Exercises

Logic Gates and Boolean Functions

When signal invert symbols appear in figures below, do not draw an inverter; treat an inverted signal as it is.

1-1 (a) Draw the logic gate implementation for the Boolean function $G = A(B + C)(D\overline{E}F)$.

(b) Draw the logic gate implementation for the Boolean function $G = (A + B)(C + D\overline{E}F)$.

1-2 (a) Draw the logic gate implementation for the Boolean function $F = (W\overline{X})(Y + Z)$.

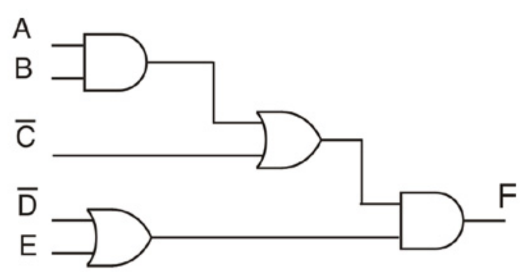
(b) Write the DeMorgan equivalent Boolean statement in Part (a) and draw its logic gate schematic.

1-3 Write the DeMorgan equivalent Boolean statement and draw its logic gate schematic for

(a) $F = A(\overline{B} + D) + EF$

(b) $F = (A + BC)D$

1-4 Draw the DeMorgan equivalent logic gate circuit for



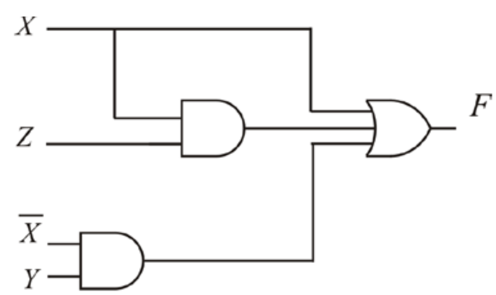
Boolean and Logic Gate Reduction

1-5 Minimize the function $F = X + \overline{X + Y} + XY$

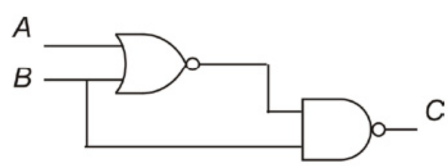
1-6 Minimize the function $F = \overline{\overline{XY} + \overline{ZY}}$

1-7 Minimize the function $F = \overline{XY} + \overline{ZY}$ putting it in a logical inverter form.

1-8 Reduce to the logic circuit to its minimum function

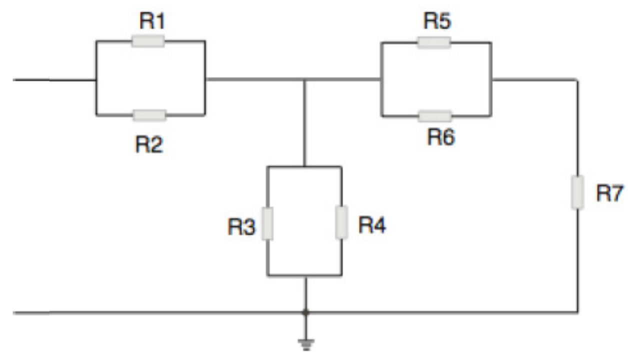


1-9 Reduce this logic gate circuit to its minimum function using Boolean reduction.

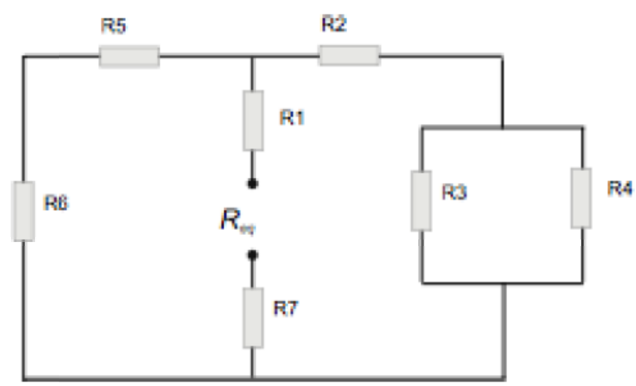


Terminal Resistance by Inspection

1-10 Write the short hand expression for R_{eq} between the terminals.



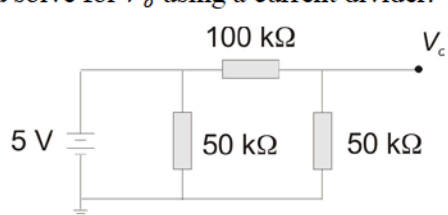
1-11 Write the short hand expression for R_{eq} between the terminals.



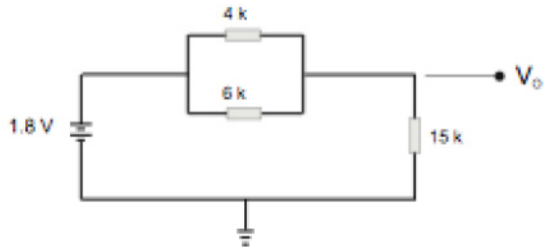
Voltage Dividers by Inspection

1-12 (a) Write the V_o expression by inspection and solve for V_o using a voltage divider.

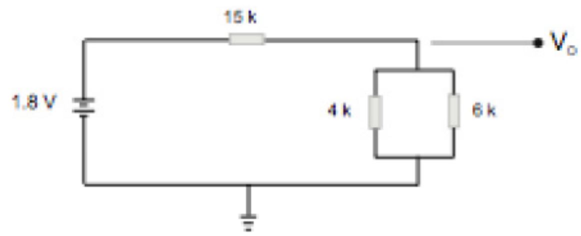
(b) Write the V_o expression by inspection and solve for V_o using a current divider.



1-13 Calculate V_o by first writing a voltage divider expression and then numerically solving for V_o for both circuits.



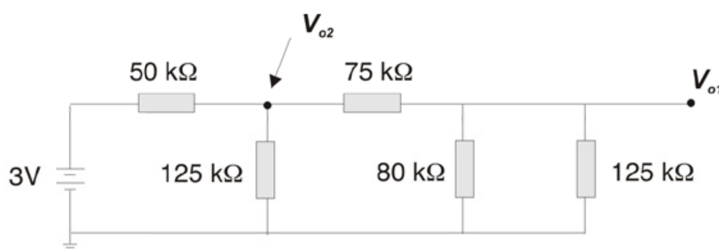
(a)



(b)

1-14 (a) Write the V_{o1} expression by inspection and solve for V_{o1} using a voltage divider.

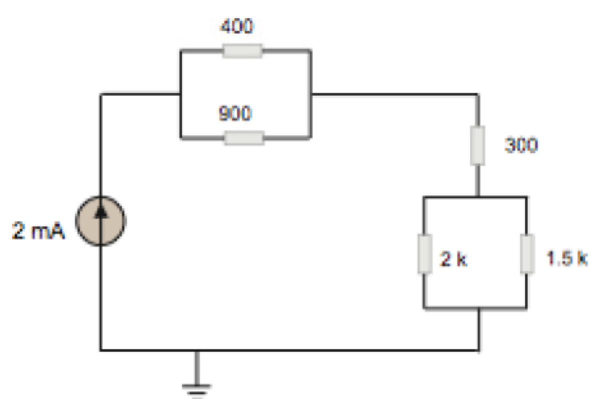
(b) Write the V_{o2} expression by inspection and solve for V_{o2} using a voltage divider.



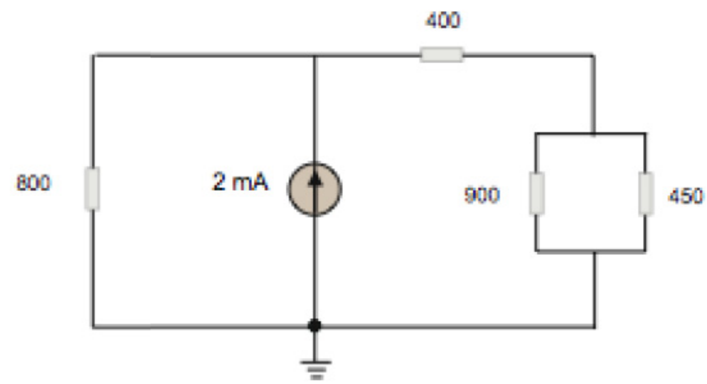
Current Dividers by Inspection

1-15 Repeat Problem 1-14 above, but solve by including a current divider.

1-16 Write the general expressions and solve for all resistor currents.



1-17 Given the circuit



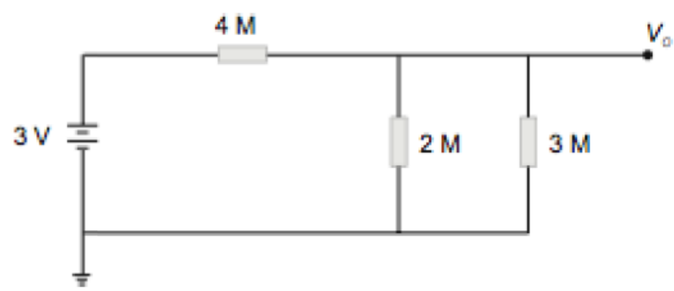
(a) Write the expression for I_{450} and solve.

(b) Write the expression for V_{800} and solve.

(c) Show that $I_{800} + I_{400} = 2$ mA.

1-18 (a) Calculate V_o using a voltage divider written by inspection

(b) Calculate I_{2M} using a current divider written by inspection.

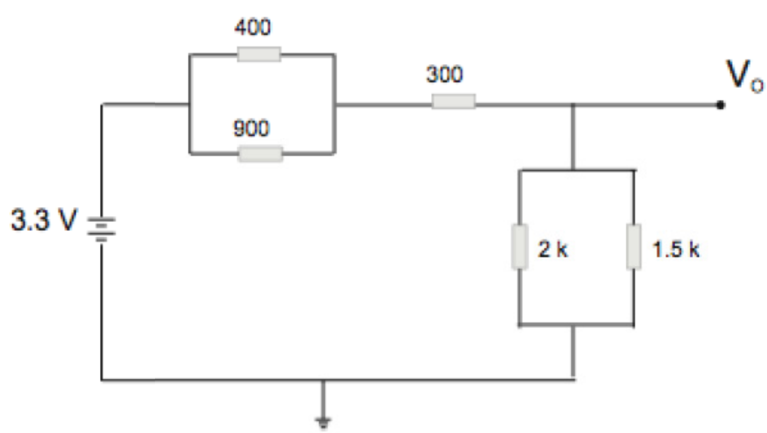


1-19 For the circuit

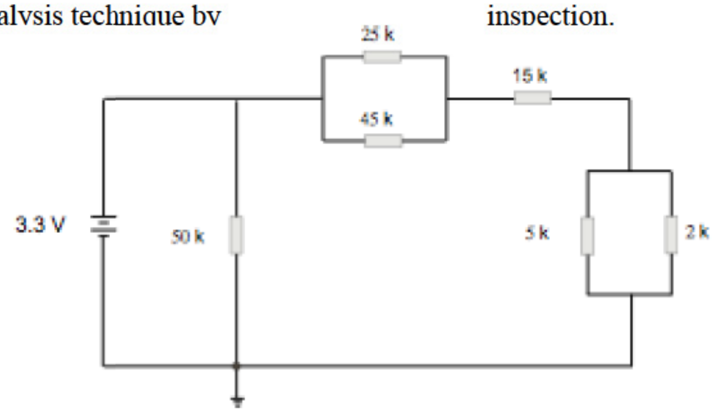
(a) Solve for V_o using a voltage divider expression

(b) Solve for I_{2k}.

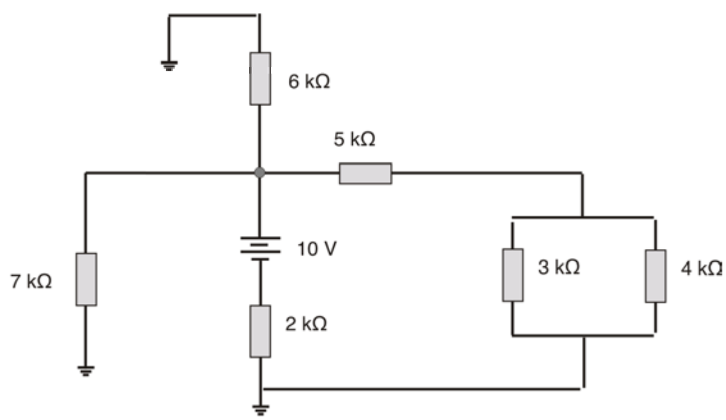
(c) Solve for I_{900}.



1-20 Calculate I_{2k} using the circuit analysis technique by inspection.

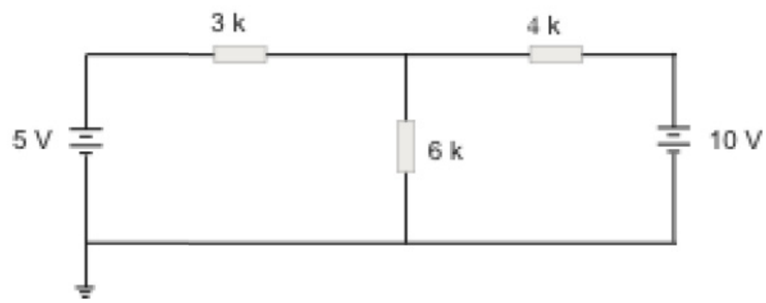


1-21 Using analysis by inspection, write the expression for the voltage across the 2 kΩ resistor and solve for its value.



Mixing Voltage and Current Divider Analysis

1-22 Find I_{6k}.



<u>*Hint*</u>: when we have two power supplies and a linear (resistive) network, we solve in three steps.

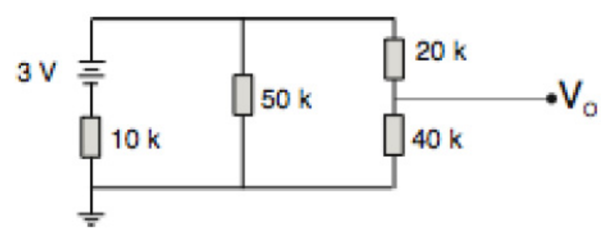
(1) Set one power supply to 0 V and calculate current in the 6 kΩ resistor from the non-zero power supply.

(2) Reverse the power supply roles and recalculate I_{6k}.

(3) The final answer is the sum of the two currents

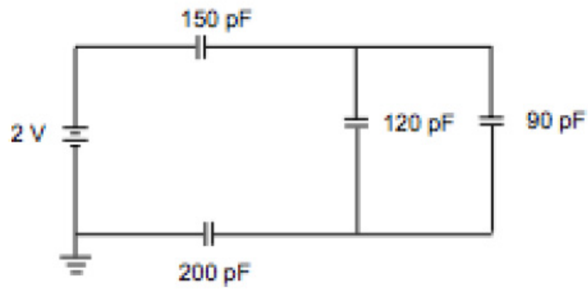
This is known as the superposition theorem and can be applied only for linear elements.

1-23 Solve for V_O using a method of inspection (current divider, voltage-divider, or both).



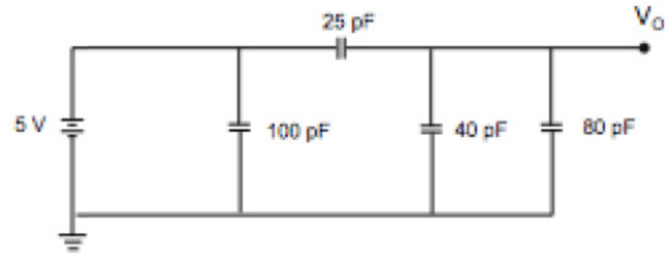
Capacitors

1-24 Find the equivalent capacitance at the input nodes and calculate the charge-discharge energy W for the parallel capacitors.

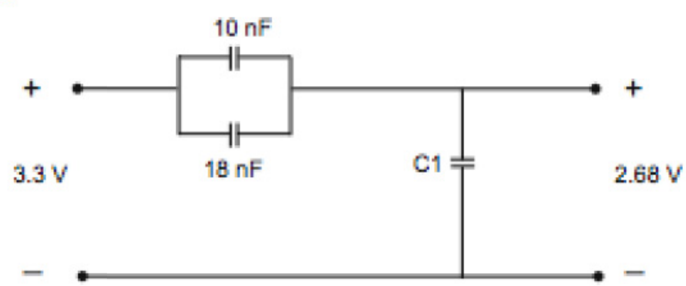


1-25 (a) What is the energy W needed to charge the circuit?

(b) Write the capacitance voltage divider expression for V_o and solve for the value.



1-26 Find C_1 and the energy to charge C_1.



1-27 The 2 nF capacitors are precharged to 3 V, and the 5 nF capacitor is precharged to 1.2 V.
At $t = 0$, switch S1 closes.
What is the final voltage?