

 

 **PHYSICS 132**

**Homework # 1**   **2nd. Semester 2015-16**

**NAME: STUDENT ID#:**

1- An electric dipole with dipole moment

 **P** = (3.00**i**+4.00**j**) (1.25×10-3C.m)

Is in an electric field **E** = (6000 N/C)**i**.

1. what is the potential energy of the electric dipole?

$$U=-\vec{p}.\vec{E}=-\left(3.75×10^{-3}\hat{i}+5×10^{-3}\hat{j}\right).\left(6×10^{3}\hat{i}\right)=-\left(3.75×10^{-3}\right)\*\left(6×10^{3}\right)=-22.5 J $$

1. what is the torque acting on it ?

$$\vec{τ}=\vec{p}×\vec{E}=\left|\begin{matrix}\hat{i}&\hat{j}&\hat{k}\\3.75×10^{-3}&5×10^{-3}&0\\6×10^{3}&0&0\end{matrix}\right|$$

$$\vec{τ}=\left|\begin{matrix}5×10^{-3}&0\\0&0\end{matrix}\right|\hat{i}-\left|\begin{matrix}3.75×10^{-3}&0\\6×10^{3}&0\end{matrix}\right|\hat{j}+\left|\begin{matrix}3.75×10^{-3}&5×10^{-3}\\6×10^{3}&0\end{matrix}\right|\hat{k}$$

$$\vec{τ}=\left(0\right)\hat{i}-\left(0\right)\hat{j}+\left(0-30\right)\hat{k}$$

$$\vec{τ}=-30\hat{k} N.m$$

c) If an external agent turns the dipole until its electric dipole moment is

 **P** = (-4.00**i** +3.00**j**) (1.25×10-3C.m)

How much work is done by the agent?

$$W\_{external}=∆U=U\_{f}-U\_{i}$$

from part (a)

$$U\_{i}=-\vec{p\_{i}}.\vec{E}=-22.5 J$$

and

$$U\_{f}=-\vec{p\_{f}}.\vec{E}=-\left(-5×10^{-3}\hat{i}+3.75×10^{-3}\hat{j}\right).\left(6×10^{3}\hat{i}\right)=\left(5×10^{-3}\right)\*\left(6×10^{3}\right)=30 J $$

Thus,

$$W\_{external}=∆U=U\_{f}-U\_{i}=30-\left(-22.5\right)=52.5 J$$