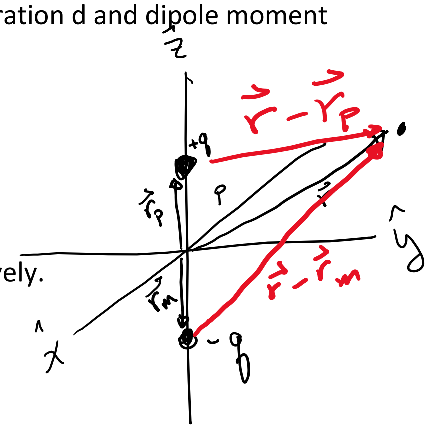
1) The potential at $\vec{r}$ due to a finite dipole (with point charge separation d and dipole moment qd) can be defined in Mathematica as follows,




```
rp = {0, 0, d / 2};
rm = {0, 0, -d / 2};
V[r_] := q / Sqrt[(r - rp).(r - rp)] - q / Sqrt[(r - rm).(r - rm)]
```

where $\overrightarrow{r_p}$ and $\overrightarrow{r_m}$ are the locations of charge q and $-q$, respectively.

a) Determine the $\vec{E}$-field in cartesian coordinates using Grad.
b) Transform the $\vec{E}$-field to spherical coordinates
c) Transform the $\vec{E}$-field to cylindrical coordinates

2) Solve the Possion equation for the region shown below (see RegionUnion[region1,region2]), where the charge density is a constant, $\rho = \frac{1}{4\pi}$. Implement the solution with periodic boundary conditions on the left and right edges of the rectangle (shown in red). The potential should vanish on the rest of the boundary.