Contents

L5P03.problem ...................................................... 2
L5P05.problem ...................................................... 4
L6P15.problem ...................................................... 5
L6P05.problem ...................................................... 5
L6P06.problem ...................................................... 6
L6P14.problem ...................................................... 8
E2P01.problem ...................................................... 9
E2P03.problem ...................................................... 10
L5P12.problem ...................................................... 11
E2P04.problem ...................................................... 12
L6P16.problem ...................................................... 13
L6P17.problem ...................................................... 14
L6P18.problem ...................................................... 15
L6P19.problem ...................................................... 16
L6P20.problem ...................................................... 16
L7P11.problem ...................................................... 17
L7P04.problem ...................................................... 17
L7P05.problem ...................................................... 18
L7P12.problem ...................................................... 18
L7P13.problem ...................................................... 19
L7P14.problem ...................................................... 20
L7P15.problem ...................................................... 20
L8P03.problem ...................................................... 21
L6P21.problem ...................................................... 22
L8P01.problem ...................................................... 22
L8P06.problem ...................................................... 24
L8P10.problem ...................................................... 25
L8P02b.problem ..................................................... 27
L9P10.problem ...................................................... 27
L9P11.problem ...................................................... 28
v_1 = 6 \text{ V}, \ v_4 = 5 \text{ V} \ i_2 = 5 \text{ A}, \ i_3 = 3 \text{ A}, \ i_5 = -5 \text{ A}

In all components the current polarity is shown by the arrow and the voltage polarity is shown by the symbols. You may need to reference, in addition to the current course notes, the notes on power.

Use Kirchhoff’s laws to find the following voltages and currents.

v_2 = \hspace{2em} \text{volts}

v_3 = \hspace{2em} \text{volts}

v_5 = \hspace{2em} \text{volts}

Tries 0/6

i_1 = \hspace{2em} \text{amps}

i_4 = \hspace{2em} \text{amps}

Tries 0/6
Compute the power in each component and check whether or not it is dissipating (load) or supplying (source) energy, or neither (implying that P=0). Please don’t forget to include the sign for each power value entered.

\[ P_1 = \quad \] watts
A. Absorbing
B. Supplying
C. Neither

\[ P_2 = \quad \] watts
A. Absorbing
B. Supplying
C. Neither

\textit{Tries 0/6}

\[ P_3 = \quad \] watts
A. Absorbing
B. Supplying
C. Neither

\[ P_4 = \quad \] watts
A. Absorbing
B. Supplying
C. Neither

\[ P_5 = \quad \] watts
A. Absorbing
B. Supplying
C. Neither

\textit{Tries 0/6}
v2 = -22 V, v4 = 7 V, v6 = 16 V i1 = 4 A, i3 = -3 A, i5 = -1 A

Find v1, v3, v5, i2, i4, i6. The current and voltage polarities are shown for each component.

v1 (in volts) = 

v3 (in volts) = 

v5 (in volts) = 

Tries 0/6
i2 (in amps) = 

i4 (in amps) = 

i6 (in amps) = 

Tries 0/6
**HW4**

**R1 = 5 ohms R2 = 6 ohms R3 = 8 ohms**

What is the equivalent resistance of these three resistors when looking into the terminals from the left?

- A. \( \frac{R_1 R_2 R_3}{R_1 + R_2 + R_3} = 12.6315789473684 \text{ Ohms} \)
- B. \( \frac{R_1 R_2 R_3}{R_1 R_2 + R_2 R_3 + R_1 R_3} = 2.03389830508475 \text{ Ohms} \)
- C. \( R_1 + R_2 + R_3 = 19 \text{ Ohms} \)
- D. \( \min(R_1, R_2, R_3) = 5 \text{ Ohms} \)


**R1 = 7 ohms R2 = 7 ohms R3 = 3 ohms**

Can series/parallel reduction methods be used to find the equivalent resistance of this circuit without any other types of transformations?

- A. Yes
- B. No

If so, \( R_{ab} = \) (if not, write 0) \( \underline{\text{ohms}} \)

**Tries 0/6**
R1 = 5 ohms  R2 = 8 ohms  R3 = 3 ohms  R4 = 8 ohms  R5 = 8 ohms  R6 = 9 ohms

Imagine using an ohmmeter to measure the resistance between the nodes with labels a and b. For the circuit above, answer the following questions to see if we can predict this resistance by using our basic tools to combine resistors in series and resistors in parallel.

Element R1 and Element R5 are in series:

25. A  Yes   B  No

Element R1 and Element R2 are in parallel:

26. A  Yes   B  No

Tries 0/6
Element R2 and Element R4 are in parallel:
27. A  Yes       B  No

Element R3 and Element R4 are in series:
28. A  Yes       B  No

Element R5 and Element R6 are in series:
29. A  Yes       B  No

Tries 0/6

Can series/parallel reduction methods be used to find the equivalent resistance of this circuit without any other transformations?
A. Yes
B. No

If so, $R_{ab} =$ \hspace{2cm} $\Omega$ (enter 0 if it cannot be done)

Tries 0/6
Can series/parallel reduction methods be used to find the equivalent resistance of this circuit, between terminals a and b, without any other transformations?

A. Yes
B. No
The circuit below contains two ideal instruments (ammeter and voltmeter):

\[ V_{S} = 24 \text{ V} \quad R = 5 \text{ ohm} \]

a) Determine the voltage \( V_1 \) across the ideal ammeter (in volts), and then use KVL to determine \( V_m \) across the ideal voltmeter (in volts).

\[ V_1 = \underline{\text{V}} \]
\[ V_m = \underline{\text{V}} \]

Tries 0/6

b) Use Ohm’s Law to determine the current \( I \) thru the resistor \( R \) (in amps).

\[ I = \underline{\text{A}} \]

Tries 0/6
The circuit below contains an ideal ammeter (inserted incorrectly!):

\[ V_S = 22 \text{ V} \quad R_1 = 3 \text{ ohm} \quad R_2 = 3 \text{ ohm} \]

a) Determine the voltage \( V_m \) across the ideal ammeter (in volts), and then use KVL to determine \( V_1 \) across the resistor R1 (in volts).

\[ V_m = \boxed{\text{V}} \]
\[ V_1 = \boxed{\text{V}} \]

Tries 0/6

b) Use Ohm’s Law to determine the current \( I_1 \), \( I_2 \), and then KCL to determine the current \( I_m \) (in amps).

\[ I_1 = \boxed{\text{A}} \]
\[ I_2 = \boxed{\text{A}} \]
\[ I_m = \boxed{\text{A}} \]

Tries 0/6
What is the total number of nodes in the circuit?

Tries 0/6

(1) Given that \(V_2 = -44\ V,\ V_3 = 37\ V,\ and\ V_6 = 17\ V\), use KVL to find \(V_1,\ V_4,\ and\ V_5\).

\[ v_1 = \] V,
\[ v_4 = \] V,
\[ v_5 = \] V

Tries 0/6

(2) Given that \(I_2 = -11\ A,\ I_3 = -15\ A,\ and\ I_6 = 39\ A\), use KCL to find \(I_1,\ I_4,\ and\ I_5\).

\[ i_1 = \] A,
\[ i_4 = \] A,
\[ i_5 = \] A

Tries 0/6
A flex sensor is a flattened resistor which resistance changes as it is softly bent through an angle.

\[ V_s = 5 \text{ V} \quad R_{\text{bias}} = 20 \text{ k}\Omega \]

Determine the voltage \( V_A \) when the flex sensor takes on its minimum value of \( R_{\text{flex}} = 30 \text{ k}\Omega \).

\[ V_A = \text{V} \]

Determine the voltage \( V_A \) when the flex sensor takes on its maximum value of \( R_{\text{flex}} = 60 \text{ k}\Omega \).

\[ V_A = \text{V} \]

\[ \text{Tries 0/6} \]
Voltage Divider Circuit

Find the voltage $V_3$.
Here are the circuit values:

$V_s = 20\,\text{V}$
$R_1 = 10\,\text{k}\Omega$
$R_2 = 6\,\text{k}\Omega$
$R_3 = 3\,\text{k}\Omega$

$V_3 = \underline{\phantom{0}} \,\text{V}$

*Tries 0/6*
Find the voltage $V_4$.
Here are the circuit values:
$V_s = 13 \text{ V}$
$R1 = 871 \Omega$
$R2 = 200 \Omega$
$R3 = 300 \Omega$
$V_4 = \underline{\underline{\text{V}}}$

_Tries 0/6_
Two Voltage Source Circuit

Find the voltage across the nodes x and y. Here are the circuit values:

Vs1 = 26 V  
Vs2 = 40 V  
R1 = 3 kΩ  
R2 = 5 kΩ  
R3 = 6 kΩ  
R4 = 4 kΩ

First, compute \( V_{zy} \) (use KVL)

\[
V_{zy} = V_5 = \quad \text{V}
\]

Tries 0/6

Then, compute \( V_{xy} \) (use VDR)

\[
V_{xy} = V_6 = \quad \text{V}
\]

Tries 0/6
Current Divider

In the circuit above, we know that
\[ I_s = 0.5 \text{ A} \quad R_2 = 40 \, \Omega \]
Find the resistor R1 such that \( I = 300 \, \text{mA} \). \[ R_1 = \text{ } \Omega \]

Tries 0/6

Current Divider

In the circuit above, it is known that
\[ I_s = 4 \, \text{mA} \quad R_1 = 1 \, \text{k}\Omega \quad R_2 = 2.7 \, \text{k}\Omega \quad R_3 = 3.3 \, \text{k}\Omega \]

Find the current through resistors R2 and R3:
\[ I = \text{ } \text{mA} \]

Tries 0/6
This homework exercise is a review on sine and cosine functions. In this ECE class you will need to use sine and cosine waves a lot.

The general form of a sine (or cosine) function is:

\[ x(t) = A \sin(2\pi f t) \]
\[ = A \sin\left(\frac{2\pi}{T} t\right) \]
\[ = A \sin(\omega t) \]

where \( A \) is the amplitude of the sinusoid. The angular frequency \( \omega \) (measured in radians) = \( 2\pi f \) (that is 2 pi f). The frequency \( f \), measured in hertz (Hz) or cycles/second, and the period \( T \), measured in seconds, are related according to

\[ f = \frac{1}{T}. \]

a) Given the sine function \( x(t) = 12 \sin(17\pi t) \), answer the following questions: .......(\( \pi \) is pi!)

i) What is the amplitude of the function? 

ii) What is the frequency of the function? ___ Hz

Tries 0/6

iii) What is the period of the function? ___ s

iv) How many cycles are there in 3 seconds? ___ Cycles

Tries 0/6

b) A cosine function has a period of 0.08333 and an amplitude of 34. Fill in the blanks to form the correct equation:

\[ \cos( ___ \pi t) \] .......(\( \pi \) is pi!)

Tries 0/6

---

Note: the symbol \( \pi \) is the mathematical value pi (about 3.14).

What is the rms voltage of \( V_1=80 \cos (120 \pi t) \) ___ V (rms)

Tries 0/6

What is the rms voltage of \( V_2=2*100 \cos (120 \pi t) \) ___ V (rms)

Tries 0/6
What is the rms voltage of this function, $V_3$?

$V_{\text{rms}}$

*Tries 0/6*

---

$V_1(t)$ is a square wave that goes from 0 to 5 V with 70% duty cycle. What is the rms voltage of $V_1$?

$V_{\text{rms}}$

*Tries 0/6*

$V_2(t)$ is a square wave that goes from 0 to 10 V with 70% duty cycle. What is the rms voltage of $V_2$?

$V_{\text{rms}}$

*Tries 0/6*

$V_3(t)$ is a square wave that goes from 0 to 10 V with 35% duty cycle. What is the rms voltage of $V_3$?

$V_{\text{rms}}$

*Tries 0/6*

---

The graph above shows about two complete periods of a certain power profile (it goes on forever in both directions). The graph is drawn to scale. Answer these questions about this waveform:

What is the maximum height of the graph (in Watts)?

W

*Tries 0/6*
What is the period for the function? \( \text{s} \)

**Tries 0/6**

What is the average value of this function? \( \text{W} \)

**Tries 0/6**

---

The graph above shows nearly two periods of a certain periodic signal (it goes on forever in both directions). The graph is drawn to scale. Answer these questions about this signal:

What is the period for the function? \( \text{s} \)

**Tries 0/6**

What is the RMS value of this function? \( V_{\text{rms}} \)

**Tries 0/6**
for the voltage source: $V_s = 3 \text{ V}$, $R = 200 \Omega$, and for the current source: $I_s = 35 \text{ mA}$.

Find the values of power that describe each element. Be sure to include the proper sign to indicated delivering/absorbing.

For the voltage source, $P_V = \boxed{\text{mW}}$

For the resistor, $P_R = \boxed{\text{mW}}$

For the current source, $P_I = \boxed{\text{mW}}$

Tries 0/6

For the voltage source, $V_s = 2.2 \text{ V}$, $R = 200 \Omega$, and for the current source, $I_s = 55 \text{ mA}$.

Find the values of power that describe each element. Be sure to include the proper sign to indicated delivering/absorbing.

For the voltage source, $P_V = \boxed{\text{mW}}$

For the resistor, $P_R = \boxed{\text{mW}}$

For the current source, $P_I = \boxed{\text{mW}}$

Tries 0/6
What is the open-circuit voltage of the circuit described by this IV characteristic?  

What is the short-circuit current of the circuit described by this IV characteristic? 

Tries 0/12
Current Divider

In this problem, it may help to first establish which resistors are truly in parallel.

In the circuit above, it is known that:
\[ I_{s1} = 3 \text{ A} \quad I_{s2} = -5 \text{ A} \quad R_1 = 10 \Omega \quad R_2 = 6 \Omega \quad R_3 = 3 \Omega \]

Use the current divider rule to find \( I_1 \).

\[ I_1 = \text{ [ ] A} \]

_Tries 0/6_

(1) An unknown circuit is powered by a variable power supply (perhaps different combinations of battery cells or a DC power supply like in the lab).

The current and voltage were measured for each configuration:

For each set, Apply Ohm’s Law to determine the effective resistance by computing the ratio \( V/I \).

\[ I_1 = -3 \text{ A}; \quad V_1 = 2 \text{ v}; \quad V_1/I_1 = \text{ [ ] Ohms (i.e. V/A)} \]

\[ I_2 = -1.5 \text{ A}; \quad V_2 = 1 \text{ v}; \quad V_2/I_2 = \text{ [ ] Ohms (i.e. V/A)} \]

\[ I_3 = 1 \text{ A}; \quad V_3 = 6 \text{ v}; \quad V_3/I_3 = \text{ [ ] Ohms (i.e. V/A)} \]

\[ I_4 = 2.4 \text{ A}; \quad V_4 = 8.8 \text{ v}; \quad V_4/I_4 = \text{ [ ] Ohms (i.e. V/A)} \]

_Tries 0/6_
Could the circuit be a linear circuit (i.e. is the relationship between I and V a linear relationship)?
A. Yes
B. No

Could the circuit be made of one resistor only?
A. Yes
B. No

Tries 0/6

(2) Another circuit is powered by a variable power supply. The current and voltage were measured for each configuration; For each set, compute the ratio V/I.
I1 = -2.5 A; V1 = -12.5 v; V1/I1 = Ohms (i.e. V/A)
I2 = -2 A; V2 = -10 v; V2/I2 = Ohms (i.e. V/A)
I3 = -1 A; V3 = -5 v; V3/I3 = Ohms (i.e. V/A)
I4 = 1.7 A; V4 = 8.5 v; V4/I4 = Ohms (i.e. V/A)

Tries 0/6

Is the circuit a linear circuit (i.e. is the relationship between I and V a linear relationship)?
A. Yes
B. No

Could the circuit be made of one resistor only?
A. Yes
B. No

Tries 0/6
If the i-v characteristic for the electrical component C can be described by the linear equation:

\[ i = 0.29v + 0.05 \]

(Hint: Look carefully for any minus signs in the equation. They don’t show up very well.)

Find the voltage, current and power for component C, given the following connections to terminals a and b. Also state whether component C is a source (supplying energy) or a load (dissipating energy).

a) An ideal voltage source \( V_{s} = 10 \text{ V} \) is connected to the a-b terminals as shown. (hint: you must combine the given equation \( i = 0.29v + 0.05 \) of circuit C with the equation of the connected source to solve for v and i...)

\[ v = \text{V}, \quad i = \text{A} \]

Tries 0/6

P (for circuit C) = \text{W}

Component C is
A. a source
B. a load
C. neither

Tries 0/6
b) A $53 \, \Omega$ resistor is connected to the a-b terminals as shown.

![Resistor Diagram]

(hint: you must use the given equation $i = 0.29v + 0.05$, and combine it with another equation to solve for $v$ and $i$...)

$v = \underline{V},$

$i = \underline{A}$

$Tries \ 0/6$

$P \ (of \ circuit \ C) = \underline{W}$

Component C is

A. a source
B. a load
C. neither

$Tries \ 0/6$

The i-v characteristics for subcircuits C1 and C2 are graphed below.
a) From the given graph, find the numerical values for $i$ and $v$, obtained when connecting the two circuits $C_1$ and $C_2$.

\[
i = \underline{\hspace{2cm}} \text{A}
\]
\[
v = \underline{\hspace{2cm}} \text{V}
\]

_Tries 0/6_

b) The given $i$-$v$ graph for subcircuit $C_1$ represents the following circuit:

Using the given graph, find $v_s$ and $R_1$:

\[
v_s = \underline{\hspace{2cm}} \text{V}
\]

_Tries 0/6_

\[
R_1 = \underline{\hspace{2cm}} \text{ohms}
\]

_Tries 0/6_

c) The given $i$-$v$ graph for subcircuit $C_2$ represents the following circuit (Note: since the $i$-$v$ characteristic goes through the origin (0,0), and it is linear, subcircuit $C_2$ does not contain a source, but a resistor only):

Using the given graph, find the resistance $R_2$: $R_2 = \underline{\hspace{2cm}}$

_Tries 0/6_
What is the effective (Thevenin/Norton) resistance of the circuit described by this IV characteristic?

\[ \Omega \]

Tries 0/6

Consider the following Thevenin circuit:

\[ V_{Th} = 12 \text{ V}, \quad R_{Th} = 31 \text{ } \Omega \]

Applying basic circuit laws to the above circuit with the parameter values given,
a) find the value of \( V \) when \( I = 0 \) (open circuit on the right):

\[ V = \text{[volts (when I=0)]} \]

Tries 0/6

b) find the value of \( I \) when \( V = 0 \) (short circuit on the right):

\[ I = \text{[amps (when V=0)]} \]

Tries 0/6
c) Use the previous two results, and think about the shape of the IV graph for the given circuit (draw it on paper); check the one correct statement below:

Choices: The IV graph is increasing, The IV graph is decreasing.

- (choose one)

d) It is a known fact that any Thevenin circuit has a linear i-v characteristic described by the equation \( I = a*V + b \):

Give the value of the coefficients \( a \) and \( b \) in the above equation for \( i \) for the given circuit:

(hint: it is helpful to look at all the results you obtained in the previous parts)

\[ a = \text{[ ]} \]
\[ b = \text{[ ]} \]

Tries 0/6

Consider the following Norton circuit:

With the following parameters:

\( i_N = 16.5 \text{ A}, R_N = 33 \ \Omega \)

Applying basic circuit laws to the above circuit with the parameter values given,
a) find the value of $V$ when $I=0$:

$$V = \underline{\text{volts (when I}=0)$$

Tries 0/6

b) find the value of $I$ when $V=0$:

$$I = \underline{\text{amps (when V}=0)$$

Tries 0/6

c) Use the previous two results, and think about the shape of the IV graph for the given circuit (draw it mentally); check the one correct statement below:

Choices: The IV graph has positive slope, The IV graph has negative slope.

• (choose one)

Tries 0/6

d) It is a known fact that any Norton circuit has a linear i-v characteristic described by the equation $I = a*V + b$:

Give the value of the coefficients $a$ and $b$ in the above equation for $I$ for the given circuit:

(hint: it is helpful to look at all the results you obtained in the previous parts)

$$a = \underline{\text{}}$$

$$b = \underline{\text{}}$$

Tries 0/6

e) Find $V_{Th}$ and $R_{Th}$ for the Thevenin circuit below such that it has an i-v characteristic identical to the i-v characteristic for the given Norton circuit.
e1) \( V_{Th} = \) volts

Tries 0/6

e2) \( R_{Th} = \) Ohms

Tries 0/6