

# Physics 2140 Homework #5

5 problems

Complete by October 1

▷ 1.

Consider a proton (charge  $e = 1.6 \times 10^{-19}$  C) and an electron (charge  $-e$ ). Assume  $PE_{\infty} = 0$ .

(a) Before doing any calculations, would the potential energy increase or decrease if the two charges are moved farther apart?

(b) What is their potential energy if they are separated by a distance of  $10^{-10}$  m?

(c) What is their potential energy if they are separated by twice the distance?

(d) If the electron moves from the first distance to the second, find  $\Delta PE$ . Does the potential energy increase or decrease?

(e) Suppose  $PE_{\infty} = 5 \times 10^{-18}$  J instead. How does your answer to part (d) change?

▷ 2.

When an electron moves from some location A to some other location B, the electric field does  $3.94 \times 10^{-19}$  J of work on it. Find the potential difference  $\Delta V = V_B - V_A$  between the two points.

▷ 3.

An *electron-volt* (1 eV) is the energy an electron (charge  $-1.6 \times 10^{-19}$  C) gains by moving through a potential difference of 1 volt.

(a) How many joules is this?

(b) How many electron volts of energy does it take to pull an electron away from the proton in a hydrogen atom? Assume the electron starts off  $1.05 \times 10^{-10}$  m from the proton, and we end up with the electron very far away from the proton (basically at infinity).

▷ 4.

What is the potential 2 m from a  $4 \mu\text{C}$  charge if

(a) the potential at infinity is zero?

(b) the potential at infinity is 5 V?

(c) the potential 1 meter from the charge is 5 V?

▷ 5.

Four negative charges,  $q = -3 \text{ nC}$ , sit on the four corners of a square with side  $a = 1 \text{ m}$ . Find the potential at the center of the square, if  $V_{\infty} = 0 \text{ V}$ . Also, what is the electric field at the center of the square?