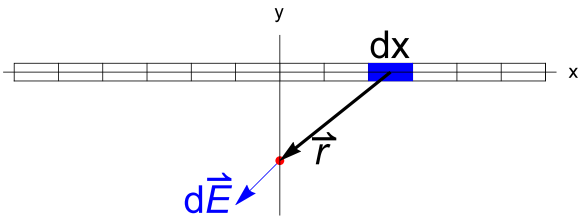


3. A metal sphere with $R = 2\,m$ has $Q = 1\,nC$.
a) find E for $r = 0.25\,m$

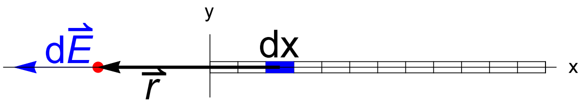
b) same for $r = 3\,m$.

IV. *Extra credit*

1. For $\lambda = 1\,\mu C/m$ find E at the red dot, at a distance $D = 1\,m$ away from an infinite line. (see lecture notes.)



2. The same, $D = 1\,m$ away from the end of a semi-infinite line:



$$dE = k\lambda\, dx/(D + x)^2$$