Reading List
Chapter 14.4, 14.7, 14.8,14.9 of Hambley textbook
14.9 of Hambley textbook
Chapter 3 of Hambley textbook

P1. (Hambley 14.23) Output Impedance of Op-Amp Circuits
Analyze each of the ideal op-amp circuits shown in the figure below to find expressions for i_0 . What is the value of the output impedance for each of these circuits? Why? (Note: the bottom end of the input voltage source is not grounded in part b of the figure. Thus, we say this source is floating)

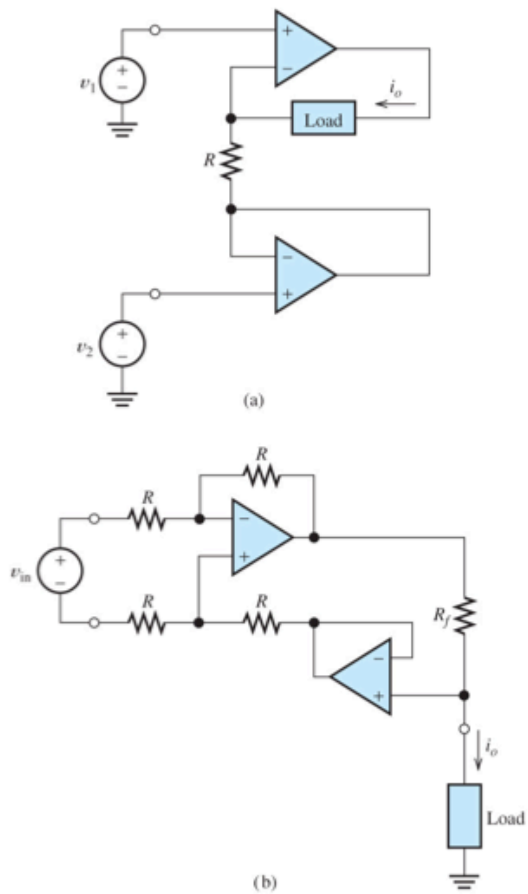

Fig.1 Circuit schematics for problem 1.

P2.(Hambley 14.30) Gain Tolerance
Suppose that we design an inverting amplifier using 5% tolerance resistors and an ideal op-amp. The nominal amplifier gain is -2. What are the minimum and maximum gain possible, assuming the resistors are within the stated tolerance? What is the percentage tolerance of the gain ? (Gain tolerance %= 100*(GainMax-GainMin)/(GainNominal))

P3.(Hambley P14.34) Two Op-Amp Circuits in Tandem

The circuit shown in the figure below employs negative feedback. Use the summing point constraint for both amps to derive expressions for the voltage gains A1=V_{o1}/V_{in}; A2=V_{o2}/V_{in}

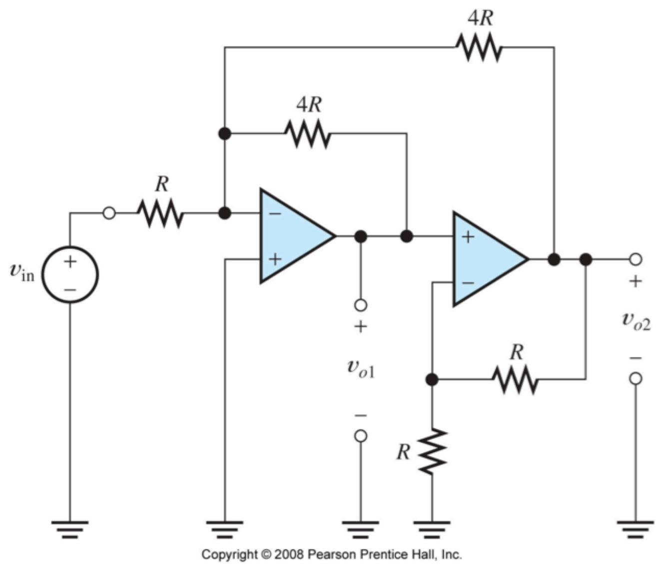

Fig.2 Circuit Schematic for Problem 3

P4.(Hambley 14.48) Analysis with full Op-Amp Model

The objective of this problem is to investigate the effects of finite gain, finite input impedance, and non-zero output impedance of the op-amp on the inverting amplifier. The circuit, including the op-amp model, is shown in the figure below.

A.Derive an expression for the circuit voltage gain v_o/v_s . Evaluate for $A_{OL}=10^5$, R_{in} = 1M Ohm, R_o =25 Ohm, R1=1K Ohm, R2=10K Ohm. Compare this results to the gain with an ideal op-amp.

B.Derive an expression for the circuit input impedance $Z_{in} = v_s/i_s$. Evaluate for $A_{OL}=10^5$, R_{in} = 1M Ohm, R_o =25 Ohm, R1=1K Ohm, R2=10K Ohm. Compare this results to the input impedance with an ideal op-amp.

C.Derive an expression for the circuit output impedance $Z_o = v_o/i_o$. Evaluate for $A_{OL}=10^5$, R_{in} = 1M Ohm, R_o =25 Ohm, R1=1K Ohm, R2=10K Ohm. Compare this results to the output impedance with an ideal op-amp.

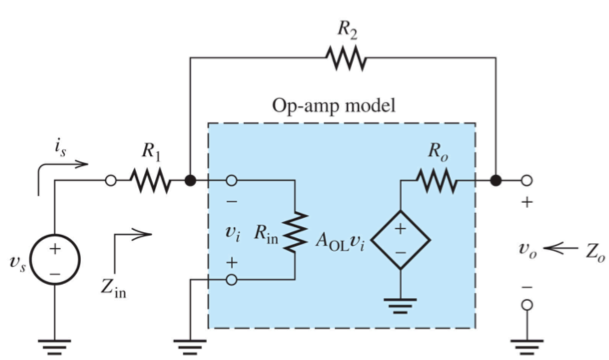

Fig.3 Circuit Schematic for Problem 4

P5 (Hambley 3.25) Capacitors in Seriers and in Parallel

Find the equivalent capacitance between terminals X and Y for each of the circuits shown in the figure

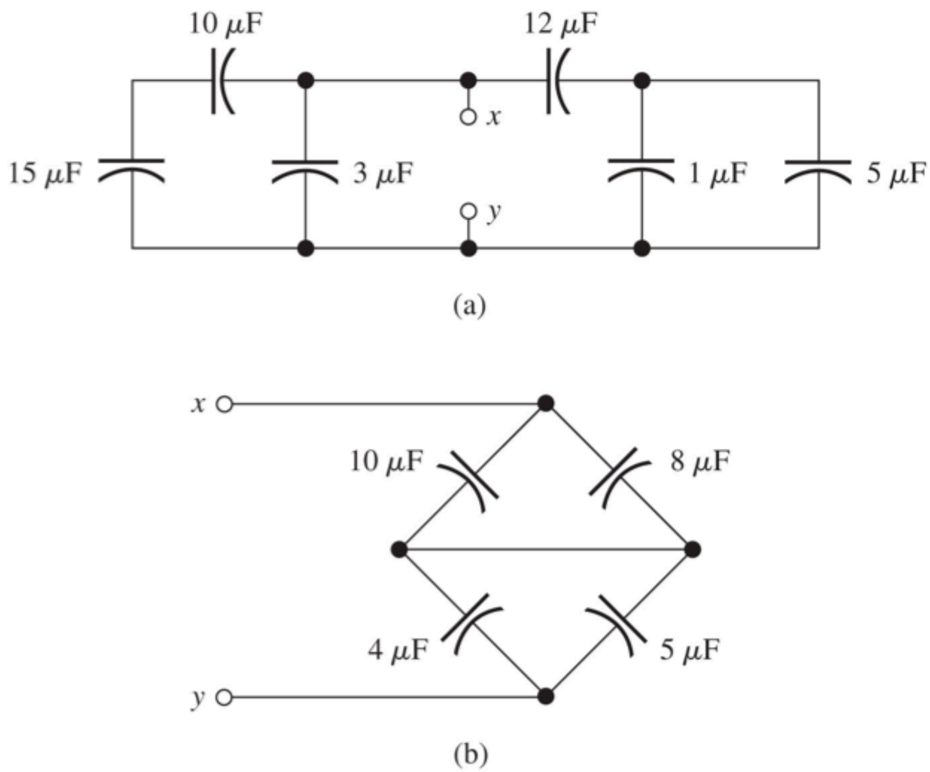

Fig.4 Circuit Schematic for Problem 5

P6.(Hambley 3.28) Capacitors Charging Behavior

Two initially uncharged capacitors C_1=15uF and C_2=10uF are connected in series. Then, a 10V source is connected to the series combination, as shown in the figure below. Find the voltages v_1 and v_2 after the source is applied. (Hint: the charges stored on the two capacitors must be equal because the current is the same in both capacitors)

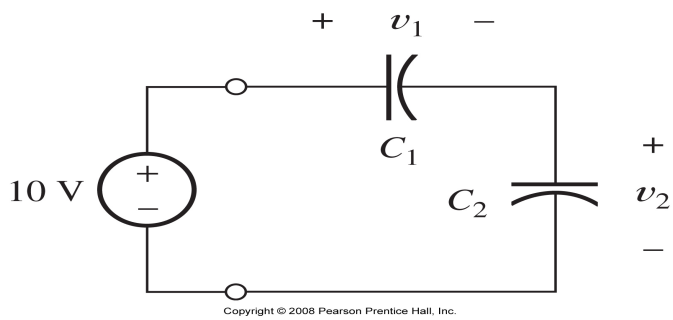

Fig.5 Circuit Schematic for Problem 6

P7 (Hambley 3.48) Inductor Behavior

The voltage across a 2H inductance is shown in the figure below. The initial current in the inductance is i(0)=0. Sketch the current, power, and stored energy to scale versus time.

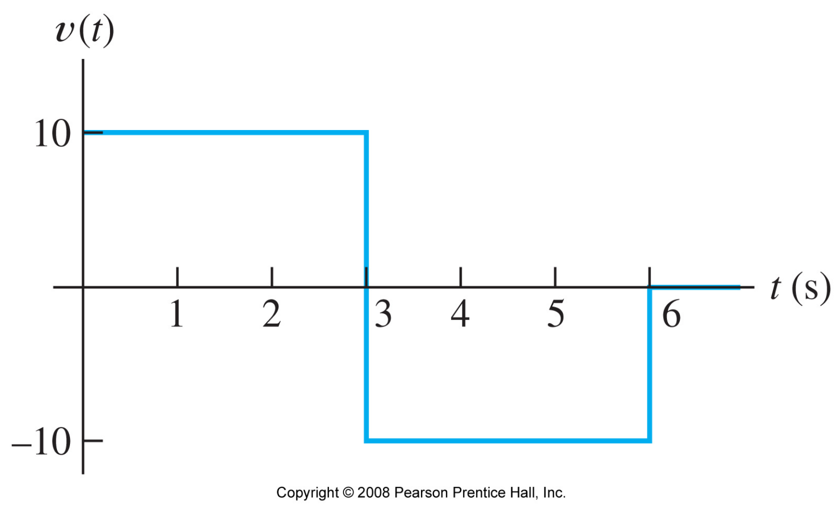

Fig.6 Voltage waveform for Problem 7

P8. (Hambley 14.75) Differentiator

Sketch the output voltage of the ideal op-amp circuit shown in the figure below to scale versus time.

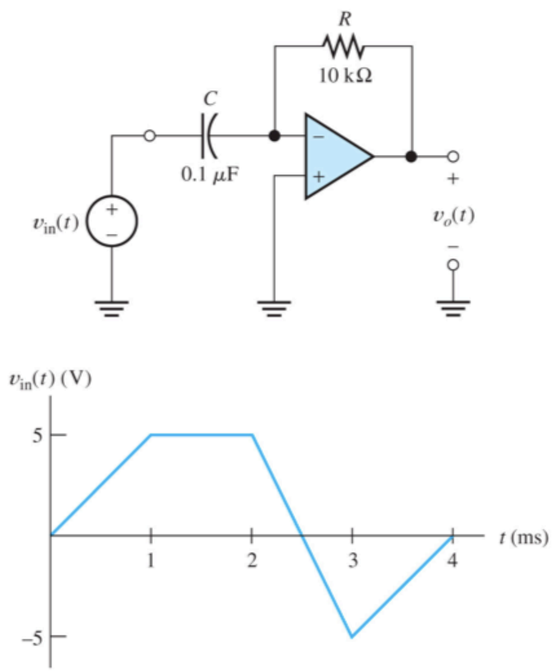

Fig.7 Circuit Schematic for Problem 8