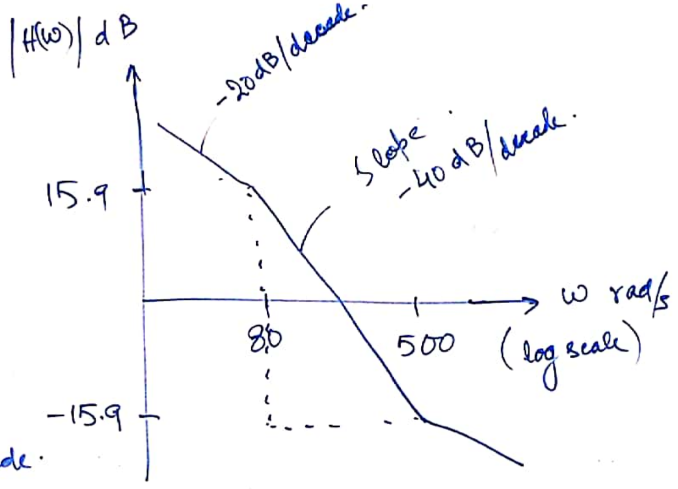
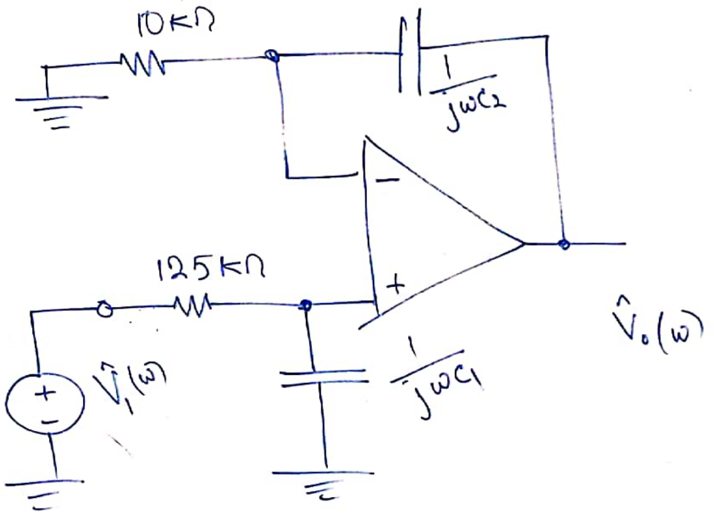
Ex 13-3-2.

Step 1: Slope decreases at pole
therefore 80 rad/s is at pole.
Slope increases at zero
so 500 rad/s is at zero.

Step 2: Slope b/w 80 rad/s & 500 rad/s.

$$\text{Slope} = \frac{-15.9 - 15.9}{\log_{10}\left(\frac{500}{80}\right)} = -40\ \frac{dB}{decade}.$$





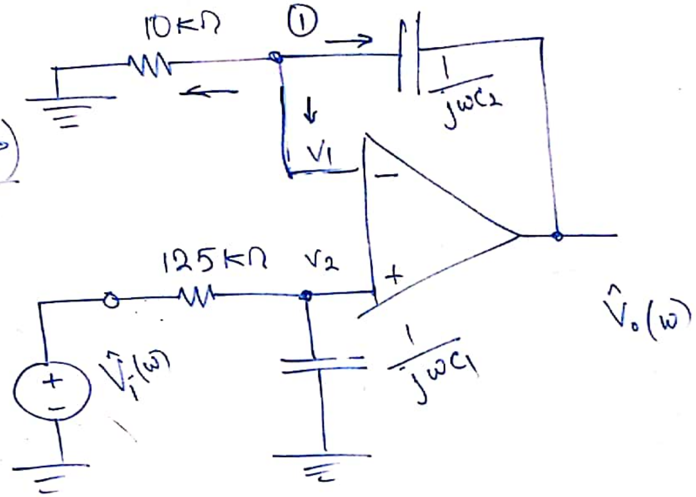
Step 3. at low freq Slope = -20 dB/decade = -1 × 20

$$H(\omega) = \frac{K}{j\omega}\left(\frac{1 + j\frac{\omega}{500}}{1 + j\frac{\omega}{80}}\right)$$

Ex 13-3-2.

$$\hat{V}_2 = \frac{1/j\omega C_1}{125000 + \frac{1}{j\omega C_1}} \times \hat{V}_i = \frac{1}{j\omega C_1\left(125000 + \frac{1}{j\omega C_1}\right)} V_1$$

$$= \frac{V_i}{(1 + j\omega C_1 \times 125000)}$$



Applying KCL at node ① $(V_1 = V_2)$

$$\frac{V_1}{10000} + \frac{V_1 - V_o}{1/j\omega C_2} = 0.$$

$$V_o \times j\omega C_2 = \frac{V_1}{10000} + j\omega C_2 V_1 = V_1\left(\frac{1}{10000} + j\omega C_2\right)$$

$$V_o = V_1\left(\frac{1}{j\omega C_2 \times 10000} + 1\right) = V_1\left(\frac{1 + j\omega C_2 \times 10000}{j\omega C_2 \times 10000}\right)$$

$$H(\omega) = \frac{V_o}{V_i} = \frac{1}{1 + j\omega C_1 \times 125000} \times \frac{(1 + j\omega C_2 \times 10000)}{(j\omega C_2 \times 10000)}$$

$$= \frac{1}{(j\omega)(C_2 \times 10000)} \cdot \frac{\left(1 + \frac{j\omega}{1/10000 C_2}\right)}{\left(1 + \frac{j\omega}{1/125000 C_1}\right)} \quad ②$$

From Bode plot

$$H(\omega) = \frac{K}{j\omega}\left(\frac{1 + \frac{j\omega}{500}}{1 + j\omega/80}\right) \quad ①$$

Comparing ① & ②

$10000 C_2 = 1/500$

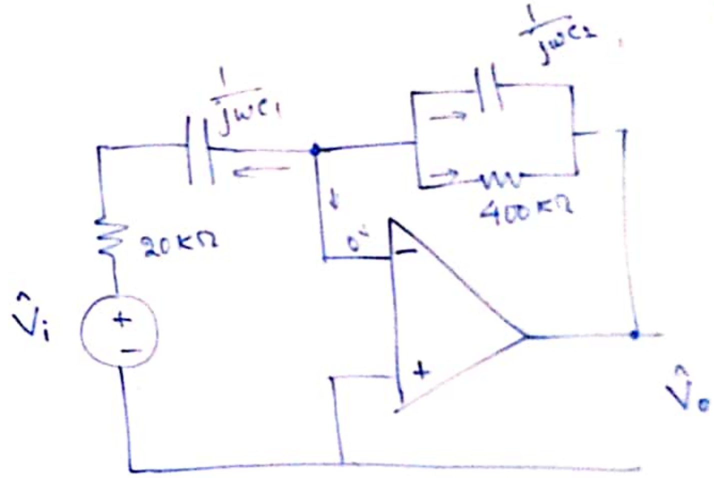
$C_2 = \frac{1}{5000000} = 0.2\ \mu F$

$125000 C_1 = \frac{1}{80}$

$C_1 = \frac{1}{80 \times 125000} = 0.1\ \mu F$

Ex 13.3-3.

Step 1 Slope of the Bode plot decrease at 40 and 160 rad/s.



Step 2. At low freq slope is 1 × 20 dB/decade.

∴ write at term $K(j\omega)^1$

$$H(\omega) = \left(\frac{K j\omega}{\left(1 + j\frac{\omega}{40}\right)\left(1 + j\frac{\omega}{160}\right)} \right)$$

Now determine Network function from the circuit:
Applying KCL at (–)

$$\frac{-V_i}{20 + \frac{1}{j\omega C_1}} - \frac{V_o}{1/j\omega C_2} - \frac{V_o}{400000} = 0$$

$$V_o\left(j\omega C_2 + \frac{1}{400000} \right) = \frac{-V_i \times j\omega C_1}{j20\omega C_1 + 1}$$

Find C_1 & C_2.

$$\hat{H}(\omega) = \frac{V_o}{V_i} = \frac{-j\omega C_1 \cdot j\omega C_2}{(1 + j\omega C_2 \times 400000)(1 + j20\omega C_1)} \quad \ldots\ldots (2)$$

Compare eq (1) & (2) to find C_1 & C_2

Applying KCL at (−) input.

$$\frac{0-V_i}{20000+\frac{1}{j\omega C_1}} + \frac{0-V_o}{400000} + \frac{0-V_o}{1/j\omega C_2} = 0.$$

$$V_o\left(\frac{1}{400000} + j\omega C_2\right) = \frac{-V_i}{20000+\frac{1}{j\omega C_1}}$$

$$V_o\left(\frac{1+j\omega C_2\times 400000}{400000}\right) = -\frac{V_i \; j\omega C_1}{1+j\omega C_1\times 20000}$$

$$H(\omega) = \frac{V_o}{V_i} = -\frac{j\omega C_1\times 400000}{(1+j\omega C_1\times 20000)(1+j\omega C_2\times 400000)}$$

$$= \frac{-C_1\times 400000\times j\omega}{\left(1+\frac{j\omega}{1/20000C_1}\right)\left(1+\frac{j\omega}{1/400000C_2}\right)}$$

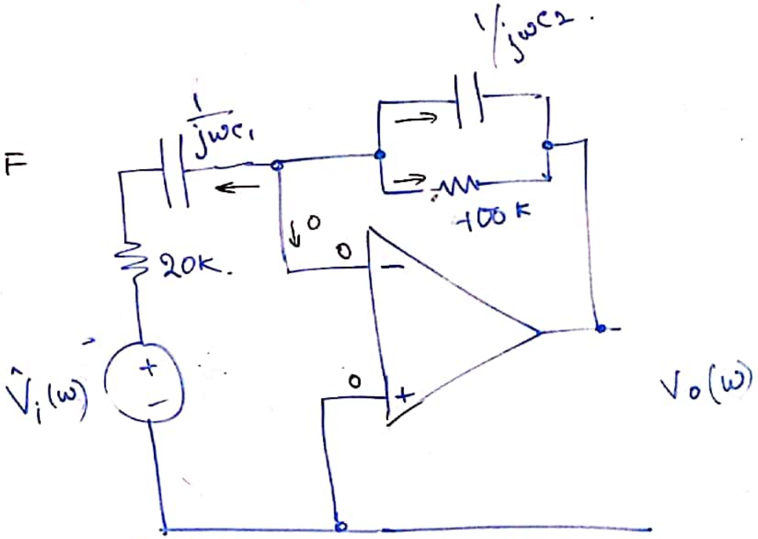
$$40 = \frac{1}{20000C_1}$$

$$C_1 = \frac{1}{800000} = 1.25\ \mu F$$

$$160 = \frac{1}{400000C_2}.$$

$$C_2 = \frac{1}{64000000}$$

$$= 15.625\ nF.$$



Bode Plot : $H(\omega) = \frac{K\,j\omega}{\left(1+\frac{j\omega}{40}\right)\left(1+\frac{j\omega}{160}\right)}$