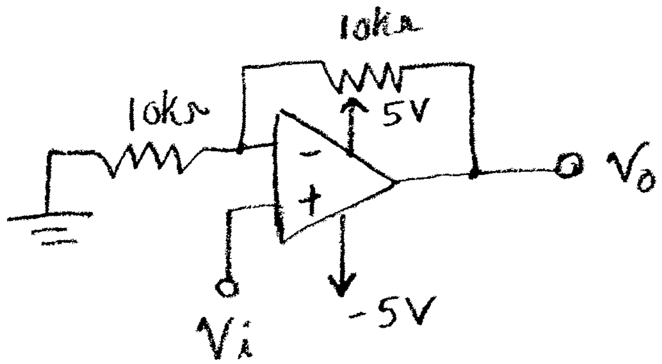
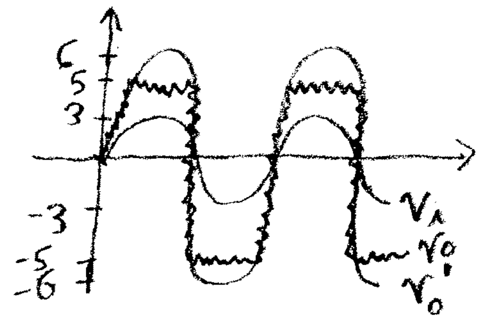
11. Name one characteristic of an ideal op-amp.

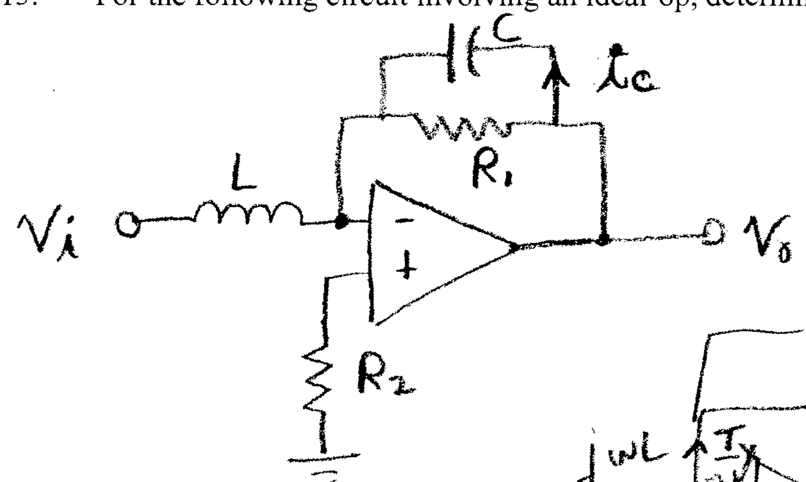
12. The input signal for the following ideal op-amp circuit is $v_i(t) = 3\sin(\omega t)$ V. Sketch the output signal, clearly indicating the maximum and minimum values of the amplitude.

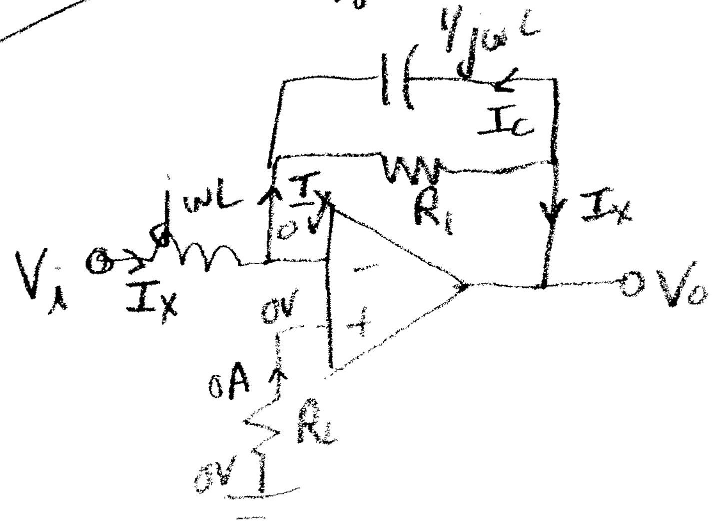


$G = 1 + \frac{10K}{10K} = 2$



13. For the following circuit involving an ideal-op, determine the relationship $\frac{I_C(\omega)}{V_i(\omega)}$





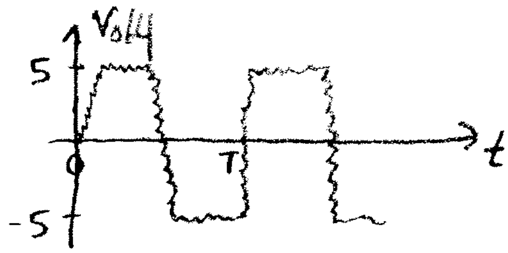
$$-V_i + I_x j\omega L + 0 = 0 \Rightarrow I_x = \frac{V_i}{j\omega L}$$

$$I_C = -I_x \frac{R_1}{R_1 + \frac{1}{j\omega C}}$$

1 9. $\frac{V_2}{V_1} = \frac{-1}{4}$

4 10. $-\frac{2A}{3}\frac{1}{\sqrt{(\omega L)^2+\left(\frac{R}{(3/4)^2}\right)^2}}\cos\left(\omega t - \tan^{-1}\left(\frac{\omega L}{R/(3/4)^2}\right)\right)$ A

1 11. infinite input resistance



$\omega = 2\pi f = \frac{2\pi}{T}$

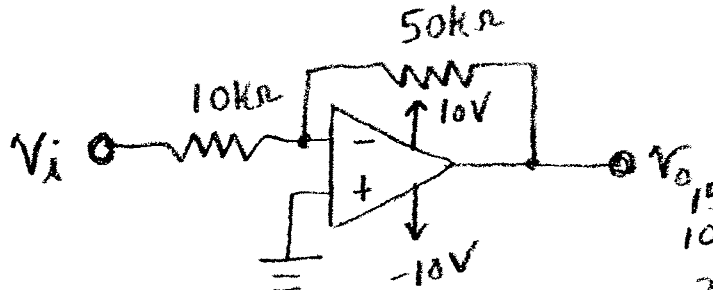
$T = \frac{2\pi}{\omega}$

2 12.

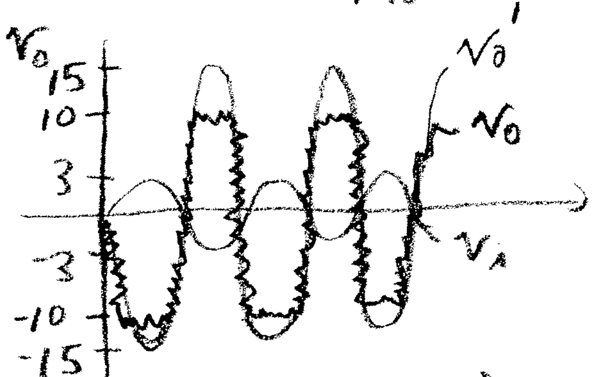
4 13. $\frac{-R_1}{j\omega L\left(R_1+\frac{1}{j\omega C}\right)} = \frac{-R_1 C}{L(j\omega C R_1+1)}$

11. Name one characteristic of an ideal op-amp.

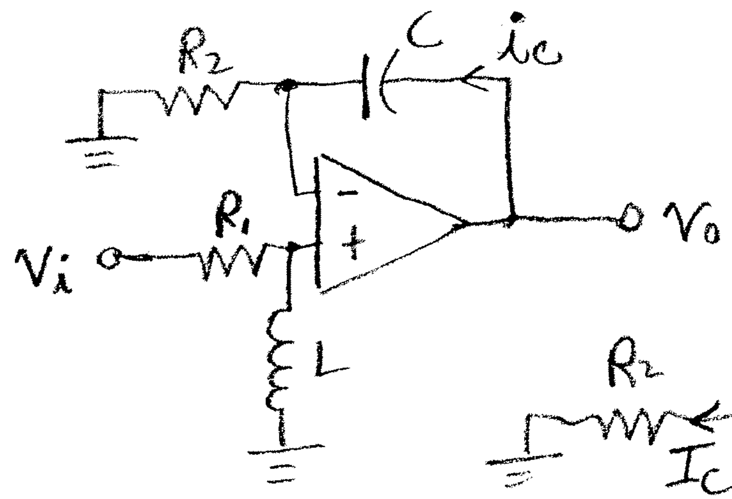
12. The input signal for the following ideal op-amp circuit is $v_i(t) = 3\sin(\omega t)$ V. Sketch the output signal, clearly indicating the maximum and minimum values of the amplitude.

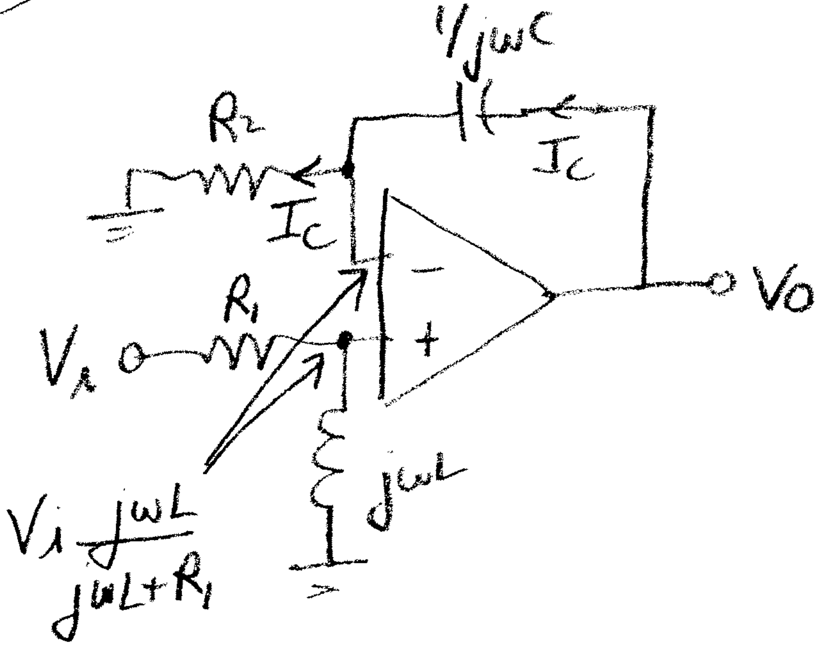


$G = -\frac{50K}{10K} = -5$



13. For the following circuit involving an ideal-op, determine the relationship $\frac{I_c(\omega)}{V_i(\omega)}$





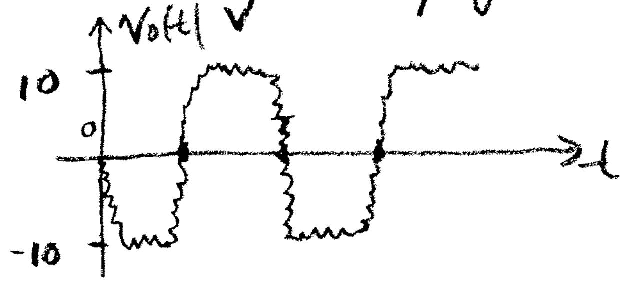
$$-V_i \frac{j\omega L}{j\omega L + R_1} + R_2 I_c = 0$$

$$\frac{I_c}{V_i} = \frac{j\omega L}{R_2(j\omega L + R_1)}$$

1 9. $\frac{V_2}{V_1} = \frac{7}{3}$

4 10. $\left(\frac{3}{2}A \Big/ \sqrt{\left(\frac{-1}{\omega C}\right)^2 + \left(\frac{R}{(2/3)^2}\right)^2}\right) \cos\left(\omega t - \tan^{-1} \frac{-1/\omega C}{R/(2/3)^2}\right)$ A

1 11. infinite open-loop gain ✓



$\omega = 2\pi f = 2\pi/T$

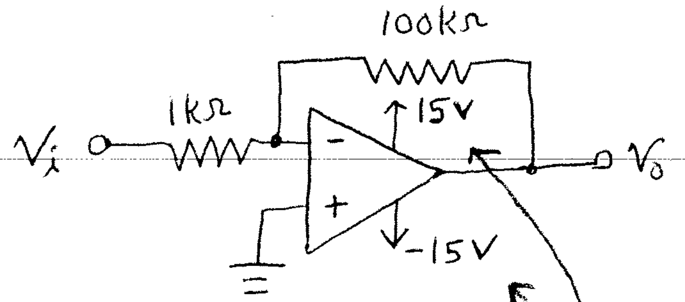
$T = 2\pi/\omega$

2 12.

4 13. $\frac{j\omega L}{R_2(j\omega L + R_1)}$

11. Name one characteristic of an ideal op-amp.

12. The input signal for the following ideal op-amp circuit is $v_i(t) = 0.3\cos(\omega t)$ V. Sketch the output signal, clearly indicating the maximum and minimum values of the amplitude.



standard inverting amplifier

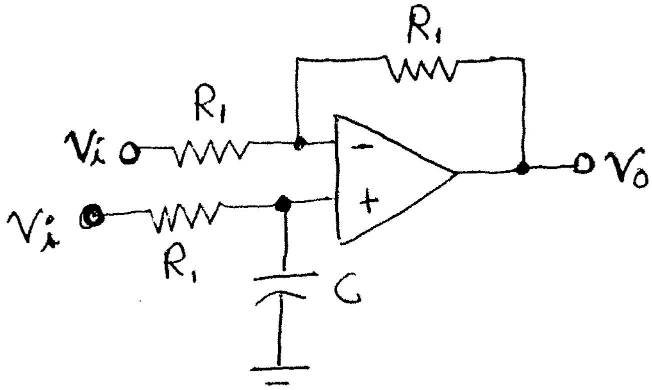
$A_v = \frac{-100K}{1K} = -100$

$V_o(t) = -30\cos(\omega t)$

but

limits output

13. For the following circuit involving an ideal-op, determine the relationship $\frac{V_o(\omega)}{V_i(\omega)}$



$$V_o = V_i \times \frac{\frac{1}{j\omega C}}{\frac{1}{j\omega C} + R_1} \times \left(1 + \frac{R_1}{R_1}\right) + V_i \times \left(-\frac{R_1}{R_1}\right)$$

$$= \frac{2V_i}{1 + j\omega RC} - V_i = \frac{2V_i - V_i - j\omega RC V_i}{1 + j\omega RC}$$

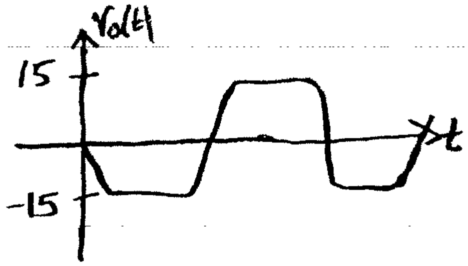
$$= V_i \frac{(1 - j\omega RC)}{1 + j\omega RC}$$

1 9. $\frac{V_2}{V_1} = \frac{-9}{4}$

3 10. $-\frac{3}{8}\frac{A\omega C}{(\frac{9}{64})^2+(\omega RC)^2}\cos\left(\omega t + 90^\circ - \tan^{-1}\frac{\omega RC}{9/64}\right)$

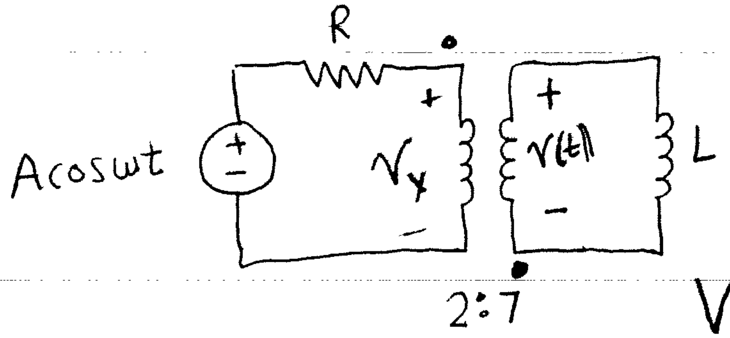
1 11. infinite input resistance, zero input current, zero input Δ, ...

2 12.



4 13. $\frac{V_o}{V_i} = \frac{1 - j\omega RC}{1 + j\omega RC} = \frac{2}{1+j\omega RC} - 1$

16. For the following circuit involving an ideal transformer, determine $v(t)$ (in the time domain).



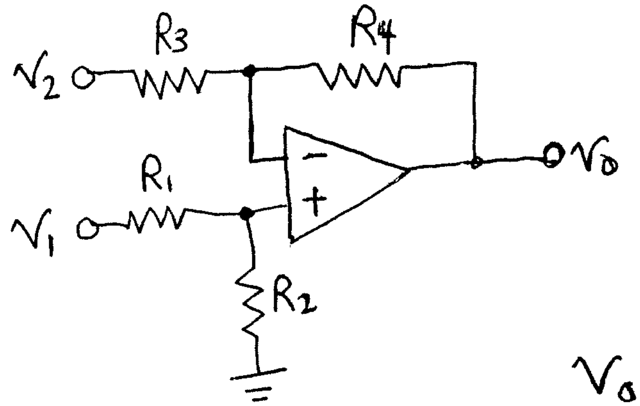
$$\frac{V}{V_x} = \frac{-7}{2}$$

$$V = -\frac{7}{2} V_x$$

$$V_x = A \times \frac{j\omega L / (7/2)^2}{\left[j\omega L / (7/2)^2\right] + R}$$

$$V_x(t) = \frac{A \times \frac{4}{49}\omega L}{\sqrt{R^2 + \left(\frac{\omega L 4}{49}\right)^2}} \cos\left(\omega t + 90^\circ - \tan^{-1}\frac{\frac{\omega L 4}{49}}{R}\right)$$

17. For the following circuit involving an ideal-op, determine the relationship for V_o as a function of V_1, V_2, and the R's



$$V_o = V_1 \frac{R_2}{R_1 + R_2}\left(1 + \frac{R_4}{R_3}\right) - V_2\left(\frac{R_4}{R_3}\right)$$

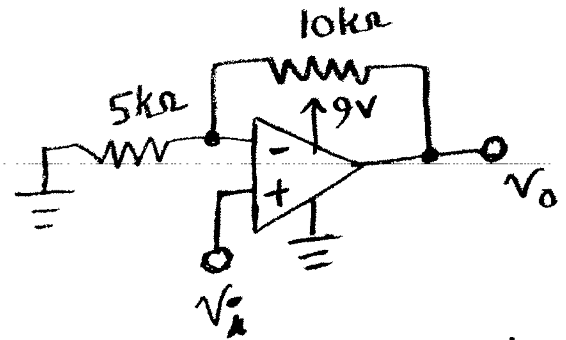
2 15. $\dfrac{R}{\sqrt{1+(\omega RC)^2}\sqrt{R^2+\left(\omega L-\frac{1}{\omega C}\right)^2}}$

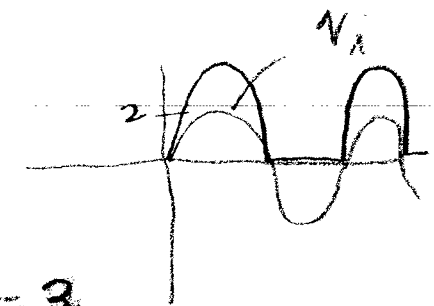
2 16. $-\frac{7}{2}\dfrac{A\frac{4}{49}\omega L}{\sqrt{R^2+\left(\frac{\omega L4}{49}\right)^2}}\cos\left(\omega t+90^\circ-\tan^{-1}\frac{\frac{\omega L4}{49}}{R}\right)\ V$

3 17. $v_0 = v_1\dfrac{R_2}{R_1+R_2}\left(1+\dfrac{R_4}{R_3}\right)-v_2\left(\dfrac{R_4}{R_3}\right)$

11. Name one characteristic of an ideal op-amp.

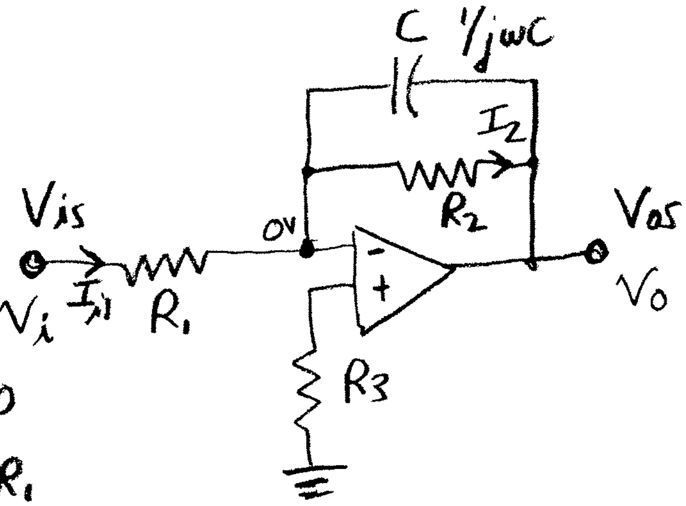
12. The input signal for the following ideal op-amp circuit is $v_i(t) = 2\sin(\omega t)$ V. Sketch the output signal, clearly indicating the maximum and minimum values of the amplitude.





$$G = 1 + \frac{10k}{5k} = 3$$

13. For the following circuit involving an ideal-op, determine the relationship $\dfrac{I_{2s}(\omega)}{V_{is}(\omega)}$



$$-V_{is} + R_1 I_{is} = 0$$

$$I_{is} = V_{is}/R_1$$

$$0 + \left(\frac{1}{j\omega C} // R_2\right) I_{is} + V_{os} = 0$$

$$I_{2s} R_2 + V_{os} = 0$$

$$V_o = -\frac{V_{is}}{R_1}\left(\frac{1}{j\omega C} // R_2\right)$$

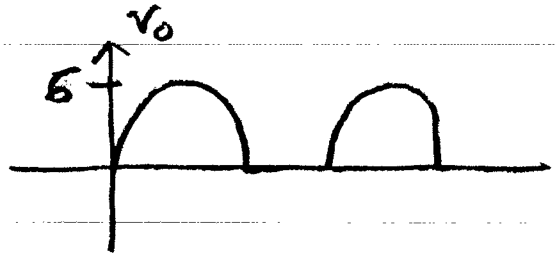
$$I_{2s} = -\frac{V_{os}}{R_2} = \frac{V_{is}}{R_1 R_2}\left(\frac{1}{j\omega C} // R_2\right) = \frac{V_{is}}{R_1 R_2} \frac{\frac{1}{j\omega C} R_2}{\frac{1}{j\omega C} + R_2}$$

$$= \frac{1}{R_1} \frac{1}{1 + j\omega C R_2}$$

1 9. $v_2/v_1 = -5/6$

3 10. $v(t) = \frac{2}{9}\frac{A}{\omega C}\cos(\omega t - 90^\circ)$ V

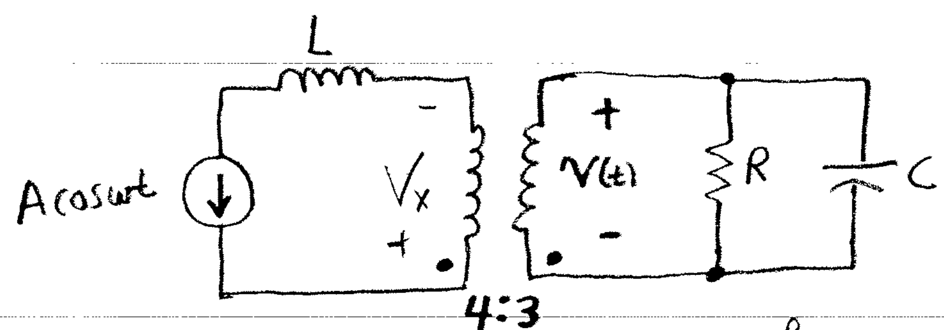
1 11. $V_- - V_+ = 0$ with feedback



2 12.

5 13. $\frac{I_2}{V_i} = \frac{1}{R_1 R_2}\left(\frac{1}{j\omega C} \| R_2\right) = \frac{1}{R_1}\frac{1}{1+j\omega C R_2}$

16. For the following circuit involving an ideal transformer, determine $v(t)$ (in the time domain).



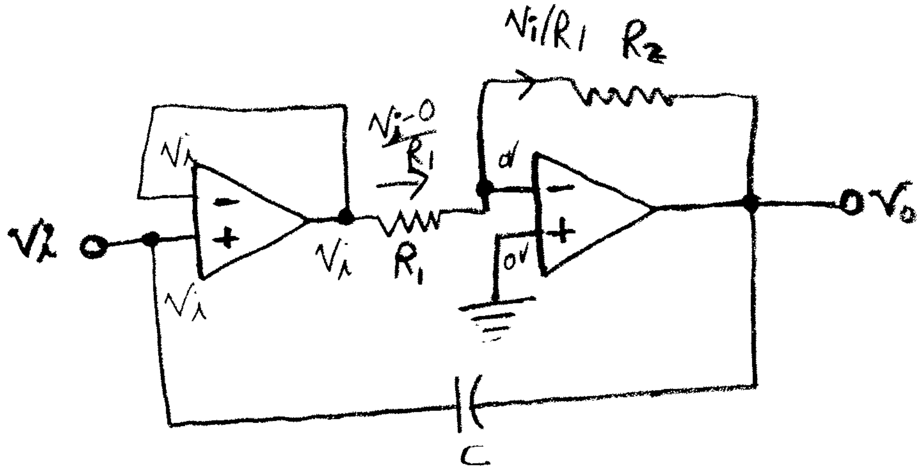
$$R \parallel \frac{1}{j\omega C} = \frac{R\frac{1}{j\omega C}}{R+\frac{1}{j\omega C}} = \frac{R}{1+j\omega RC}$$

$$V_X = (A\angle 0^\circ)\frac{\frac{R}{1+j\omega RC}}{(3/4)^2}$$

$$V/V_X = -3/4$$

$$V = \frac{-3}{4}V_X = -A\frac{R}{1+j\omega RC}\left(\frac{4}{3}\right)$$

17. For the following circuit involving ~~an~~ ideal-ops, determine the relationship $\frac{V_o(\omega)}{V_i(\omega)}$



$$0 + \frac{V_i}{R_1}R_2 + V_o = 0$$

$$\frac{V_o}{V_i} = \frac{-R_2}{R_1}$$

$$\frac{R\omega L}{\frac{\sqrt{R^2+(\omega L)^2}}{\sqrt{R^2+\left(\frac{1}{\omega C}\right)^2}}}$$

3 15. $\dfrac{\omega L R}{\sqrt{R^2+(\omega L)^2}\sqrt{R^2+\left(\frac{1}{\omega C}\right)^2}}$, $\dfrac{\omega L R}{\sqrt{\left(R^2+\frac{L}{C}\right)^2+\left(\omega L R-\frac{R}{\omega C}\right)^2}}$

5 16. $-\dfrac{4R}{3}\dfrac{1}{\sqrt{1+(\omega RC)^2}}\cos(\omega t-\tan^{-1}\omega RC)$

3 17. $\dfrac{V_0}{V_i}=\dfrac{-R_2}{R_1}$