

SAMPLE PROBLEM B

The Photoelectric Effect

PROBLEM

Light of frequency of 1.00×10^{15} Hz illuminates a sodium surface. The ejected photoelectrons are found to have a maximum kinetic energy of 1.78 eV. Find the threshold frequency for this metal.

SOLUTION

Given: $KE_{max} = (1.78 \text{ eV})(1.60 \times 10^{-19} \text{ J/eV})$
 $KE_{max} = 2.85 \times 10^{-19} \text{ J}$ $f = 1.00 \times 10^{15} \text{ Hz}$

Unknown: $f_t = ?$

Use the expression for maximum kinetic energy, and solve for f_t .

$$KE_{max} = hf - hf_t$$
$$f_t = \frac{hf - KE_{max}}{h}$$
$$f_t = \frac{(6.63 \times 10^{-34} \text{ J}\cdot\text{s})(1.00 \times 10^{15} \text{ Hz}) - (2.85 \times 10^{-19} \text{ J})}{6.63 \times 10^{-34} \text{ J}\cdot\text{s}}$$

$$f_t = 5.70 \times 10^{14} \text{ Hz}$$

PRACTICE B

The Photoelectric Effect

1. In the photoelectric effect, it is found that incident photons with energy 5.00 eV will produce electrons with a maximum kinetic energy 3.00 eV. What is the threshold frequency of this material?
2. Light of wavelength 350 nm falls on a potassium surface, and the photoelectrons have a maximum kinetic energy of 1.3 eV. What is the work function of potassium? What is the threshold frequency for potassium?
3. Calculate the work function of sodium using the information given in Sample Problem B.
4. Which of the following metals will exhibit the photoelectric effect when light of 7.0×10^{14} Hz frequency is shined on it?
 - a. lithium, $hf_t = 2.3 \text{ eV}$
 - b. silver, $hf_t = 4.7 \text{ eV}$
 - c. cesium, $hf_t = 2.14 \text{ eV}$