EE 100/42 Spring 2009
Solutions to Homework 1

1.9

The positive reference for V_{ba} is terminal b, where the head of arrow is pointing. Then, we have $V_{ba} = -V = 12V$. Also, i is the current entering terminal a, and i_{ba} is the current leaving terminal a. Then, we have $i = -i_{ba} = 2A$. Thus, current enters the positive reference and energy is being delivered to the device.

1.11

$$i(t) = \frac{dq(t)}{dt} = \frac{d}{dt}(2 + 3t) = \mathbf{3A}$$

1.37

At the node joining elements A and B, we have $ia + ib = 0$, thus, $i_a = -2A$. For the node at the top end of element C, we have $ib + ic = 3$. Thus, $i_c = 1A$. Finally, at the top right-hand corner node, we have $3 + ie = id$. Thus, $id = 4A$. Elements A and B are in series.

1.42

Summing voltages for the lower left-hand, we have $-5 + Va + 10 = 0$, which yields $Va = -5V$. Then for the top-most loop, we have $Vc - 15 - Va = 0$, which yields $Vc = 10V$. Finally, writing KCL around the outside loop, we have $-5 + Vc + Vb = 0$, which yields $Vb = -5V$.

1.56

The power delivered to the resistor is

$$p(t) = \frac{V^2(t)}{R} = \mathbf{2.5 * \exp(-4t)}$$

and the energy delivered is

$$w = \int_0^\infty p(t)dt = \int_0^\infty 2.5\exp(-4t)\,dt = \left[\frac{2.5\exp(-4t)}{-4}\right]_0^\infty = \frac{2.5}{4} = \mathbf{0.625J}$$

1.58

The equation for resistance is given as $R = \frac{pL}{A}$

a. If the length of the wire is doubled, then resistance will be doubled to **1 ohm.**

b. If the diameter of the wire is doubled, then cross sectional area A is increased by a factor of 4. The resistance will be decreased by a factor of 4 to **0.125** ohm.

1.63

This is a parallel circuit and the voltage across each element is 10V positive at the top end. Thus, the current flows through the resistor is

$$i_R = \frac{10V}{5\Omega} = \mathbf{2A}$$

Applying KCL, we find that the current flows through the voltage source are 0. Computing power for each element, we have

$$P_{current-source} = \mathbf{-20W}$$

Thus, the current source delivers power.

$$P_R = (i_R)^2 R = \mathbf{20W}$$

$$P_{voltage-source} = \mathbf{0}$$

2.1

The approach for this problem to find the equivalent resistance from the right most ones first.

(a)

$\frac{1}{\frac{1}{12}+\frac{1}{24}} = 8 \text{ ohm}$ the 12 and 24 ohm resistors are in parallel, we replace with Req1.

$8 + 3 + 4 = 15 \text{ ohm}$ the 3, 4 and Req1 are in series, we replace with Req2.

$\frac{1}{\frac{1}{15}+\frac{1}{30}} = 10 \text{ ohm}$ Req2 is in parallel with the 30 ohm resistor, we replace with Req3.

$10 + 3 + 7 = \mathbf{20\ ohm}$ the final equivalent resistance is sum of Req3, the 3 and 7 ohm resistors.

(b)

$$\frac{1}{\frac{1}{60}+\frac{1}{15}} = 12 \text{ ohm}$$

$$12 + 6 = 18 \text{ ohm}$$

$$\frac{1}{\frac{1}{9}+\frac{1}{18}} = 6 \text{ ohm}$$

$6 + 6 = 12$ ohm

$$\frac{1}{\frac{1}{12}+\frac{1}{24}} = 8 \text{ ohm}$$

$10 + 8 + 5 = \mathbf{23\ ohm}$

2.3

(a)
$$\frac{1}{\frac{1}{20+30}+\frac{1}{30+20}} = \mathbf{25\ ohm}$$

(b)
$$\frac{1}{\frac{1}{20}+\frac{1}{30}} \parallel \frac{1}{\frac{1}{30}+\frac{1}{20}} = \mathbf{24\ ohm}$$

2.36

$$\mathrm{V1} = \frac{\mathrm{R1}}{\mathrm{R1}+\mathrm{R2}+\mathrm{R3}} * \mathrm{Vs} = \mathbf{5V}$$

$$\mathrm{V2} = \frac{\mathrm{R2}}{\mathrm{R1}+\mathrm{R2}+\mathrm{R3}} * \mathrm{Vs} = \mathbf{7V}$$

$$\mathrm{V3} = \frac{\mathrm{R3}}{\mathrm{R1}+\mathrm{R2}+\mathrm{R3}} * \mathrm{Vs} = \mathbf{13V}$$

2.44

$$\mathrm{i}_3 = \frac{\mathrm{R2}}{\mathrm{R2}+\mathrm{R3}} * \mathrm{i}_\mathrm{s} = \frac{15}{15+5} * 8 = \mathbf{6A}$$