## Chapter 34 Problem 49<sup>†</sup>

## Given

 $v = 4.2 \times 10^5 \; m/s$  Work function of potassium  $\phi = 2.30 \; eV$ 

## Solution

Find the wavelength of light shining on a potassium surface.

Convert the work function of potassium from electron-volts to joules.

$$\phi = 2.30 \ eV\left(\frac{1.6 \times 10^{-19} \ J}{1 \ eV}\right) = 3.68 \times 10^{-19} \ J$$

Begin with the equation for the photoelectric effect and substitute in the relationship  $c=\lambda f$  and  $K=\frac{1}{2}mv^2$ 

$$K_{max} = hf - \phi$$
$$\frac{1}{2}mv^2 = \frac{hc}{\lambda} - \phi$$

Solve for  $\lambda$ 

$$\frac{1}{2}mv^2 + \phi = \frac{hc}{\lambda}$$
$$\lambda = \frac{hc}{\frac{1}{2}mv^2 + \phi}$$

Substitute in the provided values

$$\lambda = \frac{(6.63 \times 10^{-34} \ J \cdot s)(3.0 \times 10^8 \ m/s)}{\frac{1}{2}(9.11 \times 10^{-31} \ kg)(4.2 \times 10^5 \ m/s)^2 + (3.68 \times 10^{-19} \ J)} = 4.43 \times 10^{-7} \ m = 443 \ nm$$