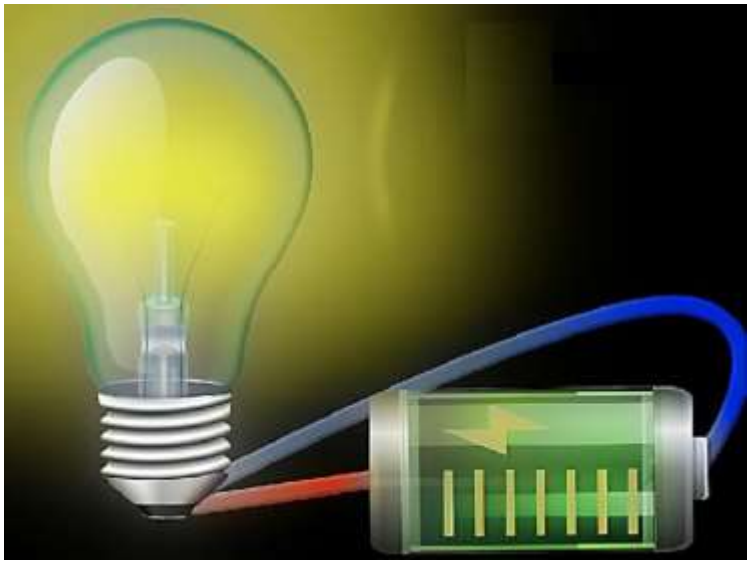
Physics Unit 17- DC Circuits



DC Circuits is a major unit within Physics and is continuing the build upon Electricity. We cover a ton of ground in this course and get into some pretty neat electrical setups. We will cover with great detail series and parallel circuits, combination circuits, and advanced Kirchhoff's Circuits. The content is delivered both through highly conceptual lessons as well as detailed and organized quantitative approaches.

I find my students often find Electrical Circuits as a fun and refreshing look at the real world around us. In the beginning it may not seem all that fascinating to wire up a light-bulb. When you actually start to understand how the circuits work and how to control them better you will notice how interesting this world becomes!

For the AP students out there this course marks the final course within AP Physics 1. You will also find this content within AP Physics 2 as well.

Course Homepage: https://www.physicscourseonline.com/p/dc-circuits

Course Curriculum

First Section

1 - Kirchhoff's Laws (8:01)	Start
2 - Series Circuits Introduction (12:43)	Start
3 - Series Circuits Example VIRP Table (10:16)	Start
4 - Parallel Circuits Introduction (13:15)	Start
5 - Parallel Circuits - VIRP Table (8:41)	Start
6 - Conceptual Lights Part 1 (9:42)	Start
7 - Conceptual Lights Part 2 (8:13)	Start
8 - Conceptual Lights Phet-10 (2:53)	Start
9 - Combination Circuits - Equivalent Resistance Part 1 (9:28)	Start
10 - Combination Circuits - Equivalent Resistance Part 2 (4:09)	Start
11 - Combination Circuits - Equivalent Resistance Part 3 (3:24)	Start
12 - Applying Kirchhoff's Laws (14:30)	Start

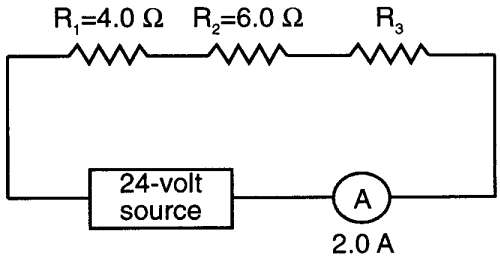
Regents **Name:**

Circuits 7 - Series **Date:**

1. A student needs a 4-ohm resistor to complete a circuit. Only a large quantity of 1-ohm resistors are available. Which of the following should be done to complete the circuit?

   A) Connect four 1-ohm resistors in series.
   B) Connect four 1-ohm resistors in parallel.
   C) Connect two of the 1-ohm resistors in series and two in parallel.
   D) Connect only two 1-ohm resistors in parallel.

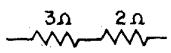
2. The diagram below shows a circuit with three resistors.

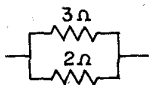


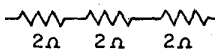
   What is the resistance of resistor R_3?

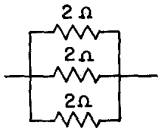
   A) 6.0 Ω B) 2.0 Ω C) 12 Ω D) 4.0 Ω

3. Which circuit segment has an equivalent resistance of 6 ohms?

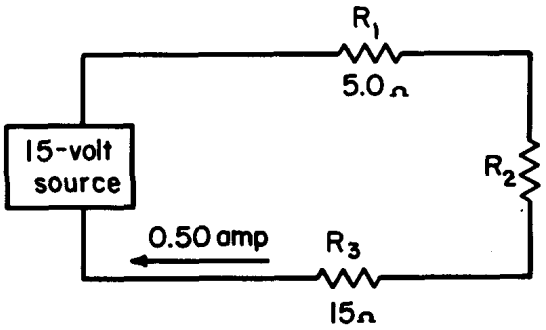
   A) 

   B) 

   C) 

   D) 

Base your answers to questions **4** and **5** on the diagram below which shows 3 resistors connected to a 15-volt source.



4. If resistor R_3 is removed and replaced by a resistor of lower value, the resistance of the circuit will

   A) decrease B) increase
   C) remain the same

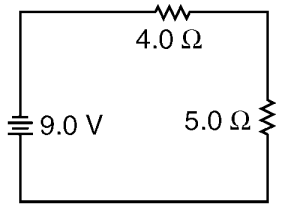
5. The total resistance of the circuit is

   A) 10 Ω B) 20 Ω C) 30 Ω D) 40 Ω

6. A 2.0-ohm resistor and a 4.0-ohm resistor are connected in series with a 12-volt battery. If the current through the 2.0-ohm resistor is 2.0 amperes, the current through the 4.0-ohm resistor is

   A) 1.0 A B) 2.0 A C) 3.0 A D) 4.0 A

7. A 9.0-volt battery is connected to a 4.0-ohm resistor and a 5.0-ohm resistor as shown in the diagram below.



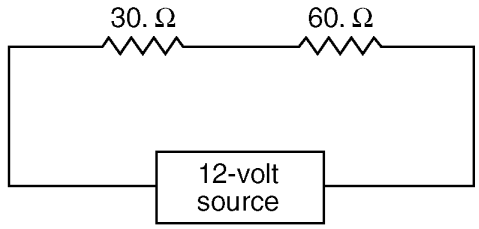
   What is the current in the 5.0-ohm resistor?

   A) 1.0 A B) 2.3 A C) 1.8 A D) 4.0 A

8. A 10.-ohm resistor and a 20.-ohm resistor are connected in series to a voltage source. When the current through the 10.-ohm resistor is 2.0 amperes, what is the current through the 20.-ohm resistor?

   A) 1.0 A B) 2.0 A C) 0.50 A D) 4.0 A

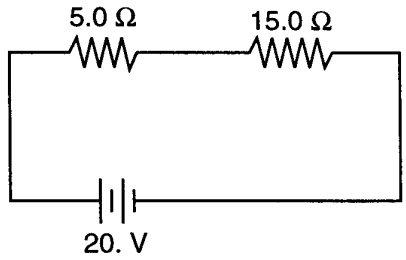
9. A 30.-ohm resistor and a 60.-ohm resistor are connected in an electric circuit as shown below.



   Compared to the electric current through the 30.-ohm resistor, the electric current through the 60.-ohm resistor is

   A) smaller B) larger
   C) the same

10. The diagram below shows two resistors connected in series to a 20.-volt battery.



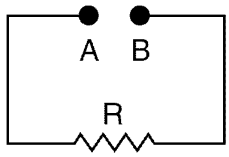
    If the current through the 5.0-ohm resistor is 1.0 ampere, the current through the 15.0-ohm resistor is

    A) 1.0 A B) 0.33 A C) 3.0 A D) 1.3 A

Regents **Name:**

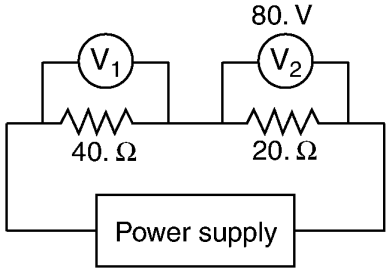
Circuits 8 - Series **Date:**

1. What must be inserted between points *A* and *B* to establish a steady electric current in the incomplete circuit represented in the diagram below?



A) switch
B) voltmeter
C) magnetic field source
D) source of potential difference

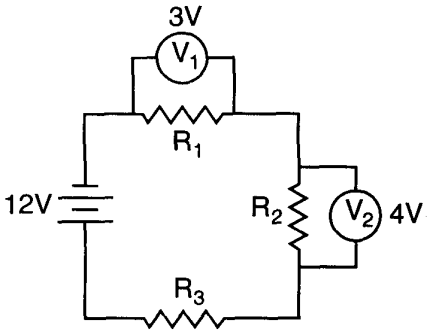
2. In the circuit shown below, voltmeter V_2 reads 80. volts.



What is the reading of voltmeter V_1?

A) 160 V B) 80. V C) 40. V D) 20. V

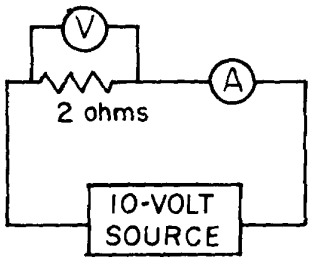
3. The diagram below shows three resistors, R_1, R_2, and R_3, connected to a 12-volt battery.



If voltmeter V_1 reads 3 volts and voltmeter V_2 reads 4 volts, what is the potential drop across resistor R_3?

A) 12 V B) 5 V C) 0 V D) 4 V

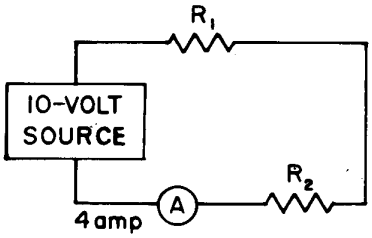
4. Base your answer to the following question on the diagram below.



The reading of voltmeter V will be

A) 0.2 volt B) 5 volts C) 10 volts D) 20 volts

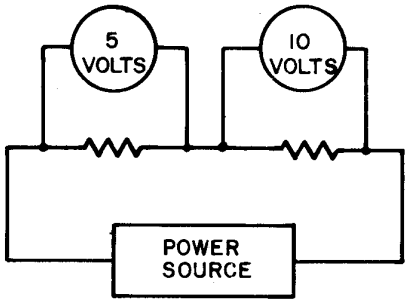
5. Base your answer to the following question on the circuit diagram below.



The voltage drop at R_1 will be

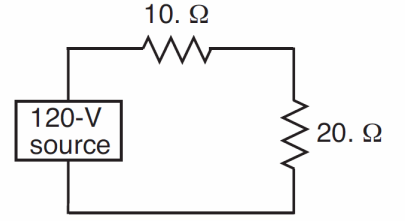
A) less than 10 volts B) 10 volts
C) 20 volts D) more than 20 volts

6. What is the voltage of the power supply shown on the diagram below?



A) 0.5 volt B) 10 volts C) 15 volts D) 50 volts

7. The diagram below represents a circuit consisting of two resistors connected to a source of potential difference.



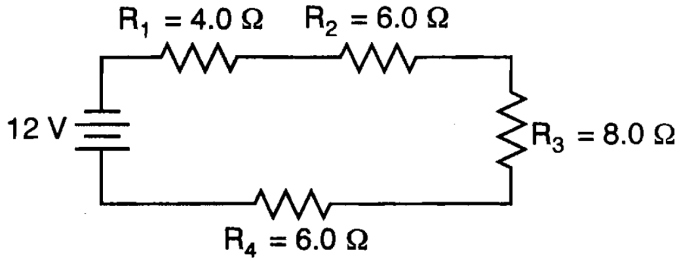
What is the current through the 20.-ohm resistor?

A) 0.25 A B) 6.0 A C) 12 A D) 4.0 A

8. Circuit *A* has four 3.0-ohm resistors connected in series with a 24-volt battery, and circuit *B* has two 3.0-ohm resistors connected in series with a 24-volt battery. Compared to the total potential drop across circuit *A*, the total potential drop across circuit *B* is

   A) one-half as great B) twice as great
   C) the same D) four times as great

9. The circuit diagram below represents four resistors connected to a 12-volt source.



   What is the total current in the circuit?

   A) 0.50 A B) 2.0 A C) 8.6 A D) 24 A

10. A 3.0-ohm resistor arid a 6.0-ohm resistor are connected in series in an operating electric circuit. If the current through the 3.0-ohm resistor is 4.0 amperes, what is the potential difference across the 6.0-ohm resistor?

    A) 8.0 V B) 2.0 V C) 12 V D) 24 V

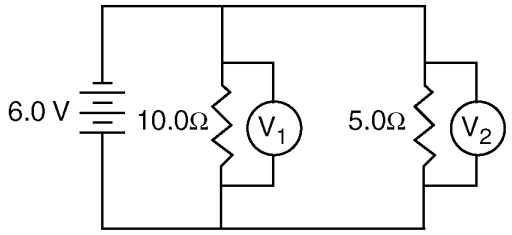
Regents **Name:**

Circuits 10 - Parallel 1 **Date:**

1. A 3-ohm resistor and a 6-ohm resistor are connected in parallel across a 9-volt battery. Which statement best compares the potential difference across each resistor?

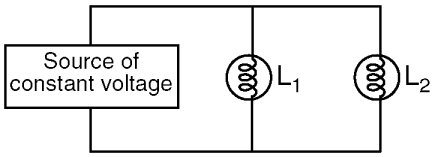
   A) The potential difference across the 6-ohm resistor is the same as the potential difference across the 3-ohm resistor.
   B) The potential difference across the 6-ohm resistor is twice as great as the potential difference across the 3-ohm resistor.
   C) The potential difference across the 6-ohm resistor is half as great as the potential difference across the 3-ohm resistor.
   D) The potential difference across the 6-ohm resistor is four times as great as the potential difference across the 3-ohm resistor.

2. In the circuit diagram below, what are the correct readings of voltmeters V_1 and V_2?



   A) V_1 reads 2.0 V and V_2 reads 4.0 V
   B) V_1 reads 4.0 V and V_2 reads 2.0 V
   C) V_1 reads 3.0 V and V_2 reads 3.0 V
   D) V_1 reads 6.0 V and V_2 reads 6.0 V

3. In the diagram below, lamps L_1 and L_2 are connected to a constant voltage power supply.



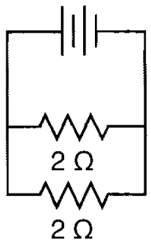
   If lamp L_1 burns out, the brightness of L_2 will

   A) decrease B) increase
   C) remain the same

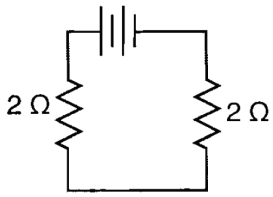
Name:

4. Which circuit has the *smallest* equivalent resistance?

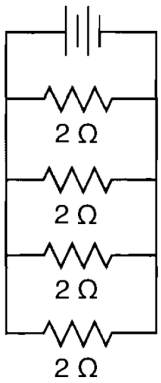
A)



B)



C)



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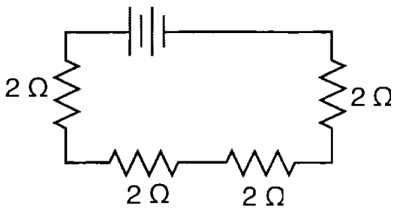
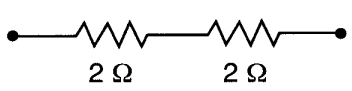
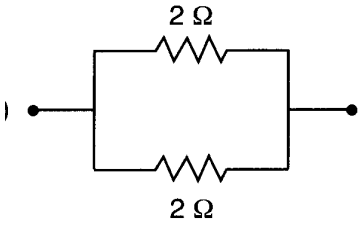
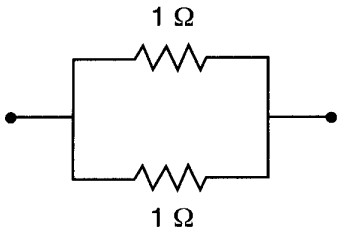


5. Which combination of resistors has the *smallest* equivalent resistance?

A) 

B) 

C) 

D) 

6. Three identical lamps are connected in parallel with each other. If the resistance of each lamp is X ohms, what is the equivalent resistance of this parallel combination?

A) $X\,\Omega$ B) $\frac{X}{3}\,\Omega$

C) $3X\,\Omega$ D) $\frac{3}{X}\,\Omega$

7. Three resistors, 4 ohms, 6 ohms, and 8 ohms, are connected in parallel in an electric circuit. The equivalent resistance of the circuit is

A) less than $4\,\Omega$
B) between $4\,\Omega$ and $8\,\Omega$
C) between $10\,\Omega$ and $18\,\Omega$
D) $18\,\Omega$

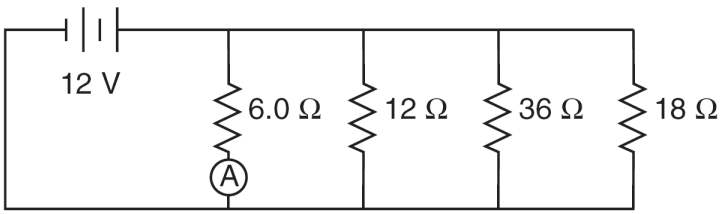
8. A circuit consists of a 10.0-ohm resistor, a 15.0-ohm resistor, and a 20.0-ohm resistor connected in parallel across a 9.00-volt battery. What is the equivalent resistance of this circuit?

A) $0.200\,\Omega$ B) $1.95\,\Omega$

C) $4.62\,\Omega$ D) $45.0\,\Omega$

Name:

____ 9. Base your answer to the following question on the diagram below, which represents an electric circuit consisting of four resistors and a 12-volt battery.



What is the equivalent resistance of this circuit?

A) 72 Ω B) 18 Ω C) 3.0 Ω D) 0.33 Ω

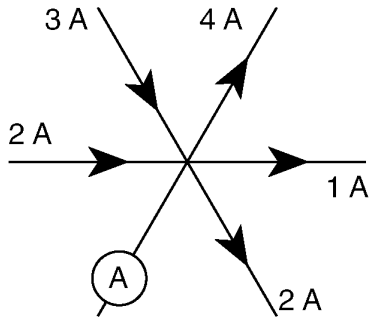
____ 10. Two identical resistors connected in series have an equivalent resistance of 4 ohms. The same two resistors, when connected in parallel, have an equivalent resistance of

A) 1 Ω B) 2 Ω C) 8 Ω D) 4 Ω

Regents **Name:**

Circuits 11 - Parallel 2 **Date:**

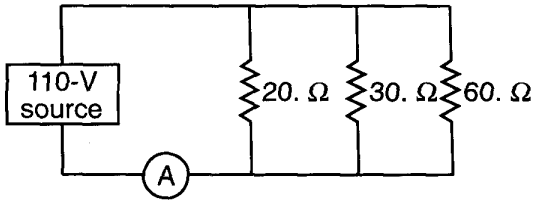
1. The diagram below represents currents in a segment of an electric circuit.



What is the reading of ammeter *A*?

A) 1 A B) 2 A C) 3 A D) 4 A

2. In the diagram below of a parallel circuit, ammeter *A* measures the current supplied by the 110-volt source.

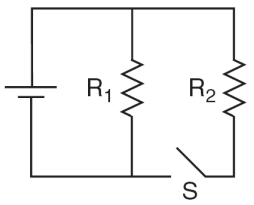


The current measured by ammeter *A* is

A) 1.0 A B) 0.10 A
C) 5.5 A D) 11 A

3. In which circuit would current flow through resistor R_1, but *not* through resistor R_2 while switch *S* is open?

A)



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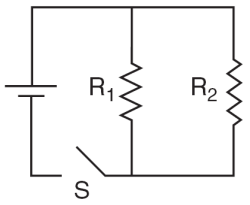
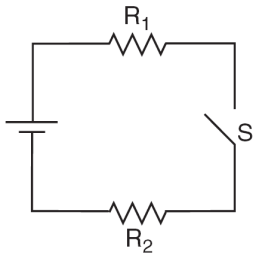
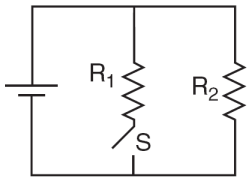


C)

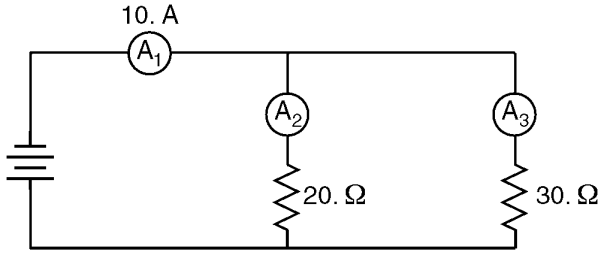


D)



Name:

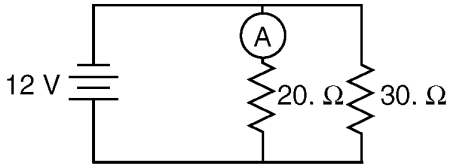
4. In the circuit diagram shown below, ammeter A_1 reads 10. amperes.



What is the reading of ammeter A_2?

A) 6.0 A B) 10. A C) 20. A D) 4.0 A

5. Base your answer to the following question on the information and diagram below. A 20.-ohm resistor and a 30.-ohm resistor are connected in parallel to a 12-volt battery as shown. An ammeter is connected as shown.

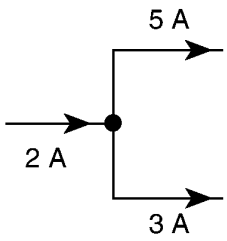


What is the current reading of the ammeter?

A) 1.0 A B) 0.60 A C) 0.40 A D) 0.20 A

6. Which diagram shows correct current direction in a segment of an electric circuit?

A)



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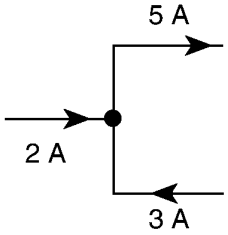
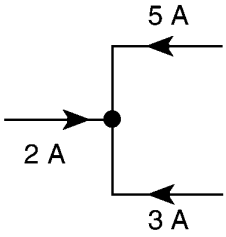


C)



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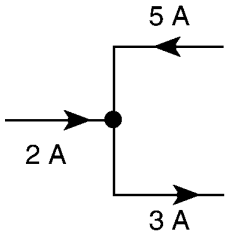
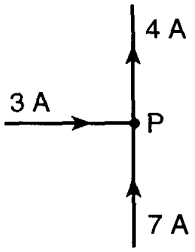


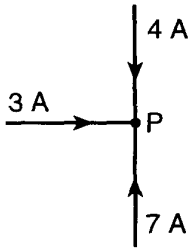
Name:

7. Which diagram below correctly shows currents traveling near junction *P* in an electric circuit?

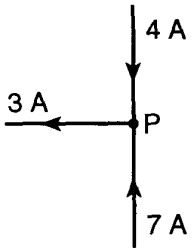
A)



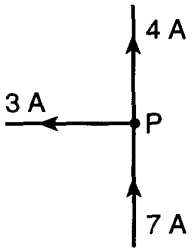
B)



C)



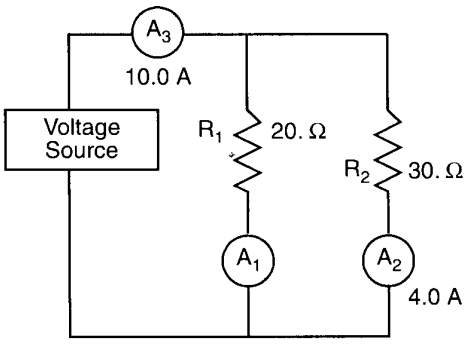
D)



8. As the number of resistors in a parallel circuit is increased, what happens to the equivalent resistance of the circuit and total current in the circuit?

A) Both equivalent resistance and total current decrease.
B) Both equivalent resistance and total current increase.
C) Equivalent resistance decreases and total current increases.
D) Equivalent resistance increases and total current decreases.

Base your answers to questions **9** and **10** on the diagram below, which shows two resistors and three ammeters connected to a voltage source.



9. What is the current reading of ammeter A_1 ?

A) 10.0 A B) 6.0 A
C) 3.0 A D) 4.0 A

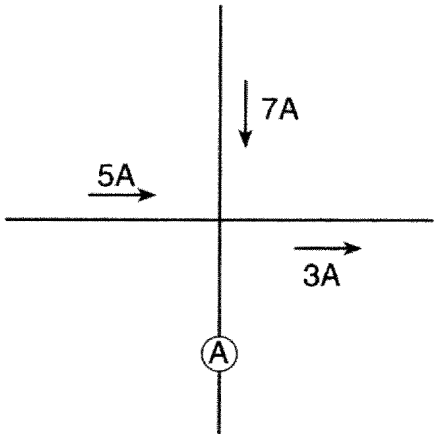
10. What is the potential difference across the source?

A) 440 V B) 220 V
C) 120 V D) 60. V

Regents **Name:**

Circuits 12 - Meters **Date:**

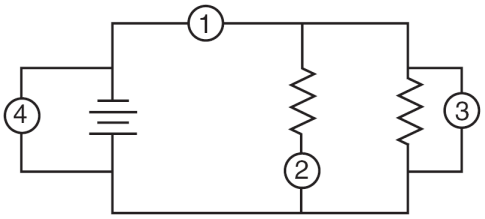
1. The diagram below shows currents in a segment of an electric circuit.



What is the reading of ammeter *A*?

A) 1 A B) 5 A C) 9 A D) 15 A

2. In the electric circuit diagram below, possible locations of an ammeter and a voltmeter are indicated by circles 1, 2, 3, and 4



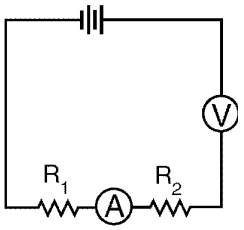
Where should an ammeter be located to correctly measure the total current and where should a voltmeter be located to correctly measure the total voltage?

A) ammeter at 1 and voltmeter at 4
B) ammeter at 2 and voltmeter at 3
C) ammeter at 3 and voltmeter at 4
D) ammeter at 1 and voltmeter at 2

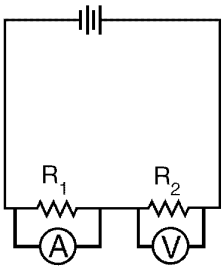
Name:

3. In which circuit represented below are meters properly connected to measure the current through resistor R_1 and the potential difference across R_2?

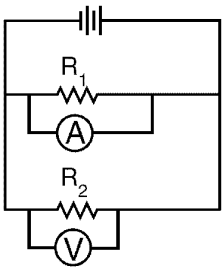
A)



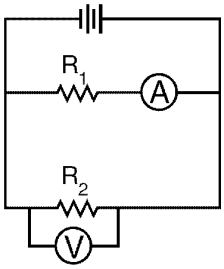
B)



C)



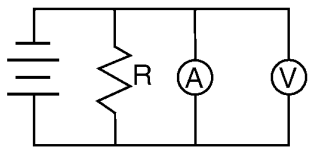
D)



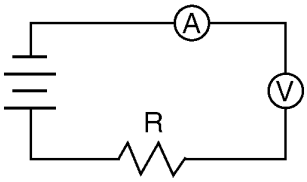
Name:

4. Which circuit diagram below correctly shows the connection of ammeter *A* and voltmeter *V* to measure the current through and potential difference across resistor *R*?

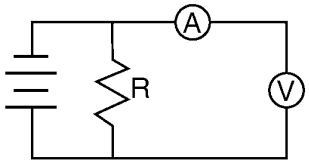
A)



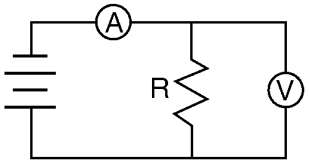
B)



C)

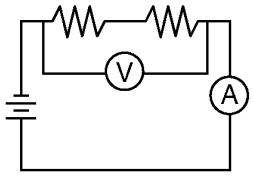


D)

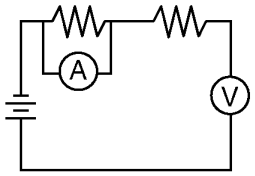


5. Which circuit diagram shows voltmeter V and ammeter A correctly positioned to measure the total potential difference of the circuit and the current through each resistor?

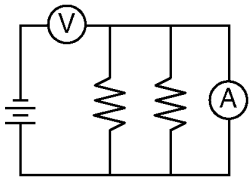
A)



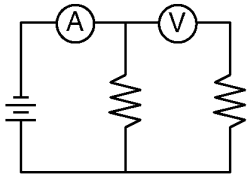
B)



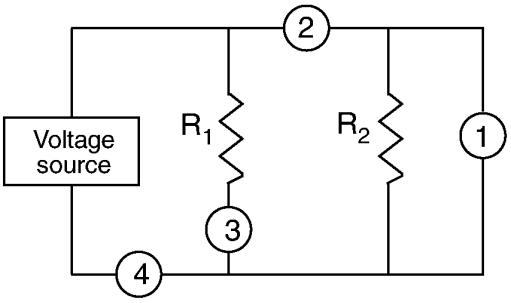
C)



D)



6. Two resistors are connected to a source of voltage as shown in the diagram below.



At which position should an ammeter be placed to measure the current passing only through resistor R_1?

A) 1 B) 2 C) 3 D) 4

Name:

7. A student uses a voltmeter to measure the potential difference across a circuit resistor. To obtain a correct reading, the student must connect the voltmeter

   A) in parallel with the circuit resistor
   B) in series with the circuit resistor
   C) before connecting the other circuit components
   D) after connecting the other circuit components

8. A high resistance is connected in series with the internal coil of a galvanometer to make

   A) a motor
   B) an ammeter
   C) a voltmeter
   D) a generator

9. Compared to the resistance of the circuit being measured, the internal resistance of a voltmeter is designed to be very high so that the meter will draw

   A) no current from the circuit
   B) little current from the circuit
   C) most of the current from the circuit
   D) all the current from the circuit

10. Which statement about ammeters and voltmeters is correct?

   A) The internal resistance of both meters should be low.
   B) Both meters should have a negligible effect on the circuit being measured.
   C) The potential drop across both meters should be made as large as possible.
   D) The scale range on both meters must be the same.

Electric Current & DC Circuits

PSI AP Physics 2 Name_____

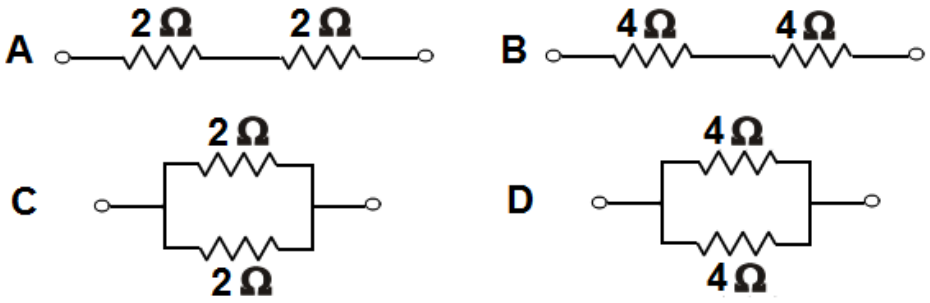
Multiple-Choice

1. The length and radius of an aluminum wire is quadrupled. By which factor does the resistance change?

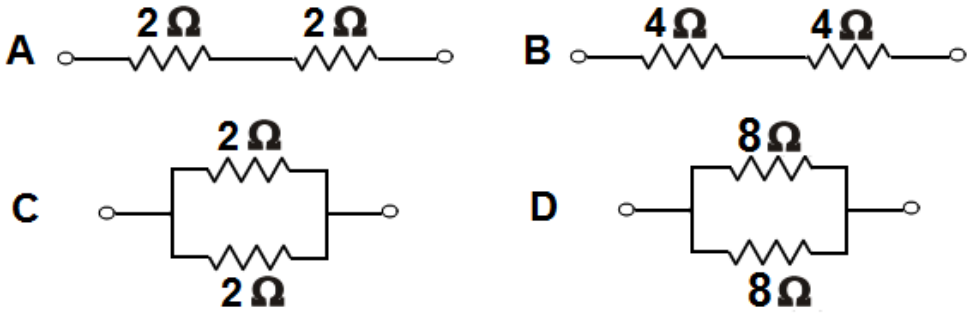
   (A) 2 (B) 1/2 (C) 1/4 (D) 1

2. A copper wire has a length L and cross-sectional area A. What happens to the resistivity of the wire if the length is doubled and cross-sectional area halved?

(A) Four times as large (B) Stays the same (C) Half as large (D) Quarter as large

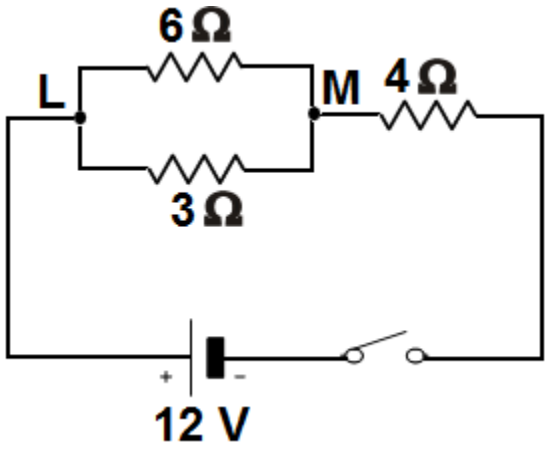


3. Which circuit has greater resistance between the terminals?
   (A) A (B) B (C) C (D) D



4. Which circuits have the same resistance between the terminals?
   (A) A and B (B) B and C (C) C and D (D) A and D

Questions 5-7



5. In the circuit shown above, what is the value of the net resistance?

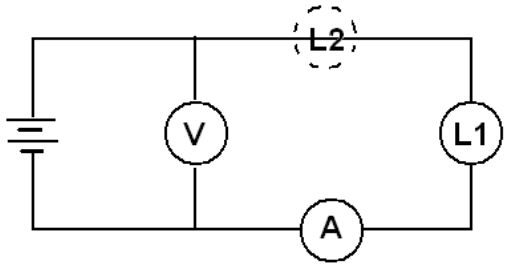
   (A) 0.75 Ω (B) 4.5 Ω (C) 6 Ω (D) 13 Ω

6. What is the current in 4 - Ω resistor?

   (A) 2A (B) 3A (C) 9A (D) 12A

7. What is the voltage between points L and M?

   (A) 2 V (B) 4 V (C) 8 V (D) 12 V



8. A lamp L1, a voltmeter V, an ammeter A, and a battery with zero internal resistance are connected as shown above. Connecting another lamp L2 in series with the first lamp as shown by the dashed lines would

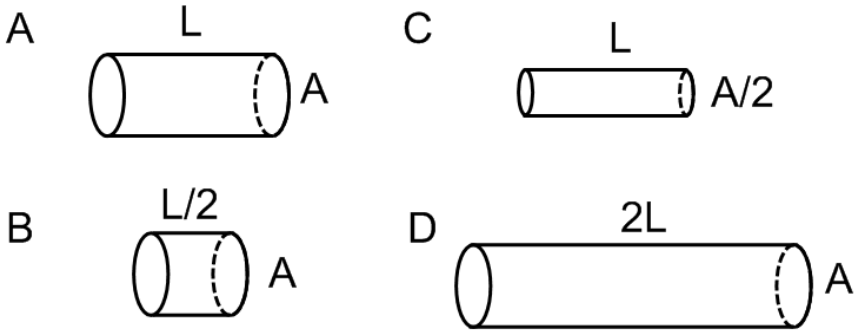
   (A) Increase the ammeter reading

   (B) Increase the voltmeter reading

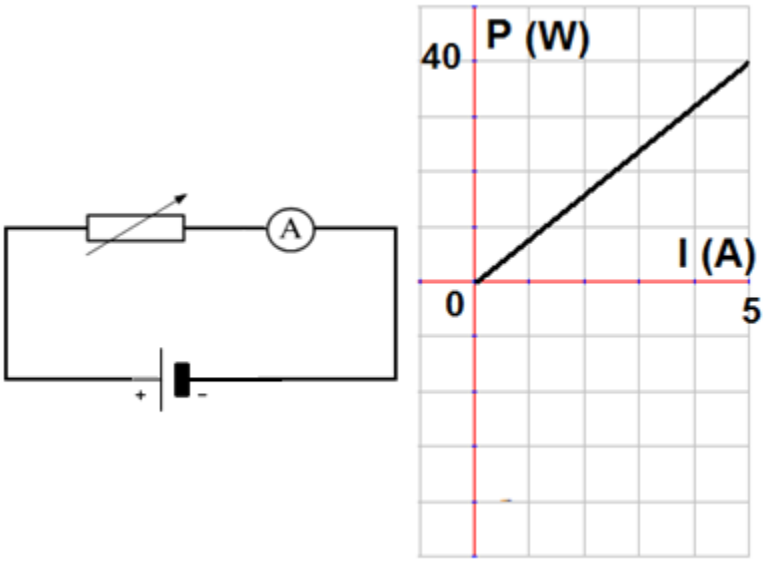
   (C) Decrease the ammeter reading

   (D) Decrease the voltmeter reading

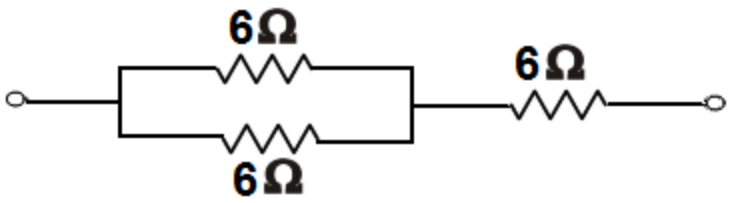
9. The four resistors shown below have the lengths and cross-sectional areas indicated and are made of material with the same resistivity. Which has the smallest resistance?



(A) A (B) B (C) C (D) D



10. The circuit shown above left is made up of a variable resistor and a battery with negligible internal resistance. A graph of the power P dissipated in the resistor as a function of the current I supplied by the battery is given above right. What is the emf of the battery?
(A) 0.125 V (B) 5 V (C) 8 V (D) 40 V

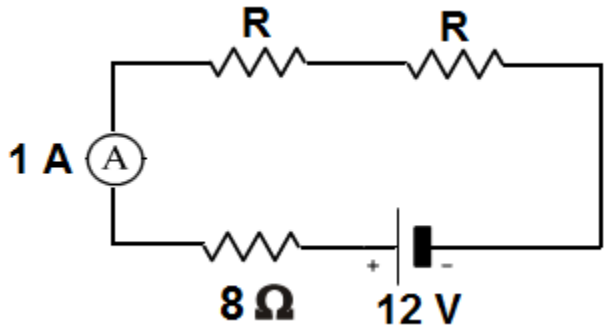


11. The equivalent resistance between the junction points of the above circuit shown on the diagram is:

    (A) 2 Ω (B) 6 Ω (C) 9 Ω (D) 18 Ω

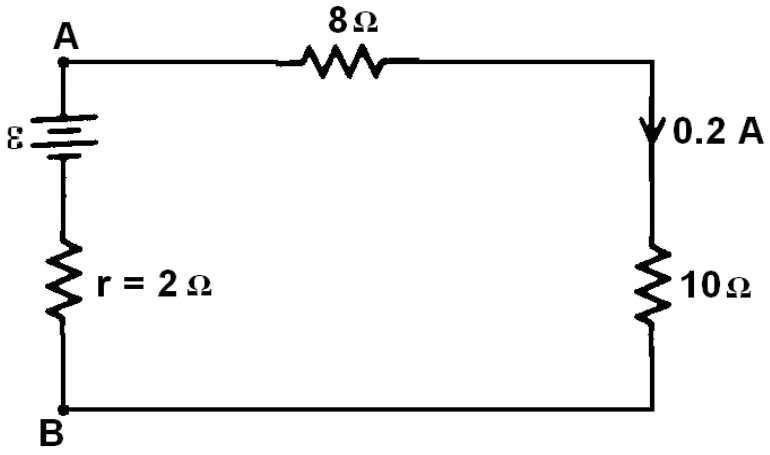
12. A heating spiral of resistance R converts electrical energy into thermal energy that is transferred to the liquid in which the spiral is immersed. If the voltage across the spiral is V, the thermal energy transferred to the liquid in time t is:

    (A) Vrt (B) V^2Rt (C) VR^2t (D)V^2t/R



13. In the circuit two identical resistors R are connected in series with 8-Ω resistor and 12- V battery. What is the value of R if the current in the circuit I = 1 A?

    (A) 2 Ω (B) 4 Ω (C) 8 Ω (D) 12 Ω

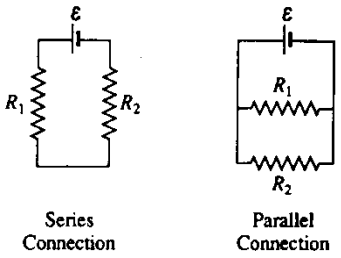


Questions 14-16 relate to the following circuit diagram which shows a battery with an internal resistance of 2.0 ohms connected to an 8-ohm and a 10-ohm resistor in series. The current in the 10-ohm resistor is 0.2 amperes.

14. What is the emf of the battery?
    (A) 0.4 V (B) 3.6 V (C) 4 V (D) 12 V

15. What is the potential difference across the terminals A and B of the battery?
    (A) 1.2 V (B) 2.4 V (C) 3.6 V (D) 12.2 V

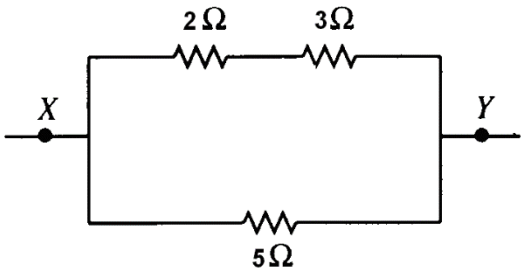
16. What power is dissipated by the 2-ohm internal resistance of the battery?
    (A) 0.08 W (B) 0.8 W (C) 1.2 W (D) 6.5 W



17. In the diagrams above, resistors R_1 and R_2 are shown in two different connections to the same source of emf ε that has no internal resistance. How does the power dissipated by the resistors in these two cases compare?
    (A) It is greater for the series connection.
    (B) It is greater for the parallel connection.
    (C) It is the same for both connections.
    (D) One must know the values of R_1 and R_2 to know which is greater.

18. The product 3 amperes x 3 volts x 3 seconds is equal to
    (A) 27 C (B) 27 N (C) 27 J (D) 27 W

Questions 19-20 refer to the following diagram that shows part of a closed electrical circuit.



19. The electrical resistance of the part of the circuit shown between point X and point Y is

    (A) 1.4 Ω (B) 2.5 Ω (C) 6.2 Ω (D) 10 Ω

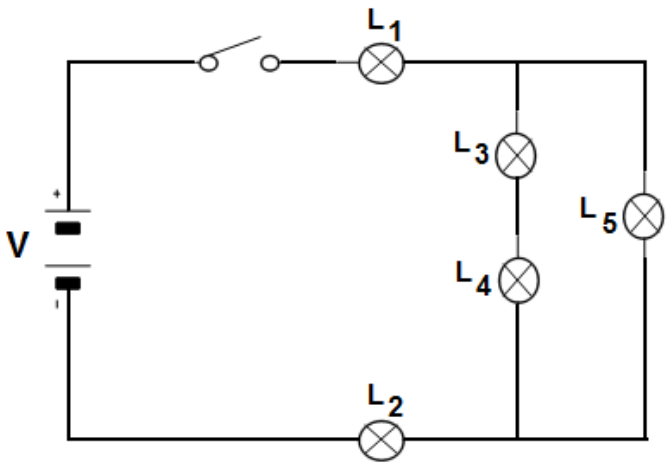
20. When there is a steady current in the circuit, the amount of charge passing a point per unit of time is:

    (A) the same everywhere in the circuit
    (B) greater at point X than at point Y
    (C) greater in the 2 Ω resistor than in the 5 Ω resistor
    (D) the same in the 2 Ω resistor as in the 5 Ω resistor

21. A certain coffeepot draws 2.0 A of current when it is operated on 110 V household lines. If electrical energy costs 10 cents per kilowatt-hour, how much does it cost to operate the coffeepot for 5 hours?

    (A) 2.4 cents (B) 4.8 cents (C) 8.0 cents (D) 11 cents

Questions 22-24



Five identical light bulbs are connected to a 120 V power supply. Each light bulb has a resistance of 15 Ω. The switch is closed.

22. What is the net resistance of the circuit?

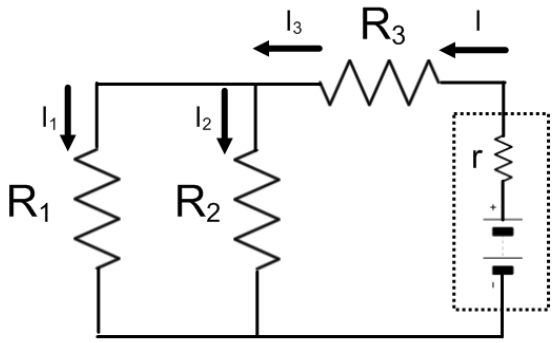
(A) 3 Ω (B) 30.1 Ω (C) 40 Ω (D) 75 Ω

23. What is the current in the light bulb L_1?

(A) 1.6 A (B) 3 A (C) 8 A (D) 40 A

24. Which light bulb or bulbs could burn out without causing any others to go out?

(A) Only L_1 (B) Only L_2 (C) Only L_4 (D) Only L_5



A circuit, shown above, has three resistors R_1 = 60Ω, R_2 = 30Ω, and R_3 = 20Ω, and a 120V battery with an internal resistance r = 4Ω. Use this circuit to answer questions 25 – 27.

25. What is the relationship between the three labeled currents?

(A) $I_1 = I_2 < I < I_3$
(B) $I_1 + I_2 + I_3 = I$
(C) $I_2 > I_1 > I_3 > I$
(D) $I_1 + I_2 = I_3 = I$

26. If V_1 represents the potential difference across the first resistor, V_2 across the second resistor, V_3 across the third resistor and V the terminal voltage in the battery. What is the relationship between the V_1, V_2, V_3, and V?

(A) $V_1 = V_2 = V - V_3$
(B) $V_1 + V_2 + V_3 = V$
(C) $V_1 = V_2 = V_3 < V$
(D) $V > V_3 > V_2 > V_1$

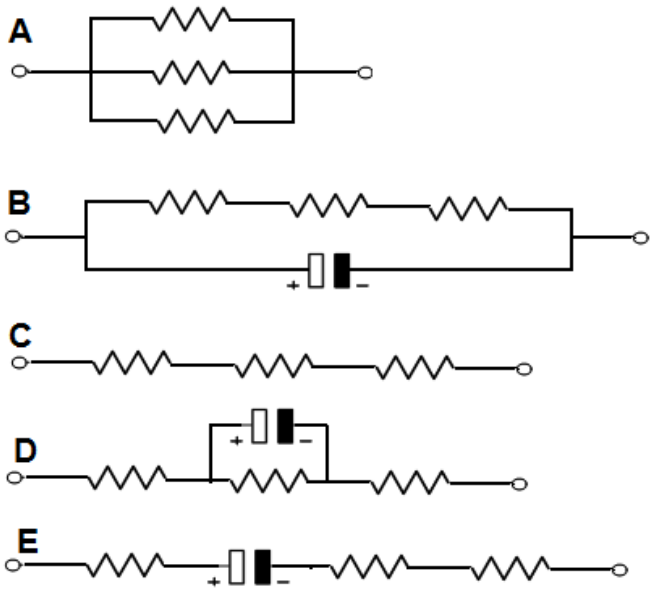
27. What is the ratio of current I_1 in resistor R_1 to the current in I_2 in resistor R_2?

(A) $\frac{I_1}{I_2} = \frac{1}{3}$ (B) $\frac{I_1}{I_2} = \frac{1}{2}$ (C) $\frac{I_1}{I_2} = \frac{2}{3}$ (D) $\frac{I_1}{I_2} = \frac{2}{1}$

28. A battery has an emf of $\mathcal{E}$ and an internal resistance of r. What resistance R, when connected across the terminals of the battery will make the terminal voltage to be ½$\mathcal{E}$?

(A) ½ r (B) 2r (C) r (D) 4r

Questions 29-30 relate to the five incomplete circuits below composed of resistors R, all of equal resistance, and capacitors C, all of equal capacitance. A battery that can be used to complete any of the circuits is available.

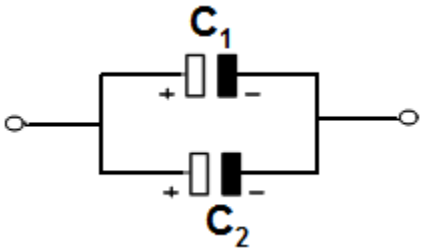


29. Into which circuit should the battery be connected to obtain the greatest steady power dissipation?

(A) A (B) B (C) C (D) E

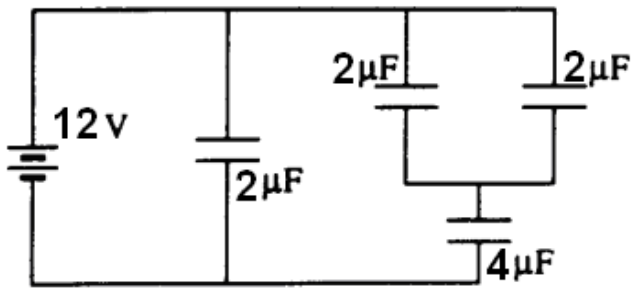
30. Which circuit will retain stored energy if the battery is connected to it and then disconnected?

(A) B (B) C (C) D (D) E



31. Two capacitors are connected in parallel as shown above. A voltage V is applied to the pair. What is the ratio of charge stored on C_1 to the charge stored on C_2, when $C_1 = 3C_2$?
(A) 1/3 (B) 2/3 (C) 3/1 (D) 3/2

Questions 32-33 refer to the circuit shown below.



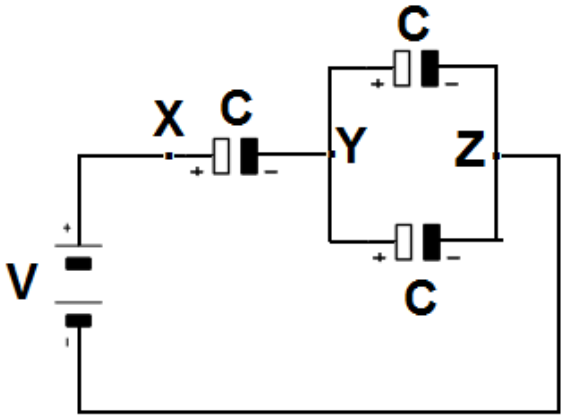
32. The equivalent capacitance for this network is:

(A) 1.5 μF (B) 2 μF (C) 4 μF (D) 10 μF

33. The charge stored in the circuit is:

(A) 12μC (B) 18 μC (C) 24 μC (D) 48 μC

Questions 34-36



Three capacitors with an equal capacitance C are connected to a battery V.

34. What is the net capacitance of the circuit?

(A) 3C (B) 2C (C) 3/2 C (D) 2/3 C

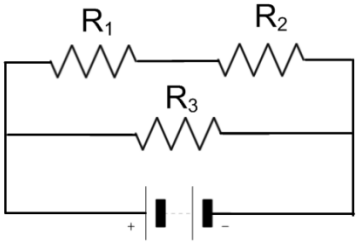
35. What is the net charge stored in the circuit?

(A) CV (B) 3CV/2 (C) 2CV/3 (D) CV/3

36. What is the potential difference between the points X and Y?

(A) 1/3 V (B) 1/2 V (C) 3/2 V (D) 2/3 V

Multi-correct Section: For each question or incomplete statement, two of the answers are correct. For each questions you must select both answers.

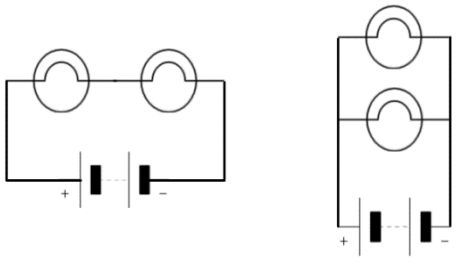


37. In reference to the circuit above, which of the follow statements are true? Choose two answers.

(A) The current in R_1 must be the same as the current in R_2.
(B) The current in R_3 must be the same as the current in the battery.
(C) The voltage across R_1 must be the same as the voltage across R_2.
(D) The voltage across R_3 must be the same as the voltage across the battery.

38. A single resistor is connected across the terminals of a battery. Which of the following will leave the power output unaffected? Choose two answers.

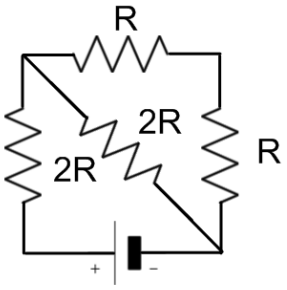
(A) Reducing both the resistance and the voltage by a factor of 4.
(B) Reducing the resistance by a factor of 4 and the voltage by a factor of 2.
(C) Doubling both the resistance and the voltage.
(D) Doubling the voltage and increasing the resistance by a factor of 4.



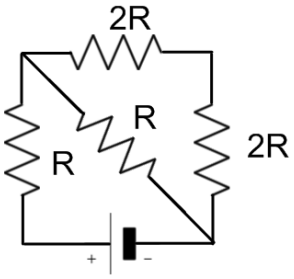
39. The diagrams above show four light bulbs of the same type. Two are in series and two are in parallel. Which of the following statements are true? Choose two answers.

(A) The light bulbs in the series circuit are brightest since they get the total current.
(B) The light bulbs in the parallel circuit draw more power than in the series circuit.
(C) The series circuit has more total resistance than the parallel circuit.
(D) The parallel circuit has the less total current than the series circuit.

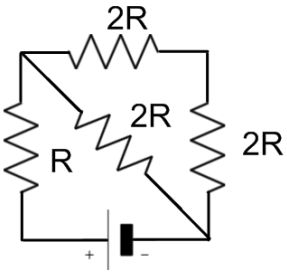
40. The following diagrams show resistors in four different circuits. Which two have the same total resistance? Choose two answers.



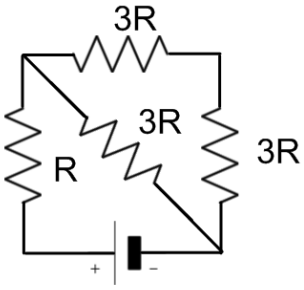
(A)



(B)



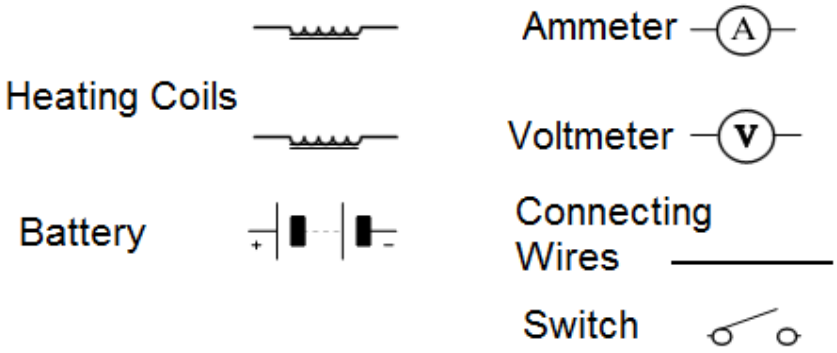
(C)



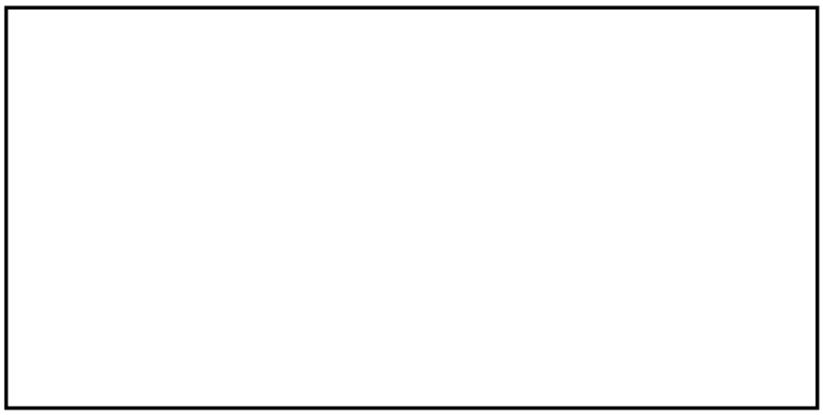
(D)

Free-Response Problems

1. A physics student has an assignment to make an electrical heating system with the set of materials listed below:



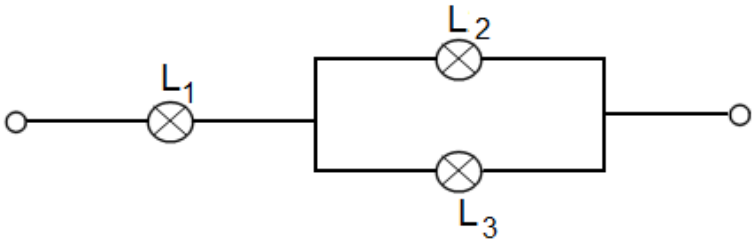
   a. In a space below draw a diagram showing all the elements connected in one electrical circuit that can provide the maximum rate of heat produced. Use two meters in your circuit, they will help to measure the heat rate.



   The battery has an emf of 12 V and an internal resistance of 0.5 Ω and each heating coil has a resistance of 17.3 Ω.

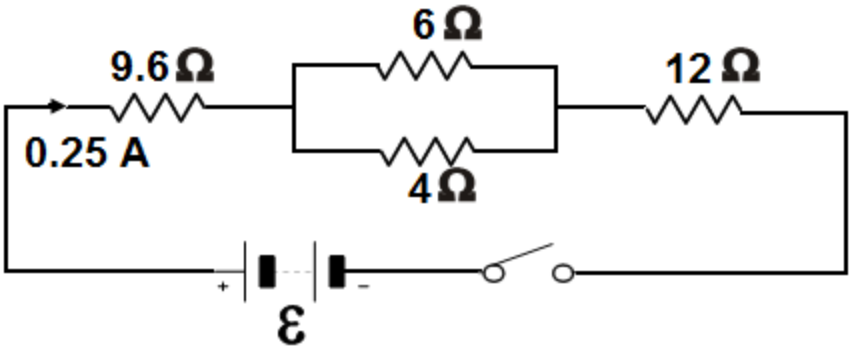
   b. When the switch is closed, what is the current running through the battery?
   c. What is the terminal voltage on the battery?
   d. What is the rate of energy delivered by the heating system?
   e. If the switch is closed for 5 min, what is the total energy dissipated in the coils?

2. An electric motor in a toy car can operate when connected to a 6 V battery and has a current of 0.5 A. A physics student wants to run the toy car but unfortunately he could only find a 12 V battery in the physics lab. The student also found a box with a set of five 6-Ω resistors.
    a. Use the given materials to design an electric circuit in which the electric motor will operate properly.
        i. Draw the circuit including all devices.
        ii. Explain your reasoning in designing this particular circuit.
    b. Calculate the net resistance of the circuit.
    c. Calculate the power dissipated in the circuit.



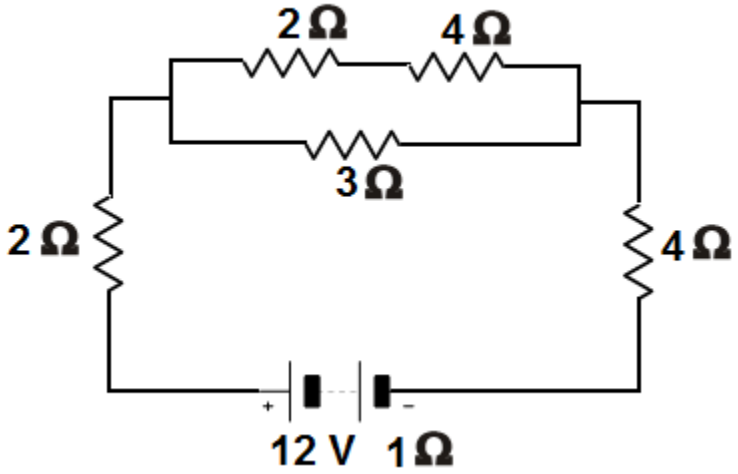
3. Three light bulbs are connected in the circuit shown on the diagram. Each light bulb can develop a maximum power of 75 W when connected to a 120-V power supply. The circuit of three light bulbs is connected to a 120 V power supply.

    a. What is the resistance of the circuit?
    b. What is the power dissipated by the circuit?
    c. How would you compare this power to the power when all bulbs are connected in parallel?
    d. What is the current in light bulb L_1?
    e. What is the voltage across light bulb L_1?
    f. What is the voltage across light bulb L_2?



4. Four resistors are connected in a circuit. The circuit is connected to a battery with emf ε and negligible internal resistance. The current through 9.6 Ω resistor is 0.25 A.

    a. What is the net resistance of the circuit?
    b. What is the voltage drop across 6- Ω resistor?
    c. What is the current in 4- Ω resistor?
    d. What is the emf of the battery?
    e. What is the net power dissipation?



5. Five resistors are connected to a battery with an emf of 12 V and an internal resistance of 1 Ω.

    a. Calculate the external resistance of the circuit.
    b. Calculate the current in the battery.
    c. Calculate the terminal voltage of the battery.
    d. Calculate the power dissipation in the 3- Ω resistor.
    e. Calculate the power dissipation in the internal resistance.

6. Students in the physics lab have a 30W light bulb and a 40W light bulb. Both are meant to be used in a 120V outlet. They experiment connecting the bulbs in series and in parallel to 120V.

   The first student thinks that the 40W bulb will be brighter than the 30W bulb regardless of the connection since brightness depends on the power output and the 40W bulb has a lower resistance therefore a higher power output.

   The second student thinks that the 30W bulb will be brighter in either case because, for the same current, the greater the resistance, the greater the power output and the 30W bulb has the greater resistance.

   a. Ignoring if the prediction is correct, what aspect of the first student's argument is correct and incorrect? Explain your reasoning.

   b. Ignoring if the prediction is correct, what aspect of the second student's argument is correct and incorrect? Explain your reasoning.

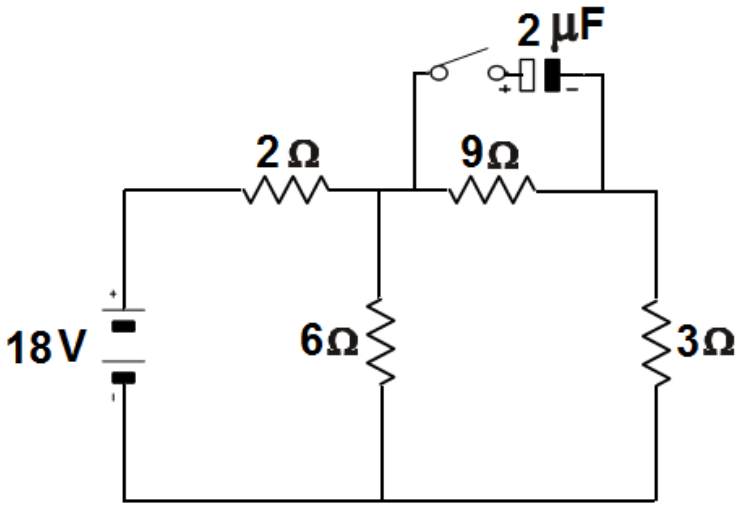
   c. Rank the following light bulbs from 1 to 4, 1 being the brightest and 4 being the least bright. Justify your answer.

      _____ the 30W bulb in parallel

      _____ the 40W bulb in parallel

      _____ the 30W bulb in series

      _____ the 40W bulb in series



7. Four resistors and a capacitor are connected to an 18 V battery with negligible internal resistance, as shown on the diagram. Initially the capacitor is disconnected from the battery – switch is open

   a. Calculate the net resistance of the circuit.
   b. Calculate the current in the 2-Ω resistor.
   c. Calculate the current in the 3-Ω resistor.

Switch is closed and the current reached constant value.

   d. Calculate the charge on the capacitor.
   e. Calculate the energy stored in the capacitor.

8. A few students in the lab are given various resistors, an ammeter, and a battery with internal resistance. They are asked to determine the emf and the internal resistance. Using only the equipment given.

    a. Describe a procedure they should use to collect data to determine the emf and internal resistance.

    b. Write and an equation that relates emf, internal resistance, external resistance, and current.

    c. The following is a chart of the data they came up with. Use this data to create a graph from which you can determine the emf and the internal resistance.

Current (A)	Resistance (Ω)
6.25	5
5.88	10
4.44	20
4.04	30
1.39	40
1.18	50

    d. Calculate the emf and the internal resistance.

The students are now given a voltmeter and new resistor to use with the rest of the equipment. They are now asked to determine if the new resistor is ohmic.

    e. Draw a circuit diagram of the circuit that the students should use to determine if the resistor is ohmic.

    f. Describe a procedure they should use to collect data and determine if the new resistor is ohmic.

Multiple Choice Answers

1. C	11. C	21. D	31. C
2. B	12. D	22. C	32. C
3. B	13. A	23. B	33. D
4. D	14. C	24. D	34. D
5. C	15. C	25. D	35. C
6. A	16. A	26. A	36. D
7. B	17. B	27. B	37. A, D
8. C	18. C	28. C	38. B, D
9. B	19. B	29. A	39. B, C
10. C	20. D	30. E	40. A, D

Free Response Answers

1. a) Heating coils in parallel, voltmeter in parallel, ammeter in series.
   b) 1.3 A
   c) 11.35 V
   d) 15.7 W
   e) 4470 J

2. a) Two resistors in series with the motor. This reduces the currents to the required 0.5 A.
   b) 24 Ω
   c) 6 W

3. a) 288 Ω b) 50 W c) The power is less. d) 0.42 A e) 80 V f) 40 V

4. a) 24 Ω b) 0.6 V c) 0.15 A d) 6 V e) 1.5 W

5. a) 8 Ω b) 1.3 A c) 10.7 V d) 2.25 W e) 1.7 W

6. a) The 40W bulb does have a lower resistance than the 30W bulb so when the voltage across each is the same, the lower the resistance the higher the power. However the voltage is only the same for each bulb when they are connected in parallel.

   b) The 30W bulb does have a higher resistance than the 40W bulb so when the current though each light bulb is the same the higher the resistance, the higher the power. However, they will only have the same current when they are connected in series.

   c) Ranking: 2, 1, 3, 4
   Corresponding powers: 40W, 30W, 9.4W, 7.1W

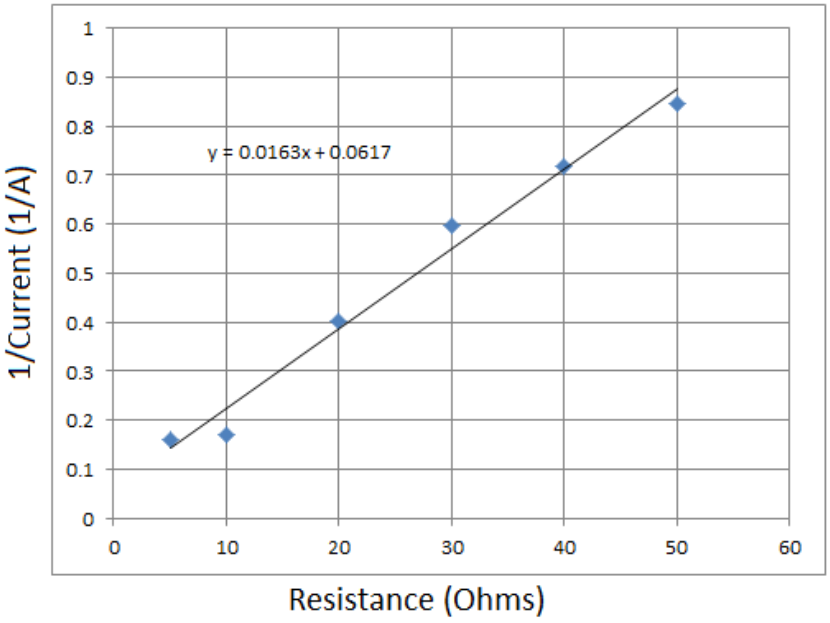
7. a) 6 Ω b) 3 A c) 1 A d) 18 C e) 81 J

8. a) Connect the first resistor in series with the ammeter and the battery. Record the current and the external resistance. Repeat for all the other resistors.

b) $V_T = \varepsilon - Ir$

$IR = \varepsilon - Ir$ $\qquad \frac{1}{I} = \frac{R}{\varepsilon} + \frac{r}{\varepsilon}$

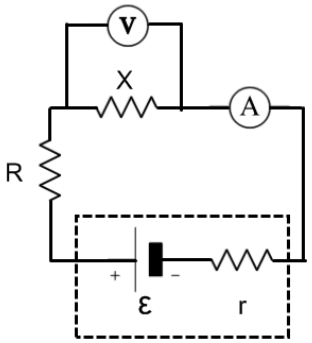
c)



d) $slope = \frac{1}{\varepsilon} = 0.0163$ $\qquad \varepsilon = \frac{1}{0.0163} = 61V$

$intercept = \frac{r}{\varepsilon} = 0.0617$ $\qquad r = (\varepsilon)(intercept) = (61)(0.0617) = 3.8\Omega$

e)



f)

They should set up the circuit as shown and measure the current and the voltage. Then repeat for all of the known resistors. Then they should graph current verses voltage. If the relationship is linear, the resistor is Ohmic.

Name: _____ **Class:** _____ **Date:** _____ **ID: A**

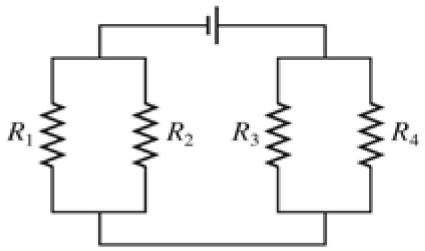
AP Circuits Conceptual Questions MC

____ 1) Four unequal resistors are connected in series with each other. Which one of the following statements is correct about this combination?
A) The equivalent resistance is equal to that of any one of the resistors.
B) The equivalent resistance is equal to average of the four resistances.
C) The equivalent resistance is less than that of the smallest resistor.
D) The equivalent resistance is less than that of the largest resistor.
E) The equivalent resistance is more than the largest resistance.

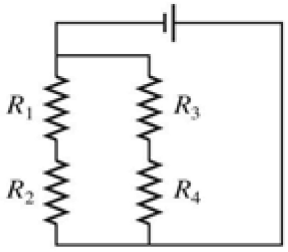
____ 2) Four unequal resistors are connected in a parallel with each other. Which one of the following statements is correct about this combination?
A) The equivalent resistance is less than that of the smallest resistor.
B) The equivalent resistance is equal to the average of the four resistances.
C) The equivalent resistance is midway between the largest and smallest resistance.
D) The equivalent resistance is more than the largest resistance.
E) None of the other choices is correct.

____ 3) Draw a circuit with a battery connected to four resistors, *R*1, *R*2, *R*3, and *R*4, as follows. Resistors *R*1 and *R*2 are connected in parallel with each other, resistors *R*3 and *R*4 are connected in parallel with each other, and both parallel sets of resistors are connected in series with each other across the battery.

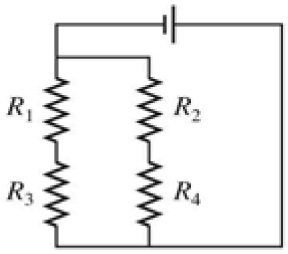
A)



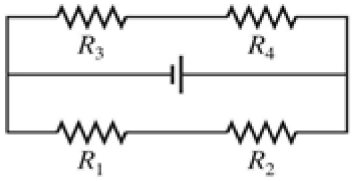
B)



C)



D)



____ 4) When unequal resistors are connected in parallel in a circuit,
A) the same current always runs through each resistor.
B) the potential drop is always the same across each resistor.
C) the largest resistance has the largest current through it.
D) the power generated in each resistor is the same.

____ 5) When unequal resistors are connected in series across an ideal battery,
A) the same power is dissipated in each one.
B) the potential difference across each is the same.
C) the current flowing in each is the same.
D) the equivalent resistance of the circuit is less than that of the smallest resistor.
E) the equivalent resistance of the circuit is equal to the average of all the resistances.

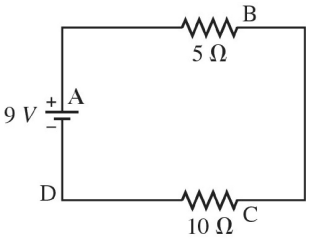
____ 6) As more resistors are added in series to a constant voltage source, the power supplied by the source
A) increases.
B) decreases.
C) does not change.
D) increases for a time and then starts to decrease.

____ 7) As more resistors are added in parallel across a constant voltage source, the power supplied by the source
A) increases.
B) decreases.
C) does not change.
D) increases for a time and then starts to decrease.

____ 8) When different resistors are connected in parallel across an ideal battery, we can be certain that
A) the same current flows in each one.
B) the potential difference across each is the same.
C) the power dissipated in each is the same.
D) their equivalent resistance is greater than the resistance of any one of the individual resistances.
E) their equivalent resistance is equal to the average of the individual resistances.

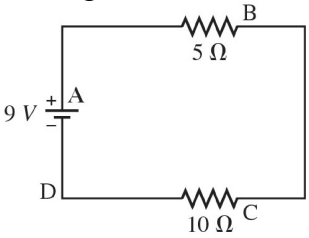
____ 9) The lamps in a string of decorative lights are connected in parallel across a constant-voltage power source. What happens if one lamp burns out? (Assume negligible resistance in the wires leading to the lamps.)
A) The brightness of the lamps will not change appreciably.
B) The other lamps get brighter equally.
C) The other lamps get brighter, but some get brighter than others.
D) The other lamps get dimmer equally.
E) The other lamps get dimmer, but some get dimmer than others.

____ 10) A 9-V battery is hooked up to two resistors in series using wires of negligible resistance. One has a resistance of 5 Ω, and the other has a resistance of 10 Ω. Several locations along the circuit are marked with letters, as shown in the figure. Which statements about this circuit are true? (There could be more than one correct choice.)



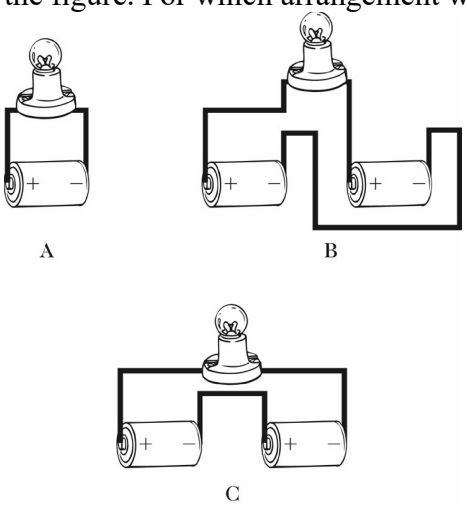
A) The current is exactly the same at points A, B, C, and D.
B) The current at A is greater than the current at B, which is equal to the current at C, which is greater than the current at D.
C) The current at A is greater than the current at B, which is greater than the current at C, which is greater than the current at D.
D) The potential at B is equal to the potential at C.
E) The potential at D is equal to the potential at C.

____ 11) A 9-V battery is hooked up to two resistors in series. One has a resistance of 5 Ω, and the other has a resistance of 10 Ω. Several locations along the circuit are marked with letters, as shown in the figure. Through which resistor is energy being dissipated at the higher rate?



A) the 10-Ω resistor
B) the 5-Ω resistor
C) Energy is being dissipated by both resistors at the same rate.

____ 12) Identical ideal batteries are connected in different arrangements to the same light bulb, as shown in the figure. For which arrangement will the bulb shine the *brightest*?



A) A
B) B
C) C

AP Circuits Conceptual Questions MC
Answer Section

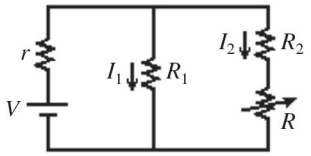
1) ANS: E PTS: 1 REF: Var: 1
2) ANS: A PTS: 1 REF: Var: 1
3) ANS: A PTS: 1 REF: Var: 1
4) ANS: B PTS: 1 REF: Var: 1
5) ANS: C PTS: 1 REF: Var: 1
6) ANS: B PTS: 1 REF: Var: 1
7) ANS: A PTS: 1 REF: Var: 1
8) ANS: B PTS: 1 REF: Var: 1
9) ANS: A PTS: 1 REF: Var: 1
10) ANS: A
D

PTS: 1 REF: Var: 1
11) ANS: A PTS: 1 REF: Var: 1
12) ANS: C PTS: 1 REF: Var: 1

Name: _____ **Class:** _____ **Date:** _____ **ID: A**

AP Circuits Word Problems 1 MC

____ 1) In the circuit shown in the figure, the resistor *R* has a variable resistance. As *R* is decreased, what happens to the currents?



A) *I*1 remains unchanged and *I*2 increases.
B) *I*1 decreases and *I*2 decreases.
C) *I*1 decreases and *I*2 increases.
D) *I*1 increases and *I*2 decreases.
E) *I*1 increases and *I*2 increases.

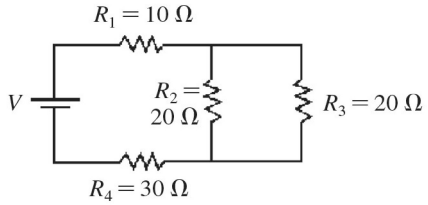
____ 2) A current of 5.0 A flows through an electrical device for 10 seconds. How many electrons flow through this device during this time? ($e = 1.60 \times 10^{-19}$ C)
A) 0.20
B) 20
C) 2.0
D) 3.1 x 10^{20}
E) 31 x 10^{20}

____ 3) How much charge must pass by a point in a wire in 10 s for the current inb the wire to be 0.50 A?
A) 20 C
B) 2.0 C
C) 5.0 C
D) 0.050 C

____ 4) Two 4.0-Ω resistors are connected in parallel, and this combination is connected in series with 3.0 Ω. What is the equivalent resistance of this system?
A) 1.2 Ω
B) 5.0 Ω
C) 7.0 Ω
D) 11 Ω

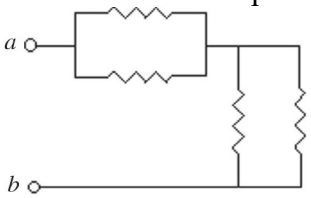
____ 5) A 2.0-Ω resistor is in series with a parallel combination of 4.0-Ω, 6.0-Ω, and 12-Ω resistors. What is the equivalent resistance of this system?
A) 24 Ω
B) 4.0 Ω
C) 1.8 Ω
D) 2.7 Ω

____ 6) What is the equivalent resistance in the circuit shown in the figure?



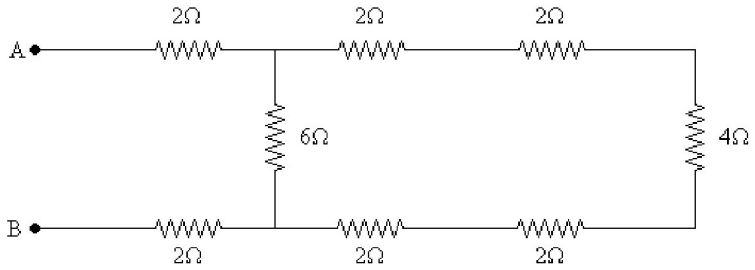
A) 80 Ω
B) 55 Ω
C) 50 Ω
D) 35 Ω

____ 7) The resistors in the circuit shown in the figure each have a resistance of 700 Ω. What is the equivalent resistance between points *a* and *b* of this combination?



A) 700 Ω
B) 2800 Ω
C) 175 Ω
D) 1400 Ω

____ 8) A number of resistors are connected across points A and B as shown in the figure. What is the equivalent resistance between points A and B?



A) 4 Ω
B) 6 Ω
C) 8 Ω
D) 10 Ω
E) 12 Ω

____ 9) A 22-A current flows into a parallel combination of 4.0-Ω, 6.0-Ω, and 12-Ω resistors. What current flows through the 12-Ω resistor?

A) 18 A
B) 11 A
C) 7.3 A
D) 3.7 A

____ 10) A 6.0-Ω and a 12-Ω resistor are connected in parallel across an ideal 36-V battery. What power is dissipated by the 6.0-Ω resistor?
A) 220 W
B) 48 W
C) 490 W
D) 24 W

____ 11) The following three appliances are connected in parallel across an ideal 120-V dc power source: 1200-W toaster, 650-W coffee pot, and 600-W microwave. If all were operated at the same time what total current would they draw from the source?
A) 4.0 A
B) 5.0 A
C) 10 A
D) 20 A

____ 12) A certain 20-A circuit breaker trips when the current in it equals 20 A. What is the maximum number of 100-W light bulbs you can connect in parallel in an ideal 120-V dc circuit without tripping this circuit breaker?
A) 11
B) 17
C) 23
D) 27

AP Circuits Word Problems 1 MC
Answer Section

1)	ANS:	C	PTS: 1	REF:	Var: 1
2)	ANS:	D	PTS: 1	REF:	Var: 5
3)	ANS:	C	PTS: 1	REF:	Var: 3
4)	ANS:	B	PTS: 1	REF:	Var: 1
5)	ANS:	B	PTS: 1	REF:	Var: 1
6)	ANS:	C	PTS: 1	REF:	Var: 1
7)	ANS:	A	PTS: 1	REF:	Var: 9
8)	ANS:	C	PTS: 1	REF:	Var: 1
9)	ANS:	D	PTS: 1	REF:	Var: 1
10)	ANS:	A	PTS: 1	REF:	Var: 1
11)	ANS:	D	PTS: 1	REF:	Var: 1
12)	ANS:	C	PTS: 1	REF:	Var: 1

Name: _____ Class: _____ Date: _____ ID: A

AP Circuits Word Problems 2 MC

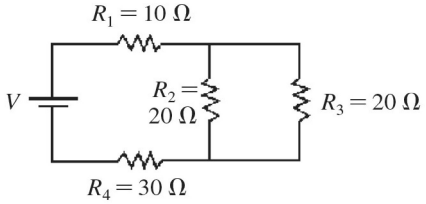
____ 1) A15-Ω resistor is connected in parallel with a 30-Ω resistor. If this combination is now connected in series with an ideal 9.0-V battery and a 20-Ω resistor, what is the current through the 15-Ω resistor?
A) 0.10 A
B) 0.13 A
C) 0.20 A
D) 0.26 A

____ 2) Three resistors of resistances 4.0 Ω, 6.0 Ω, and 10 Ω are connected in parallel. If this combination is now connected in series with an ideal 12-V battery and a 2.0-Ω resistor, what is the current through the 10-Ω resistor?
A) 0.59 A
B) 2.7 A
C) 11 A
D) 16 A

____ 3) Two resistors having resistances of 5.0 Ω and 9.0 Ω are connected in parallel. A 4.0-Ω resistor is then connected in series with the parallel combination. An ideal 6.0-V battery is then connected across the series-parallel combination. What is the current through the 9.0-Ω resistor?
A) 0.35 A
B) 0.53 A
C) 0.83 A
D) 0.30 A
E) 0.67 A

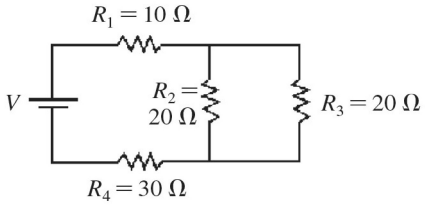
____ 4) Four resistors having resistances of 20 Ω, 40 Ω, 60 Ω, and 80 Ω are connected in series across an ideal dc voltage source. If the current through this circuit is 0.50 A, what is the voltage of the voltage source?
A) 20 V
B) 40 V
C) 60 V
D) 80 V
E) 100 V

____ 5) If $V = 40$ V and the battery is ideal, what is the potential difference across $R1$ in the figure?



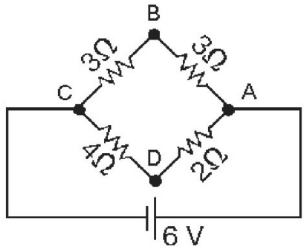
A) 6.7 V
B) 8.0 V
C) 10 V
D) 20 V

____ 6) If $V = 20$ V and the battery is ideal, what is the current through $R3$ in the figure?



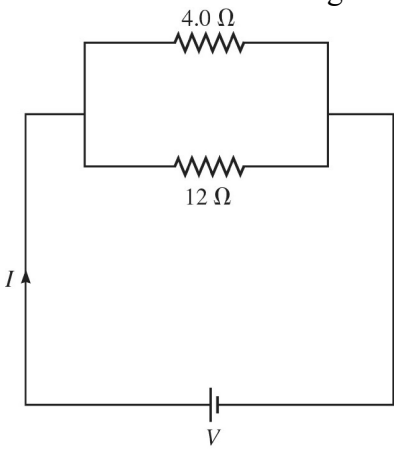
A) 0.050 A
B) 0.20 A
C) 1.0 A
D) 4.0 A

____ 7) What current flows from the battery in the circuit shown in the figure? The battery is ideal, and all the numbers are accurate to two significant figures.



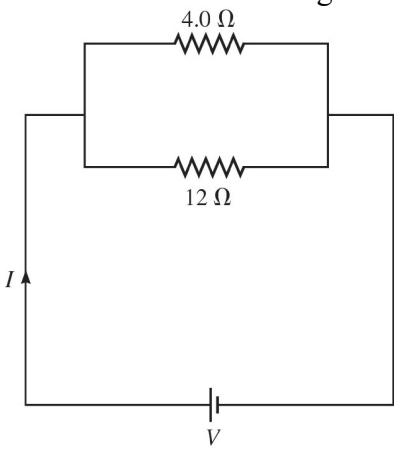
A) 0.35 A
B) 2.0 A
C) 2.5 A
D) 3.0 A

____ 8) A 4.0-Ω resistor is connected to a 12-Ω resistor and this combination is connected to an ideal dc power supply with voltage V as shown in the figure. If the total current in this circuit is $I = 2.0$ A, what is the value of voltage V?



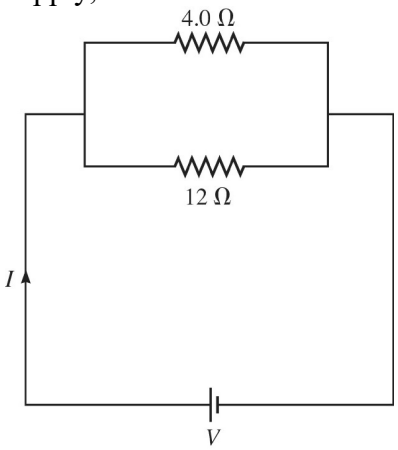
A) 2.0 V
B) 3.0 V
C) 6.0 V
D) 1.5 V
E) 8.0 V

____ 9) A 4.0-Ω resistor is connected with a 12-Ω resistor and both of these are connected across an ideal dc power supply with voltage V as shown in the figure. If the total current in this circuit is $I = 2.0$ A, what is the current through the 4.0-Ω resistor?



A) 2.0 A
B) 2.5 A
C) 0.5 A
D) 3.0 A
E) 1.5 A

____ 10) A 4.0-Ω resistor is connected with a 12-Ω resistor and this combination is connected across an ideal dc power supply with $V = 6.0$ V, as shown in the figure. When a total current I flows from the power supply, what is the current through the 12-Ω resistor?



A) 1.5 A
B) 2.0 A
C) 2.5 A
D) 3.0 A
E) 0.50 A

Name: _____ Class: _____ Date: _____ ID: A

AP Circuits Word Problems 2 MC

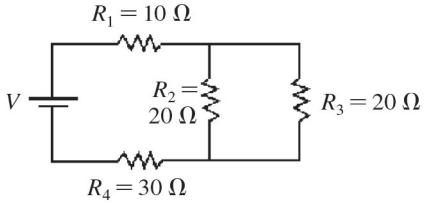
____ 1) A15-Ω resistor is connected in parallel with a 30-Ω resistor. If this combination is now connected in series with an ideal 9.0-V battery and a 20-Ω resistor, what is the current through the 15-Ω resistor?
A) 0.10 A
B) 0.13 A
C) 0.20 A
D) 0.26 A

____ 2) Three resistors of resistances 4.0 Ω, 6.0 Ω, and 10 Ω are connected in parallel. If this combination is now connected in series with an ideal 12-V battery and a 2.0-Ω resistor, what is the current through the 10-Ω resistor?
A) 0.59 A
B) 2.7 A
C) 11 A
D) 16 A

____ 3) Two resistors having resistances of 5.0 Ω and 9.0 Ω are connected in parallel. A 4.0-Ω resistor is then connected in series with the parallel combination. An ideal 6.0-V battery is then connected across the series-parallel combination. What is the current through the 9.0-Ω resistor?
A) 0.35 A
B) 0.53 A
C) 0.83 A
D) 0.30 A
E) 0.67 A

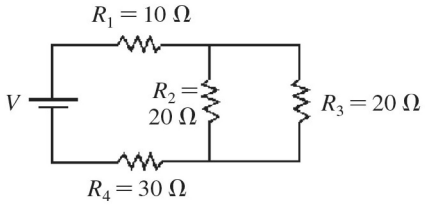
____ 4) Four resistors having resistances of 20 Ω, 40 Ω, 60 Ω, and 80 Ω are connected in series across an ideal dc voltage source. If the current through this circuit is 0.50 A, what is the voltage of the voltage source?
A) 20 V
B) 40 V
C) 60 V
D) 80 V
E) 100 V

____ 5) If $V = 40$ V and the battery is ideal, what is the potential difference across $R1$ in the figure?



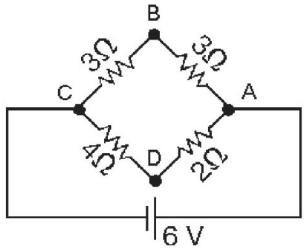
A) 6.7 V
B) 8.0 V
C) 10 V
D) 20 V

____ 6) If $V = 20$ V and the battery is ideal, what is the current through $R3$ in the figure?



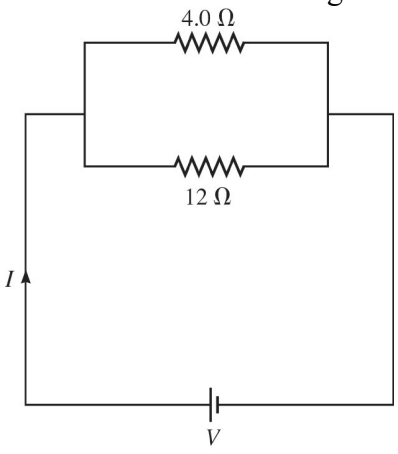
A) 0.050 A
B) 0.20 A
C) 1.0 A
D) 4.0 A

____ 7) What current flows from the battery in the circuit shown in the figure? The battery is ideal, and all the numbers are accurate to two significant figures.



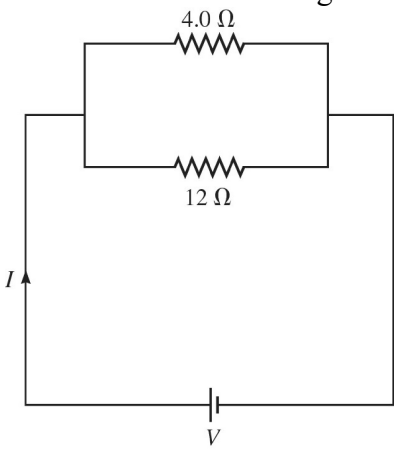
A) 0.35 A
B) 2.0 A
C) 2.5 A
D) 3.0 A

____ 8) A 4.0-Ω resistor is connected to a 12-Ω resistor and this combination is connected to an ideal dc power supply with voltage V as shown in the figure. If the total current in this circuit is $I = 2.0$ A, what is the value of voltage V?



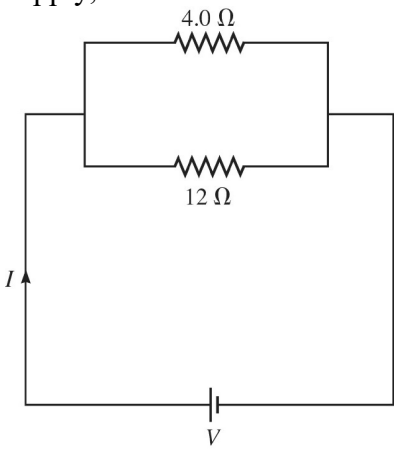
A) 2.0 V
B) 3.0 V
C) 6.0 V
D) 1.5 V
E) 8.0 V

____ 9) A 4.0-Ω resistor is connected with a 12-Ω resistor and both of these are connected across an ideal dc power supply with voltage V as shown in the figure. If the total current in this circuit is $I = 2.0$ A, what is the current through the 4.0-Ω resistor?



A) 2.0 A
B) 2.5 A
C) 0.5 A
D) 3.0 A
E) 1.5 A

____ 10) A 4.0-Ω resistor is connected with a 12-Ω resistor and this combination is connected across an ideal dc power supply with $V = 6.0$ V, as shown in the figure. When a total current I flows from the power supply, what is the current through the 12-Ω resistor?



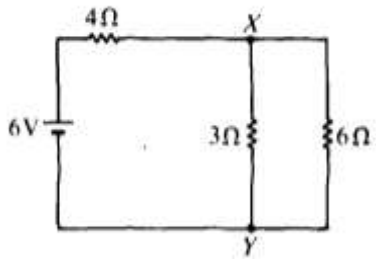
A) 1.5 A
B) 2.0 A
C) 2.5 A
D) 3.0 A
E) 0.50 A

AP Circuits Word Problems 2 MC
Answer Section

1)	ANS: C	PTS: 1	REF: Var: 1	
2)	ANS: A	PTS: 1	REF: Var: 1	
3)	ANS: D	PTS: 1	REF: Var: 1	
4)	ANS: E	PTS: 1	REF: Var: 1	
5)	ANS: B	PTS: 1	REF: Var: 1	
6)	ANS: B	PTS: 1	REF: Var: 1	
7)	ANS: B	PTS: 1	REF: Var: 1	
8)	ANS: C	PTS: 1	REF: Var: 1	
9)	ANS: E	PTS: 1	REF: Var: 1	
10)	ANS: E	PTS: 1	REF: Var: 1	

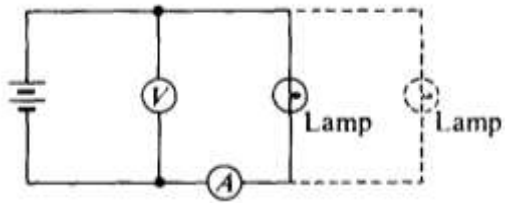
AP Physics – Circuits – Series and Parallel MC 1

Multiple Choice

1. 

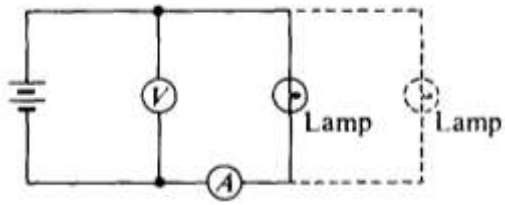
In the circuit shown above, what is the value of the potential difference between points X and Y if the 6–volt battery has no internal resistance?

a. 2 V
b. 3 V
c. 4 V
d. 6V

2. 

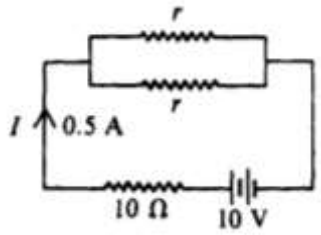
How would the <u>ammeter</u> reading change when another lamp is connected in parallel with the first lamp as shown by the dashed lines?

a. increases, because the current through the ammeter splits to feed both branches
b. remains the same, because the ammeter measures the current provided by the battery
c. decreases, because the resistance of the circuit is increased
d. remains the same, because energy is conserved in the circuit

3. 

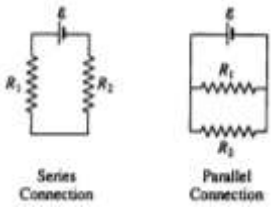
How would the <u>voltmeter</u> reading change when another lamp is connected in parallel with the first lamp as shown by the dashed lines?

a. decreases, because the current is split between the two branches
b. remains the same, because charge is conserved in the circuit
c. increases, because the resistance of the circuit is increased
d. remains the same, because energy is conserved in the circuit

4. 

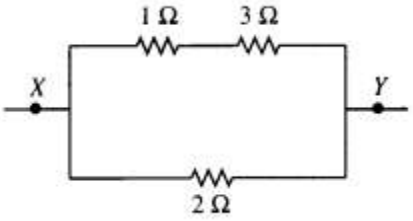
In the circuit shown above, the value of r for which the current I is 0.5 ampere is

a. 1 Ω
b. 5 Ω
c. 10 Ω
d. 20 Ω

5. 

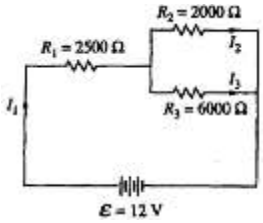
In the diagrams above, resistors R_1 and R_2 are shown in two different connections to the same source of emf ε that has no internal resistance. How does the power dissipated by the resistors in these two cases compare?

a. It is greater for the series connection, because the current is not split.
b. It is greater for the series connection, because the equivalent resistance is greater
c. It is greater for the parallel connection, because the total current is greater.
d. It is greater for the parallel connection, because both resistors have the same voltage.

6. 

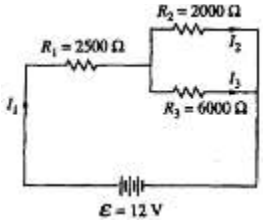
The diagram above shows part of a closed electrical circuit. When there is a steady current in the circuit, the amount of charge passing a point per unit of time is

a. greater in the 1 Ω resistor than in the 3 Ω resistor
b. greater in the 1 Ω resistor than in the 2 Ω resistor
c. greater in the 2 Ω resistor than in the 3 Ω resistor
d. greater at point X than at point Y

7. 

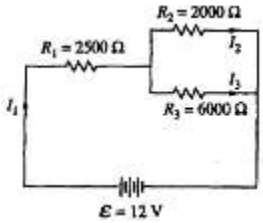
Which current is greater I_1 or I_2?

a. I_1 is greater, because it has more resistance.
b. I_2 is greater, because it has less resistance.
c. I_1 is greater, because of charge conservation.
d. I_2 is greater, because of energy conservation.

8. 

What is the current I_1?

a. 1 mA
b. 3 mA
c. 4 mA
d. 12 mA

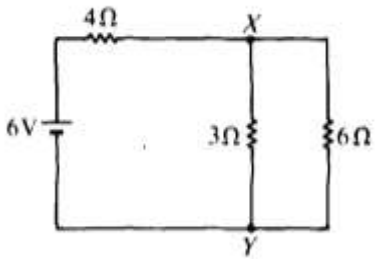
9. 

Which of the following changes would increase the value of I_1?

a. Remove R_3 and the branch containing it.
b. Replace R_2 with another 6000 Ohm resistor.
c. Add an 8000 Ohm resistor in parallel with R_2 and R_3.
d. Rewire the circuit, putting all three resistors in series.

AP Physics – Circuits – Series and Parallel MC 1

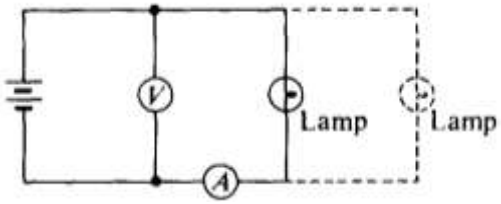
Multiple Choice

1. 

In the circuit shown above, what is the value of the potential difference between points X and Y if the 6–volt battery has no internal resistance?

e. 2 V
f. 3 V
g. 4 V
h. 6V

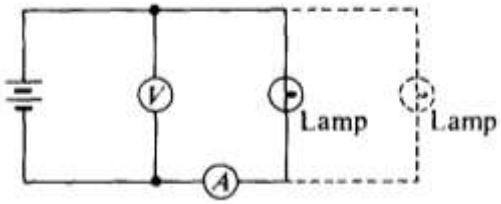
ANS: A

2. 

How would the <u>ammeter</u> reading change when another lamp is connected in parallel with the first lamp as shown by the dashed lines?

e. increases, because the current through the ammeter splits to feed both branches
f. remains the same, because the ammeter measures the current provided by the battery
g. decreases, because the resistance of the circuit is increased
h. remains the same, because energy is conserved in the circuit

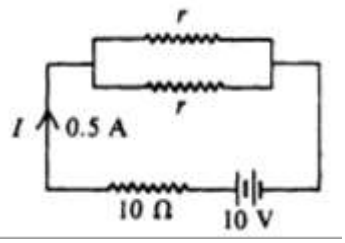
ANS: A

3. 

How would the <u>voltmeter</u> reading change when another lamp is connected in parallel with the first lamp as shown by the dashed lines?

e. decreases, because the current is split between the two branches
f. remains the same, because charge is conserved in the circuit
g. increases, because the resistance of the circuit is increased
h. remains the same, because energy is conserved in the circuit

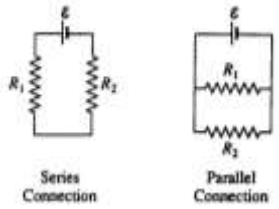
ANS: D

4. 

In the circuit shown above, the value of r for which the current I is 0.5 ampere is

e. 1 Ω
f. 5 Ω
g. 10 Ω
h. 20 Ω

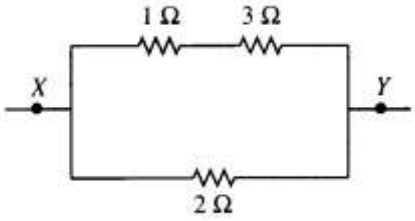
ANS: D

5. 

In the diagrams above, resistors R_1 and R_2 are shown in two different connections to the same source of emf ε that has no internal resistance. How does the power dissipated by the resistors in these two cases compare?

e. It is greater for the series connection, because the current is not split.
f. It is greater for the series connection, because the equivalent resistance is greater
g. It is greater for the parallel connection, because the total current is greater.
h. It is greater for the parallel connection, because both resistors have the same voltage.

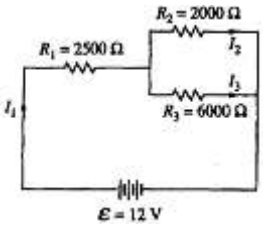
ANS: C

6. 

The diagram above shows part of a closed electrical circuit. When there is a steady current in the circuit, the amount of charge passing a point per unit of time is

e. greater in the 1 Ω resistor than in the 3 Ω resistor
f. greater in the 1 Ω resistor than in the 2 Ω resistor
g. greater in the 2 Ω resistor than in the 3 Ω resistor
h. greater at point X than at point Y

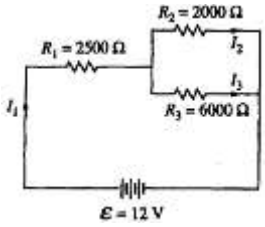
ANS: C

7. 

Which current is greater I_1 or I_2?

e. I_1 is greater, because it has more resistance.
f. I_2 is greater, because it has less resistance.
g. I_1 is greater, because of charge conservation.
h. I_2 is greater, because of energy conservation.

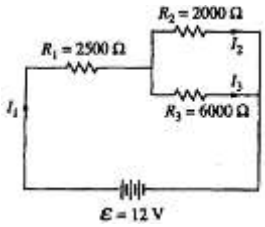
ANS: C

8. 

What is the current I_1?

e. 1 mA
f. 3 mA
g. 4 mA
h. 12 mA

ANS: B

9. 

Which of the following changes would increase the value of I_1?

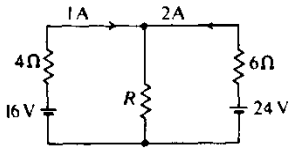
e. Remove R_3 and the branch containing it.
f. Replace R_2 with another 6000 Ohm resistor.
g. Add an 8000 Ohm resistor in parallel with R_2 and R_3.
h. Rewire the circuit, putting all three resistors in series.

ANS: C

AP Physics – Circuits – Series and Parallel 2

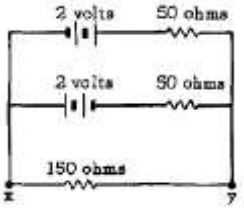
Multiple Choice

1. In the circuit shown, what is the resistance R?

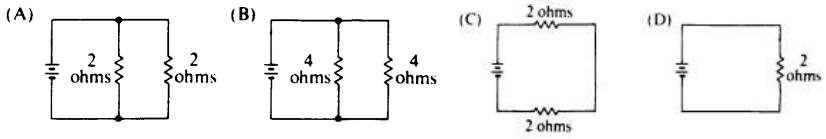


   a. 3 Ω
   b. 4 Ω
   c. 6 Ω
   d. 12 Ω

2. In the circuit shown, the current in each battery is 0.04 ampere. What is the potential difference between the points x and y?

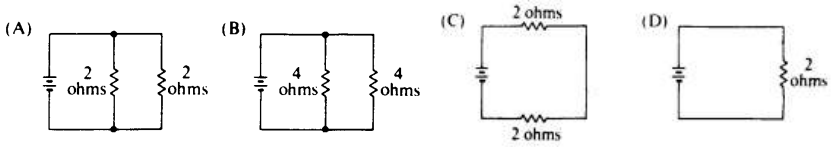


   a. 8 V
   b. 2 V
   c. 0 V
   d. 4 V

3. 

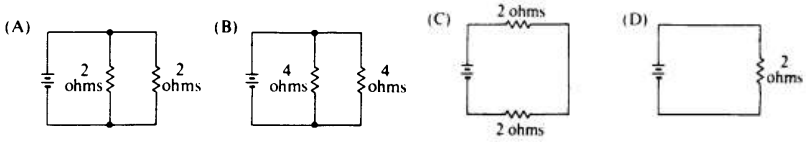
   The batteries in each of the circuits shown above are identical and the wires have negligible resistance. In which circuit is the current furnished by the battery the greatest?

   a. A
   b. B
   c. C
   d. D

4. 

   The batteries in each of the circuits shown above are identical and the wires have negligible resistance. In which circuit is the equivalent resistance connected to the battery the greatest?

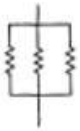
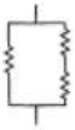
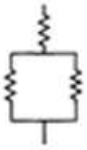
   (A) A
   (B) B
   (C) C
   (D) D

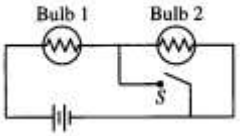
5. 

   The batteries in each of the circuits shown above are identical and the wires have negligible resistance. Which circuit dissipates the least power?

   (A) A
   (B) B
   (C) C
   (D) D

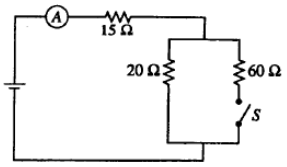
6. Which of the following combinations of 4Ω resistors would dissipate 24 W when connected to a 12 Volt battery?

(A)  (B)  (C)  (D) 

7. 

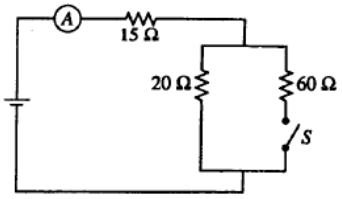
The circuit in the figure above contains two identical lightbulbs in series with a battery. At first both bulbs glow with equal brightness. When switch S is closed, which of the following occurs to the bulbs?

	Bulb I	Bulb 2
a.	Goes out	Gets brighter
b.	Gets brighter	Goes out
c.	Gets brighter	Gets slightly dimmer
d.	Gets slightly dimmer	Gets brighter

8. 

When the switch S is open in the circuit shown above, the reading on the ammeter A is 2.0 A. When the switch is closed, the reading on the ammeter is

(A) Doubled
(B) increased slightly but not doubled
(C) the same
(D) decreased slightly

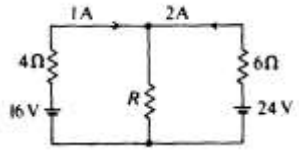
9. 

Two conducting cylindrical wires are made out of the same material. Wire X has twice as much resistance than wire Y. Which of the following could be true?

(A) Wire X is twice the diameter of wire Y.
(B) Wire X is twice as long and twice the diameter of wire Y.
(C) Wire Y is twice as long and twice the diameter of wire X.
(D) Wire Y is twice as long as wire X.

AP Physics – Circuits – Series and Parallel 2

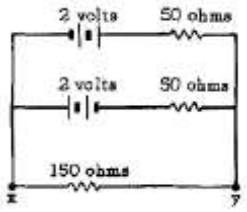
Multiple Choice

1. 

In the circuit shown above, what is the resistance R?

e. 3 Ω
f. 4 Ω
g. 6 Ω
h. 12 Ω

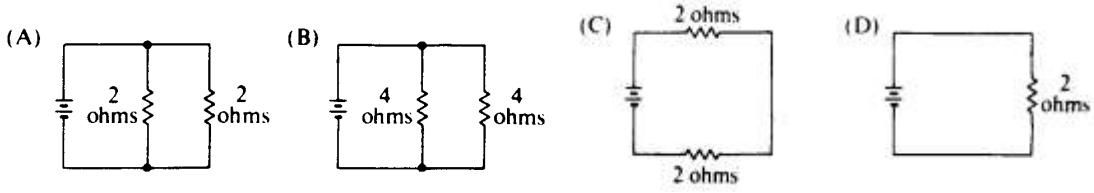
ANS: B

2. 

In the circuit shown above, the current in each battery is 0.04 ampere. What is the potential difference between the points x and y?

e. 8 V
f. 2 V
g. 0 V
h. 4 V

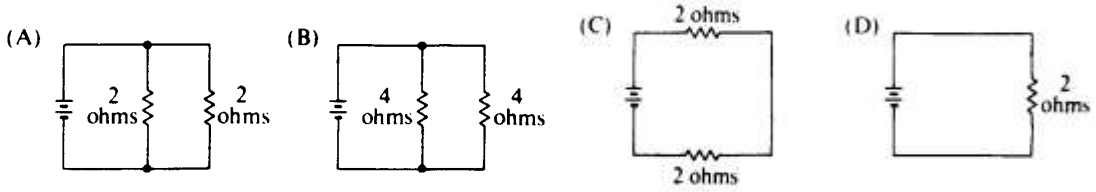
ANS: C

3. 

The batteries in each of the circuits shown above are identical and the wires have negligible resistance. In which circuit is the current furnished by the battery the greatest?

e. A
f. B
g. C
h. D

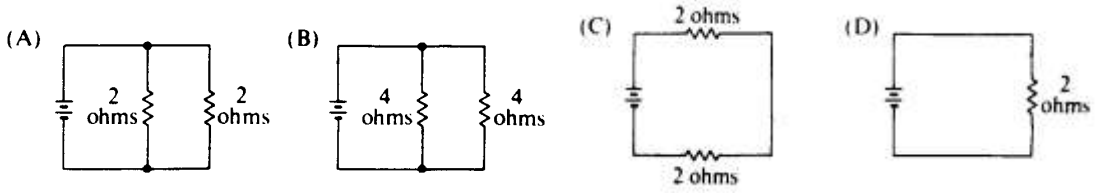
ANS: A

4. 

The batteries in each of the circuits shown above are identical and the wires have negligible resistance. In which circuit is the equivalent resistance connected to the battery the greatest?

(A) A
(B) B
(C) C
(D) D

ANS: C

5. 

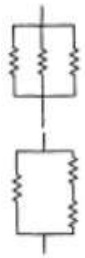
The batteries in each of the circuits shown above are identical and the wires have negligible resistance. Which circuit dissipates the least power?

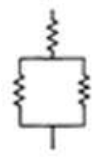
(E) A
(F) B
(G) C
(H) D

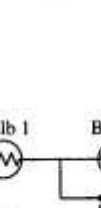
ANS: C

6. Which of the following combinations of 4Ω resistors would dissipate 24 W when connected to a 12 Volt battery?

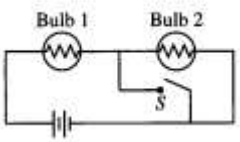
(B) 

(C) 

(D) 

(E) 

ANS: D

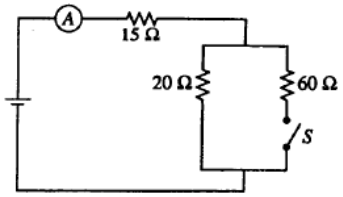
7. 

The circuit in the figure above contains two identical lightbulbs in series with a battery. At first both bulbs glow with equal brightness. When switch S is closed, which of the following occurs to the bulbs?

Bulb I Bulb 2

e. Goes out Gets brighter
f. Gets brighter Goes out
g. Gets brighter Gets slightly dimmer
h. Gets slightly dimmer Gets brighter

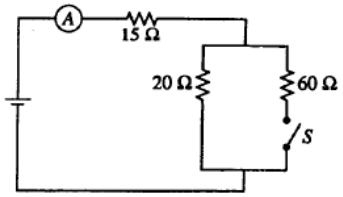
ANS: B

8. 

When the switch S is open in the circuit shown above, the reading on the ammeter A is 2.0 A. When the switch is closed, the reading on the ammeter is

(A) Doubled
(B) increased slightly but not doubled
(C) the same
(D) decreased slightly

ANS: B

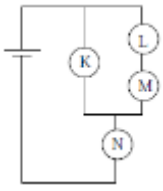
9. 

Two conducting cylindrical wires are made out of the same material. Wire X has twice as much resistance than wire Y. Which of the following could be true?

(E) Wire X is twice the diameter of wire Y.
(F) Wire X is twice as long and twice the diameter of wire Y.
(G) Wire Y is twice as long and twice the diameter of wire X.
(H) Wire Y is twice as long as wire X.

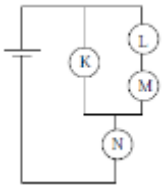
ANS: C

Multiple Choice

10. 

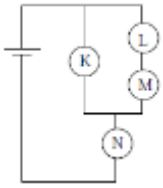
Four identical light bulbs K, L, M, and N are connected in the electrical circuit shown above. Rank the current through the bulbs.

a. K > L > M > N
b. L = M > K = N
c. L > M > K > N
d. N > K > L = M

11. 

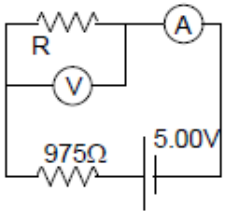
Four identical light bulbs K, L, M, and N are connected in the electrical circuit shown above. Bulb K burns out. Which of the following statements is true?

a. Only bulb N goes out.
b. Bulb N becomes brighter.
c. The brightness of bulb N remains the same.
d. Bulb N becomes dimmer but does not go out.

12. 

Four identical light bulbs K, L, M, and N are connected in the electrical circuit shown above. Bulb M burns out. Which of the following statements is true?

a. Only bulb M goes out.
b. Bulb N goes out but at least one other bulb remains lit.
c. The brightness of bulb N remains the same.
d. Bulb N becomes dimmer but does not go out.

13. 

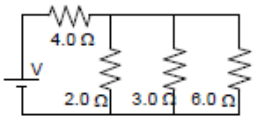
The voltmeter in the accompanying circuit diagram has internal resistance 10.0 kΩ and the ammeter has internal resistance 25.0 Ω. The ammeter reading is 1.00 mA. The voltmeter reading is most nearly:

a. 1.0 V
b. 3.0 V

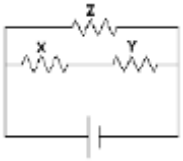
c. 4.0 V
d. 5.0 V

14. When two resistors, having resistance R_1 and R_2, are connected in parallel, the equivalent resistance of the combination is 5 Ω. Which of the following statements about the resistances is correct?
    a. Both R1 and R2 are greater than 5 Ω.
    b. Both R_1 and R_2 are equal to 5 Ω.
    c. Both R_1 and R_2 are less than 5 Ω.
    d. The sum of R_1 and R_2 is 5 Ω.

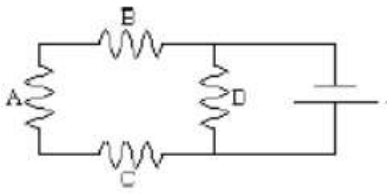
15. When a single resistor is connected to a battery, a total power *P* is dissipated in the circuit. How much total power is dissipated in a circuit if *n* identical resistors are connected in series using the same battery? Assume the internal resistance of the battery is zero.
    a. n^2P
    b. nP
    c. P/n
    d. P/n^2

16. 

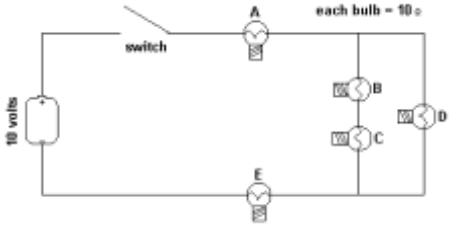
In the accompanying circuit diagram, the current through the 6.0–Ω resistor is 1.0 A. What is the power supply voltage *V*?
    a. 10 V
    b. 18 V
    c. 24 V
    d. 30 V

17. 

Given the simple electrical circuit above, if the current in all three resistors is equal, which of the following statements must be true?
    a. X, Y, and Z all have equal resistance
    b. X and Y have equal resistance
    c. X and Y added together have the same resistance as Z
    d. X and Y each have more resistance than Z

18. 

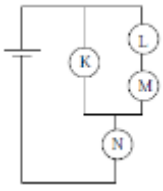
If all of the resistors in the above simple circuit have the same resistance, which would dissipate the greatest power?
    a. resistor A
    b. resistor B
    c. resistor C
    d. resistor D

19. 

Five identical light bulbs, each with a resistance of 10 ohms, are connected in a simple electrical circuit with a switch and a 10 volt battery as shown in the diagram. Which bulb (or bulbs) could burn out without causing other bulbs in the circuit to also go out?

a. only bulb D
b. only bulb E
c. only bulbs C or D
d. bulbs B, C, or D

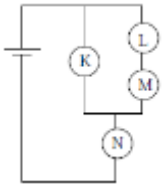
Multiple Choice

20. 

Four identical light bulbs K, L, M, and N are connected in the electrical circuit shown above. Rank the current through the bulbs.

e. K > L > M > N
f. L = M > K = N
g. L > M > K > N
h. N > K > L = M

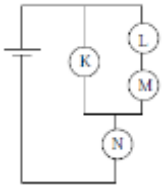
ANS: D

21. 

Four identical light bulbs K, L, M, and N are connected in the electrical circuit shown above. Bulb K burns out. Which of the following statements is true?

e. Only bulb N goes out.
f. Bulb N becomes brighter.
g. The brightness of bulb N remains the same.
h. Bulb N becomes dimmer but does not go out.

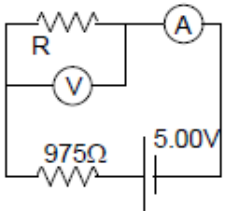
ANS: D

22. 

Four identical light bulbs K, L, M, and N are connected in the electrical circuit shown above. Bulb M burns out. Which of the following statements is true?

e. Only bulb M goes out.
f. Bulb N goes out but at least one other bulb remains lit.
g. The brightness of bulb N remains the same.
h. Bulb N becomes dimmer but does not go out.

ANS: D

23. 

The voltmeter in the accompanying circuit diagram has internal resistance 10.0 kΩ and the ammeter has internal resistance 25.0 Ω. The ammeter reading is 1.00 mA. The voltmeter reading is most nearly:

e. 1.0 V
f. 3.0 V
g. 4.0 V
h. 5.0 V

ANS: C

24. When two resistors, having resistance R_1 and R_2, are connected in parallel, the equivalent resistance of the combination is 5 Ω. Which of the following statements about the resistances is correct?

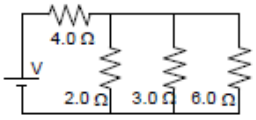
e. Both R1 and R2 are greater than 5 Ω.
f. Both R_1 and R_2 are equal to 5 Ω.
g. Both R_1 and R_2 are less than 5 Ω.
h. The sum of R_1 and R_2 is 5 Ω.

ANS: A

25. When a single resistor is connected to a battery, a total power *P* is dissipated in the circuit. How much total power is dissipated in a circuit if *n* identical resistors are connected in series using the same battery? Assume the internal resistance of the battery is zero.

e. n^2P
f. nP
g. P/n
h. P/n^2

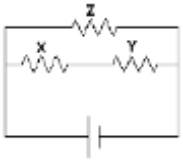
ANS: C



26. In the accompanying circuit diagram, the current through the 6.0–Ω resistor is 1.0 A. What is the power supply voltage *V*?

e. 10 V
f. 18 V
g. 24 V
h. 30 V

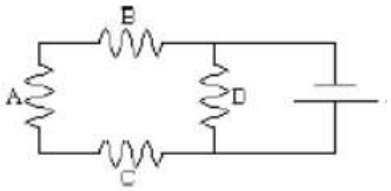
ANS: D



27. Given the simple electrical circuit above, if the current in all three resistors is equal, which of the following statements must be true?

e. X, Y, and Z all have equal resistance
f. X and Y have equal resistance
g. X and Y added together have the same resistance as Z
h. X and Y each have more resistance than Z

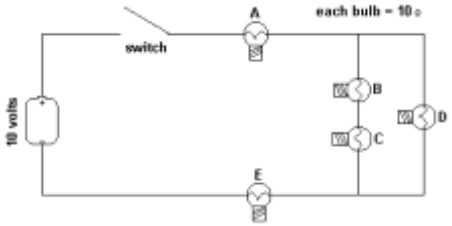
ANS: C

28. 

If all of the resistors in the above simple circuit have the same resistance, which would dissipate the greatest power?

e. resistor A
f. resistor B
g. resistor C
h. resistor D

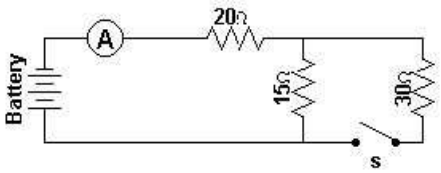
ANS: D

29. 

Five identical light bulbs, each with a resistance of 10 ohms, are connected in a simple electrical circuit with a switch and a 10 volt battery as shown in the diagram. Which bulb (or bulbs) could burn out without causing other bulbs in the circuit to also go out?

e. only bulb D
f. only bulb E
g. only bulbs C or D
h. bulbs B, C, or D

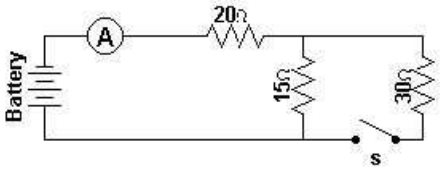
ANS: A

30. 

An ideal battery, an ideal ammeter, a switch and three resistors are connected as shown. With the switch open as shown in the diagram the ammeter reads 2.0 amperes.

With the switch open, what would be the potential difference across the 15 ohm resistor?

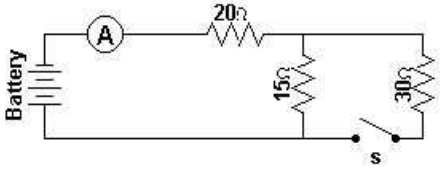
(A) 30 V
(B) 40 V
(C) 60 V
(D) 70 V

31. 

An ideal battery, an ideal ammeter, a switch and three resistors are connected as shown. With the switch open as shown in the diagram the ammeter reads 2.0 amperes.

With the switch open, what must be the voltage supplied by the battery?

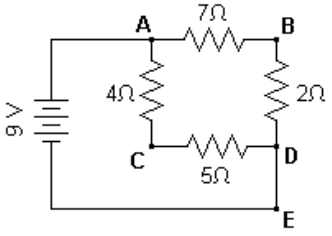
(A) 30 V
(B) 40 V
(C) 60 V
(D) 70 V

32. 

An ideal battery, an ideal ammeter, a switch and three resistors are connected as shown. With the switch open as shown in the diagram the ammeter reads 2.0 amperes.

When the switch is closed, what would be the current in the circuit?

(A) 1.7 A
(B) 2.0 A
(C) 2.3 A
(D) 3.0 A

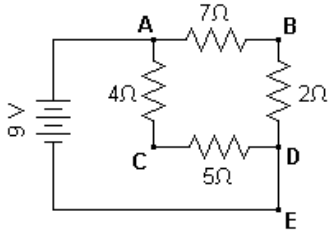
33. 

A 9–volt battery is connected to four resistors to form a simple circuit as shown above.

How would the current through the 2 ohm resistor compare to the current through the 4 ohm resistor?

(A) twice as large
(B) one–half as large
(C) equally as large
(D) four times as large

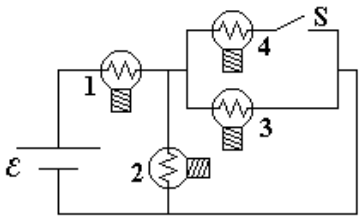
34. A 9–volt battery is connected to four resistors to form a simple circuit as shown.



What would be the potential at point B with respect to point C in the above circuit?

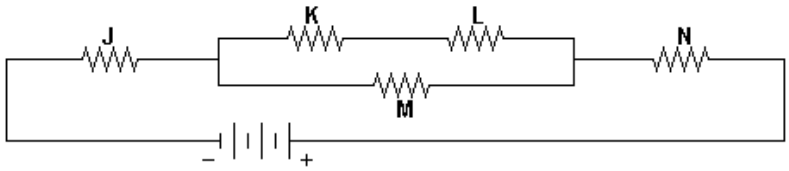
(A) +7 V
(B) +3 V
(C) 0 V
(D) –3 V

35. A circuit is connected as shown. All light bulbs are identical. When the switch in the circuit is closed illuminating bulb #4, which other bulb(s) also become brighter?



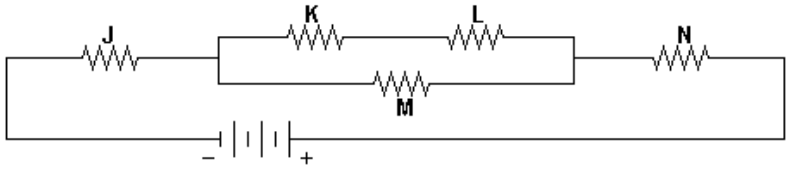
(A) Bulb #1 only
(B) Bulb #2 only
(C) Bulbs #2 and #3 only
(D) Bulbs #1, #2, and #3

36. The diagram below shows five identical resistors connected in a combination series and parallel circuit to a voltage source.

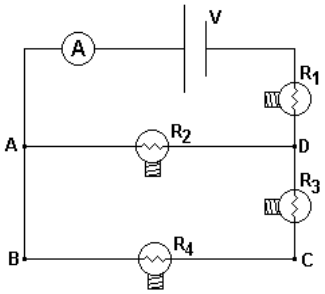


Through which resistor(s) would there be the greatest current?
(A) M only
(B) N only
(C) J and N only
(D) K and L only

37. The diagram below shows five identical resistors connected in a combination series and parallel circuit to a voltage source.

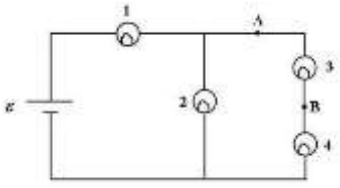


Which resistor(s) have the greatest rate of energy dissipation?
(A) M only
(B) N only
(C) J and N only
(D) K and L only



38. The circuit shown has an ideal ammeter with zero resistance and four identical resistance light bulbs which are initially illuminated. A person removes the bulb R_4 from its socket thereby permanently breaking the electrical circuit at that point. Which statement is true of the circuit after removing the bulb?
(A) The voltage from B → C increases.
(B) The power supplied by the battery increases
(C) The voltage across R_1 increases.
(D) The ammeter reading is unchanged.

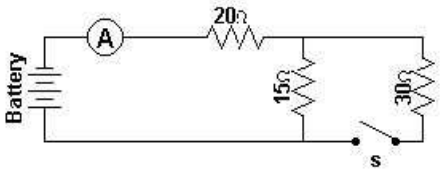
39. For the circuit shown, a shorting wire of negligible resistance is added to the circuit between points A and B. When this shorting wire is added, bulb #3 goes out. Which bulbs (all identical) in the circuit brighten?



(A) Only Bulb 4
(B) Only Bulbs 1 and 4
(C) Only Bulbs 2 and 4
(D) Bulbs 1, 2 and 4

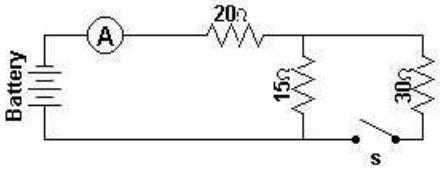
AP Physics – Circuits – Series and Parallel MC 4

Multiple Choice



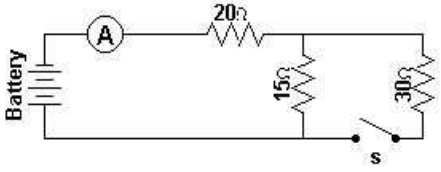
40. An ideal battery, an ideal ammeter, a switch and three resistors are connected as shown. With the switch open as shown in the diagram the ammeter reads 2.0 amperes.
With the switch open, what would be the potential difference across the 15 ohm resistor?
(A) 30 V
(B) 40 V
(C) 60 V
(D) 70 V

ANS: A



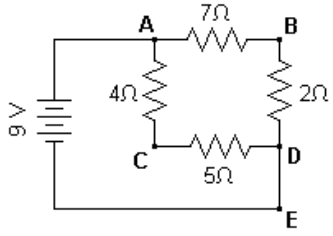
41. An ideal battery, an ideal ammeter, a switch and three resistors are connected as shown. With the switch open as shown in the diagram the ammeter reads 2.0 amperes.
With the switch open, what must be the voltage supplied by the battery?
(A) 30 V
(B) 40 V
(C) 60 V
(D) 70 V

ANS: D



42. An ideal battery, an ideal ammeter, a switch and three resistors are connected as shown. With the switch open as shown in the diagram the ammeter reads 2.0 amperes.
When the switch is closed, what would be the current in the circuit?
(A) 1.7 A
(B) 2.0 A
(C) 2.3 A
(D) 3.0 A

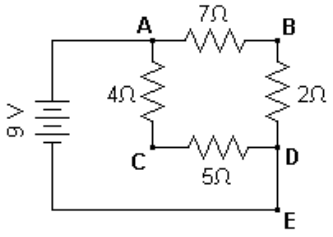
ANS: C



43. A 9–volt battery is connected to four resistors to form a simple circuit as shown above.
How would the current through the 2 ohm resistor compare to the current through the 4 ohm resistor?

(A) twice as large
(B) one–half as large
(C) equally as large
(D) four times as large

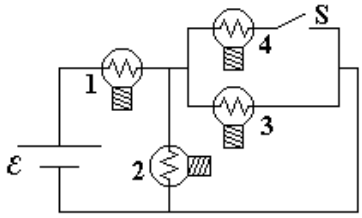
ANS: C



44. A 9–volt battery is connected to four resistors to form a simple circuit as shown above.
What would be the potential at point B with respect to point C in the above circuit?

(A) +7 V
(B) +3 V
(C) 0 V
(D) –3 V

ANS: D

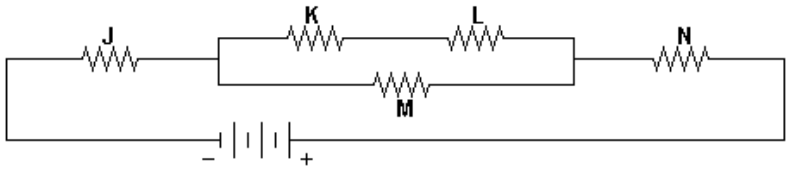


45. A circuit is connected as shown. All light bulbs are identical. When the switch in the circuit is closed illuminating bulb #4, which other bulb(s) also become brighter?

(A) Bulb #1 only
(B) Bulb #2 only
(C) Bulbs #2 and #3 only
(D) Bulbs #1, #2, and #3

ANS: A

46. The diagram below shows five identical resistors connected in a combination series and parallel circuit to a voltage source.

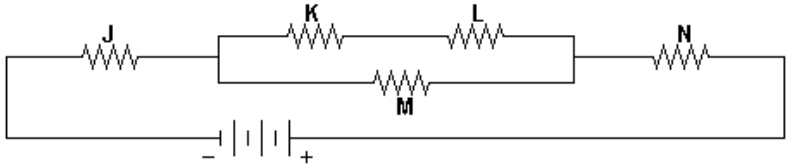


Through which resistor(s) would there be the greatest current?

(A) M only
(B) N only
(C) J and N only
(D) K and L only

ANS: C

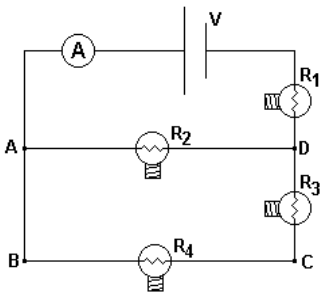
47. The diagram below shows five identical resistors connected in a combination series and parallel circuit to a voltage source.



Which resistor(s) have the greatest rate of energy dissipation?

(A) M only
(B) N only
(C) J and N only
(D) K and L only

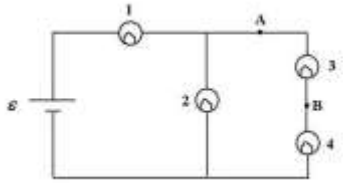
ANS: C

48. 

The circuit shown has an ideal ammeter with zero resistance and four identical resistance light bulbs which are initially illuminated. A person removes the bulb R_4 from its socket thereby permanently breaking the electrical circuit at that point. Which statement is true of the circuit after removing the bulb?

(A) The voltage from B → C increases.
(B) The power supplied by the battery increases
(C) The voltage across R_1 increases.
(D) The ammeter reading is unchanged.

ANS: A

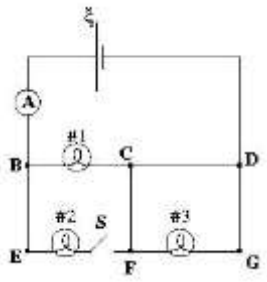
49. 

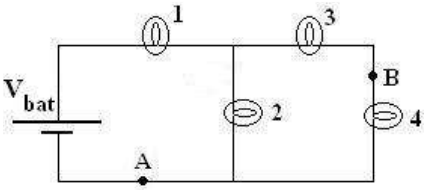
For the circuit shown, a shorting wire of negligible resistance is added to the circuit between points A and B. When this shorting wire is added, bulb #3 goes out. Which bulbs (all identical) in the circuit brighten?

(A) Only Bulb 4
(B) Only Bulbs 1 and 4
(C) Only Bulbs 2 and 4
(D) Bulbs 1, 2 and 4

ANS: B

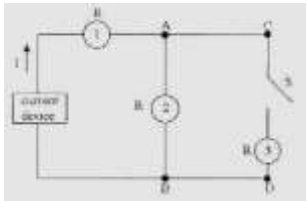
50. For the circuit shown, the ammeter reading is initially *I.* The switch in the circuit then is closed. Consequently:
    (A) The ammeter reading decreases.
    (B) The potential difference between *E* and *F* increases.
    (C) Bulb #3 lights up more brightly.
    (D) The power supplied by the battery decreases.



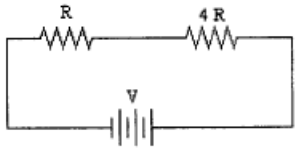


51.
For the circuit shown, when a shorting wire (no resistance) connects the points labeled A and B, which of the numbered light bulbs become brighter? Assume that all four bulbs are identical and have resistance R .
(A) Bulb 1 only
(B) Bulb 2 only
(C) Bulb 3 only
(D) Bulbs 1 and 3 only

52. In the circuit shown, a constant current device is connected to some identical light bulbs. After the switch S in the circuit is closed, which statement is correct about the circuit?
    (A) Bulb #2 becomes brighter.
    (B) Bulb #1 becomes dimmer.
    (C) All three bulbs become equally brighter.
    (D) The voltage between points C and D is decreased.

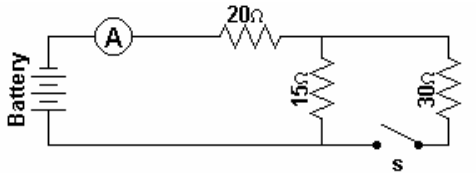


53. Two resistors, one with resistance *R* and the second with resistance 4*R* are placed in a circuit with a voltage *V*. If resistance *R* dissipates power *P*, what would be the power dissipated by the 4*R* resistance?



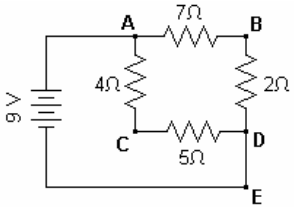
(A) 4 *P*
(B) *P*
(C) 1/2 P
(D) 1/4 P

54. A battery, an ammeter, three resistors, and a switch are connected to form the simple circuit shown. When the switch is closed what would happen to the potential difference across the 15 ohm resistor?
    (A) it would equal the potential difference across the 20 ohm resistor
    (B) it would be twice the potential difference across the 30 ohm resistor
    (C) it would equal the potential difference across the 30 ohm resistor
    (D) it would be half the potential difference across the 30 ohm resistor

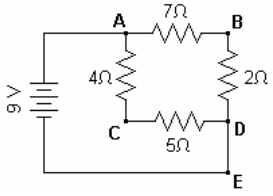


55. A 9–volt battery is connected to four resistors to form a simple circuit as shown below.

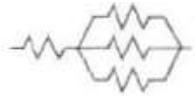
What would be the current at point E in the circuit?
    (A) 2 amp
    (B) 4 amp
    (C) 5 amp
    (D) 7 amp

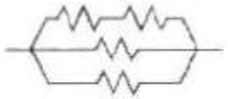


56. A 9–volt battery is connected to four resistors to form a simple circuit as shown below. What would be the potential at point B with respect to point D?
    (A) +2 V
    (B) +4 V
    (C) +5 V
    (D) +7 V

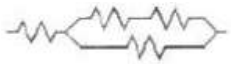


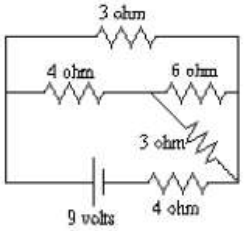
57. Given 4 identical resistors of resistance *R*, which of the following configurations would have an equivalent resistance of 4/3 *R*?

(A) 

(B) 

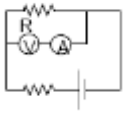
(C) 

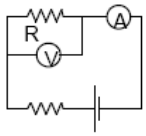
(D) 

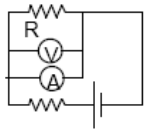


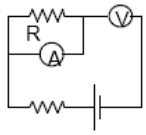
58. What would be the total current being supplied by the battery in the circuit shown?
(A) 3.0 amperes
(B) 2.0
(C) 1.5 amperes
(D) 1.0 amperes

59. Which of the following wiring diagrams could be used to experimentally determine *R* using Ohm's Law? Assume an ideal voltmeter and an ideal ammeter.

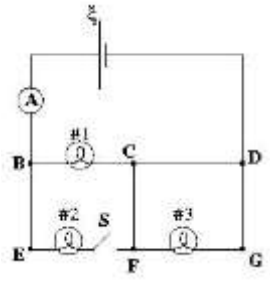
(A) 

(B) 

(C) 

(D) 

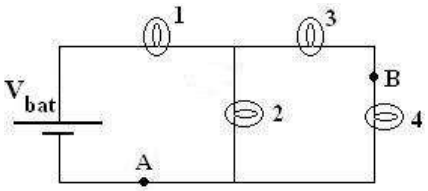
Multiple Choice

60. 

For the circuit shown, the ammeter reading is initially *I*. The switch in the circuit then is closed. Consequently:

(A) The ammeter reading decreases.
(B) The potential difference between *E* and *F* increases.
(C) Bulb #3 lights up more brightly.
(D) The power supplied by the battery decreases.

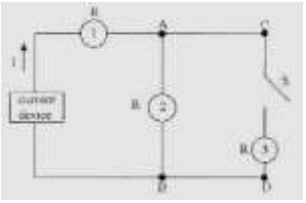
ANS: C

61. 

For the circuit shown, when a shorting wire (no resistance) connects the points labeled A and B, which of the numbered light bulbs become brighter? Assume that all four bulbs are identical and have resistance R .

(A) Bulb 1 only
(B) Bulb 2 only
(C) Bulb 3 only
(D) Bulbs 1 and 3 only

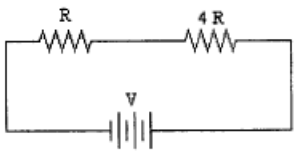
ANS: D

62. 

In the circuit shown above, a constant current device is connected to some identical light bulbs. After the switch S in the circuit is closed, which statement is correct about the circuit?

(A) Bulb #2 becomes brighter.
(B) Bulb #1 becomes dimmer.
(C) All three bulbs become equally brighter.
(D) The voltage between points C and D is decreased.

ANS: D

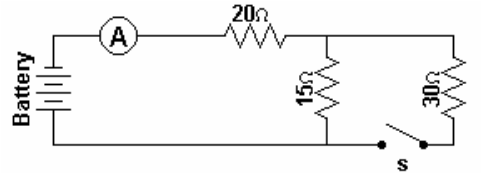
63. 

Two resistors, one with resistance *R* and the second with resistance 4*R* are placed in a circuit with a voltage *V*. If resistance *R* dissipates power *P*, what would be the power dissipated by the 4*R* resistance?

(A) 4 *P*

(B) *P*
(C) 1/2 P
(D) 1/4 P

ANS: A

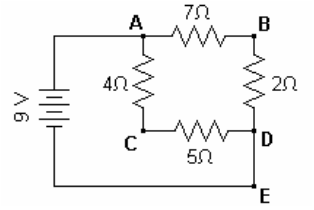
64. 

A battery, an ammeter, three resistors, and a switch are connected to form the simple circuit shown above. When the switch is closed what would happen to the potential difference across the 15 ohm resistor?

(A) it would equal the potential difference across the 20 ohm resistor
(B) it would be twice the potential difference across the 30 ohm resistor
(C) it would equal the potential difference across the 30 ohm resistor
(D) it would be half the potential difference across the 30 ohm resistor

ANS: C

65. A 9–volt battery is connected to four resistors to form a simple circuit as shown below.

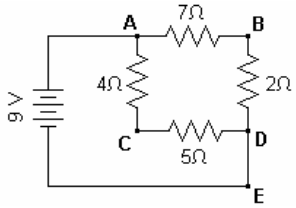


What would be the current at point E in the circuit?

(A) 2 amp
(B) 4 amp
(C) 5 amp
(D) 7 amp

ANS: A

66. A 9–volt battery is connected to four resistors to form a simple circuit as shown below.

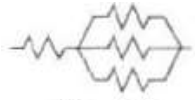


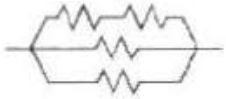
What would be the potential at point B with respect to point D?

(A) +2 V
(B) +4 V
(C) +5 V
(D) +7 V

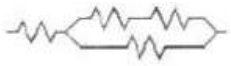
ANS: A

67. Given 4 identical resistors of resistance *R*, which of the following configurations would have an equivalent resistance of 4/3 *R*?

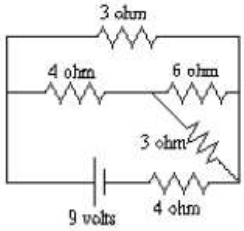
(A) 

(B) 

(C) 

(D) 

ANS: A

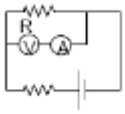
68. 

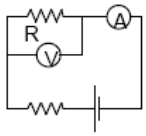
What would be the total current being supplied by the battery in the circuit shown above?

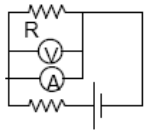
(A) 3.0 amperes
(B) 2.0
(C) 1.5 amperes
(D) 1.0 amperes

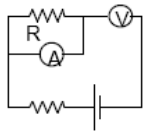
ANS: C

69. Which of the following wiring diagrams could be used to experimentally determine *R* using Ohm's Law? Assume an ideal voltmeter and an ideal ammeter.

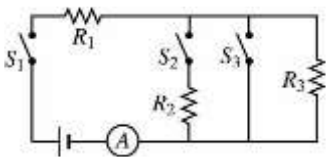
(A) 

(B) 

(C) 

(D) 

ANS: B

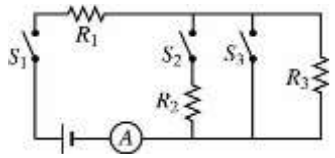
70. 

In the circuit above, the resistors all have the same resistance. The battery, wires, and ammeter have negligible resistance. A closed switch also has negligible resistance.

Closing which of the switches will produce the greatest power dissipation in R_2?

(A) S_1 only
(B) S_2 only
(C) S_1 and S_2 only
(D) S_1 and S_3 only

ANS: C

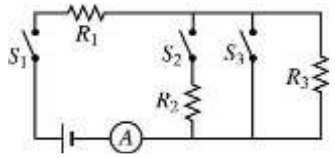
71. 

In the circuit above, the resistors all have the same resistance. The battery, wires, and ammeter have negligible resistance. A closed switch also has negligible resistance.

Closing which of the switches will produce the greatest reading on the ammeter?

(A) S_1 only
(B) S_2 only
(C) S_1 and S_2
(D) S_1 and S_3

ANS: D

72. 

In the circuit above, the resistors all have the same resistance. The battery, wires, and ammeter have negligible resistance. A closed switch also has negligible resistance.

Closing which of the switches will produce the greatest voltage across R_3?

(A) S_1 only
(B) S_2 only
(C) S_1 and S_2 only
(D) S_1 and S_3 only

ANS: A