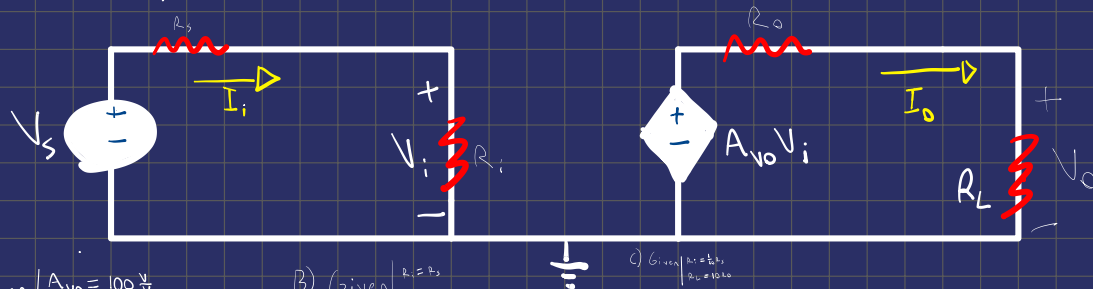


HW #1 Jason Ivey

1)



A) Given $A_{vo} = 100 \frac{V}{V}$
 $R_i = 10R_s$ $R_L = 10R_o$

$$V_i = V_s \frac{R_i}{R_i + R_s} = V_s \frac{10}{11}$$

$$V_o = A_{vo} V_i \frac{R_L}{R_L + R_o} = 100 \left(\frac{10}{11} \right) \left(\frac{10}{11} \right) = \frac{1000}{121} V_s$$

$$\frac{V_o}{V_s} = \frac{1000}{121} \approx 8.264 \frac{V}{V}$$

B) Given $R_i = R_s$
 $R_L = R_o$

$$V_i = V_s \frac{R_i}{R_i + R_s} = V_s \left(\frac{1}{2} \right)$$

$$V_o = A_{vo} V_i \frac{R_L}{R_L + R_o} = 100 \left(\frac{1}{2} \right) \left(\frac{1}{2} \right) = \frac{100}{4} V_s$$

$$\Rightarrow \frac{V_o}{V_s} = 25 \frac{V}{V}$$

C) Given $R_i = \frac{R_s}{10}$
 $R_L = 10R_o$

$$V_i = V_s \frac{R_i}{R_i + R_s} = \frac{R_s}{11R_s} V_s = \frac{1}{11} V_s$$

$$V_o = A_{vo} V_i \frac{R_L}{R_L + R_o} = 100 \left(\frac{1}{11} \right) \left(\frac{10}{11} \right) = \frac{1000}{121} V_s$$

$$\Rightarrow \frac{V_o}{V_s} = 8.264 \frac{V}{V}$$

2)

$$V_{i2} = V_s \left(\frac{100 \Omega}{1000 \Omega + 100 \Omega} \right) = V_s \left(\frac{1}{11} \right)$$

$$V_{i1} = (10V_{i2}) \left(\frac{100 \Omega}{1000 \Omega + 100 \Omega} \right) = 10V_{i2} \left(\frac{1}{11} \right) = V_{i2} \left(\frac{10}{11} \right)$$

$$V_o = V_{i1} \left(\frac{100 \Omega}{1000 \Omega + 100 \Omega} \right) = V_{i2} \left(\frac{10}{11} \right) \left(\frac{10}{11} \right) = V_{i2} \left(\frac{100}{121} \right)$$

$$\therefore V_o = \left(\frac{100}{121} \right) \left(\frac{10}{11} \right) \left(\frac{10}{11} \right) V_s \approx 75.131 V_s$$

$$\therefore \frac{V_o}{V_s} \approx 75.131 \approx 20 \log(75.131) \approx 37.516 \text{ dB}$$

$$V = IR$$

$$I = \frac{V}{R} \therefore \frac{I_o}{I_s} = \frac{V_o}{V_s} \frac{R_s}{R_o} = \frac{V_o}{V_s} \frac{R_s}{R_o} = \frac{V_o}{V_s} \frac{100 \Omega}{1000 \Omega} = \left(75.131 \right) \left(\frac{100}{1000} \right) = 7.5131$$

$$\therefore \frac{P_o}{P_i} = \frac{I_o}{I_s} \times \frac{V_o}{V_s} = 7.5131 \times 75.131 \approx 562.10 \frac{W}{W}$$

$$\frac{V_o}{V_s} = 75.131 \text{ or } 37.516 \text{ dB}$$

$$\frac{I_o}{I_s} = 7.5131$$

$$\frac{P_o}{P_i} = 562.10 \frac{W}{W}$$

3)

A) $V_o = 5V \frac{R_2}{R_2 + 5.6K\Omega} = 5V \times \frac{1}{1.6} = 3.125V$

B) $3.21V = 5V \frac{R_2}{R_2 + 5.6K\Omega}$

$$\frac{3.21V}{5V} = \frac{R_2}{R_2 + 5.6K\Omega}$$

$$.642 = \frac{R_2}{R_2 + 5.6K\Omega}$$

$$.642(R_2 + 5.6K\Omega) = R_2$$

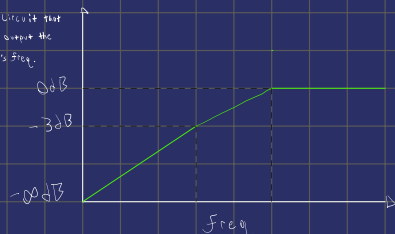
$$.642R_2 + 3.595K\Omega = R_2$$

$$.358R_2 = 3.595K\Omega$$

$$R_2 = 10.0419K\Omega$$

4)

A high-pass filter is a circuit that gives a signal V will only output the higher end of the signal $V_s \sin \omega t$.



5) Signals Need to be Amplified for many reasons:

- Driving transducers
- Measuring signals
- Increasing transmission range