① (a) $\mu = \frac{m}{L} = \frac{0.122\,kg}{8.36\,m} = 0.0146\ kg/m$

$v = \sqrt{\frac{F}{\mu}} = \sqrt{\frac{96.7N}{0.0146\,kg/m}} = 81.4\ m/s$

(b) $L = \lambda/2 \Rightarrow \lambda = 2L = 16.7m$

(c) $f = \frac{v}{\lambda} = \frac{81.4\,m/s}{16.7\,m} = 4.87\ Hz$

② (a) $y_1 = (0.15m)\left(\sin\left[(0.79)(2.3) - 13(0.16)\right]\right) = -0.039\,m$

(b) $y_2(x,t) = (0.15m)\sin(0.79x + 13t)$

(c) $y_2 = (0.15m)\sin\left[(0.79)(2.3) + 13(0.16)\right] = -0.103m$

$y = y_1 + y_2 = -0.14m$

③ (a) In the sequence of frequencies $f_1,\ f_2 = 2f_1,\ f_3 = 3f_1,\ \ldots$ the differences between successive values are always equal to f_1.

$f_1 = 420\ Hz - 315\ Hz = 105\ Hz$

(b) $f_1 = \frac{v}{2L} \Rightarrow v = 2Lf_1 = 2(0.750m)(105Hz) = 158\ m/s$

④ (a) Comparing the given forms with $\cos 2\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right)$ or $\cos(kx - \omega t)$ we find: $k = \pi = \frac{2\pi}{\lambda}$ so $\lambda = 2.0\ m$

$\omega = 4\pi = 2\pi f$ so $f = 2.0\ Hz$

$v = f\lambda = 4.0\ m/s$

(b) $y = y_1 + y_2 = 6.0\,cm\left[\cos\frac{\pi}{2}(2x+8t) + \cos\frac{\pi}{2}(2x-8t)\right]$

Use the trig identity $\cos(A+B) = 2\cos\frac{1}{2}(A+B)\cdot\cos\frac{1}{2}(A-B)$

$y = (12.0\,cm)\cos\frac{\pi}{2}(2x)\ \cos\frac{\pi}{2}8t$

No motion (at all times) when $\cos\frac{\pi}{2}(2x) = 0$

$\cos\pi x = 0 \qquad x = \frac{1}{2}m,\ \frac{3}{2}m,\ \frac{5}{2}m,\ \ldots$

(c) The amplitude maxima occur halfway between the nodes, or when $\cos\frac{\pi}{2}(2x) = \pm 1$

$x = 0,\ 1m,\ 2m,\ 3m,\ \ldots$