EECS 40 Midterm II Review Problems

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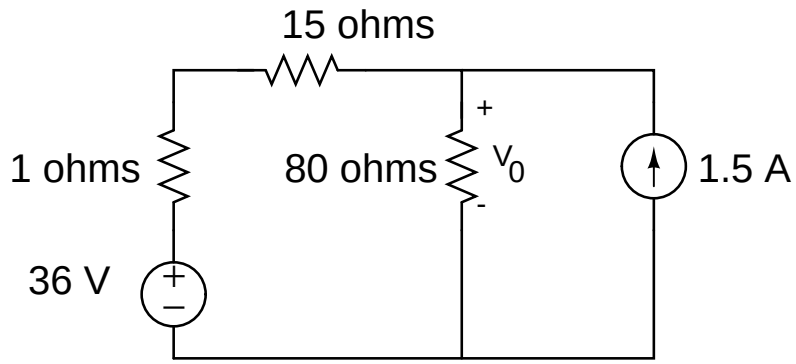
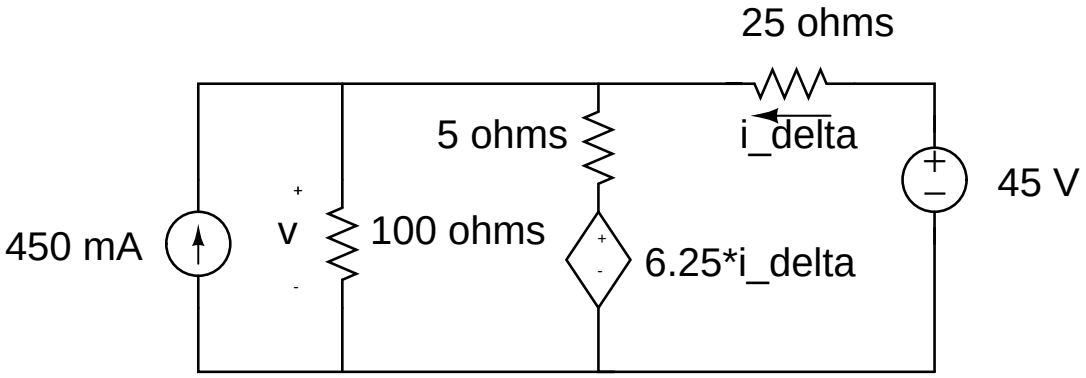
1 Circuit Analysis

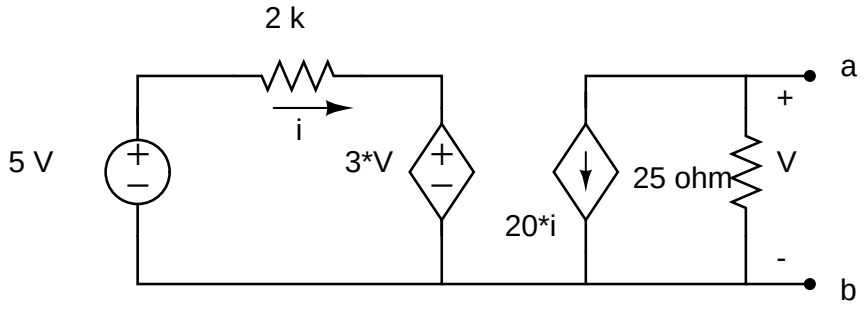
1. **Warmup Problem I**
   Find v_0 in the circuit below using NODAL analysis.



2. **Warmup Problem II**
   Using NODAL analysis, find v.

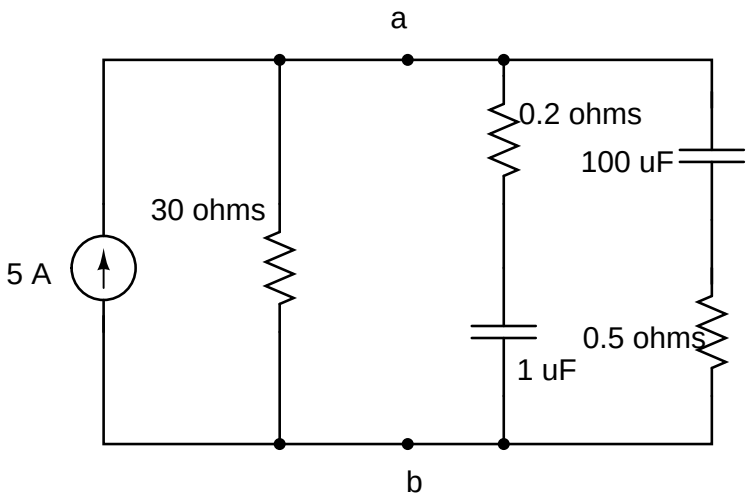


3. **Thevenin equivalent with dependent and independent sources**
   Find the thevenin equivalent of the following circuit with respect to terminals ab.



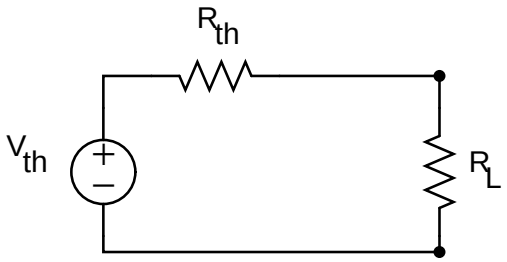
4. **Short circuits**
   After the circuit below has been in operation for a long time, good ol' Bart comes along and by "abusing his power", connects a screwdriver between terminals a and b. Assume the resistance of the screwdriver is negligable.

   a) Find the current in the screwdriver at t = 0^+ and t $\rightarrow \infty$.
   b) Derive the expression for the current in the screwdriver for t $\geq 0^+$.



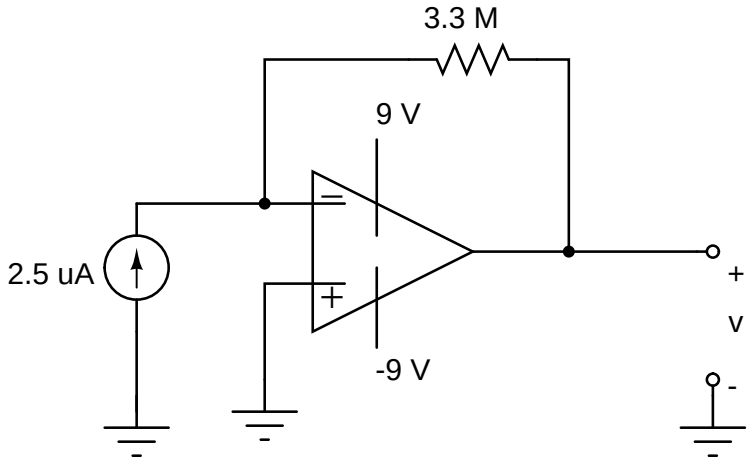
5. **Maximum Power Transfer Theorem**
   In the circuit below, find the value of R_L that maximizes the power delivered to R_L [1].

[1] Hint: Express the power delivered to R_L as a function of V_{th}, R_{th} and R_L. Then use calculus.

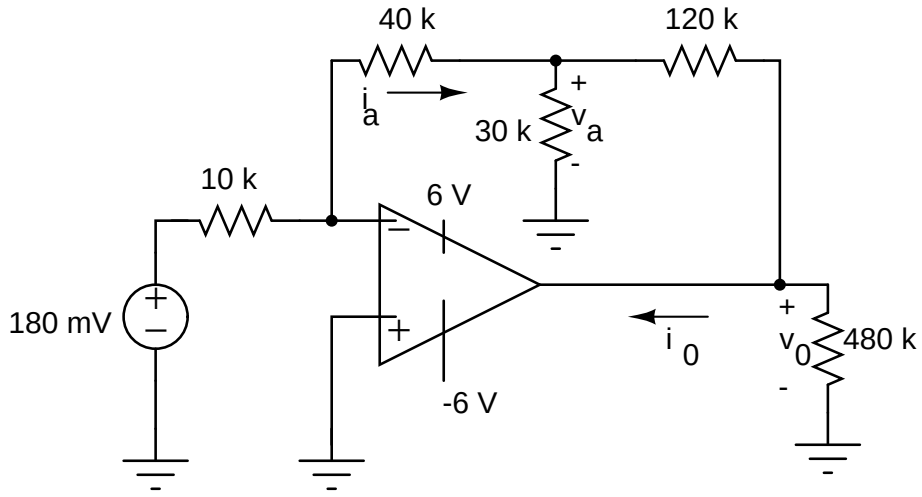


2 Operational Amplifiers

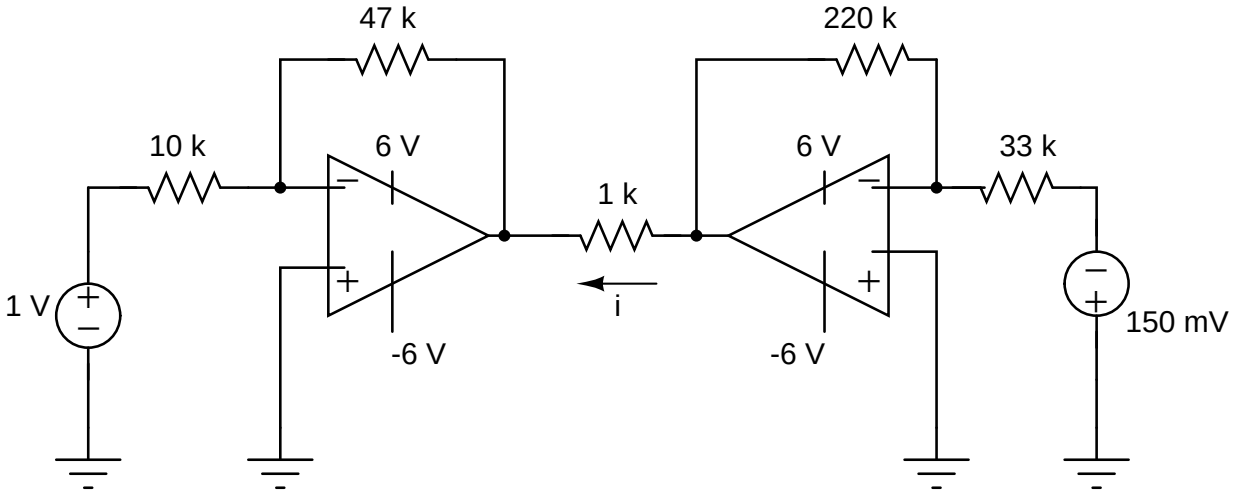
6. **Warmup Problem I**
   In the op-amp circuit below, find v. Assume the op-amp output WILL rail, if v $\geq$ 9 V or v $\leq$ -9 V.



7. **Warmup Problem II**
   In the op-amp circuit below, find v_a, v_o, i_a and i_o. Assume the op-amp output WILL rail, if $v_o \geq 6$ V or $v_o \leq -6$ V.

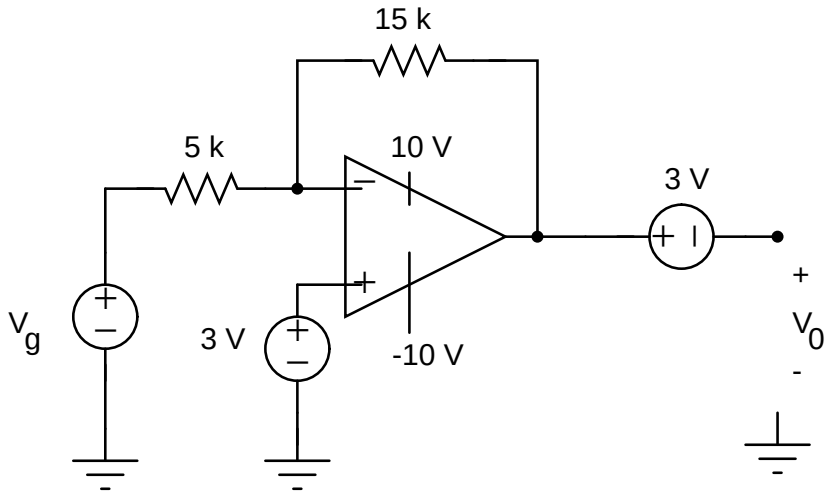


8. **Ohm's law**
   In the op-amp circuit below, find i. Assume the op-amp outputs WILL rail, if the output voltages of the two op-amps become greater than 6 V or less than -6 V.



9. **Help the Batman**[2]
   The Riddler claims the circuit below will produce an output voltage that will vary between $\pm$ 9 V as V_g varies between 0 and 6 V. Assume the op-amp outputs WILL rail, if V_0 goes above 10 V or below -10 V.

[2]Bart's favourite superhero!



Obviously, the Dark Knight detective is called into action. Unfortunately, the Batman took EECS 40 a long time ago and his circuits knowledge is a little rusty. He doesn't have enough time to review his skills, so you get to help the Batman!

a. Draw a graph of the output voltage V_0 as a function of the input voltage V_g for $0 \leq V_g \leq 6$ V.

b. Should the Batman agree with the Riddler's claim? (the fate of Gotham city rests in your hands!)