Chem. 20A

Quiz #1

Professor Baugh

T.A. Adam Makhluf

Name Alex August-Schmidt

Studer

Discus

Directic k ***must*** be shown in order to get credit. The correct SI units must be used. Write on the back of the page if needed. Good luck!

Question #1: Coulombs Law the Electric Potential Energy

A Helium nucleus and an electron are located 5.0×10^{-7}m apart

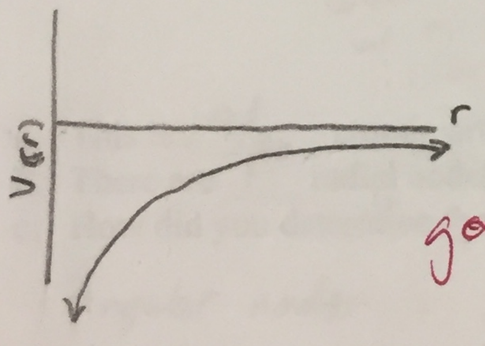
a. What is the electric potential energy between the two particles? Is the PE attractive or repulsive ? (20 pts.) It is attractive. The potential is -9.2×10^{-22} J.
b. How far apart are the particles when the energy between the particles is 7.0eV (10 pts) They are 4.1×10^{-10} m apart.
c. ***Sketch*** a plot of the electric potential energy vs. separation distance and explain the asymptotic behavior of this function (i.e. what happens to the potential as $r \to 0$ and as $r \to \infty$. (20 pts)

Question #2: Basics of Quantum Mechanics

$$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}\ J \cdot s}{m_e\ (2 \cdot 10^6\ m/s)} = 3.6 \times 10^{-10}\ m$$

$(9.109 \times 10^{-31}\ kg)$

a. What is the De Broglie wavelength of an electron with velocity 2×10^6 m/s? (15 pts.) 3.6×10^{-10} m
b. Regarding the Heisenberg uncertainty principle, if the standard deviation (or "spread") of the values in the position of an electron is 3.5×10^{-4}m, what is the minimum uncertainty in the *speed* of the particle? What about for a basketball that weighs .56 kg? (20 pts.)
c. Interpret your result from part b ~~(15 pts)~~



As $r \to 0$, the particles become exponentially attracted to each other. All of the energy in the system is Potential Ener When $r \to \infty$, the particles become dissociated, and are not "aware" of the other. ~~All energy in this case is kinetic.~~ → So the PE → 0

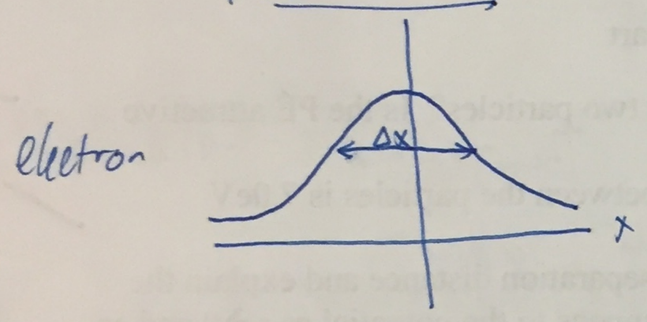
2b $\Delta V_e \geq 1.4$ m/s

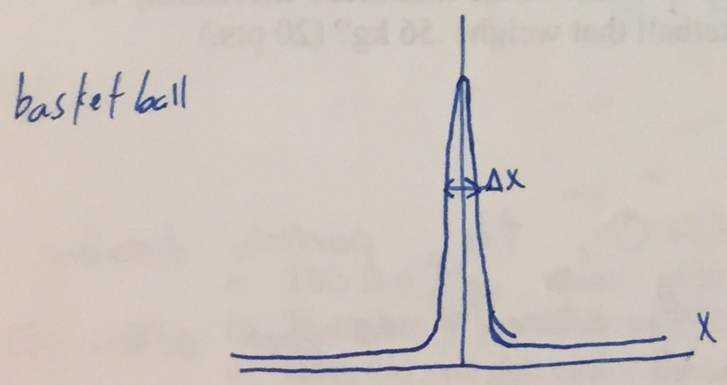
$\Delta V_b \geq 2.7 \times 10^{-31}$ m/s

2c (on back)

(2c) For an electron which has a very small mass, the given change in position is a lot, proportional to its size. Thus, the change in velocity can be much greater than that of a basket ball. For a basket ball, such a small change in position compared to its much greater mass and size results in a smaller change in velocity.

(✓ Right answer, explanation)





☆ ↑ accuracy of position, ↓ accuracy of momentum, & vice versa, shining light on a particle (electron) changes momentum, however for large