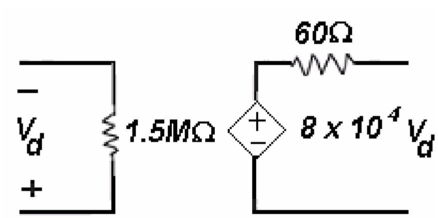
Spring, 2007

EECS70A / CSE 70A Network Analysis I
Prof. Peter Burke

Homework # 3 solution

Q1. Problem 5.1:

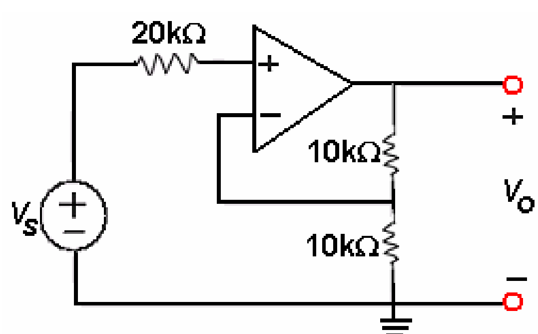


(a) Input resistance = 1.5 MΩ

(b) Output resistance = 60 Ω

(c) Voltage gain = 8×10^4 = 98 dB

Q2. Problem 5.10:



For ideal op-amp:

No currents into the input terminals.

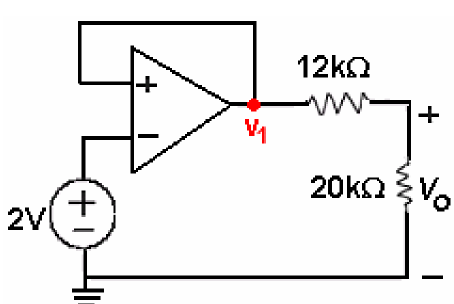
$\therefore V_+ = V_- = V_s$

Voltage divider:

$V_- = 10K\Omega / (10K\Omega + 10K\Omega)\, V_o$

$\therefore V_o / V_s = 2$

Q3. Problem 5.25:



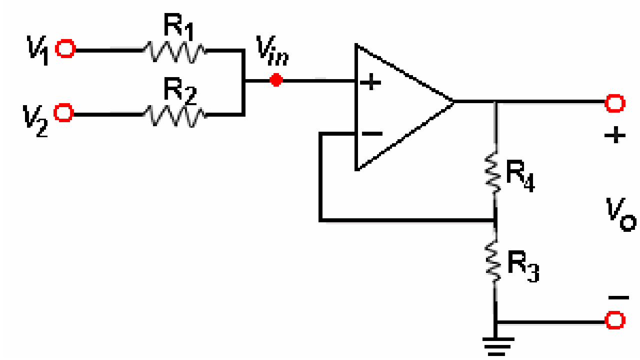
$V_+ = V_- = V_1 = 2V$

Voltage divider:

$V_o = 20K\Omega / (20K\Omega + 12K\Omega)\, V_1$

$\therefore V_o = 1.25$ V

Q4. Problem 5.34:



$V_+ = V_- = V_{in}$

Voltage divider:

$V_- = R_3 V_o / (R_3 + R_4)$

$\therefore V_o = (1 + R_4 / R_3) V_{in}$

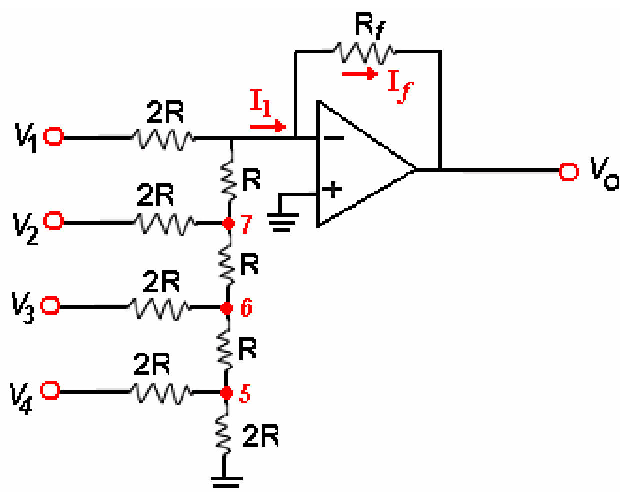
Voltage divider:

$V_{in} - V_2$

$= R_2(V_1 - V_2) / (R_1 + R_2)$

$\therefore V_o = (1 + R_4 / R_3) V_{in} = (1 + R_4 / R_3) (R_2 V_1 + R_1 V_2) / (R_1 + R_2)$

Q5. Problem 5.84:



(a) Use superposition to find I_1:

We'll find I_1 due to V_1, hence we will set rest of the voltages to zero.

$I_1 = V_1 / 2R$

Then we'll find I_1 due to V_2, hence we will set rest of the voltages to zero.

$I_1 = V_2 / 4R$

Then we'll find I_1 due to V_3, hence we will set rest of the voltages to zero.

$I_1 = V_3 / 8R$

Then we'll find I_1 due to V_4, hence we will set rest of the voltages to zero.

$I_1 = V_4 / 16R$

Therefore, total $I_1 = V_1 / 2R + V_2 / 4R + V_3 / 8R + V_4 / 16R$

Apply KCL at the inverting input terminal:

$I_1 = - V_o / R_f$

$\therefore - V_o = R_f (V_1 / 2R + V_2 / 4R + V_3 / 8R + V_4 / 16R)$

(b) $R_f = 12$ kΩ and $R = 10$kΩ

For $[V_1\ V_2\ V_3\ V_4] = [1\ 0\ 1\ 1]$,

$- V_o = R_f (V_1 / 2R + V_2 / 4R + V_3 / 8R + V_4 / 16R)$

$= (12 \times 10^3) / (10 \times 10^3) (1/2 + 0/4 + 1/8 + 1/16)$

$\therefore |V_o| = 0.825$ V

For $[V_1\ V_2\ V_3\ V_4] = [0\ 1\ 0\ 1]$

$- V_o = R_f (V_1 / 2R + V_2 / 4R + V_3 / 8R + V_4 / 16R)$

$= (12 \times 10^3) / (10 \times 10^3) (0/2 + 1/4 + 0/8 + 1/16)$

$\therefore |V_o| = 0.375$ V