Science Olympiad2013
Clio Invitational

CIRCUIT LAB C DIVISION

January 26, 2013

CLIO HIGH SCHOOL

SCHOOL NAME _____

STUDENT NAMES _____, _____

Test Portion

1. Which one of the following situations results in a conventional electric current that flows westward?

A. A beam of neutral atoms moves westward

B. A beam of protons moves eastward

C. A beam of neutrinos moves westward

D. A beam of electrons moves westward

E. A beam of protons moves westward

2. A circuit consists of a 12 volt battery and a 240 Ω resistor. The proper current flowing from the batter in this circuit is:

A. 5.0 A
B. 0.5 A
C. 50 mA
D. 5.0 mA
E. 500 μA

3. For the circuit in question 1 the voltage drop across the resistor will be:

A. 120 volts
B. 12 volts
C. 1.2 volts
D. 6 volts
E. 0 volts

4. Two wires A and B, and a variable resistor, R, are connected in series to a battery. Which one of the following results will occur if the resistance of R is increased?

A. The current through A and B will increase.
B. The voltage across A and B will increase.
C. The voltage across the entire circuit will increase.
D. The power used by the entire circuit will increase.
E. The current through the entire circuit will decrease.

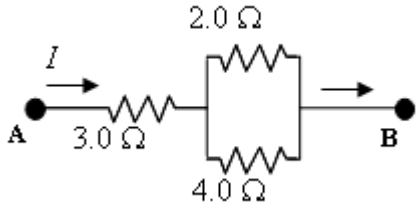
5. What is the total power dissipated by a 360 Ω resister connected across a 12.0 volt battery?

A. 0.80 W
B. 8.00 W
C. 360 W
D. 36.0 W
E. 400 mW

6. A 10 Ω and a 20 Ω resistor are connected in parallel. This combination is then connected across a 10.0 volt battery. What is the total power dissipated by the two resistors in the circuit?

A. 33 W
B. 15 W
C. 10 W
D. 670 W
E. 67 W

7. Three resistors are connected as shown in the figure. The potential difference between points **A** and **B** is 26 V.



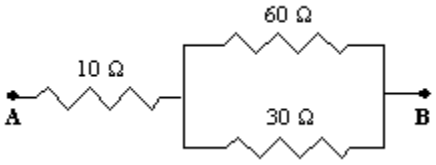
What is the equivalent resistance between the points **A** and **B**?

A. 9.0 Ω
B. 3.8 Ω
C. 4.3 Ω
D. 5.1 Ω
E. 6.8 Ω

8. In the circuit shown in the previous question, how much current flows through the 2.0 Ω resistor?

A. 10.0 A B. 6.0 A C. 8.7 A
D. 4.0 A E. 2.0 A

9. Three resistors are placed in a circuit as shown. The potential difference between points **A** and **B** is 30 V.

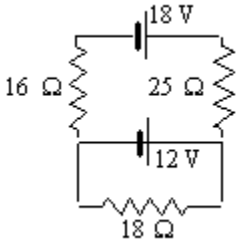


What is the potential drop across the 30 Ω resistor?

A. 20V B. 100V C. 30V

D. 10 V E. 60V

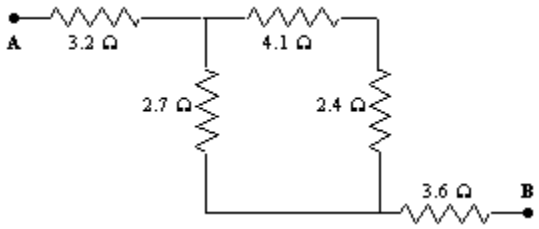
10. Three resistors and two batteries are connected as shown in the circuit diagram. What is the magnitude of the current through the 12-V battery?



A. 0.67 A B. 0.15A C. 0.52 A

D. 0.30 A E. 0.82A

11. Five resistors are connected as shown in the diagram. The potential difference between points **A** and **B** is 15 V.



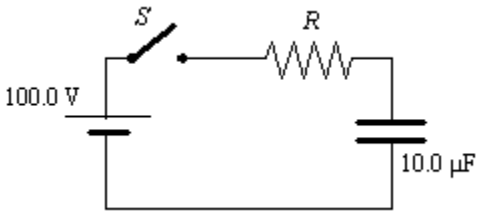
What is the current in the 2.7 Ω resistor?

A. 2.2 A B. 0.8 A C. 0.4A
D. 1.2 A E. 12 A

12. A 3.0-μF capacitor is connected in series with a 4.0-μF capacitor and a 48-V battery. What quantity of charge is supplied by the battery to charge the capacitors?

A. 7.3×10^{-4} C B. 3.0×10^{-5} C C. 8.2×10^{-5} C
D. 1.8×10^{-6} C E. 3.4×10^{-4} C

13. The figure shows a simple RC circuit consisting of a 100.0-V battery in series with a 10.0-μF capacitor and a resistor. Initially, the switch S is open and the capacitor is uncharged. Two seconds after the switch is closed, the voltage across the resistor is 37 V.



Determine the numerical value of the resistance *R*.

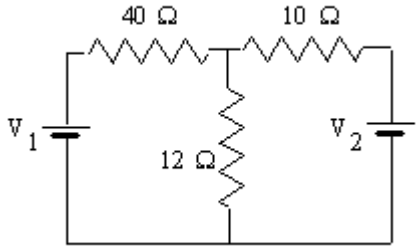
A. 5.0×10^{4} Ω B. 4.3×10^{5} Ω C. 2.70 Ω
D. 2.0×10^{5} Ω E. 0.37 Ω

14. An uncharged 5.0-μF capacitor and a resistor are connected in series to a 12-V battery and an open switch to form a simple RC circuit. The switch is closed at $t = 0$ s. The time constant of the circuit is 4.0 s.

Determine the value of the resistance *R*.

A. 8.0×10^{5} Ω B. 15 Ω C. 15 Ω
D. 8.0×10^{8} Ω E. 60 Ω

15. Three resistors and two 10.0-V batteries are arranged as shown in the circuit diagram. Which one of the following entries in the table is correct?



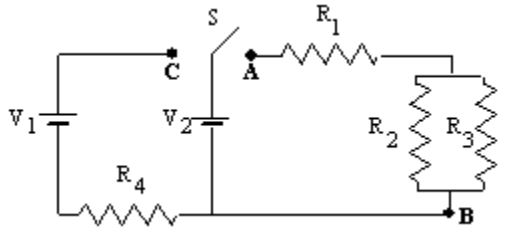
	Power Delivered by Battery 1	Power Delivered by Battery 2
A.	1.0 W	1.0 W
B.	4.0 W	1.0 W
C.	4.0 W	1.0 W
D.	1.0 W	4.0 W
E.	2.5 W	2.5 W

16. The figure shows a circuit. The switch S can be closed on either point **A** or **C**, but not both at the same time. Use the following quantities:

$V_1 = V_2 = 12$ V

$R_1 = R_4 = 1.0\ \Omega$

$R_2 = R_3 = 2.0\ \Omega$

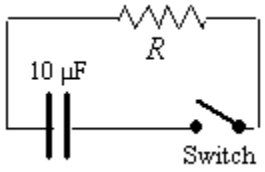


At what rate is energy dissipated by R_1 when the switch **S** is closed on **A**?

A. 144W B. 36 W C. 1.0 W

D. 4.0W E. 9.9W

17. The figure shows a simple RC circuit consisting of a 10.0-μF capacitor in series with a resistor. Initially, the switch is open as suggested in the figure. The capacitor has been charged so that the potential difference between its plates is 100.0 V. At t = 0 s, the switch is closed. The capacitor discharges exponentially so that 2.0 s after the switch is closed, the potential difference between the capacitor plates is 37 V. In other words, in 2.0 s the potential difference between the capacitor plates is reduced to 37 % of its original value.



Determine the potential drop across the resistor R at t = 2.0 s (i.e., two seconds after the switch is closed).

A. 37 V B. 87 V C. 63 V
B. 100 V E. zero V

18. A battery is manufactured to have an emf of 24.0 V, but the terminal voltage is only 22.0 V when the battery is connected across a 7.5- Ω resistor. What is the internal resistance of the battery?

A. 2.7 Ω B. 1.2 Ω C. 3.2 Ω
D. 0.75 Ω E. 0.86 Ω

Units MATCH (Answer on the THIS TEST!)

Pair each unit below with its equivalent:

1. volt	A. ampere*second
2. Ω	B. volt * ampere
3. ampere	C. watt / volt
4. farad	D. coulomb / volt
5. watt	E. volt * coulomb
6. coulomb	F. volt*second / coulomb
7. joule	G. volt * coulomb/ meter
8. newton	H. joule/ coulomb

Experimental Section

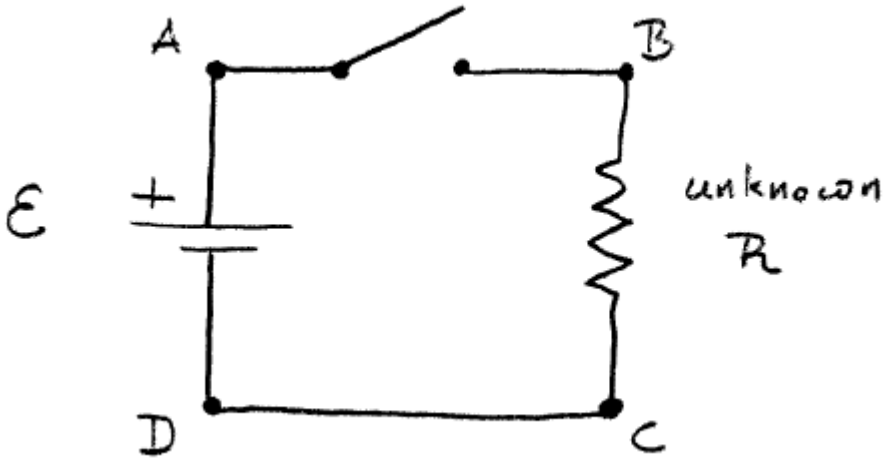
1. With the battery, bulb, and clip lead given: light the bulb in as many different ways as possible. With the batter, bulb and connector symbols, represent these schematically on your answer key:

(2 points) 2. Using your multimeter, determine the voltage of the D-cell.

(2 points) 4. The bulb uses 406 mA of current while ON. From your measured voltage and the given current determine the effective resistance of this bulb while ON.

(2 points) 5. Calculate the power dissipated by the bulb while ON.

2. With the unknown resistor, D-Cell power supply, switch and clip leads, build the circuit shown below. All voltages are measured relative to point D unless otherwise noted.



1. With the switch open, what is the voltage at point A?

2. With the switch closed, what is the voltage at point B? (Assume the switch is closed for the remaining measurements.)

3. What is the voltage at point C?

4. What is the proper current flowing through the resistor?

5. What is the value of the unknown resistor as determined by your voltage and current measurements? *Now that you are finished with your measurements please open the switch!*

6. Calculate the power dissipated by this resistor?

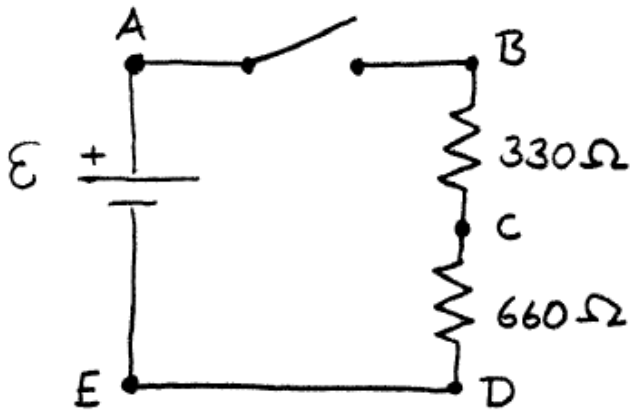
7. What is the direction of the *electron* flow in this circuit? Clockwise or Counterclockwise?

8. What is the direction of the *proper* current in this circuit? Clockwise or Counterclockwise?

9. Calculate the amount of chemical *energy* supplied by the battery to this circuit if it is left connected for 1.0 hours.

10. How much *charge* is supplied by this battery in this circuit if it is left on for a full hour?

Section 3: With the resistors, switch, the D-Cell power supply, and the clip leads, build the circuit shown below. All voltages are measured relative to point **E** unless otherwise noted. After you have built this circuit, close the switch.



Correction (The 660 Ω resistor should be replaced with a 680 Ω resistor)

1. Measure the voltage at point **A.**

2. Measure the voltage at point **B.**

3. Measure the voltage at point **C.**

4. Measure the current flowing through the 330 Ω resistor?

5. Measure the current flowing through the 680 Ω resistor?

6. Calculate the power dissipated in the 330 Ω resistor?

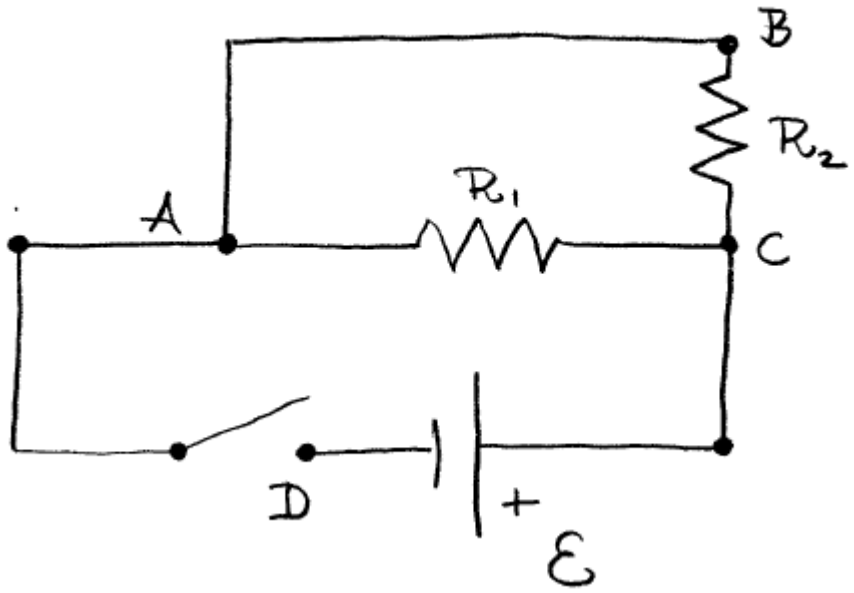
7. What is the total power supplied by the battery?

8. What is the direction of the electron flow in this circuit? Clockwise or Counterclockwise? (circle one)

9. Calculate the equivalent resistance of the resistors in this circuit?

10. *Place a short between points B and C by connecting a wire across these points.* What is the power supplied by the battery to the circuit under these circumstances? (Please remember to open the switch after you are finished!)

Section 4: With the resistors, switch, D-Cell power supply, and clip leads, build the circuit shown below. $R_1 = 270\ \Omega$ and $R_2 = 330\ \Omega$.



With the switch closed:

1. Measure the voltage across R_1

2. Measure the voltage across R_2

3. Measure the voltage between points B and D

4. Measure the current flowing through R_1

5. Measure the current flowing through R_2

6. What is the power dissipated in R_1?

7. (2 points) What is the total power supplied by the battery?

8. (2 points) What is the equivalent resistance of the resistors in this circuit?