1.26 A constant current of 2A charges a battery for 4 hours. During which the battery voltage $v(t) = 12 - 2e^{-t}$ w/ t in hours. How much energy is stored in the battery.

$$p = \frac{dw}{dt}$$

$$\int dw = \int p\,dt$$

$$\Rightarrow w = \int p\,dt \quad \text{and} \quad p = iv$$

$$w = \int iv\,dt$$

$$w = \int_0^4 (2)(12 - 2e^{-t})\,dt$$

$$= \int_0^4 (24 - 4e^{-t})\,dt$$

$$= 24t\Big|_0^4 + 4e^{-t}\Big|_0^4$$

$$= 24(4-0) + 4(e^{-4} - 1)$$

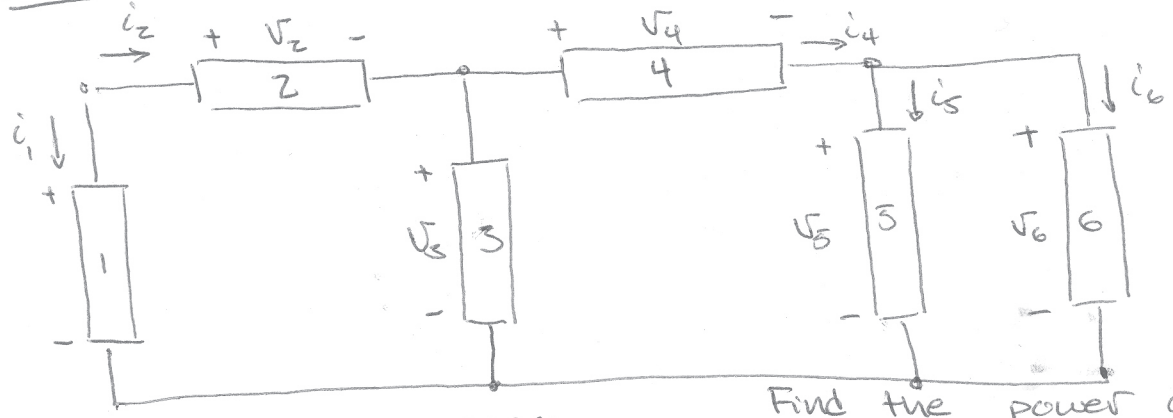
$$= 96 + (-3.9267) = \boxed{92.0733 \text{ watts}}$$

or

$$92.0733 \text{ w} \cdot \frac{3600 \text{ J}}{\text{w}}$$

$$= 331.5 \text{ kJ}$$

1.22



Find the power associated w/ each device:

	v (V)	i (A)
1:	15	-1
2:	5	1
3:	10	2
4:	-10	-1
5:	20	-3
6:	20	2

- Given 4 information -

$P = iv \rightarrow$

1: $P = (15)(-1) = \boxed{-15\ W}$

2: $(5)(1) = \boxed{5\ W}$

3: $(10)(2) = \boxed{20\ W}$

4: $(-10)(-1) = \boxed{10\ W}$

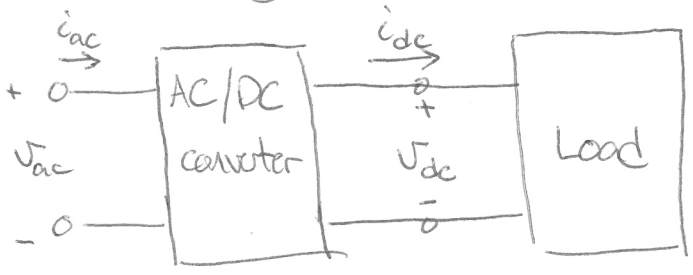
5: $(20)(-3) = \boxed{-60\ W}$

6: $(20)(2) = \boxed{40\ W}$

Use the power balance to check:

$$\boxed{-15 + 5 + 20 + 10 - 60 + 40 = 0 \checkmark}$$

2.7 given $v_{dc} = 5\,V$ when $v_{ac} = 120\,V$. when the load draws $i_{dc} = 40\,A$, the input power $p_{ac} = 300\,W$. Find the efficiency of the converter.

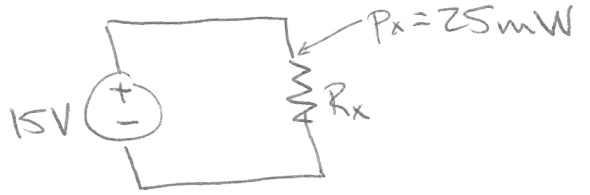


Assume that we've plugged in a wall $\Rightarrow v_{ac} = 120\,V$
$\Rightarrow v_{dc} = 5\,V$

$\therefore$ for the load $P_{load} = i_{dc} v_{dc} = (40\,A)(5\,V) = 200\,W$

If the AC/DC converter is at 300 W then the efficiency $= \frac{200\,W}{300\,W} \approx .6667 \approx \boxed{66.67\%}$

2.4 Given the resistor dissipates 25 mW, find R_x



$v = iR \Rightarrow i = v/R$

and $p = iv \Rightarrow p = \left(\frac{v}{R}\right)v = \frac{v^2}{R}$

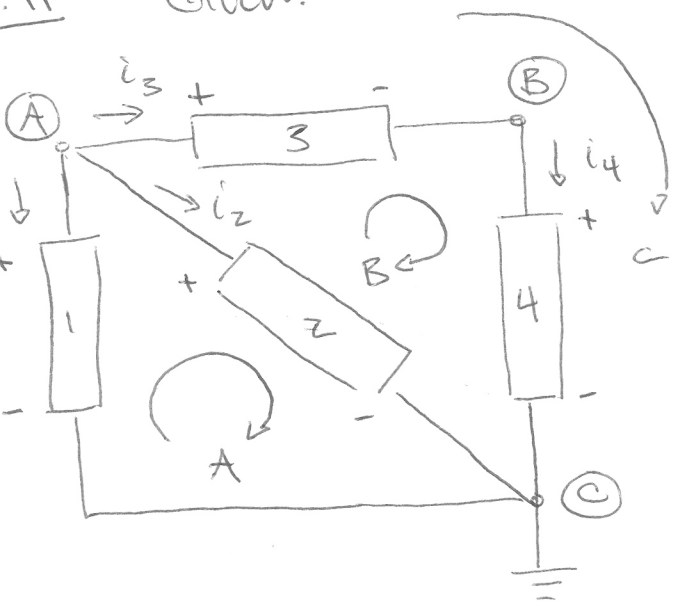
$\therefore P_x = \frac{v_x^2}{R_x} \Rightarrow R_x = \frac{v_x^2}{P_x} = \frac{(15\,V)^2}{25 \times 10^{-3}\,W} = 9000\,\Omega = \boxed{9k}$

2.7 A 10-kΩ resistor has power rating 0.25 W. Find max voltage that can be applied:

$v = iR \Rightarrow i = v/R$
$P = iv$
$\Bigg\} P = \frac{v^2}{R} \Rightarrow v = \sqrt{PR} = \sqrt{(0.25\,W)(10 \times 10$

$\Rightarrow \boxed{v = 50\,V}$

2.11 Given:



(a) Identify all nodes

nodes: Ⓐ, Ⓑ, & Ⓒ

loops: A, B, & C

(b) Identify any element connected in series or in parallel:

3 in series w/ 4

2 in ~~se~~ || w/ (3+4)

1 in series w/ 

c) Write KCL and KVL:

KCL:

Ⓐ $-i_1 - i_2 - i_3 = 0$

Ⓑ $i_3 - i_4 = 0$

Ⓒ $i_1 + i_2 + i_4 = 0$

KVL: (assign +/- ! ~~see~~ draw)

A: $-v_1 + v_2 = 0$

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

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

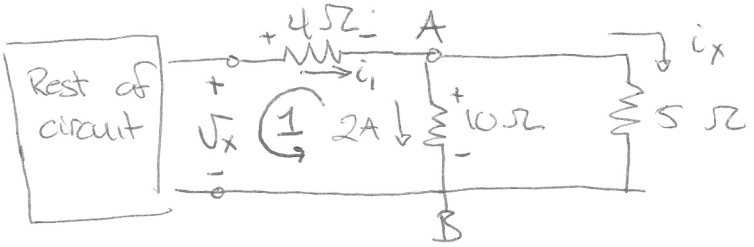
2.12 If the figure above $i_2 = 10\,mA$ and $i_4 = 20\,mA$, find i_1 and i_3:

KCL @ Ⓒ: $i_1 + i_2 + i_4 = i_1 + (10\,mA) + (20\,mA) = 0$

$i_1 + 30\,mA = 0 \Rightarrow \boxed{i_1 = -30\,mA}$

KCL @ Ⓑ $i_3 - i_4 = 0 \Rightarrow i_3 - 20\,mA = 0 \Rightarrow \boxed{i_3 = 20\,mA}$

2.21 Find v_x and i_x:



$$v_{AB} = iR = (2A)(10\,\Omega) = 20\ V$$

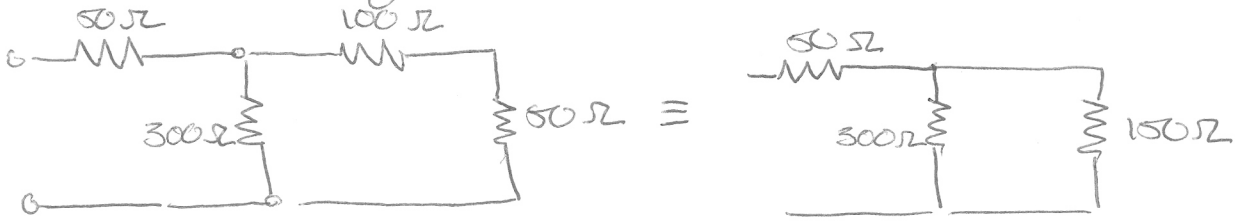
$10\,\Omega \parallel 5\,\Omega \Rightarrow v_{AB} = i_x(5\,\Omega) \Rightarrow i_x = 20\,V/5\,\Omega = \boxed{4\ A = i_x}$

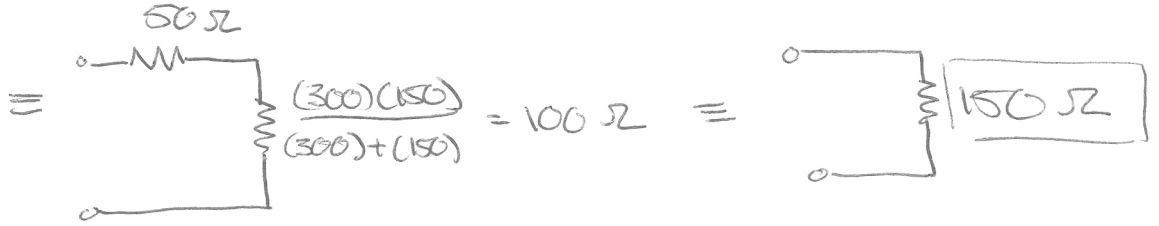
at A: $i_1 = i_x + 2 = 4A + 2A = 6A = i_1 \Rightarrow v = iR = v = (4)(6) = 24\ V$

loop 1: $v_x - v_{AB} - v_{4\Omega} = 0$

$$v_x - (20V) - (24V) = 0 \Rightarrow \boxed{v_x = 44\ V}$$

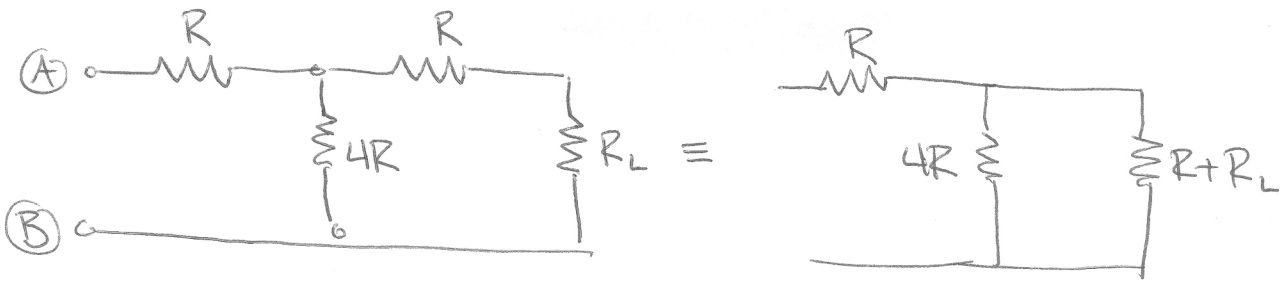
2.27 Find the equivalent resistance:

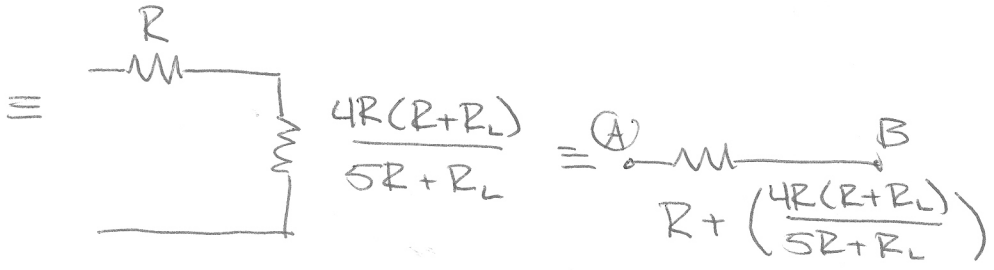




MAE 140
HW #1: KEY

2-38 Select R such that $R_{AB} = R_L$





want $R_{AB} = R_L$

$$\Rightarrow R_L = R + \frac{4R(R+R_L)}{5R+R_L} = \frac{5R^2 + RR_L + 4R^2 + 4RR_L}{5R+R_L}$$

$$\Rightarrow R_L(5R+R_L) = \cancel{5R^2} + 9R^2 + 5RR_L$$

$$\Rightarrow \cancel{5RR_L} + R_L^2 = 9R^2 + \cancel{5RR_L} \Rightarrow R_L = \pm 3R \Rightarrow R_L = 3R$$

or

$$\boxed{R = \frac{1}{3}R_L}$$