Answer on Question 59792, Physics, Electromagnetism

Question:

Calculate the potential difference between the plates of a parallel plate capacitor so that the gravitational force on a proton would be balanced by the electric field (proton mass, $m_p = 1.67 \cdot 10^{-27}\ kg$, proton charge, $e = 1.6 \cdot 10^{-19}\ C$, plate separation is $0.5\ cm$. Take $g = 9.8\ m/s^2$).

Solution:

Because the gravitational force on a proton balanced by the electric field, we can write:

$$F_e = F_g,$$

$$eE = m_p g,$$

here, e is the proton charge, E is the electric field, m_p is the proton mass and g is the acceleration due to gravity. From this formula we can find electric field:

$$E = \frac{m_p g}{e}.$$

From the other hand: $E = \frac{V}{d}$,

here, V is the potential difference between the plates of a parallel plate capacitor, d is the plate separation. So, we can equate these two formulas and find the potential difference between the plates of a parallel plate capacitor:

$$\frac{m_p g}{e} = \frac{V}{d},$$

$$V = \frac{m_p g d}{e} = \frac{1.67 \cdot 10^{-27}\ kg \cdot 9.8\ \frac{m}{s^2} \cdot 0.5 \cdot 10^{-2}\ m}{1.6 \cdot 10^{-19}\ C} = 5.11 \cdot 10^{-10}\ V.$$

Answer:

$V = 5.11 \cdot 10^{-10}\ V.$