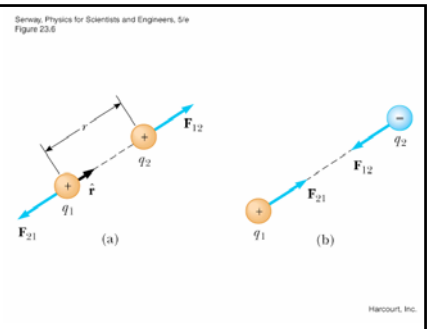
PHYS 232: Lecture supplement 1

P-23.5: Two protons in a molecule are are separated by 3.8 x 10-10 m. Compare the electric force between the protons to the gravitational force gravitational force between them.



$$F_e = \frac{k_e q_1 q_2}{r^2} = \frac{\left(8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2\right)\left(1.60 \times 10^{-19} \text{ C}\right)^2}{(3.80 \times 10^{-10} \text{ m})^2} = \boxed{1.59 \times 10^{-9} \text{ N}} \quad \text{(repulsion)}$$

$$F_g = \frac{G m_1 m_2}{r^2} = \frac{\left(6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2\right)(1.67 \times 10^{-27} \text{ kg})^2}{(3.80 \times 10^{-10} \text{ m})^2} = \boxed{1.29 \times 10^{-45} \text{ N}}$$

The electric force is $\boxed{\text{larger by } 1.24 \times 10^{36} \text{ times}}$

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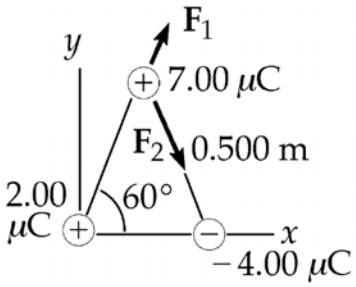
P-23.7: Three point charges are located at the corners of an equilateral triangle; calculate the electric force on the 7 μC charge.



$$F_1 = k_e \frac{q_1 q_2}{r^2} = \frac{(8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2)(7.00 \times 10^{-6} \text{ C})(2.00 \times 10^{-6} \text{ C})}{(0.500 \text{ m})^2} = 0.503 \text{ N}$$

$$F_2 = k_e \frac{q_1 q_2}{r^2} = \frac{(8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2)(7.00 \times 10^{-6} \text{ C})(4.00 \times 10^{-6} \text{ C})}{(0.500 \text{ m})^2} = 1.01 \text{ N}$$

$$F_x = (0.503 + 1.01) \cos 60.0° = 0.755 \text{ N}$$

$$F_y = (0.503 - 1.01) \sin 60.0° = -0.436 \text{ N}$$

$$\mathbf{F} = (0.755 \text{ N})\mathbf{i} - (0.436 \text{ N})\mathbf{j} = \boxed{0.872 \text{ N at an angle of } 330°}$$