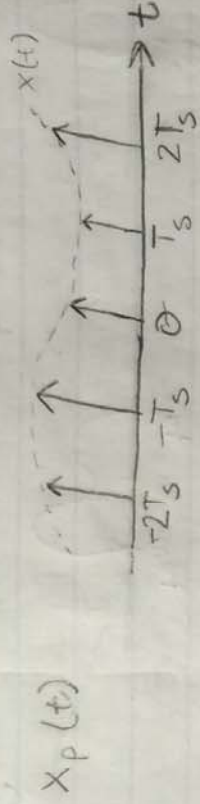


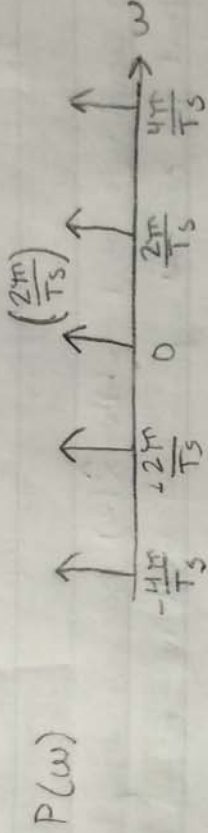
PS08: Sig Sys

1

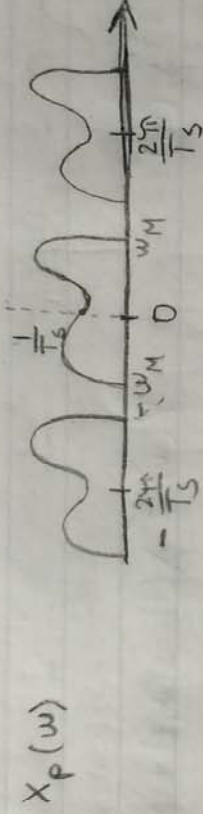
(a)



(b)



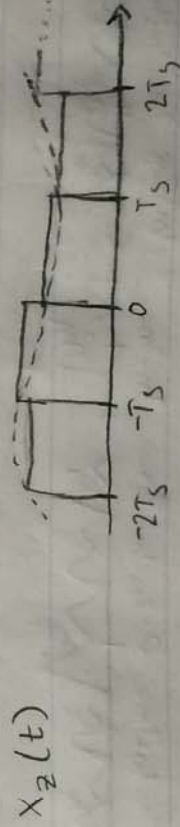
(c)



(d) $\frac{2\pi}{T_s} > 2\omega_M \rightarrow \omega_0 > 2\omega_M \rightarrow$ Nyquist frequency

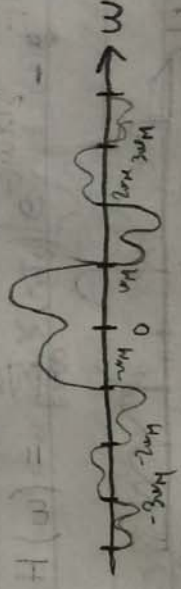
(e) Multiply it by a new $H(\omega)$ that has value T_s from $-\omega_M$ to ω_M and is periodic. Then apply $\int_{-\infty}^{\infty} H(\omega) X_p(\omega) d\omega$ to recover $x(t)$

(f)



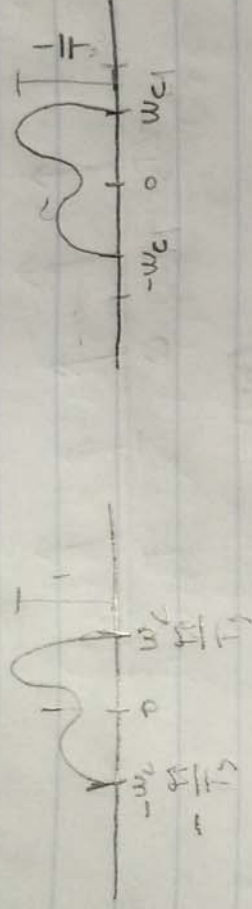
(h)

$X_2(\omega) = X_p(\omega) Z(\omega)$
So we know the transform of a rect pulse is $\text{sinc}(\omega T_s/2)$. We then shift it: $e^{-j\omega T_s/2} \text{sinc}(\omega T_s/2)$



(I)

$$\bar{X}(w) = X_2(w)H(w) \quad \hat{X}(w) = X_p(w)H(w)$$



- (j) $\bar{X}(w)$ has an amplitude of 1 while $\hat{X}(w)$ has an amplitude of $\frac{1}{T}$.
It also happens that the zeroth approximation will not be an identical copy.

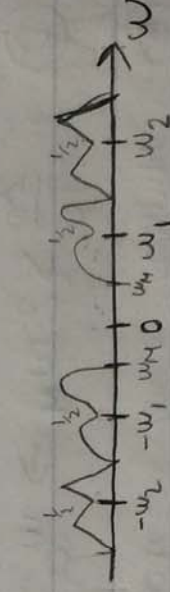
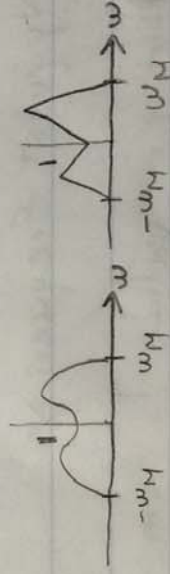
$$(k) \frac{\bar{X}(w_H)}{\hat{X}(w_H)} = 1$$

(Z)

$$X_1(w) \quad X_2(w)$$

$$Y(w) = X_1(t)\cos(w_1t) + X_2(t)\cos(w_2t)$$

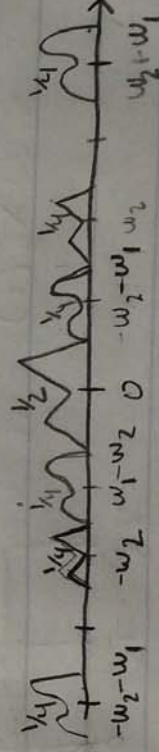
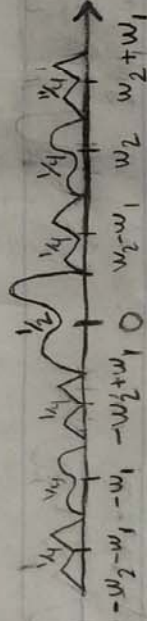
(A)



(B)

$$F\{y(t)\cos(w_1t)\}$$

$$F\{y(t)\cos(w_2t)\}$$



- (C) We sample at a high enough frequency ($> 2w_c$) that we pick up the signal completely. We then apply an ideal low pass filter with amplitude 2. This filter has a frequency spectrum between $-w_H$ and w_H , depending on which one we want to pick up we multiply $y(t)$ by either $\cos(w_1t)$ or $\cos(w_2t)$ respectively and apply the filter.

$$\textcircled{3} \quad V_{in} = V_R(t) + V_L(t) + V_{out}(t) = R i(t) + L \frac{d}{dt} i(t) + V_{out} =$$

$$\textcircled{A} \quad = RC \frac{d}{dt} V_{out}(t) + LC \frac{d}{dt} \frac{d}{dt} V_{out}(t) + V_{out}$$

$$V_{in} = LC \frac{d^2}{dt^2} V_{out}(t) + RC \frac{d}{dt} V_{out}(t) + V_{out}$$

$$\textcircled{B} \quad V_{in}(\omega) = (j\omega)^2 LC V_{out}(\omega) + j\omega RC V_{out}(\omega) + V_{out}(\omega) = (1 + j\omega RC + j^2 \omega^2 LC) V_{out}(\omega)$$

$$H(\omega) = \frac{V_{out}(\omega)}{V_{in}(\omega)} = \frac{1}{1 + j\omega RC + j^2 \omega^2 LC} = \frac{1}{(1 - \omega^2 LC) + j\omega RC}$$

$$\omega \rightarrow 0 \quad |H(\omega)| \rightarrow 1$$

$$\omega \rightarrow \infty \quad |H(\omega)| \rightarrow 0$$

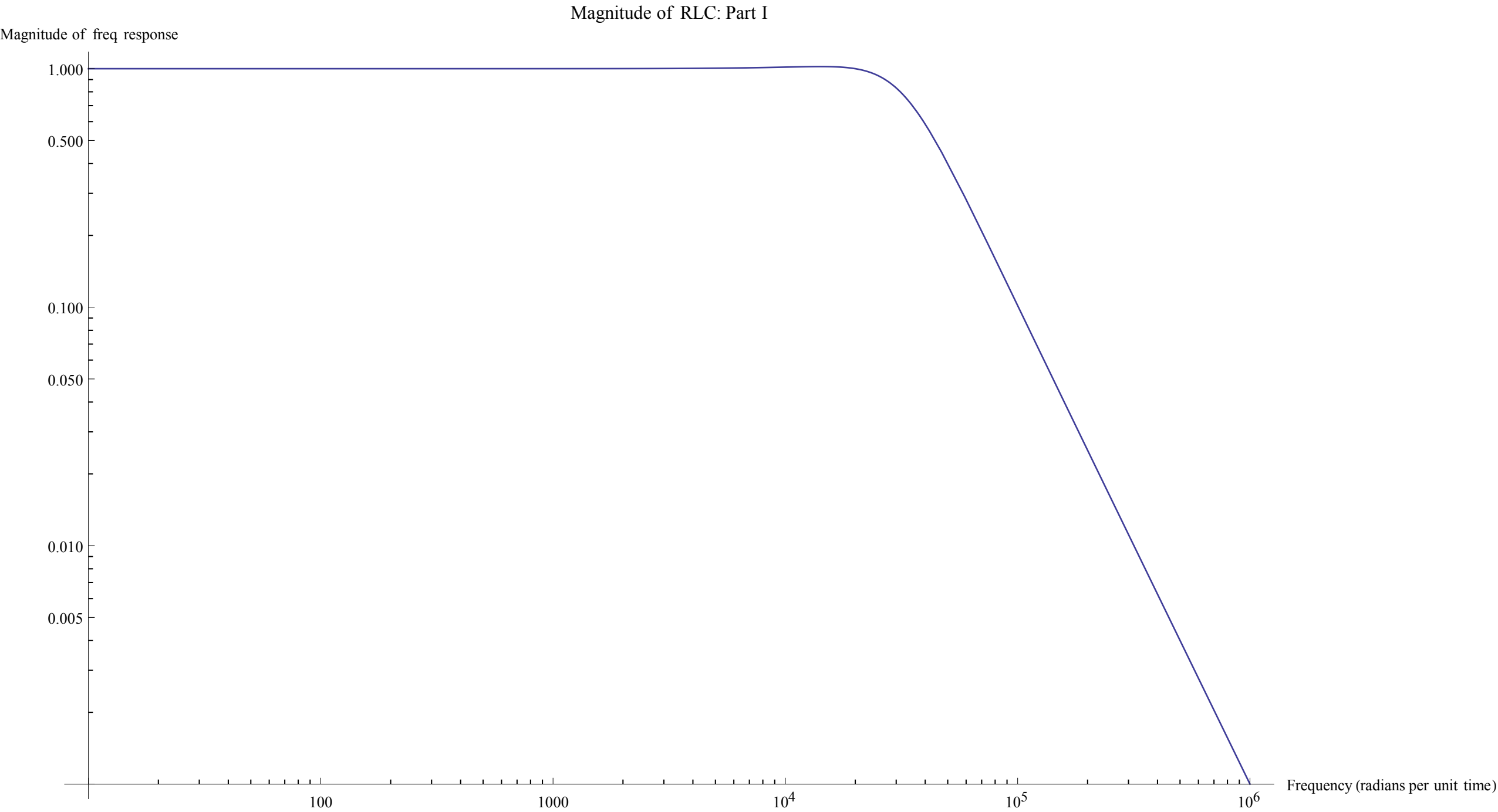
Low Pass.

$$|H(\omega)| = \frac{1}{\sqrt{(1 - \omega^2 LC)^2 + (j\omega RC)^2}} = \frac{1}{\sqrt{1 - \omega^2 R^2 C^2 + C^2 L^2 \omega^4 - 2CL\omega^2}}$$

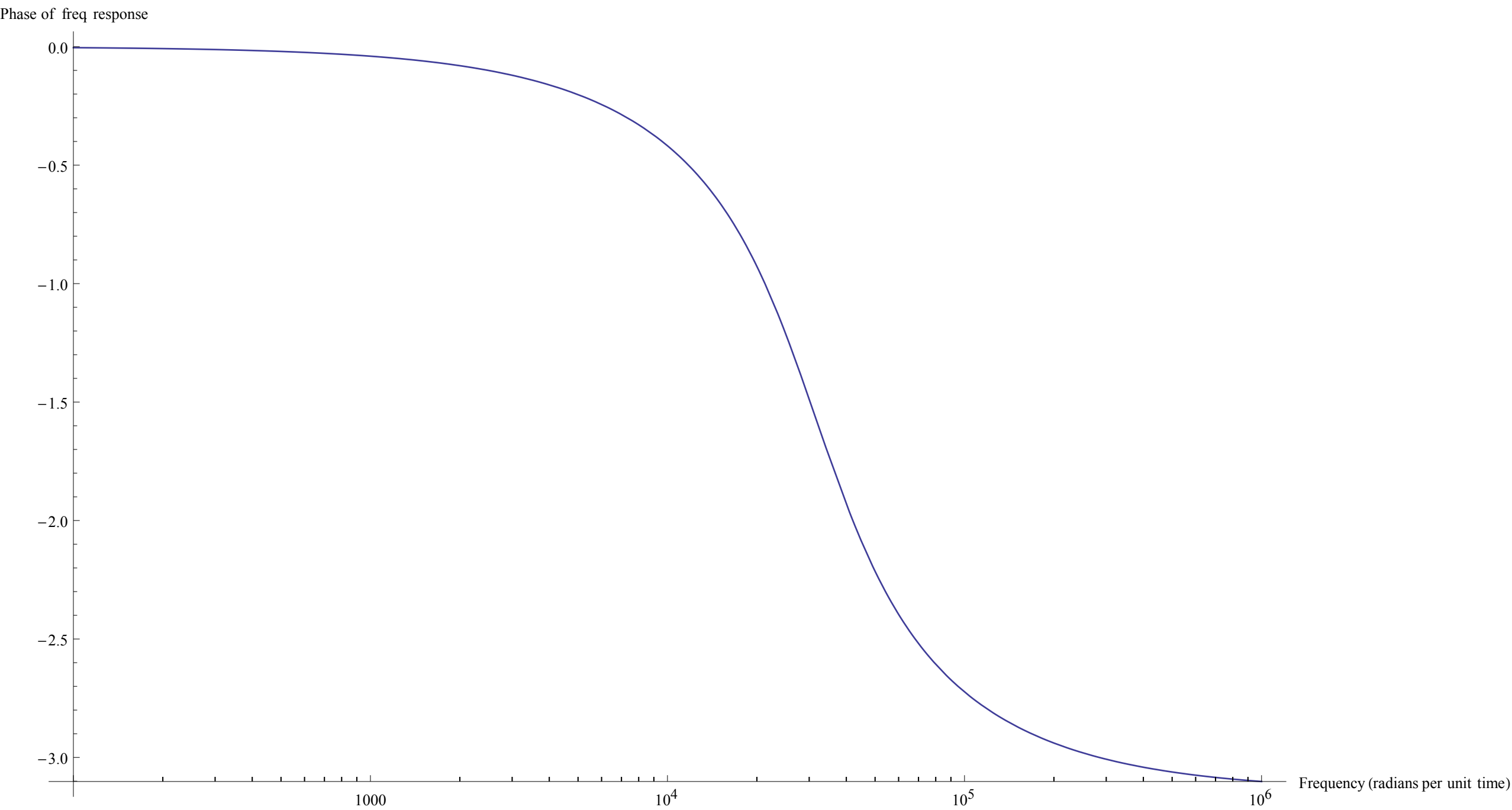
$$\textcircled{D} \quad \frac{d}{d\omega} |H(\omega)| = \frac{C\omega(2CL^2\omega^2 + CR^2 - 2L)}{(C^2\omega^2(L^2\omega^2 + R^2) - 2CL\omega^2 + 1)^{3/2}} = 0 \rightarrow$$

$$\rightarrow \underset{\omega=0}{C\omega} (2CL^2\omega^2 + CR^2 - 2L) = 0 \rightarrow 2CL^2\omega^2 + CR^2 - 2L = 0 \rightarrow \omega^2 = \frac{2L - CR^2}{2CL^2} \rightarrow$$

$$\rightarrow \omega = \sqrt{\frac{2L - CR^2}{2CL^2}} \text{ or } 0$$

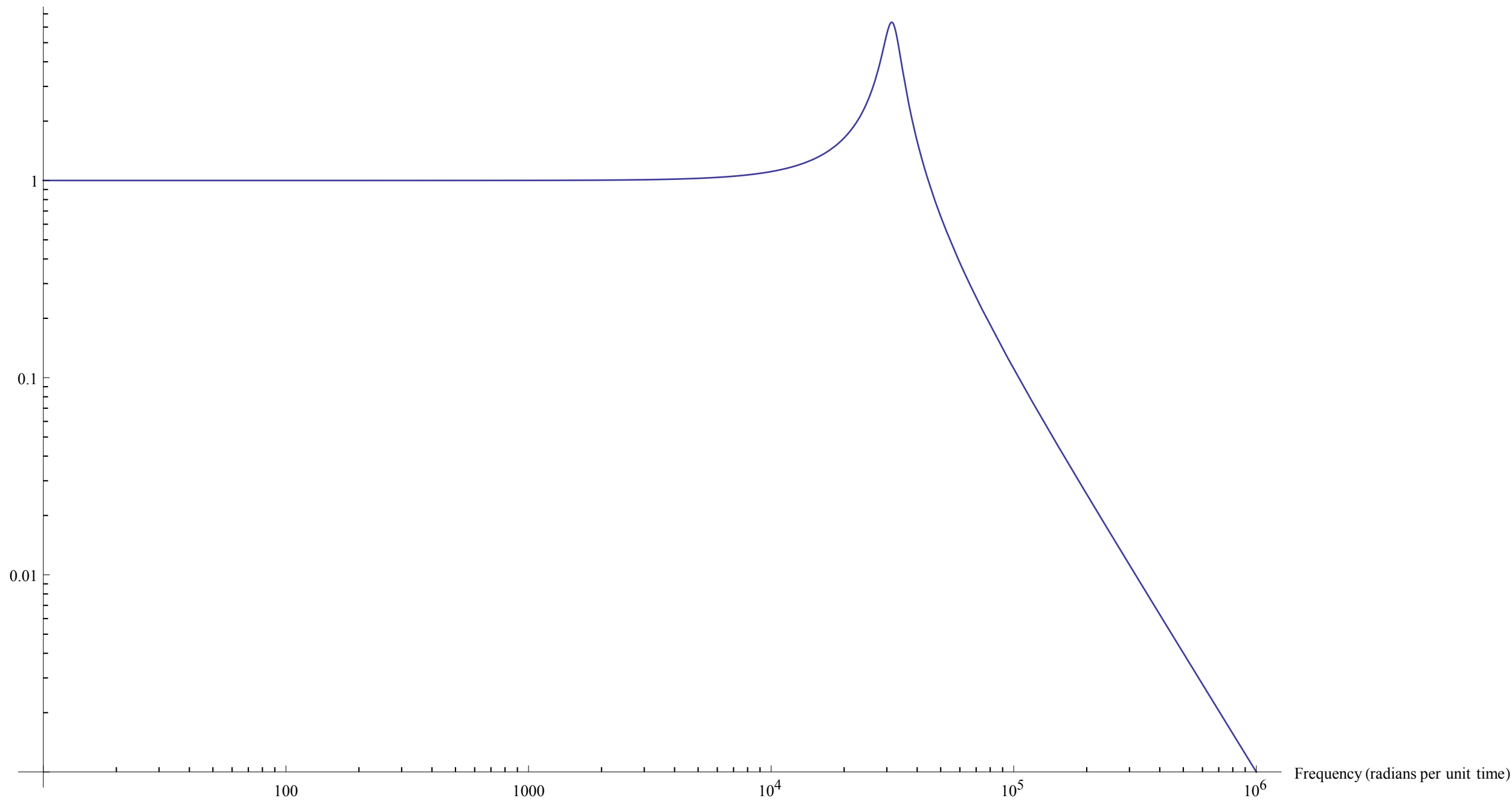


Phase of RLC: Part I



Magnitude of RLC: Part II

Magnitude of freq response



Phase of RLC: Part II

Phase of freq response

