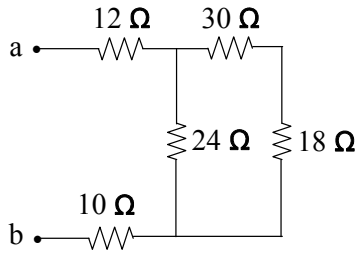
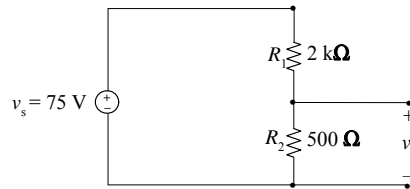


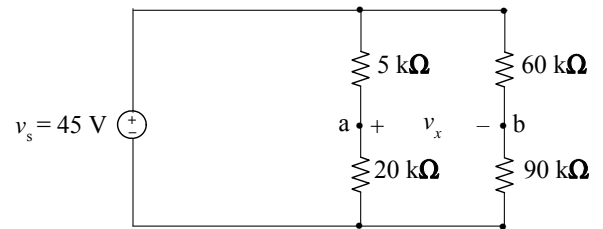
- (1) Find  $R_{ab}$  in the circuit below.



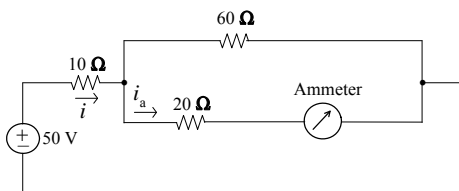
- (2) (a) Calculate the no-load voltage  $v_0$  for the voltage divider circuit shown below. (b) Calculate the power dissipated by  $R_1$  and  $R_2$ . (c) Now assume that only 1 W resistors are available. The source and the no-load voltages are the same as in (a). What must be the new minimum values of  $R_1$  and  $R_2$  to meet the new power specifications. Notice that  $R_1 > R_2$  since the no-load voltage is smaller than that across  $R_1$ . Therefore, find  $R_1$  first (why?).



- (3) (a) For the circuit shown below, find the value of  $v_x$ . Hint: use the voltage division rule twice to find the voltages across the 20 kΩ and 90 kΩ resistors. (b) Suppose the 45 V source is replaced with a general source  $v_s$  which is still positive at the upper terminal. Find  $v_x$  as a function of  $v_s$ .

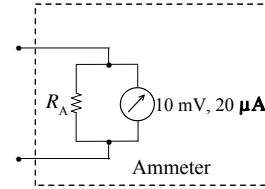


- (4) Suppose in the network of Question 1 that the voltage drop across the 24 Ω is 40 V, positive at the top of the resistor. Use voltage division to find the drop across the 18 Ω resistor.
- (5) Suppose in the network of Question 1 that the current through the 10 Ω resistor is 60 mA, flowing from left to right. Use current division to find the current through the 30 Ω resistor.
- (6) The ammeter shown below has a resistance of 0.1 Ω. What is the percentage error in the reading of this ammeter if

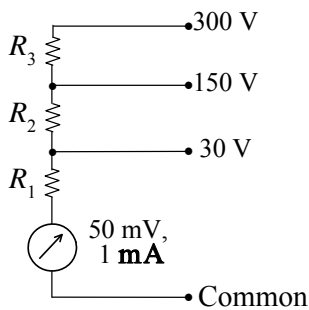


$$\% \text{ error} = \left( \frac{\text{measured value}}{\text{true value}} - 1 \right) \times 100\%$$

- (7) A 10 mV, 20  $\mu$ A d'Arsonval galvanometer is used as an ammeter by using a shunt resistor,  $R_A$  as shown. Specify the value of the shunt resistor if the full-scale reading of the ammeter is to be (a) 10 mA and (b) 100  $\mu$ A.



- (8) Consider the d'Arsonval galvanometer below which is to be used to measure three voltages ranges as shown. The **Common** is to be understood in the same way as you have encountered in the lab with the multimeter. (a) Specify the required values of the three resistors.



- (9) This is a question on the **loading effect** of a voltmeter – that is the voltmeter is not ideal and adds resistance to the circuit; consequently the meter itself affects the voltages it attempts to measure. Consider that a voltmeter has a *sensitivity* of 20-k $\Omega$ /V when set to a full-scale reading of 150 V (the sensitivity tells us how much resistance the voltmeter adds to the circuit for each volt of the scale reading – thus, this voltmeter adds 20 k $\Omega$ /V times 150 V or 3.0 M $\Omega$  to any circuit to which it is connected). (a) For the circuit shown below, find the actual voltage drop across the 200-k $\Omega$  resistor (i.e. without the voltmeter being in place). (b) What will the voltmeter read when it is connected as shown? (c) Suppose a cheap voltmeter with a sensitivity of 1-k $\Omega$ /V (full-scale reading of 150 V) was used instead. What would it read for the voltage across the 200-k $\Omega$  resistor?

