ECE 209 — Exam # 2

Estimated time for completion: <1.25 hour
24 October 2017

Rules of the Exam

Rule 1: The examination period begins at 9:30am on Tuesday 24 October 2017 and ends at 10:45pm on Tuesday 24 October 2017.

Rule 2: There are four problems.

Rule 3: The exam is closed book and closed notes. You may have an 8.5" x 11" sheet of paper with notes and a calculator.

Rule 4: Do not leave the room until you have completed the exam.

Rule 5: To receive full credit for an answer include the units along with the numerical answer.

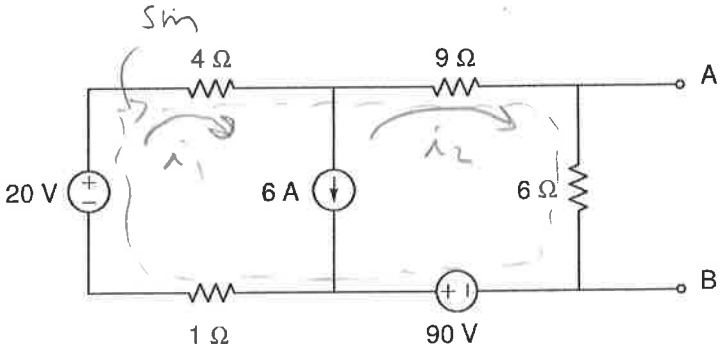
Rule 6: Show all work - answers without supporting work will not receive credit.

Answer Key

Name

Problem 1 (30 points)

Consider the circuit below:



Part A: Draw the Thévenin Equivalent Circuit with respect to terminals A and B.

Supermesh: $4i_1 + 9i_2 + 6i_2 - 90 + i_1 - 20 = 0$

$i_1 - i_2 = 6 \Rightarrow i_1 = 6 + i_2$

$5i_1 + 15i_2 = 110$

$30 + 5i_2 + 15i_2 = 110$

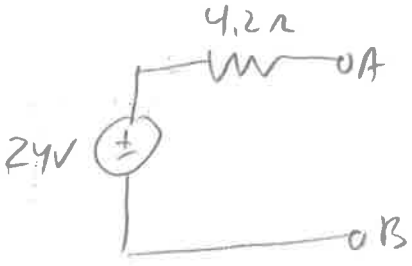
$20i_2 = 80$

$i_2 = 4A$

$V_{AB} = 6i_2 = 24V$

$R_{AB} = 6 \| 4$

$= 4.2\Omega$



$P = \frac{24^2}{4 \times 4.2}$

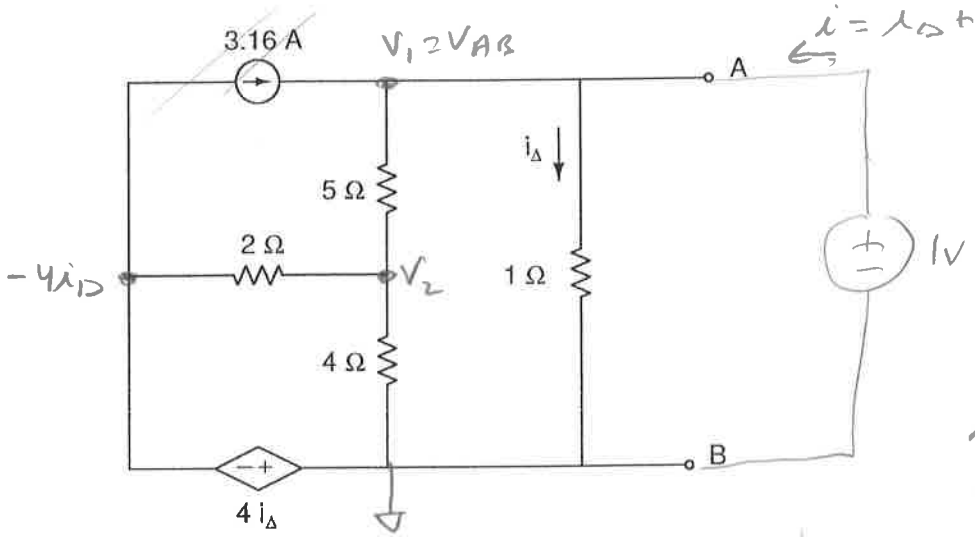
Part B: If a load resistor R_L is placed between terminals A and B:

What value of R_L produces maximum power transfer to the load? 4.2Ω

What is the maximum power dissipated by R_L? 34.3 W

Problem 2 (20 points)

Consider the circuit below:



$i = i_\Delta + \frac{V_1 - V_2}{5}$

Draw the Thévenin Equivalent Circuit with respect to terminals A and B.

KCL @ V_1: $-3.16 + \frac{V_1 - V_2}{5} + V_1 = 0$

KCL @ V_2: $\frac{V_2 + 4i_\Delta}{2} + \frac{V_2}{4} + \frac{V_2 - V_1}{5} = 0$

Constraint: $i_\Delta = V_1$

$V_1 = 2.0\,V$

$V_2 = -3.8\,V$

$V_{AB} = 2.0V$

$i_\Delta = 1$

$V_1 = 1$

KCL @ V_2:

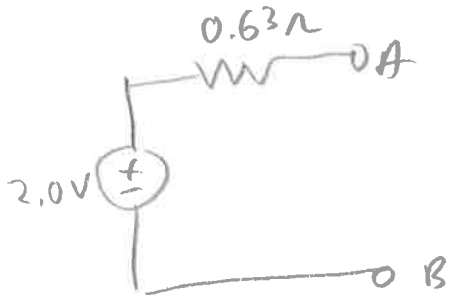
$\frac{V_2}{4} + \frac{V_2 + 4i_\Delta}{2} + \frac{V_2 - 1}{5} = 0$

$V_2 = \frac{-36}{19}$

$i = 1 + \frac{V_1 - V_2}{5}$

$= \frac{30}{19} A$

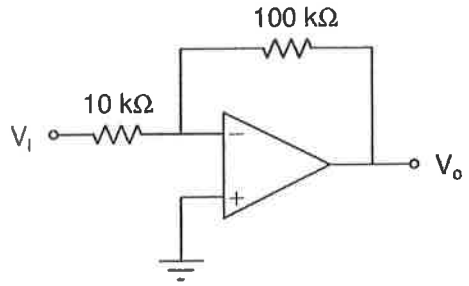
$R_{Th} = 0.63$



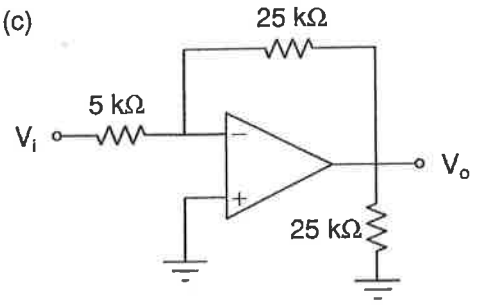
Problem 3 (20 points)

The OpAmp in the circuits below is ideal. For each of the circuits, find the voltage gain, V_o / V_i.

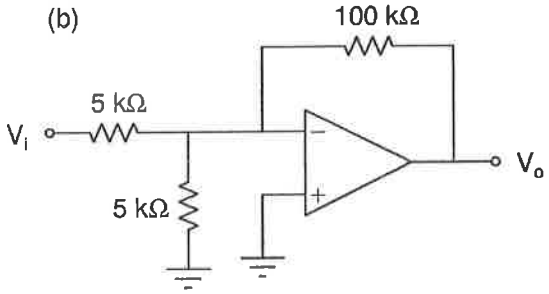
(a)



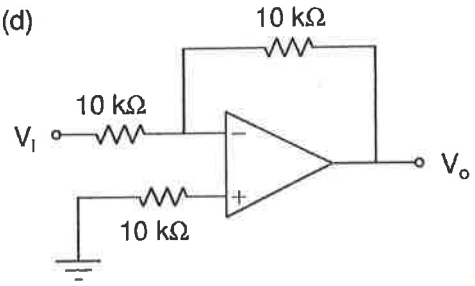
(c)



(b)



(d)



Circuit (a) Voltage Gain = _____

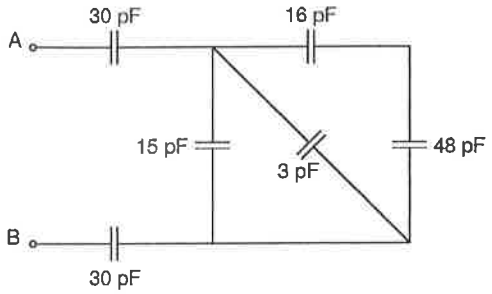
Circuit (b) Voltage Gain = _____

Circuit (c) Voltage Gain = _____

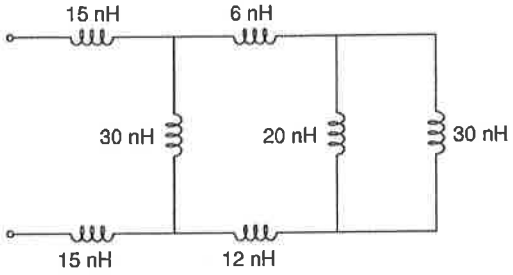
Circuit (d) Voltage Gain = _____

Problem 4 (30 points)

Consider the circuits below:



Circuit A



Circuit B

Circuit A: What is the equivalent capacitance between terminals A and B? _____

Circuit B: What is the equivalent inductance between terminals A and B? _____

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