Quiz #4 Ch21&22

Name: Solution ID#: Sec#:

Q1 Three charges (q1=q2= –2.5 μC and Q), are located at equal distance d from the origin, as shown in Figure. If the resultant electric field at Point P due to the three charges is zero, what are the magnitude and sign of charge Q?

2d2

E2

E1

P

d

d

d

d

y

x

q2

q1

Q

EQ

$$\left|q\_{1}\right|=\left|q\_{2}\right|=q$$

$$\vec{E}\_{p}=\vec{E}\_{1}+\vec{E}\_{2}+\vec{E}\_{Q}=0$$

$$\frac{kq}{2d^{2}}cos⁡(45)+\frac{kq}{2d^{2}}cos⁡(45)+\frac{kQ}{4d^{2}}=0$$

$$q\sqrt{2}+\frac{Q}{4}=0$$

$$Q=4\sqrt{2} q=4\sqrt{2} ×2.5 μC =14 μC$$

Q2 An electric dipole with dipole moment $\vec{P}\_{i}=(3.5\hat{i}+5.0\hat{j}) ×10^{-30} C.m$ is in an electric field $\vec{E}=4000\hat{i} {N}/{C}$ . If an external agent turns the dipole until its electric dipole moment is$ \vec{P}\_{f}=(-5.0\hat{i}+3.5\hat{j} )×10^{-30} C.m$, how much work the external agent does.

$$U=\left(-\vec{P}∙\vec{E}\right)$$

$$W=∆U=U\_{f}-U\_{i}=\left(-\vec{P}\_{f}∙\vec{E}\right)-\left(-\vec{P}\_{i}∙\vec{E}\right)=\left(\vec{P}\_{i}-\vec{P}\_{f}\right).\vec{E}$$

 $=\left[\left(3.5+5.0\right)\hat{i}+\left(5-3.5\right)\hat{j} \right]×10^{-30} .( 4000\hat{i})$

 $=\left[\left(8.5\right)\hat{i}+\left(1.5\right)\hat{j} \right]×10^{-30} .( 4000\hat{i})$

 $=8.5×10^{-30} × 4000$

 $=3.4×10^{-26} J$