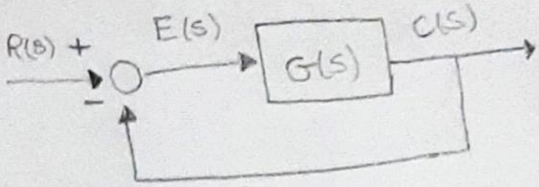
1.



a) $G(s) = \dfrac{K(s+1)}{s^2(s+3{,}6)}$

$\theta_a = \dfrac{(2K+1)\times 180}{\#polos - \#zeros}$; $K = 0,1,2$

$\sigma_a = \dfrac{\sum polos - \sum zeros}{\#polos - \# zeros}$

$\theta_a = \dfrac{(2K+1)\times 180}{3-1}$; $K = 0;1$

$\theta_a = \pm 90°$

$\sigma_a = \dfrac{(-3{,}6+0+0)-(-1)}{3-1} = \dfrac{-2{,}6}{2}$

$\sigma_a = -1{,}3$

b) $G(s) = \dfrac{K}{s(s^2+4s+5)}$

$\theta_a = \dfrac{(2K+1)\times 180}{3}$; $K = 0,1,2$

$\sigma_a = \dfrac{(0+(-2+i)+(-2-i))-0}{3-0}$

$\theta_a = \pm 60°, 180$

$0 = \dfrac{1}{\sigma} + \dfrac{1}{\sigma+2+i} + \dfrac{1}{\sigma+2-i}$

$\sigma = \begin{cases} -1{,}67 \\ -1 \end{cases}$

$\sigma_a = -\dfrac{4}{3}$

$T(s) = \dfrac{K}{s^3+4s^2+5s+K}$

s^3	1	5
		K
s^1	$-\dfrac{\begin{vmatrix}1 & 5\\ 4 & K\end{vmatrix}}{4} = \dfrac{20-K}{4}$	0
s^0	$-\dfrac{\begin{vmatrix}4 & K\\ \frac{20-K}{4} & 0\end{vmatrix}}{\frac{20-K}{4}}$	0

Linha de zeros:

$\dfrac{20-K}{4} = 0$

$K = 20$

Usando a linha acima da linha de zeros

$4s^2 + 20 = 0$

$s = \pm\sqrt{5}\, i$

Angulos de partida dos polos complexos

$\sum \theta zeros - \sum \theta polos = 180°$

$-(\theta_1 + 90° + 153{,}43°) = 180°$

$\theta_1 = -423{,}43° = -63{,}43°$

2) $K \cdot G(s) \cdot H(s) = \dfrac{10K}{s(s+2)}$

$$\sigma_a = \overline{\sum \text{polos} - \sum \text{zeros}}$$

$$\theta_a = \frac{(2K+1)180}{\#\text{polos} - \#\text{zeros}} \;;\; K = 0,1,2$$

$$\sigma_a = \frac{-2}{2} = -1$$

$$\theta_a = (2K+1) \cdot 180 \;;\; K = 0,1$$

$$\theta_a = \pm 90^\circ$$

$$\sum_1^m \frac{1}{\sigma + z_i} = \sum_1^n \frac{1}{\sigma + p_i}$$

$$\Rightarrow 0 = \frac{1}{\sigma} + \frac{1}{\sigma+2} \Rightarrow \sigma = -1$$

3) a) $G(s) = \dfrac{K(s^2 - 2s + 2)}{(s+2)(s+4)(s+5)(s+6)}$

$$\sigma_a = \frac{\sum \text{polos} - \sum \text{zeros}}{\#\text{polos} - \#\text{zeros}}$$

$$\theta_a = \frac{(2K+1) \times 180}{\#\text{polos} - \#\text{zeros}} \;;\; K = 0,1,2$$

$$\sigma_a = \frac{-17-2}{4-2} = \frac{-19}{2}$$

$$\theta_a = \frac{(2K+1) \times 180}{2} \;;\; K = 0,1$$

$$\sum_1^m \frac{1}{\sigma + z_i} = \sum_1^m \frac{1}{\sigma + p_i} \Rightarrow \frac{1}{\sigma - 1 + i} + \frac{1}{\sigma - 1 - i} = \frac{1}{\sigma+2} + \frac{1}{\sigma+4} + \frac{1}{\sigma+5} + \frac{1}{\sigma+6} \Rightarrow$$

$-5{,}5754 \checkmark$
$-4{,}4288 \times$
$-2{,}5274 \checkmark$
$1{,}4614 \times$
$5{,}5702 \times$

$$T(s) = \frac{K(s^2 - 2s + 2)}{s^4 + 17s^3 + s^2(K + 104) - s(2K - 268) + (2K+240)}$$

s^4	1	$K + 104$	$2K + 240$
s^3	17	$268 - 2K$	0
s^2	$\dfrac{-\begin{vmatrix} 1 & K+104 \\ 17 & 268-2K \end{vmatrix}}{17} = \dfrac{19K - 1500}{17}$	$\dfrac{-\begin{vmatrix} 1 & 2K+240 \\ 17 & 0 \end{vmatrix}}{17} = 2K + 240$	0
s^1	$\dfrac{-\begin{vmatrix} 17 & 268-2K \\ \frac{19K+1500}{17} & 2K+240 \end{vmatrix}}{\frac{19K-1500}{17}} = \dfrac{\dfrac{-(59K \; 42K - 268)(19K+1500) + 4080)}{17}}{\dfrac{19K+1500}{17}}$	0	
s^0	$2K + 240$	0	0

Linha de zeros

$$34K + (2K - 268)\frac{(19K + 1500)}{17} + 4080 = 0 \Rightarrow K = 115{,}58$$

Usando a linha acima da linha de zeros

$$s^2\left(\frac{19(115{,}58) + 1500}{17}\right) + 2(115{,}58) + 240 = 0$$

$$= \pm 1{,}47i$$

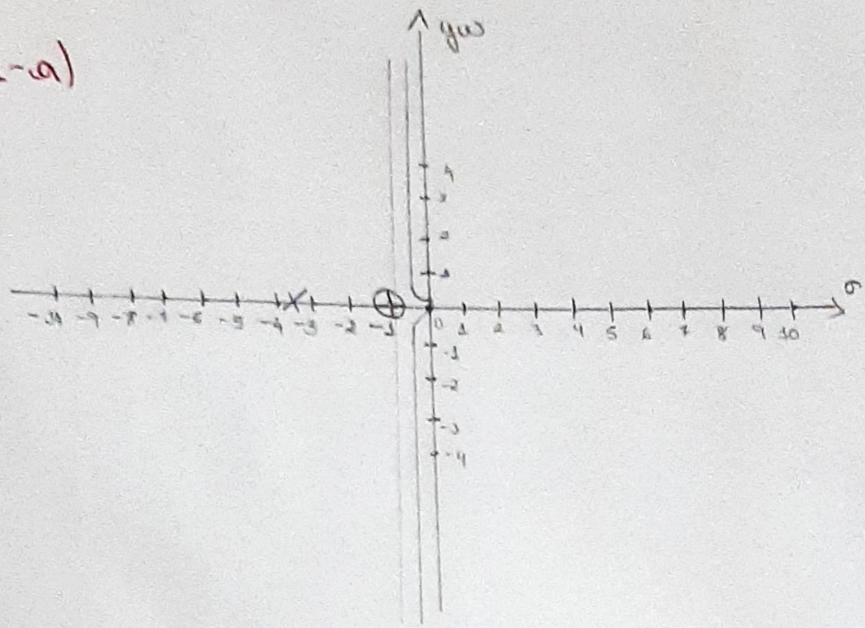
$$(\theta_1 + 180 + 180 + 180) + (171{,}87 + 171{,}87) = 180^\circ$$

$$= -16{,}26$$

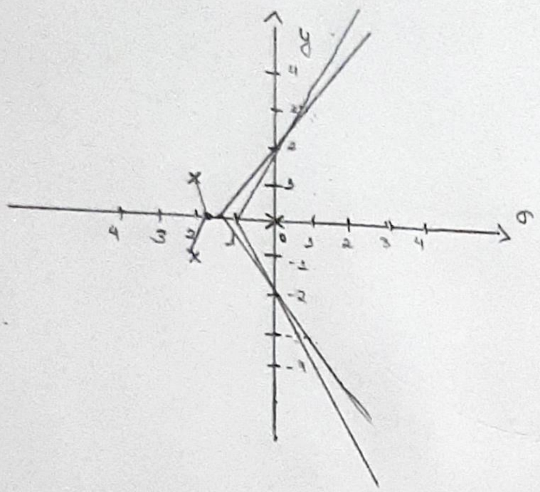
$$(113 + 9{,}46 + 11{,}3 + 18{,}43) + (\theta_2 + 90) = 180^\circ$$

$$= 137{,}32^\circ$$

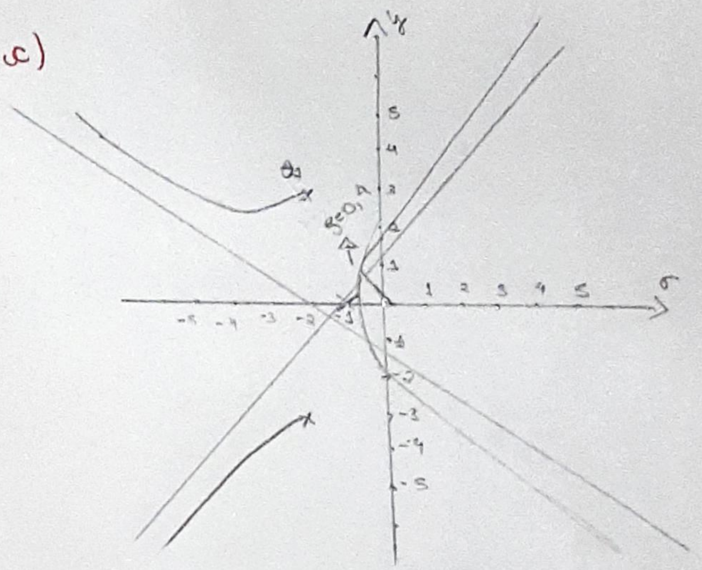
1-a)



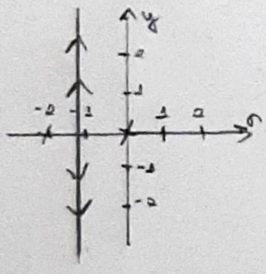
b)



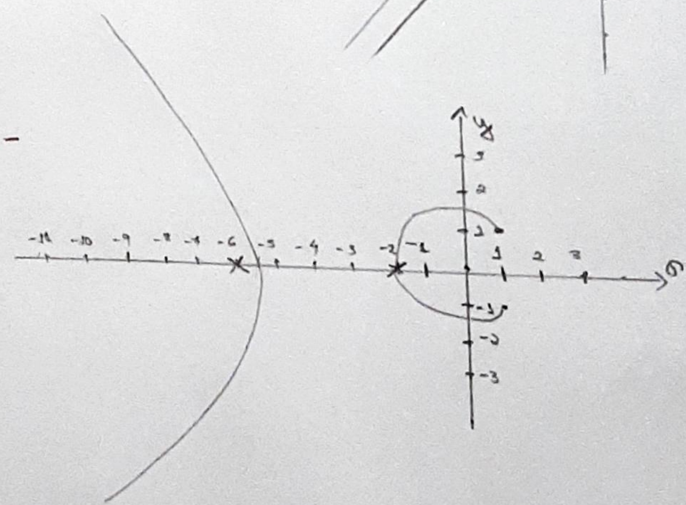
c)



2-



3-



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