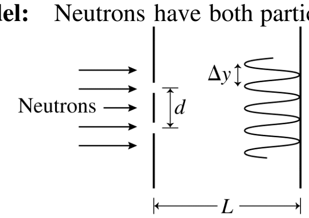
38.49. Model: Neutrons have both particle-like and wave-like properties.
Visualize:



Please refer to Figure P38.49.
Solve: **(a)** The kinetic energy of the neutron is

$$K = \tfrac{1}{2}mv^2 = \tfrac{1}{2}\left(1.67\times10^{-27}\text{ kg}\right)\left(200\text{ m/s}\right)^2 = 3.34\times10^{-23}\text{ J} = 2.09\times10^{-4}\text{ eV}$$

(b) The de Broglie wavelength at this speed is

$$\lambda = \frac{h}{mv} = \frac{6.63\times10^{-34}\text{ J s}}{\left(1.67\times10^{-27}\text{ kg}\right)\left(200\text{ m/s}\right)} = 1.985\times10^{-9}\text{ m} = 1.985\text{ nm}$$

(c) From Equation 22.7, the fringe spacing in a double-slit interference experiment is $\Delta y = \lambda L/d$, where d is the slit separation and L is the distance to the detector. From Figure P38.49, the spacing between the two peaks with $m = \pm1$ (on either side of the central maximum) is 1.4 times as long as the length of the reference bar, which gives $\Delta y = 70\ \mu\text{m}$.

Thus, the distance from the slits to the detector was

$$L = \frac{d\Delta y}{\lambda} = \frac{\left(1.0\times10^{-4}\text{ m}\right)\left(7.0\times10^{-5}\text{ m}\right)}{1.985\times10^{-9}\text{ m}} = 3.5\text{ m}$$