

ECE203 DC Circuits Homework Set 2 – Solutions

1. The heating element of a space heater is rated 2 kW, 250 V. Determine the following:
- Rated current.
 - Charge consumed in one hour at continuous rated current.
 - Energy consumed in six hours at rated continuous current and voltage.
 - Resistance
 - Current drawn from the supply and power dissipated if the heater is accidentally connected to a 125 V supply. (Assume the resistance stays constant).

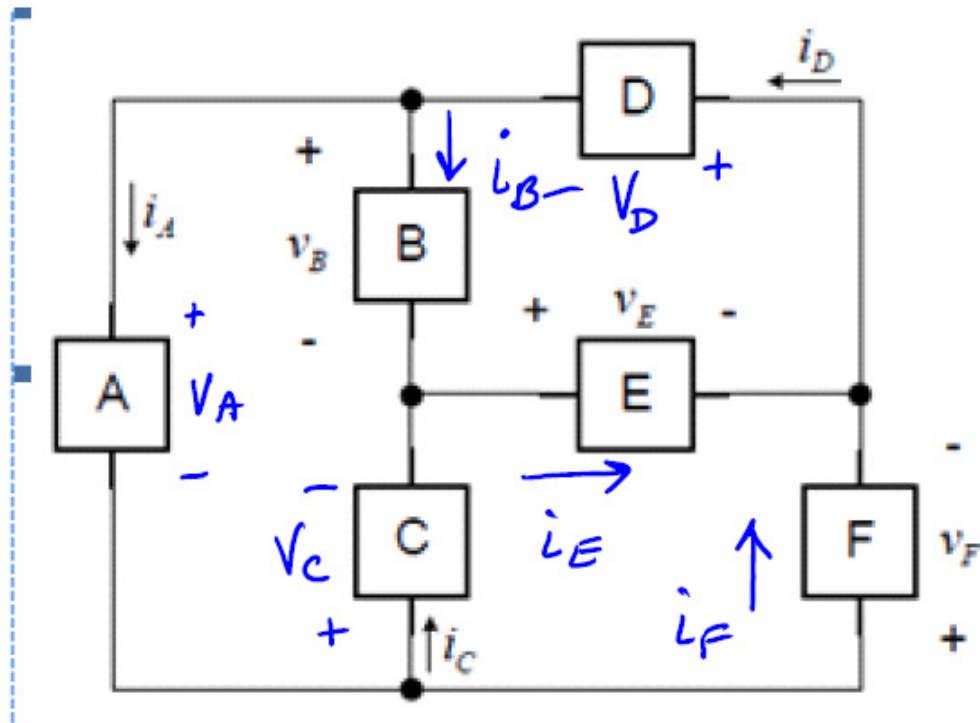
Solution

Strategy: since rated power and voltage are given, rated current is their quotient. Having determined rated current, resistance is voltage divided by current.

- a) All quantities are constant: $I = \frac{P}{V} = \frac{2000}{250} = 8 \text{ A}$
- b) Charge = Current x Time $Q = 8 \times 60 \times 60 = 28800 \text{ coulomb (28.8 kC)}$
- c) Energy = Power x Time $W = 2000 \times 6 \times 60 \times 60 = 43.2 \text{ MJ}$
- d) $R = \frac{V}{I} = \frac{250}{8} = 31.25 \Omega$
- e) The new current is given by new voltage divided by resistance: $I = \frac{125}{31.25} = 4 \text{ A}$
The corresponding power dissipated is: $P = VI = 125 \times 4 = 500 \text{ W}$

2.

Label all the missing voltages and currents in the figure below so that each element follows the passive sign convention and then calculate the power absorbed or delivered by each element. Report your results in a table like the one shown below



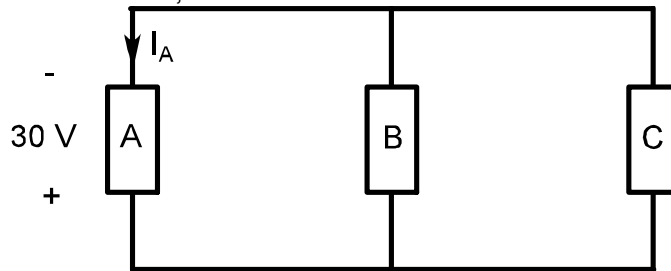
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	Voltage (V)	Current (A)	Power (W)	Absorbed or Delivered
A	1	3	3	A
B	2	-1	-2	D
C	1	5	5	A
D	0	2	0	-
E	-2	4	-8	D
F	-1	-2	2	A

$$\begin{aligned} \text{total absorbed} &= 3 + 5 + 2 = 10 \text{ W} \\ \text{total delivered} &= 2 + 8 = 10 \text{ W} \end{aligned}$$

3. **Answer T/F (explain your reasoning).**

Given that the power generated by element B is 600 mW and the power consumed by element C is 900 mW, then element A is a 300 mW source and the current I_A is -10 mA.



By Conservation of Energy: $P_A + P_B + P_C = 0$

$$\text{or } P_A = -(P_B + P_C) = -(-600 + 900) = -300 \text{ mW}$$

i.e. P_A is a 300 mW **source**, which means that the current must have a magnitude of 10 mA and because it is a source it must be entering the negative terminal (flowing downwards) so it is positive. The answer is **FALSE**.