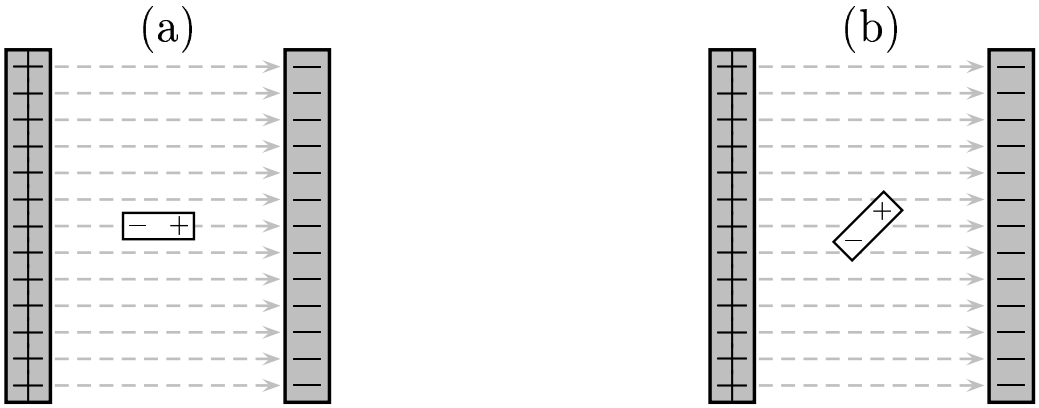
A dipole (electrically neutral) is placed in an external field.



For which situation(s) shown above is the net torque on the dipole zero?

A) (a) only
B) (b) only
C) Both (a) and (b)
D) Neither (a) or (b)

Basic Concepts: Field patterns of point charge and parallel plates of infinite extent.

The force on a charge in the electric field is given by

$$\vec{F} = q\vec{E}$$

$$\Delta\vec{E} = \frac{k\Delta q}{r^2}\hat{r}$$

$$\vec{E} = \sum \Delta\vec{E}_i \,.$$

Symmetry of the configuration will cause some component of the electric field to be zero.

Solutions: The electric dipole consists of two equal and opposite charges separated by a distance. Only in Fig. (a), the electric field is along the direction of $\vec{r}$, where $\vec{r}$ is the vector between the pair of charges. Therefore the force $\vec{F}$ is also along $\vec{r}$. This will lead to zero torque, since

$$\vec{T} = \vec{r} \times \vec{F} \propto \vec{r} \times \vec{r} = 0 \,.$$

For Fig. (b), the torque on both charges are not equal, nonzero, and the net torque is nonzero.

Answer **A**.