Chapter 34 Problem 49 [†]

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 $K = \frac{1}{2}mv^2$

$$K_{max} = hf - \phi$$

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

Solve for λ

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

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

Substitute in the provided values

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

[†]Problem from Essential University Physics, Wolfson