A guitar string is vibrating in its fundamental mode, with nodes at each end. The length of the segment of the string that is free to vibrate is 0.40 m. The maximum transverse acceleration of a point at the middle of the segment is $8.50 \times 10^3$ m/s$^2$ and has a maximum transverse velocity of 3.90 m/s. (a) What is the amplitude of this standing wave? (b) What is the wave speed for the transverse traveling wave on this string?

\[ \frac{\lambda}{2} = L \]
\[ f = \frac{v}{2L} \]

Max \[ \frac{d^2y}{dt^2} = 8.50 \times 10^3 \text{ m/s}^2 \]
Max \[ \frac{dy}{dt} = 3.90 \text{ m/s} \]

\[ \frac{d^2y}{dt^2} = \frac{d}{dt} \left( \frac{dy}{dt} \right) \]
\[ \frac{dy}{dt} = \frac{d}{dt} \left( A \omega \cos(kx - wt) \right) \]
\[ = \frac{d}{dt} \left( A \omega \cos(kx - wt) \right) \]
\[ = -A \omega^2 \sin(kx - wt) \]

So \[ A \omega^2 = 8.50 \times 10^3 \text{ m/s}^2 \]
\[ A \omega = 3.90 \text{ m/s} \]

Solving for $A$ and $\omega$,
\[ \frac{A \omega^2}{A \omega} = \omega = \frac{8.50 \times 10^3}{3.90} = 2179 \text{ rad/s} \]

\[ a) \quad A = \frac{3.90}{\omega} = 0.00179 \text{ m} \]

\[ b) \quad \text{wave speed} \quad v = \lambda f = (0.8m) \left( \frac{2179 \text{ rad/s}}{2\pi} \right) = 277.4 \text{ m/s} \]