Use the straight-line approximation to sketch the Bode (both magnitude & phase) plots for:
{label all values on both the x and y axis}

+2 tried

$$H(s) = \frac{1x10^9}{(s+100)(s+1k)^2}$$

Standard form: H(s) =

$$\frac{\cancel{1x10^9}\cdot 10}{(100)(1000)(1000)\left(\frac{S}{100}+1\right)\left(\frac{S}{1K}+1\right)^2}$$

Poles: @ $W = 100$, 1K, 1K $rads^{-1}$

No zeros.

Starting point $= 20\log_{10}(10) = 20dB$

Mag.

Start at 20dB w/ 0 slope.

@ $W = 100$ rad s^{-1} → -20 dB/dec

@ $W = 1k$ rad s^{-1} → $2(-20)$ dB/dec $= -40$ dB/dec

Phase

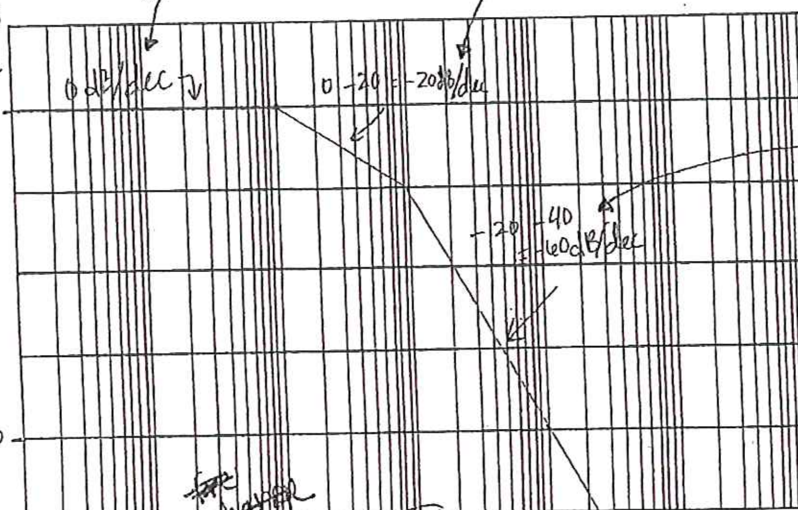
Constant >0 ∴ Start at 0°

· $10 < W < 1K$ $rads^{-1}$ → $-45°$/dec

· $100 < W < 10K$ $rads^{-1}$ → $2(-45)°$/dec $= -90°$/dec

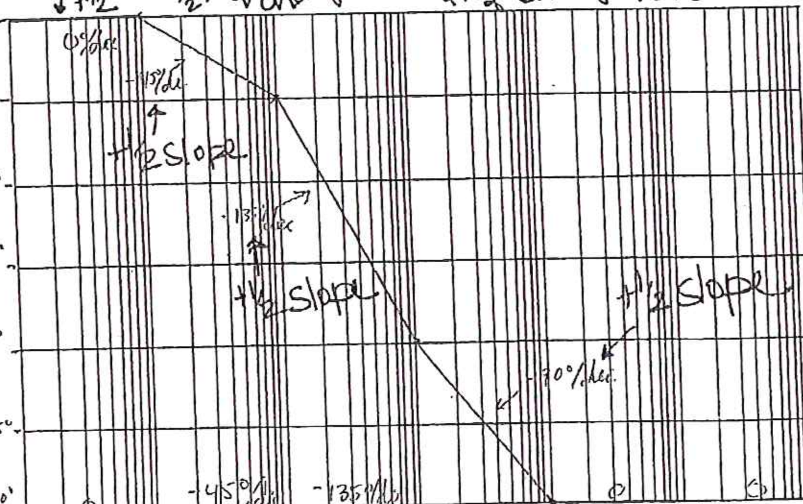
+1/2 slope dB/dec

+1/2 slope change correct



+1/2 slope change correct

value +1/2 · 1 · 0° slope +1/2 · 10 · +1/2 freq change · 100 · $1\cdot10^3$ · +1/2 freq change here · $1\cdot10^4$ · $1\cdot10^5$ · $1\cdot10^6$ ω (rad s^{-1})



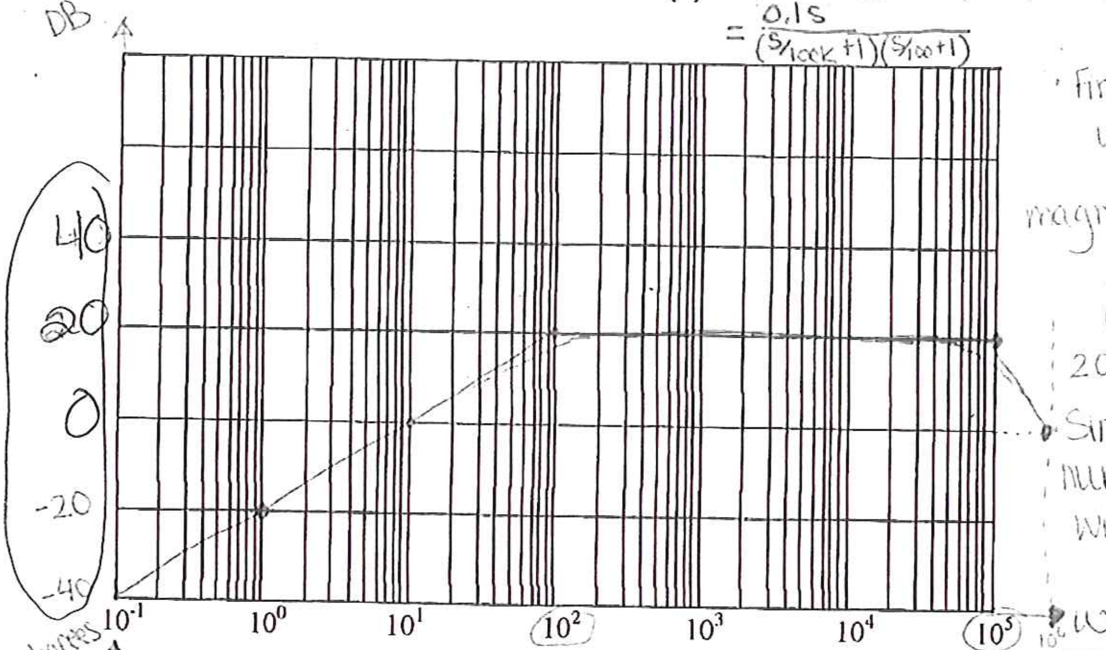
1 · 10 · -45 100 · $1\cdot10^3$ · $-90°$/dec $1\cdot10^4$ · $1\cdot10^5$ · $1\cdot10^6$ ω (rad s^{-1})

+1 range correct · $-90°$ +1 range correct

Use the straight-line approximation to sketch the Bode (both magnitude & phase) plot for: {label your axis}

$$H(s) = \frac{1x10^6 s}{(s+100k)(s+100)} = \frac{1\times10^6 \cdot s}{(100K)(100)\left(\frac{s}{100K}+1\right)\left(\frac{s}{100}+1\right)}$$

$$= \frac{0.1s}{(s/100K+1)(s/100+1)}$$



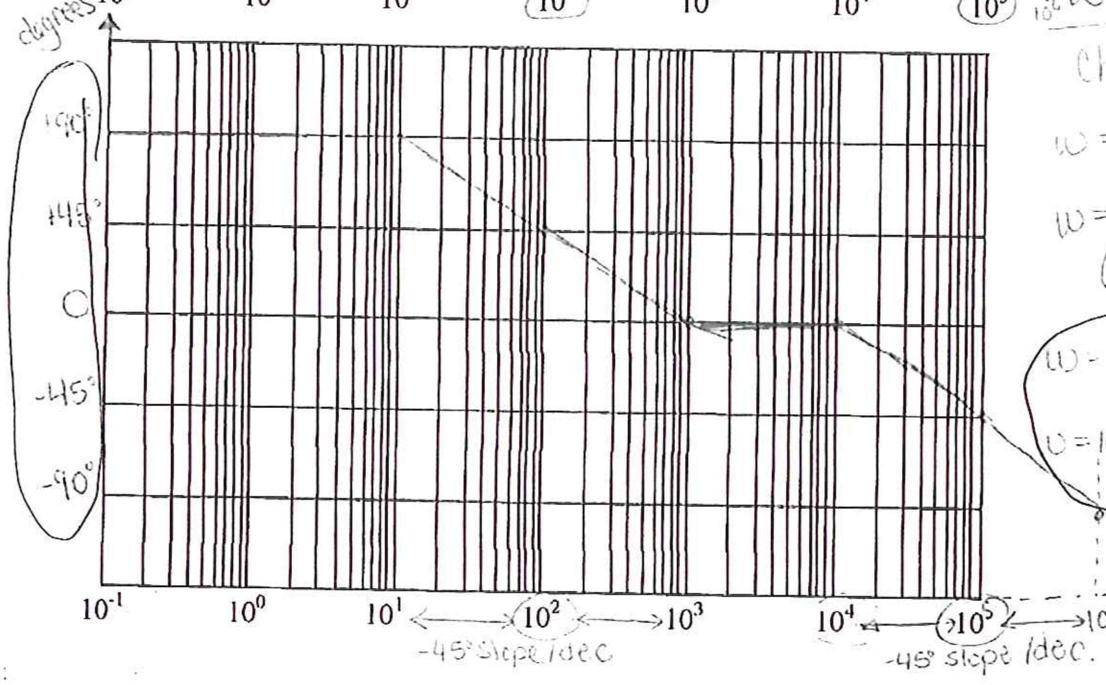
· Find starting value → use ω = 1 (< 100 & 100K)

magnitude:

$$\frac{0.1(1)}{\left(\sqrt{\tfrac{1}{100K}^2+1}\right)\left(\sqrt{\tfrac{1}{100}^2+1}\right)} = 0.1$$

$20\log(0.1) = -20dB$

Since there is an s in numerator ⇒ starts with slope = (+1)(20dB) and 90°



Changes: (magnitude)

ω = 100 ⇒ -20dB/dec

ω = 100K ⇒ -20dB/dec

(phase)

ω = 10 to ω = 1K ⇒ -45° slope/dec

ω = 10K to ω = 1×10^6 ⇒ -45° slope/dec.

Use the straight-line approximation to sketch the Bode (both magnitude & phase) plots for:
{label all values on both the x and y axis}

$$H(s) = \frac{1x10^6 s^2}{(s+10)(s+1k)\left(\frac{s}{100k}+10\right)}$$

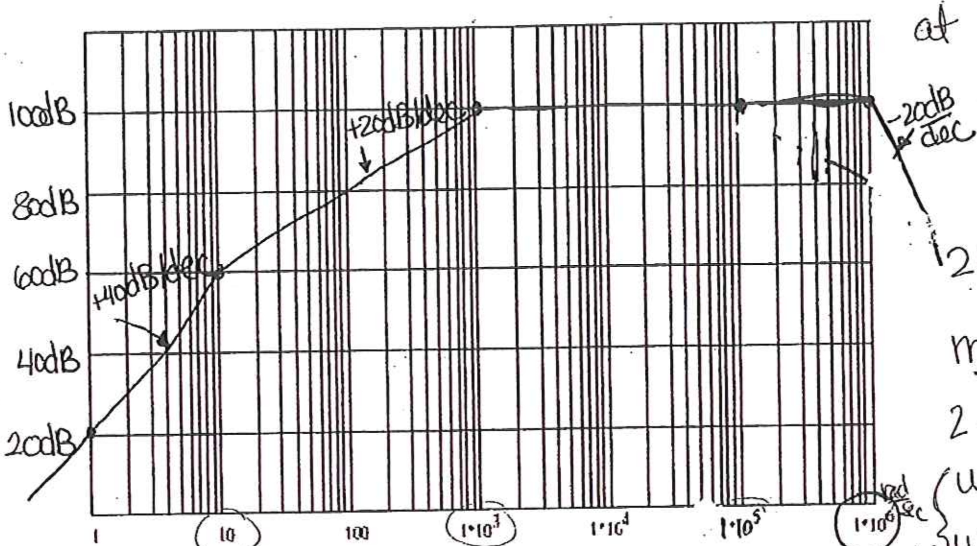
standard form: $\dfrac{1x10^6 s^2}{(10)(1k)(10)\left(\frac{s}{10}+1\right)\left(\frac{s}{1k}+1\right)\left(\frac{s}{100k(10)}+1\right)} = \dfrac{10(s^2)}{\left(\frac{s}{10}+1\right)\left(\frac{s}{1k}+1\right)\left(\frac{s}{1M}+1\right)}$

at $\omega=1$: $(s=j\omega)$

$$\frac{10(1)^2}{\sqrt{\left(\frac{1}{10}\right)^2+1^2}\sqrt{\left(\frac{1}{1k}\right)^2+1^2}\sqrt{\left(\frac{1}{1M}\right)^2+1^2}}$$

≈ 10

$20\log(10) = 20dB$



<u>magnitude:</u>

2 zero at origin: +40dB/dec

poles: $\omega=10$: -20dB/dec

$\omega=1k$: -20dB/dec

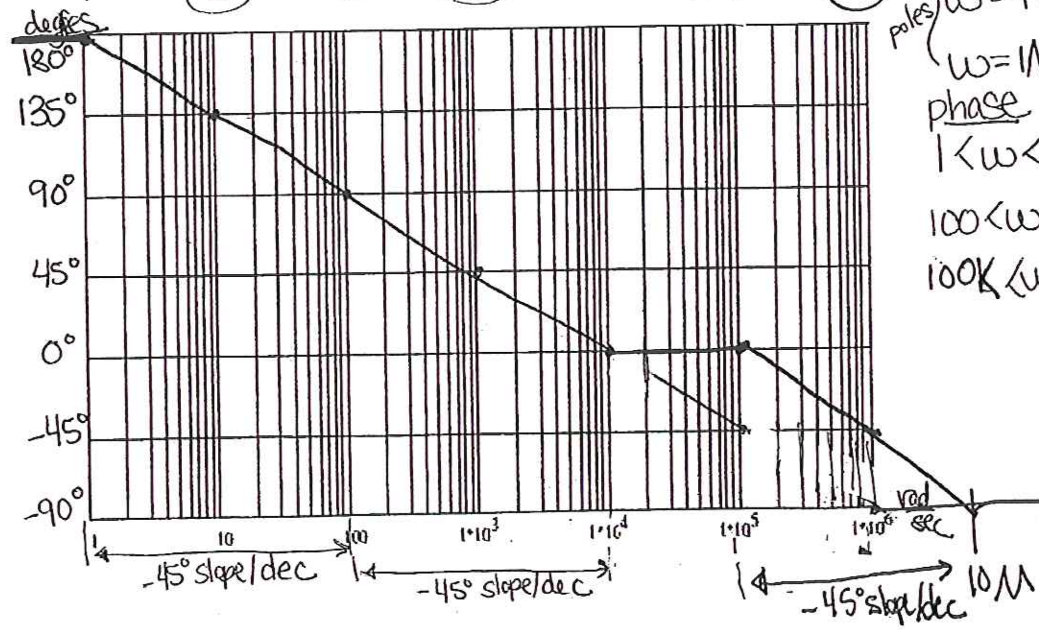
$\omega=1M$: -20dB/dec

<u>phase</u>: +180° starting value

$1<\omega<100$: -45° slope/dec

$100<\omega<10k$: "

$100k<\omega<10M$: "



a) Sketch the Bode (both magnitude & phase) plot for: {label as many y values as possible for both magnitude and phase and/or each slope along with showing all your work}

$$H(s) = \frac{-2x10^6 (s+10)^2}{s\cdot(s+1k)(s+10k)} = \frac{-2\times10^6(10)^2\left(\frac{S}{10}+1\right)^2}{s(1k)(10k)\left(\frac{S}{1k}+1\right)\left(\frac{S}{10k}+1\right)}$$

$$H(s) = \frac{-20\left(\frac{S}{10}+1\right)^2}{\left(\frac{S}{1k}+1\right)\left(\frac{S}{10k}+1\right)}$$

b) What is the estimated or actual magnitude value at ω=10k rad/sec (in dB):

cutoff freq. So 46dB - 3dB = $\underline{\underline{43dB}}$

c) What range of frequency will this circuit operate correctly:

ω=1k to ω=10k

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1 pole at origin ⇒ magnitude slope -20dB/dec
phase is -90

negative is -180 → start phase = -180-90 = -270°

starting magnitude value: ω=1: $20 \log\left[\frac{20\sqrt{\left(\frac{1}{10}\right)^2+1^2}\cdot\sqrt{\left(\frac{1}{10}\right)^2+1^2}}{\sqrt{\left(\frac{1}{1k}\right)^2+1^2}\cdot\sqrt{\left(\frac{1}{10k}\right)^2+1^2}}\right]$

= 26dB

magnitude:

(zero) 2 at ω=10: 2(+20dB/dec) = +40dB/dec

ω=1k (pole): -20dB/dec

ω=10k (pole): -20dB/dec

phase:

(zero) 1 < ω < 100 : 2(+45° slope/dec) = +90° slope/dec

(pole) 100 < ω < 10K: -45° slope/dec

(pole) 1K < ω < 100K: -45° slope/dec

$$H(s) = \frac{-2x10^6 (s+10)^2}{s \cdot (s+1k)(s+10k)}$$