

4/12/2006

University of Portland
School of Engineering

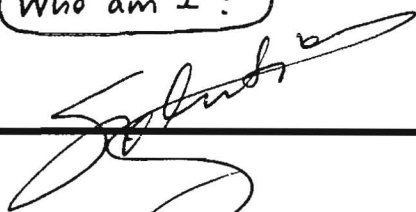

EE 261-Electrical Circuits-3 cr. hrs.
Spring 2006

SOLUTIONS TO
Midterm Exam # 2

(Monday, March 27, 2006)
(Closed Book Exam, Two Formula Sheets Allowed)
(Total Time: 55 minutes)

Name: SOLUTIONS! 



Signature:  

"An honest mind possesses a kingdom."
Lucius Annaeus Seneca (4B.C.-65A.D.)

"Honest people are the true winners of the universe."
Anonymous

It's almost impossible to determine what's going to happen next.

 Taking Inan's tests are worse than entering a dangerous war zone.

Inan's best student's total grade is 0??

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This table will be used by Inan for recording the grades!

Problem #	Points gained by
#1	0
#2	0
#3	0
#4	0
Total	0

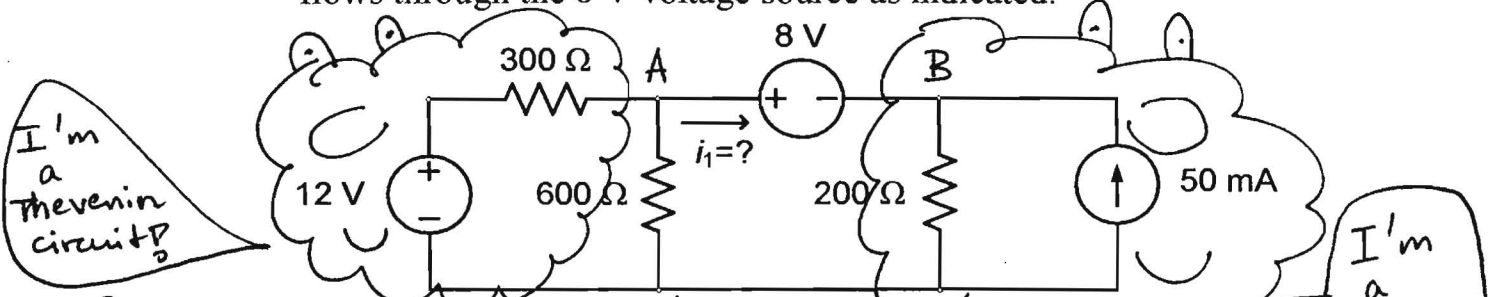
Inan's best students!

Whaaat? Inan is trying to deceive me with his usual tactics!

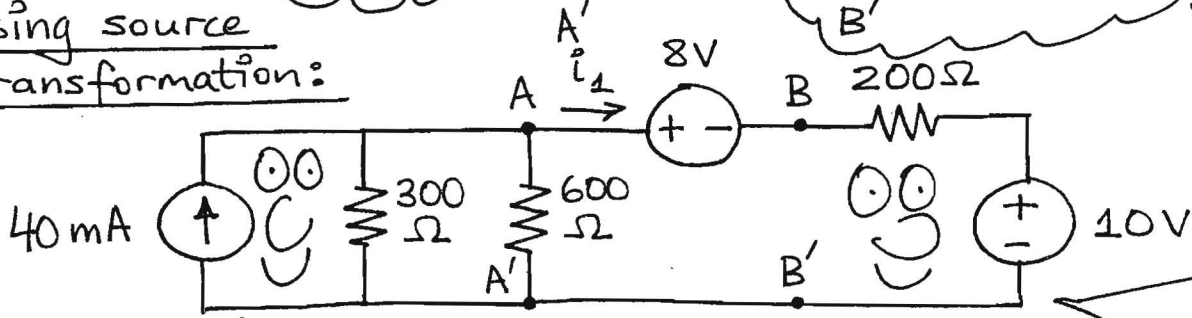
I'm zero & I'm the best grade!

NOTE: On all the problems, please show all your work, and provide the appropriate units for your answers. Also mark on the schematic to show any currents or voltages that you define in your solution.

1. (25 Points) For the resistive circuit shown, find the current i_1 that flows through the 8 V voltage source as indicated.

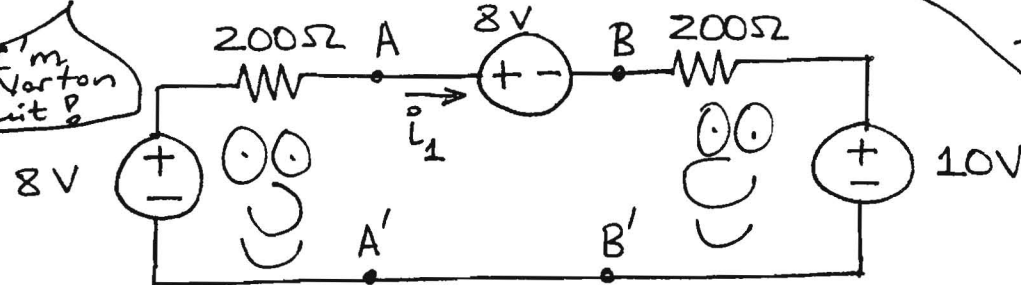


Using source transformation:



I'm now a Norton circuit!

I'm now a Thevenin circuit!



We're both Thevenin circuits!

$$i_1 = \frac{8 - 8 - 10}{200 + 200} = \frac{-10}{400} = -25 \text{ mA}$$

I've to stay focus on my work!



Norton, Thevenin, Norton, Thevenin, Norton...

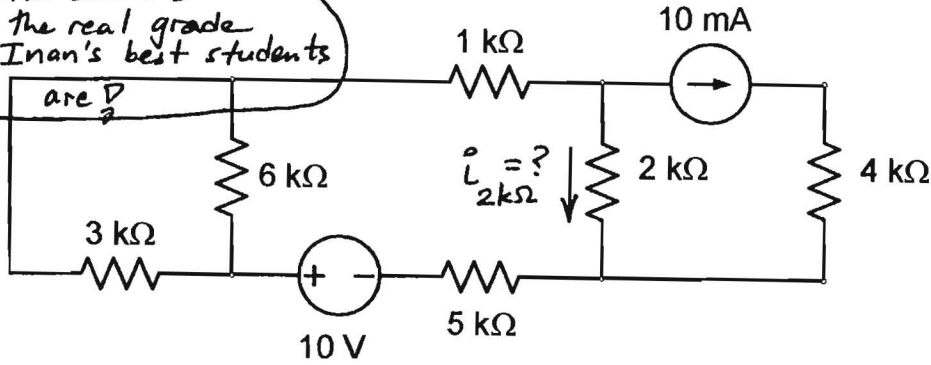
Your tactics won't work Inan!

Zero is the highest grade!

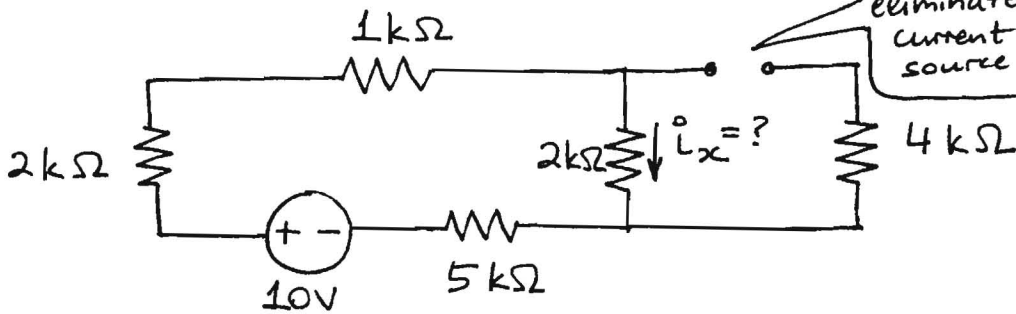
2. (25 points) Find the power absorbed by the 2 kΩ in the circuit shown.



I will show you what the real grade of Inan's best students are?

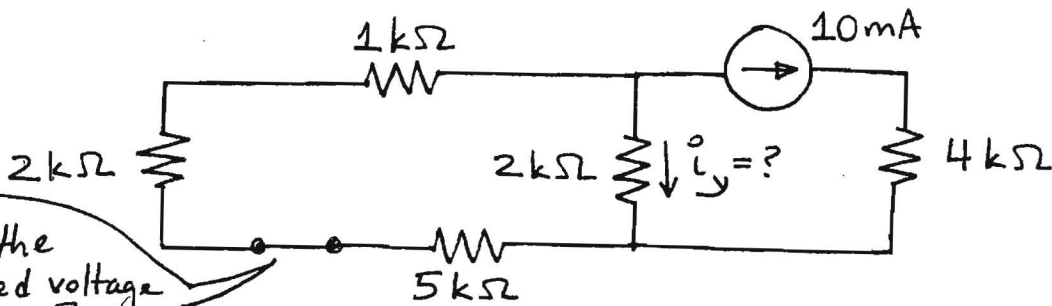


Using superposition principle:



I'm the eliminated current source!

$$i_x = \frac{10V}{2k\Omega + 1k\Omega + 2k\Omega + 5k\Omega} = \frac{10V}{10k\Omega} = 1mA$$



I'm the eliminated voltage source!

Using the current divider principle:

$$i_y = -\frac{8k\Omega}{10k\Omega} (10mA) = -8mA$$

$$i_{2k\Omega} = i_x + i_y = 1 - 8 = -7mA$$

$$P_{2k\Omega} = (-7mA)^2 (2k\Omega) = 98mW$$

Because it's Inan who trains them to do so?

Inan's cheap tactics won't work...

Inan's students always strive to get the best grade!

Zero the hero!

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3. (Total: 25 points) Consider the circuit shown below.

(a) (15 Points) Find the value of the load resistance R_L to be connected externally between terminals "a" and "b" such that the power absorbed by R_L is maximized.

They always aim for the maximum # of points

Third problem: You're doomed

Who destroyed me?

$R_{Th} = ?$

$R_{Th} = ?$

And they are trained to maximize their points under any circumstances

I'm zero & I want to be your grade

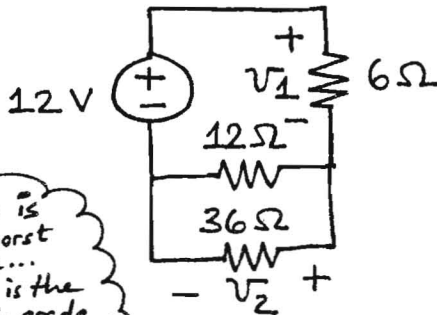
$$\therefore R_{Th} = [(12 // 6) + 12] // 24$$

$$R_{Th} = \frac{(16)(24)}{16+24} = 9.6 \Omega$$

$$\therefore R_L = R_{Th} = 9.6 \Omega$$

(b) (10 Points) Find the maximum value of the power absorbed by R_L .

Using voltage divider principle:



$$V_1 = \frac{6}{6 + (12 // 36)} (12V) = 4.8V$$

$$V_2 = 12 - V_1 = 7.2V$$

$$V_3 = \frac{12}{24 + 12} V_2 = 2.4V$$

$$\therefore V_{Th} = V_{oc} = V_1 + V_3 = 4.8 + 2.4 = 7.2V$$

$$\therefore P_{L,max} = \frac{(7.2)^2}{4(9.6)} = 1.35W$$

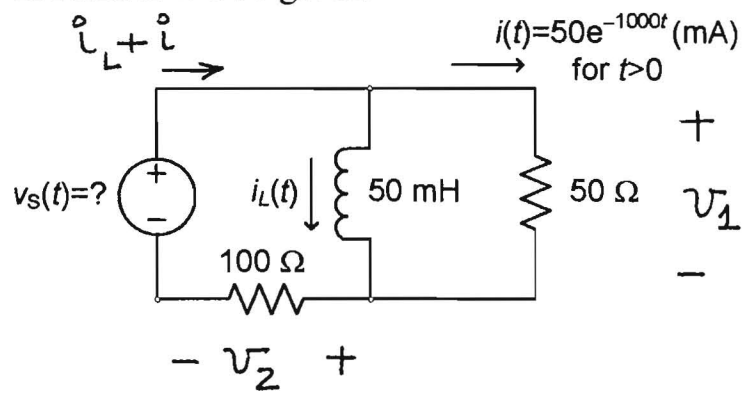
Zero is the worst grade... zero is the worst grade...

Inan teaches them about the maximum # of points theorem

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4. (25 points) In the circuit shown, given the initial condition $i_L(t=0) = 15$ mA, find the source voltage $v_S(t)$ for $t > 0$. Note that the current through the 50Ω resistor is also given.

Get zero! Zero is the best grade! :D



Find $i_L(t)$ by integrating $v_1(t)$



Maximum # of points
Maximum # of points
Maximum # of points

$$v_1(t) = 50 i(t) = 2.5 e^{-1000t} \text{ (V)}$$

$$i_L(t) = i_L(0) + \frac{1}{L} \int_0^t v_1(\tau) d\tau$$

$$= 15 \text{ mA} + 20 \int_0^t 2.5 e^{-1000\tau} d\tau$$

$$= 15 \text{ mA} - \frac{50}{1000} e^{-1000\tau} \Big|_0^t = [65 - 50e^{-1000t}] \text{ (mA)}$$

$$v_2(t) = 100 [i(t) + i_L(t)] = 100 (65 \text{ mA}) = 6.5 \text{ V}$$

$$\therefore v_S(t) = v_1(t) + v_2(t) = 6.5 + 2.5 e^{-1000t} \text{ (V) for } t > 0$$



And FYI, the maximum # of points that Inan's students strive for is 100 out of 100 :D

And despite all the cheating tactics, Inan's students maintain their focus and maximize the # of points in their grades :D

Good job! You survived! :D