LAM

ENGINEERING 11
ELECTRICAL CIRCUIT ANALYSIS

9.23.04
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EXAM 1

Each problem is worth 25 points.

1. Find V_0 in the circuit shown below.

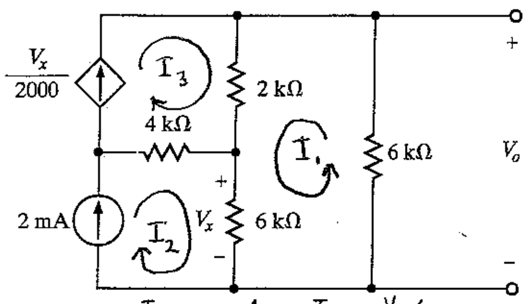
$\sum v = 0 = -6kI_1 - 2k(I_1 + \frac{V_x}{2k}) - V_x \Rightarrow -8kI_1 - 2V_x = 0$ (loop 1)

where $V_x = 6k(I_1 + 2m) = 6kI_1 + 12$; plug into

$\Rightarrow -8kI_1 - 2(6kI_1 + 12) = 0$

so $I_1 = -\frac{6}{5}$ mA

& $V_0 = 6kI_1 = -\frac{36}{5}$ V



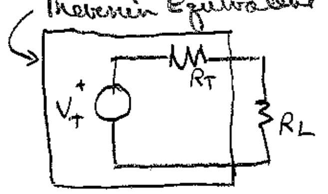
$I_2 = 2mA$; $I_3 = V_x/2k$

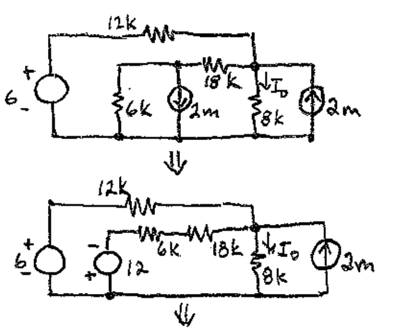
2. Consider the 8 kΩ resistor in the circuit below to be the load resistor.

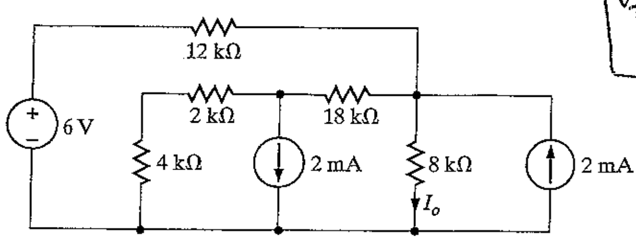
a. Find the Thevenin equivalent of the remainder of the circuit (after removing the 8 kΩ resistor). You may use any combination of methods you like to find the Thevenin equivalent.

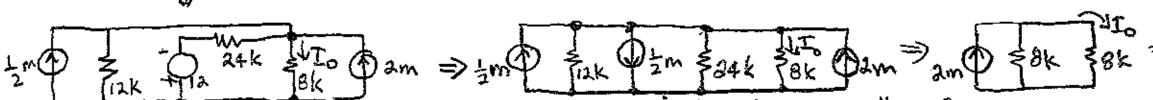
b. Find the current I_0 and the power dissipated by the resistor.

Thevenin Equivalent:



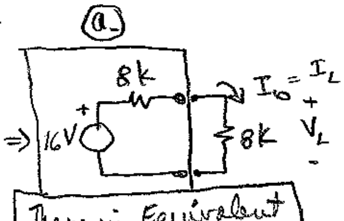






switch positions; 24‖12 = 8

(a)



Thevenin Equivalent

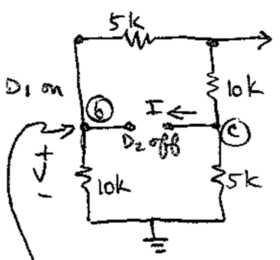
b. $I_0 = \frac{V_T}{R_T + R_L} = \frac{16}{16k} = 1\text{ mA} = I_0$

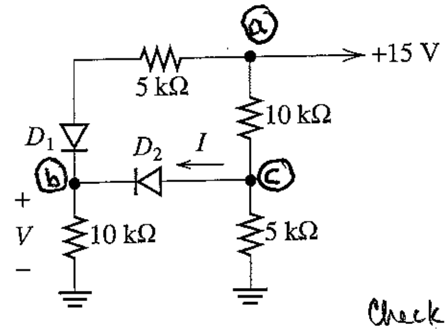
$P = V_L I_0 = RI_0^2 = 8k(1m)^2 = 8\text{ mW} = P$

EXAM 1

3. Find I and V in the circuit shown below.

Try D_1 on & D_2 off.





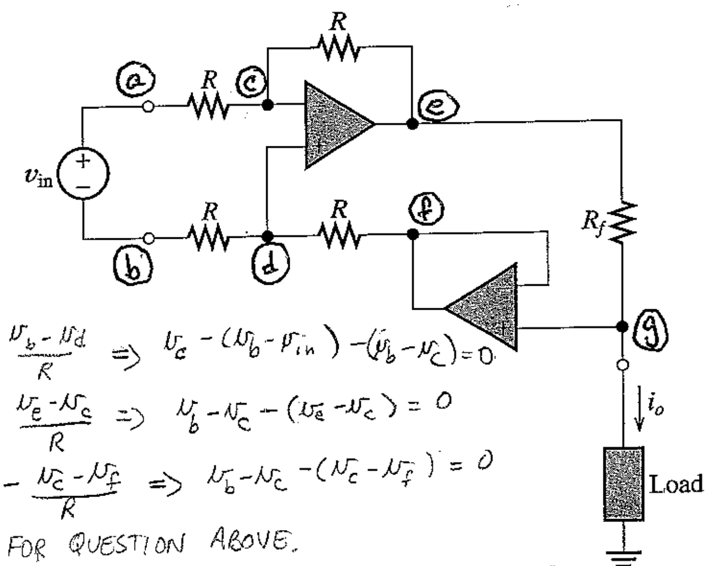
Check: D_1 has $i > 0$ (↓) ✓
D_2 has $v < 0$ $(5-10=-5<0)$ ✓

by voltage ÷, $v_b = \frac{10}{5+10}(15) = 10V$
& $v_c = \frac{5}{5+10}(15) = 5V$

so $V = 10\,V$, $I = 0$

4. Set up a sufficient number of equations to find i_0 in the circuit shown below, but ***do not solve*** them. The load can be considered to be a resistor connected to ground, and in this circuit, it does not matter what value that resistor has.

Note:
$v_d = v_c$
$v_f = v_g$
$v_a - v_b = v_{in}$
$i_o = \frac{v_e - v_f}{R_f}$



$\sum_b i = 0 = \frac{v_c - v_a}{R} - \frac{v_b - v_d}{R} \Rightarrow v_c - (v_b - v_{in}) - (v_b - v_c) = 0$

$\sum_c i = 0 = \frac{v_a - v_c}{R} + \frac{v_e - v_c}{R} \Rightarrow v_b - v_c - (v_e - v_c) = 0$

$\sum_d i = 0 = \frac{v_b - v_c}{R} - \frac{v_c - v_f}{R} \Rightarrow v_b - v_c - (v_c - v_f) = 0$

⟹ STOP HERE FOR QUESTION ABOVE.

For actual solution,
$v_b - 2v_c + v_e = -v_{in}$
$v_b - 2v_c + v_f = 0$ ⟹ $v_b - 2v_c + v_e = -R_f i_o$
$-2v_b + 2v_c = v_{in}$
$v_e - v_f = R_f i_o \Rightarrow v_f = v_e - R_f i_o$

So
$v_b - 2v_c + v_e = -v_{in}$
$v_b - 2v_c + v_e = -R_f i_o$ } ⟹ $i_o = -\frac{v_{in}}{R_f}$, so this circuit operates as a current source supplying i_o to the load.
$-2v_b + 2v_c = v_{in}$