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Name:____________________

Atomic Theory Unit – The Photoelectric Effect

In 1905, Einstein published a landmark paper that exhibited light behaves as a particle called a "photon." His experiment described the photoelectric effect and is often discussed today to introduce the important interaction between light and matter.

Using your own laptop or working with a neighbor, follow this link to a photoelectric effect simulator:

http://phet.colorado.edu/en/simulation/photoelectric

I. Spend some time exploring the simulator. What happens when you change the metal? The wavelength of light? The intensity (brightness) of the light? The voltage of the battery? Summarize a few of your findings below.

(Various) Changing the metal changes the number and speed of electrons being ejected at different wavelengths of light. The wavelength of the light sometimes prevents electrons from being ejected, sometimes increases the speed of electrons. The intensity of light seems to change the amount of electrons being ejected. Changing the voltage changes the speed and/or direction of electrons moving across the gap.

II. Exploring the effects of wavelength and intensity.

1. Select sodium. Set intensity at 25%. Set color at blue, 455 nm. Voltage at 0.00V. Press start "→" What do you see?

A few electrons are ejected across the gap at various speeds.

2. What happens when increase "intensity" (Brightness) to 50%?

More electrons are ejected! They still move at various speeds.

3. What happens when increase "intensity" to 90%?

Even more electrons are ejected! They still move at various speeds.

4. Reduce intensity to 25%. Set color at red, 700 nm? Observation?

No more electrons are ejected.

5. Increase intensity to 50%. Observation?

Still no electrons come off.

6. Increase intensity to 90%. Observation?

Still nothing.

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III. Exploring the effects of metal identity and wavelength

1. Go back to blue, 455 nm. Switch metal to zinc. Observation?

No electrons come off!

2. Increase wavelength to IR region. Observation?

Nothing happens.

3. Decrease wavelength to 280 nm. Observation?

Finally, a few electrons are ejected.

4. Decrease wavelength to 185 nm. Observation? Speed of e^-?

On average, electrons are coming off much faster now.

IV. Summarize.

1. Were there any differences or similarities between sodium and zinc in this experiment? If so, can you describe them?

Although electrons easily came off sodium at 455 nm, no electrons would come off of zinc at this wavelength.

Still, for both metals, increasing the wavelengths enough meant that the electrons stopped coming off.

2. How did changing the wavelength of light (at a constant intensity) affect the electrons coming off of the surface of the metal? When there were originally no electrons? When there were already some electrons being removed?

When there were originally no electrons coming off the surface of the metal, increasing the wavelength still didn't help. Decreasing the wavelength enough would cause electrons to start coming off.

When there were already electrons coming off the surface of the metal, increasing the wavelength would sometimes make them stop coming off or at least move more slowly. Decreasing the wavelength would cause the electrons to eject faster.

3. At a constant wavelength, how did increasing the intensity affect the removal of electrons? When there were originally no electrons? When there were already some electrons being removed?

When there were originally no electrons, increasing the intensity did nothing.

When there were already electrons present, increasing the intensity increased the number of electrons being ejected from the metal.