Answers

1. (a) $f'(x) = -g'(x) = -(I/2\rho c)\delta(x - x_1)$, $f'(-ct) = f'(ct)$, $f'(ct - L) = f'(ct + L)$
   $\dot{u}(x,t) = (I/2\rho)\{\delta(x - x_1 - ct) + \delta(x - x_1 + ct)\}$
   (b) Average velocity is $I/\rho L$, the same result as a rigid rod.
   (c) $\dot{u}(x,t) = I\sum_n \phi_n(x)\phi_n(x_1)\cos\omega_n t$, $T = (I^2/2)\sum_n \phi_n^2(x_1)\cos^2\omega_n t$.
   (d) From the above summation *T* is infinite at *t*=0. The delta function impulse is an unrealistic simplification from this point of view.

2. (a) $k = \omega\sqrt{m/T}$.
   (b) $u(x,t) = -(F/Tk)\cos\omega t \sin kx_1 \sin k(x - L)/\sin kL$ for $x > x_1$.
   (c) $u = A\cos\omega t \sin k(x_2 - L)/\sin k(x_1 - L)$, $\omega_n = n\pi\sqrt{T/m}/(L - x_1)$.
   (d) $C = \sqrt{2/mL}$, $u(x_1,t) = \left(\frac{2F\cos\omega t}{mL}\right)\sum_n \frac{\sin^2(n\pi x_1/L)}{\omega_n^2 - \omega^2}$
   (e) Both results tend to $-(F/5\pi\delta)\sin^2(5\pi x_1/L)/\sqrt{mT}$.