

- 1) Which theory of light, the **wave** or **particle** theory, best explains the following phenomena?
- the diffraction of light when light is sent through a pin-sized hole? wave
  - the photoelectric effect? particle
  - the emission of electromagnetic radiation by an excited atom? particle
- 2) The minimum threshold frequency of zinc for the photoelectric effect is in the ultraviolet range. Which of the following will occur if x-rays are shined on a zinc metal surface?
- No electrons will be emitted from the metal.
  - Electrons will be released from the metal but have no kinetic energy.
  - Electrons will be released from the metal and have kinetic energy.
  - Electrons will be released from the metal but then will immediately be recaptured by the zinc atoms.
- 3) The metal sodium has a threshold frequency which corresponds to yellow light. Describe what will happen to the electrons in the sodium metal if....
- yellow light is shined on the sodium surface:  
Electrons will be emitted (as long as  $\nu \geq \nu_c$ )
  - red light is shined on the metal surface:  
Electrons will NOT be emitted ( $\nu_{\text{red}} < \nu_c$ )
  - green light is shined on the metal surface:  
Electrons will be emitted ( $\nu_{\text{green}} > \nu_c$ )
  - green light with a greater intensity (than in previous question) is shined on the metal surface.  
More electrons will be emitted ( $\nu_{\text{green}} > \nu_c$ ), higher intensity = more photons = more electrons
- 4) Which of the following is true of the energy of a photon?
- It is proportional to the wavelength of the photon.
  - It is inversely proportional to the wavelength of the photon.
  - It is inversely proportional to the square of the wavelength of the photon.
  - It is proportional to the mass of the photon.
- $$E = \frac{hc}{\lambda}$$
- 5) Describe why the photoelectric effect gives evidence that light can exhibit properties of particles.

The photoelectric effect shows that when light interacts with matter, one electron can only absorb one quantum, or photon, of light at a time. If the electron does not gain enough energy from the photon, it will not gain enough energy to be emitted from the metal surface.