What is the magnitude of an electric field in which the electric force on a proton is equal in magnitude to its weight?

In this scenario, a proton is exposed to two fields: gravity and electric. The proton's weight is its response to the gravitational field: $F_g = mg$ where m is the proton's mass and g is the gravitational field strength ($9.8\ N/kg$ on earth). The electric field exerts a force on the proton: $F_e = qE$ where q is the proton's charge and E is the electric field strength.

We are asked to find E under the condition that the electric force is equal to the gravitational force (or weight): $F_e = F_g$

$$qE = mg$$

$$E = \frac{mg}{q} = \frac{(1.67 \times 10^{-27}\ kg)(9.8\ N/kg)}{1.6 \times 10^{-19}\ C}$$

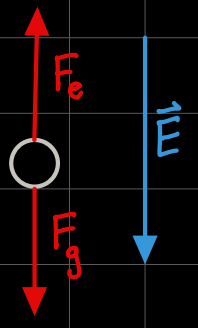
$$E = 1.02 \times 10^{-7}\ N/C$$

I made the assumption that this was happening on earth, so I used $g = 9.8\ N/kg$. If we assumed this was happening on the moon, for example, then $g = 1.63\ N/kg$. A weaker electric field would balance out with the proton's weight on the moon.

$$E = \frac{(1.67 \times 10^{-27}\ kg)(1.63\ N/kg)}{1.6 \times 10^{-19}\ C} = 1.7 \times 10^{-8}\ N/C$$

What charge (sign and magnitude) must a particle of mass 1.46 g have for it to remain stationary when placed in a downward-directed electric field of magnitude 660 N/C?

We want to make a charged particle levitate in an electric field. This means the particle will be subjected to two forces: the force of gravity pulling the particle down and the electric force pulling the particle upward. When these two forces are equal, the particle will levitate and remain stationary.



We are told that the electric field is directed downward. We know the electric force must be upward to counterbalance the weight. In order for the electric force to be opposite in direction to the electric field, the particle must be negatively charged.

To solve for the magnitude of the charge, we can set the two forces equal to each other:

$$F_e = F_g$$

$$qE = mg$$

$$q = \frac{mg}{E} = \frac{(1.46 \times 10^{-3}\ \text{kg})(9.8\ \text{N/kg})}{660\ \text{N/C}} = 2.2 \times 10^{-5}\ \text{C}$$

$$= 22\ \mu\text{C}$$