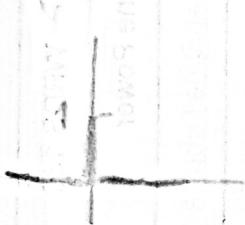


1d. step:

$$Y(s) = \frac{1}{s} H(s)$$

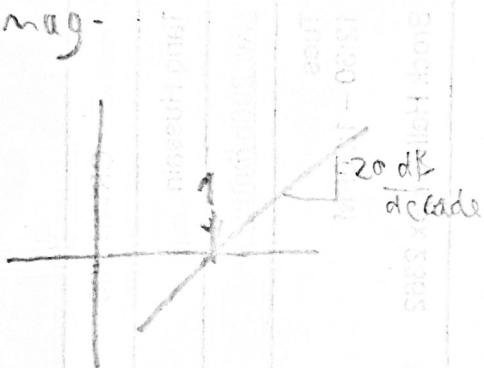
$$= \frac{1}{s} (s)$$

$$Y(s) = 1 \rightarrow \text{impulse}$$

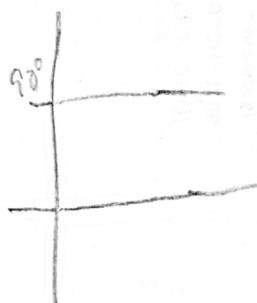


$$\text{Lade} = H(s) = s$$

mag -

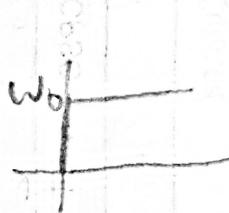


freq



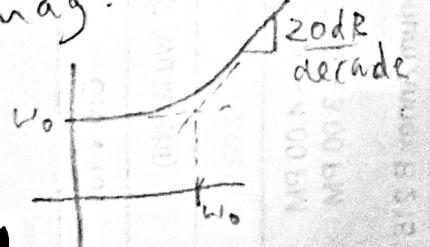
1b. Step:

$$Y(s) = 1 + \frac{w_0}{s}$$

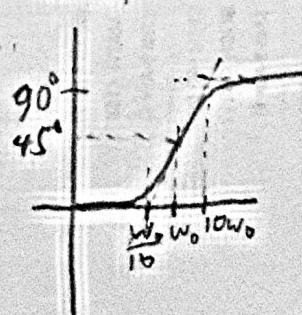


$$\text{Lade} \rightarrow H(s) = s + w_0 = w_0 \left( \frac{s}{w_0} + 1 \right)$$

mag -



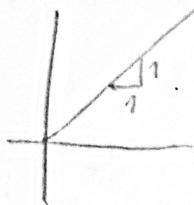
freq



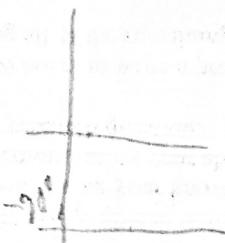
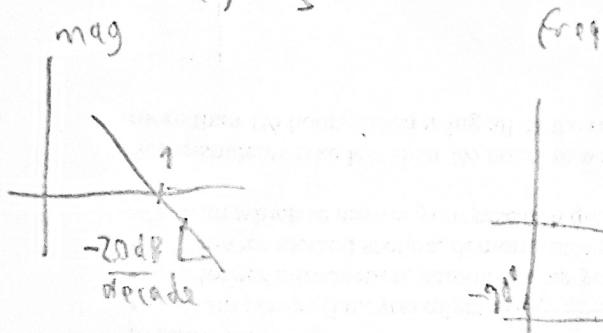
Rottensoon Paragym

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1c.  $y(s) = \frac{1}{s}$   
 $y(t) = t$



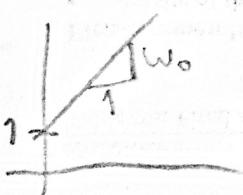
bode:  $H(s) = \frac{1}{s}$   
 mag



1d. step

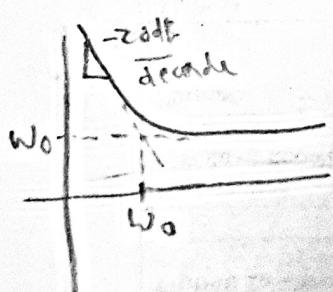
$$y(s) = \frac{1}{s} \left( \frac{w_0^2}{s} + 1 \right)$$

$$= \frac{w_0}{s^2} + \frac{1}{s} + \frac{w_0^2}{s^2}$$

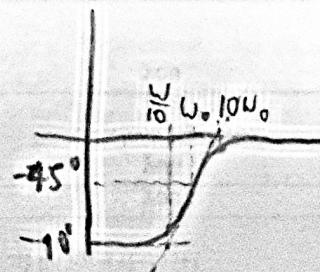


Bode:  $H(s) = \frac{w_0}{s} + 1 = w_0 \left( \frac{1}{s} \right) \left( 1 + \frac{s}{w_0} \right)$

mag



freq



1e.

Step

$$y(s) = \frac{2Ts+1}{Ts^2 + S} = \frac{1}{S} + \frac{(2-\alpha)\tau}{\tau s + 1} - \frac{1}{S} \rightarrow (\alpha-1) \left( \frac{1}{S} - \left( \frac{1}{\tau s + 1} \right) \right)$$

$$y(t) = 1 + (\alpha-1) e^{-t/\tau}$$

 $\alpha <$ 

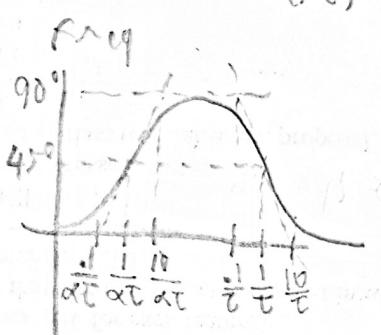
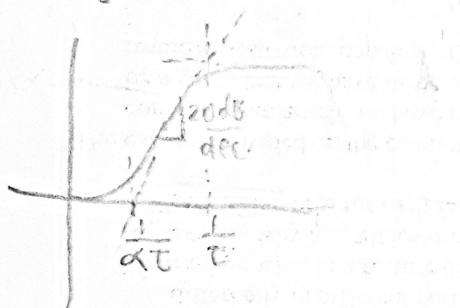
init = 1

ss = 1

time const =  $\tau$ 

$$\text{bode: } H(s) = \frac{2Ts+1}{\tau s + 1} = \frac{\left(\frac{s}{(1/\tau)} + 1\right)}{\left(\frac{s}{(1/\tau)} + 1\right)} \left( \frac{1}{\frac{s}{(1/\tau)} + 1} \right)$$

mag

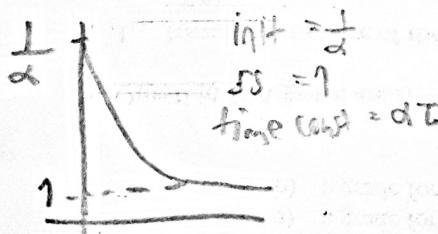


1f.

Step

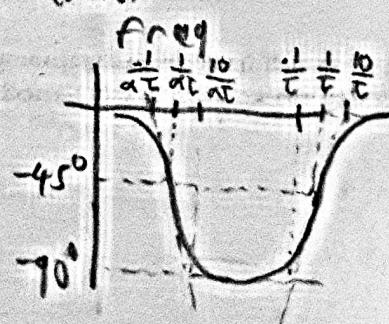
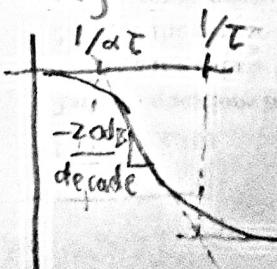
$$y(t) = \frac{Ts+1}{\alpha Ts+1} \left( \frac{1}{S} \right) = \frac{1}{S} + \frac{(1-\alpha)\tau}{\alpha\tau s + 1} = \frac{1}{S} + \frac{(1-\alpha)/\alpha}{S + \frac{1}{\alpha\tau}} = \frac{1}{S} + \frac{(1-\alpha)}{\alpha} \left( \frac{1}{S} - \left( \frac{1}{S + \frac{1}{\alpha\tau}} \right) \right)$$

$$y(t) = 1 + \left( \frac{1-\alpha}{\alpha} \right) e^{-t/\alpha\tau}$$

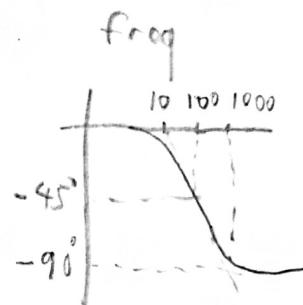
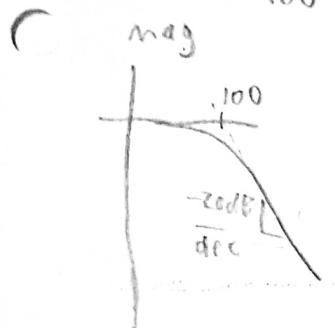


$$\text{bode: } H(s) = \left( 1 + \frac{S}{(1/\tau)} \right) \left( 1 + \frac{S}{(1/\alpha\tau)} \right)$$

mag



2a.  $H(s) = \frac{1}{s+1}$



2b. Read from bode, where,  $\omega = 10$

$$H(j\omega) = \frac{1}{j+1} = \frac{10}{j+10} \times \frac{(j-10)}{(j-10)} = \frac{10j-100}{j^2-100} = \frac{10j-100}{-101}$$

$$|H(j\omega)| = \frac{1}{\sqrt{-101}} \sqrt{10^2 + 100^2} \approx -0.995$$

C  $\angle H(j\omega) = \tan^{-1}\left(\frac{10}{-101}\right) \approx -0.1 \text{ rad}$

$$y(t) = -0.995 \sin\left(10t + \frac{\pi}{2} - 0.1\right)$$

2c.  $\omega = 100$

$$H(j\omega) = \frac{1}{j+1} = \frac{j-1}{j^2+1} = \frac{j-1}{-2}$$

$$|H(j\omega)| = \frac{1}{\sqrt{-2}} \sqrt{1^2 + 1^2} = \frac{\sqrt{2}}{2}$$

C  $\angle H(j\omega) = -\frac{\pi}{4}$

$$y(t) = \frac{\sqrt{2}}{2} \sin\left(100t + \frac{5\pi}{2}\right)$$

2d.  $\omega = 1000$

$$H(j\omega) = \frac{1}{j+1} = \frac{10j-1}{-100-1} = \frac{10j-1}{-101}$$

C  $|H(j\omega)| = \frac{1}{\sqrt{-101}} \sqrt{10^2 + 1^2} = \frac{\sqrt{101}}{101} \approx 1$

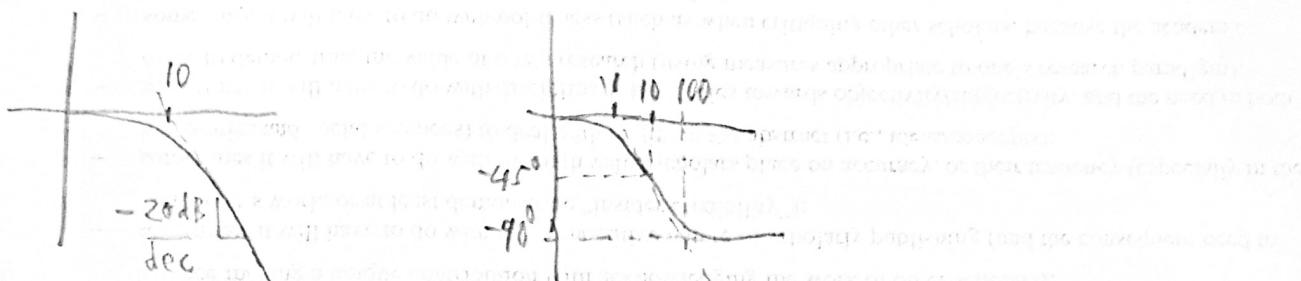
$$\angle H(j\omega) = -\frac{\pi}{2} + .1 \text{ rad} \quad (\text{symmetric to } \angle H(j10))$$

$$y(t) = \frac{\sqrt{101}}{101} \sin\left(1000t + \frac{\pi}{2} + .1\right)$$

$$3a. H(s) = \frac{1}{\frac{s}{10} + 1}$$

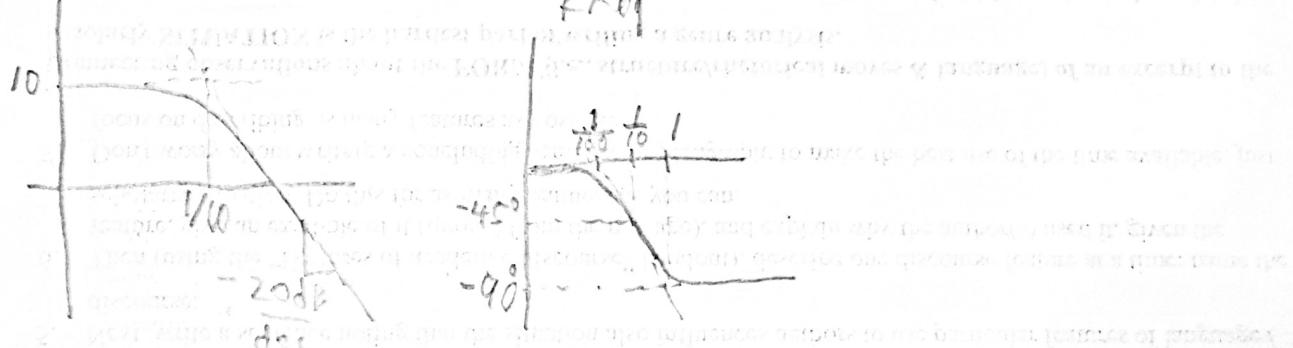
mag

freq



$$3b. H(s) = \frac{1}{s + \frac{1}{10}} \quad \left( \frac{1}{s + 1/10} \right)$$

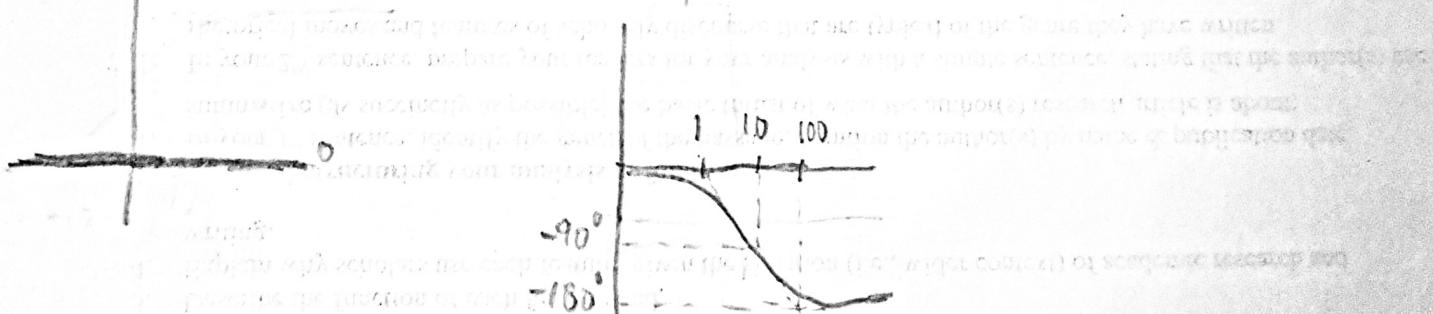
mag freq



$$3c. H(s) = \frac{1 + \frac{1}{s/10}}{1 + \frac{1}{s/10}}$$

mag

freq



$$3d. H(s) = 10 \left( \frac{1}{s/10} + 1 \right) H_3(s)$$

mag

freq

