BioE 1310 - Review DC Circuits 1/25/2010

Instructions: On the Answer Sheet, enter your 2-digit ID number (with a leading 0 if needed) in the boxes of the ID section. *Fill in the corresponding numbered circles.* Answer each of the numbered questions by filling in the corresponding circles in the numbered question section. Print your name in the space at the bottom of the answer sheet. Sign here stating that you have neither given nor received help.

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your signature

1. The coulomb is a unit of

A. charge

B. voltage

C. energy

D. capacitance

E. current

2. The following is *not* true about voltage:

A. It describes the energy required to move a unit charge from one place to another.

B. It describes the number of electrons passing a certain point in a circuit over a given period of time.

C. It can be considered for a single point in a circuit only relative to a reference point, normally called "ground."

D. When measured across a resistor, it is linearly related to the current through that resistor by Ohm's law.

E. It is roughly analogous to pressure for water flow.

3. Any network of perfect voltage sources, perfect current sources, and resistors with two access points can be replaced with

A. A variety of perfect current sources by themselves.

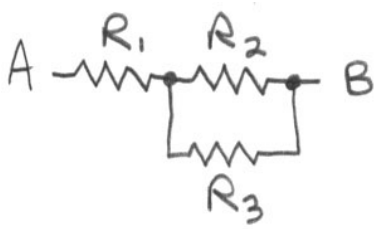
B. A unique Thevenin equivalent with a single voltage source and a single resistor.

C. A Norton equivalent, but only if no voltage sources exist in the original network.

D. A single resistor by itself.

E. A single perfect voltage source by itself.

4. What is the resistance between points A and B, if $R_1 = 10\Omega$, $R_2 = 40\Omega$, and $R_3 = 40\Omega$?



A. 20Ω

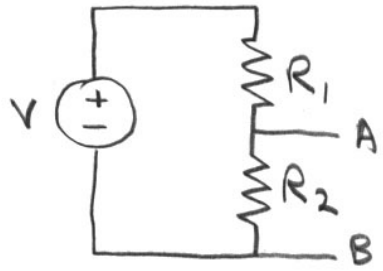
B. 90Ω

C. 10Ω

D. 50Ω

E. 30Ω

5. What is the voltage between points A and B, if $R_1 = 10\Omega$, $R_2 = 40\Omega$, and V = 5V?



A. 1V

B. 5V

C. 0V

D. 4V

E. 2V

6. The following is an appropriate thing to do the digital voltmeter in your PittKit.

A. Leave the meter in the 'voltage' setting when you put it away at the end of the day

B. Measure the voltage at one point in a circuit with the red lead, using the 'voltage' setting, leaving the black lead disconnected as a "floating" reference.

C. Measure the resistance across a collection of interconnected resistors plugged into a breadboard using the 'resistance' setting

D. Measure the resistance across a battery using the 'resistance' setting

E. Measure the resistance across a capacitor using the 'voltage' setting

7. How many joules does a 500 W toaster expend in 2 minutes?

A. 60,000 J

B. 1,000 J

C. Cannot be determined.

D. 41.7 J

E. 250 J

8. The resistance of very thin piece of copper wire is 100 Ω. The resistance another piece of wire with twice the cross-sectional area and half the length is

A. 50 Ω.

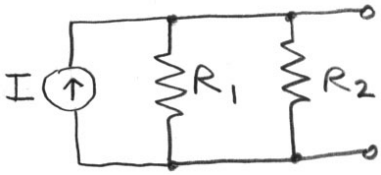
B. 200 Ω.

C. 400 Ω.

D. 25 Ω.

E. 100 Ω.

9. What are V_{thev} and R_{thev} for the Thevenin equivalent of the following circuit, if $R_1 = 100\ \Omega$, $R_2 = 100\ \Omega$, and I = 100 mA.



A. 500 mV, 200 Ω

B. 5 V, 100 Ω

C. 5 V, 50 Ω

D. 50 V, 50 Ω

E. 2.5 V, 50 Ω

10. Which of the following is *not* a factor in the danger of electrocution?

A. cardiac fibrillation

B. whether the victim is wearing rubber souled shoes

C. at least two points of contact are required to complete a circuit with the body

D. skin resistance is lowered by moisture

E. direct current does not pass through the skin capacitance

11. The condition in a component when constant current is linearly related to constant voltage is governed by

A. Inductance

B. Kirchhoff's current law.

C. Capacitance

D. Kirchhoff's voltage law.

E. Ohm's law.

12. Energy is related to power as follows:

A. Energy is the derivative of power.

B. Average energy is change in power.

C. Energy is the integral of power.

D. Energy is power divided by time.

E. None of the others is correct.

13. Any circuit only containing resistors, perfect voltage sources, and perfect current sources

A. may exhibit AC voltages or currents.

B. has a single solution in terms of the voltages and currents.

C. will dissipate energy from each of the voltage and current sources.

D. will exhibit superposition in terms of the effects of the current sources but not the voltage sources.

E. All of these are correct.

14. A battery is measured as having a voltage of 9 V without any load attached. Then an 8 Ω resistor is attached across the battery's leads and 8 V is measured across that resistor. What value of resistor would you replace the 8 Ω resistor with to yield 7 V?

A. 10.33 Ω

B. 3.5 Ω

C. 4 Ω

D. 2 Ω

E. cannot be determined

15. The following are all true about Ohm's law, *except*

A. Ohm's law is absolutely true for all electronic components.

B. It describes a property called resistance, which is a fixed proportion of current to voltage for a particular component.

C. It was invented by George Ohm, whose name happens to sound like a particular Greek letter.

D. It has a strong analogy to the flow of water in a pipe due to the difference in pressure at the two ends of the pipe.

E. It says that, for a given resistance, the greater the voltage difference across a resistor, the greater the current.

16. The following are all true about voltage, *except*

A. A single point can only have a voltage relative to some other point. If not otherwise specified, that other point is often assumed to be 'ground'.

B. The voltage between 2 points is the energy required to move a unit charge between them.

C. It specifies the number of electrons passing through a component in a given period of time.

D. It can be constant, or it can vary with time.

E. In the plumbing analogy to circuits, voltage is roughly analogous to pressure.

17. The following are useful tips about safety and electricity, *except*

A. High voltage can cause tetanus, or muscle contraction, so you can't let go!

B. It is safer to wear dry shoes with rubber soles.

C. Barefoot and dripping from the beach is an OK time to change the lightbulb.

D. Electricity usually kills by effecting the heart, so keep your heart out of the circuit.

E. Skin resistivity is lowered by water, especially salt water.

18. The joule is a unit of

A. power

B. current

C. voltage

D. charge

E. energy

19. Kirchoff's current law states that for any given node in a circuit

A. electrons can pile up endlessly without effect.

B. the sum of the currents entering the node equals the sum of the currents leaving the node.

C. the voltage with respect to ground is the same as at every other node in the circuit.

D. the voltage at that node cannot be 0 with respect to ground.

E. there can only be one connection to one other node in the entire circuit.

20. Kirchoff's voltage law states that

A. the current around any loop can never be zero.

B. power equals voltage times current.

C. the sum of the voltages around any loop must equal zero.

D. voltage is best in Russia.

E. voltage across a resistor divided by the resistance equals the current through the resistor.

21. The power dissipated by a 10 Ω resistor with 5 V across it is

A. 50 W

B. 2.5 W

C. 20 W

D. Cannot be determined from the data given.

E. 2 W

22. Two resistors are in parallel with 20 V across both of them. Each resistor is 10 KΩ. What is the current through *one* of the resistors?

A. 5 mA

B. 4 mA

C. 1 mA

D. 2 mA

E. Cannot be determined from the data given.

23. A particular voltage divider with 15 V across it consists of two resistors in series. One resistor is 20 Ω and the other is 10 Ω. What is the voltage across the 20 Ω resistor?

A. 10 V

B. 0 V

C. 15 V

D. 5 V

E. 7.5 V

24. Which of the following is *not* true about a perfect current source?

A. The only circuit that it cannot cope with is an open circuit.

B. It delivers a fixed voltage irrespective of the other components in the circuit.

C. It is capable of producing very large voltages.

D. It has an effective impedance of infinity, since a change in voltage across it results in no change in current.

E. It guarantees a certain number of electrons per second irrespective of the voltage across it.

25. The Thevenin equivalent to a circuit containing resistors, current sources and voltage sources, with two access points

A. consists of a single voltage source in parallel with a resistance.

B. consists of a single voltage source in series with a resistance.

C. consists of a single current source in series with a resistance.

D. consists of a single current source in parallel with a resistance.

E. None of the other answers is correct.

26. Which of the following is (are) true about *superposition* in solving DC circuits

I - Each current source and voltage source is considered separately, setting all the others to zero, and the resulting currents are added.
II - Setting a source to zero means making a voltage source a short circuit and making a current source an open circuit.
III - Superposition relies on the fact that Ohm's law is linear, i.e., that currents add linearly with voltage.

A. I and II

B. Only I

C. II and III

D. I and III

E. I, II, and III

27. Two resistors are in parallel with 20 V across both of them. Each resistor is 10 KΩ. What is the current through *one* of the resistors?

A. Cannot be determined from the data given.

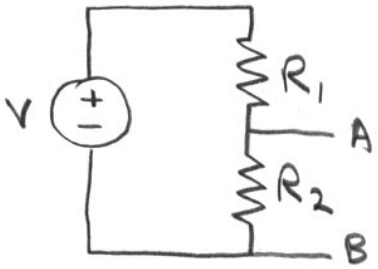
B. 4 mA

C. 5 mA

D. 1 mA

E. 2 mA

28. What is the voltage between points A and B, if $R_1 = 20\Omega$, $R_2 = 30\Omega$, and V = 15V?



A. 10V

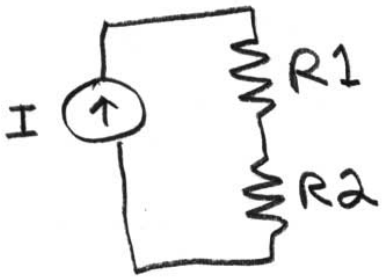
B. 9V

C. 5V

D. 0V

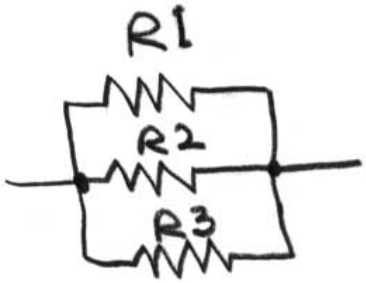
E. 15V

29. What is the voltage across R_1, given that $R_1 = 10K\Omega$, $R_2 = 5K\Omega$, and $I = 1mA$?



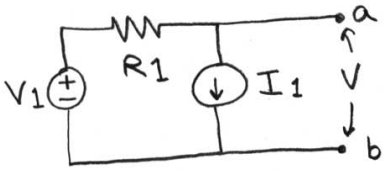
A. 15 V
B. 5 mV
C. 10 mV
D. 15 mV
E. 10 V

30. What is the resistance of the entire branch, given that $R_1 = 100K\Omega$, $R_2 = 100K\Omega$, and $R_3 = 50K\Omega$?



A. $R_1 = 200K\Omega$
B. $R_1 = 250K\Omega$
C. $R_1 = 50K\Omega$
D. $R_1 = 100K\Omega$
E. $R_1 = 25K\Omega$

31. What is the voltage between points a and b, given that $R_1 = 5\Omega$, $V_1 = 10$V, and $I_1 = 2$A?



A. 0 V
B. Cannot be determined
C. 25 V
D. 10 V
E. 20 V

32. Which of the following is (are) true about *superposition* in solving DC circuits

I - Each current source and voltage source is considered separately, setting all the others to zero, and the resulting currents are added.
II - It may be accomplished by setting the voltage of the voltage source to zero (making it a short circuit), and setting the current of the current source to zero (making it an open circuit).
III - Superposition works even when some of the components are not linear in their relationship between voltage and current.

A. Only I
B. I, II, and III
C. I and III
D. I and II
E. II and III

33. The power dissipated by a 100 Ω resistor with 5 V across it is

A. 20 mW
B. 250 mW
C. 2.5 W
D. 20 W
E. 500 mW

34. Kirchoff's current law states that for any given node in a circuit

A. the voltage with respect to ground is what is meant when no other reference point is specified.
B. the voltages around a loop add to zero.
C. current times voltage equals resistance.
D. the sum of the currents entering the node equals the sum of the currents leaving the node.
E. when a current enters a node, electric charge accumulates without appreciable effect.

35. The following are useful tips about safety and electricity, *except*

A. Skin resistivity is lowered by water, especially salt water.
B. As long as your feet are grounded you are safe.
C. High voltage can cause tetanus, or muscle contraction, so you can't let go!
D. Barefoot and dripping from the beach is a bad time to change the lightbulb.
E. Electricity usually kills by effecting the heart, so keep your heart out of the circuit.

36. Energy is related to power as follows:

A. Average energy over time is the change in power.
B. Power is the derivative of energy with respect to time.
C. Energy is the derivative of power with respect to time.
D. Energy is power divided by time.
E. None of the others is correct.

37. How many joules does a 25 W light bulb expend in 4 minutes?

A. 6,000 J

B. Cannot be determined.

C. 104 mJ

D. 6.25 J

E. 100 J

38. A particular voltage divider with 5 V across it consists of two resistors in series. One resistor is 2 KΩ and the other is 500 Ω. What is the voltage across the 2 KΩ resistor?

A. The answer cannot be determined without knowing which order the resistors are in.

B. 5 V

C. 0 V

D. 1 V

E. 4 V

39. A 3 V voltage source is connected in series with a 15 Ω resistor. The Norton equivalent

A. does not exist.

B. has a 5 A current source in parallel with a 15 Ω resistor.

C. has a 200 mA current source in series with a 15 Ω resistor.

D. has a 200 mA current source in parallel with a 15 Ω resistor.

E. has a 5 A current source in series with a 15 Ω resistor.

40. A battery is measured as having a voltage of 9 V without any load attached. Then a 5 Ω resistor is attached across the battery's leads and 5 V is measured across that resistor. What is the internal resistance of the battery?

A. 1 Ω

B. 4 Ω

C. 9 Ω

D. 5 Ω

E. cannot be determined

41. The following is <u>not</u> true about current:

A. When measured across any electrical component, current is linearly related to the voltage through that component.

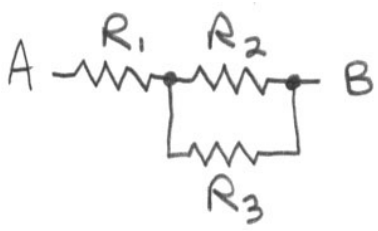
B. The unit of current is the Ampere, which equals 6.241×10^{18} electrons per second.

C. It describes the number of electrons passing a certain point per second.

D. In general, it can be said to obey Kirchhoff's Current Law, which states that no charge accumulates at any given node in a circuit.

E. Its relationship to voltage across either a capacitor or inductor (coil) takes the form of a first order differential equation with respect to time.

42. What is the resistance between points A and B, if $R_1 = 10$ MΩ, $R_2 = 40$ Ω, and $R_3 = 40$ MΩ? Calculate only to two significant digits.



A. 40 Ω

B. 50 MΩ

C. 30 Ω

D. 10 MΩ

E. 30 MΩ

43. The following are true about safety and electricity, *except*

A. High voltage can cause muscle contraction preventing the victim from releasing the wire.

B. Alternating current (AC) is inherently safer than direct current (DC), which is why we use it to transmit power.

C. Electricity usually kills by effecting the heart, so electricians are taught to use one hand near a high voltage.

D. Hospital equipment often prevents direction connection between the patient-contacting equipment and 110 V by use of optical isolators and transformers.

E. Skin resistivity is lowered by water, especially salt water.

44. The Norton equivalent to a circuit with two access points, containing resistors, current sources and voltage sources,

A. consists of a single voltage source in parallel with a resistance.

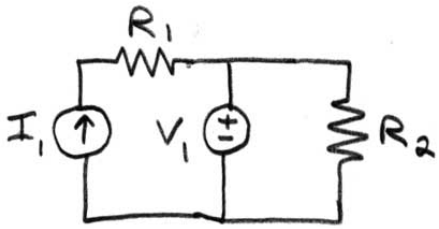
B. consists of a single current source in series with a resistance.

C. consists of a single current source in parallel with a resistance.

D. None of the other answers is correct.

E. consists of a single voltage source in series with a resistance.

45. Regarding the following circuit, which of the following is (are) true?



I - The voltage across R_1 is $I_1 \times R_1$.
II - The current through R_2 is $\frac{V_1}{R_2}$.
III - Superposition holds for this circuit.

A. I, II, and III

B. None of the other answers is correct.

C. I and III

D. II and III

E. I and II

46. How many joules does a 12 V car battery expend attempting to start a car during 5 seconds if the electric motor in the starter draws 10 amperes?

A. 600 J

B. 6.0 J

C. 24 J

D. Cannot be determined.

E. 4.17 J

47. Which of the following statements is *false* about resistors?

A. When connected in series, the conductance of two resistors adds.

B. The voltage across a resistor (positive or negative) is proportional to the current (positive or negative) flowing through the resistor.

C. The same amount of current that enters one end must leave the other.

D. If a constant voltage is across a resistor, the power dissipated as heat is proportional to that voltage squared.

E. If a constant current is flowing through a given resistor, the power dissipated as heat is proportional to that current squared.

48. The following is *not* true about voltage:

A. It is roughly analogous to pressure for water flow.

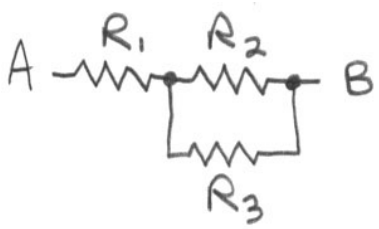
B. When measured across a resistor, it is linearly related to the current through that resistor by Ohm's law.

C. It can be considered for a single point in a circuit only relative to a reference point, normally called "ground."

D. It has only existed relatively recently, since the invention of batteries, generators, solar cells, etc.

E. It describes the energy required to move a unit charge from one place to another.

49. What is the resistance between points A and B, if $R_1 = 60\Omega$, $R_2 = 100\Omega$, and $R_3 = 100\Omega$?



A. 50Ω

B. 60Ω

C. 260Ω

D. 110Ω

E. 160Ω

50. A particular voltage divider with 12 V across it consists of two resistors in series. One resistor is 7 KΩ and the other is 17 KΩ. What is the voltage across the 17 KΩ resistor?

A. 0 V

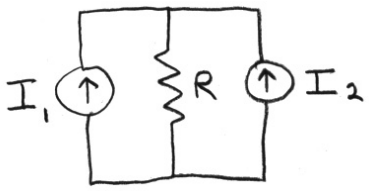
B. 6 V

C. 3.5 V

D. 8.5 V

E. 12 V

51. Given that $I_1 = 3$A, $I_2 = 5$A, and $R = 16\Omega$, what is the voltage across the resistor?



A. 2 V.

B. This circuit cannot exist because the currents conflict.

C. 32 V.

D. 128 V.

E. 0.5 V.

52. Given that $V = 5\text{V}$, $R_1 = 10\Omega$, $R_2 = 10\Omega$, what is the current through R_1?

A. 1 A.

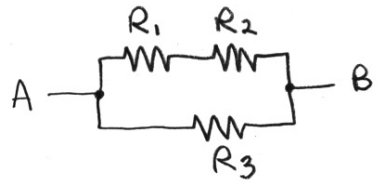
B. 500 mA.

C. 50 A.

D. 250 mA.

E. 25 A.

53. Given that, $R_1 = 20\text{K}\Omega$, $R_2 = 2\Omega$, and $R_3 = 20\text{M}\Omega$, what is the total resistance from point A to point B, to 2 orders of magnitude?



A. 20MΩ.

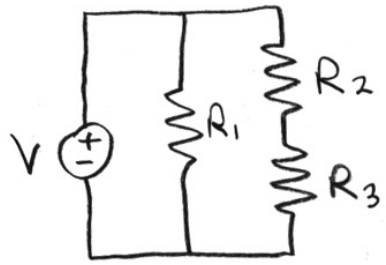
B. 20KΩ.

C. 10KΩ.

D. 10MΩ.

E. 2Ω.

54. Given that V = 10V, $R_1 = 5\text{K}\Omega$, $R_2 = 2\text{K}\Omega$, and $R_3 = 3\text{K}\Omega$, what is voltage across R_3?



A. 3V.

B. 12V.

C. 1V.

D. 2V.

E. 6V.

55. Regarding energy in electronic circuits, which of the following is *false* (or all are true)?

A. Energy is stored in a capacitor in the charge difference between the plates, as described by the equation $E = \frac{1}{2}CV^2$, and may be retrieved by discharging the capacitor.

B. Power (Energy/Time) in the form of heat is produced in a given resistor as described by the equation $P = I^2R$, and may not be efficiently retrieved as electrical power.

C. Energy is stored in a inductor in the magnetic field created by the current, as described by the equation $E = \frac{1}{2}LI^2$, and may be retrieved by harnessing the current to do work.

D. The energy stored in a battery is commonly stated in units of "ampere-hours", but the voltage of the battery must also be known to convert this into joules.

E. All are true.

56. A battery is measured as having a voltage of 9 V without any load attached. Then a 4 Ω resistor is attached across the battery's leads and 4 V is measured across that resistor. What is the internal resistance of the battery?

A. 9 Ω

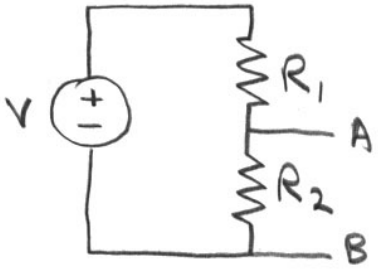
B. 1 Ω

C. 4 Ω

D. cannot be determined

E. 5 Ω

57. What is the Norton equivalent current from points A to B, if $R_1 = 30\Omega$, $R_2 = 60\Omega$, and V = 15V?



A. 500 mA.

B. 600 mA

C. 300 A.

D. 250 mA.

E. 900 A,

58. The following is *not* true about voltage, or all are true:

A. It describes the energy required to move a unit charge from one place to another.

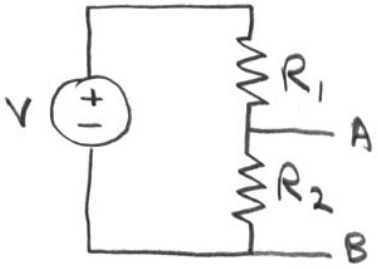
B. It is roughly analogous to pressure for water flow.

C. When measured across a resistor, it is linearly related to the current through that resistor by Ohm's law.

D. All are true.

E. It can be considered for a single point in a circuit only relative to a reference point, normally called "ground."

59. What are the Thevenin equivalent voltage T_V and Thevenin equivalent resistance T_R for the circuit between points A and B, if $R_1 = 10\Omega$, $R_2 = 10\Omega$, and V = 5V?



A. $T_V = 5\text{V}$; $T_R = 5\ \Omega$

B. $T_V = 2.5\text{V}$; $T_R = 5\ \Omega$

C. None of the other answers is correct.

D. $T_V = 2.5\text{V}$; $T_R = 10\ \Omega$

E. $T_V = 5\text{V}$; $T_R = 10\ \Omega$

60. A gasoline powered electric generator makes 1000 W of electric power for 10 minutes and then 500 W of electric power for 5 minutes. How many joules of electric energy are created in total?

A. 3.33 J

B. 750,000 J

C. 12,500 J

D. 200 J

E. None of the other answers are correct.

61. Which of the following is *not* true about the danger of electrocution?

A. Skin resistance is lowered by moisture, especially if there is salt dissolved in the moisture.

B. A smart behavior involves wearing rubber souled shoes and keeping one hand in the pocket, although this doesn't absolutely guarantee safety.

C. Although black is traditionally the color of the ground wire in electrical engineering, electricians typically use black for the "hot" line when wiring a house.

D. The cause of death is often cardiac fibrillation.

E. Skin resistance is high for 60 cycle/sec AC compared to other frequencies or DC, which accounts for its widespread use.

62. Which of the following is (are) true about *Kirchoff's current law*?

I - The sum of the currents entering a node equals the sum of the currents leaving the node..
II - The voltage at a node must always remain constant if the current through the node is constant.
III - At least at low frequencies, the number of electrons at a node cannot significantly build up at a node without creating a large voltage pushing back against them.

A. II and III

B. I, II, and III

C. II

D. I and II

E. I and III

63. Which of the following is (are) true about *superposition* in solving DC circuits

I - Each current source and voltage source is considered separately, setting all the others to zero, and the resulting currents are added.
II - Setting a source to zero means making a voltage source a short circuit and making a current source an open circuit.
III - Superposition relies on the fact that Ohm's law is linear, i.e., that currents add linearly with voltage, and cannot be relied upon to hold when non-linear components such as diodes are involved.

A. I and III

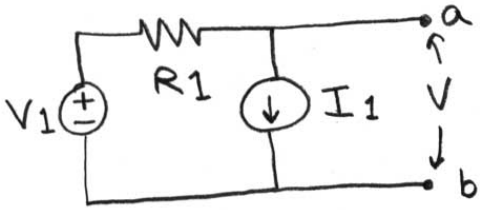
B. Only I

C. I, II, and III

D. II and III

E. I and II

64. What is the voltage between points a and b, given that $R_1 = 5\Omega$, $V_1 = 10\text{V}$, and $I_1 = 1\text{A}$?



A. None of the other answers is correct.

B. 0 V

C. 15 V

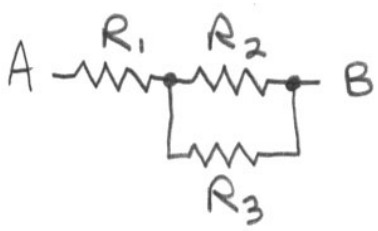
D. 10 V

E. 5 V

65. Multiplying volts × amperes × seconds yields units of

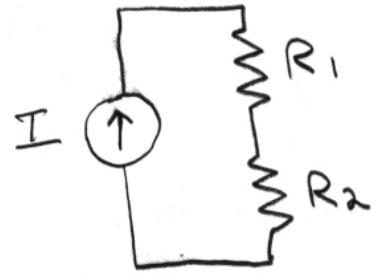
A. voltage
B. energy
C. power
D. charge
E. current

66. What is the resistance between points A and B, if $R_1 = 200\Omega$, $R_2 = 200\Omega$, and $R_3 = 200\Omega$?



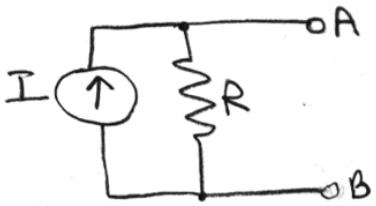
A. 300Ω
B. 100Ω
C. 400Ω
D. 600Ω
E. None of the other answers is correct.

67. What is the voltage across R_2 if $R_1 = 30\Omega$, $R_2 = 60\Omega$, and $I = 2mA$?



A. 180 mV
B. 30 mV
C. 120 mV
D. 120 V
E. 180 V

68. What are the Thevenin equivalent voltage T_V and Thevenin equivalent resistance T_R for the circuit between points A and B, if $R = 10\Omega$ and $I = 5\text{A}$?



A. $T_V = 5\text{V}$; $T_R = 2\Omega$

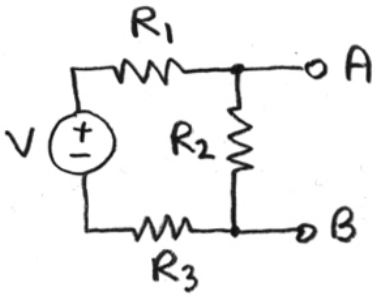
B. $T_V = 0.5\text{V}$; $T_R = 10\Omega$

C. $T_V = 50\text{V}$; $T_R = 10\Omega$

D. $T_V = 2\text{V}$; $T_R = 50\Omega$

E. None of the other answers is correct.

69. What is the voltage between points A and B, if $R_1 = 10\Omega$, $R_2 = 20\Omega$, $R_3 = 30\Omega$, and $\text{V} = 12\text{V}$?



A. None of the other answers is correct.

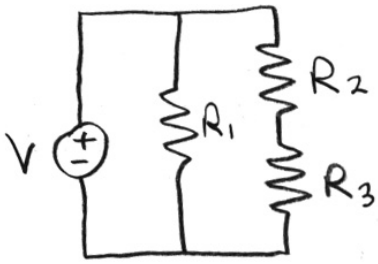
B. 6 V

C. 3 V

D. 4 V

E. 2 V

70. Given that $\text{V} = 10\text{V}$, $R_1 = 20\text{K}\Omega$, $R_2 = 10\text{K}\Omega$, and $R_3 = 10\text{K}\Omega$, what is the current through R_1?



A. 1 mA

B. 1.5 mA

C. 500 μA

D. 2 mA

E. 5 mA

71. How many joules does a 100 W soldering iron expend in 5 seconds?

A. 3000 J

B. 500 J

C. 20 J

D. Cannot be determined.

E. 50 mJ

72. The following are useful tips about safety and electricity, *except*

A. Barefoot and dripping from the beach is a bad time to change the lightbulb.

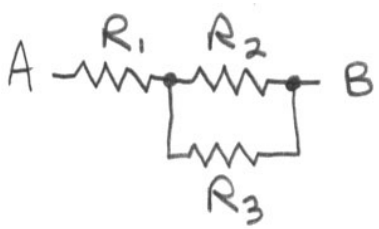
B. The green wire in house wiring is supposed to be connected to earth ground as a safety precaution, so that metal cabinets of electronic devices can be safely grounded.

C. Electricity usually kills by effecting the heart, so keep your heart out of the circuit.

D. Skin resistivity is lowered by water, especially salt water.

E. As long as both hands are touching the circuit somewhere, you are safe.

73. What is the resistance between points A and B, if $R_1 = 20$ MΩ, $R_2 = 20$ MΩ, and $R_3 = 10$ Ω? Calculate only to two significant digits.



A. 40 Ω

B. 30 MΩ

C. 20 MΩ

D. 10 MΩ

E. 10 Ω

74. The following is an appropriate thing to do the digital voltmeter in your PittKit.

A. Measure the resistance across a battery using the 'resistance' setting.

B. Measure the voltage at one point in a circuit with the red lead, using the 'voltage' setting, leaving the black lead disconnected as a "floating" reference.

C. Measure the voltage across a resistor among a collection of interconnected resistors and a battery plugged into a breadboard using the 'voltage' setting.

D. Leave the meter in the 'voltage' setting when you put it away at the end of the day.

E. Measure the resistance across a capacitor using the 'voltage' setting.

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BioE 1310 - Review DC Circuits 1/25/2010
Answer Sheet - Correct answer is A for all questions

1. The coulomb is a unit of

A. charge

B. voltage

C. current

D. energy

E. capacitance

Explanation: A coulomb is a certain amount of charge, the amount transported in 1 second by 1 ampere.
[*circuits0001.mcq*]

2. The following is *not* true about voltage:

A. It describes the number of electrons passing a certain point in a circuit over a given period of time.

B. It describes the energy required to move a unit charge from one place to another.

C. It is roughly analogous to pressure for water flow.

D. It can be considered for a single point in a circuit only relative to a reference point, normally called "ground."

E. When measured across a resistor, it is linearly related to the current through that resistor by Ohm's law.

Explanation: The number of electrons passing a certain point in a circuit over a given period of time is the current, not the voltage.
[*circuits0002.mcq*]

3. Any network of perfect voltage sources, perfect current sources, and resistors with two access points can be replaced with

A. A unique Thevenin equivalent with a single voltage source and a single resistor.

B. A single perfect voltage source by itself.

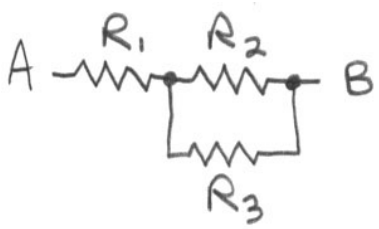
C. A variety of perfect current sources by themselves.

D. A single resistor by itself.

E. A Norton equivalent, but only if no voltage sources exist in the original network.

Explanation: A unique Thevenin equivalent exists for any such network. A Norton equivalent also exists, even if a voltage source exists in the original network.
[*circuits0003.mcq*]

4. What is the resistance between points A and B, if $R_1 = 10\Omega$, $R_2 = 40\Omega$, and $R_3 = 40\Omega$?



A. 30Ω

B. 90Ω

C. 10Ω

D. 20Ω

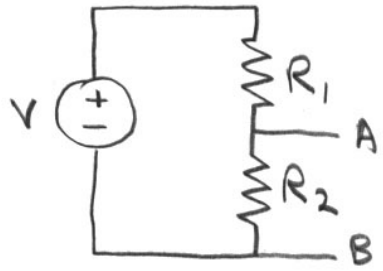
E. 50Ω

Explanation:

$$R_1 + \frac{R_2 R_3}{R_2 + R_3}$$

[*circuits0004.mcq*]

5. What is the voltage between points A and B, if $R_1 = 10\Omega$, $R_2 = 40\Omega$, and V = 5V?



A. 4V

B. 5V

C. 1V

D. 2V

E. 0V

Explanation:

$$V \frac{R_2}{R_1 + R_2}$$

[*circuits0005.mcq*]

6. The following is an appropriate thing to do the digital voltmeter in your PittKit.

A. Measure the resistance across a collection of interconnected resistors plugged into a breadboard using the 'resistance' setting

B. Measure the resistance across a battery using the 'resistance' setting

C. Measure the resistance across a capacitor using the 'voltage' setting

D. Leave the meter in the 'voltage' setting when you put it away at the end of the day

E. Measure the voltage at one point in a circuit with the red lead, using the 'voltage' setting, leaving the black lead disconnected as a "floating" reference.

Explanation:
[*circuits0007.mcq*]

7. How many joules does a 500 W toaster expend in 2 minutes?

A. 60,000 J

B. 1,000 J

C. 41.7 J

D. 250 J

E. Cannot be determined.

Explanation: 1 J = 1 W x 1 sec
[*circuits0008.mcq*]

8. The resistance of very thin piece of copper wire is 100 Ω. The resistance another piece of wire with twice the cross-sectional area and half the length is

A. 25 Ω.

B. 50 Ω.

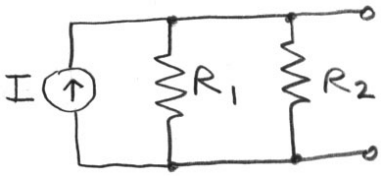
C. 100 Ω.

D. 200 Ω.

E. 400 Ω.

Explanation:
[*circuits0009.mcq*]

9. What are V_{thev} and R_{thev} for the Thevenin equivalent of the following circuit, if $R_1 = 100\ \Omega$, $R_2 = 100\ \Omega$, and I = 100 mA.



A. 5 V, 50 Ω

B. 5 V, 100 Ω

C. 50 V, 50 Ω

D. 500 mV, 200 Ω

E. 2.5 V, 50 Ω

Explanation: V_{thev} (the voltage with no load attached) is $I \times R_P$ where R_P is the resistance of R_1 in parallel with R_2. With the output shorted the current would be I, so $R_{thev} = \frac{V_{thev}}{I}$.
[*circuits0012.mcq*]

10. Which of the following is *not* a factor in the danger of electrocution?

A. direct current does not pass through the skin capacitance

B. skin resistance is lowered by moisture

C. cardiac fibrillation

D. whether the victim is wearing rubber souled shoes

E. at least two points of contact are required to complete a circuit with the body

Explanation:
[*circuits0013.mcq*]

11. The condition in a component when constant current is linearly related to constant voltage is governed by

A. Ohm's law.

B. Kirchhoff's current law.

C. Kirchhoff's voltage law.

D. Capacitance

E. Inductance

Explanation:
[*circuits0015.mcq*]

12. Energy is related to power as follows:

A. Energy is the integral of power.

B. Energy is the derivative of power.

C. Average energy is change in power.

D. None of the others is correct.

E. Energy is power divided by time.

Explanation:
[*circuits0018.mcq*]

13. Any circuit only containing resistors, perfect voltage sources, and perfect current sources

A. has a single solution in terms of the voltages and currents.

B. All of these are correct.

C. will exhibit superposition in terms of the effects of the current sources but not the voltage sources.

D. may exhibit AC voltages or currents.

E. will dissipate energy from each of the voltage and current sources.

Explanation:
[*circuits0019.mcq*]

14. A battery is measured as having a voltage of 9 V without any load attached. Then an 8 Ω resistor is attached across the battery's leads and 8 V is measured across that resistor. What value of resistor would you replace the 8 Ω resistor with to yield 7 V?

A. 3.5 Ω

B. 4 Ω

C. 2 Ω

D. 10.33 Ω

E. cannot be determined

Explanation:
[*circuits0020.mcq*]

15. The following are all true about Ohm's law, *except*

A. Ohm's law is absolutely true for all electronic components.

B. It describes a property called resistance, which is a fixed proportion of current to voltage for a particular component.

C. It has a strong analogy to the flow of water in a pipe due to the difference in pressure at the two ends of the pipe.

D. It was invented by George Ohm, whose name happens to sound like a particular Greek letter.

E. It says that, for a given resistance, the greater the voltage difference across a resistor, the greater the current.

Explanation: Ohm's law is only an approximation, and is only approximately true for components whose 'resistance' is said to be constant, i.e., in which current is proportional to the difference in voltage. It is a very good approximation in those components, but only those components.
[*circuits0058.mcq*]

16. The following are all true about voltage, *except*

A. It specifies the number of electrons passing through a component in a given period of time.

B. The voltage between 2 points is the energy required to move a unit charge between them.

C. A single point can only have a voltage relative to some other point. If not otherwise specified, that other point is often assumed to be 'ground'.

D. It can be constant, or it can vary with time.

E. In the plumbing analogy to circuits, voltage is roughly analogous to pressure.

Explanation: The number of electrons passing through a component in a given period of time is the current, not the voltage.
[*circuits0059.mcq*]

17. The following are useful tips about safety and electricity, *except*

A. Barefoot and dripping from the beach is an OK time to change the lightbulb.

B. Electricity usually kills by effecting the heart, so keep your heart out of the circuit.

C. It is safer to wear dry shoes with rubber soles.

D. Skin resistivity is lowered by water, especially salt water.

E. High voltage can cause tetanus, or muscle contraction, so you can't let go!

Explanation: It's not a joke. It kills more than 500 people every year in the USA.
[*circuits0060.mcq*]

18. The joule is a unit of

A. energy

B. voltage

C. current

D. charge

E. power

Explanation: A joule is a certain amount of energy or work, equal to 1 newton x 1 meter.
[*circuits0061.mcq*]

19. Kirchoff's current law states that for any given node in a circuit

A. the sum of the currents entering the node equals the sum of the currents leaving the node.

B. the voltage with respect to ground is the same as at every other node in the circuit.

C. electrons can pile up endlessly without effect.

D. there can only be one connection to one other node in the entire circuit.

E. the voltage at that node cannot be 0 with respect to ground.

Explanation: Because electrons are, in effect, non-compressible, they cannot build up at any given node appreciably, and all of the current entering the node must also leave it. A node may be at ground potential, so that Answer E is incorrect.
[*circuits0062.mcq*]

20. Kirchoff's voltage law states that

A. the sum of the voltages around any loop must equal zero.

B. voltage across a resistor divided by the resistance equals the current through the resistor.

C. power equals voltage times current.

D. voltage is best in Russia.

E. the current around any loop can never be zero.

Explanation: If there is no voltage difference across any of the components in the loop there will be no current, so answer E is false. Answer B is Ohm's law, and Answer C is the definition of power.
[*circuits0063.mcq*]

21. The power dissipated by a 10 Ω resistor with 5 V across it is

A. 2.5 W

B. 2 W

C. 50 W

D. 20 W

E. Cannot be determined from the data given.

Explanation: Power equals voltage times current, which, in a resistor, equals voltage squared over resistance.
[*circuits0064.mcq*]

22. Two resistors are in parallel with 20 V across both of them. Each resistor is 10 KΩ. What is the current through *one* of the resistors?

A. 2 mA

B. 1 mA

C. 5 mA

D. 4 mA

E. Cannot be determined from the data given.

Explanation: Since the same voltage is across each of the resistors, Ohm's law applies to each independently. The current through either of the resistors is 2 mA.
[*circuits0065.mcq*]

23. A particular voltage divider with 15 V across it consists of two resistors in series. One resistor is 20 Ω and the other is 10 Ω. What is the voltage across the 20 Ω resistor?

A. 10 V

B. 5 V

C. 0 V

D. 15 V

E. 7.5 V

Explanation: The voltage in a voltage divider is distributed among the resistors proportionally to the resistances.
[*circuits0066.mcq*]

24. Which of the following is *not* true about a perfect current source?

A. It delivers a fixed voltage irrespective of the other components in the circuit.

B. It has an effective impedance of infinity, since a change in voltage across it results in no change in current.

C. It guarantees a certain number of electrons per second irrespective of the voltage across it.

D. The only circuit that it cannot cope with is an open circuit.

E. It is capable of producing very large voltages.

Explanation: A current source delivers a fixed *current*, not a fixed *voltage*.
[*circuits0067.mcq*]

25. The Thevenin equivalent to a circuit containing resistors, current sources and voltage sources, with two access points

A. consists of a single voltage source in series with a resistance.

B. consists of a single voltage source in parallel with a resistance.

C. consists of a single current source in parallel with a resistance.

D. consists of a single current source in series with a resistance.

E. None of the other answers is correct.

Explanation: The Thevenin equivalent consists of a single voltage source in series with a resistance. A resistance in parallel would have no effect.
[*circuits0068.mcq*]

26. Which of the following is (are) true about *superposition* in solving DC circuits

I - Each current source and voltage source is considered separately, setting all the others to zero, and the resulting currents are added.
II - Setting a source to zero means making a voltage source a short circuit and making a current source an open circuit.
III - Superposition relies on the fact that Ohm's law is linear, i.e., that currents add linearly with voltage.

A. I, II, and III

B. I and II

C. II and III

D. I and III

E. Only I

Explanation: All three are true, Superposition relies on the linearity of the contributions from each of the sources with the others assuming their inherent resistance. A voltage source of 0 volts is a piece of wire; current flows without any voltage drop. A current source of 0 amps is an open connection, no current flows no matter what the voltage.
[*circuits0069.mcq*]

27. Two resistors are in parallel with 20 V across both of them. Each resistor is 10 KΩ. What is the current through *one* of the resistors?

A. 2 mA

B. 1 mA

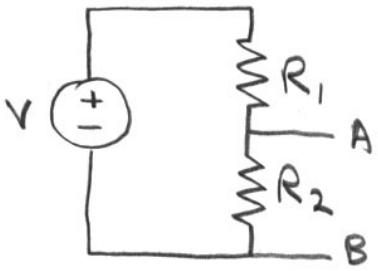
C. 5 mA

D. 4 mA

E. Cannot be determined from the data given.

Explanation: Since the same voltage is across each of the resistors, Ohm's law applies to each independently.
[*circuits0070.mcq*]

28. What is the voltage between points A and B, if $R_1 = 20\Omega$, $R_2 = 30\Omega$, and V = 15V?



A. 9V

B. 15V

C. 5V

D. 10V

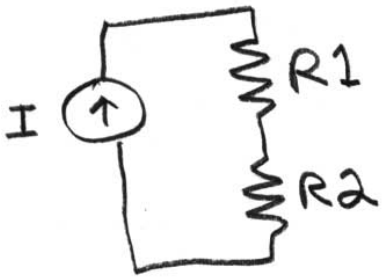
E. 0V

Explanation:

$$V\frac{R_2}{R_1 + R_2}$$

[*circuits0073.mcq*]

29. What is the voltage across R_1, given that $R_1 = 10K\Omega$, $R_2 = 5K\Omega$, and $I = 1mA$?



A. 10 V

B. 15 V

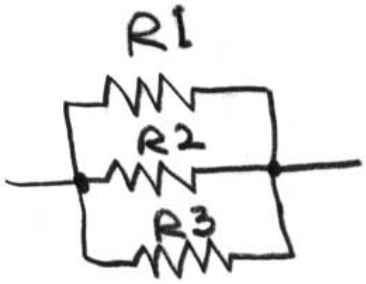
C. 5 mV

D. 10 mV

E. 15 mV

Explanation: Ohm's law, $V = IR$, applies for each resistor separately, because the same current I passes through both resistors (Kirchoff's curent law).
[*circuits0076.mcq*]

30. What is the resistance of the entire branch, given that $R_1 = 100K\Omega$, $R_2 = 100K\Omega$, and $R_3 = 50K\Omega$?



A. $R_1 = 25K\Omega$

B. $R_1 = 100K\Omega$

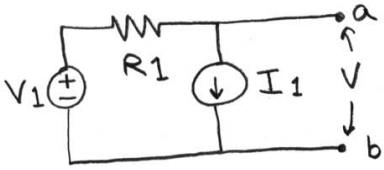
C. $R_1 = 250K\Omega$

D. $R_1 = 50K\Omega$

E. $R_1 = 200K\Omega$

Explanation: The two $100K\Omega$ resistors in parallel are equivalent to one $50K\Omega$ resistor, which in parallel with the other $50K\Omega$ is equivalent to a $25K\Omega$ resistor. Or take the reciprocal of each (the conductance), add them together and take the reciprocal.
[*circuits0077.mcq*]

31. What is the voltage between points a and b, given that $R_1 = 5\Omega$, $V_1 = 10\text{V}$, and $I_1 = 2\text{A}$?



A. 0 V

B. 10 V

C. 20 V

D. 25 V

E. Cannot be determined

Explanation: Using Kirchoff's current law, the current through the entire loop must be I_1. Using Kirchoff's voltage law, the voltage between points a and b is $V_1 - I_1 R_1$.
[*circuits0078.mcq*]

32. Which of the following is (are) true about *superposition* in solving DC circuits

I - Each current source and voltage source is considered separately, setting all the others to zero, and the resulting currents are added.
II - It may be accomplished by setting the voltage of the voltage source to zero (making it a short circuit), and setting the current of the current source to zero (making it an open circuit).
III - Superposition works even when some of the components are not linear in their relationship between voltage and current.

A. I and II

B. I, II, and III

C. II and III

D. I and III

E. Only I

Explanation: Superposition relies on the linearity of the contributions from each of the sources with the others assuming their inherent resistance. A voltage source of 0 volts is a piece of wire; current flows without any voltage drop. A current source of 0 amps is an open connection, no current flows no matter what the voltage.
[*circuits0079.mcq*]

33. The power dissipated by a 100 Ω resistor with 5 V across it is

A. 250 mW

B. 2.5 W

C. 20 W

D. 20 mW

E. 500 mW

Explanation: Power equals voltage times current, which, in a resistor, equals voltage squared over resistance.
[*circuits0080.mcq*]

34. Kirchoff's current law states that for any given node in a circuit

A. the sum of the currents entering the node equals the sum of the currents leaving the node.

B. the voltage with respect to ground is what is meant when no other reference point is specified.

C. when a current enters a node, electric charge accumulates without appreciable effect.

D. the voltages around a loop add to zero.

E. current times voltage equals resistance.

Explanation: Because electrons are, in effect, non-compressible, they cannot build up at any given node appreciably, and all of the current entering the node must also leave it. Answer B is correct, but not Kirchoff's current law. Answer D is correct but is Kirchoff's *voltage* law.
[*circuits0081.mcq*]

35. The following are useful tips about safety and electricity, *except*

A. As long as your feet are grounded you are safe.

B. Electricity usually kills by effecting the heart, so keep your heart out of the circuit.

C. Barefoot and dripping from the beach is a bad time to change the lightbulb.

D. Skin resistivity is lowered by water, especially salt water.

E. High voltage can cause tetanus, or muscle contraction, so you can't let go!

Explanation: Answer A is definitely false. If your hand touches a high voltage, having your feet grounded is very bad because your body (and heart) is now in the circuit. Electrocution kills more than 500 people every year in the USA.
[*circuits0082.mcq*]

36. Energy is related to power as follows:

A. Power is the derivative of energy with respect to time.

B. Energy is the derivative of power with respect to time.

C. Average energy over time is the change in power.

D. None of the others is correct.

E. Energy is power divided by time.

Explanation: Power (brightness of the lightbulb) is the derivative of energy (gas in the tank for the generator).
[*circuits0083.mcq*]

37. How many joules does a 25 W light bulb expend in 4 minutes?

A. 6,000 J

B. 100 J

C. 6.25 J

D. 104 mJ

E. Cannot be determined.

Explanation: 1 J = 1 W x 1 sec
[*circuits0085.mcq*]

38. A particular voltage divider with 5 V across it consists of two resistors in series. One resistor is 2 KΩ and the other is 500 Ω. What is the voltage across the 2 KΩ resistor?

A. 4 V

B. 1 V

C. 0 V

D. 5 V

E. The answer cannot be determined without knowing which order the resistors are in.

Explanation: The voltage in a voltage divider is distributed among the resistors proportionally to the resistances and independent of the order (since the same current passes through each of them).
[*circuits0087.mcq*]

39. A 3 V voltage source is connected in series with a 15 Ω resistor. The Norton equivalent

A. has a 200 mA current source in parallel with a 15 Ω resistor.

B. does not exist.

C. has a 200 mA current source in series with a 15 Ω resistor.

D. has a 5 A current source in series with a 15 Ω resistor.

E. has a 5 A current source in parallel with a 15 Ω resistor.

Explanation: The short circuit current is $3V/15\Omega$ and the Norton resistance is the same as the Thevenin resistance. The resistor in the Norton equivalent must be in parallel with the current source. A resistor in series with a current source has no effect.
[*circuits0089.mcq*]

40. A battery is measured as having a voltage of 9 V without any load attached. Then a 5 Ω resistor is attached across the battery's leads and 5 V is measured across that resistor. What is the internal resistance of the battery?

A. 4 Ω

B. 1 Ω

C. 9 Ω

D. 5 Ω

E. cannot be determined

Explanation: With the 5 Ω resistor attached the current is 1 A (because there is 5 V across the resistor). Therefore the remaining 4 volts must be across an internal resistance in the battery of 4 Ω.
[*circuits0090.mcq*]

41. The following is not true about current:

A. When measured across any electrical component, current is linearly related to the voltage through that component.

B. It describes the number of electrons passing a certain point per second.

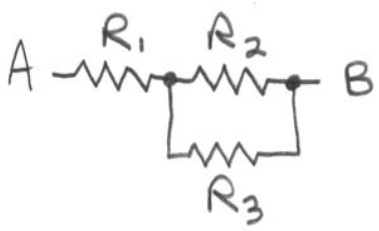
C. The unit of current is the Ampere, which equals 6.241×10^{18} electrons per second.

D. In general, it can be said to obey Kirchhoff's Current Law, which states that no charge accumulates at any given node in a circuit.

E. Its relationship to voltage across either a capacitor or inductor (coil) takes the form of a first order differential equation with respect to time.

Explanation: Only certain components are linear in their relationship between current and voltage. Ohm's law applies to certain components, generally called resistors. Coils and capacitors are linear as first order differential equations.
[*circuits0112.mcq*]

42. What is the resistance between points A and B, if $R_1 = 10$ MΩ, $R_2 = 40$ Ω, and $R_3 = 40$ MΩ? Calculate only to two significant digits.



A. 10 MΩ

B. 30 Ω

C. 50 MΩ

D. 30 MΩ

E. 40 Ω

Explanation: The total resistance is $R_1 + \frac{R_2 R_3}{R_2 + R_3}$. However, this can be simplified. Because $R_2 << R_3$, R_3 can be ignored, the total resistance becomes $R_1 + R_2$. But it can be simplified even more. Since $R_2 << R_1$, R_2 can be ignored, and the total resistance is simply R_1.
[*circuits0113.mcq*]

43. The following are true about safety and electricity, *except*

A. Alternating current (AC) is inherently safer than direct current (DC), which is why we use it to transmit power.

B. Electricity usually kills by effecting the heart, so electricians are taught to use one hand near a high voltage.

C. Hospital equipment often prevents direction connection between the patient-contacting equipment and 110 V by use of optical isolators and transformers.

D. Skin resistivity is lowered by water, especially salt water.

E. High voltage can cause muscle contraction preventing the victim from releasing the wire.

Explanation: AC is actually more dangerous than DC, because the skin impedance is lower at 60 Hz than at 0 Hz. We use AC because it permits the use of transformers to step-up and step-down the voltage for long range transmission.
[*circuits0123.mcq*]

44. The Norton equivalent to a circuit with two access points, containing resistors, current sources and voltage sources,

A. consists of a single current source in parallel with a resistance.

B. consists of a single voltage source in parallel with a resistance.

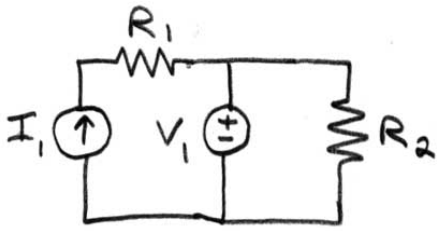
C. consists of a single current source in series with a resistance.

D. consists of a single voltage source in series with a resistance.

E. None of the other answers is correct.

Explanation: The Norton equivalent consists of a single current source in parallel with a resistance.
[*circuits0124.mcq*]

45. Regarding the following circuit, which of the following is (are) true?



I - The voltage across R_1 is $I_1 \times R_1$.
II - The current through R_2 is $\frac{V_1}{R_2}$.
III - Superposition holds for this circuit.

A. I, II, and III

B. I and II

C. I and III

D. II and III

E. None of the other answers is correct.

Explanation: Superposition can be used, by first setting the current source to 0 A (open circuit) and solving for the current through R_2 and then setting the voltage source to 0 V (short circuit) and solving for the voltage across R_1. Or one can simply realize that all the current from the current source must go through R_1, no more and no less, and the voltage across R_2 must be equal to the voltage source, no more and no less. Thus the two halves of the circuit are essentially independent.
[*circuits0128.mcq*]

46. How many joules does a 12 V car battery expend attempting to start a car during 5 seconds if the electric motor in the starter draws 10 amperes?

A. 600 J

B. 24 J

C. 4.17 J

D. 6.0 J

E. Cannot be determined.

Explanation: 1 J = 1 W x 1 sec = 1 V x 1 A x 1 sec.
[*circuits0133.mcq*]

47. Which of the following statements is *false* about resistors?

A. When connected in series, the conductance of two resistors adds.

B. The same amount of current that enters one end must leave the other.

C. The voltage across a resistor (positive or negative) is proportional to the current (positive or negative) flowing through the resistor.

D. If a constant current is flowing through a given resistor, the power dissipated as heat is proportional to that current squared.

E. If a constant voltage is across a resistor, the power dissipated as heat is proportional to that voltage squared.

Explanation: When connected in series, the *resistance* of two resistors adds.
[*circuits0134.mcq*]

48. The following is *not* true about voltage:

A. It has only existed relatively recently, since the invention of batteries, generators, solar cells, etc.

B. It describes the energy required to move a unit charge from one place to another.

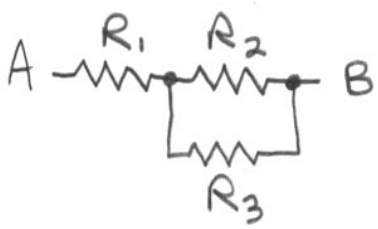
C. It is roughly analogous to pressure for water flow.

D. It can be considered for a single point in a circuit only relative to a reference point, normally called "ground."

E. When measured across a resistor, it is linearly related to the current through that resistor by Ohm's law.

Explanation: Lightening and neurons would disagree.
[*circuits0135.mcq*]

49. What is the resistance between points A and B, if $R_1 = 60\Omega$, $R_2 = 100\Omega$, and $R_3 = 100\Omega$?



A. 110Ω

B. 260Ω

C. 50Ω

D. 160Ω

E. 60Ω

Explanation:

$$R_1 + \frac{R_2 R_3}{R_2 + R_3}$$

[*circuits0136.mcq*]

50. A particular voltage divider with 12 V across it consists of two resistors in series. One resistor is 7 KΩ and the other is 17 KΩ. What is the voltage across the 17 KΩ resistor?

A. 8.5 V

B. 3.5 V

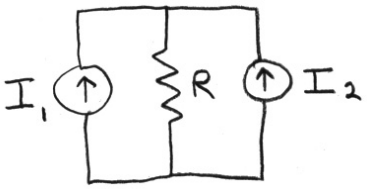
C. 0 V

D. 12 V

E. 6 V

Explanation: $12 \times \frac{17}{7+17}$
[*circuits0137.mcq*]

51. Given that $I_1 = 3\text{A}$, $I_2 = 5\text{A}$, and $R = 16\Omega$, what is the voltage across the resistor?



A. 128 V.

B. 0.5 V.

C. 2 V.

D. 32 V.

E. This circuit cannot exist because the currents conflict.

Explanation: The currents sum, since they are in parallel, and both go through the resistor, so $V = (I_1 + I_2) \times R$. If they were voltage sources instead of current sources, they would *indeed* conflict.
[*circuits0139.mcq*]

52. Given that $V = 5\text{V}$, $R_1 = 10\Omega$, $R_2 = 10\Omega$, what is the current through R_1?

A. 500 mA.

B. 250 mA.

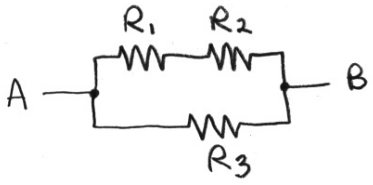
C. 50 A.

D. 1 A.

E. 25 A.

Explanation: The voltages on the two resistors in parallel must be the same, so the resistors have absolutely no effect on each other. Thus the current through R_1 is simply computed by Ohm's law, $I = \frac{V}{R_1}$.
[*circuits0140.mcq*]

53. Given that, $R_1 = 20\text{K}\Omega$, $R_2 = 2\Omega$, and $R_3 = 20\text{M}\Omega$, what is the total resistance from point A to point B, to 2 orders of magnitude?



A. 20KΩ.

B. 20MΩ.

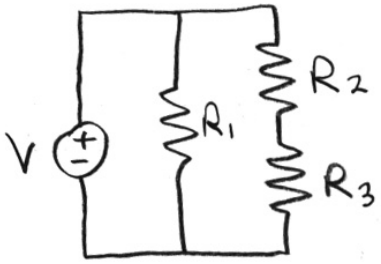
C. 2Ω.

D. 10KΩ.

E. 10MΩ.

Explanation: To 2 orders of magnitude, R_1 and R_2 in series are simply R_1, or 20KΩ. Putting R_3 in parallel doesn't change that significantly.
[*circuits0141.mcq*]

54. Given that V = 10V, $R_1 = 5\text{K}\Omega$, $R_2 = 2\text{K}\Omega$, and $R_3 = 3\text{K}\Omega$, what is voltage across R_3?



A. 6V.

B. 3V.

C. 12V.

D. 2V.

E. 1V.

Explanation: R_1 can be ignored since the same V will be across it and (R_2 R_3 in series). So it is a simple voltage divider with R_2 and R_3.
[*circuits0142.mcq*]

55. Regarding energy in electronic circuits, which of the following is *false* (or all are true)?

A. All are true.

B. Energy is stored in a capacitor in the charge difference between the plates, as described by the equation $E = \frac{1}{2}CV^2$, and may be retrieved by discharging the capacitor.

C. Energy is stored in a inductor in the magnetic field created by the current, as described by the equation $E = \frac{1}{2}LI^2$, and may be retrieved by harnessing the current to do work.

D. The energy stored in a battery is commonly stated in units of "ampere-hours", but the voltage of the battery must also be known to convert this into joules.

E. Power (Energy/Time) in the form of heat is produced in a given resistor as described by the equation $P = I^2R$, and may not be efficiently retrieved as electrical power.

Explanation: I kid you not.
[*circuits0150.mcq*]

56. A battery is measured as having a voltage of 9 V without any load attached. Then a 4 Ω resistor is attached across the battery's leads and 4 V is measured across that resistor. What is the internal resistance of the battery?

A. 5 Ω

B. 1 Ω

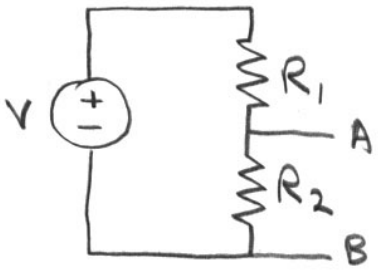
C. 9 Ω

D. 4 Ω

E. cannot be determined

Explanation: With the 4 Ω resistor attached the current is 1 A (because there is 4 V across the resistor). Therefore the remaining 5 volts must be across an internal resistance in the battery of 5 Ω.
[*circuits0151.mcq*]

57. What is the Norton equivalent current from points A to B, if $R_1 = 30\Omega$, $R_2 = 60\Omega$, and V = 15V?



A. 500 mA.

B. 300 A.

C. 250 mA.

D. 900 A,

E. 600 mA

Explanation: The Norton equivalent current can be obtained by shorting A to B and seeing how much current flows; Ohm's law with just R_1.
[*circuits0153.mcq*]

58. The following is *not* true about voltage, or all are true:

A. All are true.

B. It describes the energy required to move a unit charge from one place to another.

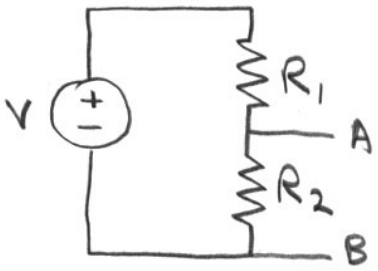
C. It is roughly analogous to pressure for water flow.

D. It can be considered for a single point in a circuit only relative to a reference point, normally called "ground."

E. When measured across a resistor, it is linearly related to the current through that resistor by Ohm's law.

Explanation: All are true.
[*circuits0170.mcq*]

59. What are the Thevenin equivalent voltage T_V and Thevenin equivalent resistance T_R for the circuit between points A and B, if $R_1 = 10\Omega$, $R_2 = 10\Omega$, and V = 5V?



A. $T_V = 2.5$V; $T_R = 5\ \Omega$

B. $T_V = 2.5$V; $T_R = 10\ \Omega$

C. $T_V = 5$V; $T_R = 5\ \Omega$

D. $T_V = 5$V; $T_R = 10\ \Omega$

E. None of the other answers is correct.

Explanation: T_V is the open circuit voltage, which is 2.5V. The short circuit current is 5V / 10 Ω = 0.5A. Therefore T_R = 2.5V / 0.5A = 5 Ω.
[*circuits0171.mcq*]

60. A gasoline powered electric generator makes 1000 W of electric power for 10 minutes and then 500 W of electric power for 5 minutes. How many joules of electric energy are created in total?

A. 750,000 J

B. 12,500 J

C. 200 J

D. 3.33 J

E. None of the other answers are correct.

Explanation: 1 J = 1 W x 1 sec
[*circuits0172.mcq*]

61. Which of the following is *not* true about the danger of electrocution?

A. Skin resistance is high for 60 cycle/sec AC compared to other frequencies or DC, which accounts for its widespread use.

B. Skin resistance is lowered by moisture, especially if there is salt dissolved in the moisture.

C. The cause of death is often cardiac fibrillation.

D. A smart behavior involves wearing rubber souled shoes and keeping one hand in the pocket, although this doesn't absolutely guarantee safety.

E. Although black is traditionally the color of the ground wire in electrical engineering, electricians typically use black for the "hot" line when wiring a house.

Explanation: Skin resistance is actually lower for 60 cycle/sec AC than DC, but its widespread use has still been adopted because of the ease with which it can be stepped up or down using transforms, permitting transmission over long distances and easy and efficient changes in voltage for low voltage appliances.
[*circuits0173.mcq*]

62. Which of the following is (are) true about *Kirchoff's current law*?

I - The sum of the currents entering a node equals the sum of the currents leaving the node..
II - The voltage at a node must always remain constant if the current through the node is constant.
III - At least at low frequencies, the number of electrons at a node cannot significantly build up at a node without creating a large voltage pushing back against them.

A. I and III

B. I and II

C. II and III

D. I, II, and III

E. II

Explanation: II is clearly not true, as when a capacitor is involved and the voltage can be increasing as the capacitor charges with a constant current.
[*circuits0174.mcq*]

63. Which of the following is (are) true about *superposition* in solving DC circuits

I - Each current source and voltage source is considered separately, setting all the others to zero, and the resulting currents are added.
II - Setting a source to zero means making a voltage source a short circuit and making a current source an open circuit.
III - Superposition relies on the fact that Ohm's law is linear, i.e., that currents add linearly with voltage, and cannot be relied upon to hold when non-linear components such as diodes are involved.

A. I, II, and III

B. I and II

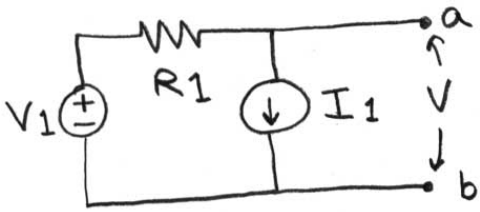
C. II and III

D. I and III

E. Only I

Explanation: All three are true, Superposition relies on the linearity of the contributions from each of the sources with the others assuming their inherent resistance. A voltage source of 0 volts is a piece of wire; current flows without any voltage drop. A current source of 0 amps is an open connection, no current flows no matter what the voltage. III is true because the currents and voltages from the different sources cannot "ignore each other" if non-linear components are involved.
[*circuits0175.mcq*]

64. What is the voltage between points a and b, given that $R_1 = 5\Omega$, $V_1 = 10\text{V}$, and $I_1 = 1\text{A}$?



A. 5 V

B. 10 V

C. 15 V

D. 0 V

E. None of the other answers is correct.

Explanation: Using Kirchoff's current law, the current through the entire loop must be I_1. Using Kirchoff's voltage law, the voltage between points a and b is $V_1 - I_1 R_1$.
[*circuits0176.mcq*]

65. Multiplying volts × amperes × seconds yields units of

A. energy

B. voltage

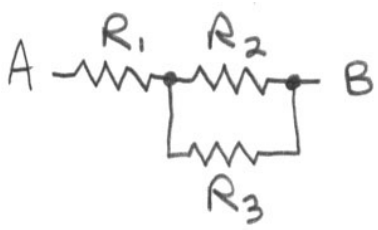
C. current

D. charge

E. power

Explanation:
1 watt = 1 ampere × 1 volt
1 joule = 1 watt × 1 second
[*circuits0196.mcq*]

66. What is the resistance between points A and B, if $R_1 = 200\Omega$, $R_2 = 200\Omega$, and $R_3 = 200\Omega$?



A. 300Ω

B. 600Ω

C. 100Ω

D. 400Ω

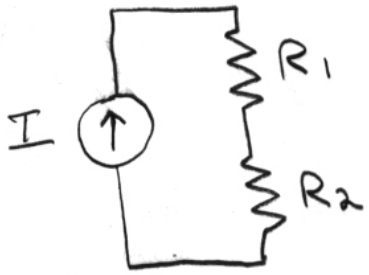
E. None of the other answers is correct.

Explanation:

$$R_1 + \frac{R_2 R_3}{R_2 + R_3}$$

[*circuits0197.mcq*]

67. What is the voltage across R_2 if $R_1 = 30\Omega$, $R_2 = 60\Omega$, and $I = 2mA$?



A. 120 mV

B. 180 mV

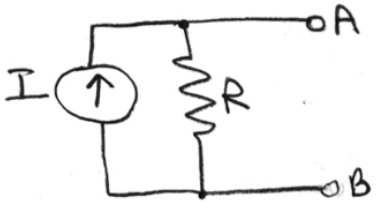
C. 120 V

D. 180 V

E. 30 mV

Explanation: Kirchhoff's Current Law says the same current, I, must pass through both resistors, so the value of R_1 is irrelevant and the voltage across R_2 is simply $I \times R_2$.
[*circuits0198.mcq*]

68. What are the Thevenin equivalent voltage T_V and Thevenin equivalent resistance T_R for the circuit between points A and B, if $R = 10\Omega$ and $I = 5$A?



A. $T_V = 50$V; $T_R = 10\Omega$

B. $T_V = 0.5$V; $T_R = 10\Omega$

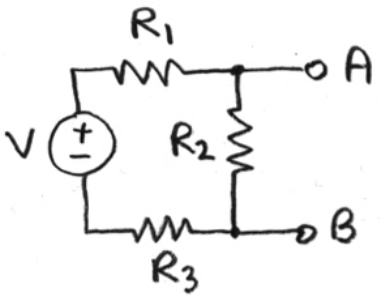
C. $T_V = 2$V; $T_R = 50\Omega$

D. $T_V = 5$V; $T_R = 2\Omega$

E. None of the other answers is correct.

Explanation: T_V is the open circuit voltage, which is $I \times R$. Since the circuit is, itself, the Norton equivalent, the resistance is simply R (the same resistance for both the Thevenin and Norton equivalents. Alternatively, the short circuit current is I, since all of the current will run through the short circuit and none through R, and the Thevenin resistance is $T_V/I = R$.
[*circuits0199.mcq*]

69. What is the voltage between points A and B, if $R_1 = 10\Omega$, $R_2 = 20\Omega$, $R_3 = 30\Omega$, and V = 12V?



A. 4 V

B. 3 V

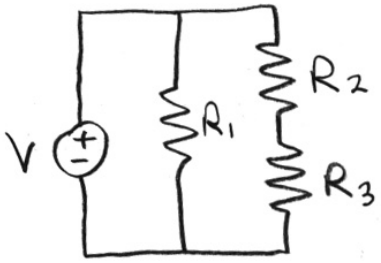
C. 2 V

D. 6 V

E. None of the other answers is correct.

Explanation: The current is $I = \frac{V}{R_1+R_2+R_3}$ and the voltage between A and B is $I \times R_2$.
[*circuits0200.mcq*]

70. Given that V = 10V, $R_1 = 20\text{K}\Omega$, $R_2 = 10\text{K}\Omega$, and $R_3 = 10\text{K}\Omega$, what is the current through R_1?



A. 500 μA

B. 1 mA

C. 2 mA

D. 1.5 mA

E. 5 mA

Explanation: R_2 and R_3 can be ignored since the same V will be across them (in series) and R_1. So the current through R_1 is simply $I = V/R_1$
[*circuits0202.mcq*]

71. How many joules does a 100 W soldering iron expend in 5 seconds?

A. 500 J

B. 3000 J

C. 20 J

D. 50 mJ

E. Cannot be determined.

Explanation: 1 J = 1 W x 1 sec
[*circuits0204.mcq*]

72. The following are useful tips about safety and electricity, *except*

A. As long as both hands are touching the circuit somewhere, you are safe.

B. Electricity usually kills by effecting the heart, so keep your heart out of the circuit.

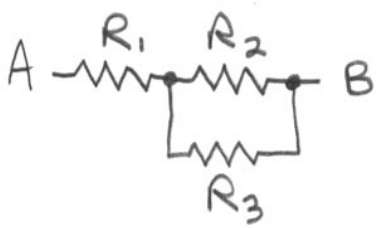
C. Barefoot and dripping from the beach is a bad time to change the lightbulb.

D. Skin resistivity is lowered by water, especially salt water.

E. The green wire in house wiring is supposed to be connected to earth ground as a safety precaution, so that metal cabinets of electronic devices can be safely grounded.

Explanation: Answer A is definitely false. If your each hand touches the circuit, a current could be generated across your heart. Electrocution kills more than 500 people every year in the USA.
[*circuits0205.mcq*]

73. What is the resistance between points A and B, if $R_1 = 20$ MΩ, $R_2 = 20$ MΩ, and $R_3 = 10$ Ω? Calculate only to two significant digits.



A. 20 MΩ

B. 10 Ω

C. 10 MΩ

D. 30 MΩ

E. 40 Ω

Explanation: The total resistance is $R_1 + \frac{R_2 R_3}{R_2 + R_3}$. However, this can be simplified. Because $R_3 << R_2$, R_2 can be ignored, the total resistance becomes $R_1 + R_3$. But it can be simplified even more. Since $R_3 << R_1$, R_3 can be ignored, and the total resistance is simply R_1.
[*circuits0206.mcq*]

74. The following is an appropriate thing to do the digital voltmeter in your PittKit.

A. Measure the voltage across a resistor among a collection of interconnected resistors and a battery plugged into a breadboard using the 'voltage' setting.

B. Measure the resistance across a battery using the 'resistance' setting.

C. Measure the resistance across a capacitor using the 'voltage' setting.

D. Leave the meter in the 'voltage' setting when you put it away at the end of the day.

E. Measure the voltage at one point in a circuit with the red lead, using the 'voltage' setting, leaving the black lead disconnected as a "floating" reference.

Explanation: The "resistance" setting should only be used for measuring passive resistance of a resistor or network of resistors. Our meter does not have an automatic shut-off, so the battery will drain if you don't leave it in the off position (D is wrong). Unless both leads are connected to the circuit, voltage between them is meaningless (E is wrong).
[*circuits0207.mcq*]