1. Using the given conversion factors, we find

(a) the distance *d in rods* to be

$$d = 4.0 \text{ furlongs} = \frac{(4.0 \text{ furlongs})(201.168 \text{ m/furlong})}{5.0292 \text{ m/rod}} = 160 \text{ rods},$$

(b) and that distance *in chains* to be

$$d = \frac{(4.0 \text{ furlongs})(201.168 \text{ m/furlong})}{20.117 \text{ m/chain}} = 40 \text{ chains}.$$

1. (a) The second hand of the smoothly running watch turns through 2π radians during 60 s . Thus,

$$\omega = \frac{2\pi}{60} = 0.105 \text{ rad/s.}$$

(b) The minute hand of the smoothly running watch turns through 2π radians during 3600 s . Thus,

$$\omega = \frac{2\pi}{3600} = 1.75 \times 10^{-3} \text{ rad / s.}$$

(c) The hour hand of the smoothly running 12-hour watch turns through 2π radians during 43200 s. Thus,

$$\omega = \frac{2\pi}{43200} = 1.45 \times 10^{-4} \text{ rad / s.}$$

1. (a) The motion from maximum displacement to zero is one-fourth of a cycle so 0.170 s is one-fourth of a period. The period is $T = 4(0.170\text{ s}) = 0.680\text{ s}$.

(b) The frequency is the reciprocal of the period:

$$f = \frac{1}{T} = \frac{1}{0.680\,\text{s}} = 1.47\,\text{Hz}.$$

(c) A sinusoidal wave travels one wavelength in one period:

$$v = \frac{\lambda}{T} = \frac{1.40\,\text{m}}{0.680\,\text{s}} = 2.06\,\text{m/s}.$$

1. (a) With a understood to mean the magnitude of acceleration, Newton's second and third laws lead to

$$m_2 a_2 = m_1 a_1 \Rightarrow m_2 = \frac{\left(6.3\times10^{-7}\,\mathrm{kg}\right)\left(7.0\,\mathrm{m/s^2}\right)}{9.0\,\mathrm{m/s^2}} = 4.9\times10^{-7}\,\mathrm{kg}.$$

(b) The magnitude of the (only) force on particle 1 is

$$F = m_1 a_1 = k\frac{|q_1||q_2|}{r^2} = \left(8.99\times10^9\right)\frac{|q|^2}{0.0032^2}.$$

Inserting the values for m_1 and a_1 (see part (a)) we obtain $|q| = 7.1 \times 10^{-11}$ C.

1. (a) Eq. 28-3 leads to

$$v = \frac{F_B}{eB\sin\phi} = \frac{6.50\times10^{-17}\,\mathrm{N}}{\left(1.60\times10^{-19}\,\mathrm{C}\right)\left(2.60\times10^{-3}\,\mathrm{T}\right)\sin 23.0^\circ} = 4.00\times10^{5}\ \mathrm{m/s}.$$

(b) The kinetic energy of the proton is

$$K = \frac{1}{2}mv^2 = \frac{1}{2}\left(1.67\times10^{-27}\,\mathrm{kg}\right)\left(4.00\times10^{5}\ \mathrm{m/s}\right)^2 = 1.34\times10^{-16}\ \mathrm{J}.$$

This is $(1.34 \times 10^{-16}$ J) / $(1.60 \times 10^{-19}$ J/eV) = 835 eV.

1. The condition for a minimum of a single-slit diffraction pattern is

$$a \sin\theta = m\lambda$$

where a is the slit width, λ is the wavelength, and m is an integer. The angle θ is measured from the forward direction, so for the situation described in the problem, it is 0.60° for $m = 1$. Thus

$$a = \frac{m\lambda}{\sin\theta} = \frac{633\times10^{-9}\ \text{m}}{\sin 0.60°} = 6.04\times10^{-5}\ \text{m}\ .$$

1. If R is the fission rate, then the power output is $P = RQ$, where Q is the energy released in each fission event. Hence,

$$R = P/Q = (1.0 \text{ W})/(200 \times 10^6 \text{ eV})(1.60 \times 10^{-19} \text{ J/eV}) = 3.1 \times 10^{10} \text{ fissions/s.}$$