ÇANKAYA UNIVERSITY

PHYS 132 – PHYSICS II

CHAPTER 21

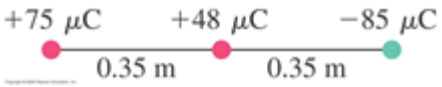
ELECTRIC CHARGE

PROBLEM SET

1) Two charged spheres are 8.45 cm apart. They are moved, and the force on each of them is found to have been tripled. How far apart are they now? **[Answer: 4,88 cm]**

2) Calculate the electric force holding the electron in orbit ($r = 0.53 \times 10^{-10} m$) around the proton nucleus of the hydrogen atom. **[Answer: $\mathbf{8.2 \times 10^{-8}}$ N]**

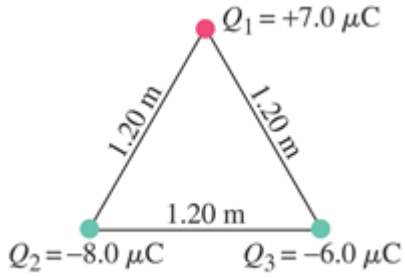
3) ***Particles of charge +75, +48, and -85 μC are placed in a line (Fig. 21–52). The center one is 0.35 m from each of the others. Calculate the net force on each charge due to the other two. **[Answer: $\vec{F}_{+75} = -150\ N\ \hat{\imath}$, $\vec{F}_{+48} = 560\ N\ \hat{\imath}$, $\vec{F}_{-85} = -420\ N\ \hat{\imath}$]**



4) Two positive point charges are a fixed distance apart. The sum of their charges is Q_T? What charge must each have in order to (*a*) maximize the electric force between them, and (*b*) minimize it? **[Answer: a) $q_1 = q_2 = Q_T/2$, b) $q_1 = 0, q_2 = Q_T$]**

5) Three charged particles are placed at the corners of an equilateral triangle of side 1.20 m (Fig. 21–53). The charges are +7.0 μC, -8.0 μC and -6.0 μC. Calculate the magnitude and direction of the net force on each due to the other two.

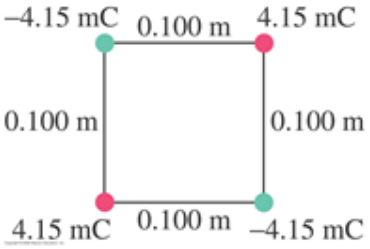
[Ans:$F_1 = 0.53\ N, \theta_1 = 265^0; F_2 = 0.33\ N, \theta_2 = 112^0; F_3 = 0.26\ N, \theta_3 = 53^0$]



6) ***Two small nonconducting spheres have a total charge of 90.0 μC. (a) When placed 1.16 m apart, the force each exerts on the other is 12.0 N and is repulsive. What is the charge on each? (b) What if the force were attractive?

[Answer: a) $60.1 \times 10^{-6}\ C$, $29.9 \times 10^{-6}\ C$, b) $106.8 \times 10^{-6}\ C$, $-16.8 \times 10^{-6}\ C$]

7) Two negative and two positive point charges (magnitude Q = 4.15 mC) are placed on opposite corners of a square as shown in Fig. 21–54. Determine the magnitude and direction of the force on each charge.**[Answer: $1.42 \times 10^7\ N, \theta = 225^0$ from the *x*-direction, or exactly towards the center of the square.]**



8) ***A charge Q is transferred from an initially uncharged plastic ball to an identical ball 12 cm away. The force of attraction is then 17 mN. How many electrons were transferred from one ball to the other? **[Answer: 1.0×10^{12} *electrons*]**

9) Two charges, $-Q_0$ and $-4Q_0$, are a distance $\boldsymbol{l}$ apart. These two charges are free to move but do not because there is a third charge nearby. What must be the magnitude of the third charge and its placement in order for the first two to be in equilibrium?

[Answer: magnitude = $\frac{4}{9}Q_0$, and distance = $\frac{1}{3}l$ from $-Q_0$ towards $-4Q_0$]

10) Two small charged spheres hang from cords of equal length $\boldsymbol{l}$ as shown in Fig. 21–55 and make small angles $\boldsymbol{\theta_1}$ and $\boldsymbol{\theta_2}$ with the vertical. (a) If $Q_1 = Q$, $Q_2 = 2Q$, and $m_1 = m_2 = m$, determine the ratio $\boldsymbol{\theta_1/\theta_2}$. (b) If $Q_1 = Q$, $Q_2 = 2Q$, $m_1 = m$ and $m_2 = 2m$ determine the ratio $\boldsymbol{\theta_1/\theta_2}$ (c) Estimate the distance between the spheres for each case. **(Hint: Use small angle approximation)**

[Answer: a) $\frac{\theta_1}{\theta_2} = 1$, b) $\frac{\theta_1}{\theta_2} = 2$, c) $d = \frac{(4lkQ^2)^{1/3}}{mg}$, $d = \frac{(3lkQ^2)^{1/3}}{mg}$]