King Abdulaziz University	Faculty of Science	Department of Physics
PHYSICS 202: CA	Summer term 2010	Quiz#1

Solution

Q1 [3 MARKS]: A charge q is located 4 cm from another charge of -5 nC. If the repulsive force created between these charges is 2.25×10^{-4} N, what is q?

It is well known that the magnitude of the electrostatic force is

$$F = \frac{k\,q_1\,q_2}{r^2}$$

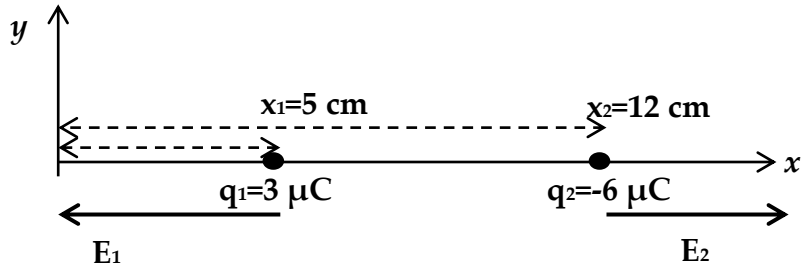
Therefore

$$q_2 = \frac{F\,r^2}{k\,q_1} = \frac{2.25\times10^{-4}\times0.04^2}{9.0\times10^{9}\times5.0\times10^{-9}} = 8.0\times10^{-9}\ \text{C}$$

Since the electrostatic force is *repulsive*, both charges have the *same sign*. Hence the unknown charge is

$$q_2 = -8.0\times10^{-9}\ \text{C}$$

Q2 [4+3 MARKS]: Two point charges are located on the x-axis as following: q_1=3 μC at x=5 cm and q_2=-6 μC at x=12 cm.
(1) Calculate the magnitude and direction of the electric field at the origin x=0.
(2) If a charge Q=-2 nC is placed now at the origin, calculate the magnitude and direction of the force acting on this charge [Hint: use the result obtained in (1)].



(1) The electric field due to charge 1 is along the *negative x-axis* and equals

$$E_1 = \frac{k\,q_1}{r_1^2} = \frac{9.0\times10^{9}\times3.0\times10^{-6}}{0.05^2} = 10.8\times10^{6}\text{N/C}$$

The electric field due to charge 2 is along the *positive x-axis* and equals

$$E_2 = \frac{k\,q_2}{r_2^2} = \frac{9.0\times10^{9}\times6.0\times10^{-6}}{0.12^2} = 3.75\times10^{6}\text{N/C}$$

Hence the resultant electric field is

$$E = E_2 - E_1 = 3.75\times10^{6} - 10.8\times10^{6} = -7.05\times10^{6}\text{N/C}$$

The *minus* sign indicates that the resultant electric field directs along the *negative x-axis*.

(2) The magnitude of the electric force is

$$F = QE = 2.0\times10^{-9}\times7.05\times10^{6} = 0.0141\ \text{N}$$

Since the charge Q is *negative*, the force will oppose the electric field. Therefore the direction of the force is along the *positive x-axis*.