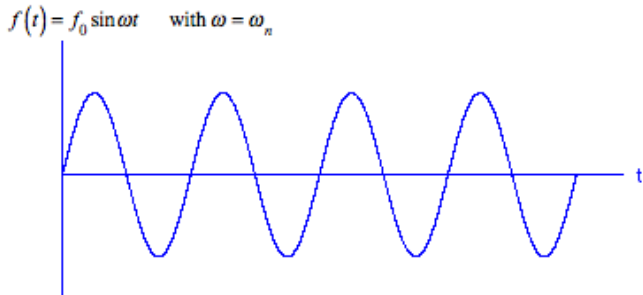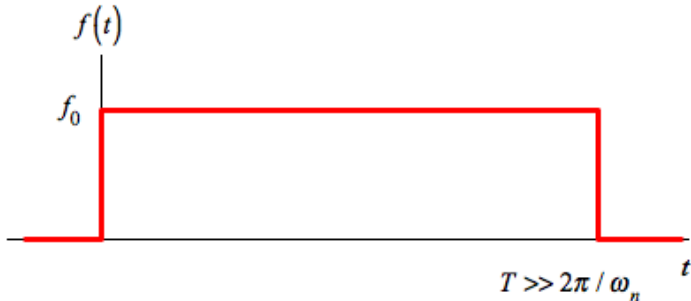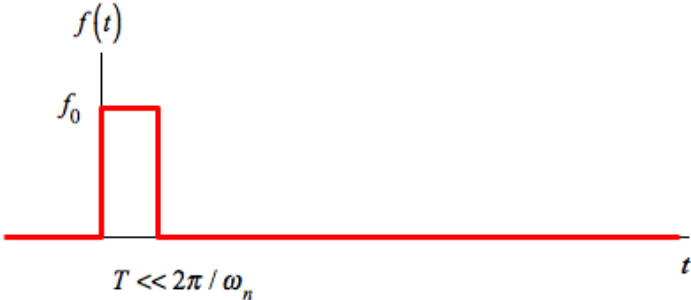**Example IV.3.4**

Discuss the qualitative response of an undamped single-DOF oscillator having a natural frequency of ω_n excited by each of the following:

$f(t)$

f_0

$T \ll 2\pi / \omega_n$

t

$f(t)$

f_0

$T \gg 2\pi / \omega_n$

t

$f(t) = f_0 \sin \omega t$ with $\omega = \omega_n$

t

Considering first the <u>short</u> duration pulse: fold and shift (by a time t) the function h(τ), multiply with f(τ) and integrate will produce the response at time t. This process has been done below with the results shown at times for which the response has maxima, minima and zero crossings, with these samples of the response shown in the top plot for x(t). To produce a more detailed picture of the response would require determination of the response at some intermediate points and then "connect the dots." However, the maxima, minima and zero crossing give some picture of relative amplitudes and frequency of response.

Carefully study the figures below and convince yourself of how this process works.
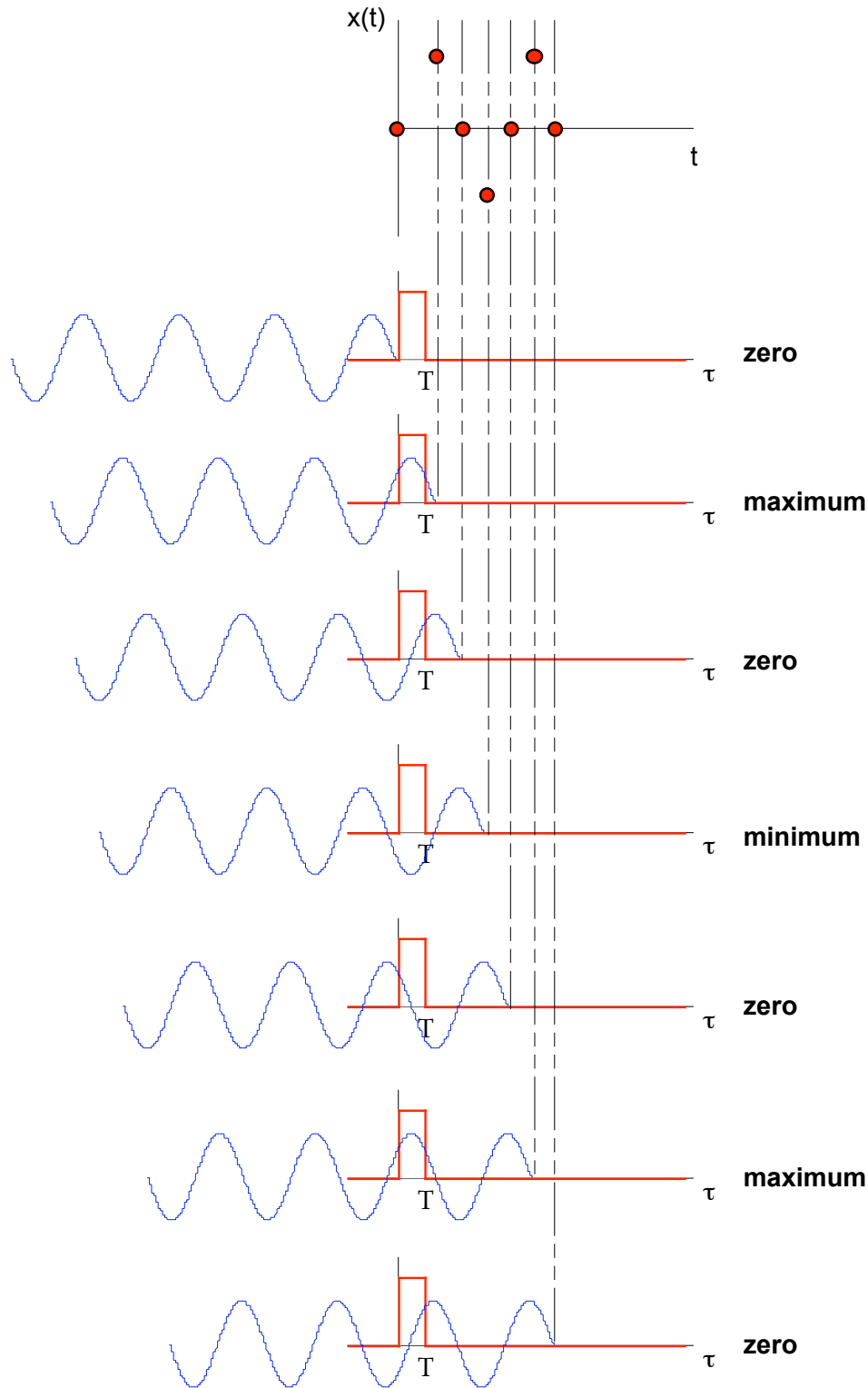
Next consider the long duration pulse. Same process as before. Note that here while the force is "turned on" the minimum value of the response is zero, whereas after the force is turned off the response will be symmetrical about the time axis (the minima being the negative of the maxima).
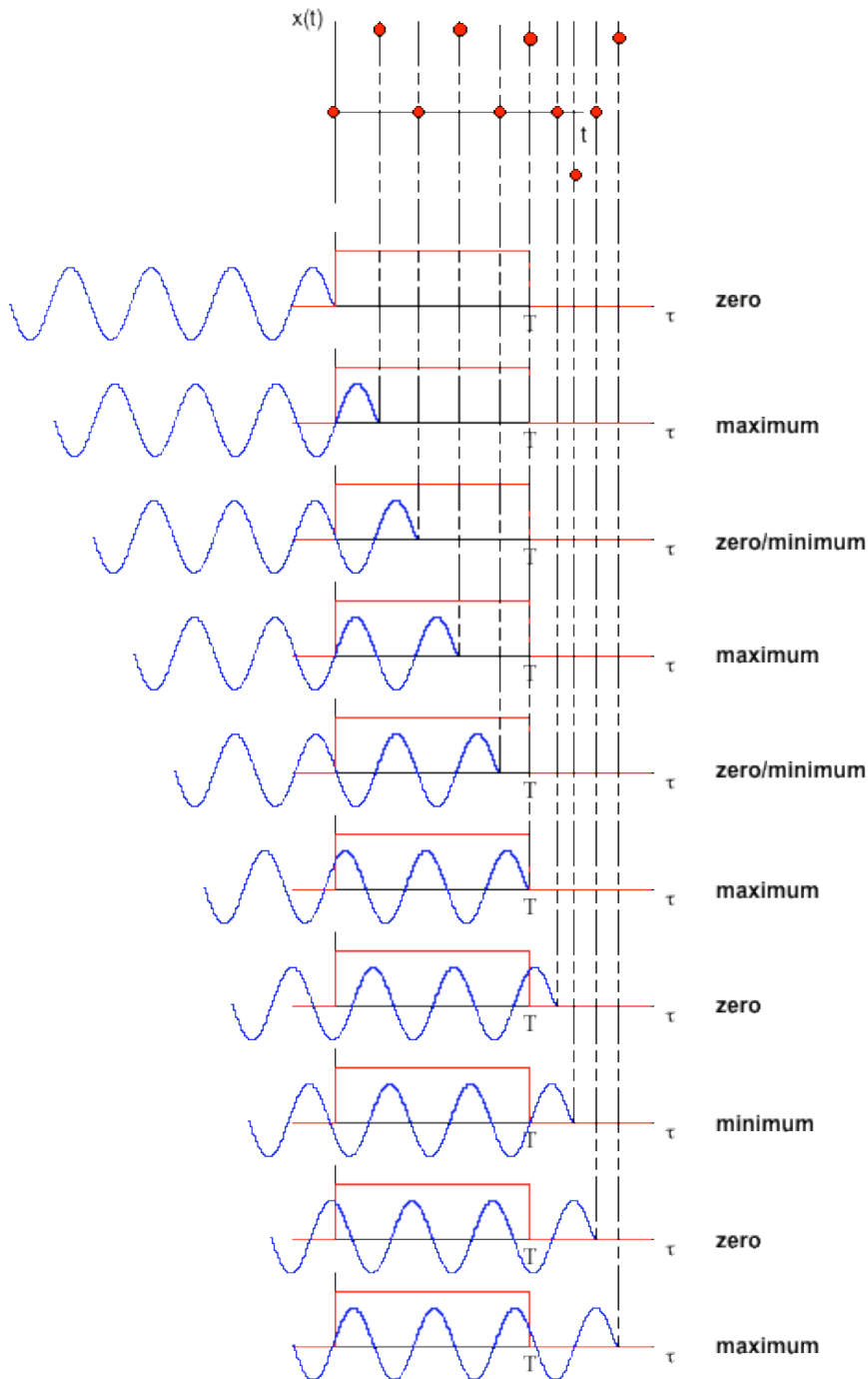
In summary, note that for short pulses, the first maximum in response occurs AFTER the impulse has been turned off, whereas for the long pulses, the first maximum in the response occurs during the action of the impulse. (Here "short" and "long" is relative the natural period of response of the oscillator.)