

AP Physics – Photoelectric Effect

1. What energy is carried by a photon of electromagnetic radiation that has a frequency of 1.55×10^{17} Hz?

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

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

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

$$E = \frac{(6.63 \times 10^{-34} \text{ J} \cdot \text{s}) (3.00 \times 10^8 \frac{\text{m}}{\text{s}})}{(550 \times 10^{-9} \text{ m})} = 0.036 \times 10^{-22} \text{ J} = \boxed{3.6 \times 10^{-24} \text{ J}}$$

3. 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 3.13×10^{15} Hz?

$$K_{Max} = hf - \phi = (4.14 \times 10^{-15} \text{ eV} \cdot \text{s}) \left(3.13 \times 10^{15} \frac{1}{\text{s}} \right) - 4.73 \text{ eV}$$

$$K_{Max} = \boxed{8.22 \text{ eV}}$$

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.

$$v = c = f\lambda \quad f = \frac{c}{\lambda} \quad E = hf = h \left(\frac{c}{\lambda} \right) = \frac{hc}{\lambda}$$

$$K_{Max} = \frac{hc}{\lambda} - \phi = \frac{1.24 \times 10^3 \text{ eV} \cdot \text{nm}}{275 \text{ nm}} - 4.31 \text{ eV} = 0.00451 \times 10^3 \text{ eV} - 4.31 \text{ eV}$$

$$K_{Max} = 4.51 \text{ eV} - 4.31 \text{ eV} = 0.200 \text{ eV}$$

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

Photoelectric Effect Gizmo Worksheet Answers

David Baud

A red circular graphic with a gradient, appearing as a semi-circle or a partial circle, located to the right of the author's name.

Photoelectric Effect Gizmo Worksheet Answers:

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<https://letsgetcooking.org.uk/files/Resources/index.jsp/Steven%20Vago%20Law%20And%20Society.pdf>

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