

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.

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

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

$$\Rightarrow w = \int p dt \quad \text{and} \quad p = i v$$

$$w = \int i v dt$$

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

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

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

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

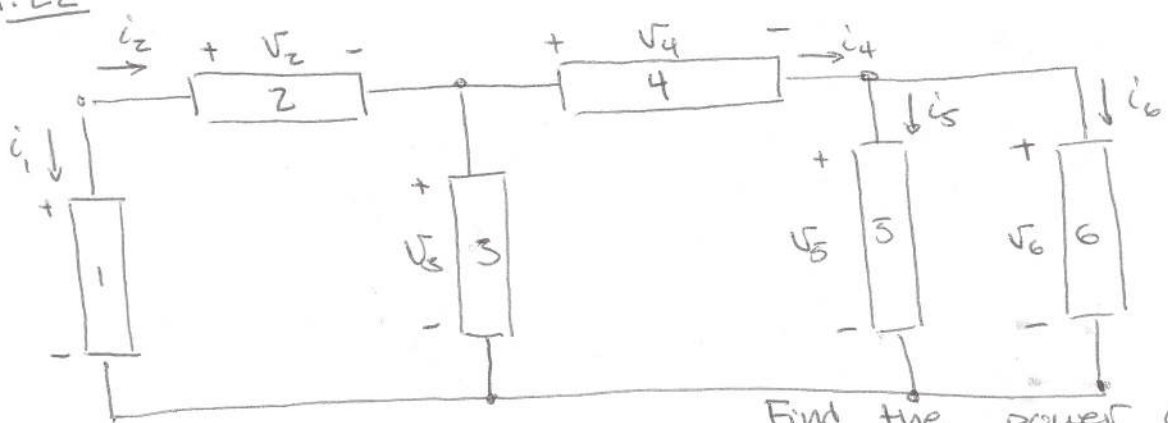
$$= 96 + (-3.9267) = 92.0733 \text{ watts}$$

or

$$92.0733 \text{ w} \cdot \frac{3600 \text{ s}}{\text{h}}$$

$$= 331.5 \text{ kJ}$$

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 information -

$P = iV \rightarrow$

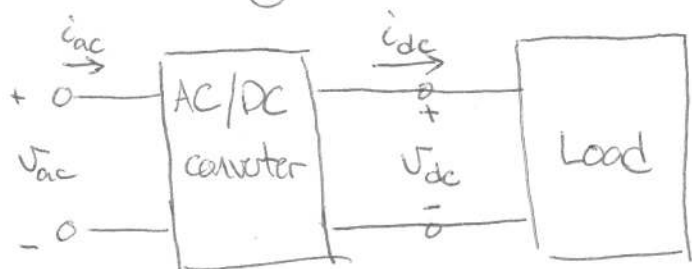
- 1: $P = (15)(-1) = \boxed{-15 \text{ W}}$
- 2: $P = (5)(1) = \boxed{5 \text{ W}}$
- 3: $P = (10)(2) = \boxed{20 \text{ W}}$
- 4: $P = (-10)(-1) = \boxed{10 \text{ W}}$
- 5: $P = (20)(-3) = \boxed{-60 \text{ W}}$
- 6: $P = (20)(2) = \boxed{40 \text{ W}}$

Use the power balance to check:

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

2.7 given $V_{dc} = 5V$ when $V_{ac} = 120V$. HW #1: KEY

when the load draws $i_{dc} = 40A$,
the input power $P_{ac} = 300W$. Find the efficiency of the converter.



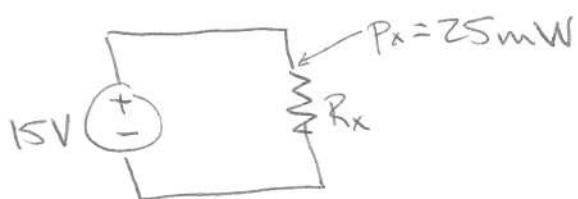
Assume that we're plugged in a wall $\Rightarrow V_{ac} = 120V$
 $\Rightarrow V_{dc} = 5V$

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

If the AC/DC converter is at 300W then

$$\text{the efficiency} = \frac{200W}{300W} \approx .6667 \approx \boxed{66.67\%}$$

4 Given the resistor dissipates 25mW, find R_x



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

$$\text{and } p = iV = P = \left(\frac{V}{R}\right)V = \frac{V^2}{R}$$

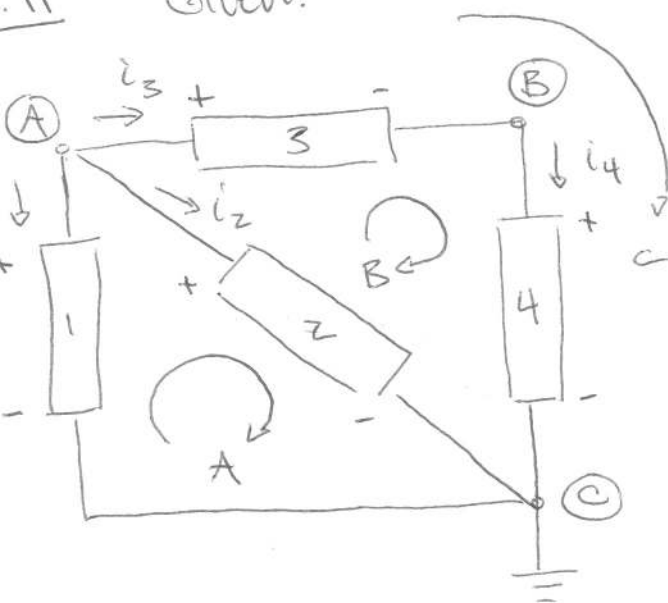
$$\therefore P_x = \frac{V_x^2}{R_x} \Rightarrow R_x = \frac{V_x^2}{P_x} = \frac{(15V)^2}{25 \times 10^{-3}W} = 9000\Omega = \boxed{9k\Omega}$$

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

$$\left. \begin{array}{l} V = iR \Rightarrow i = V/R \\ P = iV \end{array} \right\} P = \frac{V^2}{R} \Rightarrow V = \sqrt{PR} = \sqrt{(0.25W)(10 \times 10^3\Omega)} \Rightarrow \boxed{V = 50V}$$

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Given:



(a) I identify all nodes
 nodes: $\{A, B, C\}$
 loops: $\{A, B, C\}$

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

3 in series w/ 4

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

1 in series w/ 

write KCL and KVL:

KCL:

$$\textcircled{A} \quad -i_1 - i_2 - i_3 = 0$$

$$\textcircled{B} \quad i_3 - i_4 = 0$$

$$\textcircled{C} \quad i_1 + i_2 + i_4 = 0$$

KVL: (assign +/- ! see drawing)

$$A: -V_1 + V_2 = 0$$

$$B: -V_2 + V_3 + V_4 = 0$$

$$C: -V_1 + V_3 + V_4 = 0$$

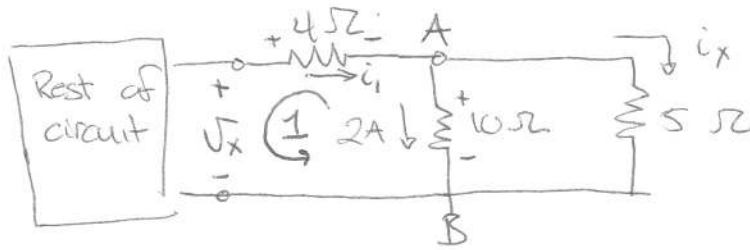
2.12 If the figure above $i_2 = 10 \text{ mA}$ and $i_4 = 20 \text{ mA}$, find i_1 and i_3 :

$$\text{KCL @ } \textcircled{C}: i_1 + i_2 + i_4 = i_1 + (10 \text{ mA}) + (20 \text{ mA}) = 0$$

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

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

2.1 Find V_x and i_x :



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

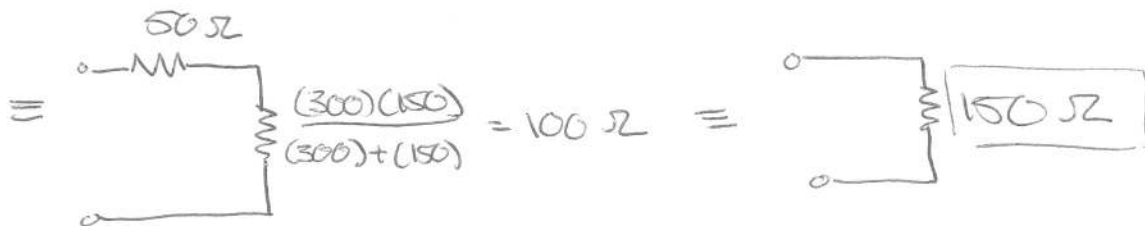
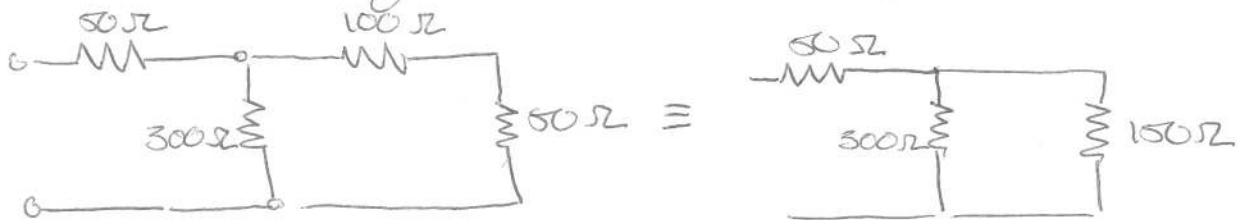
$$\frac{10\Omega}{10\Omega} \parallel \frac{5\Omega}{5\Omega} \Rightarrow V_{AB} = i_x(5\Omega) \Rightarrow i_x = 20V/5\Omega = \boxed{4A = i_x}$$

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

loop 1: $V_x - V_{AB} - V_{4\Omega} = 0$

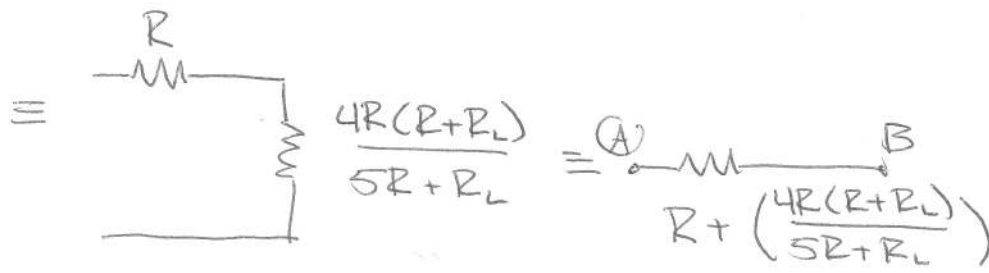
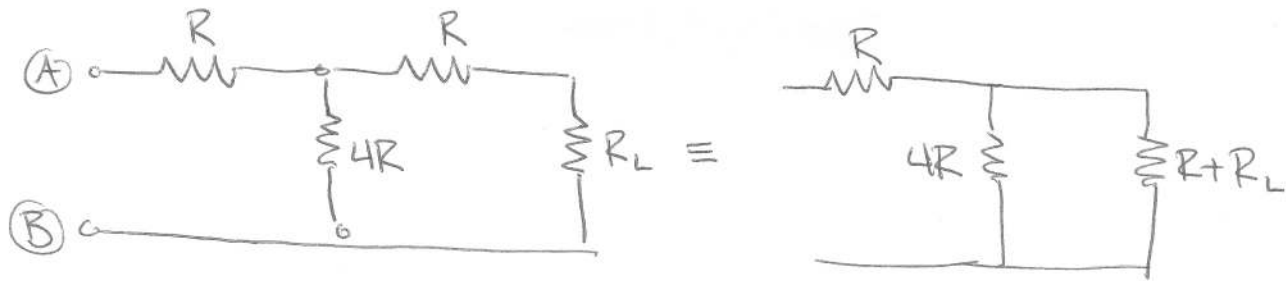
$$V_x - (20V) - (24V) = 0 \Rightarrow \boxed{V_x = 44V}$$

2.27 Find the equivalent resistance:



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

MAE 140
HW #1: KEY



want $R_{AB} = R_L$

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

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

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

or

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