

*University of Portland
School of Engineering*

EE 261-Electrical Circuits-3 cr. hrs.
Fall 2015

Midterm Exam # 1

(Friday, October 9, 2015)
(Closed Book Exam, One Formula Sheet Allowed)
(Total Time: 55 minutes)

Name: SOLUTIONS! ☺

Signature: Solutions ☺

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

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

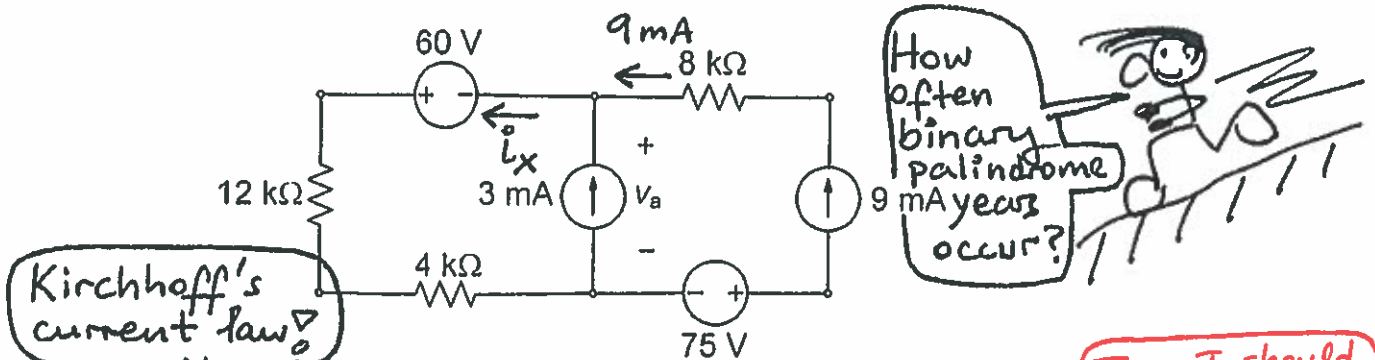
Yes, I
said
that! ☺



Inan said 2015 is
a binary palindrome
year since 2015 in
binary equals 11111011111! ☺

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

1. (20 points) In the electric circuit shown, determine the value of the voltage V_a across the 3 mA current source based on the polarity indicated. Show your work and provide brief justifications for the steps you take. Please box your answer and provide appropriate units.



KCL $\rightarrow i_x = 3\text{ mA} + 9\text{ mA} = 12\text{ mA}$

Shouldn't I be 12 mA?

Then, I should be 132 V?

KVL $\rightarrow V_a = -60 + (16\text{ k}\Omega)(3\text{ mA}) = -12\text{ V}$

Kirchhoff's voltage law

You should be able to figure that out?

Before 2015, last one occurred 48 years ago in 1967 since 1967 in binary is 1111010111



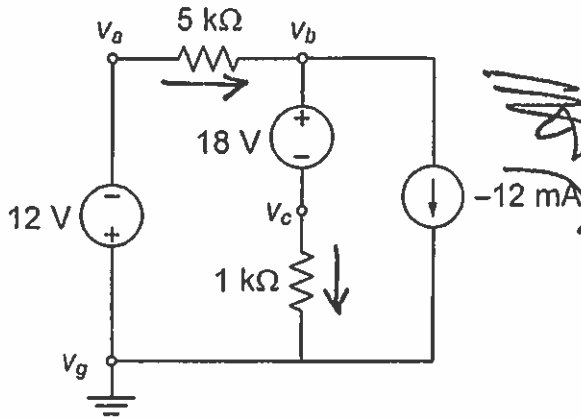
Good job!

Before that, in 1935 which in binary is 1111000111 (32 years ago)

And 1879 before 1911

Also 24 years before 1935 in 1911 since 1911 in binary is 11101110111

2. (20 Points) Consider the electric circuit shown. Determine the values of node voltages V_a , V_b , V_c , and V_g . Show your work step by step including justifications. Box your answers with appropriate units.



After 2015, what years in this century will be binary palindrome years?

$V_a = -12\text{ V}$ & $V_g = 0$

Okay, I will help!

$V_b - V_c = 18\text{ V}$

KCL $\rightarrow \frac{V_a - V_b}{5\text{ k}\Omega} + 12\text{ mA} = \frac{V_c}{1\text{ k}\Omega}$

There will only be two more!

$\rightarrow V_b + 5V_c = 48\text{ V}$

$V_b - V_c = 18\text{ V}$

$6V_c = 30\text{ V} \rightarrow V_c = 5\text{ V}$

Substituting: $V_b = 18 + V_c = 18 + 5 = 23\text{ V}$

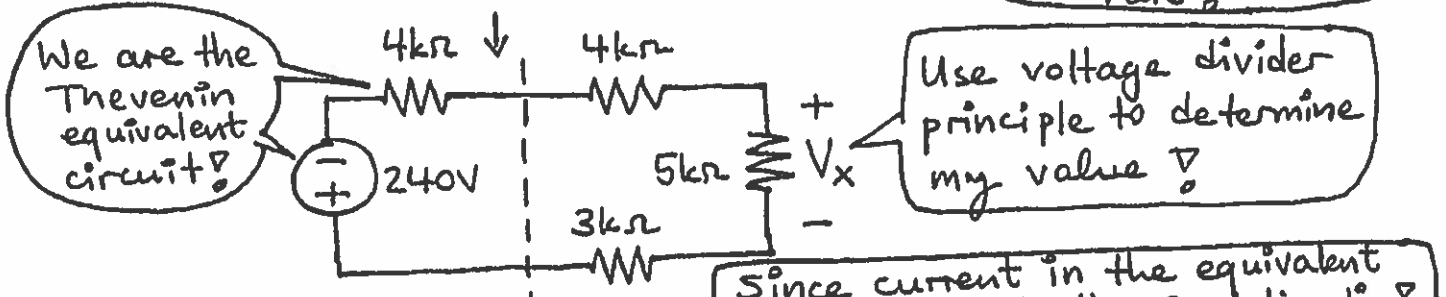
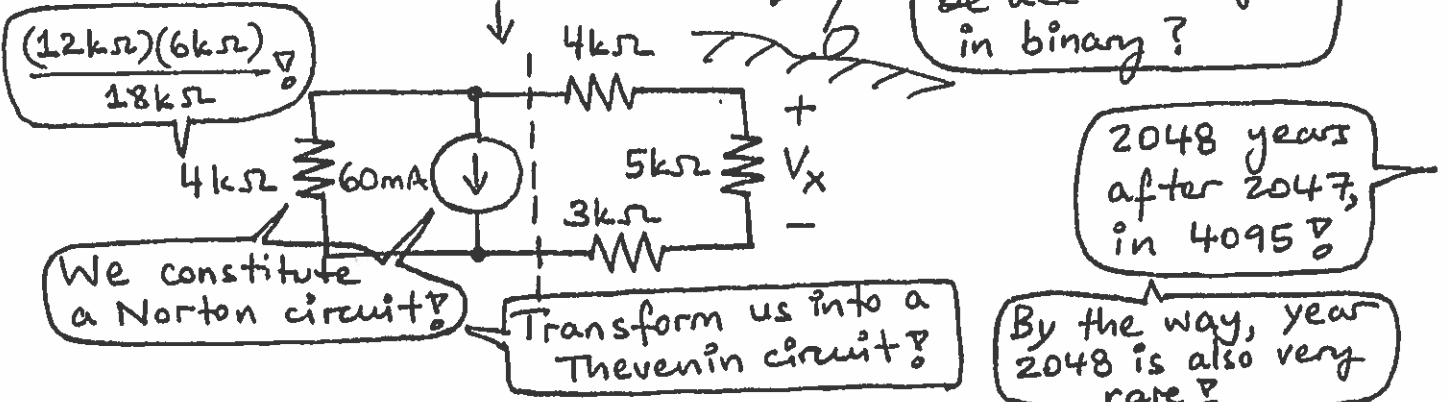
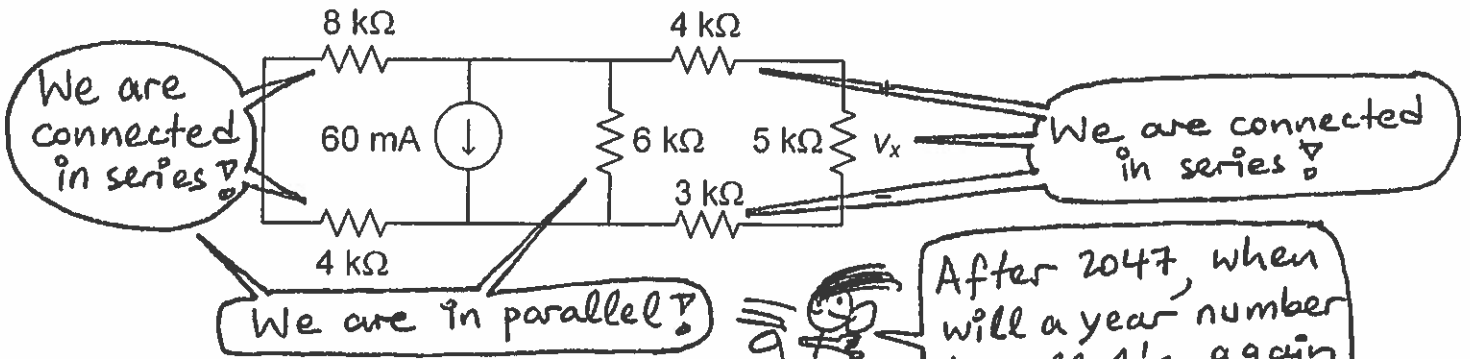
2047 has 11 ones where 11 is also palindrome!



Next one Inan said will be in 2047 and it will be a very special binary palindrome year since 2047 written in binary equals 11111111111! Wow!

And it will occur 32 years after 2015!

3. (20 Points) Consider the electric circuit shown. Determine the voltage V_x across the $5\text{ k}\Omega$ resistor on the right-hand-side as indicated. Please provide your work step by step with justifications. Box your answer.



Using VDP:

$$V_x = - \frac{5\text{ k}\Omega}{16\text{ k}\Omega} (240\text{V}) = \boxed{-75\text{V}}$$

Why my value is negative?
How so?

1111227

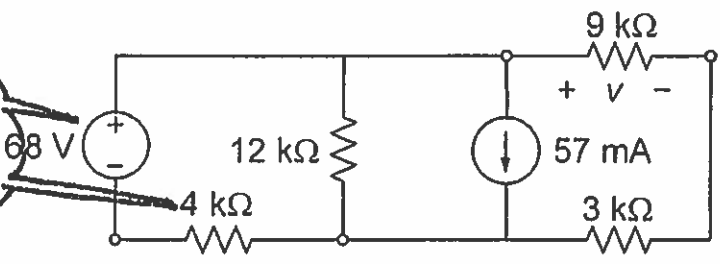
Because 2048 will be the highest-power year to occur since it equals 2^{11}

And October 24, 2048 will be a one-of-a-kind date in this century since 10242048 can be written as $2^{10}2^{11}$

4. (20 Points) For the electric circuit shown, find the value of the voltage V across the $9\text{ k}\Omega$ resistor. Show your work step by step and provide justifications. Box your answer with appropriate units.

This is really fun stuff!

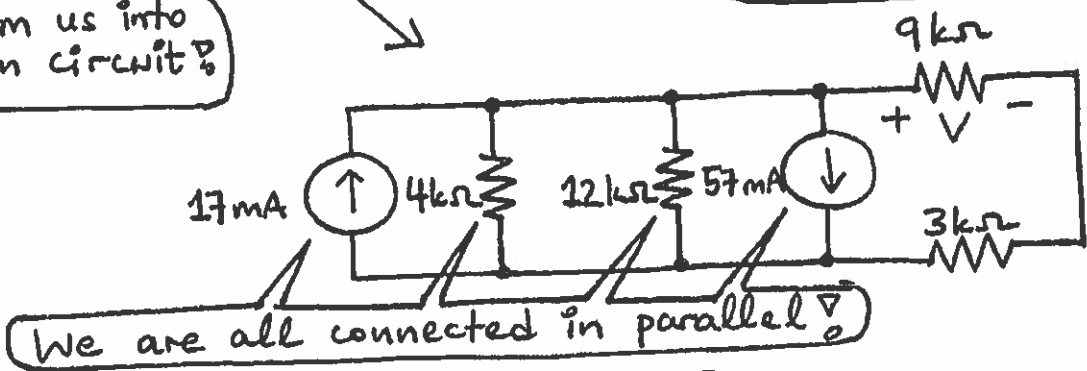
We are a Thevenin circuit!



What will be the next binary palindrome year after 2047?



Transform us into a Norton circuit!



We are all connected in parallel!

$57\text{ mA} - 17\text{ mA}$

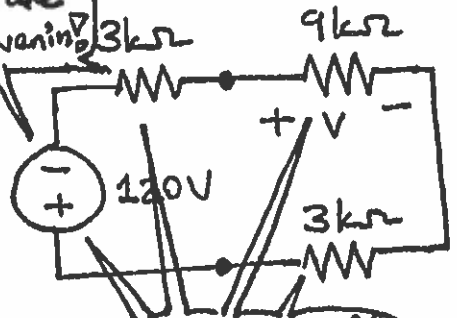


$\frac{(4\text{ k}\Omega)(12\text{ k}\Omega)}{16\text{ k}\Omega}$

We are a Norton circuit!

Norton to Thevenin circuit!

We are Thevenin!



We are all connected in series!

Using VDP: $V = - \frac{9\text{ k}\Omega}{15\text{ k}\Omega} (120\text{ V}) = \boxed{-72\text{ V}}$

It will be 2049 since it equals in binary 100000000001!

I'm negative because current flows in the CCW direction!



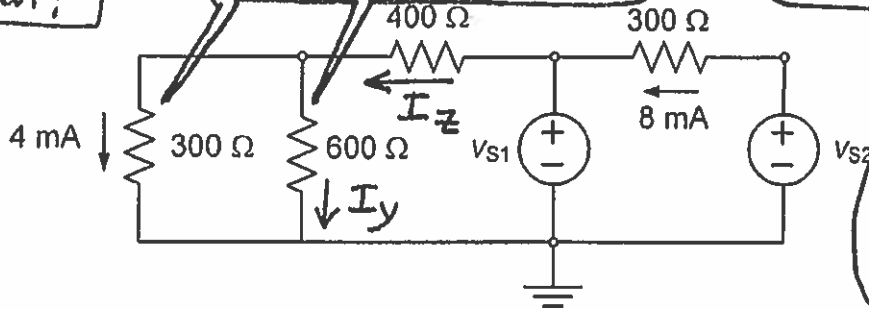
Amazing, only 2 years after 2047?

Yes! But guess when the next will be?

5. (20 Points) Two of the currents in the electric circuit shown are measured, as indicated. Using these measurements, determine the source voltages V_{S1} and V_{S2} . Show your work step by step and box your answers.



When?



We are in parallel!

We share the same voltage!

96 years after 2049, in 2145 written as 100001100001!

Ohm's law $\rightarrow V_x = (300\Omega)(4mA) = 1.2V$

Ohm's law $\rightarrow I_y = \frac{V_x}{600} = 2mA$

KCL $\rightarrow I_z = 4mA + I_y = 6mA$

Middle loop!

KVL $\rightarrow V_{S1} = 400I_z + V_x = 2.4 + 1.2 = \boxed{3.6V}$

KVL $\rightarrow V_{S2} = (300\Omega)(8mA) + V_{S1} = 2.4 + 3.6 = \boxed{6V}$

Right loop!

2145 is unreachable for me!



Wow! So if I live long enough, I can experience two more binary palindrome years in my lifetime!

Thanks Inan for making palindromes fun!

And don't forget the decimal palindrome years 1991, 2002, and the next one being 2112 to occur in the next palindrome-number century (22nd century)!