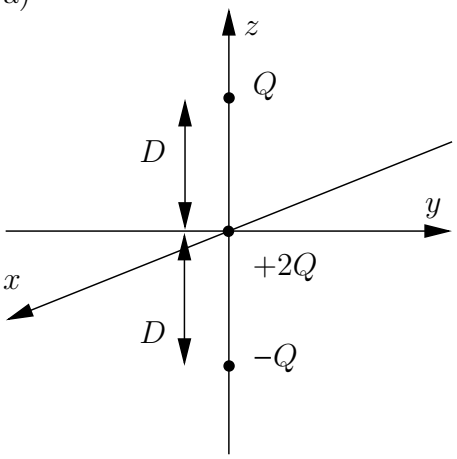
Exercises for Electromagnetic Field Theory I
(EFT I)
SS 2002

University of Kassel
Department of EE/CS
Electromagnetic Theory

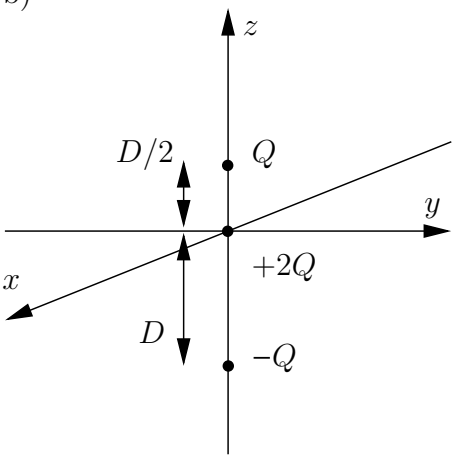
Sheet 4

Exercise 7
The picture shows two different distributions of three point charges.

a)



b)



a) Describe the electric charge density distribution mathematically.

b) Determine the dipole moment and the quadrupole moment of the distributions of point charges.

Exercise 8
Given are two point charges in vacuum with the distance a. The charge density is mathematically described by:

$$\varrho(\underline{\mathbf{R}}) = 2Q\delta(\underline{\mathbf{R}} - a\underline{\mathbf{e}}_x) - Q\delta(\underline{\mathbf{R}}).$$

a) Make a sketch of the electrical charge density distribution.

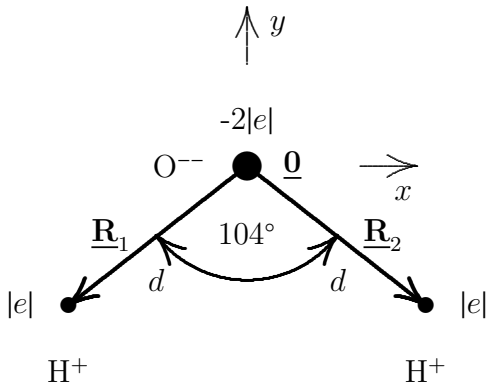
b) Determine the electrostatic potential in vacuum using the Coulomb integral

$$\Phi(\underline{\mathbf{R}}) = \frac{1}{4\pi\varepsilon_0} \iiint_{-\infty}^{+\infty} \frac{\varrho(\underline{\mathbf{R}}')}{|\underline{\mathbf{R}} - \underline{\mathbf{R}}'|} d^3\underline{\mathbf{R}}'.$$

c) Show that the äquipotential line with $\Phi = 0$ forms a circle in the xz plane with $y = 0$. Determine the parameters of the circle.

Exercise 9

A water molecule is called a *polarized molecule* because it holds a permanent electric dipole moment.
Determine the dipole moment of a water molecule (H_2O) using the charge distribution shown in the figure.



e is the elementary charge ($e = 1,602 \cdot 10^{-19}$C) and d the distance, with $d = 1$nm.
Sketch the dipole moment into the figure.