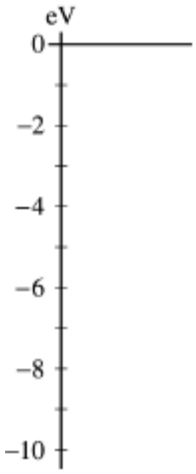
Name:_____ Date:_____

AP 2 Atomic Spectral Lines

B2003B7. An experiment is performed on a sample of atoms known to have a ground state of –5.0 eV. The gas is illuminated with "white light" (400 – 700 nm). A spectrometer capable of analyzing radiation in this range is used to measure the radiation. The sample is observed to absorb light at only 400 nm. After the "white light" is turned off, the sample is observed to emit visible radiation of 400 nm and 600 nm.

(a) In the space provided, determine the values of the energy levels and on the following scale sketch an energy level diagram showing the energy values in eV's and the relative positions of:



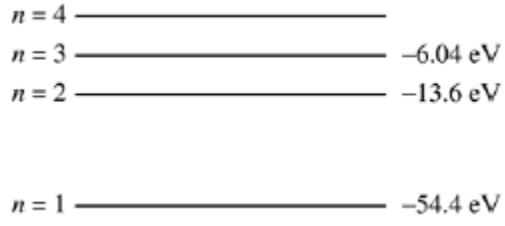
i. the ground state

ii. the energy level to which the system was first excited

iii. one other energy level that the experiment suggests may exist

(b) What is the wavelength of any other radiation, if any, that might have been emitted in the experiment? Why was it not observed?

2005B7



The diagram shows the lowest four discrete energy levels of an atom. An electron in the $n = 4$ state makes a transition to the $n = 2$ state, emitting a photon of wavelength 121.9 nm.

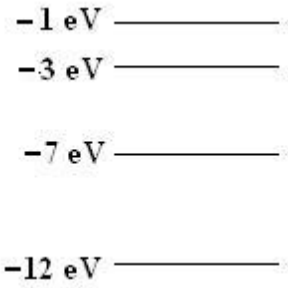
(a) Calculate the energy level of the $n = 4$ state.

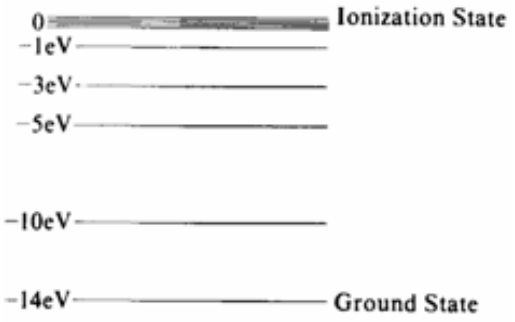
(b) Calculate the momentum of the photon.

The photon is then incident on a silver surface in a photoelectric experiment, and the surface emits an electron with maximum possible kinetic energy. The work function of silver is 4.7 eV.
(c) Calculate the kinetic energy, in eV, of the emitted electron.

(d) Determine the stopping potential for the emitted electron.

1. The diagram to the right shows the lowest four energy levels for an electron in a hypothetical atom. The electron is excited to the −1 *eV* level of the atom and transitions to the lowest energy state by emitting only two photons. Draw in the possible energy states. What are the possible emission energies?

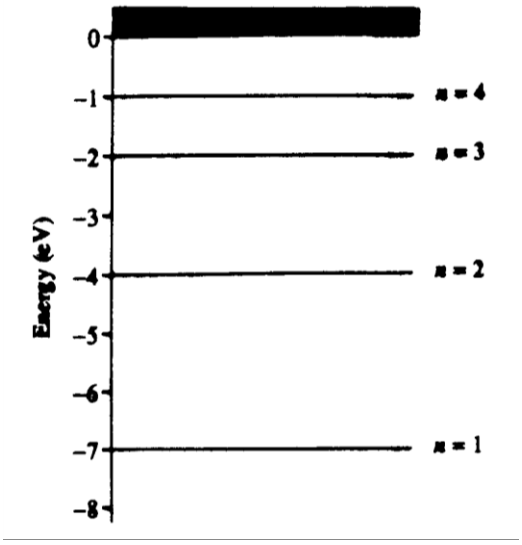




2. The energy level diagram is for a hypothetical atom. A gas of these atoms initially in the ground state is irradiated with photons having a continuous range of energies between 7 and 10 electron volts. One would expect photons of what energy levels to be emitted from the gas? Draw the energy diagram.

Questions 3-4:

A hypothetical atom has four energy states as shown.



3. Which of the following photon energies could be found in the emission spectra of this atom after it has been excited to the n = 4 state? Explain.

   (A) 1 eV (B) 2 eV (C) 3 eV (D) 4 eV (E) 5 eV

4. Which of the following transitions will produce the photon with the longest wavelength? Explain.

   (A) n = 2 to n = 1
   (B) n = 3 to n = 1
   (C) n = 3 to n = 2
   (D) n = 4 to n = 1
   (E) n = 4 to n = 3