

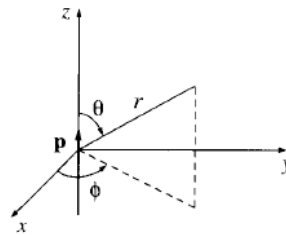
PHYSICS 507**4th HOMEWORK-Solutions****Prof. V. Lempesis****Hand in: Wednesday 28th of March 2020, time: 23:59**

1. The potential of the dipole shown in the figure at any point is given by (spherical coordinates):

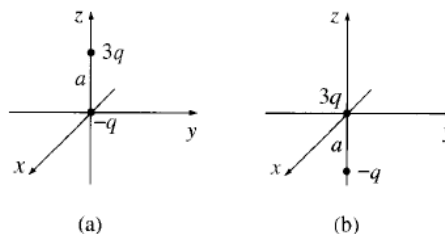
$$V_{dip} = \frac{\hat{\mathbf{r}} \cdot \mathbf{p}}{4\pi\epsilon_0 r^2} = \frac{p \cos \theta}{4\pi\epsilon_0 r^2}$$

Find the electric field (spherical coordinates).

(5 marks)



2. Two point charges, $3q$ and $-q$ by a distance a . For each of the arrangements shown in the figure find (i) the monopole moment, (ii) the dipole moment, and (iii) the approximate potential (in spherical coordinates) at large r (include both monopole and dipole contributions). (Hint: read carefully pages 149 and 150 of our textbook)



(10 marks)

3. Consider an electric charge q placed on the z -axis at $z=a$ as shown in figure. Express the potential at a point in terms of the spherical polar coordinates r and θ (consider $r > a$).

Hint: you will need the relation $(1 - 2xt + t^2)^{-1/2} = \sum_{n=0}^{\infty} P_n(x)t^n$ ($|t| < 1$). Where

$P_n(x)$ are the Legendre Polynomials.

(5 marks)