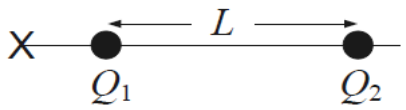
Homework #6

1- As shown in the figure (not drawn to scale), two charges Q_1 and Q_2 are held in place a distance L = 2 cm apart. When another charge is placed at point X, located 1.65 cm, 2.32 cm, and 0.79 cm to the left of Q_1, it is found to be in equilibrium. If Q_1 = 5 μC, what is Q_2?

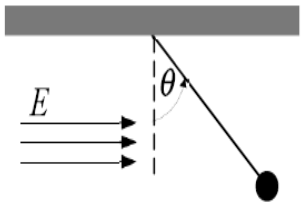


Answer: -24.5 μC, -17.3 μC, -62.4 μC

2- Two identical conducting spheres A and B carry charges 2Q and 3Q respectively. They are separated by a constant distance much larger than their diameters. A third identical conducting sphere C is uncharged. Sphere C is first touched to A, then to B and finally removed. As a result, the magnitude of the electrostatic force between A and B, initially F, becomes

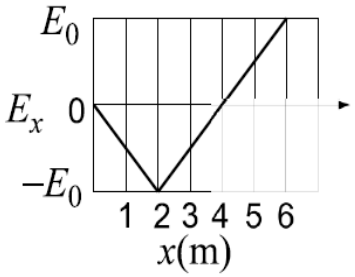
Answer: F/3

3- In the figure, a small charged ball of mass 4.0 g hangs from a support and makes an angle 35°,48°, 68° with the vertical under the influence of gravity and a horizontal electric field of magni- magnitude E = 2000 V/m. What is the charge on the ball?



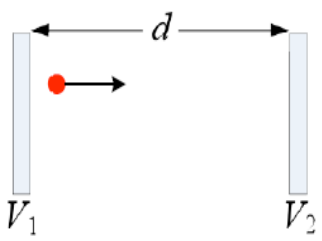
Answer: 13.7 μC, 21.8 μC, 48.5 μC

4- A graph of the x component of the electric field as a function of x in a region of space is shown in the figure. The scale of the vertical axis is E_0 = 20, 10, 10 V/m. The y and z components of the electric field are zero in this region. If the electric potential at the origin is 10, 30, 10 V, what is the electric potential (in V) at x = 6 m?



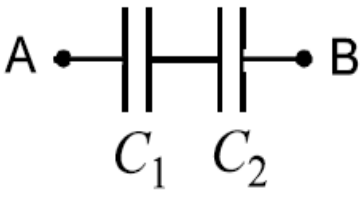
Answer: +30 V, +40 V, +20 V

5- A proton is moving rightward between two parallel charged plates separated by distance d = 1 cm as shown in the figure. The plate potentials are V_1 = 13 V and V_2 = 10 V. If the initial speed of the proton at the left plate is 32 km/s (10 km/s, 18 km/s), what is the speed of the proton just as it reaches plate 2?



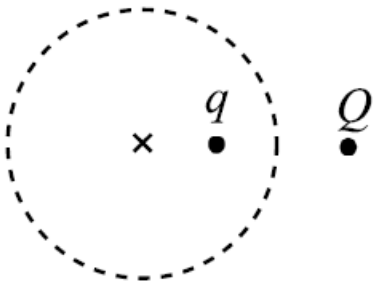
Answer: 40 km/s, 26 km/s, 30 km/s

6- Capacitors C_1 = 1 F, 2 F, 4 F and C_2 = 2 F, 3 F, 6 F are connected as shown in the figure. If the voltage difference between A and B is 3 V, how much energy is stored in the capacitors?



Answer: 3 J, 6 J, 9 J

7- As shown in the figure, point charges q = 5 C, 4 C, 7 C and Q = -2 C, -1 C, -4 C are separated by a distance of 2, 4, 6 m. Consider a spherical Gaussian surface of radius 2 m, 4 m, 6 m, whose center is 1 m, 2 m, 3 m to the left of charge q, as shown by the circle. What is the amount of electric flux (in Nm^2/C) through that surface?

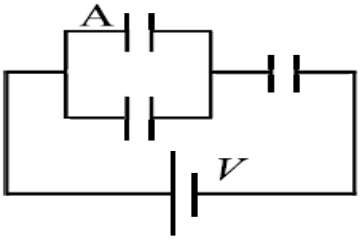


Answer: 5.65×10^{11}, 4.52×10^{11}, 7.91×10^{11}

8- A point charge is held at the center of a conducting spherical shell, whose inner and outer radii are 3 m, 2 m, 6 m, 5 m, 3 m, 8 m (see figure). The electric fields at the inner and outer sur-faces of the shell are 8×10^3, 3×10^4 , 1.5×10^3 V/m and 1×10^4 , 7×10^4, 2×10^3 V/m, respectively. What is the net charge on the shell?

Answer: 19.8 μC, 56.7 μC, 8.2 μC

9- In the figure at right, all the capacitors have the value of 1 μF, 2 μF, 4 μF, and the voltage of the battery is 1.5 V, 3 V, 6 V. What is the charge on the capacitor marked A?



Answer: 0.5 μC, 2.0 μC, 8.0 μC