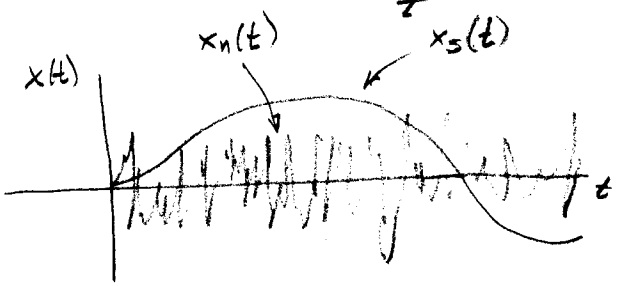
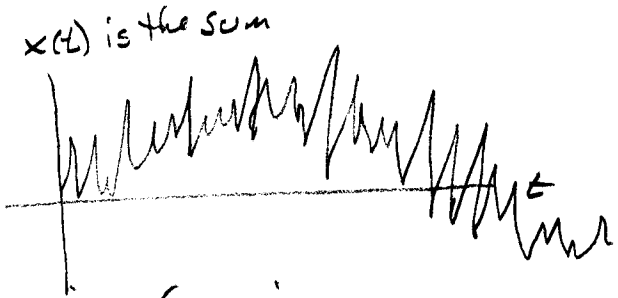
1.5 Useful Circuits Seen in the Time Domain

- In this section, we'll look at a few simple and useful circuits and interpret their action in the time domain

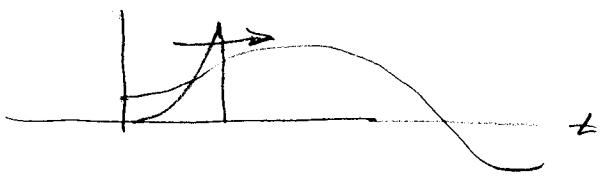
- First order low pass

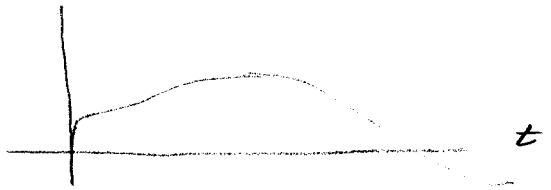
lets slowly varying signal through without much damage, while suppressing rapidly varying noise.



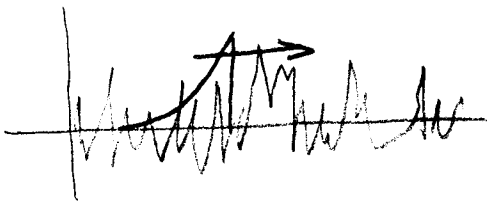


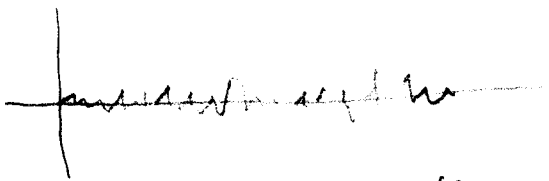
Superposition — get sum of signal, noise responses





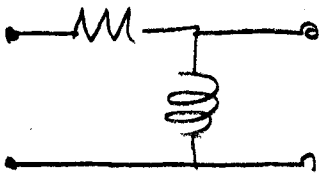
some distortion, less with very slow variation



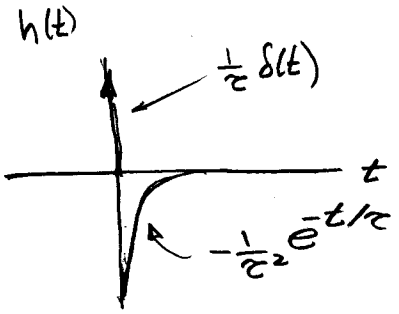


noise is greatly reduced through averaging

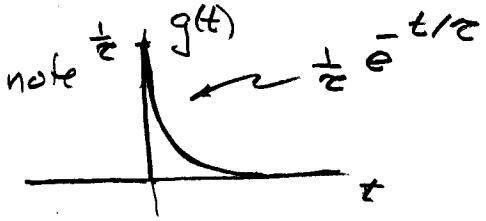
- A first order "edge picker" gives a blip when the input changes suddenly.



1st order highpass



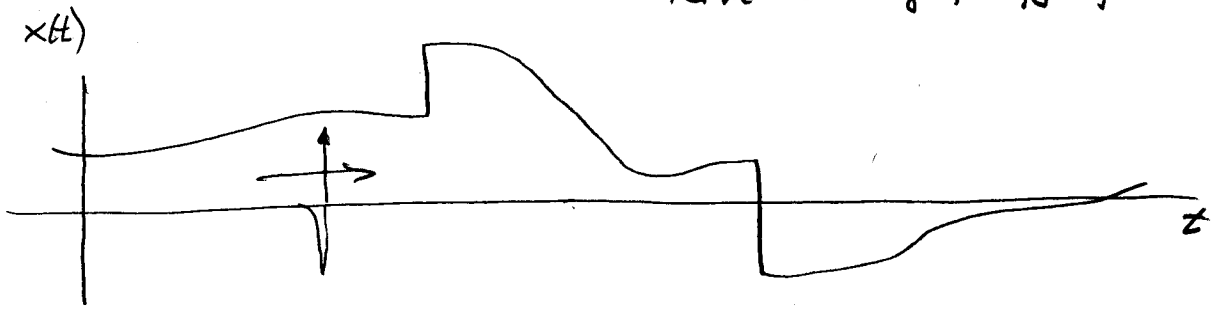
impulse and exponential have equal, opposite areas

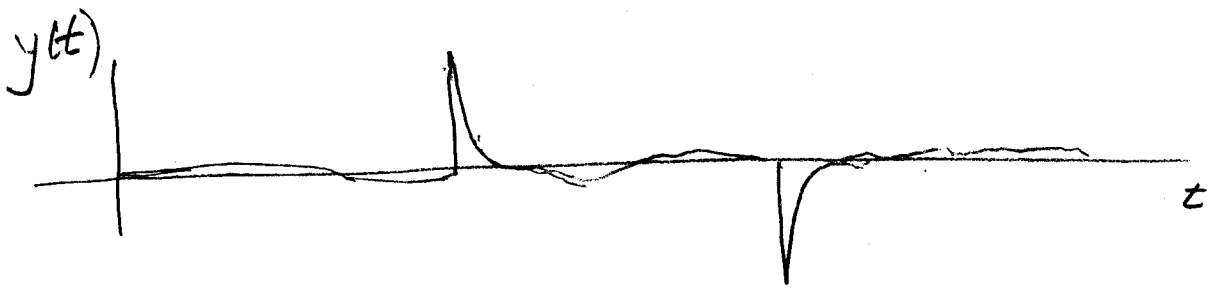


$$y(t) = h(t) \circledast x(t) = \frac{1}{\tau}\left(x(t) - \underbrace{\frac{1}{\tau}e^{-t/\tau} \circledast x(t)}\right)$$

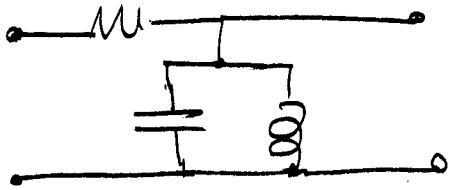
an exponentially-weighted short term average, lagging

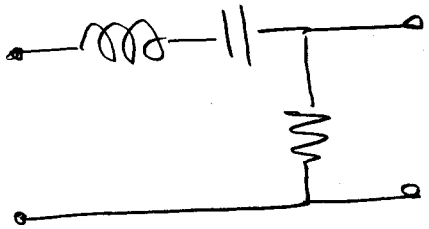
or $\dot{x}(t) \circledast g(t)$

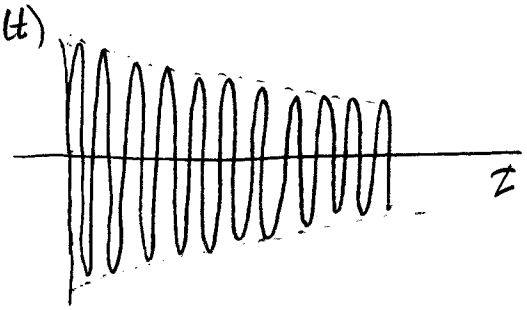


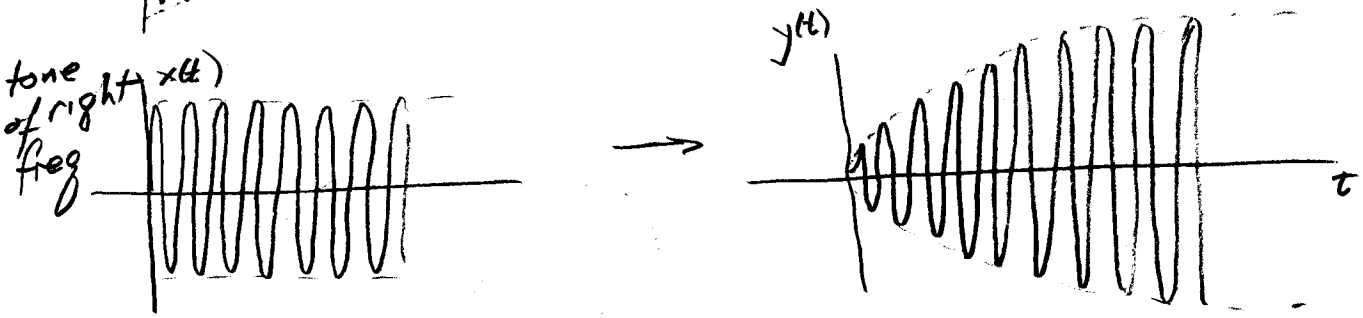


- A resonant circuit detects or tunes a radio station

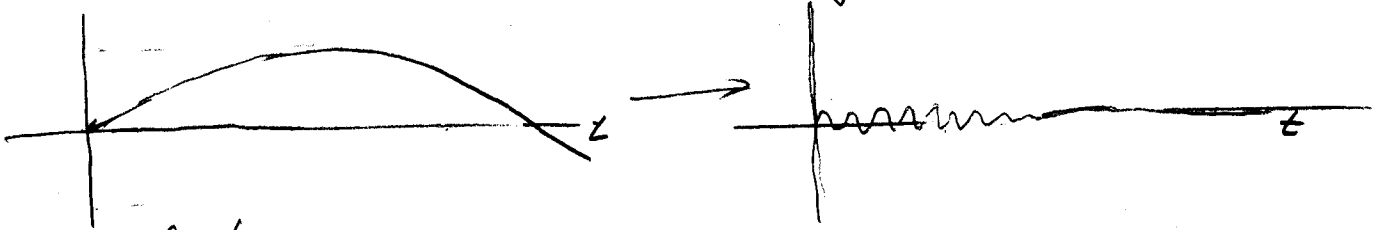




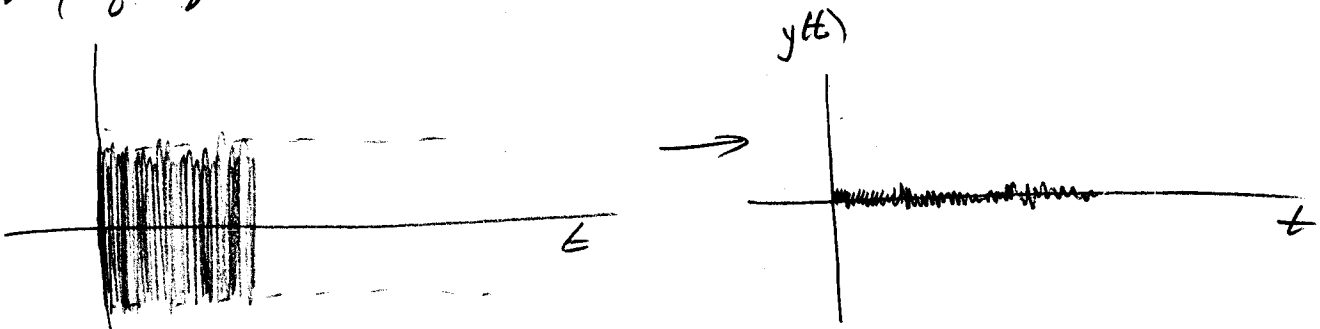




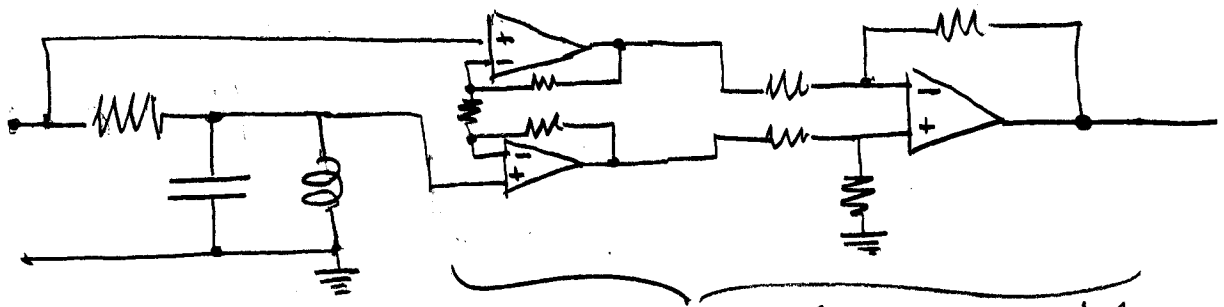
low freq tone



very high freq tone

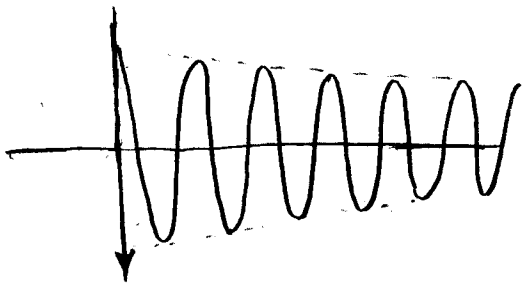


- A notch eliminates single-tone interference



A very clumsy circuit.

h(t)



At resonance, the output of the tank circuit is in phase with the input and at the same amplitude. The "$-\delta(t)$" branch subtracts the input, so response is zero