Practice problems: Circuit theory concepts

1. Refer to the circuit represented in Fig. 1, while noting that the same current flows through each element. The voltage-controlled dependent source provides a current which is 5 times as large as the voltage Vx . (a) For VR = 10 V and Vx = 2 V, determine the power absorbed by each element. (b) Is element A likely a passive or active source? Explain.

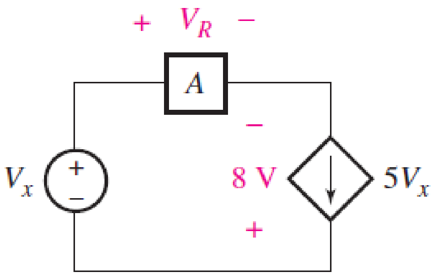

Fig. 1.

2. Refer to the circuit represented in Fig. 1, while noting that the same current flows through each element. The voltage-controlled dependent source provides a current which is 5 times as large as the voltage Vx . (a) For VR = 100 V and Vx = 92 V, determine the power supplied by each element. (b) Verify that the algebraic sum of the supplied powers is equal to zero.

3. Determine the power absorbed by each circuit shown in Fig. 2. Also verify that the algebraic sum of the absorbed powers is equal to zero.

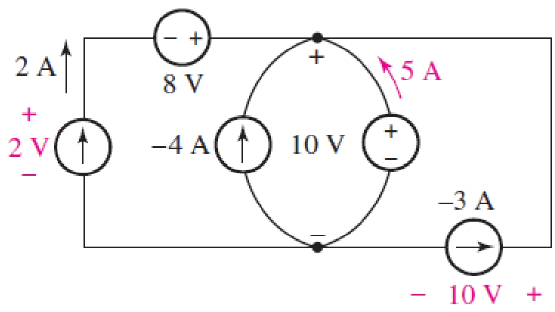

Fig. 2.

4. The circuit depicted in Fig. 3 contains a dependent current source; the magnitude and direction of the current it supplies are directly determined by the voltage labeled v_1. Note that therefore $i_2 = -3v_1$. Determine the voltage v_1 if $v_2 = 33i_2$ and $i_2 = 100$ mA.

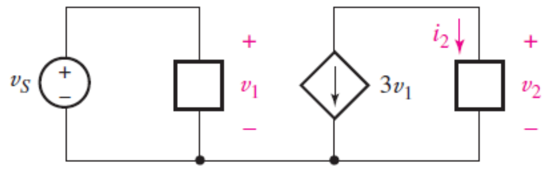

Fig. 3.

5. A 1% tolerance 1 kΩ resistor may in reality have a value anywhere in the range of 990 to 1010 Ω. Assuming a voltage of 9 V is applied across it, determine (a) the corresponding range of current and (b) the corresponding range of absorbed power. (c) If the resistor is replaced with a 10% tolerance 1 kΩ resistor, repeat parts (a) and (b).

6. In the circuit depicted in Fig. 4, i_x is determined to be 1.5 A, and the 9 V source supplies a current of 7.6 A (that is, a current of 7.6 A leaves the positive reference terminal of the 9 V source). Determine the value of resistor R_A.

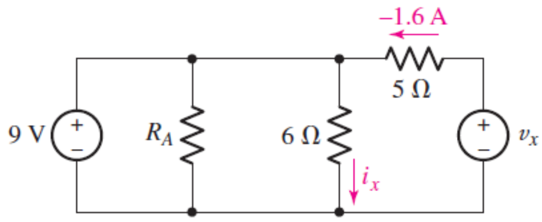

Fig. 4.

7. In the circuit of Fig. 5, it is determined that v_1 = 3 V and v_3 = 1.5 V. Calculate v_R and v_2.

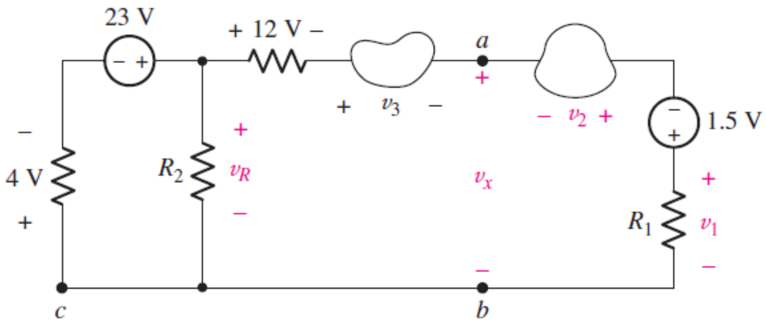

Fig. 5.

8. Compute the power absorbed by each element in the circuit of Fig. 6 if the mysterious element X is (a) a 13 Ω resistor; (b) a dependent voltage source labelled $4v_1$, “+” reference on top; (c) a dependent voltage source labelled $4i_x$, “+” reference on top.

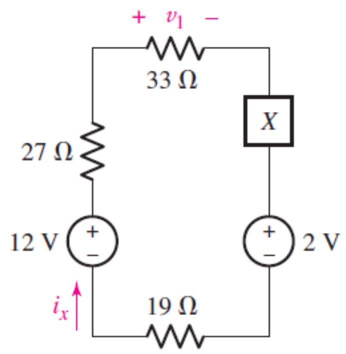

Fig. 6.

9. Although drawn so that it may not appear obvious at first glance, the circuit of Fig. 7 is in fact a single-node-pair circuit. (a) Determine the power absorbed by each resistor. (b) Determine the power supplied by each current source. (c) Show that the sum of the absorbed power calculated in (a) is equal to the sum of the supplied power calculated in (c).

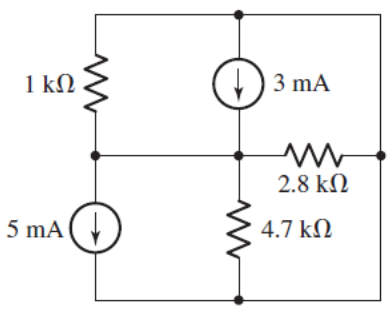

Fig. 7.

10. Calculate the equivalent resistance Req of the network shown in Fig. 8 if R1 = 2R2 = 3R3 = 4R4 etc. and R11 = 3 Ω.

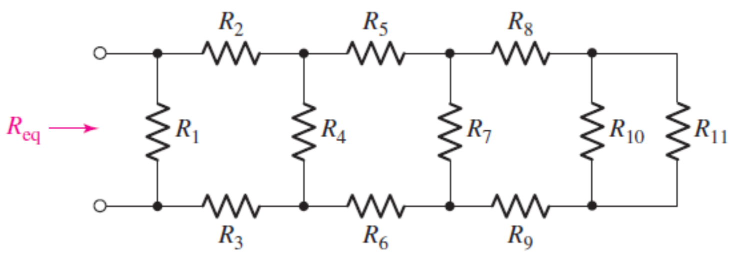

Fig. 8.