

18. (a) From Eq. 41-19,

$$F = \mu_B \left| \frac{dB}{dz} \right| = (9.27 \times 10^{-24} \text{ J/T})(1.6 \times 10^2 \text{ T/m}) = 1.5 \times 10^{-21} \text{ N} .$$

(b) The vertical displacement is

$$\begin{aligned} \Delta x &= \frac{1}{2}at^2 = \frac{1}{2} \left( \frac{F}{m} \right) \left( \frac{l}{v} \right)^2 \\ &= \frac{1}{2} \left( \frac{1.5 \times 10^{-21} \text{ N}}{1.67 \times 10^{-27} \text{ kg}} \right) \left( \frac{0.80 \text{ m}}{1.2 \times 10^5 \text{ m/s}} \right)^2 \\ &= 2.0 \times 10^{-5} \text{ m} . \end{aligned}$$