SRM UNIVERSITY – AP, AMARAVATI

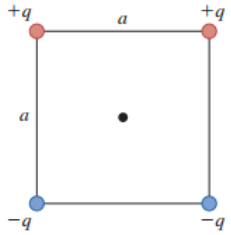
DEPARTMENT OF PHYSICS

Course - Introduction to Electricity and Magnetism

Assignment – 3

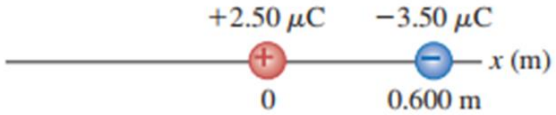
Submission date – 29/01/2019 (16:30 hours)

1. Three equal charges of 200 nC are placed in free space at (0, 0, 0); (2, 0, 0) and (0, 2, 0). Determine the total force acting on a charge of 500 nC at (2, 2, 2). **[Answer $304.6\ (\hat{\imath}+\hat{\jmath})\ \mu N$]**
2. Two small plastic spheres are given positive electrical charges. When they are 15.0 cm apart, the repulsive force between them has magnitude 0.220 N. What is the charge on each sphere
   (a) if both the two sphere have equal charges? **[Answer $0.74\ \mu C$]**
   (b) if one sphere has four times the charge of the other ? **[Answer $0.37\ \mu C$ and $1.5\ \mu C$]**
3. Two point charges are located on the *y-axis* as follows: charge at $q_1 = -1.5$ nC at y $= -0.6$ m and charge $q_2 = +3.2$ nC at the origin (y $= 0$ m). What is the total force (magnitude and direction) exerted by these two charges on a third charge $q_3 = +5$ nC located at y $= -0.4$ m?
   [Answer$2.58\ (-\hat{\jmath})\ \mu N$]
4. Two point charges of 20 nC and -20 nC are situated at (1, 0, 0) and (0, 1, 0) in free space. Determine the electric field intensity ($\vec{E}$) at (0, 0, 1). **[Answer $63.67\ (-\hat{\imath}+\hat{\jmath})\ V/\mathrm{m}$]**
5. A point charge is placed at each corner of a square with side length ***a***. The charges all have the same magnitude ***q***. Two of the charges are *positive* and two are *negative*, as shown in *Figure*. What is the direction of the net electric field at the center of the square due to the four charges?



Answer $\vec{E} = \frac{1}{\pi\epsilon_0}\frac{\sqrt{2}q}{a^2}(-\hat{\jmath})$

6. Two charges, one of +2.50 μC and the other of -3.50 μC are placed on the *x-axis*, one at the origin and the other at 0.600 m as shown in Figure. Find the position on the *x-axis* where the net force on a small charge +*q* would be zero. **[Answer $(-3.3\ m,\ 0)$]**



7. A semi-infinite rod extended from $-\infty$ to 0, along the *z-axis* carries a uniform charge distribution of 100 nC/m. Find the electric field intensity ($\vec{E}$) at point P (0, 0, 2). Calculate force acting on 10 μC charge at P. [Answer $450\ (\hat{k})\ V/\mathrm{m},\ \ 4500\ (\hat{k})\ \mu N$]
8. A thin annular disc of inner radius ***a*** and outer radius ***b*** carries a uniform surface charge density σ_s. Prove that the electric field intensity at any point on the axis ($z \geq 0$) of the disc is $\vec{E} = \frac{\sigma_s z}{2\epsilon_0}\left\{\frac{1}{\sqrt{a^2+z^2}} - \frac{1}{\sqrt{b^2+z^2}}\right\}(\hat{k})$. Compute the electric field intensity for (*i*) $b \to \infty$ i.e. very large outer radius, (*ii*) $a = 0$, i.e. solid finite disc of radius *b*; (*iii*) both $a = 0\ and\ b \to \infty$, i.e. infinite plane.