16.5 (a) The Fourier transform of the external force is

$$F(\omega) = \int_{-\infty}^{+\infty} eE_0 \Theta(t) e^{i\omega t} dt = eE_0 \int_0^{+\infty} e^{i\omega t} dt = \frac{i eE_0}{\omega},$$

and Eq (16.29) becomes $\quad v(\omega) = -\frac{F(\omega)}{i\omega M(\omega)} = -\frac{eE_0}{\omega^2 M(\omega)}$

Then, $v(t) = \frac{1}{2\pi}\int_{-\infty}^{+\infty} v(\omega) e^{-i\omega t} d\omega = -\frac{eE_0}{2\pi}\int_{-\infty}^{+\infty} \frac{e^{-i\omega t}}{\omega^2 M(\omega)} d\omega.$

Let $\xi = 2\omega a/c$, we will have

$$v(t) = -\frac{eE_0}{2\pi}\int_{-\infty}^{+\infty} \frac{\exp\{-i\xi \cdot ct/2a\}}{\left(\frac{c}{2a}\right)^2 \cdot \xi^2 M(\xi)} \cdot \frac{c}{2a} d\xi = -\frac{eE_0 a}{\pi c}\int_{-\infty}^{+\infty} \frac{e^{-i\xi T}}{\xi^2 M(\xi)} d\xi,$$

with $T = ct/2a$.

(b) For $t<0$, the integral can be evaluated with a contour enclosing the upper half plane. Since $t<0$, on the semi-circle, $|e^{-i\xi T}| \to 0$, as $|\xi| \to \infty$. From Prob. 16.4, we know there is no zeros of $M(\omega)$ in the upper half plane. By the residue theorem, the contour integral becomes 0. Therefore, the integral along the real axis is also 0. Therefore, we have established that

$v(t) = 0$, for $t \le 0$.