Spring 2008

EECS70A / CSE 70A Network Analysis I
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Homework # 4 solution

Chapter 5, Solution 1.

(a) R_{in} = **<u>1.5 MΩ</u>**

(b) R_{out} = **<u>60 Ω</u>**

(c) $A = 8x10^4$

Therefore $A_{dB} = 20 \log 8x10^4$ = **<u>98.0 dB</u>**

Chapter 5, Solution 9.

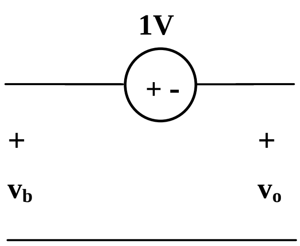
(a) Let v_a and v_b be respectively the voltages at the inverting and noninverting terminals of the op amp

$v_a = v_b = 4V$

At the inverting terminal,

$$1mA = \frac{4 - v_0}{2k} \longrightarrow \qquad v_0 = \underline{\mathbf{2V}}$$

(b)



Since $v_a = v_b = 3V$,

$-v_b + 1 + v_o = 0 \qquad\qquad v_o = v_b - 1 = \underline{\mathbf{2V}}$

Chapter 5, Solution 17.

(a) $$G = \frac{v_o}{v_i} = -\frac{R_2}{R_1} = -\frac{12}{5} = \underline{\mathbf{-2.4}}$$

(b) $$\frac{v_o}{v_i} = -\frac{80}{5} = \underline{\mathbf{-16}}$$

(c) $$\frac{v_o}{v_i} = -\frac{2000}{5} = \underline{\mathbf{-400}}$$

Chapter 5, Solution 34.

$$\frac{v_1 - v_{in}}{R_1} + \frac{v_1 - v_{in}}{R_2} = 0 \qquad (1)$$

but

$$v_a = \frac{R_3}{R_3 + R_4} v_o \qquad (2)$$

Combining (1) and (2),

$$v_1 - v_a + \frac{R_1}{R_2} v_2 - \frac{R_1}{R_2} v_a = 0$$

$$v_a\left(1 + \frac{R_1}{R_2}\right) = v_1 + \frac{R_1}{R_2} v_2$$

$$\frac{R_3 v_o}{R_3 + R_4}\left(1 + \frac{R_1}{R_2}\right) = v_1 + \frac{R_1}{R_2} v_2$$

$$v_o = \frac{R_3 + R_4}{R_3\left(1 + \frac{R_1}{R_2}\right)}\left(v_1 + \frac{R_1}{R_2} v_2\right)$$

$$v_O = \underline{\frac{R_3 + R_4}{R_3(R_1 + R_2)}(v_1 R_2 + v_2)}$$

Chapter 5, Solution 39.

This is a summing amplifier.

$$v_o = -\left(\frac{R_f}{R_1} v_1 + \frac{R_f}{R_2} v_2 + \frac{R_f}{R_3} v_3\right) = -\left(\frac{50}{10}(2) + \frac{50}{20} v_2 + \frac{50}{50}(-1)\right) = -9 - 2.5 v_2$$

Thus,

$v_o = -16.5 = -9 - 2.5v_2 \longrightarrow \underline{v_2 = 3\text{ V}}$

Chapter 6, Solution 21.

4μF in series with 12μF = (4x12)/16 = 3μF
3μF in parallel with 3μF = 6μF
6μF in series with 6μF = 3μF
3μF in parallel with 2μF = 5μF
5μF in series with 5μF = 2.5μF

Hence C_{eq} = **2.5μF**

Chapter 6, Solution 23.

(a) 3μF is in series with 6μF 3x6/(9) = 2μF

$v_{4\mu F}$ = 1/2 x 120 = **60V**

$v_{2\mu F}$ = **60V**

$v_{6\mu F} = \frac{3}{6+3}(60) = \mathbf{20V}$

$v_{3\mu F}$ = 60 - 20 = **40V**

(b) Hence w = 1/2 Cv^2

$w_{4\mu F}$ = 1/2 x 4 x 10^{-6} x 3600 = **7.2mJ**

$w_{2\mu F}$ = 1/2 x 2 x 10^{-6} x 3600 = **3.6mJ**

$w_{6\mu F}$ = 1/2 x 6 x 10^{-6} x 400 = **1.2mJ**

$w_{3\mu F}$ = 1/2 x 3 x 10^{-6} x 1600 = **2.4mJ**

Chapter 6, Solution 51.

$$\frac{1}{L} = \frac{1}{60} + \frac{1}{20} + \frac{1}{30} = \frac{1}{10}$$

L = 10 mH

$$L_{eq} = 10 \| (25+10) = \frac{10x35}{45}$$

$= \underline{\textbf{7.778 mH}}$

Chapter 6, Solution 52.

$$L_{eq} = 5//(7+3+10//(4+6)) == 5//(7+3+5)) = \frac{5x15}{20} = \underline{3.75\ \ H}$$