Problems 21.8,20,22 from MasteringPhysics with minor clarifications.

21.8 - Charged Aluminum Spheres

Two small aluminum spheres, each having mass $m = 0.0250$ kg, are separated by $l = 80.0$ cm.

Part A

How many electrons, N, does each sphere contain? (The atomic mass of aluminum is $M = 26.982$ g/mol, and its atomic number is 13.)

Part B

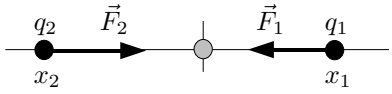
How many electrons would have to be removed from one sphere and added to the other to cause an attractive force between the spheres of magnitude $F = 1.00\times10^4$ N (roughly one ton)? Assume that the spheres may be treated as point charges.

Part C

What fraction of all the electrons in each sphere does this represent?

21.8 - Two Point Charges

Two point charges are placed on the x-axis as follows: one positive charge, q_1, is located to the right of the origin at x=x_1, and a second positive charge, q_2, is located to the left of the origin at x=x_2.



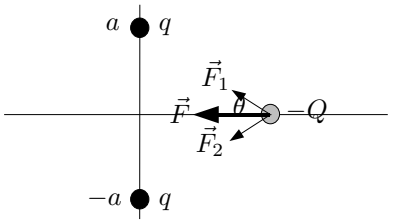
Part A

What is the total force (magnitude and direction) exerted by these two charges on a negative point charge, q_3, that is placed at the origin?

Use ϵ_0 for the permittivity of free space. Take positive forces to be along the positive x-axis. Do not use unit vectors.

21.22 - Two Point Charges

Two positive point charges q are placed on the y-axis at y=a and y=$-a$. A negative point charge $-Q$ is located at some point on the $+x$-axis.



Part A

Find the x-component of the net force that the two positive charges exert on $-Q$. (Your answer should only involve k, q, Q, a, and the coordinate x of the third charge.)

Part B

Find the y-component of the net force that the two positive charges exert on $-Q$. (Your answer should only involve k, q, Q, a, and the coordinate x of the third charge.)

Part C

What is the net force on the charge $-Q$ when it is at the origin (x=0)?