Example 1.1 A metal has a workfunction of 4.3 V. What is the minimum photon energy in Joule to emit an electron from this metal through the photo-electric effect? What are the photon frequency in Terahertz and the photon wavelength in micrometer? What is the corresponding photon momentum? What is the velocity of a free electron with the same momentum?

Solution The minumum photon energy, E_{ph}, equals the workfunction, Φ_M, in units of electron volt or 4.3 eV. This also equals

$$E_{ph} = q\Phi_M = \qquad\qquad\qquad\qquad\qquad \text{Joule}$$

The corresponding photon frequency is:

$$\nu = \frac{E_{ph}}{h} = \qquad\qquad\qquad\qquad\qquad \text{THz}$$

The corresponding wavelength equals:

$$\lambda = \frac{hc}{E_{ph}} = \qquad\qquad\qquad\qquad\qquad \mu\text{m}$$

The photon momentum, p, is:

$$p = \frac{h}{\lambda} = \qquad\qquad\qquad\qquad\qquad \text{kg m/s}$$

And the velocity, v, of a free electron with the same momentum equals

$$v = \frac{p}{m_0} = \qquad\qquad\qquad\qquad\qquad \text{m/s}$$

Where m_0 is the free electron mass.