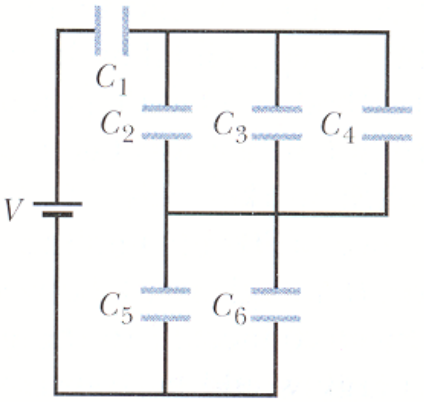
Review Problems for Celebration 1

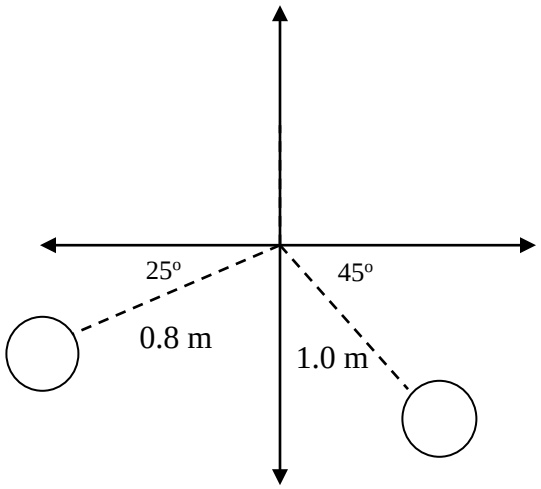
Problem 1

In the figure below, V = 12 V, $C_1 = C_5 = C_6 = 6.0\ \mu F$ and $C_2 = C_3 = C_4 = 4.0\ \mu F$. What are the charge stored on and the voltage across each capacitor?



Problem 2

The two charged spheres shown in the figure below each have mass m = 1.0 kg, radius r = 12.5 cm, and surface charge density $\sigma = 15\ nC/m^2$. What is the magnitude and direction of the force on a proton placed at the origin?



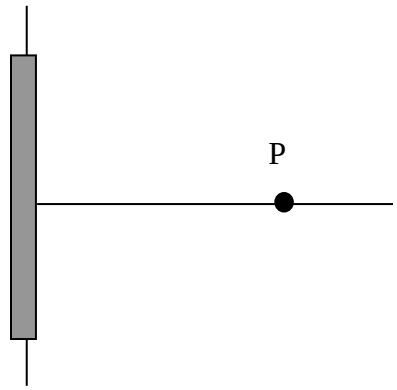
Problem 3

Charge is distributed uniformly throughout the volume of a very long solid nonconducting cylinder of radius R and uniform volume charge density ρ. Using Gauss' law, derive an expression for the electric field a distance r from the axis of the cylinder for points **(a)** inside the cylinder, and **(b)** outside the cylinder. Express your answers in terms ρ, r, and R.

(**Note**: you must start with Gauss's law and show all work to get credit)

Problem 4

Calculate the electric potential **and** the electric field at point P (4.0 m, 0 m) due to a continuous line of uniform charge density $\lambda = 2.5\ \mu C/m$, extending from (0 m, 3.0 m) to (0 m, -3.0 m) along the y-axis as shown below.



Problem 5

Charge is placed on two conducting spheres that are very far apart and connected by a long thin wire as shown in the figure below. The radius of the smaller sphere is 5.0 cm and the radius of the larger sphere is 12 cm. The electric field at the surface of the larger sphere is 200 kV/m. Find the surface charge density σ on each sphere.