FIELDS!

$$\vec{\mathbf{F}}_{gr} = -\frac{GM_1 m_2}{r^2}\hat{r}$$

for which

M_1 and m_2 refer to point MASSES measured in kilograms.

$$G \approx 6.67 \times 10^{-11} \frac{Nm^2}{kg^2}$$

$$\vec{\mathbf{F}}_e = \pm \frac{K_e Q_1 q_2}{r^2}\hat{r}$$

for which

Q_1 and q_2 refer to point CHARGES measured in Coulombs.

$$K_e \approx 8.99 \times 10^9 \frac{Nm^2}{C^2}$$

and $e \equiv q_{proton} = -q_{electron} \approx 1.60 \times 10^{-19}$ Coulombs.

NOTE: According to a tradition that developed FOR CONVENIENCE
(but which will seem incredibly INCONVENIENT until we arrive at a certain discovery)...

K_e is generally written, instead, as: $\frac{1}{4\pi\varepsilon_0}$,

for which: $\varepsilon_0 \approx 8.85 \times 10^{-12} \frac{C^2}{Nm^2}$.

That is, $\frac{1}{(4)(3.14...)(8.85 \times 10^{-12})} \approx 8.99 \times 10^9$,

(so both expressions stand for the same numerical value),

but, for reasons that will SOON become clear,

the arrangment on the left side emphasizes terms that will soon become helpful to emphasize.

GIVEN THE ABOVE,

Assume we have a POSITIVE POINT CHARGE of 50 Coulombs
sitting at the origin of some coordinate system (in the lab).
It will exert an electrostatic force an any and all charges that might be found at any locations in space.
Let's CALL THIS the "SOURCE" of such electrostatic forces.
Imagine a much smaller point charge that we place at some known distance from the source – –
The source will exert an electrostatic force on this smaller point charge.
Call this smaller point charge the "test charge".
DO THE NEXT five exercises in ANY ORDER you find most convenient.
Solve for the electrostatic force exerted by the source charge onto the test charge if:

i. The test charge is + 3 Coulombs and is 5 meters away from the source charge.
ii. The test charge is – 6 Coulombs and is 5 meters away from the source charge.
iii. The test charge is + 5 Coulombs and is 5 meters away....
iv. The test charge is + 1 Coulombs and is 5 meters away...
v. The test charge is – 2 Coulombs and is 5 meters away....

So, let

$$\vec{\mathbf{E}}_e \equiv \frac{\vec{\mathbf{F}}_e}{q_2} = \text{Electrostatic FORCE per CHARGE} = [\text{Newtons/Coulomb}]$$

$$\vec{\mathbf{E}}_e = \frac{\vec{\mathbf{F}}_e}{q_2} = \frac{\pm\frac{1}{4\pi\varepsilon_0}\frac{Q_1 \cancel{q_2}}{r^2}\hat{r}}{\cancel{q_2}} = \pm\frac{1}{4\pi\varepsilon_0}\frac{Q_1}{r^2}\hat{r}$$

$\vec{\mathbf{E}}_e \equiv$ The Electrostatic FIELD:

A charge (the source charge) exerts an electrostatic force onto ANOTHER charge (the test charge).
A charge (the source charge) exerts an ELECTROSTATIC FIELD onto a POINT in SPACE.
Then the FIELD exerts a force on any charge located at that point (the test charge).

THUS.
The ELECTROSTATIC FIELD is:
the amount of FORCE
that a known SOURCE charge WOULD (or will) exert
at a known distance from a test charge – –
always defined to be + 1 Coulomb of charge.