Session #4: Homework Problems

Problem #1

A photon with a wavelength (λ) of 3.091 x 10^{-7}m strikes an atom of hydrogen. Determine the velocity of an electron ejected from the excited state, *n* = 3.

Problem #2

Determine the minimum potential that must be applied to an α-particle so that on interaction with a hydrogen atom, a ground state electron will be excited to *n* = 6.

Problem #3

Determine if an electron travelling at a velocity of 7.2 x 10^6 km/hr is capable of ionizing a hydrogen atom with its orbiting electron in the ground state.

Problem #4

Determine for hydrogen the velocity of an electron in an n=4 state.

Problem #5

Determine the wavelength of radiation emitted by hydrogen atoms upon electron transitions from n=6 to n=2.

Problem #6

Calculate the minimum potential (V) which must be applied to a free electron so that it has enough energy to excite, upon impact, the electron in a hydrogen atom from its ground state to a state of n=5.

Problem #7

Light of wavelength λ = 4.28 x 10^{-7} m interacts with a "motionless" hydrogen atom. During this interaction it transfers all its energy to the orbiting electron of the hydrogen. What is the velocity of this electron after interaction?

Problem #8

What is the *energy gap* (in eV) between the electronic states n=3 and n=8 in a hydrogen atom?

Problem #9

(a) From information provided in your Periodic Table of the Elements, determine the *first ionization energies* (in Joules) for the horizontal columns (1) Na to Ar and (2) Ca to Cu.

(b) On a graph, plot the values obtained as a function of atomic number and attempt to explain the apparent difference in the change of ionization energy with increasing atomic number for the two series of atoms.

Problem #10

Determine the energy gap (in eV) between the electronic states n=7 and n=8 in hydrogen.

Problem #11

Determine the frequency of radiation capable of generating, in atomic hydrogen, free electrons which have a velocity of 1.3×10^{6} ms^{-1}.

Problem #12

(a) Determine if an energy level of -1.362×10^{-19} J is an allowed electron energy state in atomic hydrogen.
(b) If your answer is yes, determine its principal quantum number (n). If your answer is no, determine n for the “nearest allowed state”.