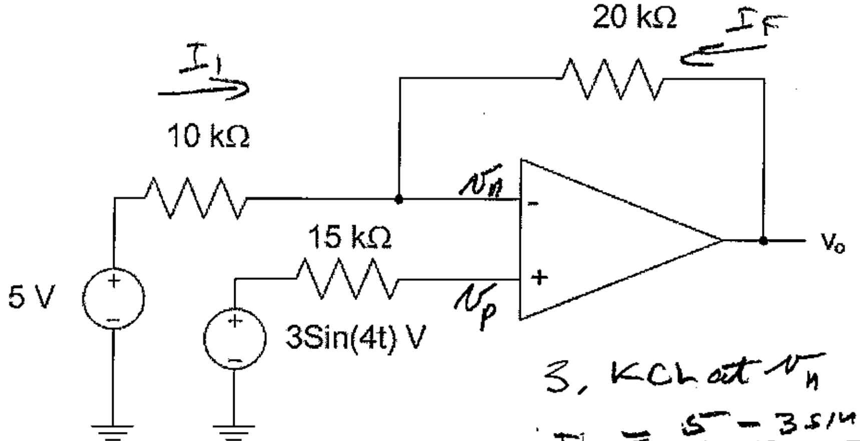
ECE 252 | Introduction to Electrical Engineering | Quiz 13AP
100 Points | Show your work. | Practice Solution

1. (50)) Assume the op amp is ideal. Find v_O.



1. Find v_p

$v_p = 3\sin 4t$

(because there is no current in the 15kΩ resistor)

2. $v_n = v_p = 3\sin 4t$

3. KCL at v_n

$I_1 = \frac{5 - 3\sin 4t}{10K}$ $\quad I_F = \frac{v_o - 3\sin 4t}{20K}$

$-I_1 - I_F = 0 \rightarrow -\frac{5-3\sin 4t}{10K} - \frac{v_o - 3\sin 4t}{20K} = 0$

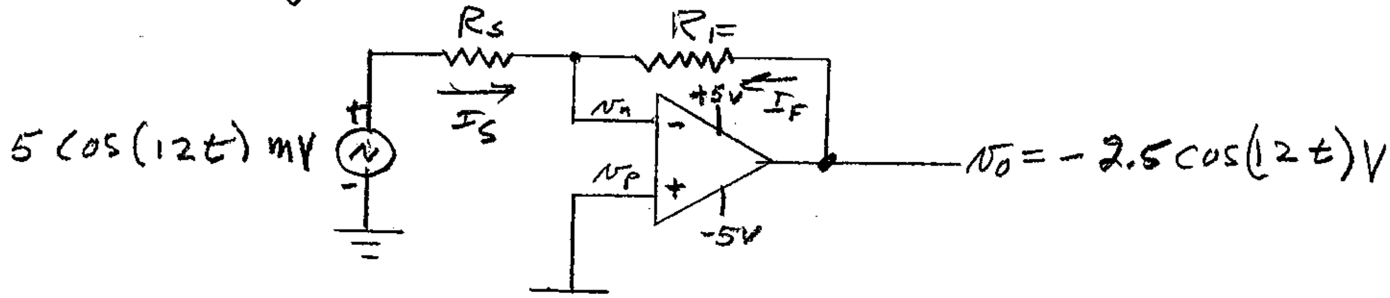
$-2(5-3\sin 4t) - (v_o - 3\sin 4t) = 0$

$v_o = -10 + 6\sin 4t + 3\sin 4t$

$= \underline{-10 + 9\sin 4t \text{ V}}$

2. (50) Design, sketch, and label an op-amp circuit with an input of 5cos(12t) mV and an output of -2.5cos(12t) V. You have an op-amp, which may be considered ideal, and a selection of resistors from 1 kΩ to 1 MΩ. In your sketch show appropriate power supplies for the op amp. Carefully analyze the circuit to prove that it produces the desired output.

The output is negative with respect to the input, so an inverting op-amp is required.



1. $v_p = 0$

2. $v_n = v_p = 0$

3. Solve KCL at v_n

$I_S = \frac{5\cos(12t)\times 10^{-3}}{R_S}$

3. (continued)

$I_F = \frac{-2.5\cos(12t)}{R_F}$

$-I_S - I_F = 0 \rightarrow -\frac{5\cos(12t)\times 10^{-3}}{R_S} - \frac{-2.5\cos(12t)}{R_F} = 0$

$\frac{R_F}{R_S} = \frac{2.5\cos(12t)}{5\cos(12t)\times 10^{-3}} = 500$

Let $R_S = 1k\Omega$ and $R_F = 500k\Omega$

Power supplies must span the range of the output voltage, and must be equal and opposite.