

Assignment 4 (part 2) solutions

Question 1

- b) Power equal to zero $\rightarrow V_1 = 0, V_2 = -4V, V_s = V_2 = -4V (I_{V_s} = 0)$
(V_1 is the voltage at node connecting current source with 100Ω resistor, V_2 is node at $-ve$ input to opamp.)
- c) KCL at $V_2 \rightarrow V_o - V_s/5800 + 0.04 = V_s/200 \rightarrow V_o = 30V_s - 232$
 $V_o/10k + V_s/200 = 40mA \rightarrow V_o/10 + V_s/0.2 = 40 \rightarrow V_s = 7.9V$

Question 2

- a) $V_2 = 0 \rightarrow 4V_1 = V_1 \rightarrow V_1 = 0 \rightarrow P_{(dependent\ sources)} = 0W, P_{6V} = 6^2/400 = 0.09W$
- b) $I_{400\Omega} = 6/400 = 0.015A \rightarrow V_o = -0.015 * 8000 = -120V$
- c) $I_L = V_o/R_L = -120/12k = -10mA = -0.01A$
 $I_o = I_{400\Omega} - I_L = 0.015 + 0.01 = 0.025A$
 $Q = I_o * t = 0.025 * 3600 = 90C$

Question 3

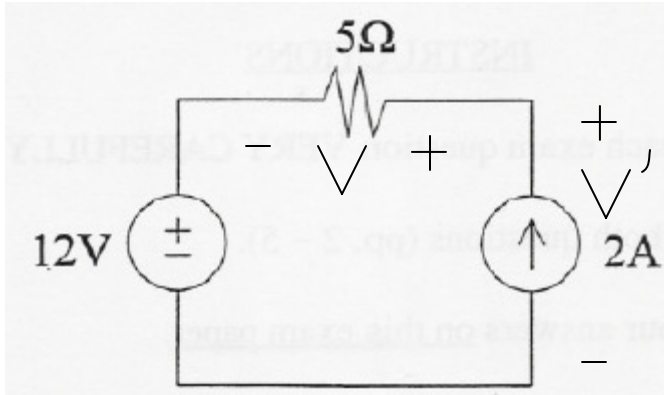
- a) $I_F = (200I_F - 12)/100 \rightarrow I_F = 2I_F - 0.12 \rightarrow I_F = 0.12A$
- b) $V_X = 700 * 0.12 = 24V$. The power supplied by the $12V$ source is $-1.44W$ (negative means consumed) while the dependent source supplies 0 power.
- c) $V_o = 400I_F + V_X = 400 * 0.12 + 24 = 72V \rightarrow P = V_o^2/81 = 64mW$

Question 4

- a) $(1/60 + 1/60)V_R = 0.2 + 24/60 \rightarrow V_R = 18V, P = V_R^2/R = 5.4W$
- b) $I_{60\Omega} = 24 - 18/60 = 0.1A \rightarrow P_{24V} = 2.4W$ (supplied)
 $V_{100\Omega} = 20V \rightarrow V_{200mA} = 18 + 20 = 38V \rightarrow P_{200mA} = 38 * 0.2 = 7.6W$ (supplied)
- c) $I_R = 200mA \rightarrow V_R = 24V \rightarrow R = V/I = 120\Omega$

Question 5

- a) $V = 5 * 2 = 10V, V' = 10 + 12 = 22V, P' = 22 * 2 = 44W$ (current source supplied)
- b) $P = I^2 R = 4/5 = 20W$ (resistor consumed). $P'' = V * 2 = 24W$ (voltage source consumed)
- c) the power absorbed by the resistor doesn't change since the current is fixed by the $2A$ source.



Question 6

- b) $V_{oc} = I_{in} \cdot R + V_s \rightarrow$ not ohmic
 c) $V_{ov}/I_{in} = -R/2 + 1 \rightarrow$ ohmic

Question 7

- a) $V_+ = V_- = 0.03 \cdot 200 = 6V$
 $P_{200\Omega} = V^2/R = 36/200 = 0.18W$
 $I = 9 - 6/120 = 0.025 A$
 $P_{120\Omega} = I_2 R_1 = 0.075W$. $P_{400\Omega} = I_2 R_2 = 0.25W$
- b) $V_o = V_+ - 400I = 6 - 10 = -4V$
 $I_L = V_o/R_L = -4/160 = -0.025A$
 $I_o = I_L - I = -0.025 - 0.025 = -0.05A$