COMPLEX ELECTRIC DIPOLES

Consider a set of charges, each of magnitude $q = 4\pi\varepsilon_0 d^2 E_0$.

a. Use Maple to plot the resulting electric fields in the region

$-10d < x < 10d$, $-10d < y < 10d$, $-10d < z < 10d$,

when the positions of the charges are as follows:

i. one charge $+q$ at $z = 0.9d$, $x = y = 0$

ii. like **i** plus another charge $-q$ at $z = -0.9d$, $x = y = 0$

iii. like **ii** plus another pair of charges $\pm q$ at $y = \pm 0.9d$, $x = z = 0$

iv. like **ii** plus another pair of charges:

$+q$ at $z = -0.9d$, $y = +0.6d$, $x = 0$

$-q$ at $z = +0.9d$, $y = +0.6d$, $x = 0$

b. For each case, multiply the resulting field by an appropriate power of $r = \sqrt{(x^2+y^2+z^2)}$ so that, at large r, the magnitude of the field vectors becomes independent of r. For each case, plot the modified field. Be sure to give the power of r.

c For each charge distribution, what is the direction and magnitude of the dipole moment $\boldsymbol{p}$?

Your solution to this exercise should include

- Maple output (eight 3-dimensional vector graphs)
- the input for each graph
- for each case **i -iv**, the dipole moment and the power law