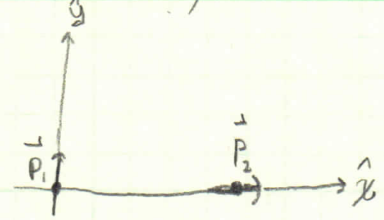
4.5 / 4.29 | Kimble, Zachary | EM Griffiths | 09/13/18 | 1/

4.5



$$\vec{P}_1 = P_{1y}\,\hat{y}$$
$$\vec{P}_2 = P_{2x}\,\hat{x}$$

$$E_1(r\hat{x}) = \frac{1}{4\pi\varepsilon_0}\frac{1}{r^3}\left[3(\vec{p}_1\cdot\hat{x})\hat{x} - \vec{p}_1\right] = \frac{1}{4\pi\varepsilon_0}\frac{1}{r_3}\left(-P_{1y}\,\hat{y}\right) = \frac{-P_{1y}}{4\pi\varepsilon_0 r^3}\,\hat{y}$$

$$\vec{E}_2(-r\hat{x}) = \frac{1}{4\pi\varepsilon_0}\frac{1}{r^3}\left[3(\vec{P}_2\cdot(-\hat{x}))(-\hat{x}) - \vec{P}_2\right] = \frac{1}{4\pi\varepsilon_0}\frac{1}{r^3}\left[2P_{2x}\hat{x}\right] = \frac{2P_{2x}}{4\pi\varepsilon_0 r^3}\,\hat{x}$$

$$\vec{N}_1 = \vec{P}_1\times\vec{E}_2 = \frac{2P_{2x}P_{1y}}{4\pi\varepsilon_0 r^3}(\hat{y}\times\hat{x}) = -\frac{2P_{2x}P_{1y}}{4\pi\varepsilon_0 r^3}\,\hat{z}$$

$$\vec{N}_2 = \vec{P}_2\times\vec{E}_1 = \frac{-P_{2x}P_{1y}}{4\pi\varepsilon_0 r^3}(\hat{x}\times\hat{y}) = \frac{P_{2x}P_{1y}}{4\pi\varepsilon_0 r^3}\,\hat{z} = -2\vec{N}_1$$

4.29

a) $\vec{F}_1 = (\vec{P}_1\cdot\vec{\nabla})\vec{E}_2 = P_{1y}\frac{\partial}{\partial y}\vec{E}_2$

$\vec{F}_2 = (\vec{P}_2\cdot\vec{\nabla})\vec{E}_1 = P_{2x}\frac{\partial}{\partial x}\vec{E}_1$

$$E_1(r\hat{r}) = \frac{1}{4\pi\varepsilon_0}\frac{1}{r^3}\left[3(\vec{p}_1\cdot\hat{r})\hat{r} - \vec{p}\right];\quad \hat{r} = \sin\theta\cos\phi\,\hat{x} + \sin\theta\sin\phi\,\hat{y} + \cos\theta\,\hat{z}$$

$$E_1 = \frac{1}{4\pi\varepsilon_0 r^3}\left[3P_{1y}\sin\theta\sin\phi\,\hat{r} - P_{1y}\,\hat{y}\right]$$