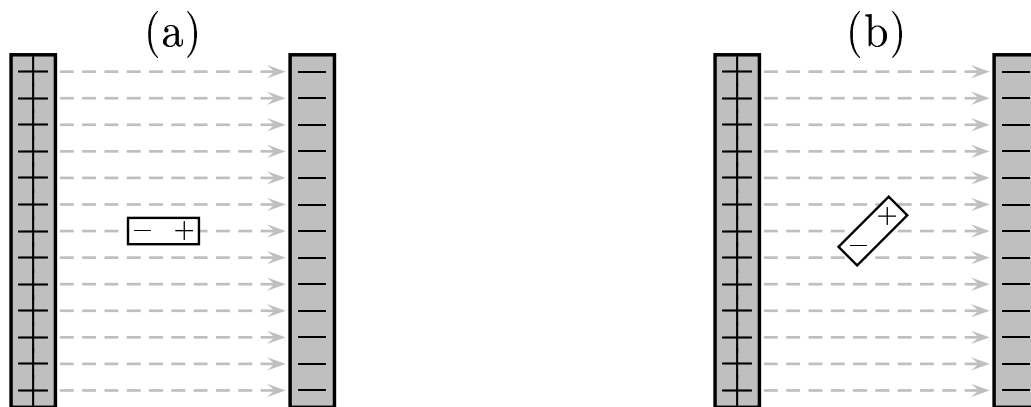


A dipole (electrically neutral) is placed in an external field.



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**.