

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 ΔPE . 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 3.94×10^{-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 -1.6×10^{-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 1.05×10^{-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?