

Discharge Lamps Homework Activity

Learning Goals: Be able to explain how a discharge lamp works and how energy is transferred in each process involved in a discharge lamps.

For this problem, you will be investigating the [Discharge Lamps Simulation](#).

a. (2 pts; 0.2 each) Begin by exploring the 1-atom panel and the Configurable Atom. (A few non-obvious simulation controls: You can select the # of empty electronic energy levels in the configurable atom and adjust their location. And you can move the atom about in the discharge tube.) Consider the following True/False statements:

True False If the spacing between two electronic energy levels in atom A is larger than in atom B, then the wavelength of the light emitted by atom B will be longer.

True False If the spacing between two electronic energy levels in atom A is smaller than in atom B, then fewer photons will be emitted by atom B.

True False Photons are emitted *as* electrons in the atom jump up in energy

True False The colors emitted by an atom depends on how much kinetic energy the free electron has when it hits the atom

True False The colors emitted depends on the number of free electrons passing through the lamp.

True False When a free electron hits an atom, the atom is always excited to the highest energy level possible.

True False The kinetic energy of the free electron at the point of collision increases as the voltage of the battery increases.

True False The kinetic energy of the free electron at the point of collision is higher if the atom is closer to the source of electrons

True False The *only* way to emit IR photons is if there are empty electronic energy levels really close to the ground state (lowest energy level).

True False When atomic electrons are excited to a higher level, they always return to their lowest energy level by jumping down one level at a time.

b. (0.5 pts) How many possible colors can an atom with 6 electronic energy levels (Ground state through level 5) emit?

c. (essay) In some discharge lamps, the work function of the metal cathode is overcome by heating the electrons so they have enough thermal energy to get out. The voltage difference across the plates then give these electrons a certain amount of electrostatic potential energy. As always, energy must be conserved. Track and explain the transfers and conversions between different forms of energy that occur in a discharge lamp that make it work to produce light. Be sure to include the main physics ideas about how atoms

behave which are needed to make sense of what's going on.

