Keystone - Chapter 18: A Microscopic View of Electric Circuits

Two circuits are assembled using 1.5-volt batteries, thick copper connecting wires, and long bulbs. Bulbs A, B, and C are identical long bulbs. Compasses are placed under the wires at the indicated locations.



Figure 1: Two circuits containing long bulbs

(a) On sketches of the circuits, draw the directions the compass needles will point, and indicate the approximate magnitude of the compass deflections in degrees. Note that the deflection is given at one location. If you do not have enough information to give a number, then indicate whether it will be greater than, less than, or equal to 5 degrees. (Assume that the compasses are adequately far away from the steel-jacketed batteries.)

(b) Briefly explain your reasoning about the magnitudes of the compass deflections.

(c) On the same sketches of the circuits, show very approximately the distribution of surface charge.

(d) The tungsten filament in each of the bulbs is 4 mm long with a radius of  $6 \times 10^{-6}$  meter. Calculate the electric field inside each of the three bulbs,  $E_A$ ,  $E_B$ , and  $E_C$ .

This problem is 18.P.54, Two circuits containing long bulbs, from M&I vol 2, second edition.