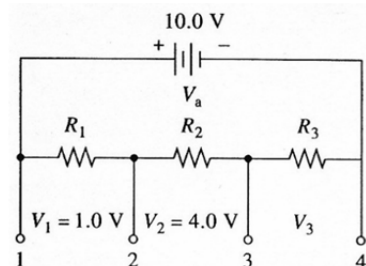


Complete the following on separate paper. Show your work and clearly identify your answers. Assume two significant figures for all given resistance and capacitance values.

Series and Parallel Resistors and Capacitors

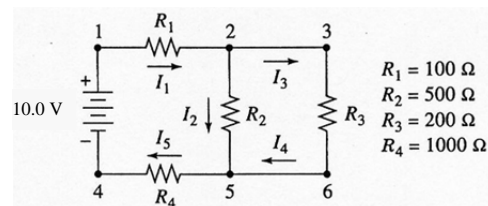
1. It was desired to assemble the voltage divider shown below. Two of each of the following resistors were available: 50 Ω , 100 Ω , and 200 Ω .

- Describe a suitable combination of the resistors that would give the indicated voltages.
- What would be the potential drop across R_3 ?
- What current would be drawn from the source?
- What power is dissipated by the circuit?

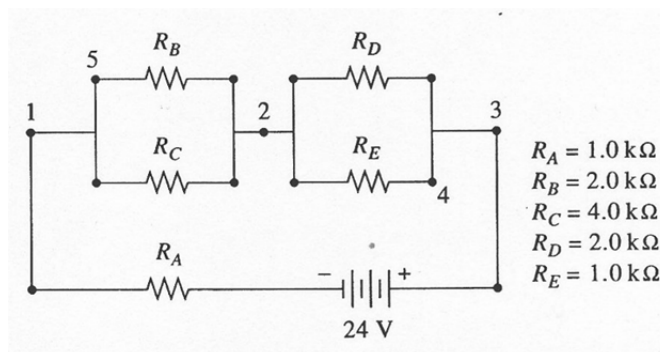


2. Assume that for a circuit similar to that shown in Problem 1, $R_1 = 200 \Omega$, $R_2 = 300 \Omega$, $R_3 = 500 \Omega$, and $V_b = 12.0 \text{ V}$.
- Calculate the voltage V_2 .
 - What would be the power loss in resistor R_2 ?
 - What fraction of the total power lost by the circuit would be dissipated in resistor R_2 ?

3. For the following circuit, calculate
- the potential difference across each of the resistors.
 - the magnitude of each of the currents shown.
 - the power dissipated by resistor R_2 .
 - the potential difference between points 3 and 4.



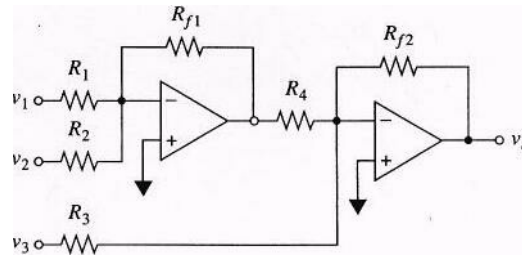
4. For the circuit shown below, calculate
- the power dissipated between points 1 and 2.
 - the current drawn from the source.
 - the potential difference across resistor R_A .
 - the potential difference across resistor R_D .
 - the potential difference between points 5 and 4.



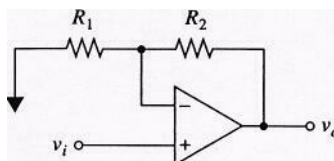
5. The current in a circuit is to be determined by measuring the potential difference across a precision resistor in series with the circuit.
 - (a) What should be the resistance of the resistor in ohms if 1.00 V is to correspond to 50 μA ?
 - (b) What must be the resistance of the voltage-measuring device if the relative error in the current measurement is to be less than 1.0%?
6. How long would it take to discharge a 0.035 μF capacitor to 1% of its full charge through a resistance of (a) 10 $\text{M}\Omega$, (b) 1 $\text{M}\Omega$, (c) 1 $\text{k}\Omega$?
7. A series RC circuit consisted of a 25-V dc source, a 50 $\text{k}\Omega$ resistor, and a 0.015 μF capacitor.
 - (a) Calculate the time constant for the circuit.
 - (b) Calculate the current and potential differences across the capacitor and the resistor during a charging cycle; employ as times 0, 1, 2, 3, 4, 5 and 10 ms.
 - (c) Repeat the calculations in (b) for a discharge cycle.

Operational Amplifier Circuits

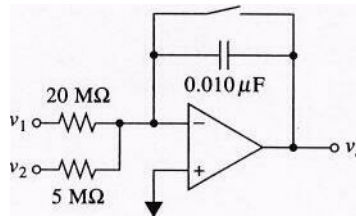
1. Design a circuit having an output given by: $-v_o = 2v_1 - 3v_2 - 6v_3$, where v_1 , v_2 , and v_3 are input potentials and v_o is the output potential of the circuit. You may use at most two operational amplifiers to accomplish this task. Verify the output of your circuit with a calculation.
2. Design a circuit for calculating the average value of three input voltages divided by 1000. Verify the output of your circuit with a calculation.
3. For the following circuit:



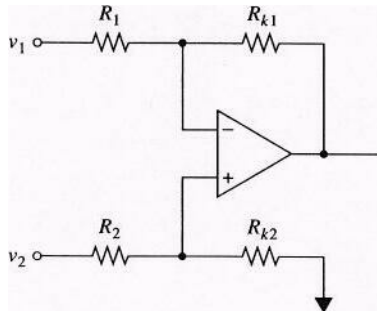
- (a) write an expression that gives the output voltage in terms of the three input voltages and the various resistances.
 - (b) indicate the mathematical operation performed by the circuit when $R_1 = R_{f1} = 200 \text{ k}\Omega$; $R_4 = R_{f2} = 400 \text{ k}\Omega$; $R_2 = 50 \text{ k}\Omega$; $R_3 = 10 \text{ k}\Omega$.
4. Derive a relationship between v_{in} and v_{out} for following circuit:



5. Derive an expression for the output potential of the following circuit:



6. Show that when the four resistances are equal, the following circuit becomes a subtracting circuit.



Digital Electronics, A/D, D/A Conversion

- Three analog to digital converters all have a range of 0 to 10V and a digitization uncertainty of ± 1 LSB. What is the maximum absolute *and relative* uncertainty in the digitization of a 5.0 V signal if the converters have (a) 8 bits? (b) 12 bits? (c) 16 bits?
- Repeat problem 1, assuming a 0.2 V signal is digitized.
- A particular 12-bit ADC has a rise time (a response time) of $15 \mu\text{s}$. What is the highest frequency that can be accurately recorded with this device, using the Nyquist criterion as a guide?