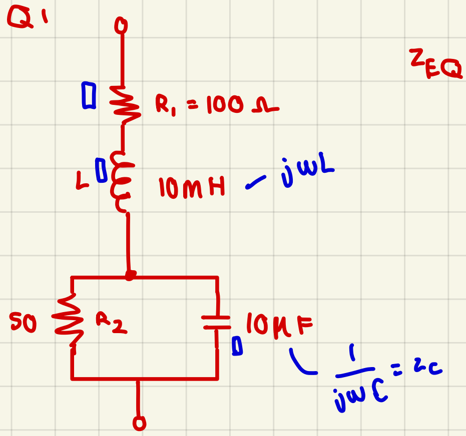
Q1



$$Z_{EQ} = Z_{R_1} + Z_L + Z_{R_2} // Z_C$$

$$= 100 + j(10^4)(10)(10^{-3}) + \frac{R_2 \frac{1}{j\omega C}}{R_2 + \frac{1}{j\omega C}}$$

$$\frac{R_2}{j\omega C R_2 + 1}$$

$$= \frac{50}{j(10^4)(10\times10^{-6})(50) + 1}$$

$$= \frac{50}{j5 + 1} \frac{(1-j5)}{(1-j5)}$$

$$= \frac{50 - j250}{1 + 25}$$

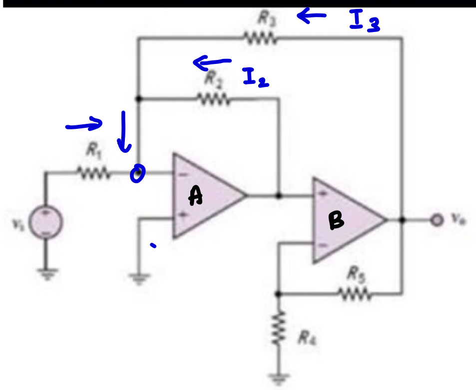
$$= \frac{50}{26} - \frac{j250}{26}$$

$$= 100 + j100 + \frac{50}{26} - j\frac{250}{26}$$

$$= 101.9 + j90.38$$

$$Z_R + Z_L + Z_{R2} // Z_C \qquad \frac{Z_{R2} Z_C}{Z_{R2} + Z_C}$$

[redacted]



Given R₁=10Ω, R₂=10 Ω, R₃=10 Ω, R₄=10 Ω and R₅= 30 Ω.

- ○ Av= -2.25(V/V)
- ○ Av= 0.80(V/V)
- ● Av= -0.80(V/V)
- ○ Av= 2.25(V/V)

[redacted]

$V_s = R_1 I_1$

$V^+ = V^- = 0$

$I^+ = I^- = 0 = I_{in}$

$V^+ = V^- = 0$

KCL @ -ve A node:

$I_s + I_{F1} + I_{F2} = 0$

$$\frac{V_s - \cancel{V^-}}{R_1} + \frac{V_B^+ - \cancel{V^-}}{R_2} + \frac{V_o - \cancel{V^-}}{R_3} = 0$$

$$\frac{V_s}{R_1} + \frac{V_B^+}{R_2} + \frac{V_o}{R_3} = 0$$

$$V_B^+ = \left[-\frac{V_s}{R_1} - \frac{V_o}{R_3} \right] R_2$$

KCL @ -ve B Node:

$I_s + I_F = 0$

$$\frac{0 - V_B^-}{R_4} + \frac{V_o - V_B^-}{R_5} = 0$$

$$-\frac{V_B^-}{R_4} + \frac{V_o - V_B^-}{R_5} = 0$$

$$V_B^- = V_o \left(\frac{\frac{1}{R_5}}{\frac{1}{R_4} + \frac{1}{R_5}} \right)$$

$$= V_o \left(\frac{R_4}{R_4 + R_5} \right)$$

$$\frac{R_4 + R_5}{R_4 R_5}$$

$$V_B^- \left(\frac{1}{R_4} + \frac{1}{R_5} \right) = \frac{V_o}{R_5} \times \frac{R_4 R_5}{R_4 + R_5}$$

$V_B^+ = V_B^-$

$$\left[-\frac{V_s}{R_1} - \frac{V_o}{R_3} \right] R_2 = V_o \left(\frac{R_4}{R_4 + R_5} \right)$$

$$-\frac{V_s R_2}{R_1} - \frac{V_o R_2}{R_3} = \frac{V_o R_4}{R_4 + R_5}$$

$$\frac{V_o R_4}{R_4 + R_5} + \frac{V_o R_2}{R_3} = -\frac{V_s R_2}{R_1}$$

$$V_o \left(\frac{R_4}{R_4 + R_5} + \frac{R_2}{R_3} \right) = -V_s \frac{R_2}{R_1}$$

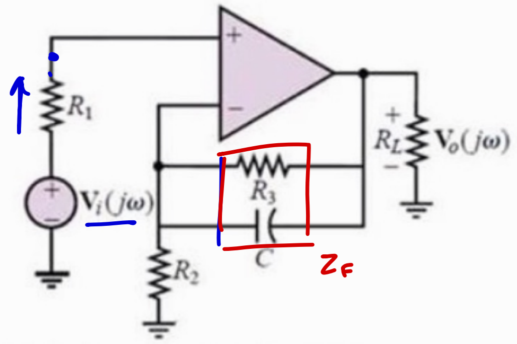
$$\frac{V_o}{V_s} = -\frac{R_2}{R_1} \div \left(\frac{R_4}{R_4 + R_5} + \frac{R_2}{R_3} \right)$$

$$= -1 \div \frac{5}{4}$$

$$= -0.8$$

[redacted]

The circuit shown in the figure is an active filter with. Determine the cutoff frequency (ω_0) and pass-band gain (A_V) of the filter.



Given $R_1=2k\Omega, R_2=5k\Omega, R_3=50k\Omega, C=100nF$.

- ω_0 = 2000 rad/sec; A_V = 8.22 dB.
- ω_0 = 200 rad/sec; A_V = 20.83 dB. ✓
- ω_0 = 2000 rad/sec; A_V = 20.83 dB.
- ω_0 = 200 rad/sec; A_V = 8.22 dB.

[redacted]

$$Z_F = R_3 // C$$

$$= \frac{R_3 \frac{1}{j\omega C}}{R_3 + \frac{1}{j\omega C}}$$

$$= \frac{R_3}{j\omega C R_3 + 1}$$

$V^+ = V_i \qquad i^+ = i^- = 0$

$$\omega = \frac{1}{R_F C_F} = 200 \text{rad/s}$$

KCL @ Negative Node :

$I_F + I_2 = 0$

$$\frac{V_o - V^-}{Z_F} + \frac{0 - V^-}{R_2} = 0$$

$$\frac{V_o - V_i}{Z_F} - \frac{V_i}{R_2} = 0$$

$$\frac{V_o}{Z_F} = \frac{V_i}{Z_F} + \frac{V_i}{R_2}$$

$$H = \frac{V_o}{V_i} = 1 + \frac{Z_F}{R_2}$$

$$= 1 + \frac{R_3}{j\omega C R_3 + 1} = 1 + \frac{R_3}{(j\omega C R_3 + 1) R_2}$$

$$= 1 + \frac{R_3}{R_2}\left(\frac{1}{j\omega C R_3 + 1}\right)$$

$\omega \to 0, \quad H = 1 + \frac{R_3}{R_2}$ } Test 2 condition

$\omega \to \infty, \quad H = 1$

≈ 0

$$A_V = 20\lg\left(1 + \frac{50}{5}\right)$$

$$= 20.83$$