1.

a) $T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{2kg}{100\,N/m}} = 0.889s$

b) the same! Amplitude does not affect period

2.


3 a) Shown is $2.5\lambda$. So $2.5\lambda = 30cm$ $\quad k = \frac{2\pi}{\lambda} = \frac{2\pi}{12cm} = \frac{\pi}{6}\,cm^{-1} = 0.524\,cm^{-1}$

$\Rightarrow \lambda = \frac{30cm}{2.5} = 12cm.$

b) $v = f\lambda = 20Hz \cdot 12cm = 240cm/s.$

c) $y = A\sin(kx - \omega t) = 3cm \cdot \sin\left(\frac{\pi}{6}cm^{-1}\,x - 2\pi \cdot 20Hz\,t\right)$

$\uparrow$ negative since it moves right

$= 3cm \sin\left(0.524cm^{-1} - 125.7\frac{rad}{s}\,t\right)$

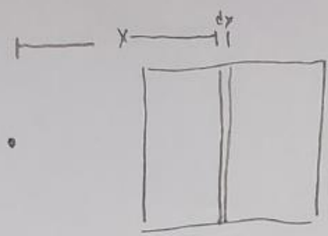
d) $V_{max} = A\omega = 3cm \cdot 2\pi \cdot 20Hz = 377\,cm/s$

4. a) This is the $n=5$ harmonic.

$f_n = \frac{n}{2L}\sqrt{F/\mu} \Rightarrow F = \left(\frac{2L f_n}{n}\right)^2 \mu = \left(\frac{2.4m \cdot 600Hz}{5}\right)^2\left(\frac{5\times10^{-3}kg}{4m}\right) = 1152N$

b) $f_1 = f_5/5 = \cancel{270.4}\ 120\,Hz$

5.




- slice the rectangle into vertical strips so we can use the equation.
- Parameterize with $x$ as shown, $x_{min} = L$, $x_{max} = L + W$
- $dA = H\,dx$, so $dm = \sigma\, dA = H\sigma\, dx$
- $\int dI = \int_L^{L+W} dm \left(\frac{1}{12}H^2 + x^2\right)$

$$= \int_L^{L+W} H\sigma\, dx \left(\frac{1}{12}H^2 + x^2\right)$$

$$= \sigma \int_L^{L+W} \left(\frac{H^3}{12} + Hx^2\right) dx$$

$$= \sigma \left(\frac{H^3 x}{12} + \frac{H x^3}{3}\right)\Bigg|_L^{L+W}$$

$$= \sigma \left(\frac{H^3(L+W)}{12} + \frac{H(L+W)^3}{3} - \frac{H^3 L}{12} - \frac{H(L^3)}{3}\right)$$