Quiz 9

Name: _____ Student Number: _____

Electron Charge = -1.6×10^{-19} Coulomb

Electron Mass = 9.11×10^{-31} kg

Proton Mass = 1.67×10^{-27} kg

Gravitational Constant G = 6.67×10^{-11} Nt m^2 / kg^2

Coulomb Constant k = 9×10^{9} Nt m^2/ $Coul^2$

1. a) (2 marks) How many electrons comprise a negative 0.1 Coulomb charge?

$$\#\ electrons = \frac{-0.1\ Coulomb.}{-1.6 \times 10^{-19}\ Coul.}$$

$$= 6.25 \times 10^{17}$$

b) (2 marks) An object has 10^6 protons and 2×10^6 electrons. What is the net charge in Coulombs?

$$Net\ Charge = 10^6 (1.6 \times 10^{-19}\ Coul) + 2 \times 10^6 (-1.6 \times 10^{-19}\ Coul)$$

$$= -1.6 \times 10^{-13}\ Coulomb.$$

2. (6 marks) A hydrogen atom consists of an electron and a proton separated by a distance of 5×10^{-11} m.

a) Is the Coulomb force between an electron and a proton attractive or repulsive?

Proton + } ⇒ Attractive Force
Electron − }

b) Calculate the magnitude of the Coulomb force between the electron and the proton.

$$F_{coul} = \frac{k\, q_{prot}\, q_{elec}}{r^2}$$

$$= \frac{9\times10^{9} \times (1.6\times10^{-19})^2}{(5\times10^{-11})^2}$$

$$= 9.2\times10^{-8}\ \text{Nt.}$$

c) How does this force compare to the gravitational attraction between the electron and the proton?

$$\frac{F_{coul}}{F_{Grav}} = \frac{k q^2/r^2}{G\, m_{prot}\, m_{elec}/r^2}$$

$$= \frac{k q^2}{G\, m_p\, m_e}$$

$$= \frac{9\times10^{9}\,(1.6\times10^{-19})^2}{6.67\times10^{-11} \times 1.67\times10^{-27} \times 9.11\times10^{-31}}$$

$$= 2.27\times10^{39}$$

Total = 10 marks