

$$1) \mathcal{Z}(s) = \frac{K}{(s+1)(s+10)}$$

$$\mathcal{Z}(jw) = \frac{K}{(jw+1)(jw+10)}$$

$$\angle \mathcal{Z}(jw) = -(\arctg(w) + \arctg(\frac{w}{10}))$$

$$b) \text{ para } K=100$$

$$w=0,1 \quad |\mathcal{Z}(jw)| = \frac{100}{\sqrt{0,1^2+1} \cdot \sqrt{0,1^2+100}} = 9,95$$

$$\angle \mathcal{Z}(jw) = -(\arctg(0,1) + \arctg(\frac{0,1}{10})) = -6,3^\circ$$

:

mod	ang
9,95	-6,3°
9,98	-12,95°
8,9	-29,42°
7,78	-43,23°
7	-50,7°
4,38	-74,74°
2,25	-97,76°
0,7	-129,3°
0,009	-173,71°

$$\text{Modulo} = \frac{100}{\sqrt{w^2 + 1^2} * \sqrt{w^2 + 10^2}}$$

VICTOR
CALEBE

①

data
 S T Q Q S S D

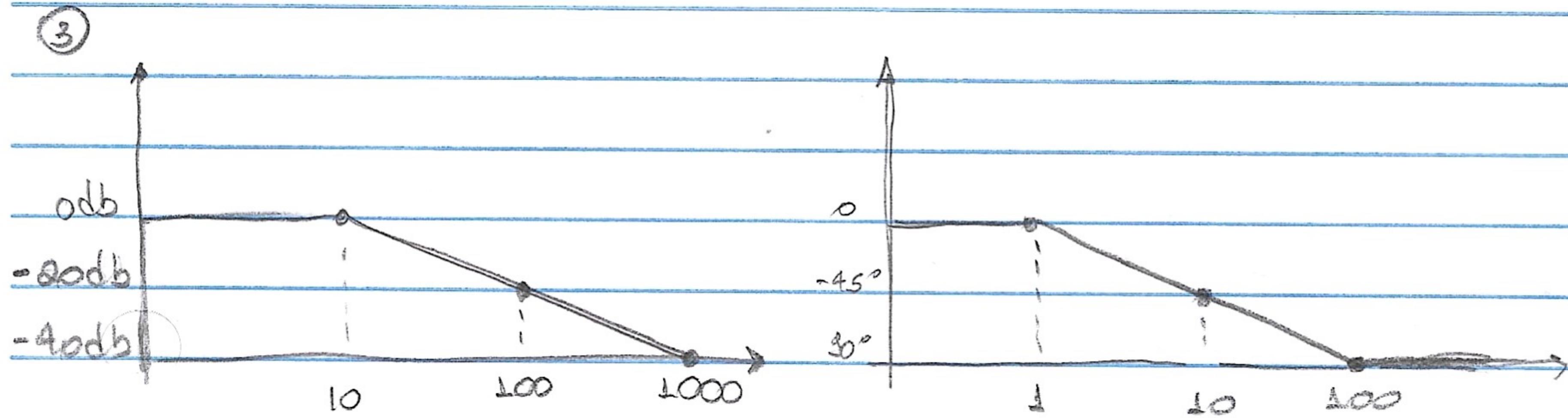
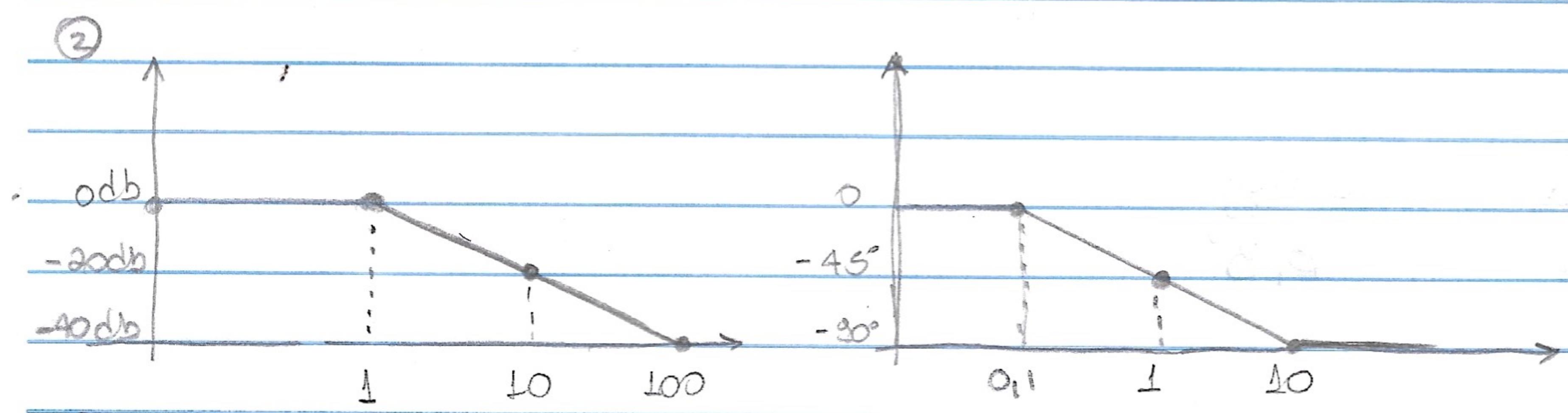
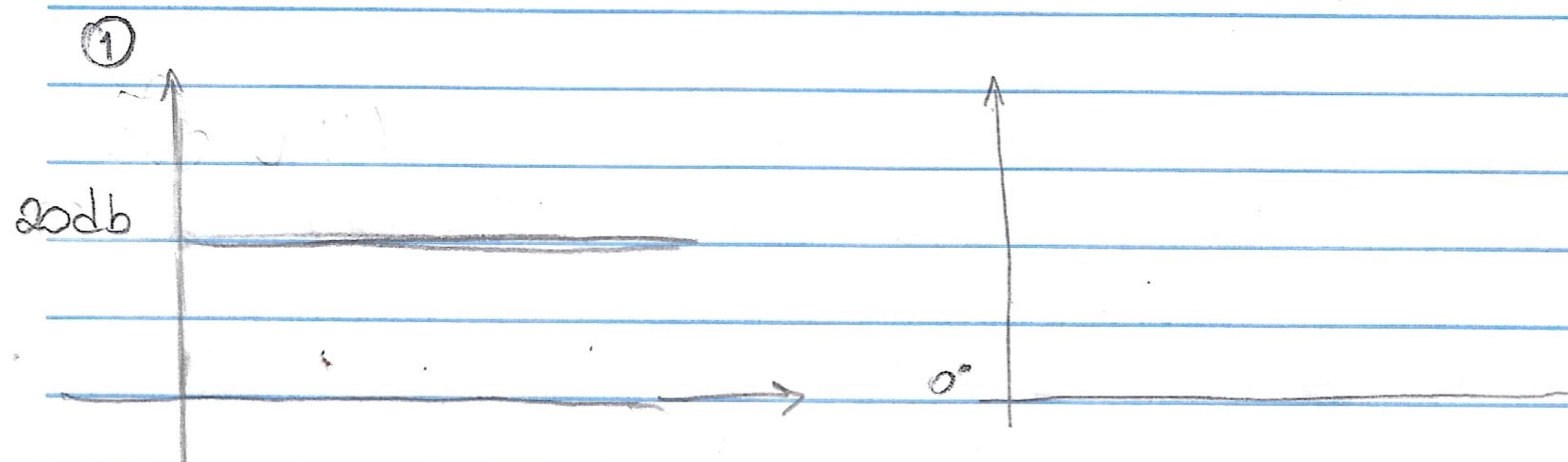
$$C \gg 10 \Rightarrow 100$$

$$(jw+1)(jw+10)$$

$$L(jw) = \frac{100}{(jw+1)(jw+10)} = \frac{100}{(jw+2)\cdot 10 \cdot (jw+1)}$$

$$\textcircled{1} \quad \textcircled{2} \quad \textcircled{3}$$

$$D(jw) = 10 \cdot \frac{1}{(jw+1)} \cdot \frac{1}{(jw+10)}$$



módulo:

$$W = 0,0001 \rightsquigarrow 20 + 0 + 0 = 20 \text{ db}$$

$$W = 0,001 \rightsquigarrow 20 + 0 + 0 = 20 \text{ db}$$

$$W = 0,01 \rightsquigarrow 20 + 0 + 0 = 20 \text{ db}$$

$$W = 0,1 \rightsquigarrow 20 + 0 + 0 = 20 \text{ db}$$

$$W = 1 \rightsquigarrow 20 + 0 + 0 = 20 \text{ db}$$

$$W = 10 \rightsquigarrow 20 - 20 + 0 = 0 \text{ db}$$

$$W = 100 \rightsquigarrow 20 - 40 - 20 = -40 \text{ db}$$

$$W = 100 \rightsquigarrow 20 - 60 - 40 = -80 \text{ db}$$

$$W = 1000 \rightsquigarrow 20 - 80 - 60 = -120 \text{ db}$$

ângulo:

$$W = 0,0001 \rightsquigarrow 0^\circ + 0 + 0 = 0^\circ$$

$$W = 0,001 \rightsquigarrow 0^\circ + 0^\circ + 0^\circ = 0^\circ$$

$$W = 0,01 \rightsquigarrow 0^\circ + 0^\circ + 0^\circ = 0^\circ$$

$$W = 0,1 \rightsquigarrow 0^\circ + 0^\circ + 0^\circ = 0^\circ$$

$$W = 1 \rightsquigarrow 0^\circ - 45^\circ + 0^\circ = -45^\circ$$

$$W = 10 \rightsquigarrow 0^\circ - 90^\circ - 45^\circ = -135^\circ$$

$$W = 100 \rightsquigarrow 0^\circ - 90^\circ - 90^\circ = -180^\circ$$

$$W = 1000 \rightsquigarrow 0^\circ - 90^\circ - 90^\circ = -180^\circ$$

(2)

2) a) ~~$G(s) = \frac{10}{s+10} + \frac{100}{s+100}$~~

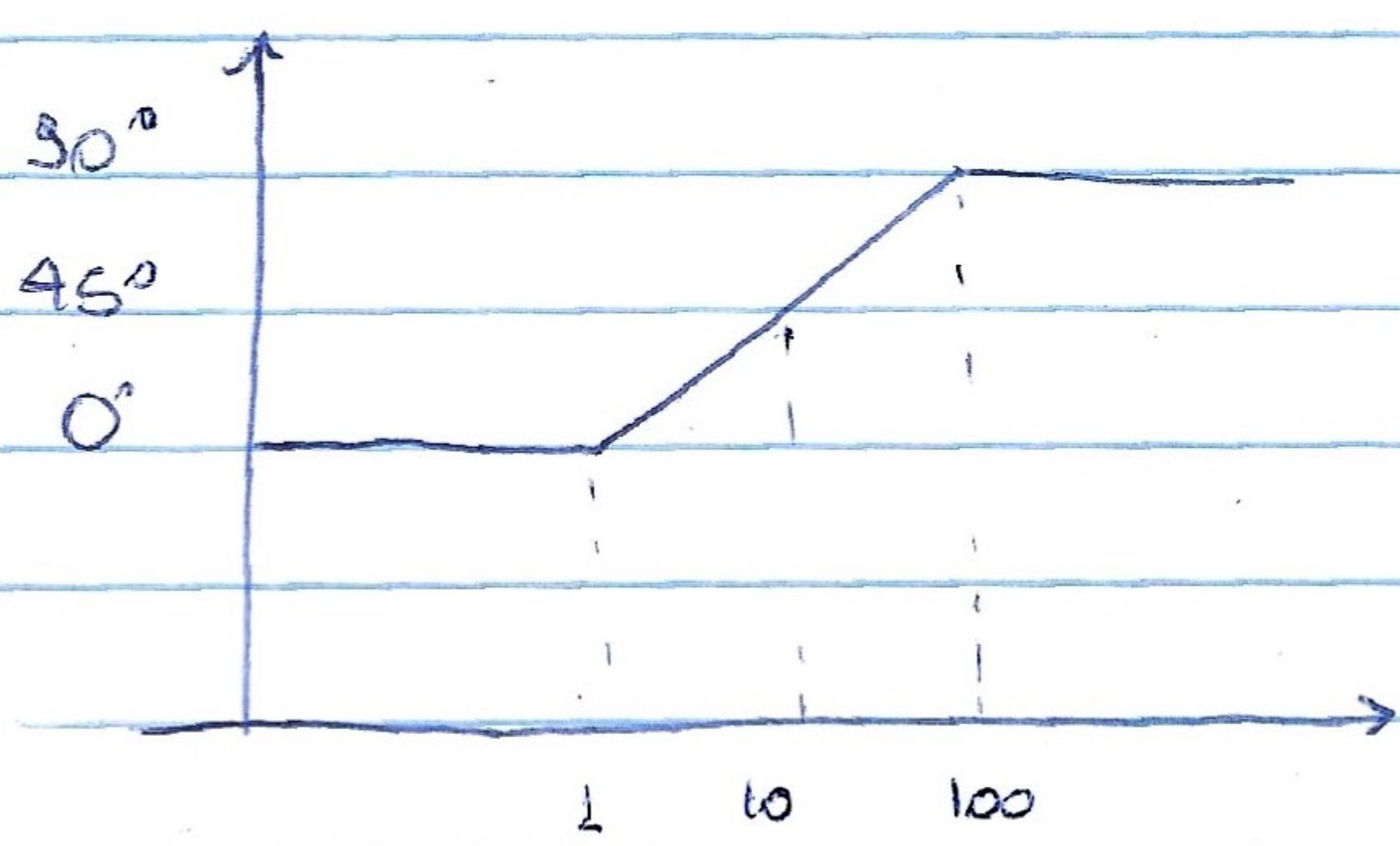
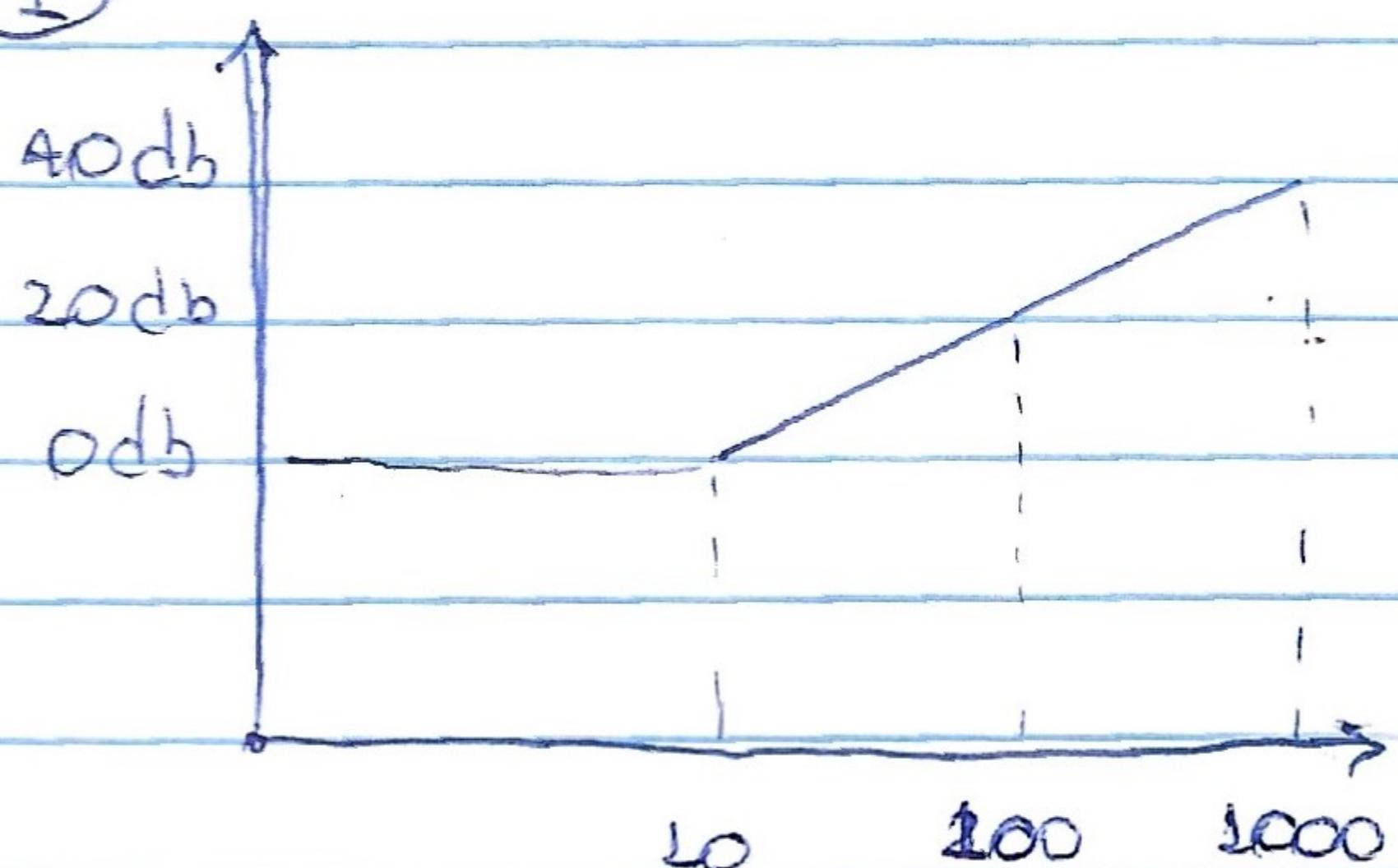
$$G_1(s) = \frac{10 (s+10)}{(s+100)} = \frac{100 (s/10 + 1)}{100 (s/100 + 1)}$$

$$G_1(s) = \left(\frac{s+1}{10} \right) / \frac{s+1}{100}$$

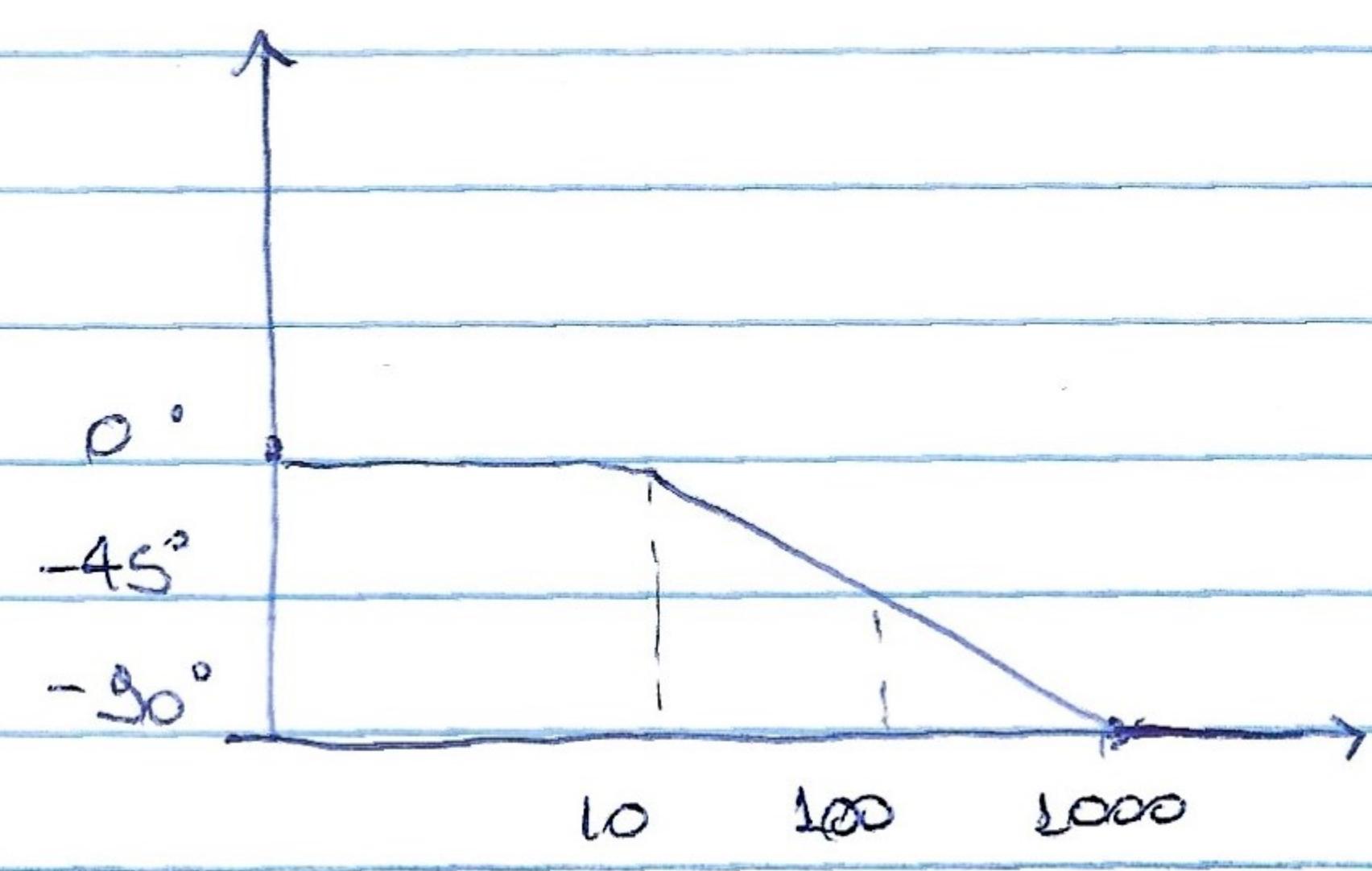
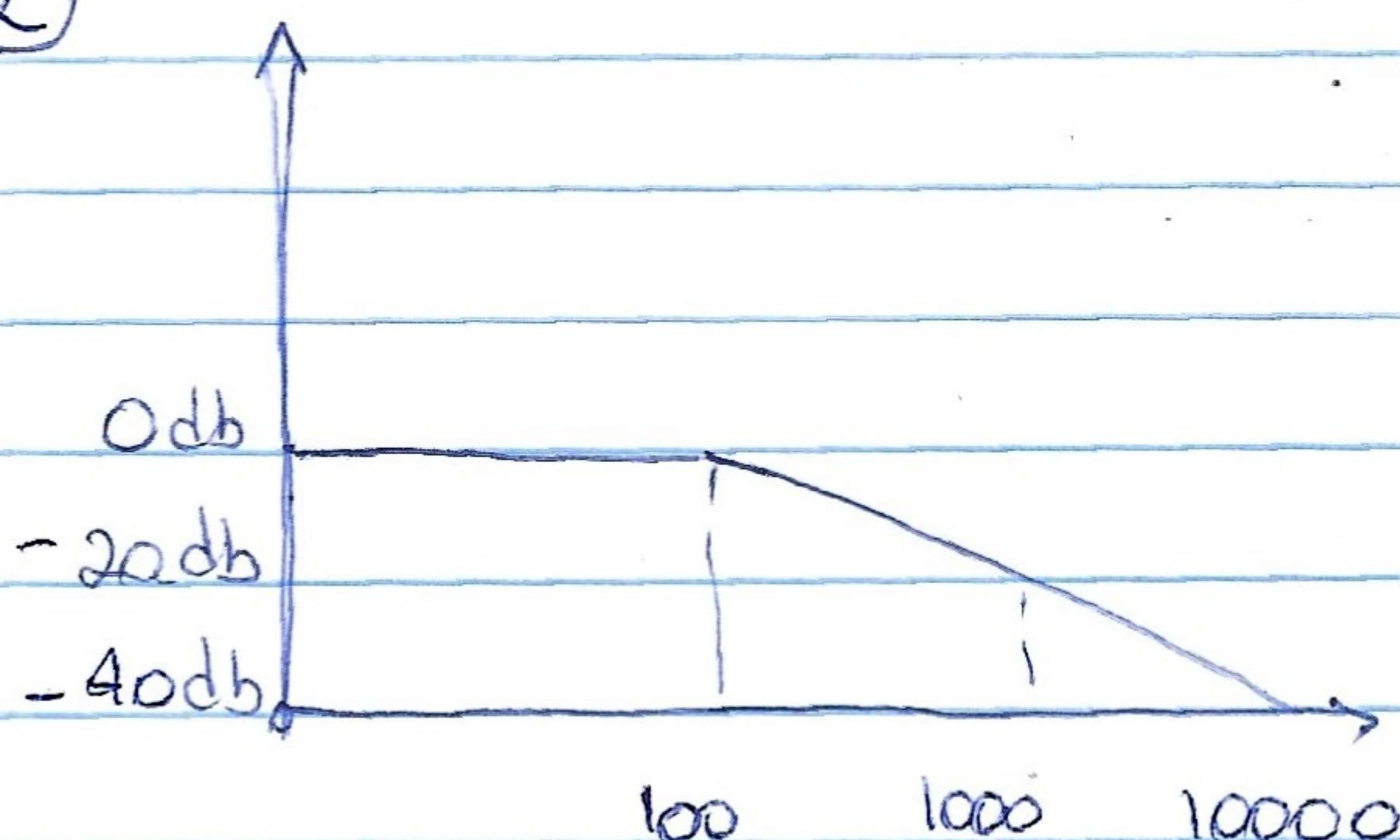
(1)

(2)

(1)



(2)



$$W = 0,0001 \quad : \text{modulo} = 0 \text{db}$$

$$\phi = 0^\circ$$

$$W = 0,001 \quad : \quad = 0 \text{ db}$$

$$= 0^\circ$$

$$W = 0,01 \quad : \quad = 0 \text{ db}$$

$$= 0^\circ$$

$$W = 0,1 \quad : \quad = 0 \text{ db}$$

$$= 0^\circ$$

$$W = 1 \quad : \quad = 0 \text{ db}$$

$$= 45^\circ$$

$$W = 10 \quad : \quad = 20 \text{ db}$$

$$= 45^\circ$$

$$W = 100 \quad : \quad = 40 \text{ db}$$

$$= 0^\circ$$

$$W = 1000 \quad : \quad = 40 \text{ db}$$

$$= 0^\circ$$

data

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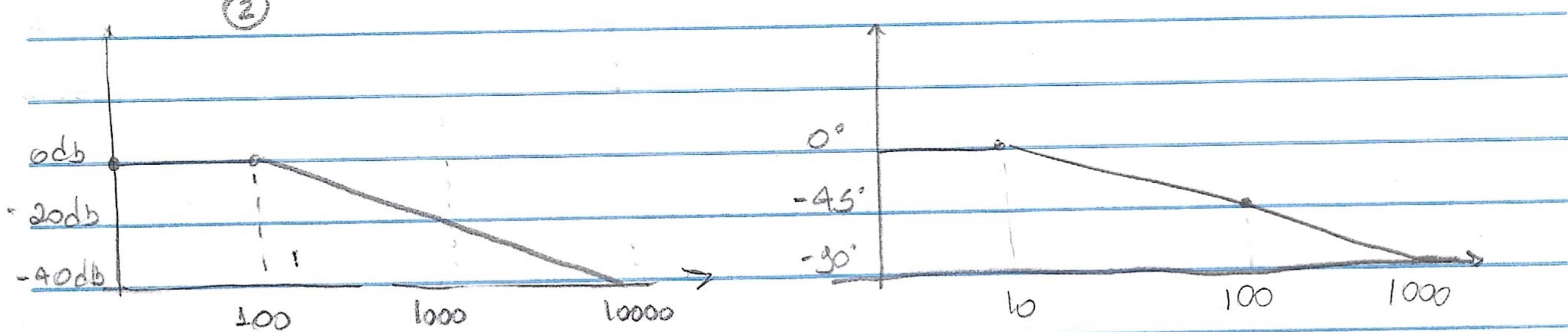
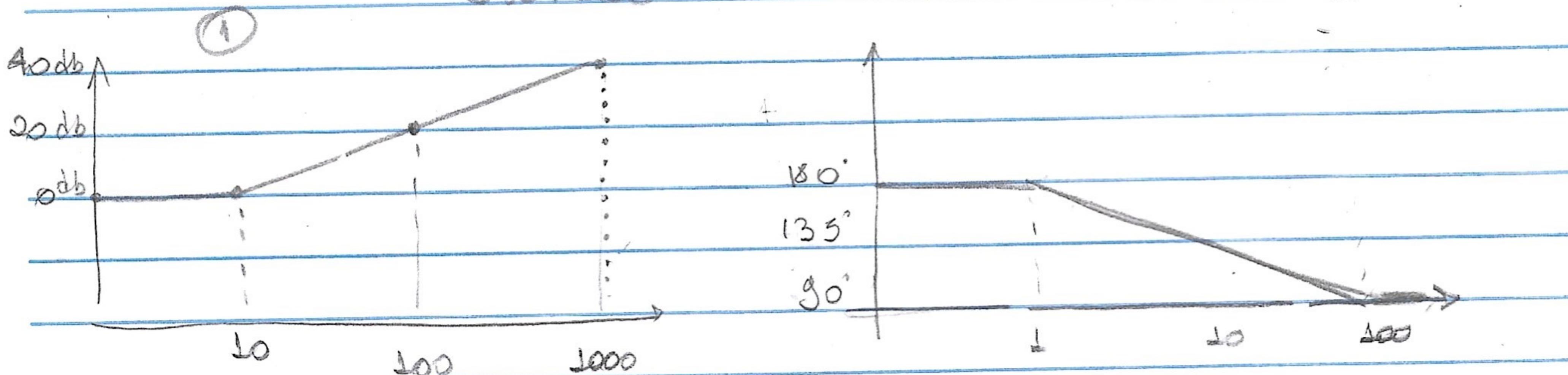
2) b)

$$G_2(s) = \frac{10(s-10)}{s+100}$$

$$G_2(jw) = \frac{10(jw-10)}{jw+100}$$

$$G_2(jw) = \frac{100(jw/10 - 1)}{100(jw/100 + 1)}$$

$$G_2(jw) = \frac{(jw/10 - 1)}{jw/100 + 1} \quad ①$$



módulo

$$W = 0,0001 = 0 \text{ db}$$

Angulo

180°

$$W = 0,001 = 0 \text{ db}$$

180°

$$W = 0,01 = 0 \text{ db}$$

180°

$$W = 0,1 = 0 \text{ db}$$

180°

$$W = 1 = 0 \text{ db}$$

180°

$$W = 10 = 0 \text{ db}$$

135°

$$W = 100 = 20 \text{ db}$$

45°

$$W = 1000 = 20 \text{ db}$$

0°

$$2) \quad P = 20 \text{ W}$$

$$W = 0,0001 = 0 \text{ db}$$

$$W = 0,001 = 0 \text{ db}$$

$$W = 0,01 = 0 \text{ db}$$

$$W = 0,1 = 0 \text{ db}$$

$$W = 1 = 0 \text{ db}$$

$$W = 10 = 0 \text{ db}$$

$$W = 100 = 0 \text{ db}$$

$$W = 1000 = 0 \text{ db}$$

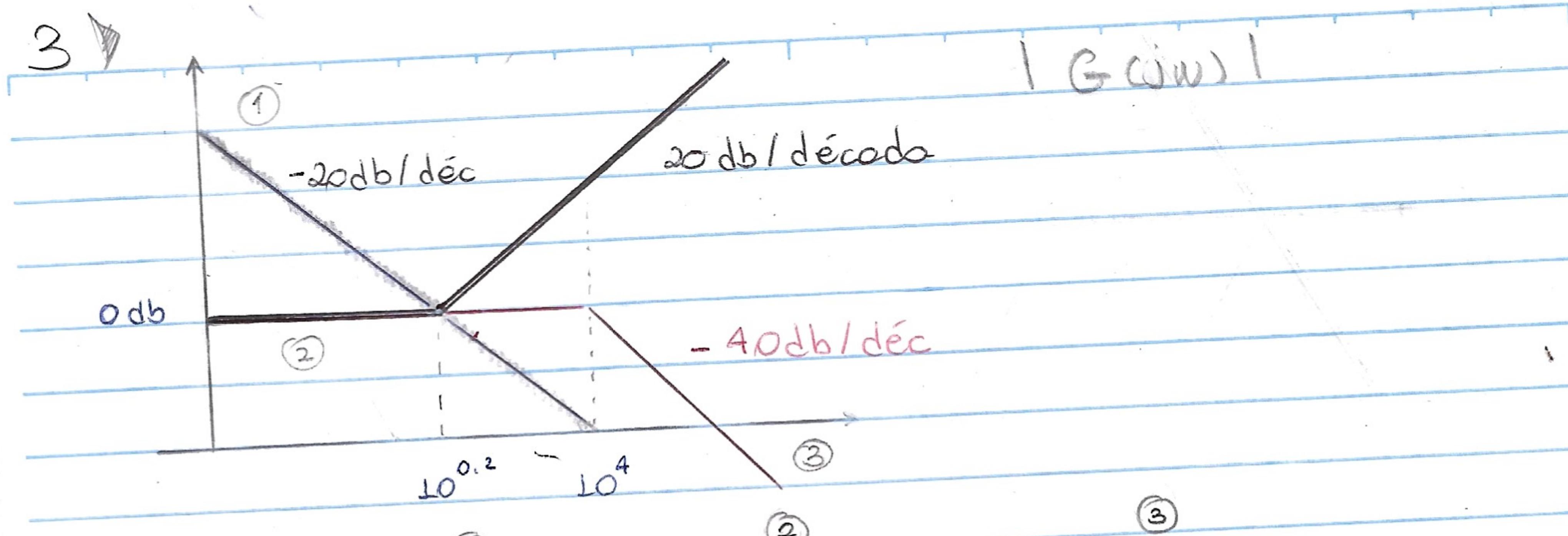
$$W = 10000 = 0 \text{ db}$$

$$W = 100000 = 0 \text{ db}$$

$$W = 1000000 = 0 \text{ db}$$

$$W = 10000000 = 0 \text{ db}$$

4)



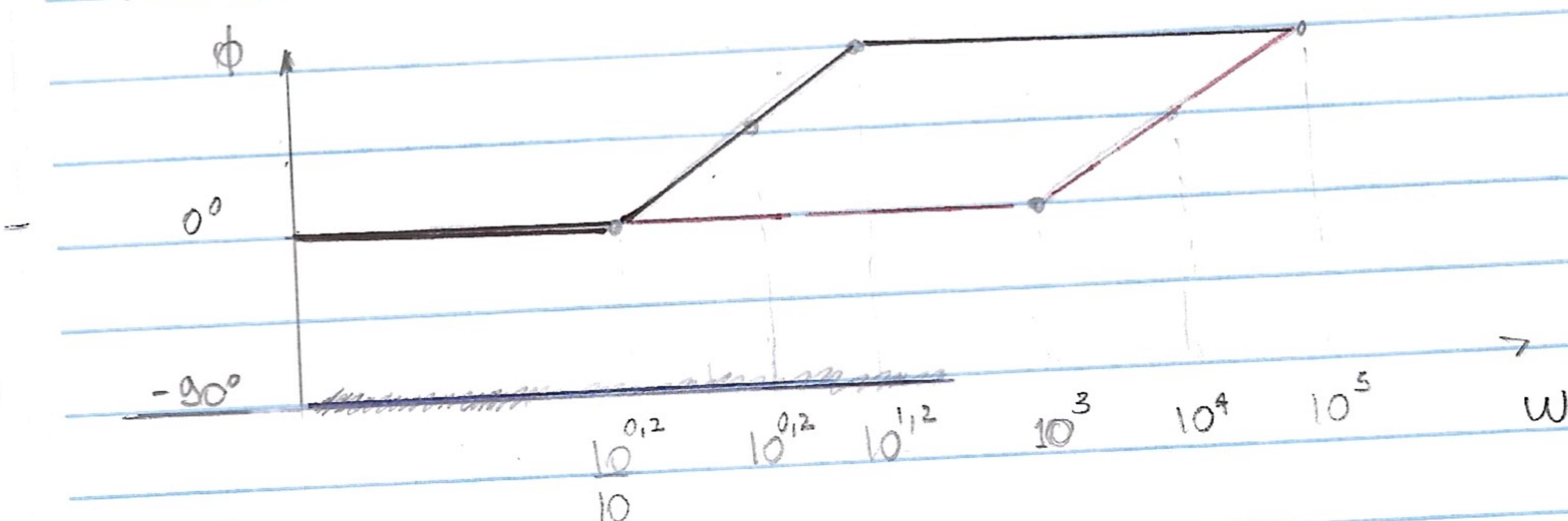
$$G_1(jw) = \frac{1}{jw} \cdot \left(\frac{jw + 1}{10^{0.2}} \right) \cdot \frac{1}{\left(\frac{jw + 1}{10^4} \right)^2}$$

Subindo o gráfico 12db

$$20 \log(\alpha) = 12 \quad ; \quad \alpha = 10^{0.6}$$

$$G(jw) = \frac{1}{jw} \cdot \left(\frac{jw + 1}{10^{0.2}} \right) \cdot \left(\frac{1}{\left(\frac{jw + 1}{10^4} \right)^2} \right) \cdot 10^{0.6}$$

$\angle G(jw)$



$$w = 0,0001 : \phi = -90^\circ$$

$$w = 0,001 : \phi = -90^\circ$$

$$w = 0,01 : \phi = -90^\circ$$

$$w = 0,1 : \phi = -90^\circ$$

$$w = 1 : \phi = -90^\circ$$

$$w = 10 : \phi = 0^\circ$$

$$w = 100 : \phi = 0^\circ$$

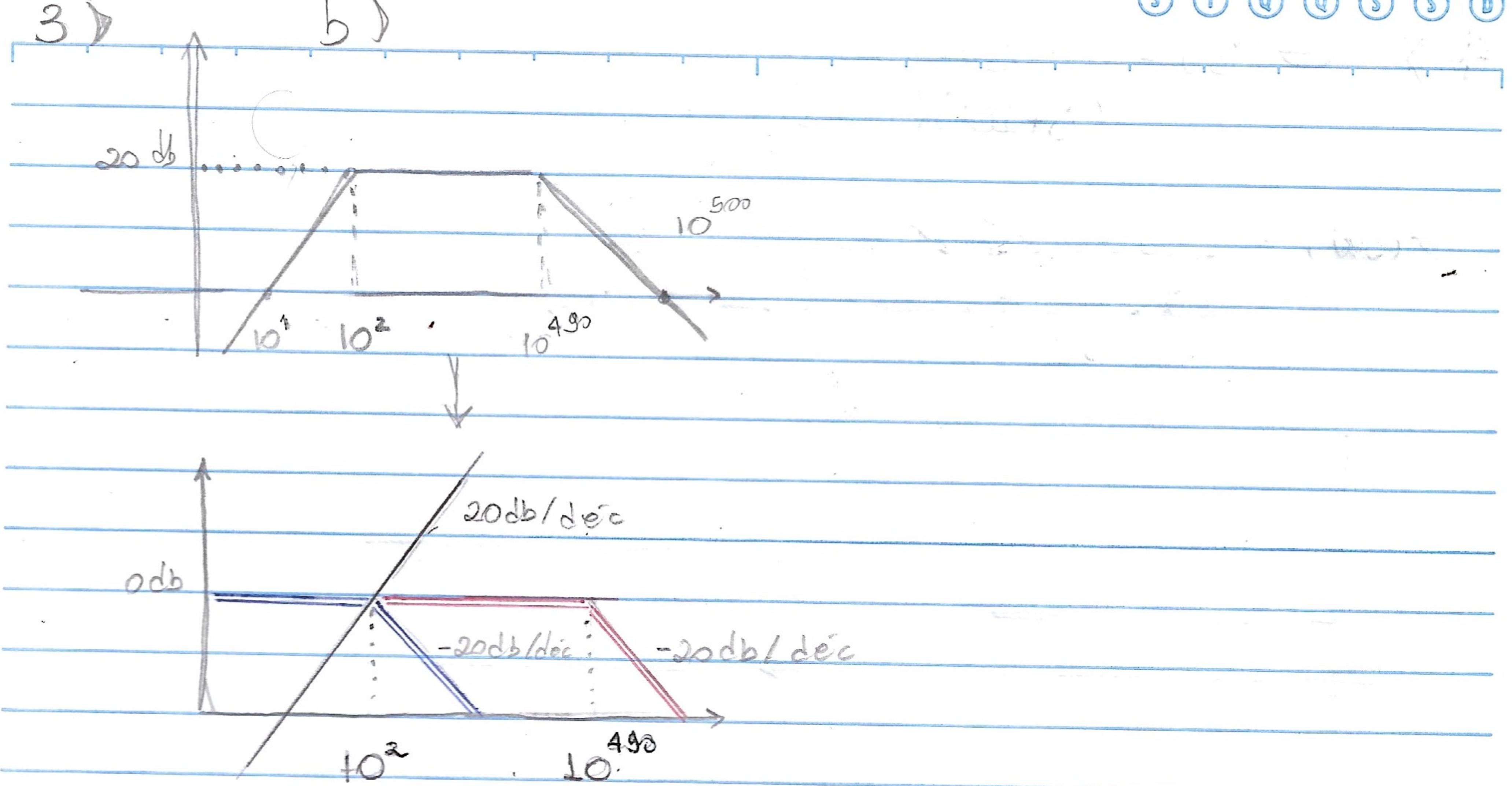
$$w = 1000 : \phi = 0^\circ$$

$$w = 10000 : \phi = 45^\circ$$

$$w = 100000 : \phi = 90^\circ$$

(5)

3) b)

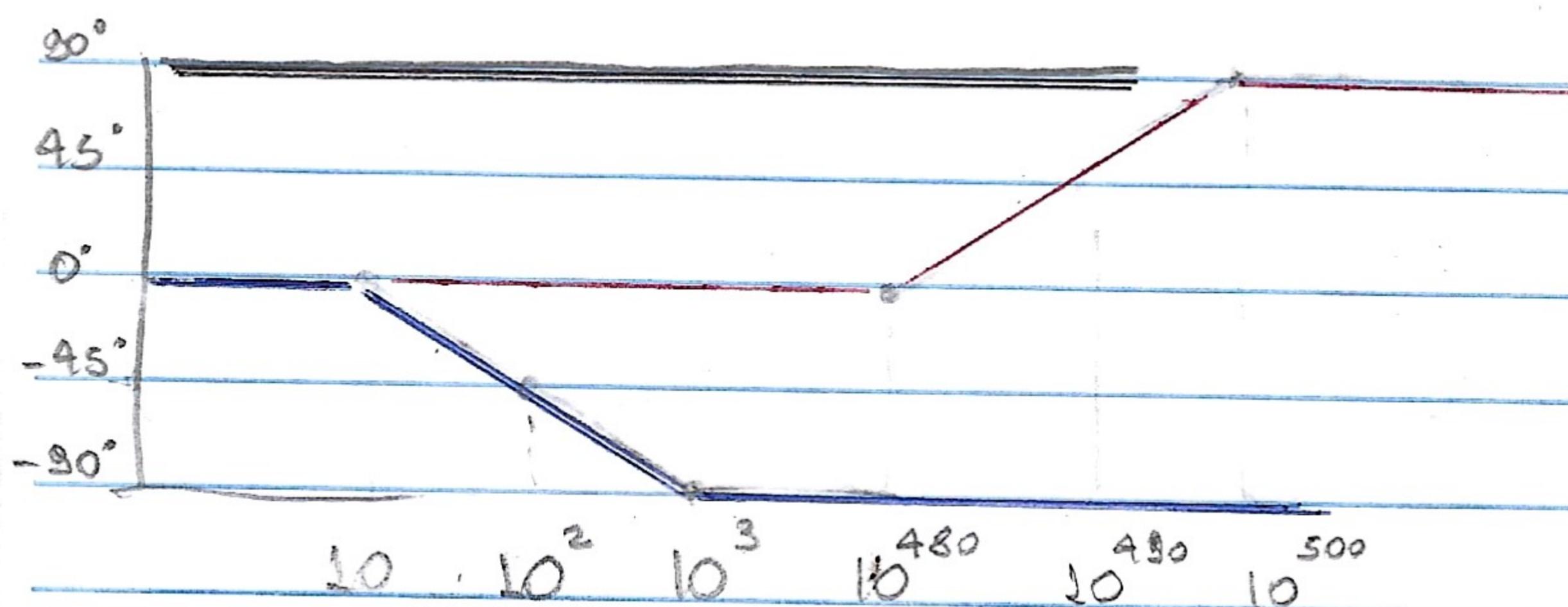


$$G(j\omega) = \frac{j\omega}{10^2} \cdot \left(\frac{j\omega + 1}{10^2} \right)^{-1} \cdot \left(\frac{j\omega + 1}{10^{4.90}} \right)^{-1}$$

Como a altura da bore é 20 dB
 $20 \log(\kappa) = 20 ; \kappa = 10$

$$G(j\omega) = 10 \cdot \frac{j\omega}{10^2} \left(\frac{j\omega + 1}{10^2} \right)^{-1} \cdot \left(\frac{j\omega + 1}{10^{4.90}} \right)^{-1}$$

$$G(j\omega) = 10 \cdot \frac{\omega}{10^2} \left(\frac{\omega + 1}{10^2} \right)^{-1} \cdot \left(\frac{\omega + 1}{10^{4.90}} \right)^{-2}$$



$$W = 0,0001 \therefore \phi = 90^\circ$$

$$W = 0,001 \therefore \phi = 30^\circ$$

$$W = 0,01 \therefore \phi = 30^\circ$$

$$W = 0,1 \therefore \phi = 30^\circ$$

$$W = 1 \therefore \phi = 30^\circ$$

$$W = 10 \therefore \phi = 90^\circ$$

$$W = 100 \therefore \phi = 45^\circ$$

$$W = 1000 \therefore \phi = 0^\circ$$

$$W = 10^{4.80} \therefore \phi = 0^\circ$$

$$W = 10^{4.80} \therefore \phi = 45^\circ$$

$$W = 10^{5.00} \therefore \phi = 90^\circ$$

data 12.05.21

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$$4) G(s) = (s+1)$$

$$(s+10)(s+100)$$

$$G(s) = \frac{(s+1)}{10(s+1) \cdot 100(s+1)}$$

10

100

$$G(s) = 10^{-3} \cdot s+1 \cdot \left(\frac{s+1}{10}\right)^{-1} \cdot \left(\frac{s+1}{100}\right)^{-1}$$

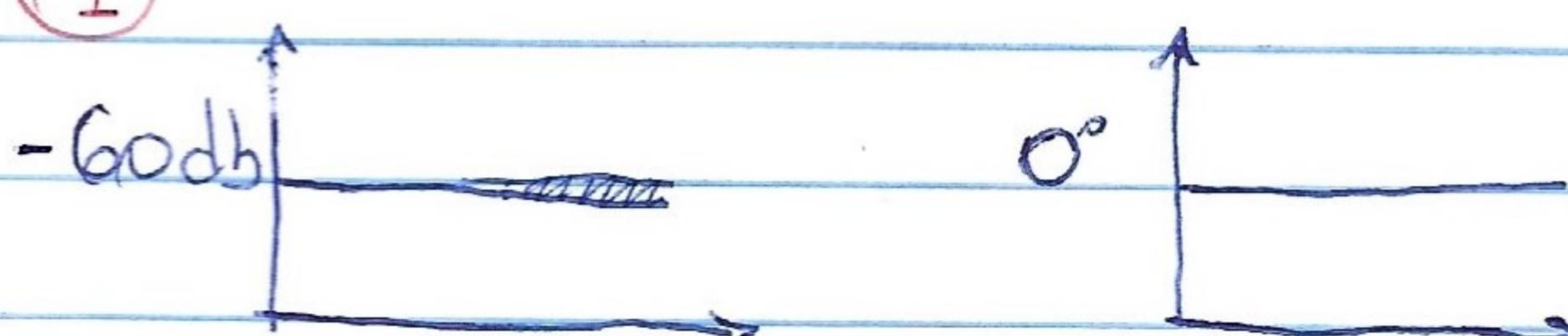
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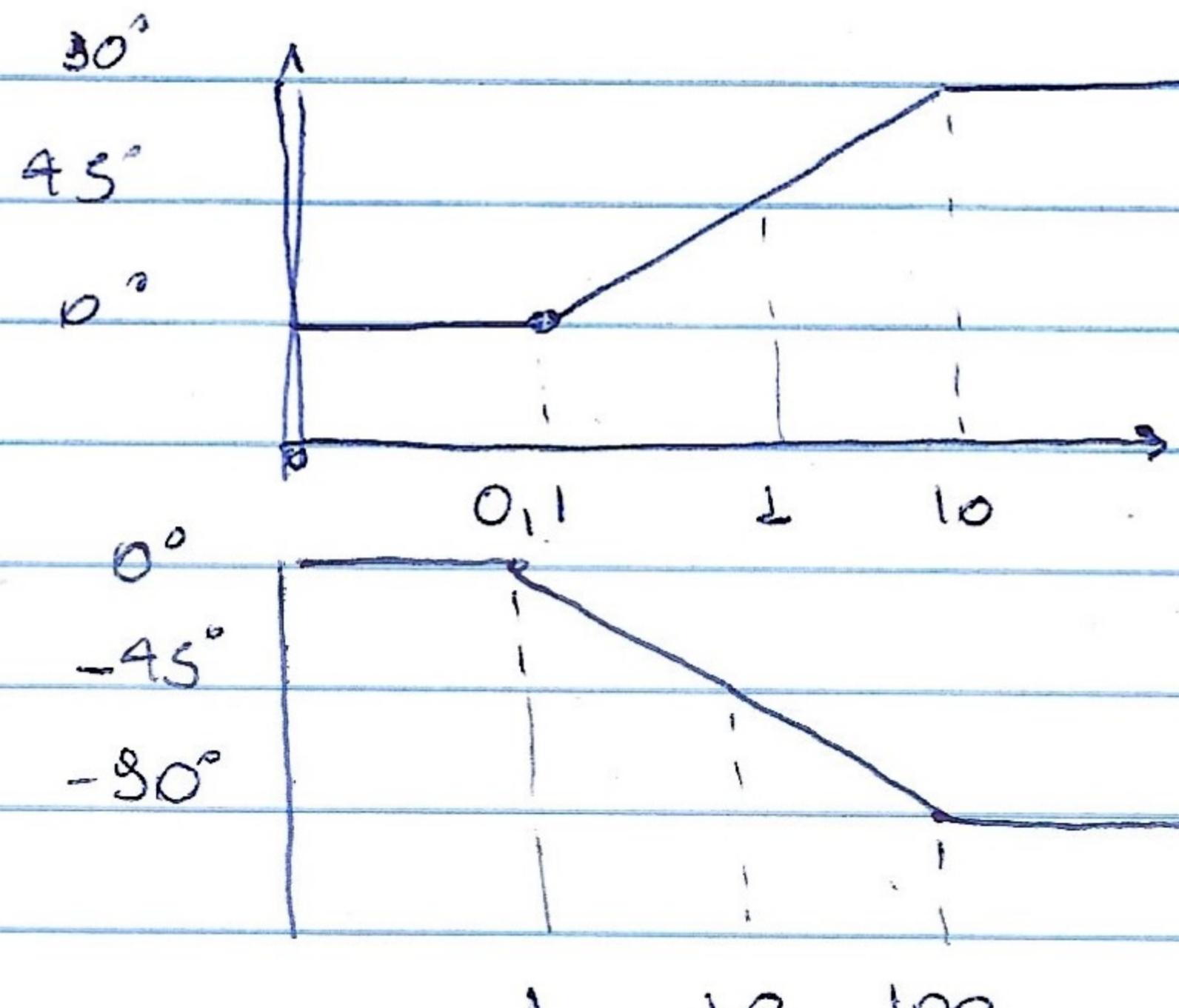
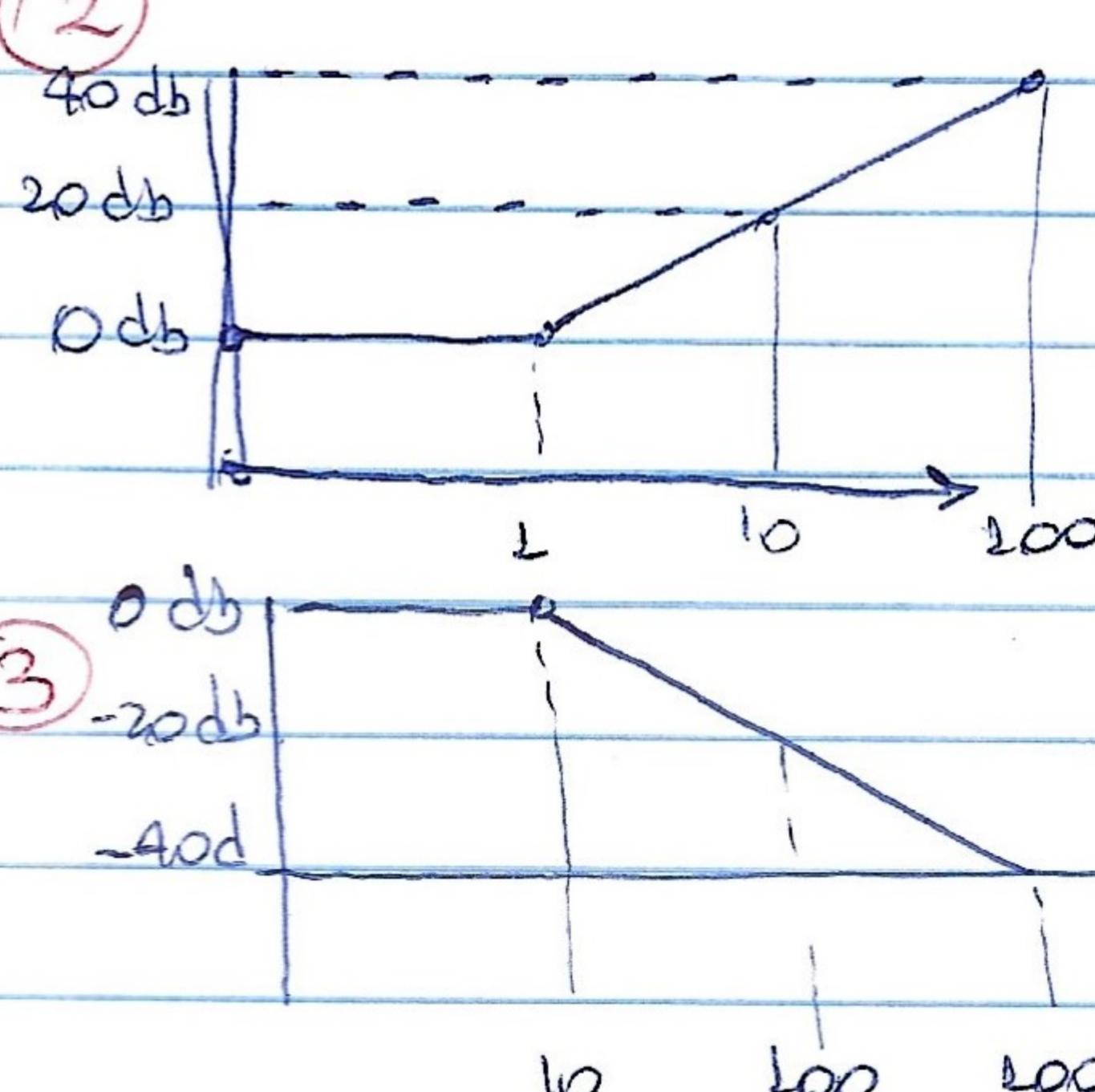
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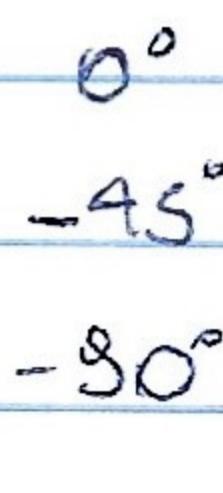
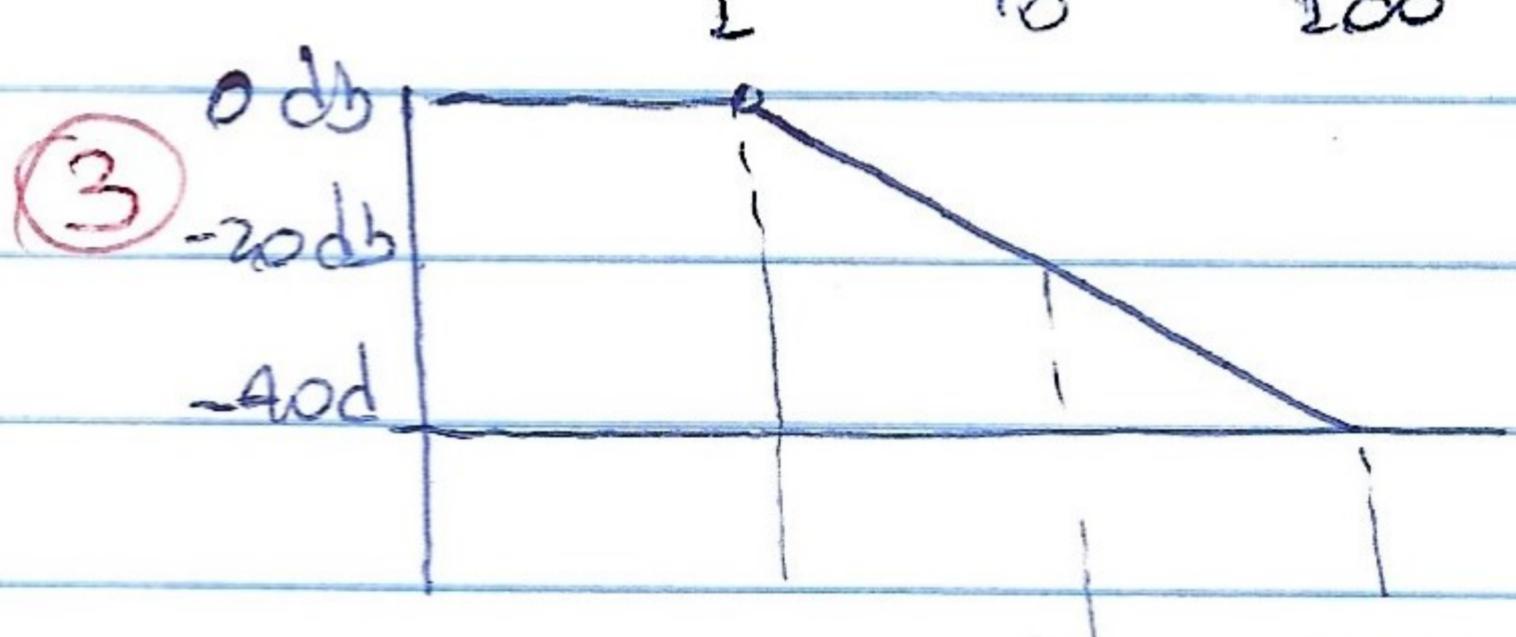
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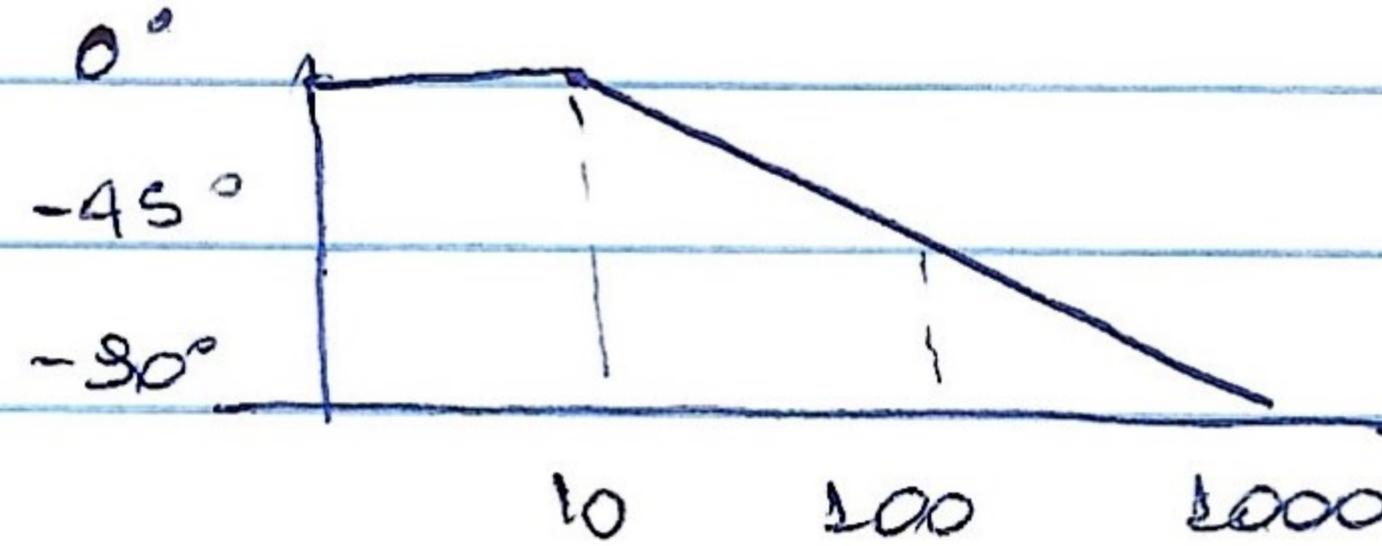
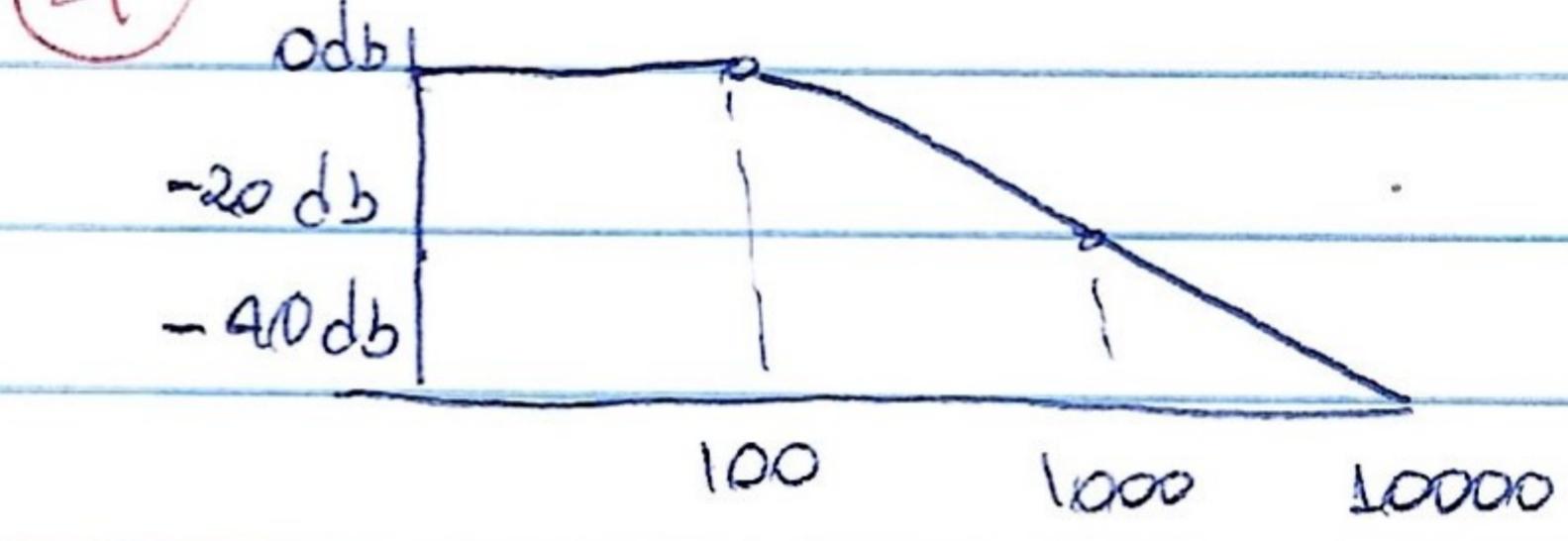
②



③



④



$$W = 0,0001 \quad \therefore \text{mod} = -60 \text{db} \quad ; \quad \phi = 0^\circ$$

$$W = 0,001 \quad \therefore \quad = -60 \text{db} \quad ; \quad \phi = 0^\circ$$

$$W = 0,01 \quad \therefore \quad = -60 \text{db} \quad ; \quad \phi = 0^\circ$$

$$W = 0,1 \quad \therefore \quad = -60 \text{db} \quad ; \quad \phi = 0^\circ$$

$$W = 1 \quad \therefore \quad = -60 \text{db} \quad ; \quad \phi = 45^\circ$$

$$W = 10 \quad \therefore \quad = -40 \text{ db} \quad ; \quad \phi = 45^\circ$$

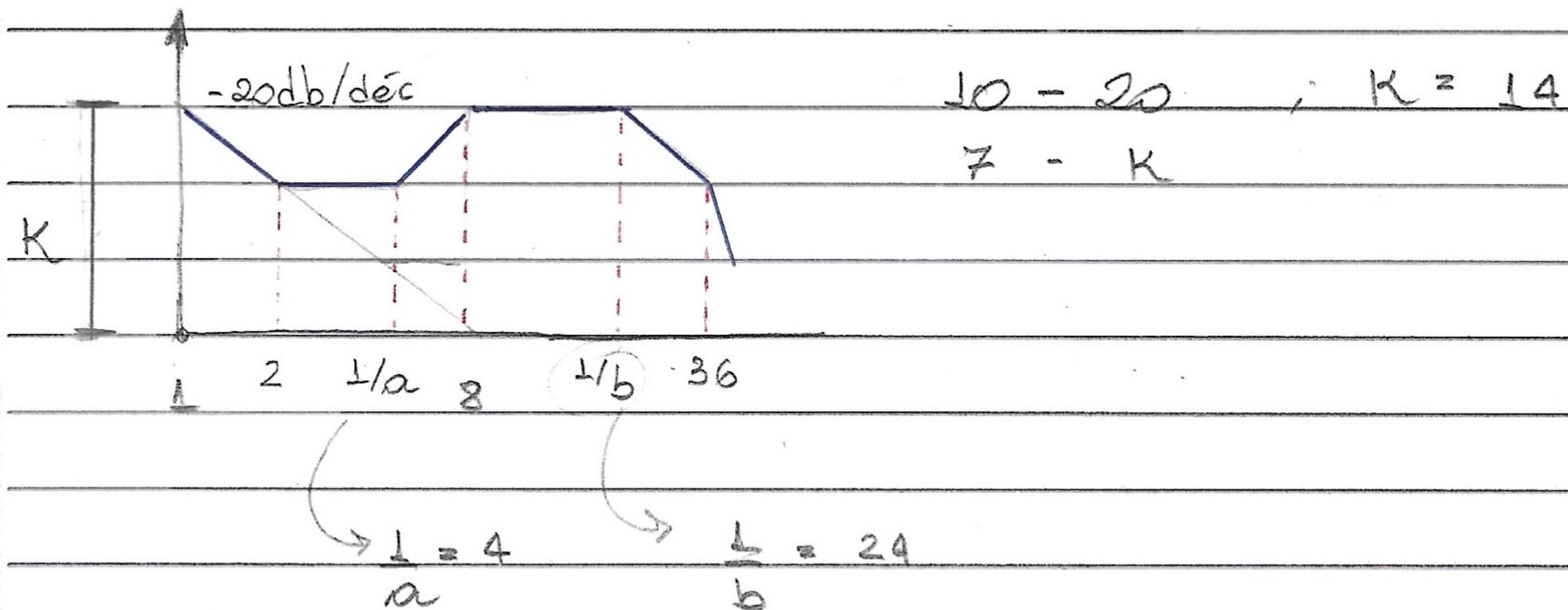
$$W = 100 \quad \therefore \quad = -40 \text{ db} \quad ; \quad \phi = -45^\circ$$

$$W = 1000 \quad \therefore \quad = -60 \text{ db} \quad ; \quad \phi = -90^\circ$$

$$5) G_{\text{GS}} = \frac{K}{2} \cdot \left(1 + \frac{\Delta}{2} \right) \cdot \left(\frac{L}{a} + \frac{\Delta}{2} \right)$$

$$\frac{K}{2} \cdot \left(1 + \frac{\Delta}{8} \right) \left(1 + \frac{\Delta}{2/b} \right) \left(1 + \frac{\Delta}{36} \right)$$

* A parcela ③ devia estar com ganho zero
com $w=1$, porém como subiu K



$$a = \frac{L}{4}$$

$$b = \frac{L}{24}$$