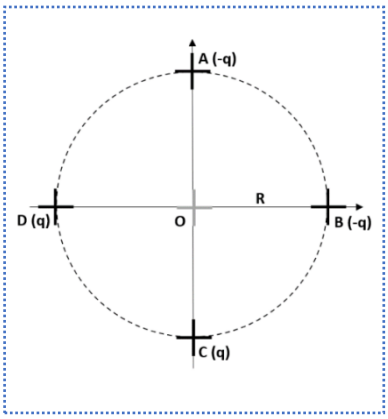
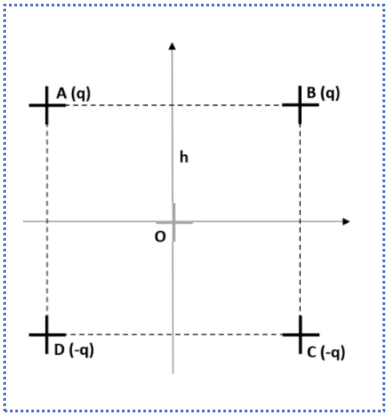
TD1: Electromagnetism

Discrete charge distributions

Exercise 1: Calculation of the electrostatic field created by a discrete charge distribution

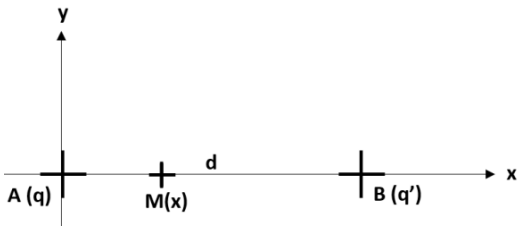




For each charge distribution above:

1. Draw the vectors of the fields created at point O by the charges of the distribution.
2. Calculate their vector form and their norm in terms of Coulomb's constant k, the charge q et the characteristic length for each geometry.
3. Calculate the total field at point O as well as its norm.
4. What would the force exerted on a charge Q, placed at point O, be? Give its norm.

Exercise 2: Electric field on an axis



We study the field created on the line AB by a charge q at point A and a charge q' at point B separated by a distance d. Assume a point M on this line at $x > 0$.

1. Draw the electric fields created by charges q and q' assuming that they are both positive.
2. Calculate the electric field created by charge q as function of k, q, and distance x.
3. Calculate the electric field created by charge q' as a function of k, q' and distances x and d. Discuss separately the cases $x < d$ and $x > d$.
4. Can the electrostatic field be zero? If yes, what must the signs of the two charges be? What must x be?

TD2: Electromagnetism

Electrostatic potential

Exercise 1: Potential

1. For the distributions in exercise 1 of TD1, calculate the potential at point O.
2. Calculate the energy of a charge Q added at point O. What is the physical explanation of your result when $qQ > 0$ and when $qQ < 0$?

Exercise 2: Zero potential

Can the electrostatic potential be zero in exercise 2 of TD1? Discuss separately the cases $0 < x < d$ and $|x| > d$.

Exercise 3: Calculation of electric field using the potential

The electrostatic potential at a point M(x, y, z) is $V(x, y, z) = 5x - 3x^2y + 2yz^2$. Calculate the electric field and its norm at point M.

Exercise 4: Calculation of electrostatic energy

Calculate the energy necessary to place the charges on the corners of the rectangle below.

