

HW # 12

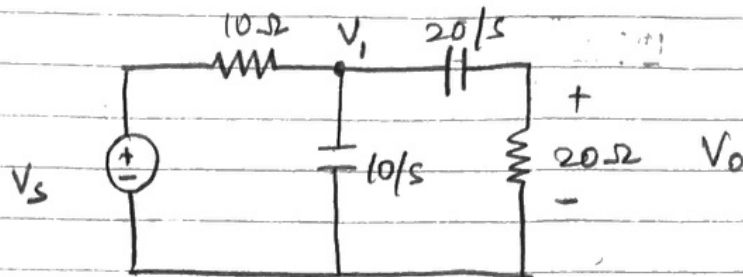
* 14.6

* 14.12

* 14.15

* 14.22

14.6



KCL at node 1:

$$\textcircled{1/2} \quad \frac{V_1 - V_s}{10} + \frac{V_1}{10/s} + \frac{V_1}{(20/s + 20)} = 0$$

$$\Rightarrow V_1 + sV_1 + \frac{V_1}{(2/s + 2)} = V_s$$

$$\Rightarrow (s+1)V_1 + \frac{0.5sV_1}{(s+1)} = V_s$$

$$\textcircled{1/2} \Rightarrow \frac{(s^2 + 2.5s + 1)V_1}{(s+1)} = V_s \quad \text{--- (1)}$$

Now,

$$V_o = \left(\frac{20}{20 + 20/s} \right) V_1$$

$$\textcircled{1/2} \therefore V_o = \frac{s}{(s+1)} V_1 \quad \text{--- (2)}$$

From (1) & (2)

$$V_s = \frac{(s^2 + 2.5s + 1)}{s} V_o$$

$$\textcircled{1/2} \therefore H(s) = \frac{V_o(s)}{V_s(s)} = \frac{s}{s^2 + 2.5s + 1}$$

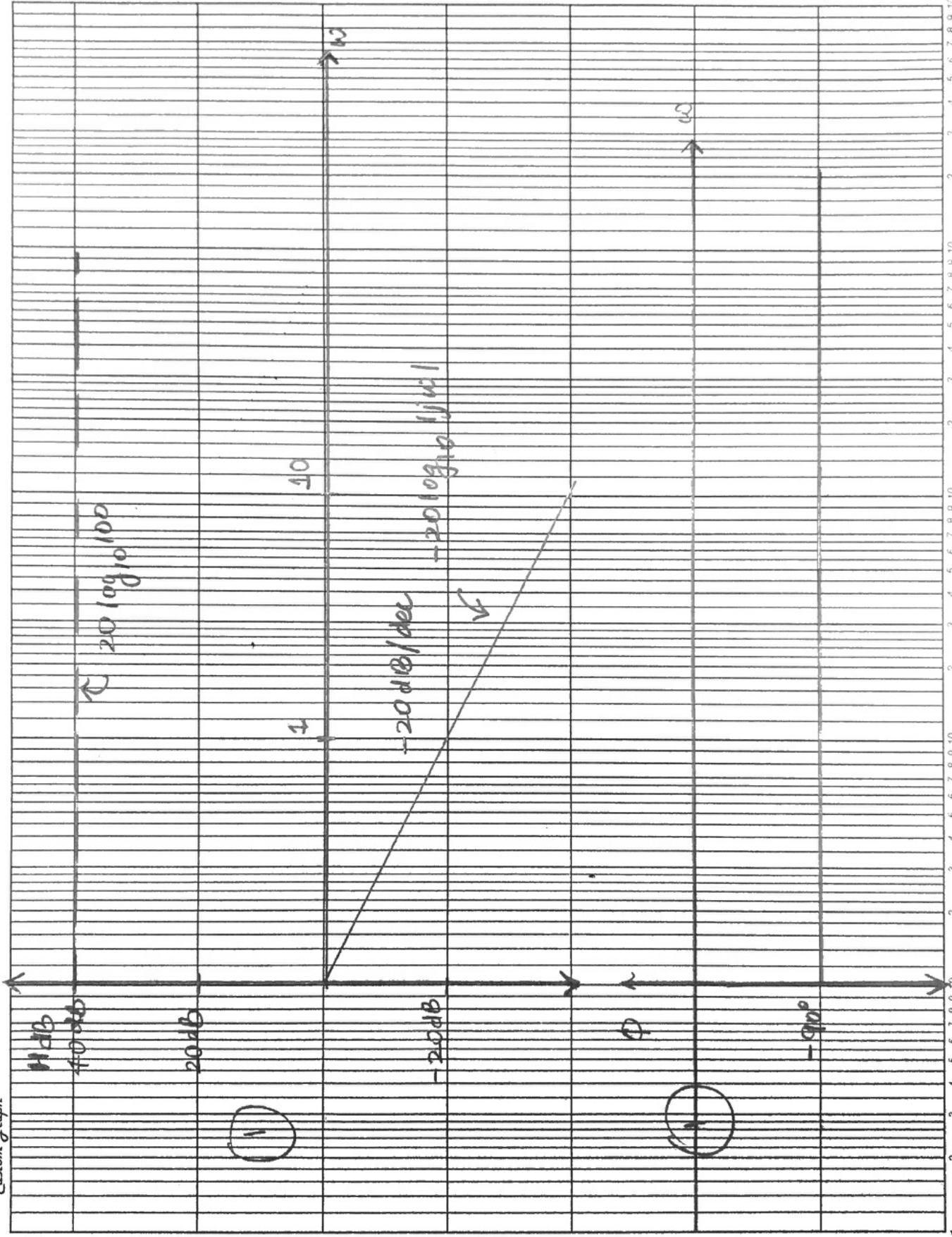
14.12

$$T(s) = \frac{100(s+10)}{s(s+10)}$$

$$\therefore T(\omega) = \frac{100}{j\omega}$$

$$\begin{aligned} \textcircled{1/2} \quad H_{dB} &= 20 \log_{10} 100 - 20 \log_{10} |j\omega| \\ &= 40 - 20 \log_{10} |j\omega| \end{aligned}$$

$$\textcircled{1/2} \quad \phi = -90^\circ$$



14.15

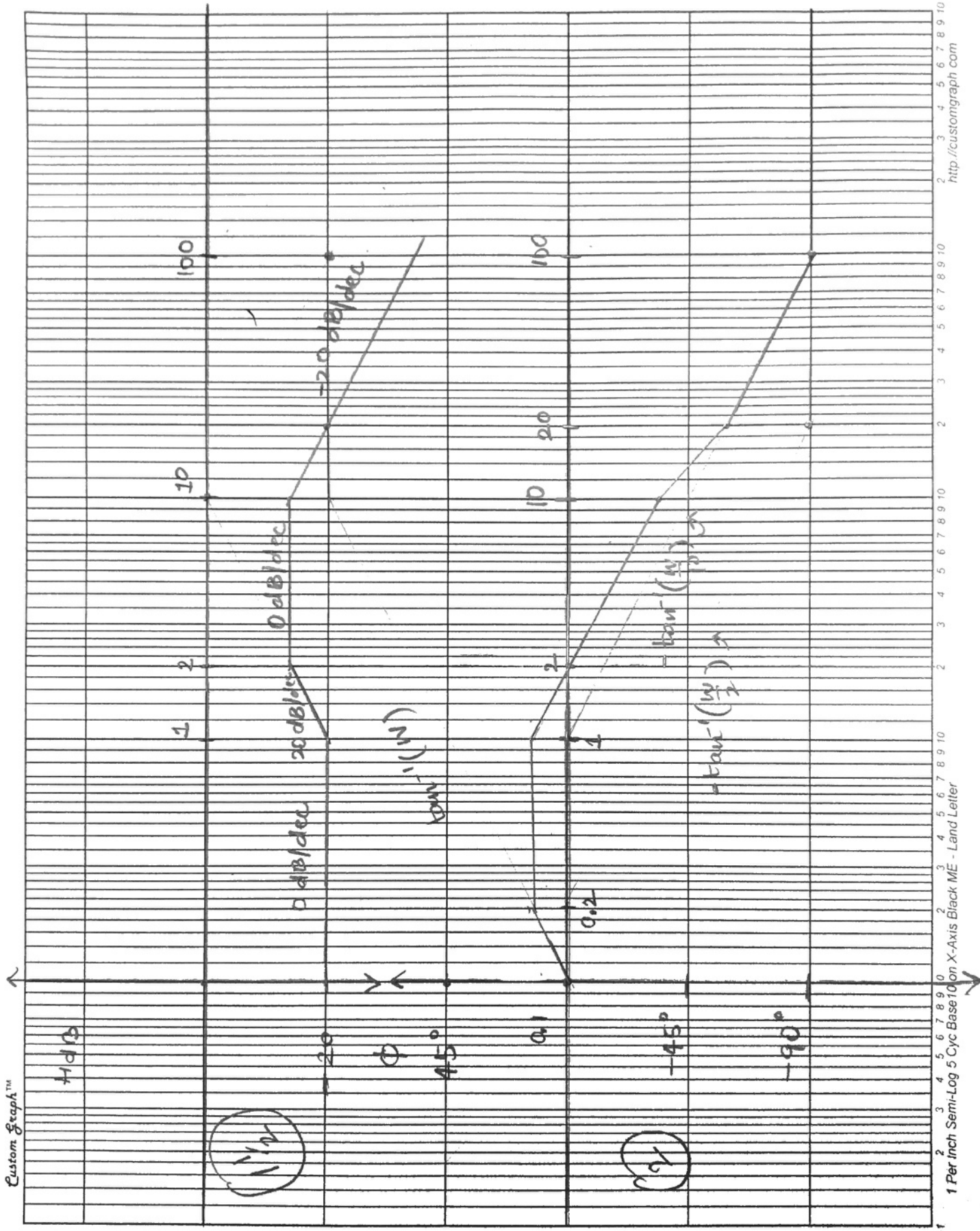
$$H(s) = \frac{2(s+1)}{(s+2)(s+10)}, \quad s = j\omega.$$

$$= \frac{2}{20} \frac{(1+j\omega)}{(1+j\omega/2)(1+j\omega/10)}$$

$$\left(\frac{1}{2}\right) = \frac{0.1 (1+j\omega)}{(1+j\omega/2)(1+j\omega/10)}$$

$$\left(\frac{1}{2}\right) H_{dB} = 20 \log_{10} 0.1 + 20 \log_{10} |1+j\omega| - 20 \log_{10} |1+j\omega/2| - 20 \log_{10} |1+j\omega/10|$$

$$\left(\frac{1}{2}\right) \phi = \tan^{-1}\left(\frac{\omega}{1}\right) - \tan^{-1}\left(\frac{\omega}{2}\right) - \tan^{-1}\left(\frac{\omega}{10}\right)$$



14.22

(i) $20 \log_{10} k = 0$

(1)

$\Rightarrow \underline{k = 1}$

(ii) Zero: 20 dB/dec at $\omega = 2$

(1)

$H_1(\omega) = 1 + \frac{j\omega}{2}$

(iii) Pole: -20 dB/dec at $\omega = 20$

(1)

$H_2(\omega) = \frac{1}{(1 + \frac{j\omega}{20})}$

(iv) Pole: -20 dB/dec at $\omega = 100$

(1)

$H_3(\omega) = \frac{1}{(1 + \frac{j\omega}{100})}$

$\therefore H(\omega) = k \cdot H_1(\omega) \cdot H_2(\omega) \cdot H_3(\omega)$

$= \frac{(1 + \frac{j\omega}{2})}{(1 + \frac{j\omega}{20})(1 + \frac{j\omega}{100})}$

(1)

$= (\frac{1}{2} \times 20 \times 100) \frac{(2 + j\omega)}{(20 + j\omega)(100 + j\omega)}$

$= 1000 \frac{(2 + j\omega)}{(20 + j\omega)(100 + j\omega)}$