Part of the motivation for doing these problems is to (re)-familiarize yourself with the values of the physical constants which you will encounter frequently. You should also get comfortable with using different units which can be convenient in different applications. Please keep a list of frequently used constants handy. For example, the value of $hc$ in “convenient” units is $1240 \text{eV} \cdot \text{nm}$.

1.1) What is the de Broglie wavelength of a baseball moving at $40 \text{m/s}$? Is this a reasonable speed? What is the de Broglie wavelength of an electron whose kinetic energy is $150 \text{eV}$? (3 points)

1.2) Feynman says that the ratio of the size of an apple to that of an atom is the same as the size of the earth to that of the apple. Check this! It is a nice way of explaining relative sizes. (2 points)

1.3) **Photoelectric effect:** The cutoff frequency for photons for ejecting electrons from Na is found to be $4.4 \times 10^{14} \text{s}^{-1}$. What is the work function of sodium in eV? Compare the result to the binding energy of an electron in a hydrogen atom. (2 points)

1.4) A $6.2 \text{keV}$ x-ray photon is scattered by a Compton collision with an electron and its frequency is shifted by $0.01\%$. (a) Through what angle is the photon scattered? (b) What is the kinetic energy imparted to the electron involved in the collision? Compare this to the rest energy $m_ec^2$ of the electron. (3 points)