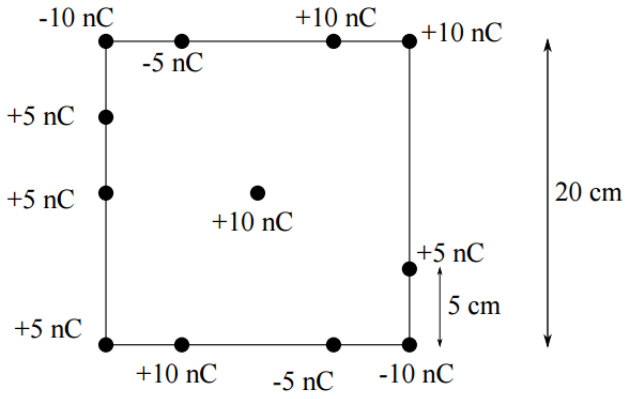
PHY 152 Practice Problem Set 2

1. As shown in the figure below, a central particle of charge +10 nC is surrounded by a square array of charged particles, separated by 5 cm, 10 cm, or 15 cm along the perimeter of the square. Each side of the square is 20 cm. What is the net electric force on the central particle?



2. (a) A negative charge $-q$ lies midway between two positive charges $+Q$. What must Q be such that the electric force on all three charges is zero? (b) Three identical charges q form an equilateral triangle of side a, with two charges on the x-axis and one on the positive y-axis. Find an expression for the electric field at points on the y-axis above the uppermost charge. Show that your result reduces to the field of a point charge $3q$ for $y \gg a$.

3. Two balloons A and B of radius r are filled with He gas of density ρ_{He}, while the air outside has density ρ_{air}. The balloons are made with rubber so that they can be charged by rubbing against hair. They are held together with insulating strings of length L and negligible mass. Treating each balloon as point charge Q, find an expression for the angle θ at equilibrium. You can assume that θ is small. (Hint: Why do the balloons float? When there is only one balloon, what is the equilibrium configuration? What happens if you try to tilt it from equilibrium?)