Intro to ECSE

Quiz 1

Fall 2022

1.	/20
2.	/20
3.	/8
Total	/48

Name __________________

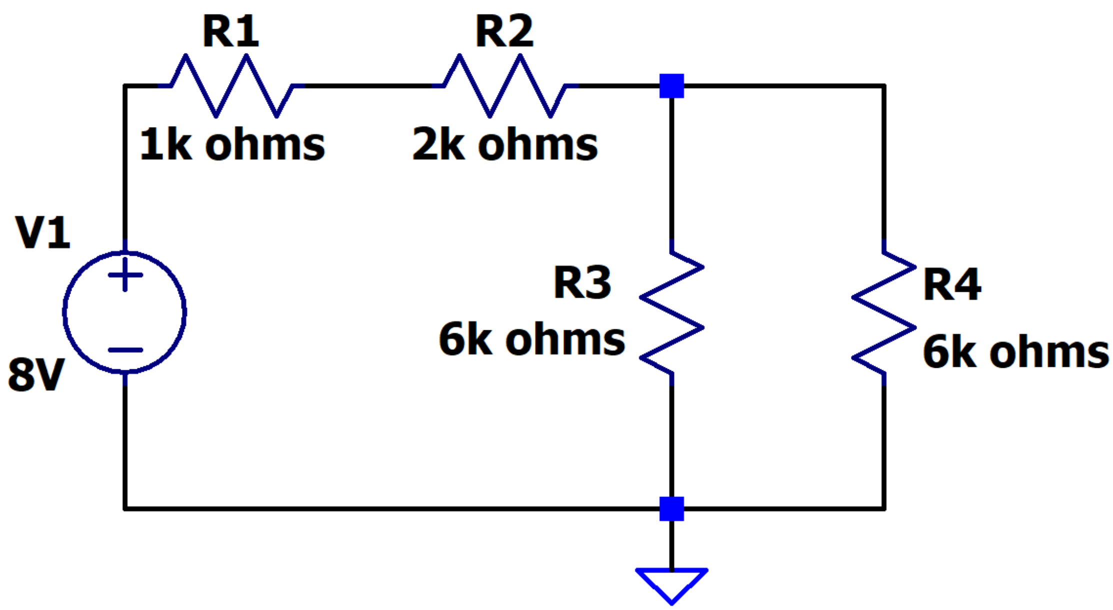
Notes:
SHOW ALL WORK. BEGIN WITH FORMULAS, THEN SUBSTITUTE VALUES AND UNITS. No credit will be given for numbers that appear without justification.
Use the backs of pages if there is not enough room on the front.

For partial credit on some questions, you may want to re-draw circuit diagrams as you simplify the circuits.

Many problems can be solved using more than one method. Check your answers by using a second method.

At least skim through the entire quiz before you begin and then start with the problems you know best. The proctor will only answer clarification questions where wording is unclear or where there may be errors/typos. No other questions will be responded to.

Problem 1 (20 pts) - Voltage Dividers, Series and Parallel Resistors, Ohm's law



1.1: (2 pts) Which resistors are in parallel in the circuit above?

R3 and R4

Resistors (circle all that apply)	R1 R2 R3 R4

1.2 (4 pts) Find the equivalent resistance of the schematic above. (Combine all resistors into one resistor and draw the circuit below). Show all work for full credit!

$R_1 := 1k\Omega$ $\quad R_2 := 2k\Omega$ $\quad R_3 := 6k\Omega$ $\quad R_4 := 6k\Omega$ $\quad V_1 := 8V$

$$R_{34} := \frac{R_3 \cdot R_4}{R_3 + R_4} = 3 \times 10^3\,\Omega$$

or students may use inverse relationship to combine parallel resistances

$$R_{1234} := R_1 + R_2 + R_{34} = 6 \times 10^3\,\Omega$$

Redrawn circuit below:

R_{eq} or R_{1234}	(ohms)

1.3 (3 pts) Find the current through R2.

The current through R2 is the same as the current through R_{1234}

$$I_{R2} := \frac{V_1}{R_{1234}} = 1.333 \text{ mA}$$

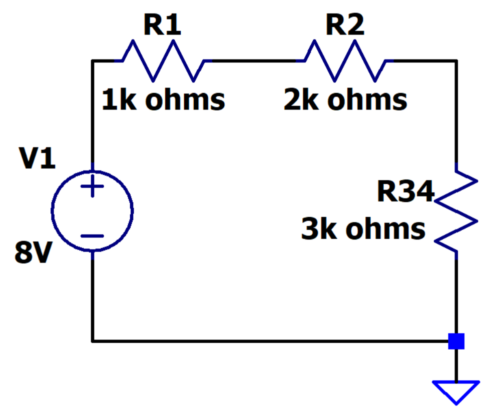
I_{R2}	(A or mA) Circle unit

1.4: (5 pts) Find the voltage across R3. Redraw the circuit that helps you find VR3.

$$V_{R3} := V_1 \cdot \frac{R_{34}}{R_1 + R_2 + R_{34}} = 4 \text{ V}$$

Note: The voltage across R34 is the same as the voltage across R3 and the voltage across R4.

<u>Your redrawn circuit schematic below that helps you find this voltage:</u>



V_{R3}	(V)

1.5: (6 pts) Design problem: You are given the following set of resistors and there is no extra supply around. You find a way to make a resistor value of 8k ohms. Describe ways to make the 8k ohm resistor you need by 1) combining resistor in series 2) combining resistors in parallel .....you may also choose to ***3) combining resistors in series and in parallel***

Random Box of Resistors (each listed below is just one resistor!)		
1k ohm	4k ohm	18k ohm
16k ohm	16k ohm	2k ohm
1k ohm	20k ohm	6k ohm

Series combination
(draw schematic and write equation):

There are many solutions

series circuit

$$4k\Omega + 2k\Omega + 1k\Omega + 1k\Omega = 8\,k\Omega$$

$$6k\Omega + 2k\Omega = 8\,k\Omega$$

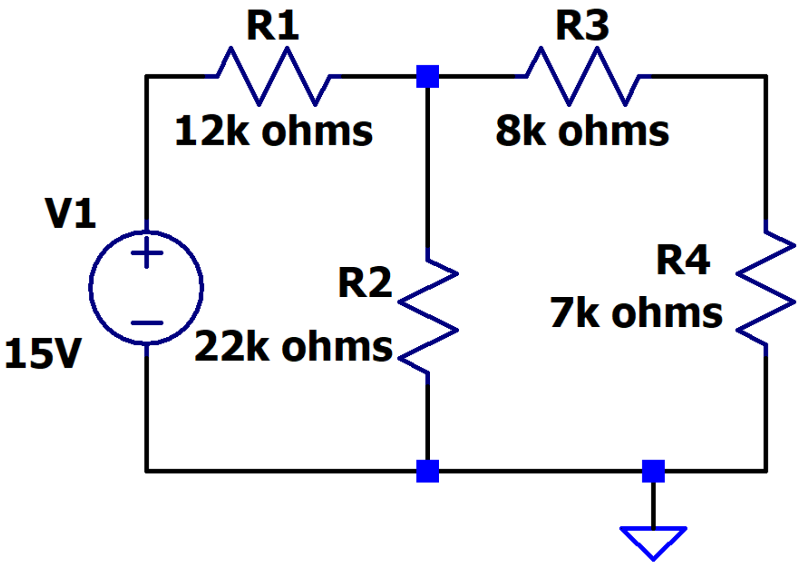
Parallel combination
(draw schematic and write equation):

Easiest solution

parallel circuit

$$\frac{16k\Omega \cdot 16k\Omega}{16k\Omega + 16k\Omega} = 8\,k\Omega$$

Problem 2 (20 pts) - KCL, KVL, Ohm's law



2.1: (4 pts) In the circuit above, how many nodes and loops are there?

4 nodes
3 loops

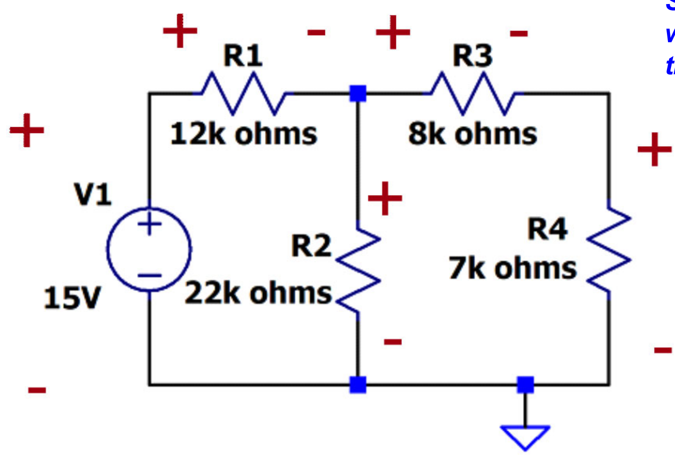
Nodes	
Loops	

2.2 (2 pts) In the circuit above, how many unknowns must you solve for? (Note: Using only KCL, KVL, and Ohm's law, without reductions or assumptions...)

4 unknowns from 4 resistors

Unknowns	

2.3: (2 pts) Draw your reference marks on the diagram above.



Students can arrange these any way they want but equation must correspond with their reference marks.

2.4 (8 pts) Write the linear independent equations that will find all voltages for all resistors. If you use a variable other than voltage to solve, write how you would convert to voltage in the end.

$V_{1p2} := 15V$ $R_{1p2} := 12k\Omega$ $R_{2p2} := 22k\Omega$ $R_{3p2} := 8k\Omega$ $R_{4p2} := 7k\Omega$

KVL loop left

$$-V_{1p2} + V_{R1p2} + V_{R2p2} = 0$$

(1) $V_{R1p2} + V_{R2p2} + 0V_{R3p2} + 0V_{R4p2} = 15$

KVL loop right

$$-V_{R2p2} + V_{R3p2} + V_{R4p2} = 0$$

(2) $0V_{R1p2} - V_{R2p2} + V_{R3p2} + V_{R4p2} = 0$

KCL middle node top

$$-I_{R1p2} + I_{R2p2} + I_{R3p2} = 0$$

(3) $\frac{-1}{12\cdot 10^3}\cdot V_{R1p2} + \frac{1}{22\cdot 10^3}\cdot V_{R2p2} + \frac{1}{8\cdot 10^3}\cdot V_{R3p2} + 0\cdot V_{R4p2} = 0$

KCL right top node

$$-I_{R3p2} + I_{R4p2} = 0$$

(4) $$0\cdot V_{R1p2} + 0\cdot V_{R2p2} + \frac{-1}{8\cdot 10^3}\cdot V_{R3p2} + \frac{1}{7\cdot 10^3}\cdot V_{R4p2} = 0$$

2.5 (4 pts) Convert your linear independent equations into matrices. ***You do NOT have to solve this to get an answer matrix. If you do write your answer, <u>it won't be graded</u> but you can check by seeing if you get an answer matrix if you'd like.***

$$M := \begin{pmatrix} 1 & 1 & 0 & 0 \\ 0 & -1 & 1 & 1 \\ \frac{-1}{12\cdot 10^3} & \frac{1}{22\cdot 10^3} & \frac{1}{8\cdot 10^3} & 0 \\ 0 & 0 & \frac{-1}{8\cdot 10^3} & \frac{1}{7\cdot 10^3} \end{pmatrix} \qquad C_1 := \begin{pmatrix} 15 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

Students do NOT need to solve but as a check

$$M^{-1}\cdot C_1 = \begin{pmatrix} 8.605 \\ 6.395 \\ 3.411 \\ 2.984 \end{pmatrix}$$

Problem 3 (8 pts) - Proof of Skills and Coming to Class

3.1: (2 pts) Name one of your TAs or SAs (first name is fine)

Chenyi Kuang
Jennifer Canfield
Noah Kader
Lorenzo Rivera
Ye Tang
Nazifa Rumman
Hao Lu
Hongji Guo
Yiping An

3.2: (2 pts) What is the idea of a "double deadline", as it pertains to Intro to ECSE.

All assignments have on on time deadline and a late deadline.

Students can write more if they'd like:
Assignments will not be penalized for late deadline.
It allows for iteration and resubmission.
It is a good life pro tip to force yourself to get work done before the main deadline and get feedback.

3.3 (2 pts) How many Proof of Skills main categories (i.e. Professional Accountability) are there?

Proof of Skills Categories (circle one)	1 2 3 4 5 6 7

5

3.4 (2 pts) Name any catagory other than Professional Accountablity.

Wording doesn't have to be exact...just a check that they actually tried them...

Professional Accountability

Circuit Simulation

Experimental Measurement and Personal Instrumentation

MATLAB and Simulink Basics

Community, Communication, Asking for Help, Helping Others