P3323 quiz5-1 September 19, 2016

1. The dipole moment of a collection of point charges is

$$\mathbf{p} = \sum_{i=1}^{n} q_i \mathbf{r}'$$

Four charges are placed a distance a from the origin in the y-z plane as shown. What is the dipole moment  $\mathbf{p}$ ?



2. A neutral atom has polarizability  $\alpha$ . The atom is placed in a uniform electric field  $\mathbf{E} = E_0 \hat{\mathbf{z}}$ . What is the force on the atom?

A)  
$$\mathbf{F} = \alpha E_0 \frac{\partial}{\partial z} E_0 \hat{\mathbf{z}}$$

B)

 $\mathbf{F} = 0$ 

- C) A and B
- D) None of the above

3. A neutral atom with polarizability  $\alpha$  is located at the origin. A point charge q is placed at  $\mathbf{r}$ , where  $|\mathbf{r}| \gg a$ , and a is the size of the atom. What is the force of attraction between them?

A)  

$$\mathbf{F} = 0$$
B)  

$$\mathbf{F} = -2\alpha \left(\frac{q^2}{4\pi\epsilon_0}\right)^2 \frac{1}{r^5} \hat{\mathbf{r}}$$
C)  

$$\mathbf{F} = 2\alpha \left(\frac{q^2}{4\pi\epsilon_0}\right)^2 \frac{1}{r^5} \hat{\mathbf{r}}$$
D)  

$$\mathbf{F} = -\alpha \left(\frac{q^2}{4\pi\epsilon_0}\right)^2 \frac{1}{r^4} \hat{\mathbf{r}}$$

4. At dipole  $\mathbf{p} = q d\hat{\mathbf{x}}$  is placed in an electric field  $\mathbf{E} = E\hat{\mathbf{y}}$ . What is the torque on the dipole?



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