EE 202-HW 1 Solution (Term 121)

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Problem 1: Solution:

The power absorbed by the element is $p(t) = v(t)i(t) = 40t^3 - 300t^2 + 500t$ mW

This power being delivered to the element is maximum at 1.0566 seconds and it is equal to 240.563 mW.

This power being extracted from the element is maximum at 3.943 seconds and it is equal to 240.563 mW.

Problem 2: Solution:

For the currents:

Apply KCL at the node between g and j elements: $i_j = -i_g = -10$ A.

Apply KCL at the node between h, e, f, and j elements:

$i_h = -i_e - i_f - i_j = -7 - 14 + 10 = -11$ A.

Apply KCL at the node between d and h elements: $i_d = -i_h = 11$ A.

For the voltages:

Apply KVL at the lower-right loop:

$v_c - v_g - v_j + v_f = 0 \Rightarrow v_c = v_g + v_j - v_f = 20 + 10 - 18 = 12$ V.

Apply KVL at the lower-middle loop: $-v_e - v_f = 0 \Rightarrow v_e = -v_f = -18$ V.

Apply KVL at the lower-middle loop: $-v_e - v_f = 0 \Rightarrow v_e = -v_f = -18$ V.

Apply KVL at the lower-left loop:

$v_e - v_h - v_d + v_b = 0 \Rightarrow v_b = -v_e + v_h + v_d = 18 - 15 - 7 = -4$ V.

Apply KVL at the upper loop: $-v_a - v_c - v_b = 0 \Rightarrow v_a = -v_c - v_b = -12 + 4 = -8$ V.

Table with power:

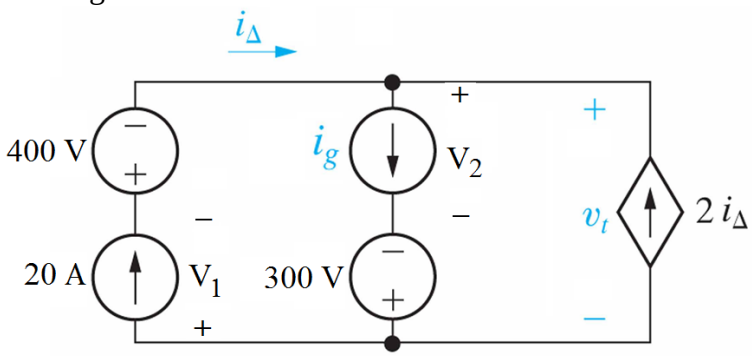
	Voltage (V)	Current (A)	x	power (W)	
A	-8	5	-1	40	absorbed
B	-4	-6	-1	-24	generated
C	12	-15	1	-180	generated
D	-7	11	-1	77	absorbed
E	-18	7	1	-126	generated
F	18	14	-1	-252	generated
G	20	10	1	200	absorbed
H	-15	-11	1	165	absorbed
J	10	-10	-1	100	absorbed

$\sum$ Absorbed Power $= 40 + 77 + 200 + 165 + 100 = 582$ W absorbed.

$\sum$ Generated Power $= -24 - 180 - 126 - 252 = -582 = 582$ W generated.

Problem 3: Solution:

Assign V1 and V2 in the passive sign direction with 20A and ig currents sources, respectively, see the figure.



Apply KVL in the right loop to get: $300 - V_2 + 500 = 0 \Rightarrow V_2 = 800$ V.

Apply KVL in the right loop to get: $V_1 + 400 + 500 = 0 \Rightarrow V_1 = -900$ V.

Apply KCL in the upper node to get: $-i_\Delta - 2i_\Delta + ig = 0 \Rightarrow i_\Delta = 20$ A.

Power calculations:

$p_{400V} = 400 i_\Delta = 8$ kW.

$p_{300V} = -300 i_g = -18$ kW.

$p_{20A} = V_1(20) = -18$ kW.

$p_{ig} = V_2(i_g) = 48$ kW.

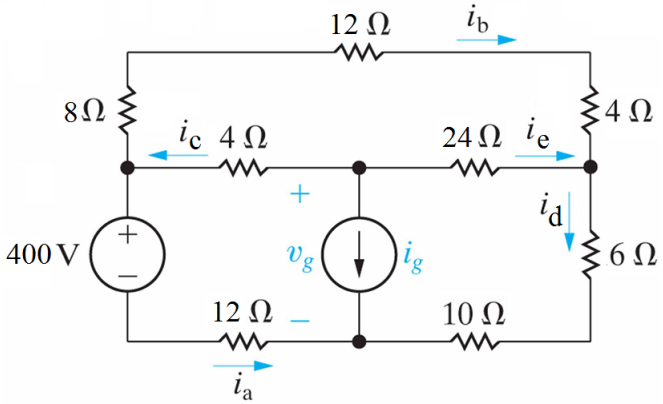
$p_{2i_\Delta} = -V_t(2i_\Delta) = -20$ kW.

$\sum$ Absorbed Power $= 8$ kW $+ 48$ kW $= 56$ kW.

$\sum$ Generated Power $= 18$ kW $+ 18$ kW $+ 20$ kW $= 56$ kW.

Problem 4: Solution:

Assign current i_c, i_d, and i_e in the circuit as shown in the figure.



Apply KVL and Ohm's Law in the outer loop to get:

$(8+12+4)i_b + (6+10)i_d - 12i_a - 400 = 0 \Rightarrow i_d = 25$ A.

Apply KCL at the lower-middle node to get: $-i_g - i_d - i_a = 0 \Rightarrow i_g = -i_d - i_a = -45$ A.

Apply KCL at the left-middle node to get: $-i_c + i_a + i_b = 0 \Rightarrow i_c = i_a + i_b = 30$ A.

Apply KVL and Ohm's Law in the lower-left loop to get:

$-400 - 4i_c + v_g - 12i_a = 0 \Rightarrow v_g = 760$ V.

Apply KCL at the right-middle node to get: $-i_e + i_d - i_b = 0 \Rightarrow i_e = i_d - i_b = 15$ A.

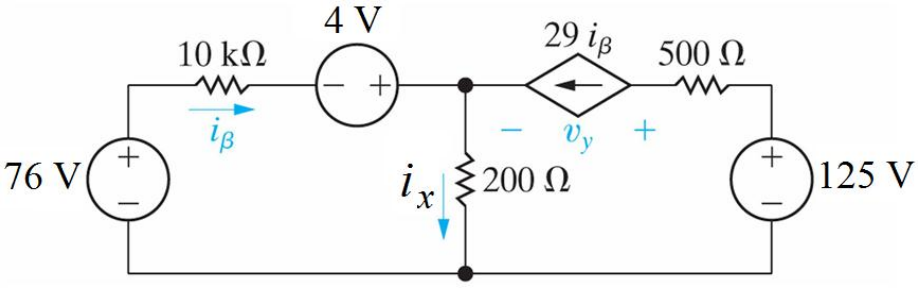
$\sum$ Absorbed Power $= (8+12+4)(10)^2 + 4(30)^2 + 24(15)^2 + (6+10)(25)^2 + (400)(20)$

$= 34.2$ kW absorbed.

$\sum$ Generated Power $= (760)(-45) = 34.2$ kW generated.

Problem 5: Solution:

Assign a current ix in the circuit as shown in the figure.



Apply KCL at the top-middle node to get: $i_x - i_\beta - 29i_\beta = 0 \Rightarrow i_x = 30i_\beta$.

Apply KVL and Ohm's Law in the left loop to get: $-76 + 10000i_\beta - 4 + 200i_x = 0$.

Substitute equation (1) in (2) to get: $-76 + 10000i_\beta - 4 + 200(30i_\beta) = 0 \Rightarrow i_\beta = 5$ mA.

Substitute in (1) to get: $i_x = 150$ mA.

Now apply KVL in the right loop to get:

$-200i_x - v_y - 500(29i_\beta) + 125 = 0 \Rightarrow v_y = 22.5$ V.

$\sum$ Absorbed Power $= 10000(i_\beta)^2 + 200(i_x)^2 + 500(29i_\beta)^2 + (v_y)(29i_\beta) = 18.525$ W absorbed.

$\sum$ Generated Power $= -(76)(0.005) - (4)(0.005) - (125)(29i_\beta) = 18.525$ W generated.