**Homework 2**

**P2.1.4** The current through a resistor is 4sin100*πt* A when the voltage across it is 60sin100*πt* V. Find the resistance and the average power dissipated.

**Solution:** ****Ω; **; ** **= =** = W.

**P2.1.5** The triangular voltage waveform of Figure P2.1.5 is applied to a 100 Ω resistor. Determine: (a) the resistor current, (b) *p*(*t*), and (c) the average power dissipation.



**Solution:** *v* = 10*t* V,  min; *v* V,  min; *v* V,  min.

(a) A,  min; A,  min;

A,  min.

(b)  W,  min,

*p*(*t*)  W,  min,

*p*(*t*) W,  min.

(c) 

 W.

**P2.2.5** Determine in Figure P2.2.5 the voltage across each current source, the current through each voltage source, and the power delivered or absorbed by each source.



**Solution:** *Vab* = 20 V, *IX* = 0.8V*ab* = 16 A. **Step 1:** Current leaving node ‘a’ through dependent source is 16 A; current entering node ‘a’ from 10 A source is 10 A. From KCL, 6A must enter node ‘a’ from the 20 V source.



**Step 2:** Voltage drop across the CCVS = 0.5*IX* = 8 V; From KVL, the voltage drop across the VCCS is 12 V.

**Step 3:** The 20 V source delivers 20×6 = 120 W.

**Step 4:** The 10 A source delivers 20×10 = 200 W.

**Step 5:** VCCS absorbs 12×16 = 192 W.

**Step 6:** CCVS absorbs 8×16 = 128 W.

**Step 7:** Check: the total power delivered is 320 W, and the total power absorbed is also 320 W.

**P2.2.6** Determine the total power delivered or absorbed by each source in Figure P2.2.6, assuming the voltage sources are 1 V each, *I*1 = 2 A, *I*2 = 1 A, and *I*3 = 1 A.



**Solution:** **Step 1:** The current leaving node ‘a’ through *V*1 is *I*2 + *I*3 = 1 + 1 = 2 A. The source *V*1 **absorbs** 1×2 = 2 W.

**Step 2:** The current leaving node ‘b’ through *V*2 is *I*1 – *I*3 = 2 – 1 = 1 A. The source *V*2 **delivers** 1×1 = 1 W.



**Step 3:** The current entering node ‘c’ through *V*3 is *I*1 + *I*2 = 3 A. *V*3 **absorbs** 1×3 = 3 W.

**Step 4:** From KVL, *Vab* = 2 V, *Vac* = 2 V, and *Vbc* = 0. The source *I*1 neither absorbs nor delivers power; the source *I*2 **delivers** 2 W; the source *I*3 **delivers** 2 W.

**Step 5:** Check: The total power delivered is: 1 + 2 + 2 = 5 W; the total power absorbed is also: 2 + 3 = 5 W.

**P2.3.15** Determine *VX* in Figure P2.3.15, where *R*1 and *R*2 need not be specified.



**Solution:** **Initialize.** The circuit is already marked with the given values and the required *VX*. The nodes may be labelled ‘a’, ‘b’, and ‘c’.

**Deduce.** **Step 1:** From KCL at node ‘a’, 7 A enter the ‘a’ from *R*2.



**Step 2:** From Ohm’s law, voltage drop across the 3 Ω resistor is 45 V in the direction of 15 A.

**Step 3:** From Ohm’s law, voltage drop across the 2 Ω resistor is 12 V in the direction of 6 A.

**Step 4:** From KVL around the outer loop, starting at node ‘b’ and going CW: -12 + 37 + VX – 45 = 0, which gives *VX* = 20 V.

Note that this 20 V is a voltage rise across *R*2 in the direction of 7A. This means that *R*2 = -20/7 Ω and does not obey Ohm’s law because it is a negative resistance.

**P2.3.21** Determine the power delivered or absorbed by the 3 V source in Figure P2.3.21.



**Solution:** **Initialize.** The circuit is marked with the given values. To determine the power delivered or absorbed by the 3 V source, the current through the source *IS* should be determined. The nodes may be labeled ‘a’, ‘b’, and ‘c’.



**Deduce.** **Step 1:** From Ohm’s law, the current in the 5 Ω resistor is 3/5 = 0.6 A.

**Step 2:** From KVL, the voltage across the 4 Ω resistor is 5 – 3 = 2 V drop in the direction of *IX*. It follows that *IX* = 2/4 = 0.5 A, and the source voltage of the CCVS is 1 V.

**Step 3:** From KVL around the loop formed by the 3 V source, the 2 Ω resistor and the 2*IX* source, the voltage across the 2 Ω resistor is 2 V, of the polarity shown. From Ohm’s law, the current through this resistor is 1 A in the direction of a voltage drop.

**Step 4:** From KCL at node ‘b’, 1 + 0.6 = 0.5 + *IS*, so that *IS* = 1.1 A. It follows that the 3 V source delivers 3×1.1 = 3.3 W.

**P2.3.22** Determine the power delivered or absorbed by the dependent source in Figure P2.3.22.



**Solution:** **Initialize.** The circuit is marked with given values. To determine the power delivered or absorbed by the dependent source, the voltage *VX* across the source and the source current should be determined. The nodes may be labeled ‘a’, ‘b’, and ‘c’.

**Deduce.** **Step 1:** From KVL, *Vbc* = 10 – 5 = 5 V.



**Step 2:** From KVL, the voltage across the 2 Ω resistor is 8 V.

**Step 3:** From KCL around a surface enclosing the 5 V source and the 10 Ω resistor, a current *IX* leaves node ‘a’.

**Step 4:** From KCL, the current through the 2 Ω resistor is 2*IX* in the direction of the 8 V drop. It follows from Ohm’s law that 2×2*IX* = 8, so that *IX* = 2 A.

**Step 5:** From KVL, *Vbc* = 5 = *VX* – *IX*×1. Substituting *IX* = 2 A gives *VX* = 7 V. It follows that the dependent source delivers 7×2 = 14 W.

**P2.3.29** Determine the power delivered or absorbed by the dependent source in Figure P2.3.29.



**Solution: Initialize.** The circuit is marked with given values. To determine the power delivered or absorbed by the dependent source, the voltage *VX* should be determined.



**Deduce.** **Step 1:** From KCL around a surface enclosing the dependent source and the two batteries, the current through the lower 10 Ω resistor is 100 mA in the direction shown.

**Step 2:** From Ohm’s law, *VX* = 10×0.1 = 1 V, so that the source current of the dependent source is 2 A. Since the voltage across the source is 15 V, and the 2 A is in the direction of a 15 V drop across the source, the source absorbs 15×2 = 30 W.