## Practice Problem Set 3

#1. *A dipole and a charge*

A dipole with charges $\pm q$ and separation $2a$ is located a distance x from a point charge Q, oriented as shown in Figure 20.32 of the textbook (reproduced here for convenience). For both a) and b), consider the $x \gg a$ limit.

a) What is the net torque (magnitude and direction) on the dipole?

b) What is the net force (magnitude and direction) on the dipole?

c) Does the previous answer surprise you? How could you have you have predicted it based on results from the chapter?
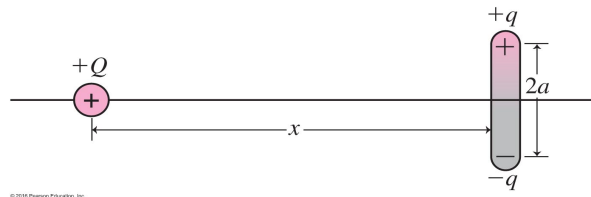
#2. *A Charged Cross, or Practice With Integrals*

a) Consider a thin rod of length $2a$ placed along the x axis and centered at the origin (see Figure 1). Considering the rod has a uniformly distributed charge q (where $q > 0$), find the electric field at the point P at a distance x from the origin on the positive side of the x axis (assume $x > a$). Does your result agree with your expectations in the $x \gg a$ limit?

b) Consider a thin rod, also of length $2a$, placed along the y axis and centered at the origin (see Figure 2). The rod has a uniformly distributed charge $-q$ (where $q > 0$). Find the electric field at the point P at a distance x from the origin on the positive side of the x axis. Does your result agree with your expectations in the $x \gg a$ limit?

c) Now, suppose these two metal rods are positioned as shown in Figure 3 (assume no charge is exchanged), with the negatively charged rod placed horizontally. What is the field at the point P at a distance x from the origin, on the positive side of the x axis?
Try taking the $x \gg a$ limit. In this limit, with what power of x does the electric field decay? Is this behaviour reminiscent of a specific charge distribution?
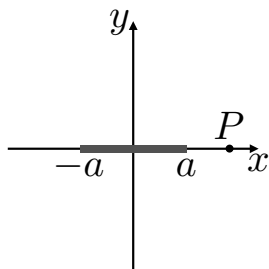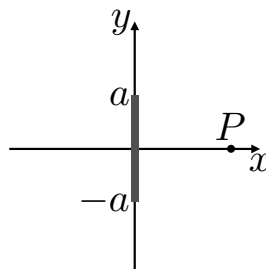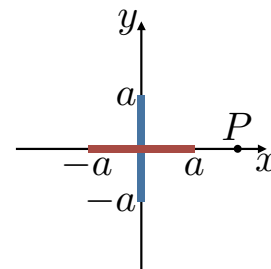

Figure 1   Figure 2   Figure 3