P3323 quiz5-1
September 19, 2016

1. A neutral sphere is uniformly polarized with polarization $\mathbf{P} = P\hat{\mathbf{z}}$ What is potential at $r > R$ where R is the radius of the sphere? The dipole moment of the sphere is $\mathbf{p} = \mathbf{P}\frac{4}{3}\pi R^3$.

   A) zero

   B)

   $$V(r,\theta) = (\frac{4}{3}\pi R^3 P)\frac{\cos\theta}{4\pi\epsilon_0 r^2}$$

   C)

   $$V(r,\theta) = (\frac{4}{3}\pi R^3 P)\frac{r\cos\theta}{4\pi\epsilon_0 R^3}$$

   D)

   $$V(r,\theta) = \frac{P}{4\pi\epsilon_0}\frac{1}{r}$$

2. The electric field inside a neutral, and uniformly polarized sphere with polarization $\mathbf{P} = P\hat{\mathbf{z}}$ is

   A) zero

   B)

   $$\mathbf{E} = \frac{\mathbf{P}r}{\epsilon_0 R}$$

   C)

   $$\mathbf{E} = -\frac{\mathbf{P}}{3\epsilon_0}$$

   D) None of the above

3. What is the dipole moment of a single charge q located at $\mathbf{r} = \mathbf{a}$?

A) zero

B)

$\mathbf{p} = -q\mathbf{a}$

C)

$\mathbf{p} = q\mathbf{a}$

D)

$\mathbf{p} = 2q\mathbf{a}$

4. What is the average electric field over a sphere of radius R with a single charge q at $\mathbf{r} = \mathbf{a}$?

   A)

   $$\mathbf{E}_{ave} = -\frac{q\mathbf{a}}{4\pi\epsilon_0 R^3}$$

   B)

   $$\mathbf{E}_{ave} = -\frac{\mathbf{p}}{4\pi\epsilon_0 R^3}, \quad \text{where } \mathbf{p} = q\mathbf{a}$$

   C)

   $$\mathbf{E}_{ave} = -\frac{\mathbf{P}}{3\epsilon_0}, \quad \text{where } \mathbf{P} = \frac{\mathbf{p}}{\frac{4}{3}\pi R^3}$$

   D) All of the above