MAE140 Win12 HW1 Solutions

T R & T, 1.14, 1.22, 1.24, 2.2, 2.5, 2.11, 2.17, 2.23, 2.28, 2.38

1-14
(100W-12W)*1000h=88kWh (less energy)
88kWh*7.2 cents/kWh = 633.6 cents cheaper

1-22
Device 1: P=v*i=15*(-1)=-15W (delivering)
Device 2: P=v*i=5*1=5W (absorbing)
Device 3: P=10*2=20W (absorbing)
Device 4: P=(-10)*(-1)=10W (absorbing)
Device 5: P=20*(-3)=-60W (delivering)
Device 6: P=20*2=40W (absorbing)

Power balance:
-15+5+20+10-60+40=0

1-24

From the figure, it's easy to tell that:

$v_2 = 10\ V, v_3 = 0\ V, v_5 = v_6 = -5V$

2-2

$$P = i^2R \Rightarrow i = \sqrt{\frac{P}{R}} = \sqrt{\frac{12\ mW}{6.2\ k\Omega}} = \sqrt{\frac{60}{31}}\ mA \approx 1.39\ mA$$

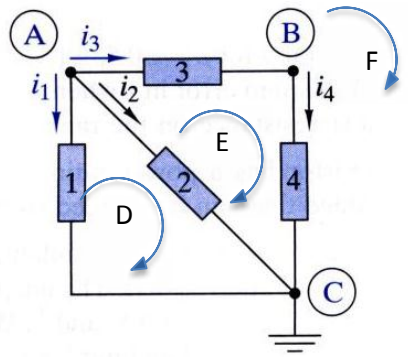
2-5

$$v = iR \Rightarrow R_x = \frac{50\ V}{10\ mA} = 5\ k\Omega$$

$$P = vi = 50\ V \times 10\ mA = 500mW$$

2-11

(a) All the nodes: A, B and C. The loops: D,E and F



(b) 3 in series with 4, 1 in parallel with 2

(c) KCL:

A: $-i_1 - i_2 - i_3 = 0$

B: $i_3 - i_4 = 0$

C: $i_1 + i_2 + i_4 = 0$

KVL:

D: $-v_1 + v_2 = 0$

E: $-v_2 + v_3 + v_4 = 0$

F: $-v_1 + v_3 + v_4 = 0$

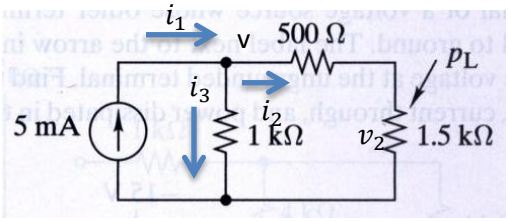
2-17

Using KCL, we can get the equations:

A: $i_1 - i_2 + i_3 - i_4 = 0 \Rightarrow i_1 = 10 + 15 + 5 = 30\ mA$

C: $-i_3 + i_4 + i_5 = 0 \Rightarrow i_5 = -15 - 5 = -20\ mA$

2-23



Using KCL, we can get:

$i_1 - i_2 - i_3 = 0$

So

$$i_2 + i_3 = \frac{v}{(0.5 + 1.5)k\Omega} + \frac{v}{1k\Omega} = i_1 = 5\ mA \Rightarrow v = \frac{10}{3}\ V$$

According to voltage divide rule,

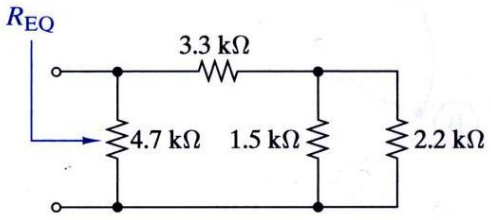
$$v_2 = \frac{1.5}{2}v = 2.5\ V$$

Then,

$$i_2 = \frac{v_2}{1.5k\Omega} = \frac{5}{3}\ mA$$

$$P = i_2 v_2 = \frac{5}{3} \cdot 2.5 = 4.17\ mW$$

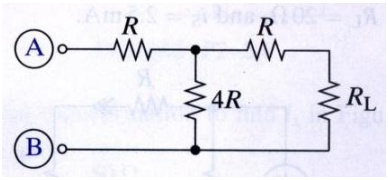
2-28



1) $1.5k\Omega \; and \; 2.2k\Omega$ are in parallel. $R_1 = \left(\frac{1}{1.5} + \frac{1}{2.2}\right)^{-1} = 0.89 \; k\Omega$
2) $R_1 \; and \; 3.3k\Omega$ are in series. $R_2 = 3.3 + R_1 = 4.19 \; k\Omega$
3) $4.7 \; k\Omega \; and \; R_2$ are in parallel.

$$R_{EQ} = \left(\frac{1}{4.7} + \frac{1}{4.19}\right)^{-1} = 2.22 \; k\Omega$$

2-38



$$R_{AB} = R + \left({}^{1}/_{4R} + {}^{1}/_{(R+R_L)}\right)^{-1} = R + \frac{4R(R+R_L)}{5R+R_L} = R_L$$

$$\Rightarrow R_L^2 = 9R^2 \; \Rightarrow R = {}^{R_L}/_{3}$$