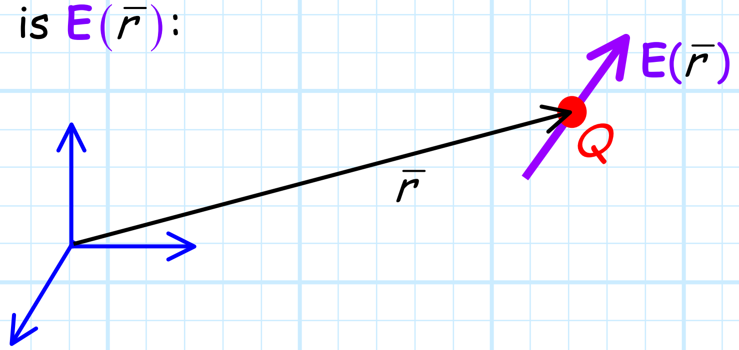
The Electric Force

Say a **charge** Q is located at some **point** in space, a point denoted by position vector $\bar{r}$.

Likewise, there exists **everywhere** in space an **electric field** (we neither know nor care **how** this electric field was **created**).

The value (both magnitude and direction) of the electric field vector at point $\bar{r}$ is $\mathbf{E}(\bar{r})$:

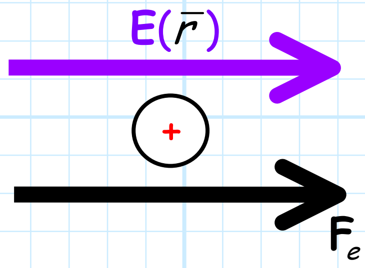


Q: *Our "**field theory**" of electromagnetics says that the electric field will apply a **force** on the charge. Precisely what **is** this force (i.e., its magnitude and direction)?*

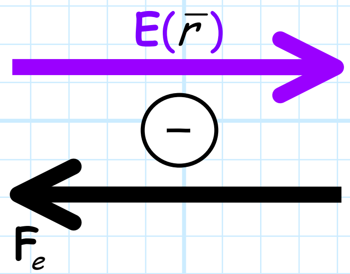
A: Fortunately, the answer is rather **simple**! The **force** $\mathbf{F}_e$ on charge Q is the **product** of the **charge** (a scalar) and the value of the **electric field** (a vector) at the point where the charge is located:

$$\mathbf{F}_e = Q\ \mathbf{E}(\bar{r}) \qquad [N]$$

Note therefore, that the force vector will be **parallel** (or **anti-parallel**) to the electric field!



$Q > 0$ (charge is **positive**) so $\mathbf{F_e}$ points in the **same** direction as the electric field.



$Q < 0$ (charge is **negative**) so $\mathbf{F_e}$ points in the **opposite** direction as the electric field.

Note the **magnitude** of the electric force will increase **proportionally** with an increase in **charge** and/or and increase in the electric field **magnitude**.