Answer on Question #78379 Physics / Other

Consider an electron and a proton separated by a distance of 1.0 nm.

A.) Calculate the magnitude of the gravitational force between them.

B.) Calculate the magnitude of the electric force between them.

C.) Explain how the ratio of these gravitational and electric forces would change if the distance were increased to 1.0 m.

$m_e = 9.11 \times 10^{-31}$ kg

$m_p = 1.67 \times 10^{-27}$ kg

$q_e = q_p = 1.60 \times 10^{-19}$ C

Solution:

a) The gravitational force

$$F_g = G\frac{m_e m_p}{r^2} = 6.67 \times 10^{-11}\frac{9.11 \times 10^{-31} \times 1.67 \times 10^{-27}}{(1.00 \times 10^{-9})^2} = 1.01 \times 10^{-49}\ \text{N}$$

b) The electric force

$$F_e = k\frac{q_e q_p}{r^2} = 9.00 \times 10^{9}\frac{1.60 \times 10^{-19} \times 1.60 \times 10^{-19}}{(1.00 \times 10^{-9})^2} = 2.30 \times 10^{-10}\ \text{N}$$

c) The ratio of forces

$$\frac{F_e}{F_g} = \frac{k\frac{q_e q_p}{r^2}}{G\frac{m_e m_p}{r^2}} = \frac{k\ q_e q_p}{G\ m_e m_p} = 2.28 \times 10^{39}$$

is not dependent on distance.

Answers

a) 1.01×10^{-49} N
b) 2.30×10^{-10} N
c) 2.28×10^{39}, not change.