# AP Physics - Photoelectric Effect

 What energy is carried by a photon of electromagnetic radiation that has a frequency of 1.55 x 10<sup>17</sup> Hz?

$$E = hf = 6.63 \times 10^{-34} J \times \left( 1.55 \times 10^{17} \frac{1}{8} \right) = 10.3 \times 10^{-17} J = 1.03 \times 10^{-16} J$$

A photon has a wavelength of 550 nm. How much energy does this represent in Joules?

$$v = f\lambda \quad so \quad c = \lambda f \qquad f = \frac{c}{\lambda} \qquad E = hf \qquad E = \frac{hc}{\lambda}$$

$$E = \frac{\left(6.63 \times 10^{-34} J \times \right) 3.00 \times 10^3 \frac{Mc}{X}}{\left(550 \times 10^{-9} Mc\right)} = 0.036 \times 10^{-22} J = \boxed{3.6 \times 10^{-24} J}$$

 What is the maximum kinetic energy of a photoelectron that has been liberated from a silver metal surface by a photon that has a frequency of 3.13 x 10<sup>15</sup> Hz?

$$K_{Max} = hf - \phi = (4.14 \times 10^{-15} eV \cdot \chi) (3.13 \times 10^{15} \frac{1}{\chi}) - 4.73 eV$$
  
 $K_{Max} = 8.22 eV$ 

4. What is the velocity of a photoelectron that has been liberated from a zinc metal surface by a photon that has a wavelength of 275 nm?

Consulting the table, we find that the work function for zinc is 4.31 eV. We can use this and the wavelength of the incident photons to find the kinetic energy of the ejected electrons. We can then solve for their velocity.

$$v = c = f\lambda$$
  $f = \frac{c}{\lambda}$   $E = hf = h\left(\frac{c}{\lambda}\right) = \frac{hc}{\lambda}$   
 $K_{Max} = \frac{hc}{\lambda} - \phi = \frac{1.24 \times 10^3 eV \cdot \pi m}{275 \pi m} - 4.31 eV = 0.00451 \times 10^3 eV - 4.31 eV$   
 $K_{Max} = 4.51 eV - 4.31 eV = 0.200 eV$ 

$$K_{Max} = 0.200 e \text{K} \left( \frac{1.60 \times 10^{-19} J}{1 e \text{K}} \right) = 0.32 \times 10^{-19} J = 3.2 \times 10^{-20} J$$

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**Kathleen Armour** 

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