Circuit Lab C - Pearl City Invitational - Circuit Lab C - Pearl City Invitational - 12-12-2020

1. (0.00 pts) School and Team Name

2. (0.00 pts) Team Number

3. (0.00 pts) Student Names

4. (1.00 pts) Which of the following scientists discovered that the sum of the **voltages** in a closed circuit is equal to zero?

- A) Andre-Marie Ampere
- B) Charles-Augustin de Coulomb
- C) Gustav Kirchhoff
- D) Alessandro Volta
- E) Georg Ohm
- F) Nikola Tesla

5. (1.00 pts) Which of the following scientists discovered the electromagnetic interaction between two parallel wires carrying electrical currents?

- A) Michael Faraday
- B) Andre-Marie Ampere
- C) Charles-Augustin de Coulomb
- D) Gustav Kirchhoff
- E) Alessandro Volta
- F) Georg Ohm

6. (1.00 pts) Which of the following scientists discovered that the sum of currents entering a fixed point in the circuit equals to the sum of currents leaving the same point?

- A) Nikola Tesla
- B) Michael Faraday
- C) Andre-Marie Ampere
- D) Charles Augustin de Coulomb
- E) Gustav Kirchhoff
- F) Alessandro Volta

7. (1.00 pts) Which of the following scientists discovered the relationship between the electromotive force and the magnitude of current and resistance in a circuit?

- A) Georg Ohm
- B) Nikola Tesla
- C) Michael Faraday
- D) Andre-Marie Ampere
- E) Charles-Augustin de Coulomb
- F) Gustav Kirchhoff

8. (1.00 pts) Which of the following scientists discovered that the electric field inside of a closed conductor is zero?

- A) Alessandro Volta
- B) Georg Ohm
- C) Nikola Tesla
- D) Michael Faraday
- E) Andre-Marie Ampere
- F) Charles-Augustin de Coulomb

9. (1.00 pts) Which of the following scientists invented one of the first electrochemical cells?

- A) Gustav Kirchhoff
- B) Alessandro Volta
- C) Georg Ohm
- D) Nikola Tesla
- E) Michael Faraday
- F) Andre-Marie Ampere

10. (1.00 pts) Which of the following scientists discovered that the strength of the force between two charges was proportional to the magnitude of both charges?

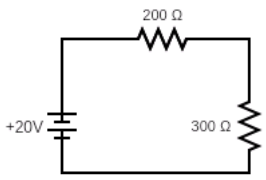
- A) Charles-Agustin de Coulomb
- B) Gustav Kirchhoff
- C) Alessandro Volta
- D) Georg Ohm
- E) Nikola Tesla
- F) Michael Faraday

11. (1.00 pts) Which of the following is the unit of electromagnetic force?

- A) Newton
- B) Coulomb
- C) Newton-Coulomb
- D) Newton per Coulomb
- E) Volt
- F) Watt

12. (1.00 pts) Which of the following is the unit for electrical conductivity?

- A) Ohm
- B) Ohm-meter
- C) Siemen
- D) Siemen-meter
- E) Farad
- F) Farad-meter



Use the image above to answer questions 13 -16.

13. (1.00 pts) What is the equivalent resistance of the circuit?

- A) 120 v
- B) 200 Ω
- C) 250 Ω
- D) 300 Ω
- E) 500 Ω
- F) None of the above

14. (1.00 pts) What is the current going through the 300 Ω resistor?

- A) 0.0400 mA
- B) 0.0667 mA
- C) 1.00 mA
- D) 40.0 mA

E) 66.7 mA

F) None of the above

15. (1.00 pts) What is the electrical potential difference across the 200 Ω resistor?

A) 0.04 V

B) 8 V

C) 12 V

D) 20 V

E) 4000 V

F) None of the above

16. (1.00 pts) What is the power dissipated by the 200 Ω resistor?

A) 0 mW

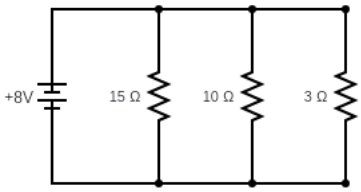
B) 16 mW

C) 64 mW

D) 320 mW

E) 6400 mW

F) None of the above



Use the image above to answer questions 17-21.

17. (1.00 pts) What is the equivalent resistance of the circuit?

A) 0.5 Ω

B) 2 Ω

C) 10 Ω

D) 28 Ω

E) 450 Ω

F) None of the above

18. (1.00 pts) What is the total current flowing from the battery?

A) 0.0178 A

B) 0.286 A

C) 2.0 A
D) 4.0 A
E) 16 A
F) None of the above

19. (1.00 pts) What is the electric potential difference across the 15 Ω resistor?

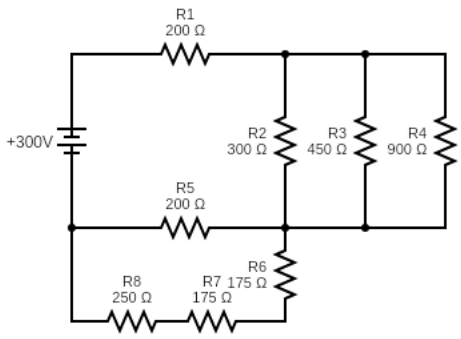
A) 0 V
B) 2.0 V
C) 8.0 V
D) 16 V
E) 60 V
F) None of the above

20. (1.00 pts) What is the current flowing through the 10 Ω resistor?

A) 0.8 A
B) 1.0 A
C) 4.0 A
D) 10 A
E) 22.4 A
F) None of the above

21. (1.00 pts) How much power is dissipated from the entire circuit?

A) 0 W
B) 2 W
C) 8 W
D) 16 W
E) 32 W
F) None of the above



Use the image above to answer questions 22 - 27.

22. (2.00 pts) What is the equivalent resistance of the entire circuit?

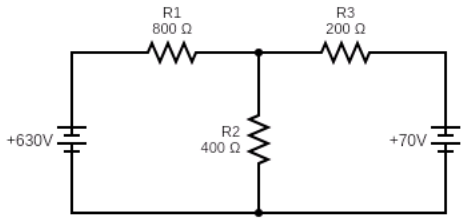
23. (2.00 pts) What is the voltage across resistor R1?

24. (2.00 pts) What is the current running through resistor R2?

25. (2.00 pts) What is the voltage across resistor R3?

26. (2.00 pts) What is the voltage across R5?

27. (2.00 pts) What is the power dissipated across resistors R6, R7, and R8?

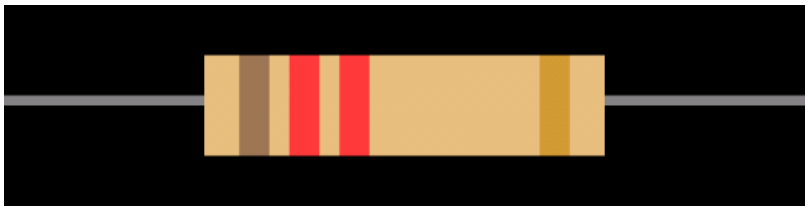


Use the image above to answer questions 28 - 30.

28. (2.00 pts) What is the current running through resistor R1?

29. (2.00 pts) What is the voltage running across resistor R2?

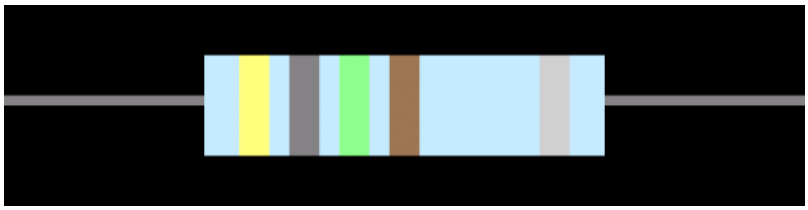
30. (2.00 pts) How much power is dissipated from resistor R3?



Use the image above to answer questions 31 & 32.

31. (1.00 pts) What is the resistance of the resistor?

32. (1.00 pts) What is the tolerance of the resistor?

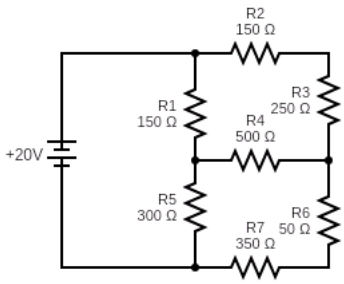


Use the image above to answer questions 33 & 34.

33. (2.00 pts)
If this resistor was connected to a 20.0 Volt battery, what would you expect the current running through the resistor to be (express your answer in terms of milliamps rounded to the nearest hundredth).

34. (2.00 pts) What is the highest possible resistance value this resistor may have?

35. (2.00 pts)
You hook up a resistor to a 12 Volt battery and find that the current running through the circuit is 16.0 mA. What are the colors of the first four bands assuming it is a five-band resistor?



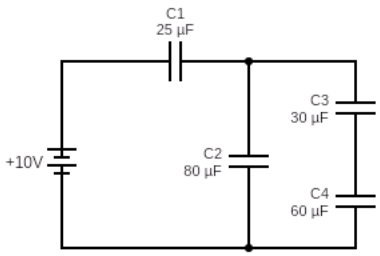
Use the image above to answer questions 36 - 39.

36. (3.00 pts) What is the equivalent resistance of the circuit? *Round your answer to three significant figures.*

37. (3.00 pts) What is the voltage across resistor R1? *Round your answer to three significant figures.*

38. (3.00 pts) What is the current running through resistor R4? *Round your answer to three significant figures.*

39. (5.00 pts) What is the total power dissipated from resistors R2, R4, and R6? *Round your answer to three significant figures.*



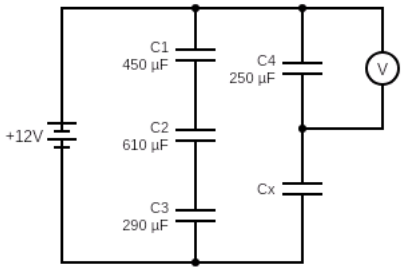
Use the image above to answer questions 40 - 43.

40. (2.00 pts) What is the equivalent capacitance of the circuit?

41. (2.00 pts) What is the charge going through capacitor C1?

42. (2.00 pts) How much energy is stored in capacitor C2?

43. (2.00 pts) What is the voltage across capacitors C3 and C4?



Use the image above to answer questions 44 - 48.

44. (2.00 pts) If the voltmeter reads 4 Volts across capacitor C4, what is the capacitance of capacitor C_x? *Round your answer to three significant figures.*

45. (3.00 pts) Using the value you computed from your previous answer, what is the total capacitance of the circuit? *Round your answer to three significant figures.*

46. (2.00 pts) How much charge is stored in capacitor C4? *Round your answer to three significant figures.*

47. (2.00 pts) How much energy is stored in capacitor C4? *Round your answer to three significant figures.*

48. (2.00 pts)
Suppose that capacitor C_X is a parallel plate capacitor with a distance of 6.25 mm between the two plates. What is the magnitude of the strength of the electric field inside the capacitor?

49. (1.00 pts)
A charge ***Q*** produces an electric field of some magnitude ***d*** centimeters away. What will happen to the magnitude of the electric field if the charge magnitude and distance are both doubled?

- A) It will be **1/4 times** as much
- B) It will be **1/2 times** as much
- C) It will be **2 times** as much
- D) It will be **4 times** as much
- E) It will be **8 times** as much
- F) It will remain **unchanged**

50. (1.00 pts)
A certain source charge produces an electric field of 2.0 N/C at a point 4.0 cm away from the charge. What is the magnitude of the electric field 10 cm away from the same source charge?

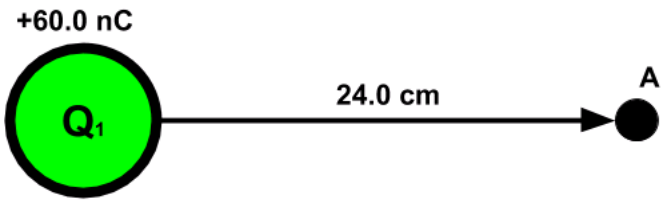
- A) 0.32 N/C
- B) 0.80 N/C
- C) 2.0 N/C
- D) 5.0 N/C
- E) 12.5 N/C
- F) 20 N/C

51. (1.00 pts)
Two charges, Q_1 and Q_2, are d centimeters apart. The electric field of Q_1 exerts some force on Q_2. If both charges tripled in magnitude and the distance between them tripled, by what factor would -

A) It will be **1/9 times** as much
B) It will be **1/3 times** as much
C) It will be **3 times** as much
D) It will be **9 times** as much
E) It will be **27 times** as much
F) It will remain **unchanged**

52. (1.00 pts) Consider the situation given in the previous question. How will the magnitude of the strength of the electric field produced by Q_1 be affected?

A) It will be **1/9 times** as much
B) It will be **1/3 times** as much
C) It will be **3 times** as much
D) It will be **9 times** as much
E) It will be **27 times** as much
F) It will remain **unchanged**



Use the image above to answer questions 53 - 57.

53. (2.00 pts) What is the strength of the electric field produced by Q_1 at point A?

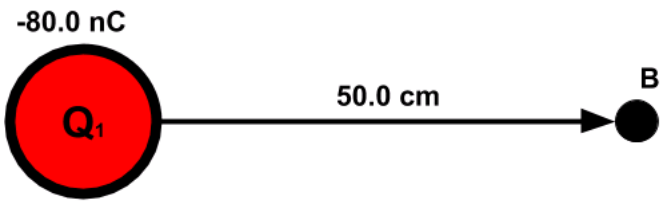
54. (2.00 pts) What is the electric potential at point A?

55. (2.00 pts) Suppose an electron is placed at point A. What is the magnitude of the force between these two charges (use e = 1.60 x 10^-19 C for elementary charge)?

56. (1.00 pts) True/False: The two charges will repel each other.

○ True ○ False

57. (2.00 pts) Given that an electron sits at point A, what is the electric potential energy between the two charges?



Use the image above to answer questions 58 - 64.

58. (2.00 pts) What is the strength of the electric field produced by Q_1 at point B?

59. (1.00 pts) What do the electric field lines of Q_1 look like?

○ A) Rotate clockwise around the charge
○ B) Rotate counterclockwise around the charge
○ C) Flow into the charge
○ D) Flow away from the charge
○ E) There are no electric field lines for the charge

60. (2.00 pts) What is the electric potential at point B?

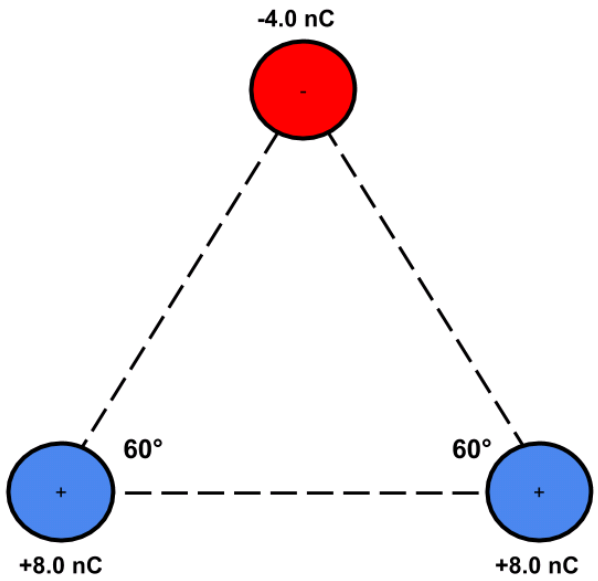
61. (2.00 pts) Suppose an object of negligible volume with a charge of -20.0 nC (called Q_2 is placed at point B). What is the force between Q_1 and Q_2?

62. (1.00 pts) True/False: The electric field lines of the two charges will intersect four-fifths of the way from Q_1 to Q_2.

○ True ○ False

63. (2.00 pts) What is the electric potential energy between the two charges?

64. (3.00 pts) How much work would need to be applied to Q_2 in order for the distance between the two charges to be shortened to 15.0 cm?



Use the image above to answer questions 65 & 66.

65. (1.00 pts) What direction is the force that the two positive charges exert on the negative charge?

○ A) To the left
○ B) To the right
○ C) Downwards
○ D) Upwards
○ E) Out of the screen
○ F) Into the screen

66. (4.00 pts) What is the magnitude of the force being exerted on the negative charge as a result from the two positive charges? *Use the proper amount of significant figures.*

67. (1.00 pts) When properly taking measurements of a circuit, an ammeter will be connected in _____ while a voltmeter will be connected in _____.

- A) Series; Series
- B) Series; Parallel
- C) Parallel; Series
- D) Parallel; Parallel
- E) A what and a what?

68. (1.00 pts) In an ideal situation, an ammeter will have a resistance of _____ and a voltmeter will have a resistance of _____.

- A) Zero; Zero
- B) Zero; Infinity
- C) Infinity; Zero
- D) Infinity; Infinity
- E) wait what

69. (1.00 pts) True/False: Electrocution is more dangerous when your skin is dry.

- True
- False

70. (2.00 pts) Which of these are advantages of alternating current over direct current? (all or nothing)

(Mark **ALL** correct answers)

- [ ] A) Cheaper
- [ ] B) Easier to store
- [ ] C) More consistent with supplying power to devices
- [ ] D) Better for long distance transmission
- [ ] E) Less dangerous

71. (2.00 pts) What are the two main roles of a transformer for long distance transmission of electricity?

72. (1.00 pts) A certain transformer has 150 turns in the primary coil and 60 turns in the secondary coil. What is the output voltage if the primary voltage is 480 V?

A) 192 V
B) 1200 V
C) 28,800 V
D) 43,200 V
E) 72,000 V

73. (1.00 pts) Consider the transformer mentioned in the previous question. What is the output current if the primary current is 2.6 A?

A) 1.04 A
B) 6.5 A
C) 156 A
D) 182 A
E) 390 A

74. (2.00 pts)
You have an AC supply of 1500 volts that you want to step down using a transformer. If the primary side has 200 turns, how many turns should you have on the secondary coil if you want the voltage to be stepped down to 120 volts?

75. (1.00 pts) True/False: Transformers **only** work for AC.

True False

76. (1.00 pts)
Consider two wires carrying current are placed next to each other. If the two currents move in the same direction, then the two wires will _____ each other. If they move in opposite directions, then the two wires will _____ each other

A) Repel; Repel
B) Repel; Attract
C) Attract; Repel
D) Attract; Attract
E) Not interact; Repel
F) Not interact; Not interact

77. (1.00 pts)
Consider two wires placed next to each other with currents running through them in opposite directions (Wire 1 runs north and Wire 2 runs south). Wire 1 exerts a force of ***F*** on Wire 2 due to its magnetic field. What will the force Wire 1 exerts on Wire 2 be if both currents are doubled?

A) ***F/4***
B) ***F/2***
C) ***2F***
D) ***4F***
E) ***8F***

F) No change

78. (1.00 pts)
Consider two wires placed next to each other with currents running through them in opposite directions (Wire 1 runs north and Wire 2 runs south). Wire 1 exerts a force of ***F*** on Wire 2 due to its magnetic field. What will the force Wire 1 exerts on Wire 2 be if the distance between them is tripled?

A) ***F/9***
B) ***F/3***
C) ***3F***
D) ***9F***
E) ***27F***
F) No Change

79. (1.00 pts)
Let's say you are trying to make an electromagnetic by wrapping a current-carrying wire around an iron nail. If you are looking down on the nail from the head and start wrapping the wire at the head, would you wrap it clockwise or counterclockwise if you want the tip of the nail to be the North Pole?

A) Clockwise
B) Counterclockwise
C) An electromagnetic cannot be created this way
D) I don't want to make an electromagnet

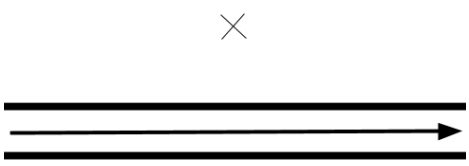
80. (1.00 pts) If the tip of the nail is the north pole of the electromagnet, what do the magnetic field lines coming from the tip look like?

A) They move into the tip
B) They move away from the tip
C) They rotate clockwise around the tip
D) They rotate counterclockwise around the tip
E)

81. (1.00 pts) If you wanted to change the strength of the magnetic field, which of the following changes would have no effect on changing the strength of the magnetic field?

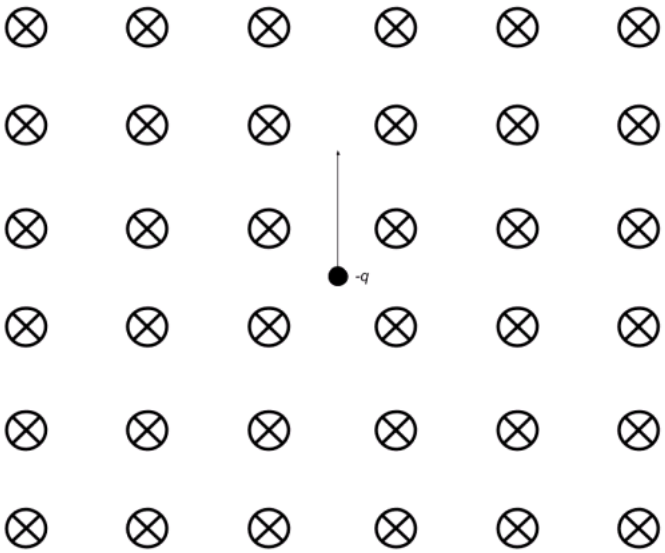
A) Changing the material of the nail
B) Changing the current running through the wire
C) Changing the number of coils around the nail
D) Changing the length of the nail
E) All of these will change the magnitude of the magnetic field

82. (1.00 pts)



The image above shows a wire carrying a current (moving from left to right). At the point marked with an X, which direction is the magnetic field moving?

- A) Toward the left
- B) Toward the right
- C) Toward the top of the screen
- D) Toward the bottom of the screen
- E) Out of the screen
- F) Into the screen



The image above depicts an electron in a magnetic field. Use the image above to answer questions 83 - 86.

83. (1.00 pts) The arrow on the electron represents the velocity of the particle. What direction is the force acting on the electron?

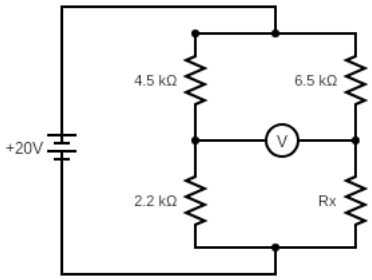
- A) To the left
- B) To the right
- C) Toward the top of the screen
- D) Toward the bottom of the screen
- E) Out of the screen
- F) Into the screen

84. (2.00 pts) How would the previous answer be different if it was a proton instead of an electron?

- A) To the left
- B) To the right
- C) Toward the top of the screen
- D) Toward the bottom of the screen
- E) Out of the page
- F) Into the page

85. (3.00 pts)
The magnetic field depicted has a magnetic flux density of 12.0 Tesla. If the electron is moving at the speed of light (3.00 x 10^8 m/s), what is the magnitude of the force that the magnetic field applies onto the electron (e = 1.60 x 10^-19 C)? *Use proper significant figures in your answer.*

86. (4.00 pts)
Given the information above, the electron moves in a certain circular path within the magnetic field. What is the radius of this path (Hint: Mass of an electron = 9.11 x 10^-31 kg)? *Use proper significant figures in your answer.*

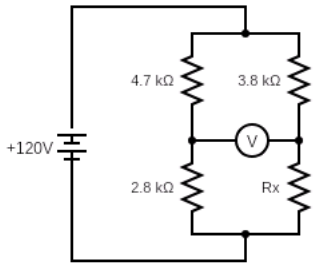


Use the image above to answer questions 87 - 89.

87. (1.00 pts) What is the particular circuit shown called?

88. (3.00 pts) If the reading on the volt meter is 0 Volts, what is the value of R_X?

89. (3.00 pts) What is the equivalent resistance of the circuit?

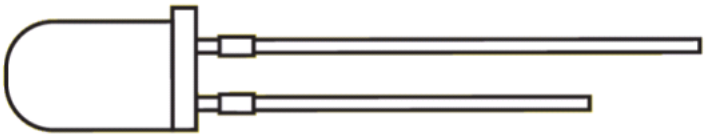


Use the image above to answer questions 90 & 91.

90. (4.00 pts) If the reading on the voltmeter in the circuit is 16.0 Volts, what is the value of resistor R_x?

91. (3.00 pts) What is the equivalent resistance of this circuit?

92. (1.00 pts)



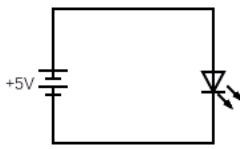
The image shown above is an LED. What does LED stand for?

93. (1.00 pts) What is the long end called?

94. (1.00 pts) What is the short end called?

95. (2.00 pts) Which end of the LED connects to which part of the battery?

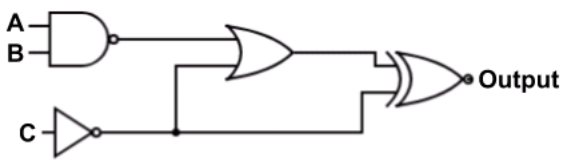
96. (3.00 pts)



Hermary connects an LED into a circuit that looks like this. She eventually finds that the LED quickly broke. Please tell Hermary what she did wrong

97. (3.00 pts) Please explain the difference between conventional current and electron flow.

98. (1.50 pts)



Use the logic gate shown above to write the outputs of the following combinations:

1) A = 0; B = 0; C = 0

2) A = 0; B = 0; C = 1

3) A = 0; B = 1; C = 0

99. (1.50 pts) Use the logic gate shown above to write the outputs of the following combinations:

1) A = 1; B = 0; C = 0

2) A = 0; B = 1; C = 1

3) A = 1; B = 0; C = 1

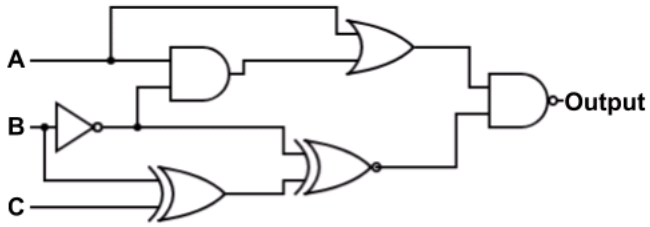
100. (1.00 pts) Use the logic gate shown above to write the outputs of the following combinations:

1) A = 1; B = 1; C = 0

2) A = 1; B = 1; C = 1

Do not fill in the third blank for this part.

101. (1.50 pts)



Use the logic gate shown above to write the outputs of the following combinations:

1) A = 0; B = 0; C = 0

2) A = 0; B = 0; C = 1

3) A = 0; B = 1; C = 0

102. (1.50 pts) Use the logic gate shown above to write the outputs of the following combinations:

1) A = 1; B = 0; C = 0

2) A = 0; B = 1; C = 1

3) A = 1; B = 0; C = 1

103. (1.00 pts) Use the logic gate shown above to write the outputs of the following combinations:

1) A = 1; B = 1; C = 0

2) A = 1; B = 1; C = 1

Do not fill in the third blank for this part.

104. (1.50 pts) $\overline{(A+B)} \oplus \overline{C}$

Use the equation shown above to write the outputs of the following combinations:

1) A = 0; B = 0; C = 0

2) A = 0; B = 0; C = 1

3) A = 0; B = 1; C = 0

105. (1.50 pts) $\overline{(A+B)} \oplus \overline{C}$

Use the equation shown above to write the outputs of the following combinations:

1) A = 1; B = 0; C = 0

2) A = 0; B = 1; C = 1

3) A = 1; B = 0; C = 1

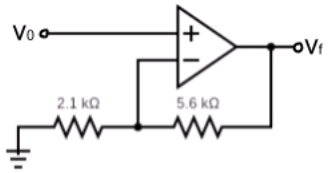
106. (1.00 pts) $\overline{(A+B)} \oplus \overline{C}$

Use the equation shown above to write the outputs of the following combinations:

1) A = 1; B = 1; C = 0

2) A = 1; B = 1; C = 1

Do not fill in the third blank for this part.



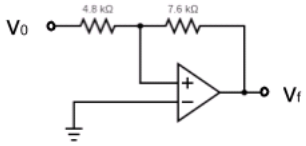
Use the image above to answer questions 107 & 108.

107. (1.00 pts) What type of op-amp is shown above?

- A) Inverting Op-amp
- B) Non-inverting Op-amp

C) Differential Op-Amp
D) Summing Op-amp
E) Differentiator Op-amp
F) Integrator Op-amp

108. (3.00 pts) If the input voltage (v_0) is 9.0 Volts, what is the output voltage (v_f)?



Use the image above to answer questions 109 & 110.

109. (1.00 pts) What type of op-amp is shown above?

A) Inverting Op-amp
B) Non-inverting Op-amp
C) Differential Op-amp
D) Summing Op-amp
E) Differentiator Op-amp
F) Integrator Op-amp

110. (3.00 pts) If the input voltage (v_0) is 25 Volts, what is the output voltage (v_f)?

Thank you for completing the Circuit Lab event for today! Your scores will be released in the later future as the results are announced. I hope you enjoyed the event, and I wish you the best of luck with the rest of your day!