DATE: NAME: CLASS:

UNIT 3

Unit 3 Summary

BLM 3-1

Goal • Use this summary to review the concepts in Unit 3, Characteristics of Electricity.

Chapter 7 Static charge is produced by electron transfer.

- Static charge is electric charge that is held in one place. (7.1)
- An atom or material becomes charged when electrons transfer into it or out of it. (7.1)
- Insulators keep charges in one place, whereas conductors allow charges to move more easily. (7.1)
- Like charges repel. Opposite charges attract. Neutral objects are attracted to charged objects. (7.2)
- Electric force is a force at a distance. Electric force can be increased by increasing the amount of charge on objects and by decreasing the distance between charged objects. (7.2)

Chapter 8 Ohm's law describes the relationship of current, voltage, and resistance.

- Unlike charges gain electric potential energy when they are moved farther apart. (8.1)
- Voltage (potential difference) is the change in potential energy per coulomb of charge. (8.1)
- Electrical energy depends on the amount of charge and the voltage. (8.1)
- Current electricity is the continuous flow of charge in a complete circuit. (8.2)
- Ohm's law states that the electrical resistance of the circuit is the ratio of the voltage to the current. (8.3)

Chapter 9 Circuits are designed to control the transfer of electrical energy.

- The current is the same in each part of a series circuit, and each load uses a portion of the same voltage. (9.1)
- The current in each part of a parallel circuit depends on the resistance of that path. (9.1)
- When resistors are placed in series, the total resistance of the circuit increases. When resistors are placed in parallel, the total resistance decreases. (9.1)
- Power consumption multiplied by time of use equals the amount of electrical energy used by a device. (9.2)
- Electrical energy can be conserved by changing habits or by using more energy-efficient devices. (9.3)
- Electrical energy is generated in a variety of ways, each with its own benefits and risks. (9.4)

DATE: NAME: CLASS:

UNIT 3

Conduction/Induction Charge Diagrams

BLM 3-10

Goal • Represent charging by induction and charging by conduction.

Questions

1. In terms of the movement of charge, what is the difference between charging by induction and charging by conduction?

_____

_____

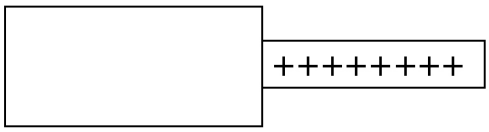
_____

_____

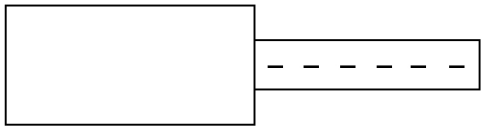
2. Each diagram represents a neutral solid object and a charged rod. Draw the charges on the neutral solid object. Use (–) to represent negative charges and (+) to represent positive charges.

(a)

(b)



(c)



(d)

3. Refer to question 2.

(a) Which diagrams show charging by conduction? _____

(b) Which diagrams show charging by induction? _____

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UNIT 3 # Forces and Electrical Charges **BLM 3-11**

Goal • Review your knowledge of electric charge and its interaction with conductors, insulators, and electroscopes.

What to Do

Use a check mark (✔) to classify the following items as conductors or insulators.

Item	Conductor	Insulator
1. Human body		
2. Air		
3. Wood		
4. Rubber		
5. Plastic		
6. Aluminum		
7. Silver		
8. Wool		
9. Copper		
10. Iron		
11. Fur		

Complete questions 12 to 16 using the terms below. Terms may be used more than once.

negative, *negatively*, *opposite*, *positive*, *positively*

12. _____ charges are unlike charges.

13. Two like charges are either both _____ or both _____.

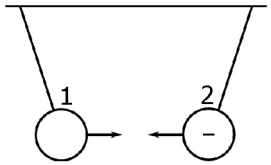
14. If two _____ charges are brought together, they will be attracted.

15. If a _____ or _____ charged object is brought near a neutral electroscope, the leaves will separate.

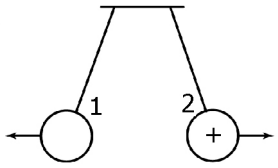
16. If a _____ charged balloon is brought near a positively charged rod, the balloon is attracted to the rod.

17. The diagrams show two charged pith balls hanging on thin threads. Ball 2 has either a positive (+) or a negative (–) charge. The arrows indicate whether the two balls are attracted or repelled. Indicate the charge of ball 1 in each diagram.

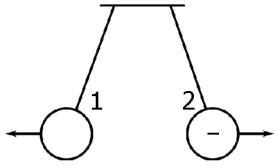
(a)



(b)



(c)



DATE: NAME: CLASS:

UNIT 3

Pop Can Race

BLM 3-12

Goal • Apply your knowledge of electric charge by designing an experiment.

Charge separation causes objects to interact in different ways. Use your experience from the activities in Chapter 7 to help you design an experiment to solve the following problem.

Question

How can you make an empty pop can roll the greatest distance without touching it?

Hypothesize

Write a hypothesis for your experiment.

_____

_____

Materials

- fur or wool
- rubber rod
- plastic or glass rod
- PVC pipe
- balloon
- empty pop can
- plastic wrap and/or plastic bags

Procedure

1. You can work with a partner or in a group. Include any or all of the above materials in the design of your experiment. Write your procedure below.

   _____

   _____

   _____

   _____

2. Test the procedure and revise it as necessary. If you touch the can during the race, the can will be disqualified.

3. Write the revised procedure on the back of the page. Have your procedure approved by your teacher. You will use this procedure in a race against your classmates.

Observations

As your group tests each part of the procedure, write your observations below. You will need to refer to these observations when you decide which method will give you the best chance of winning.

_____

_____

_____

_____

Results

Record the results of the race. Describe briefly how each group (including your own group) moved its can and how well each method worked.

_____

_____

_____

_____

Conclusion

Draw specific conclusions about your group's method of moving the pop can. If your group's method worked, explain why. If your group's method did not work or did not work well, explain why.

_____

_____

_____

Analyze

1. Was your original hypothesis correct? Explain.

   _____

   _____

2. Evaluate your group's approach to this activity. What aspects of your group's procedure and interaction would you change in future investigations?

   _____

   _____

DATE: NAME: CLASS:

UNIT 3

Investigating Static Electricity

BLM 3-13

Goal • Use these pages to complete Conduct an Investigation 7-2C, Investigating Static Electricity.

Question

How do charged objects affect each other?

Procedure

1. Consider the objects in the table. State a hypothesis about how the objects will interact based on their charges.

_____

_____

Charged Object on Watch Glass	Charged Object in Hand			
	Plastic straw	Acetate strip	Glass rod	Ebonite rod
Plastic straw				
Acetate strip				
Glass rod				
Ebonite rod				

2. Follow steps 2 to 8 on page 243 of *Discovering Science 9*. Record your observations in the table.

Analyze

1. Analyze the data you collected. When two identically charged objects were brought together, such as the two plastic straws, how did they interact with each other?

_____

_____

2. List all the pairs of objects that interacted in the same way as identically charged objects.

_____

_____

_____

3. List all the pairs of objects that interacted in an opposite way to identically charged objects.

_____

_____

_____

Conclude and Apply

1. Based on your observations, state:

   (a) how two objects with the same charge interact

_____

_____

   (b) how two objects with opposite charges interact

_____

_____

2. Describe a situation in which the laws of static charge are observed and used in everyday life.

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

Chapter 7 Review

BLM 3-14

Goal • Check your understanding of Chapter 7.

What to Do

Circle the letter of the best answer.

1. Which best describes static electricity?
   A. charges that can be collected and held in one place
   B. charges that exist on a neutral object
   C. charges that power your computer
   D. charges that travel through a conductor

2. Which correctly identifies the charges on the particles of an atom?

	Proton	Electron	Neutron
A.	negative	positive	neutral
B.	neutral	negative	positive
C.	positive	negative	neutral
D.	positive	neutral	negative

3. Which statements describes a solid neutral object becoming positively charged?
   A. Electrons have been added to this object.
   B. Electrons have been removed from this object.
   C. Protons have been added to this object.
   D. Protons have been removed from this object.

4. An object contains 5 million electrons. It is neutral. How can this be?
   A. Electrons have no charge.
   B. It also contains 5 million protons.
   C. The electrons are spread out evenly in the object.
   D. The object is an insulator.

5. Static charge can apply a force without touching the other object. What is this type of force called?
   A. action-at-a-distance force
   B. contact force
   C. imaginary force
   D. long distance force

6. Which is true of charged objects?
   A. Like charges attract and neutral objects are attracted to charged objects.
   B. Like charges attract and opposite charges repel.
   C. Like charges repel and opposite charges attract.
   D. Like charges repel and neutral objects are repelled by charged objects.

7. Which would increase the force between two charged objects?
   A. decreasing the charge on the objects
   B. increasing the charge on the objects
   C. increasing the distance between the objects
   D. placing a third object near the first two

8. Which best describes a neutral solid object that is charged by conduction?
   A. The electrons in the neutral object transfer onto a positively charged object.
   B. The electrons in the neutral solid object relocate when a charged object is brought near.
   C. The protons in the neutral object transfer onto a negatively charged object.
   D. The protons in the neutral solid object relocate when a charged object is brought near.

9. Which best describes a neutral solid object that is charged by induction?
   A. The electrons in the neutral object relocate when a charged object is brought near.
   B. The electrons in the neutral object transfer onto a positively charged object.
   C. The protons in the neutral object relocate when a charged object is brought near.
   D. The protons in the neutral object transfer onto a negatively charged object.

10. An electroscope that is charged positive would have its metal leaves separated. A negatively charged rod is brought close to, but not touching the knob of the positive electroscope. What would the metal leaves do?
    A. become negatively charged
    B. move closer together
    C. move farther apart
    D. not move

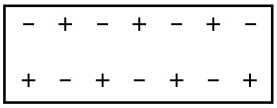
Match the Term on the left with the best Descriptor on the right.
Each Descriptor may be used only once.

Term	Descriptor
_____ 11. electroscope	A. materials that allow electrons to travel freely
_____ 12. Van de Graaff generator	B. the unit of electric charge
_____ 13. acetate	C. device used to produce large amounts of static charge
_____ 14. conductors	D. allowing charge to flow into Earth's surface
_____ 15. grounding	E. materials that do not allow electrons to travel freely
_____ 16. coulomb	F. device used to detect static charge
	G. acquires a negative charge by friction

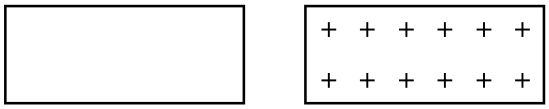
Short Answer Questions

17. Two charged objects are positioned 5 cm away from each other. Describe the change in the force between these two objects when
    (a) the charge on one of the objects is increased
    (b) the distance between the objects is increased to 10 cm
    (c) the charge on both of the objects is decreased

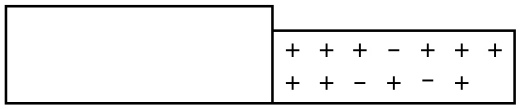
18. The diagram below represents a neutral solid object.



Use (–) to represent electrons and (+) to represent protons to complete the diagrams.
(a) A positive rod is positioned near the original object.



(b) A positive rod is touched to the original object.



19. The Styrofoam™ chips used for packing often have a static charge and "cling" to you. Describe how you could use an acetate strip to determine whether the Styrofoam™ chips are positively or negatively charged.

_____

_____

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UNIT 3 # Fruit Battery **BLM 3-15**

Goal • Use these pages to complete Conduct an Investigation 8-1C, Fruit Battery.

Question

What materials are needed to make a voltage-producing electrochemical cell?

Procedure

1. Give the table a title. _____

		Metal 2			
		Aluminum	Zinc	Iron	Copper
Metal 1	Aluminum				
	Zinc				
	Iron				
	Copper				

2. Follow steps 2 to 9 on pages 256 and 257 of *Discovering Science 9*. Record your observations in the table.

Analyze

1. In Part 1, what combination of metals produced the highest voltage?

_____

2. In Part 1, what combination of metals produced the lowest voltage?

_____

3. In general, how did the voltage produced by two similar metals in Part 1 compare to the voltage produced when the two metals were different types?

_____

_____

_____

4. Why was it important to use the same openings in the fruit each time?

_____

_____

_____

5. In Part 2, how did the voltage produced by the two metals in water compare to when the metals were in the fruit? Give a possible explanation for this result.

_____

_____

_____

Conclude and Apply

1. What materials are needed to produce a high voltage in an electrochemical cell?

_____

_____

2. Suppose that you needed to produce a higher voltage from a fruit battery. Suggest two ways that you could do this.

_____

_____

_____

_____

3. Batteries purchased from stores are used for devices like MP3 players and cellphones. List several reasons why fruit batteries would not be a good replacement for these store-bought batteries.

_____

_____

_____

4. List at least 10 different uses for a battery.

_____

_____

_____

_____

_____

_____

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UNIT 3 # Making Light Bulbs Glow **BLM 3-16**

Goal • Use your knowledge of circuits to make light bulbs work.

What to Do

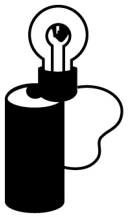
In each diagram below, the electric light will not work. Explain what is wrong with each arrangement. Then correct each diagram so that the light will work. The side of a battery does not conduct electricity.

1. Problem: _____

_____

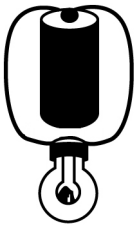
2. Problem: _____

_____



3. Problem: _____

_____



4. Problem: _____

_____

5. Problem: _____

_____

6. Problem: _____

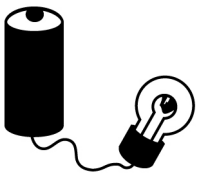
_____

7. Problem: _____

_____

8. Problem: _____

_____



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UNIT 3

Make Your Own Dimmer Switch

BLM 3-17

Goal • Design a dimmer switch.

What to Do

Follow the steps below to design your own dimmer switch. Then answer the questions in the spaces provided.

Materials

- C or D battery
- 15 cm of insulated wire
- flashlight bulb
- mechanical pencil lead

Procedure

1. Strip 2 cm of insulation from each end of the wire.
2. Arrange the materials in a circuit. (Note: Handle the pencil lead gently, as it is fragile.)
3. Rearrange the circuit until you are able to change the brightness of the bulb without disconnecting the circuit.
4. Demonstrate your dimmer switch to the class.

Questions

1. Draw your circuit in the space below.

2. How can you brighten or dim the light bulb?

_____

_____

_____

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UNIT 3

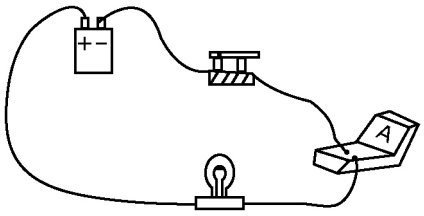
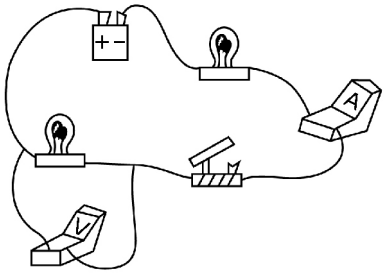
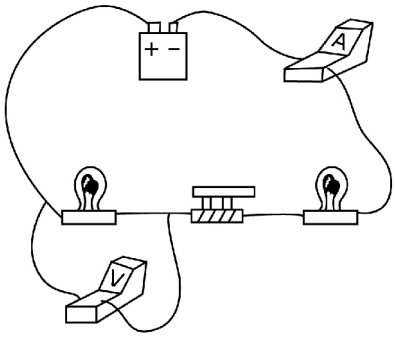
Drawing Circuit Diagrams

BLM 3-18

Goal • Practise drawing circuit diagrams.

What to Do

Complete the questions to show what you know about drawing circuit diagrams.

1. Circuit A 	(a) Draw a circuit diagram.	(b) Is this circuit open or closed? _____ (c) If this is a closed circuit, what is the source of the potential difference? _____ What is the load? _____
2. Circuit B 	(a) Draw a circuit diagram.	(b) Is this circuit open or closed? _____ (c) If this is a closed circuit, what is the source of the potential difference? _____ What is the load? _____
3. Circuit C 	(a) Draw a circuit diagram.	(b) Is this circuit open or closed? _____ (c) If this is a closed circuit, what is the source of the potential difference? _____ What is the load? _____

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UNIT 3

Circuit Symbols

BLM 3-19

Goal • Assess your knowledge of symbols related to circuitry.

What to Do

Draw the circuit symbol for each component.

Component	Circuit Symbol
1. conducting wire	
2. bulb	
3. voltmeter	
4. open switch	
5. cell	
6. closed switch	
7. battery (3 cells)	
8. ammeter	
9. resistor	

Short Answer Question

10. Define each of the following terms.

(a) source _____

_____

(b) conductor _____

_____

(c) load _____

_____

(d) switch _____

_____

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UNIT 3

Unit 3 Key Terms

BLM 3-2

Goal • Review the Unit 3 Key Terms.

Chapter 7	Chapter 8	Chapter 9
acetate	amperes	circuit breaker
action-at-a-distance forces	battery	efficiency
atoms	circuit diagrams	electrical energy
charging by conduction	current electricity	electrical power
charging by induction	electrical resistance	Energuide
conductors	electric circuit	fuel cell
contact forces	electric current	fuse
coulomb	electric load	generator
electric force	electric potential energy	grounding terminal
electrons	electrochemical cells	hydroelectric
force	electrodes	joule
grounding	electrolyte	junction point
insulators	energy	kilowatt-hour
laws of static charge	ohm	non-renewable
neutral	Ohm's law	nuclear energy
protons	potential difference	parallel circuit
static charge	resistance	power
Van de Graaff generator	resistor	power rating
	volt	renewable
	voltage	series circuit
		thermal energy
		transformer
		turbine
		watt

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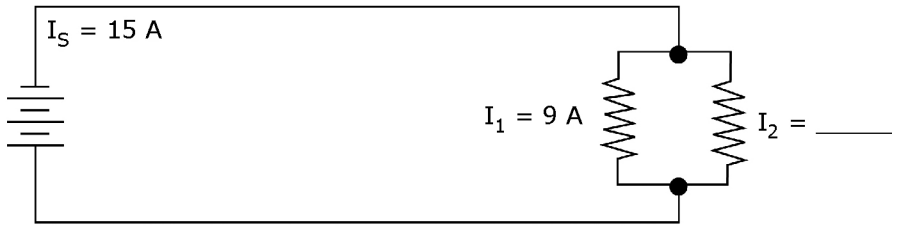
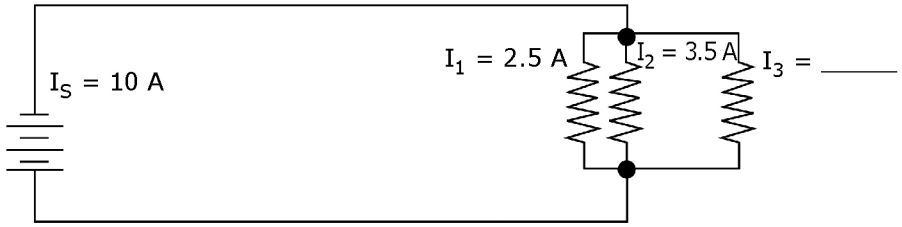
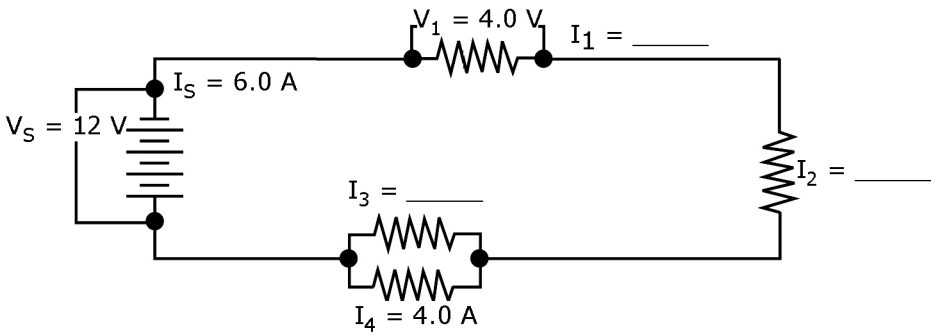
UNIT 3 # Calculate the Current **BLM 3-20**

Goal • Practise calculating current.

What to Do

Calculate the current in each of the following circuit diagrams. The current at the source is represented by I_S.

Circuit Diagram	Current
1. 	I_2 = _____
2. 	I_3 = _____
3. 	I_1 = _____ I_2 = _____ I_3 = _____

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UNIT 3

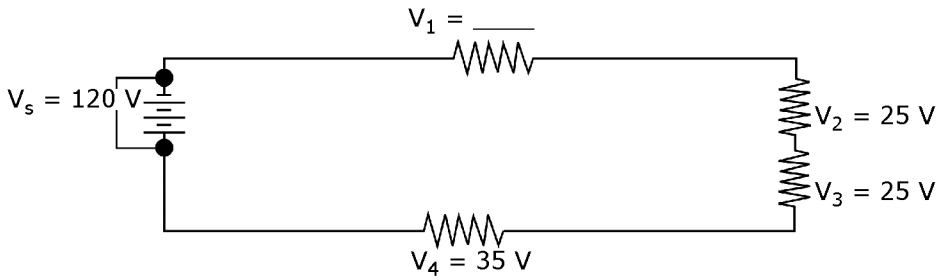
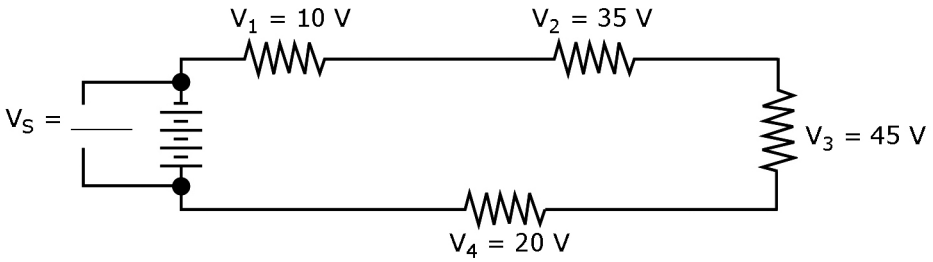
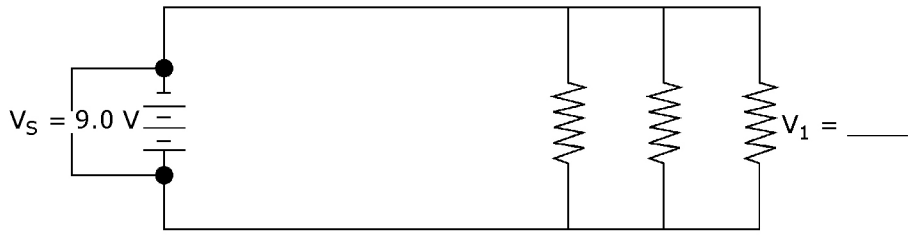
Calculate the Potential Difference

BLM 3-21

Goal • Practise potential difference calculations.

What to Do

Calculate the missing potential difference in each of the following circuit diagrams. The voltage at the source is represented by V_S.

Circuit Diagram	Voltage
1. 	V_1 = _____
2. 	V_S = _____
3. 	V_1 = _____

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UNIT 3

Find Out Activity 8-2D, Measuring Current

BLM 3-22

Goal • Use these pages to complete Find Out Activity 8-2D, Measuring Current.

What to Do

1. Give the table a title. _____

Bulb Type (V)	Measured Current (mA)

State a hypothesis about the relationship between the voltage of a light bulb in a circuit and the resulting current.

_____

_____

2. Follow steps 2 to 4 on page 266 of *Discovering Science 9*. Record your measurements in the table.

What Did You Find Out?

1. (a) Which circuit had the largest current?

_____

(b) Which circuit had the smallest current?

_____

2. Why is it important to connect the positive lead of the ammeter to the positive side of the battery?

_____

_____

3. What is the purpose of the switch in this circuit?

_____

_____

4. When you measure an unknown current, you should start with the meter set to a large current scale and then decrease the scale. Explain the purpose of starting with a higher setting.

_____

_____

_____

_____

5. Predict the resulting current in your circuit if a light bulb with double the voltage of your highest voltage light bulb were used.

_____

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UNIT 3

Resist Your Thirst

BLM 3-23

Goal • Use this page to complete Find Out Activity 8-3A, Resist Your Thirst.

What to Do

1. Give the table a title. _____

Description of Straws	Time (s)
Single straw	
Single straw with folds	
3 straws side by side	
3 straws end to end	

2. Follow steps 2 to 5 on page 271 of *Discovering Science 9*. Record your times in the table.

What Did You Find Out?

1. List the four straw types, from your data table, in order from least resistance to most resistance.

_____

_____

2. State the relationship between the amount of resistance and the time required to drink the fluid.

_____

_____

_____

3. What factors do you think influence the amount of resistance?

_____

_____

_____

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UNIT 3 **Ohm's Law** BLM 3-24

Goal • Review your understanding of how to use Ohm's law.

Questions

1. What is the resistance of a toaster if a current of 12.5 A flows through it when it is connected to 120 V?

2. A light bulb has a resistance of 90 Ω. What current flows through the bulb when it is connected to 120 V?

3. A current of 0.50 A flows through a light bulb that has a resistance of 18 Ω. What is the voltage across this light bulb?

4. A flashlight bulb has a resistance of 4.0 Ω. What current passes through the bulb if it is connected to 3.0 V?

5. What potential difference is necessary to produce a current of 0.60 A in a load that has a resistance of 25 Ω?

6. The current through a load in a circuit is 2.5 A. If the potential difference across the load is 75 V, what is the resistance of the load?

7. (a) An 80 V potential difference is measured across a light bulb that has a resistance of 16 Ω. What is the current through this light bulb?

   (b) If the light bulb was replaced by a bulb with twice the resistance, what would be the new current through the bulb?

8. A 25 mA current flows through a 300 Ω lamp. What is the voltage across the lamp?

DATE: NAME: CLASS:

UNIT 3

Resistor Colour Code (optional)

BLM 3-25

Goal • Practise using the resistor colour code.

What to Do

Use the resistor colour code table to answer the questions.

Colour	black	brown	red	orange	yellow	green	blue	violet	grey	white
Numeric value	0	1	2	3	4	5	6	7	8	9

1. Give the value of each resistor indicated by the colour bands.

	First Band Colour	Second Band Colour	Third Band Colour	Resistor Value (Ω)
(a)	blue	green	red	
(b)	violet	black	yellow	
(c)	green	blue	brown	
(d)	brown	red	black	
(e)	grey	violet	orange	
(f)	red	brown	red	

2. A current of 0.20 A flows through a resistor when connected to a 46 V power supply.
   (a) What is the value of this resistor? _____
   (b) What are the first three bands of colour on this resistor? _____
   _____

3. A current of 2.5 mA flows through a resistor when connected to a 16 V power supply.
   (a) What is the value of this resistor? _____
   (b) What are the first three bands of colour on this resistor? _____
   _____

DATE: NAME: CLASS:

UNIT 3

Practising Calculating Resistance

BLM 3-26

Goal • Practise calculating resistance.

What to Do

Read pages 273 and 274 of *Discovering Science 9*. Use the practice problems to help you calculate answers to the following questions. Show all your work.

1. Only 2.5×10^{-3} A of current pass through a portable CD player. If the CD player is operated by a 9.0 V battery, what is the resistance within the circuit?

2. An automobile headlight has an average resistance of 24 Ω. Car batteries provide a potential difference of 12 V. What amount of current passes through the headlight?

3. In a portable radio, 0.50 A of current are flowing through a conductor that provides 18 Ω of resistance. What potential difference is provided by the battery?

4. A clothes dryer uses a 220 V power source. The coils of the heater provide an average resistance of 12 Ω. What amount of current is flowing through the heating coils?

5. A 9.0 V battery maintains a current of 3.0 A through a portable radio. What is the resistance of the conductor?

6. What is the resistance of a hair dryer plugged into a 110 V outlet with a 10 A current flowing through it?

7. A light bulb will allow 0.50 A to flow through it. If the outlet provides a potential difference of 110 V, how much resistance is provided by the bulb?

8. An automobile headlight has a resistance of 40 Ω when attached to a standard 12 V battery. How much current flows through the headlight?

9. A portable CD player, operating with four 1.5 V batteries connected in series, provides a resistance of 15 000 Ω. What amount of current is flowing through the CD player?

10. An electric motor has an operating resistance of 25 Ω when a 4.8 A current is flowing through it. What is the potential difference of the outlet the motor is plugged into?

DATE: NAME: CLASS:

UNIT 3

Electricity Crossword Puzzle

BLM 3-27

Goal • Demonstrate your knowledge of the terms used in Chapter 8.

What to Do

Create a list of Key Terms from the descriptions below. Then find the Key Terms in the crossword puzzle.

Across	Key Term
2. unit of measure for electrical resistance	
5. a unit of measure for electrical potential difference	
6. a unit of measure for electric current	
8. a device used to measure electric current	
10. a device used to measure voltage	
15. difference in electrical potential between two points (two words)	

Down	Key Term
1. a unit of measure for electrical charge	
3. complete pathway for electricity to flow	
4. a unit of measure for power	
7. a device used to convert chemical energy into electricity	
9. flow of electrons through a conductor (two words)	
11. rate of energy conversion, or rate of doing work	
12. a device that can be turned on and off to control electric current	
13. any device that converts electrical energy to another form of energy	
14. ratio of the potential difference across a device to the current that passes through it	

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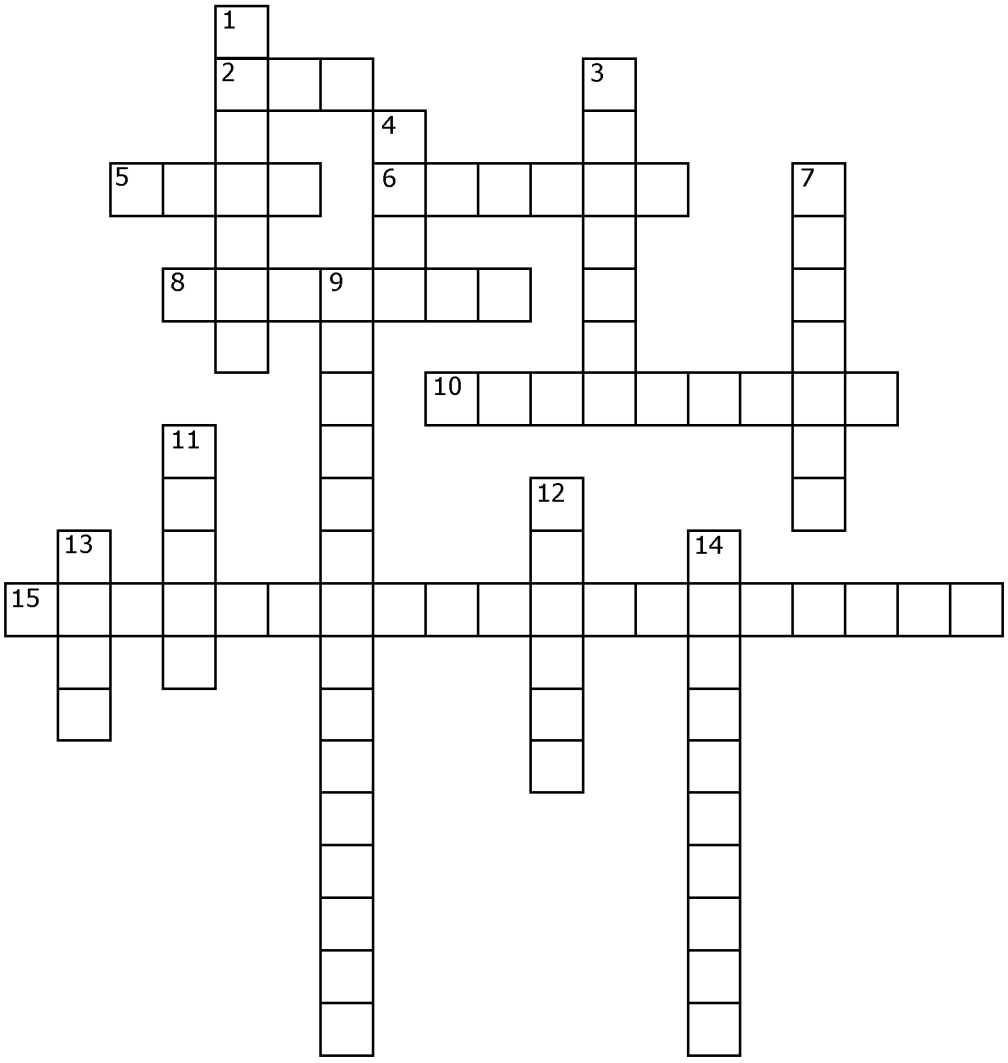
BLM 3-27 continued



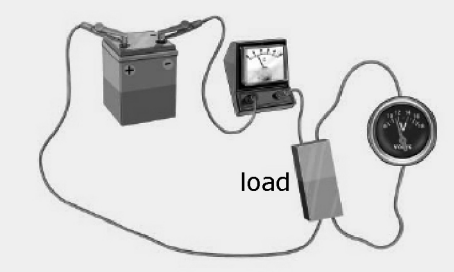
DATE: NAME: CLASS:

UNIT 3 # Calculating Resistance **BLM 3-28**

Goal • Use this page to complete Think About It Activity 8-3B, Calculating Resistance.

What to Do

1. A battery is connected to a load as shown. The voltage across the device and the current through the device is measured.



2. Different batteries are connected to this same load and the following data is obtained. Give the table a title.

Voltage (V)	Current (A)	Resistance (Ω)
3.0	1.2	
4.5	1.7	
6.0	2.5	
9.0	3.6	
12.0	5.0	

3. Using Ohm's law, calculate the resistance for each set of voltage-current data.

4. Calculate the average resistance of your five calculated resistances. To find the average, add the five resistances and divide the sum by 5. Record the average resistance. Include correct units.

What Did You Find Out?

1. How did the resistances you calculated for the sets of data compare? Were they exactly the same, close, or very different?

_____

_____

2. Given that the same load was used, explain why you think the values calculated might not be exactly the same for each set of data.

_____

_____

UNIT 3 # Resistors and Ohm's Law **BLM 3-29**

Goal • Use these pages to complete Core Lab Conduct an Investigation 8-3D, Resistors and Ohm's Law.

Question

How do the calculated value and measured value of resistors compare?

Procedure

1. Give the table a title. _____

Resistor Value (Ω)	Voltage (V)	Current (A)	Calculated Resistance (Ω)
#1			
#2			

2. Follow steps 2 to 10 on pages 278 and 279 of *Discovering Science 9*. Record your measurements in the table.

Analyze

1. Using the calculated resistances for resistor #1, calculate the average resistance. Record this value. Include correct units.

2. Using the calculated resistances for resistor #2, calculate the average resistance. Record this value. Include correct units.

Conclude and Apply

1. For each resistor, compare the average value of the resistance to the value obtained from the colour code.

2. Give a possible reason for the calculated value and colour code value not being exactly the same.

_____

_____

_____

3. As the current through an individual resistor is increased, what happens to the voltage across that same resistor?

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

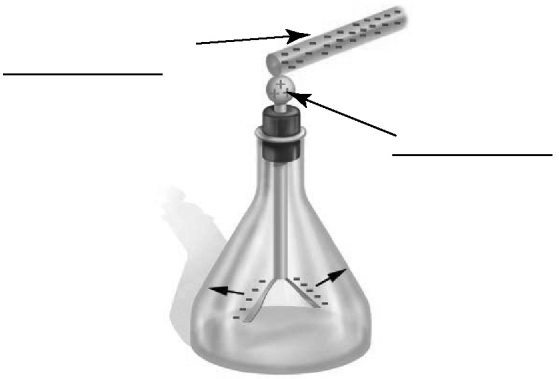
Chapter 7 Key Terms

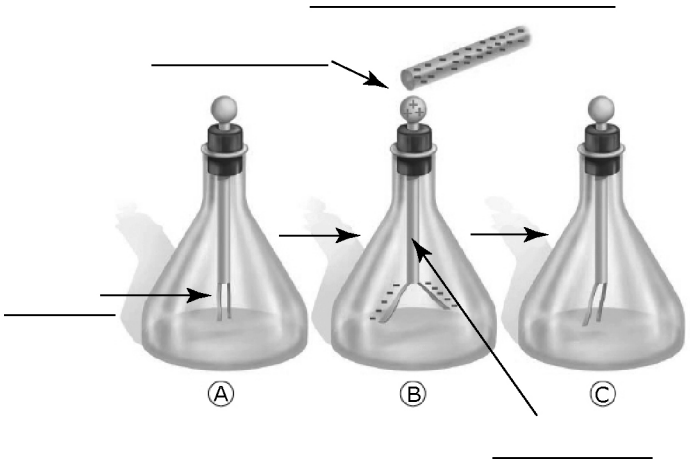
BLM 3-3

Goal • Review the Key Terms in Chapter 7.

Label the diagrams with the terms below.

Charging by Conduction
Charging by Induction
conductor
electric force
negative
neutral
positive





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UNIT 3 **Chapter 8 Review** BLM 3-30

Goal • Check your understanding of Chapter 8.

What to Do

Circle the letter of the best answer.

1. The amount of electric energy stored in charge depends on which two factors?
   A. current and amount of resistance
   B. current and amount of voltage
   C. voltage and amount of charge
   D. voltage and amount of resistance

2. Which combination of materials could be used to produce the best electrochemical cell?
   A. an aluminum electrode, a copper electrode, and an acidic solution
   B. an aluminum electrode, a copper electrode, and water
   C. two silver electrodes and an acidic solution
   D. two silver electrodes and water

3. Which is not a common energy source used to produce electrical energy?
   A. elastic
   B. friction
   C. piezoelectric crystals
   D. thermocouples

4. Which is not an electric load?
   A. battery
   B. buzzer
   C. light bulb
   D. resistor

5. Which statement correctly defines the difference between static electricity and current electricity?
   A. In static electricity, the charge stays in one place, whereas current electricity is the flow of charge in a circuit.
   B. Static electricity is the flow of charge in a circuit, whereas in current electricity the charge stays in one place.
   C. Static electricity is the flow of negative charge, whereas current electricity is the flow of positive charge.
   D. Static electricity is the flow of positive charge, whereas current electricity is the flow of negative charge.

6. Which correctly defines conventional current?
   A. the current caused by sources other than batteries
   B. the flow of charge from negative to positive
   C. the flow of charge from positive to negative
   D. the flow of electrons

7. What is the name of an electric device that slows down current and changes electrical energy into other forms?
   A. battery
   B. conductor
   C. resistor
   D. switch

8. What is the purpose of an ohmmeter?
   A. to measure charge
   B. to measure current
   C. to measure resistance
   D. to measure voltage

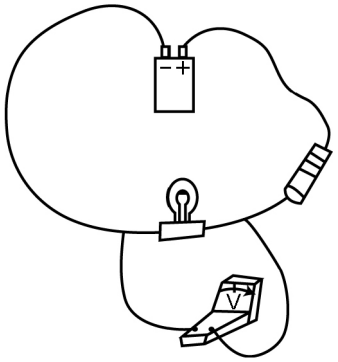
9. A current of 2.0 A flows through a 12 Ω resistor. What is the voltage across this resistor?
   A. 2.0 V
   B. 6.0 V
   C. 12 V
   D. 24 V

Match the Term on the left with the best Descriptor on the right.
Each Descriptor may be used only once.

Term	Descriptor
_____ 10. voltmeter _____ 11. ammeter _____ 12. current _____ 13. voltage _____ 14. resistance _____ 15. circuit	A. the amount of charge passing a given point per second B. a device used to measure current C. a complete path for current to travel D. a device used to measure potential difference E. slows down the movement of charge F. the flow of positive charge G. the amount of electric potential energy per unit of charge

Short Answer Questions

16. Draw a circuit diagram for the following circuit.



17. Calculate the following using Ohm's law.

(a) A light bulb is connected to a 9.0 V battery. The current through the light bulb is measured to be 300 mA. What is the resistance of the light bulb?

(b) A 16 V source is connected to a 2.5 kΩ load. What is the current through this load? Give your answer in both amperes (A) and milliamperes (mA).

18. You are given a load of an unknown resistance. Describe how you would determine this load's resistance using a battery, voltmeter, ammeter, and connecting wires.

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UNIT 3 # Series Circuits **BLM 3-31**

Goal • Review your understanding of series circuits.

What to Do

Circle the best term in the brackets to correctly complete each statement.

1. A series circuit has (more than one, only one) path for current to travel.

2. In a series circuit, the current at one location in the circuit is (equal to, different from) the current at another location in the circuit.

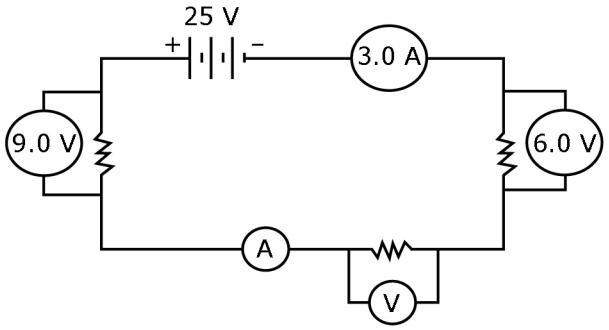
3. If two different resistors are connected in series, the voltage across one resistor will be (equal to, different from) the voltage across the second resistor.

4. By adding a resistor in series with an original resistor, the total resistance of the circuit (increases, decreases).

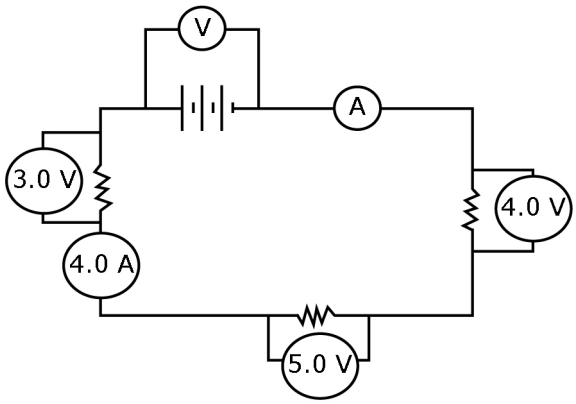
5. The sum of the voltages across each of the resistors in a series circuit is (equal to, different from) the voltage supplied by the battery.

Find the unknown voltage at V, and current at A, in each of the following circuits.

6. Voltage = _____ Current = _____



7. Voltage = _____ Current = _____



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UNIT 3 # Parallel Circuits **BLM 3-32**

Goal • Review your understanding of parallel circuits.

What to Do

Circle the best term in the brackets to correctly complete each statement.

1. A parallel circuit has (only one, more than one) path for current to travel.

2. Two different resistors are connected in parallel. The current through one of the resistors will be (equal to, different from) the current through the other resistor.

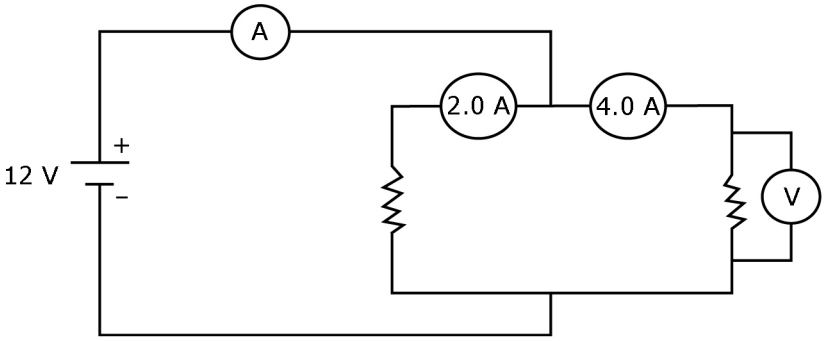
3. If two different resistors are connected in parallel, the voltage across one resistor will be (equal to, different from) the voltage across the second resistor.

4. By adding a resistor in parallel with an original resistor, the total resistance of the circuit (increases, decreases).

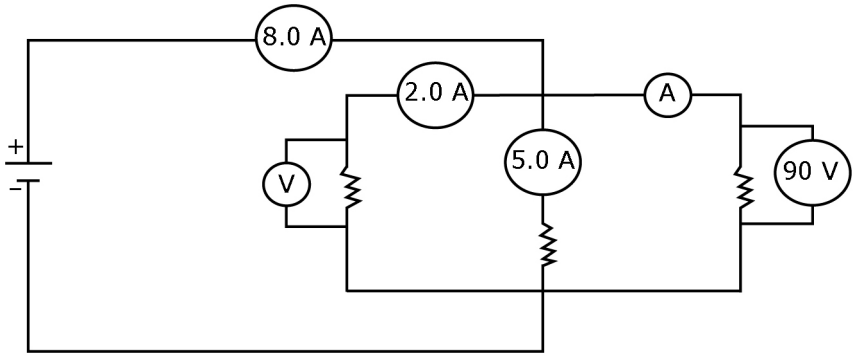
5. The total current entering the junction of a parallel circuit must be (equal to, different from) the sum of the currents through each branch of the parallel circuit.

Find the unknown voltage at V, and current at A, in each of the following circuits.

6. Voltage = _____ Current = _____



7. Voltage = _____ Current = _____



DATE: NAME: CLASS:

UNIT 3

Comparing Series and Parallel Circuits

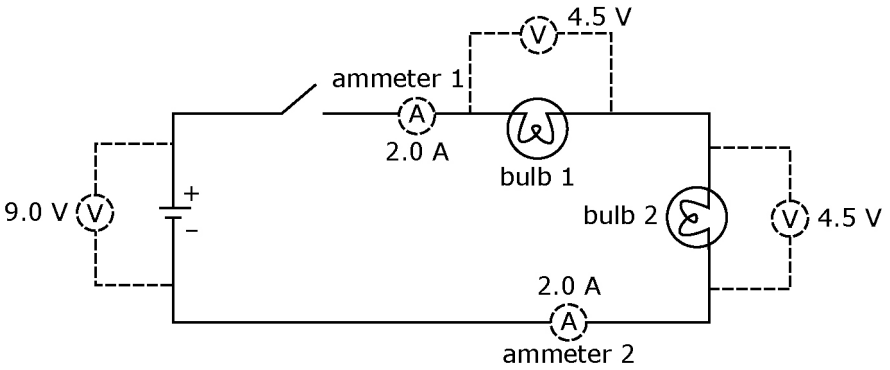
BLM 3-33

Goal • Determine differences between series circuits and parallel circuits.

Questions

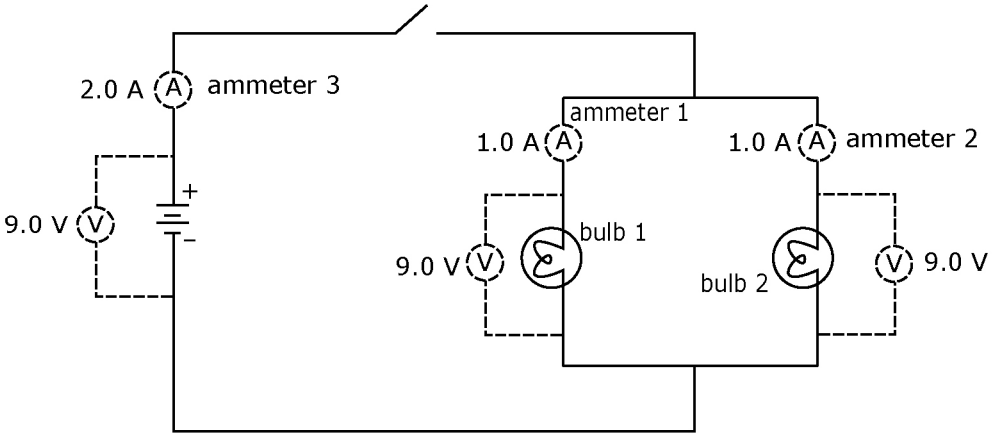
Complete each table by circling the best term in each set of the brackets. Then place the two tables side by side to compare series circuits and parallel circuits.

Series Circuits



Question	Answer
Number of paths for electron flow	(one / multiple)
Effect of removing a load from the circuit	The circuit is opened. Electrons (can / cannot) flow.
Voltage or potential drop	The sum of the voltage lost in the loads or resistors in the ENTIRE circuit is (less than / equal to / greater than) the total voltage supplied by the battery.
Current	• The current (varies / is the same) throughout the circuit. • The current (in the only path / in each of the paths) is dependent on the total resistance in the circuit.
Resistance	• When resistors or loads are placed in series, the total resistance of the circuit is (decreased / unchanged / increased), since the total resistance is the sum of the resistances of each of the resistors or loads. • When the total resistance is (decreased / increased), the total current will (decrease / increase) since $V = IR$.
Connecting cells to form a battery	• The effective voltage is the (sum of / same as) the voltages of each of the individual cells. • The maximum overall lifespan of the battery is (less than / the same as / greater than) the lifespan of each of the individual cells.

Parallel Circuits



Question	Answer
Number of paths for electron flow	(one / multiple)
Effect of removing a load from the circuit	The circuit is not opened. Electrons (do not / continue to) flow through the remaining paths.
Voltage or potential drop	The sum of the voltage lost in the loads or resistors in EACH BRANCH of the circuit is (less than / equal to / greater than) the total voltage supplied by the battery.
Current	• The total current entering or leaving a junction point is (the sum of the current in all of the paths / the same as the current in one of the paths). • The current (in the only path / in each of the paths) is dependent on the total resistance in that path.
Resistance	• When resistors or loads are placed in parallel, the total resistance of the circuit is (decreased / increased). • When the total resistance is (decreased / increased), the total current will (decrease / increase) since $V = IR$.
Connecting cells to form a battery	• The effective voltage is the (sum of the voltage of the cells/ same as the voltage of a single cell). • The maximum overall lifespan of the battery is (the sum of the lifespans of all the cells/the same as the lifespan of each of the individual cells).

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UNIT 3 **Designing Circuits** BLM 3-34

Goal • Draw labelled circuit diagrams.

Questions

1. Draw a circuit diagram consisting of a 9.0 V battery, an ammeter, and a 25 Ω resistor in series. Include a voltmeter that is measuring the potential difference across the resistor.

2. Draw a circuit diagram consisting of a battery made up of two 1.5 V cells, one closed switch, two light bulbs, and an ammeter in series. Show the direction in which the current flows.

3. Draw a circuit diagram consisting of a battery made up of four 1.5 V cells connected in series, one closed switch, one light bulb, two 0.50 Ω resistors in series, and a voltmeter reading the potential difference across the bulb. Show the direction in which the current flows.

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UNIT 3

Drawing Series and Parallel Circuit Diagrams

BLM 3-35

Goal • Practise drawing circuit diagrams for series and parallel circuits.

Questions

1. Draw a circuit diagram of a series circuit consisting of a 12 V electrical source, one open switch controlling the electron flow in the entire circuit, two light bulbs, and a 10 Ω resistor.

2. Draw a circuit diagram of a parallel circuit consisting of a 9.0 V electrical source, an open switch controlling the electron flow in the entire circuit, and three 5.0 Ω resistors,

3. Draw a circuit diagram consisting of three 1.5 V cells connected in parallel. one open switch controlling the electron flow in the entire circuit, two light bulbs connected in series, and two 15 Ω resistors connected in parallel.

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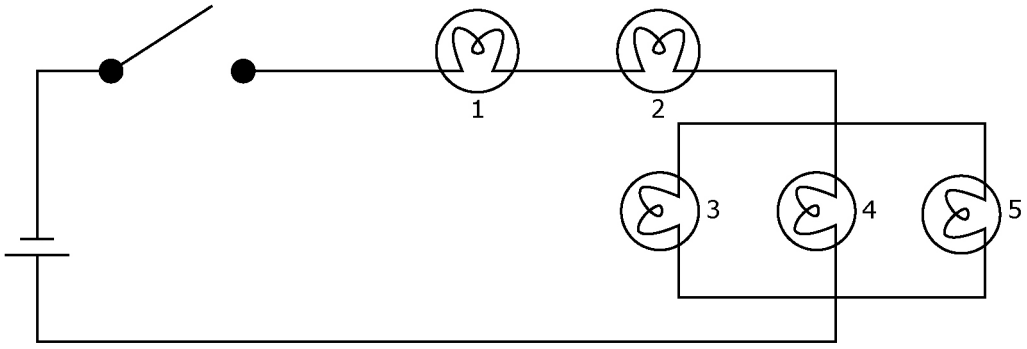
UNIT 3 # Understanding Circuit Diagrams **BLM 3-36**

Goal • Practise interpreting circuit diagrams.

Questions

1. Describe what will happen to the current in the circuit below for each case.

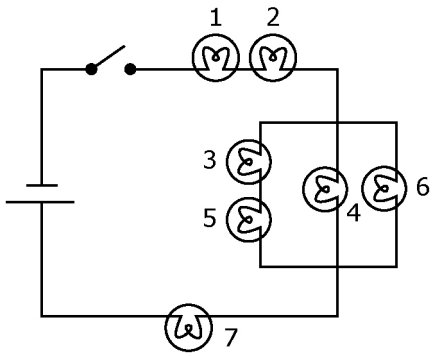


(a) the switch is closed _____

(b) the switch is closed and bulb 1 is removed _____

(c) the switch is closed and bulb 5 is removed _____

2. The switch on this circuit is closed. Which bulbs will be lit for each case?



(a) bulb 1 is removed _____

(b) bulb 2 is removed _____

(c) bulb 3 is removed _____

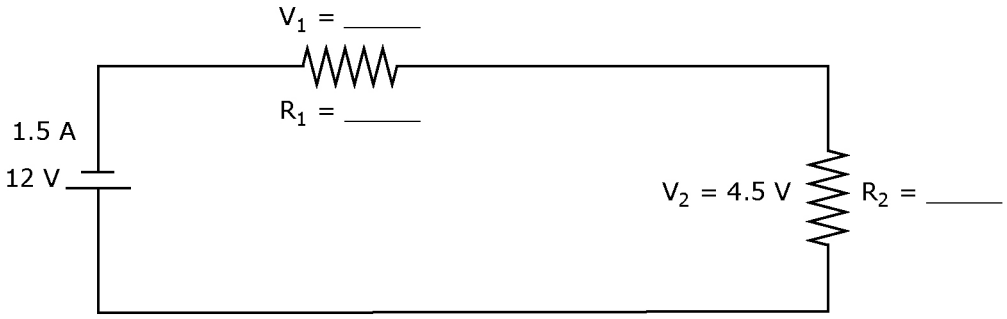
(d) bulb 4 is removed _____

(e) bulb 5 is removed _____

(f) bulb 6 is removed _____

(g) bulb 7 is removed _____

3. Calculate the missing quantities for the circuit below.



DATE: NAME: CLASS:

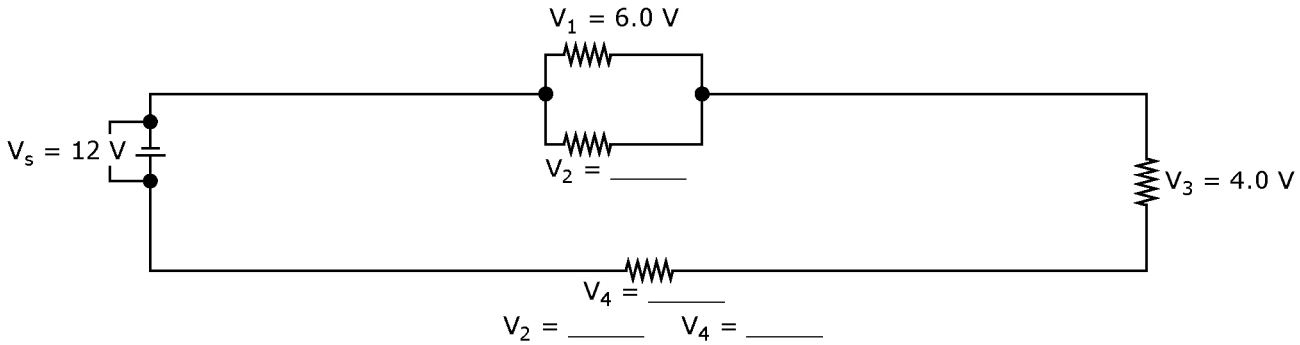
UNIT 3 # Calculate Voltage and Current **BLM 3-37**

Goal • Practise calculating voltage and current in a circuit.

What to Do

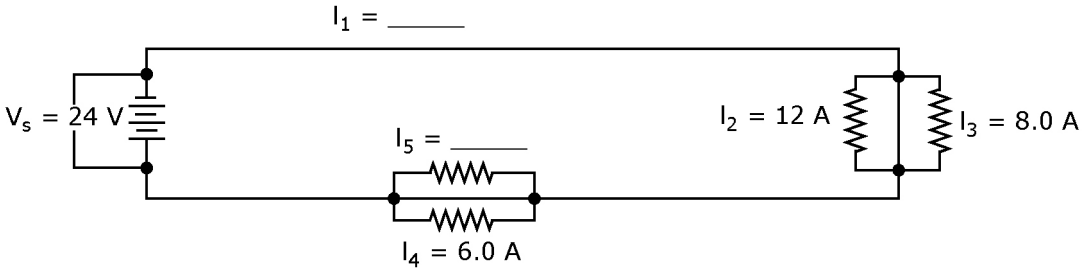
Calculate the missing values in the circuits below. Show your calculations.

1.



V_2 = _____ V_4 = _____

2.



I_1 = _____ I_5 = _____

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UNIT 3 # Compound Circuits **BLM 3-38**

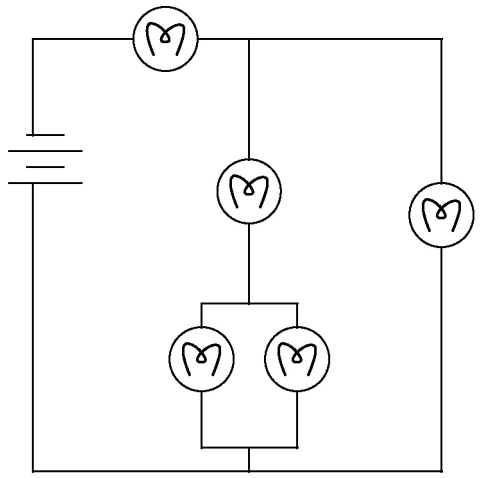
Goal • Practise working with compound circuits.

What to Do

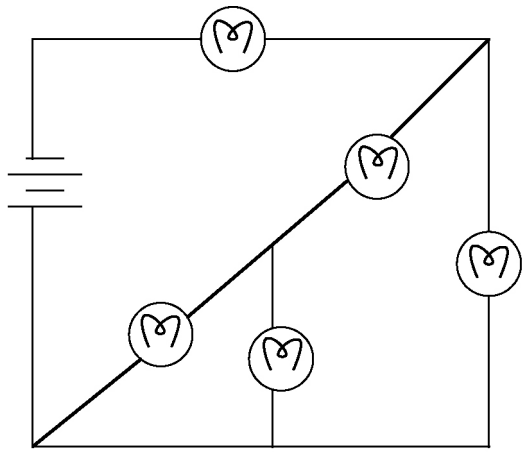
1. Consider the circuits below. How could you remove one bulb from each circuit and still have the circuit work?

- Circle the bulbs that you could remove without affecting the operation of any other bulb.
- Cross out the bulbs that would cause all bulbs to not light if you removed them.

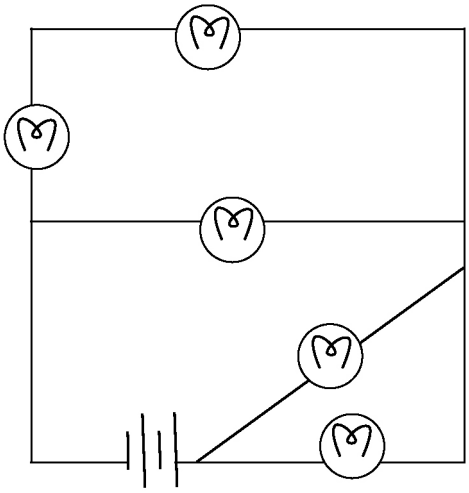
(a)



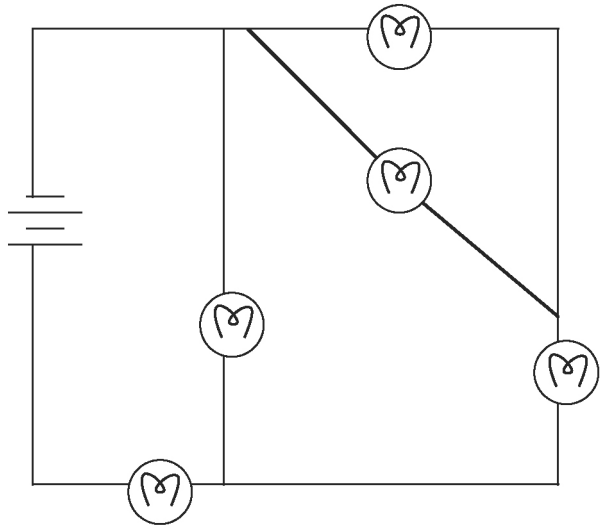
(b)



(c)



(d)



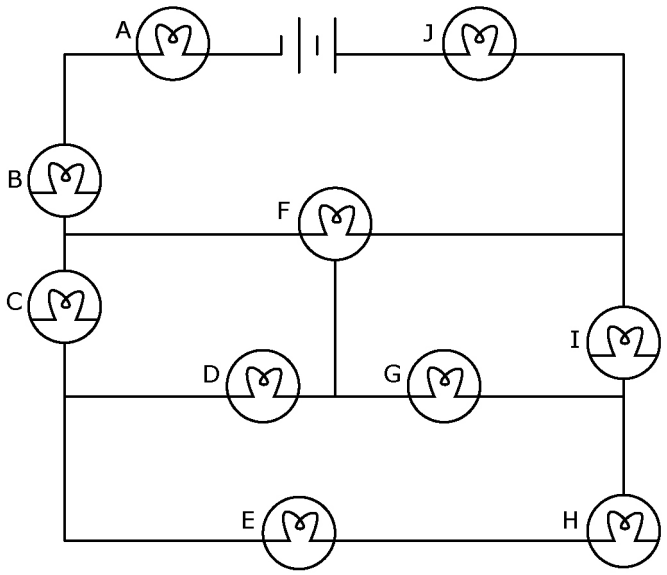
2. Use the circuit diagram below.

(a) List two bulbs that are connected in series. _____

(b) List three bulbs that are connected in series. _____

(c) List two bulbs that are connected in parallel. _____

(d) List two other bulbs that are connected in parallel._____



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UNIT 3

A Series of Lights and Cells

BLM 3-39

Goal • Use these pages to complete Find Out Activity 9-1D, A Series of Lights and Cells.

What to Do

1. Give each table a title.

Part 1 Table _____

Current (mA)	Voltage (V)
Ammeter 1 =	Bulb 1 =
Ammeter 2 =	Bulb 2 =
	Battery =

Part 2 Table _____

Current (mA)	Voltage (V)
Ammeter 1 =	Bulb 1 =
Ammeter 2 =	Bulb 2 =
	Battery =

2. Follow steps 2 to 7 on page 298 of *Discovering Science 9*. Record your measurements in the tables.

What Did You Find Out?

Part 1

1. Compare the current in ammeters 1 and 2.

_____

_____

_____

2. Compare the voltage across the two bulbs.

_____

_____

_____

3. Add the voltage of the bulbs together. Compare the total voltage lost on the two bulbs to the battery voltage.

_____

_____

_____

4. What is the relationship between the number of bulbs in a series circuit and the current? How could you test your theory?

_____

_____

_____

_____

Part 2

5. Compare the currents and voltages measured in Part 1 with those measured in Part 2.

_____

_____

_____

6. What is the relationship between current and voltage in a series circuit?

_____

_____

_____

7. Use the relationship between current and voltage when cells are connected in series to explain how series connections of cells could be useful.

_____

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

Chapter 8 Key Terms

BLM 3-4

Goal • Review the Key Terms in Chapter 8.

Create a list of 10 key terms from the descriptions below. Then find the key terms in the puzzle.

Description	Key Term
1. a unit used to measure electric current (6 letters)	
2. a picture that uses symbols to represent the different components of a circuit (7 letters, 7 letters)	
3. a complete pathway that allows electrons to flow (8 letters, 7 letters)	
4. any device that transforms electrical energy into other forms of energy (8 letters, 4 letters)	
5. the two terminals in a battery (10 letters)	
6. the ability to do work (6 letters)	
7. the mathematical relationship comparing voltage, current, and resistance (4 letters, 3 letters)	
8. the type of electrical energy stored in a battery (8 letters, 9 letters)	_____ _____ energy
9. the property of any material that slows down the flow of electrons and converts electrical energy into other forms of energy (10 letters)	
10. the amount of electric potential energy per one coulomb of charge (7 letters)	

DATE: NAME: CLASS:

BLM 3-4 continued

C I R C U I T D I A G R A M V H U S E
A O E L E C T R I C P O T E N T I A L
Z R U D V R Y E B O U N H F A Q D G E
D B T E H N D L I R H B Y G Q H M I C
P T N X Q G T X C E E F X D Y F E K T
Z W Z I M E K C G N Y S G A I Z H N R
C O V K S L A M P E R E I V K E G J I
S H E C A E W J M R B V L S C F Z L C
F M I U V C R F K G C W O E T L I M L
J S T H J T X S X Y N D A L E A J R O
E L E C T R I C C I R C U I T J N L A
G A D B A O M B T P V O K U P A Q C D
S W X P W D O W F M S Q L A R O G M E
J B O Y I E C Y Q U L P S Z T K N E R
A R J Q O S N M V C E N E R P F L P W

DATE: NAME: CLASS:

UNIT 3

Parallel Lights and Cells

BLM 3-40

Goal • Use these pages to complete Find Out Activity 9-1E, Parallel Lights and Cells.

What to Do

1. Give each table a title.

Part 1 Table _____

Current (mA)	Voltage (V)
Ammeter 1 =	Bulb 1 =
Ammeter 2 =	Bulb 2 =
Ammeter 3 =	Bulb 3 =
	Battery =

Part 2 Table _____

Current (mA)	Voltage (V)
Ammeter 1 =	Bulb 1 =
Ammeter 2 =	Bulb 2 =
Ammeter 3 =	Bulb 3 =
	Battery =

2. Follow steps 2 to 9 on page 299 of *Discovering Science 9*. Record your measurements in the tables.

What Did You Find Out?

Part 1

1. Compare the voltage across the three bulbs.

_____

_____

_____

2. Compare the current through each bulb, as measured by the three ammeters.

_____

_____

_____

3. Add the current in ammeter 1 and ammeter 2. Compare this to the current leaving the cell and through bulb 3 (ammeter 3).

_____

_____

4. What is the relationship between the number of bulbs in a parallel circuit and the current?

_____

_____

_____

How could you test your theory?

_____

_____

_____

5. What is the relationship between current and voltage in different parts of a parallel circuit?

_____

_____

_____

Part 2

6. Compare the currents and voltages measured in Part 1 with those measured in Part 2.

_____

_____

_____

7. (a) Describe the effect on voltage and current of connecting cells in parallel.

_____

_____

_____

(b) Given this effect, how can parallel connections of cells be used?

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

Resistors in Series and Parallel

BLM 3-41

Goal • Use these pages to complete Core Lab Conduct an Investigation 9-1F, Resistors in Series and Parallel

Question

How does the total resistance of a circuit change when resistors are connected in series and in parallel?

Procedure

Part 1 Resistors in Series

1. Give the table a title. _____

Resistance (Ω)	Voltage (V)	Current (A)
Resistor 1 =	Voltage across resistor 1 =	Total current leaving the battery =
Resistor 2 =	Voltage across resistor 2 =	
Resistor 3 =	Voltage across resistor 3 =	
	Voltage across battery =	

2. Follow steps 2 to 7 on pages 300 and 301 of *Discovering Science 9*. Record your data in the table.

Part 2 Resistors in Parallel

3. Give the table a title. _____

Resistance (Ω)	Voltage (z)	Current (A)
Resistor 1 =	Voltage across resistor 1 =	Total current leaving the battery =
Resistor 2 =	Voltage across resistor 2 =	
	Voltage across battery =	

4. Follow steps 9 to 15 on page 301 of *Discovering Science 9*. Record your data in the table.

Analyze

Part 1

1. Use Ohm's law ($R = V \div I$) to calculate the total resistance of your series circuit. (Use the battery voltage and the current leaving the battery.)

2. Compare the total resistance calculated in question 1 to the individual resistors used in the circuit. Is the total resistance greater than or less than the individual resistors?

_____

3. Compare the voltage across each resistor. Does each resistor lose the same amount of voltage?

_____

4. Add the voltages on each of the three resistors. Compare the total voltage lost on the three resistors to the battery voltage.

_____

Part 2

5. Use Ohm's law to calculate the total resistance of your parallel circuit. (Use the battery voltage and the current leaving the battery.)

6. Compare the total resistance calculated in question 5 to the individual resistors used in the circuit. Is the total resistance greater than or less than the individual resistors?

_____

7. Compare the voltage across each resistor. Does each resistor lose the same amount of voltage?

_____

Conclude and Apply

1. Write a short paragraph that states the relationships of the following terms in a series circuit: total resistance, individual resistors, total voltage, voltage across each resistor.

_____

_____

_____

_____

_____

2. Write a short paragraph that states the relationships of the following terms in a parallel circuit: total resistance, individual resistors, total voltage, and voltage across each resistor.

_____

_____

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

Energy Transformations in Resistors

BLM 3-42

Goal • Use this page to complete Find Out Activity 9-2A, Energy Transformations in Resistors.

What to Do

1. Predict how the size of a resistor affects the amount of heat generated in a circuit.

_____

_____

_____

2. Give the table a title. _____

	Resistor 1 _____ Ω	**Resistor 2** _____ Ω	**Resistor 3** _____ Ω
Initial temperature of thermometer (°C)			
Time to increase thermometer temperature to 5.0 °C (s)			

4. Follow steps 3 to 9 on page 305 of *Discovering Science 9*. Record your data in the table.

What Did You Find Out?

1. What form of energy is being produced by the resistors?

_____

2. Compare the amount of resistance of the resistors to how quickly each transformed the electrical energy from the power supply.

_____

_____

3. Which of these resistors had the greatest amount of current? Explain your answer.

_____

_____

_____

4. Based on your observations in this experiment, explain the relationship between current and the rate at which energy is transformed by the resistor.

_____

_____

_____

_____

DATE: NAME: CLASS:

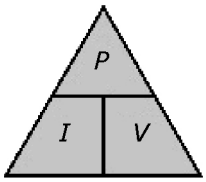
UNIT 3 # Calculating Power **BLM 3-43**

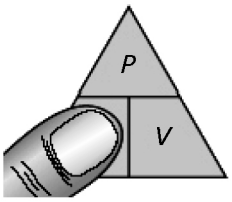
Goal • Review your understanding of calculating power.

Think About It

When calculating the power of an electrical device, it is more common to talk about the voltage and current rather than energy and time. You can calculate the power of an electrical device by multiplying voltage and current. The equation is $P = VI$, where P is in watts, V is in volts, and I is in amperes.

You can place the power formula in a triangle graphic to make it easier to manipulate. Cover up the variable you are solving for to see the formula required. To solve for the current, (I), cover up the I to see that the formula is $I = P \div V$.





What to Do

Answer the following questions Show all your work.

1. What is the power output of a 6.0 V battery if it supplies a current of 2.0 A?

2. A flashlight bulb operates on 3.0 V and draws a current of 4.0 A. What is the power of this bulb?

3. A 60 W light bulb is connected to 120 V. What current passes through the light bulb?

4. A voltmeter measures 15 V across a 45 W resistor. What current is passing though the resistor?

5. A circuit draws a current of 25 mA from a 12 V battery. What is the power output of this battery?

6. A light bulb is connected to 120 V and uses 1.2 A. What is the power rating of this bulb?

7. What is the current through a 1200 W hair dryer if it is connected to 120 V?

8. A 0.20 A current passes through a 450 Ω resistor. Calculate the electric power "lost" in this resistor. (Hint: Use Ohm's law to find the voltage.)

DATE: NAME: CLASS:

Electrical Power and Energy

Goal • Calculate power and energy.

What to Do

Answer the following questions. Show all your work.

1. A current of 5.0 A flows through a flashlight bulb when it is connected to 6.0 V. What is the power of this bulb?

2. A 600 W electric heater is connected to a 120 V source. What current flows through the heater?

3. A 2.5 A current flows through a 100 W lamp. What is the voltage across the lamp?

4. What is the current through a 6.0 W light bulb when it is connected to a 1.5 V battery?

5. (a) A 40 W light bulb is connected to a power supply and draws a current of 0.75 A. What is the voltage of the power supply?

(b) If the 40 W light bulb is replaced by a 100 W light bulb, how much current will flow through the 100 W bulb?

6. What is the power, in watts, of an unknown device if a current of 35 mA flows through the device when it is connected to 3.0 V?

7. How much energy, in joules, is consumed by a 120 W light bulb if it is left on for 15 min?

8. How much energy, in joules, is consumed by a 1400 W hair dryer if it is used for 10 min?

9. How much energy, in joules, is consumed by a 200 W stereo if it is left on for 4.0 h?

DATE: NAME: CLASS:

UNIT 3

Power Problems

BLM 3-45

Goal • Practise calculating the cost of energy.

What to Do

Answer the following questions. Show all your work.

1. A portable hair dryer, plugged into a 110 V outlet, has a current of 10 A flowing through it. What is the power rating of the hair dryer?

2. A current of 0.50 A flows through a light bulb connected to a 110 V outlet. How much power is "lost" by this bulb?

3. A toaster connected to a 110 V power source has 6.0 A of current flowing through it. How much power is dissipated as heat?

4. A light bulb draws 1.25 A of current from a 120 V gasoline-powered generator.
   (a) How much power does the generator produce?

   (b) If the generator runs for 5.0 min, how much energy will the lamp convert into heat and light?

DATE: NAME: CLASS:

UNIT 3 Calculating Energy Consumption BLM 3-46

Goal • Review your understanding of calculating energy consumption.

Think About It

You can calculate the amount of electrical energy that a particular device consumes by using the power rating and the amount of time. Since power (P) is defined as energy transferred (E) per time interval (t), the equation is $P = E \div t$, where P is in watts, E is in joules, and t is in seconds. You can rearrange the equation to get $E = Pt$, where E is measured in joules (or W•s), or express the energy using the larger unit of kilowatt-hours (kW•h).

You can place the energy formula in a triangle graphic to make it easier to manipulate. Cover up the variable you are solving for to see the formula required. To solve for power, (P), cover up the P to see that the formula is $P = E \div t$.

What to Do

Answer the following questions. Show all your work.

1. What is the power of an electric mixer that uses 72 000 J of energy in 50 s?

2. What is the power rating of a toaster that uses 210 000 J of energy while toasting bread for 140 s?

3. How much electrical energy is consumed by a 1400 W microwave oven if it is used for 55 s?

4. How much electrical energy is consumed by a 900 W coffee maker if it is used for 10 min?

5. How much electrical energy is consumed by a 750 W air conditioner if it is left on for 24 h?

6. How much energy is consumed by a flashlight battery that is switched on for 2 min, in which the voltage drop is 6 V, and the current flowing through the bulb is 0.35 A? (Hint: Use $P = VI$ to find the power in watts.)

7. How much energy does an electric clothes dryer consume if it is used for 30 min? The operating voltage of the dryer is 240 V, and the current flowing through the heating element is 20.83 A.

DATE: NAME: CLASS:

UNIT 3

The Price of Energy

BLM 3-47

Goal • Practise making calculations related to electricity.

What to Do

Answer the following questions. Show all your work.

1. A meter reader determines that a business has used 3550 kW•h of energy in two months. If electricity costs 10cents per kW•h, calculate the bill.

2. An electric heater draws 1100 W of power. Electricity costs 8cents per kW•h. How much does it cost to operate the heater 3.0 h a day for 30 days?

3. A 730 W toaster and 1200 W electric frying pan are plugged into the same 100 V outlet. How much will it cost to operate the two appliances at 8 cents per kW•h if they are used for 20 h?

4. A toaster is used an average of 5.0 h a month. The toaster draws 8.0 A of current from a 110 V outlet. If electricity costs 8 cents per kW•h, how much will it cost to operate the toaster for one year?

DATE: NAME: CLASS:

UNIT 3

The Cost of Electricity

BLM 3-48

Goal • Use the page to complete Think About It Activity 9-2B, The Cost of Electricity.

What to Do

1. Give the table a title. _____

Appliance	Power (W)	Time of Use Each Day (h)	Energy (kW.h)	Cost (cents)	Cost (dollars)
Television	200	2.0			
Stereo	80	1.5			
Kichen stove	12000	2.0			
Microwave	1400	0.5			
Bedroom light	100	4.0			

2. Calculate the energy consumed, in kilowatt-hours, by each of the appliances. Be sure to change the power in watts to kilowatts.

3. Using the cost of electricity as 9.6 cents per kilowatt-hour, calculate the daily cost of each appliance in cents and in dollars.

What Did You Find Out?

1. Which appliance had the greatest daily cost?

_____

2. Considering all the electrical devices in your home, state which ones you think would have the greatest daily cost.

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

A Current View of Power

BLM 3-49

Goal • Use this page to complete Conduct an Investigation 9-2C, A Current View of Power.

Question

What is the relationship of resistance, current, and power?

Procedure

1. Give the table a title. _____

Resistance (Ω)	Voltage (V)	Current (A)	Power (W)
1			
2			
3			

2. Follow steps 2 to 8 on page 311 of *Discovering Science 9*. Record your data in the table.

Analyze

1. Compare the voltage across each of your three resistors.

_____

_____

2. Compare the current through each resistor.

_____

_____

3. Which resistor had the greatest power?

_____

4. In one or two sentences, relate power, resistance, and current.

_____

_____

_____

Conclude and Apply

1. Given what you have learned in this investigation, would a 60 W or 100 W light bulb have more resistance? Explain your answer.

_____

_____

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

Chapter 9 Key Terms

BLM 3-5

Goal • Review the Key Terms in Chapter 9.

Key Terms

circuit breaker
efficiency
electrical energy
electrical power
EnerGuide
fuel cell
fuse
generator
grounding terminal
hydroelectric
joule
junction point
kilowatt-hour
non-renewable
nuclear energy
parallel circuit
power
power rating
renewable
series circuit
thermal energy
transformer
turbine
watt

1. Work in a small group. Choose three key terms and write a riddle about each one. Other group members should write riddles about three different key terms.

2. Ask other group members to guess the answers to your riddles while you guess the answers to theirs. Together, check the answers, and revise the riddles as needed.

For example:

I act as a switch and safety device that can cut off all power coming into your home.

What am I? _____

Riddle 1:

_____

_____

_____

_____

What am I? _____

DATE: NAME: CLASS:

BLM 3-5 continued

Riddle 2:

_____

_____

_____

_____

What am I? _____

Riddle 3:

_____

_____

_____

_____

What am I? _____

DATE: NAME: CLASS:

UNIT 3

Putting Energy Conversions to Good Use

BLM 3-50

Goal • Use this page to complete Find Out Activity 9-3A, Putting Energy Conversions to Good Use.

What to Do

1. Give the table a title. _____

	Incandescent Light Bulb	Compact Fluorescent Light Bulb
Power rating		
Initial Temperature (°C)		
Final Temperature (°C)		
Brightness		

2. Follow steps 2 to 6 on page 315 of *Discovering Science 9*. Record your data in the table.

What Did You Find Out?

1. Describe the energy conversions that are taking place in the light bulbs.

_____

_____

2. From your observations, which of the two light bulbs
   (a) uses less energy per second?

_____

   (b) produces more light?

_____

   (c) produces more heat?

_____

3. What is the relationship between energy, heat, and light for each of the bulbs?

_____

_____

_____

Why do you think this is the case?

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

Calculating Energy Efficiency

BLM 3-51

Goal • Practise making calculations related to energy efficiency.

What to Do

Answer the following questions. Show all your work.

1. How efficient is a 60 W incandescent light bulb that produces 1800 J of light energy from 35 kJ of electrical energy?

2. What is the percent efficiency of each fluorescent light bulb?
   (a) A bulb that uses 2100 J of electrical energy to produce 410 J of light energy.

   (b) A bulb that produces 4.5 kJ of light energy from 22.4 kJ of electrical energy.

3. How efficient is each electric motor?
   (a) A motor that uses 32 000 J of electrical energy to produce 26 000 J of useful energy.

   (b) A motor that uses 15 000 J of energy and produces 3500 J of waste energy.

4. A kettle is designed to be 84.8% energy efficient. If the kettle uses 99 kJ of electrical energy to boil 250 mL of water, what is the amount of useful energy, and the amount of wasted energy?

DATE: NAME: CLASS:

UNIT 3

Calculating Energy Input or Output

BLM 3-52

Goal • Practise making calculations related to efficiency, energy input, and energy output.

What to Do

Answer the following questions. Show all your work.

1. A 100 W electric motor runs for 10 min and produces 40 kJ of useful mechanical energy. How efficient is the electric motor?

2. A 1500 W microwave oven takes 7.0 min to cook three potatoes. It has an output of 85 050 J of energy. What is the efficiency of the microwave?

3. A 1200 W hair dryer is 46.3% efficient. In 5 min it consumes 360 000 J of electricity.
   (a) How many joules of useful heat energy are produced?

   (b) How many joules of energy are wasted?

DATE: NAME: CLASS:

UNIT 3

Generating an Electric Current

BLM 3-53

Goal • Use this page to complete Activity 9-4A, Generating an Electric Current.

What to Do

1. Give the table a title. _____

Description of Magnet or Coil Movement		Ammeter Reading
(a) move the magnet inside the coil of wire	at regular speed	
	at fast speed	
	at slow speed	
(b) move the magnet over the outside of the coil of wire	at regular speed	
	at fast speed	
	at slow speed	
(c) move the coil of wire over the stationary magnet	from end to end of the magnet	
	from side to side of the magnet	
(d) move the magnet over the outside of the coil of wire	parallel to the coil	
	perpendicular to the coil	
	at other angles to the coil	

2. Follow steps 2 to 5 on page 325 of *Discovering Science 9*. Record your data in the table.

What Did You Find Out?

1. Describe how electricity and magnetism are related.

_____

_____

_____

2. How does the magnet's speed affect the electric current produced?

_____

_____

3. How does the position of the coil or magnet affect the electric current produced?

_____

_____

4. What combination of conditions generates the largest current?

_____

DATE: NAME: CLASS:

UNIT 3 BLM 3-54

The Efficiency of Producing and Transmitting Electrical Energy

Goal • Practise making calculations related to the energy efficiency.

Think About It

A. Different methods are used to produce electrical energy. By comparing the useful output energy to the input energy, we can determine which methods of producing electricity are most efficient.
However, efficiency is not the only factor when considering which energy sources are best. We also need to consider their impact on the environment.

B. Electrical energy produced at a generating station cannot be stored, and is transmitted through high voltage transmission lines. As the current flows, about 9% of the electrical energy is lost as thermal energy to the air around the wires. Scientists are studying the effects of electromagnetic radiation (which increases in strength as the voltage increases) on life near power lines.

Efficiency of Energy Conversions

Energy Source	Energy Converted into Electricity
Fossil fuels: Petroleum Natural gas Coal	 20% 21% 22%
Nuclear	20%
Wind	30%
Hydroelectric	20%
Solar cell	7% to 30%, depending on type
Fuel cell	65%

What to Do

Answer the following questions. Show all your work.

1. What is the percent efficiency of transmitting electrical energy through power lines?

2. Churchill Falls Hydroelectric Generating Station, east of Labrador City, produces 5428 MW of electricity in a year. How much of that energy is lost to the air through transmission?

3. One type of solar panel has a power rating of 0.25 kW. If one panel receives about 4 h of direct sunlight in a day, it can produce about 1 kW•h of electricity. Suppose a home uses about 20 kW•h of electricity in a day.

   (a) How many solar panels are required to produce that amount of energy?

   (b) How many panels are required to produce that amount of electricity if there are only 3 h of direct sunlight available?

4. The Fermeuse Wind Farm, south of St. John's, can produce 27 MW of electricity in a year.

   (a) There are nine wind turbines at Fermeuse. How much electricity can each turbine produce?

   (b) How much wind energy is input at each turbine? (Hint: The efficiency of wind energy is 30%.)

5. Which energy source in the chart has the lowest percent of waste energy?

   _____

DATE: NAME: CLASS:

UNIT 3

Chapter 9 Review

BLM 3-55

Goal • Check your understanding of Chapter 9.

What to Do

Circle the letter of the best answer.

1. Two identical resistors are connected in series to a battery. How does the current through the second resistor compare to the current through the first resistor?
   A. half the current
   B. no current
   C. the same current
   D. twice the current

2. Two identical resistors are connected in parallel to a battery. How does the voltage across the second resistor compare to the voltage across the first resistor?
   A. half the voltage
   B. half the voltage of the battery
   C. the same voltage
   D. twice the voltage

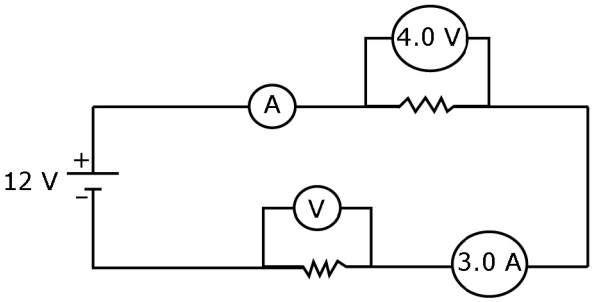
3. A load is connected to a battery. If a second identical load is added in series to the first, what happens to the total resistance of the circuit and the current leaving the battery?
   A. Total resistance decreases and the current decreases.
   B. Total resistance decreases and the current increases.
   C. Total resistance increases and the current decreases.
   D. Total resistance increases and the current increases.

4. A load is connected to a battery. If a second identical load is added in parallel to the first, what happens to the total resistance of the circuit and the current leaving the battery?
   A. Total resistance decreases and the current decreases.
   B. Total resistance decreases and the current increases.
   C. Total resistance increases and the current decreases.
   D. Total resistance increases and the current increases.

5. Which units would be used if measuring a large amount of energy?
   A. coulomb
   B. joule
   C. kilowatt-hour
   D. watt

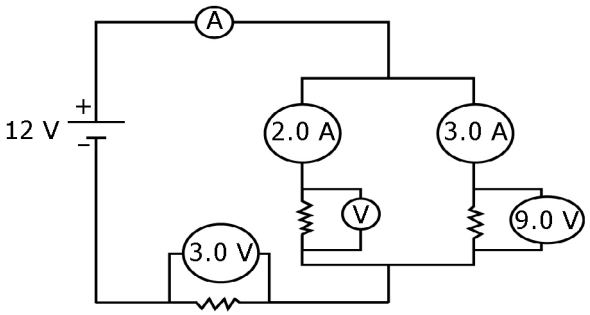
6. Which best represents a series pathway?
   A. driving across Canada
   B. going through the checkouts at a large grocery store
   C. running a lap on an oval running track
   D. walking from home to school

7. In the circuit below, what are the readings on the voltmeter V, and ammeter A?



	Voltmeter, V	Ammeter, A
A.	3.0 V	1.0 A
B.	4.0 V	3.0 A
C.	8.0 V	3.0 A
D.	12 V	9.0 A

8. In the circuit below, what are the readings on the voltmeter V, and ammeter A?



	Voltmeter, V	Ammeter, A
A.	9.0 V	2.0 A
B.	9.0 V	5.0 A
C.	12 V	5.0 A
D.	12 V	12 A

9. What is the current through a 180 W light bulb, if it is connected to 120 V?
   A. 0.67 A
   B. 1.5 A
   C. 120 A
   D. 21 600 A

10. What is the energy consumption of an 1800 W microwave oven used for 30 min?
   A. 0.90 kW•h
   B. 54 kW•h
   C. 900 kW•h
   D. 54 000 kW•h

11. What is the efficiency of an electric motor if it uses an input energy of 22 500 J to produce 15 000 J of useful energy?
   A. 0.67%
   B. 15%
   C. 66.7%
   D. 150%

12. Which statement is True about compact fluorescent light bulbs?
   A. A 13 W CFL bulb uses about the same amount of energy as a 60 W incandescent light bulb.
   B. A CFL bulb is cheaper than an incandescent light bulb.
   C. A CFL bulb lasts longer than an incandescent light bulb.
   D. The efficiency of a CFL bulb is lower than that of an incandescent light bulb.

13. Which energy source does not use a generator to convert mechanical energy to electricity?
   A. nuclear
   B. solar
   C. thermal
   D. wind

Match the term on the left with the best descriptor on the right. Each descriptor may be used only once.

Term	Descriptor
_____ 14. junction point	A. more than one path for current to travel
_____ 15. series circuit	B. a unit of energy measurement
_____ 16. parallel circuit	C. comparison of useful energy to input energy
_____ 17. joule	D. a unit of power measurement
_____ 18. watt	E. one path for current to travel
_____ 19. power	F. rate at which energy is transformed
_____ 20. efficiency	G. location where pathways combine
	H. rate of flow of current

Short Answer Questions

21. A battery is connected to two light bulbs connected in parallel. If the first light bulb "burns out," what happens to the second light bulb? Explain.

_____

_____

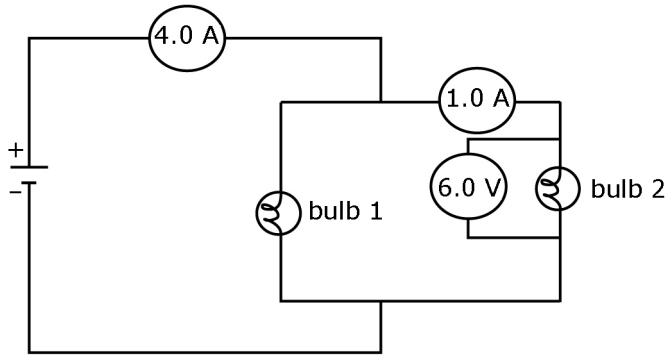
_____

22. A 1400 W hair dryer is used for 15 min.
    (a) Calculate the electrical energy consumed in the following units.
        (i) joules

        (ii) kilowatt-hours

    (b) If the cost of electricity is 8cents per kW•h, calculate how much it costs to use this hair dryer.

23. Use the circuit diagram below to calculate the following values.



    (a) the current through bulb 1

    (b) the voltage across bulb 1

    (c) the power lost in bulb 1

24. Describe four ways of conserving energy in the home.

_____

_____

_____

_____

_____

25. Identify three different types of generating stations and describe their impact on the environment.

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

Unit 3 Test

BLM 3-56

Goal • Test your understanding of Unit 3, Characteristics of Electricity.

What to Do

Circle the letter of the best answer.

1. Which shows the correct charge for electrons and protons?

	Proton	Electron
A.	negative	negative
B.	negative	positive
C.	positive	negative
D.	positive	positive

2. A neutral solid object is rubbed with wool and becomes positively charged. Which statement best describes the transfer of charge?
   A. Electrons are transferred from the object onto the wool.
   B. Electrons in the solid object have been destroyed.
   C. Protons are created in the solid object.
   D. Protons are transferred from the wool onto the object.

3. Which is one of the laws of static charge?
   A. like charges attract
   B. neutral objects are repelled by charged objects
   C. opposite charges attract
   D. opposite charges repel

4. Both AA and AAA batteries have a 1.5 V potential difference across their terminals. How is it possible for them to have different amounts of electrical potential energy?
   A. They are different sizes.
   B. They can separate different amounts of charge.
   C. They have different amounts of resistance.
   D. They have different voltages.

5. Which correctly describes a load in an electric circuit?
   A. It can turn the circuit on or off by closing or opening the circuit.
   B. It is the source of electric energy.
   C. It is the wire through which electric current flows.
   D. It transforms electrical energy into other forms of energy.

6. Which is the correct calculation for electrical resistance?
   A. the current across a load divided by the potential difference flowing through it
   B. the current flowing through a load divided by the potential difference across it
   C. the potential difference across a load divided by the current flowing through it
   D. the potential difference across a load multiplied by the current flowing through it

7. Which correctly identifies the meter used to measure each quantity?

	Voltage	Current	Resistance
A	ammeter	voltmeter	ohmmeter
B	ohmmeter	ammeter	voltmeter
C	voltmeter	ammeter	ohmmeter
D	voltmeter	ohmmeter	ammeter

8. Which describes the current in a series circuit?
   A. The current decreases as it moves through the circuit.
   B. The current is greatest at the negative terminal of the battery.
   C. The current is greatest through the load.
   D. The current is the same at every point in the circuit.

9. A circuit contains a battery and a resistor. Which correctly describes the total resistance when a second resistor is added to a circuit in either series or parallel?

	Series Circuit	Parallel Circuit
A	total resistance decreases	total resistance decreases
B	total resistance decreases	total resistance increases
C	total resistance increases	total resistance decreases
D	total resistance increases	total resistance increases

10. Two light bulbs are connected in parallel to a source of constant voltage. If one bulb is unscrewed, what will happen to the voltage across the other bulb?
    A. voltage will become zero
    B. voltage will be half
    C. voltage will double
    D. voltage will remain the same

**Match the Term on the left with the best Descriptor on the right.
Each Descriptor may be used only once.**

Term	Descriptor
_____ 11. coulomb	A. only one path for current to travel
_____ 12. current	B. charge that remains in one location
_____ 13. joules	C. unit of energy
_____ 14. Ohm's law	D. the rate in which energy is transformed
_____ 15. power	E. amount of energy per unit of charge
_____ 16. resistance	F. ability to do work
_____ 17. series circuit	G. more than one path for current to travel
_____ 18. parallel circuit	H. continuous flow of charge
_____ 19. static charge	I. relationship of voltage, current, and resistance
_____ 20. voltage	J. unit of charge
	K. slows down current and changes electrical energy into other forms

Short Answer Questions

21. Draw negative (–) signs and positive (+) signs in the blank rectangles to represent each charge.

(a) neutral (b) negative (c) positive

22. (a) Explain the difference between an insulator and a conductor.

_____

_____

(b) Give an example of an insulator. _____

(c) Give an example of a conductor. _____

23. In terms of charge transfer, what is the difference between charging by conduction and charging by induction?

_____

_____

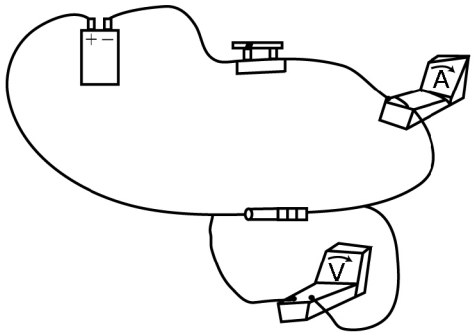
24. Two charged objects are located near one another. Circle the correct term in the brackets to complete each sentence.
    (a) Increasing the charge on one of the objects (increases / decreases) the force between the two charged objects.
    (b) Increasing the distance between the two objects (increases / decreases) the force between the two charged objects.
    (c) Decreasing the distance between the two objects (increases / decreases) the force between the two charged objects.

25. When testing an unknown charge, the only certain way to identify the type of charge is to observe its repulsion with a known charge. Explain why.

    _____

    _____

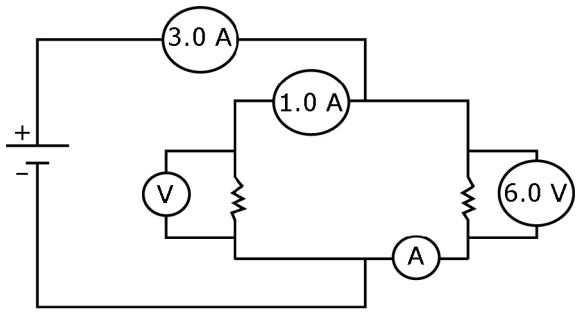
26. Draw a circuit diagram for the circuit below.



27. Use Ohm's law to calculate each quantity.
    (a) A circuit takes 0.60 A of current from a 12 V battery. What is the resistance of this circuit?

    (b) A 12 MW resistor is connected to a 60 kV high power line. What is the current, in milliamperes (mA) through this resistor?

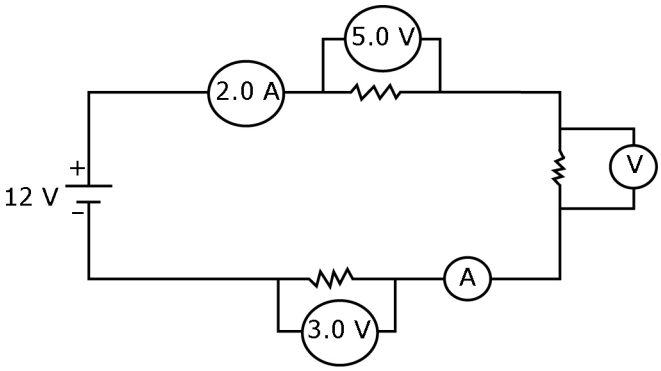
28. Consider the circuit diagram below.



(a) Are the resistors in the above circuit connected in series or parallel? _____

(b) Determine the voltage V, and the current A.

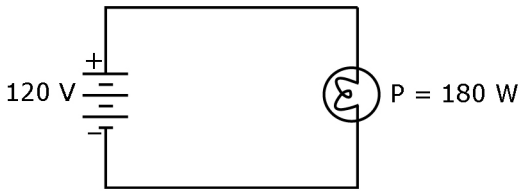
29. Consider the circuit diagram below.



(a) Are the resistors in the above circuit connected in series or parallel? _____

(b) Determine the voltage at V, and the current at A.

30. Consider the circuit diagram below.



(a) If the light bulb has a power rating of 180 W, what is the current through the bulb?

(b) If the light bulb is left on for 12 h, how much electrical energy, in kilowatt-hours, is consumed by the light bulb?

(c) If the cost of electricity is 7cents per kilowatt-hour, how much did it cost to operate the light bulb in part (b)?

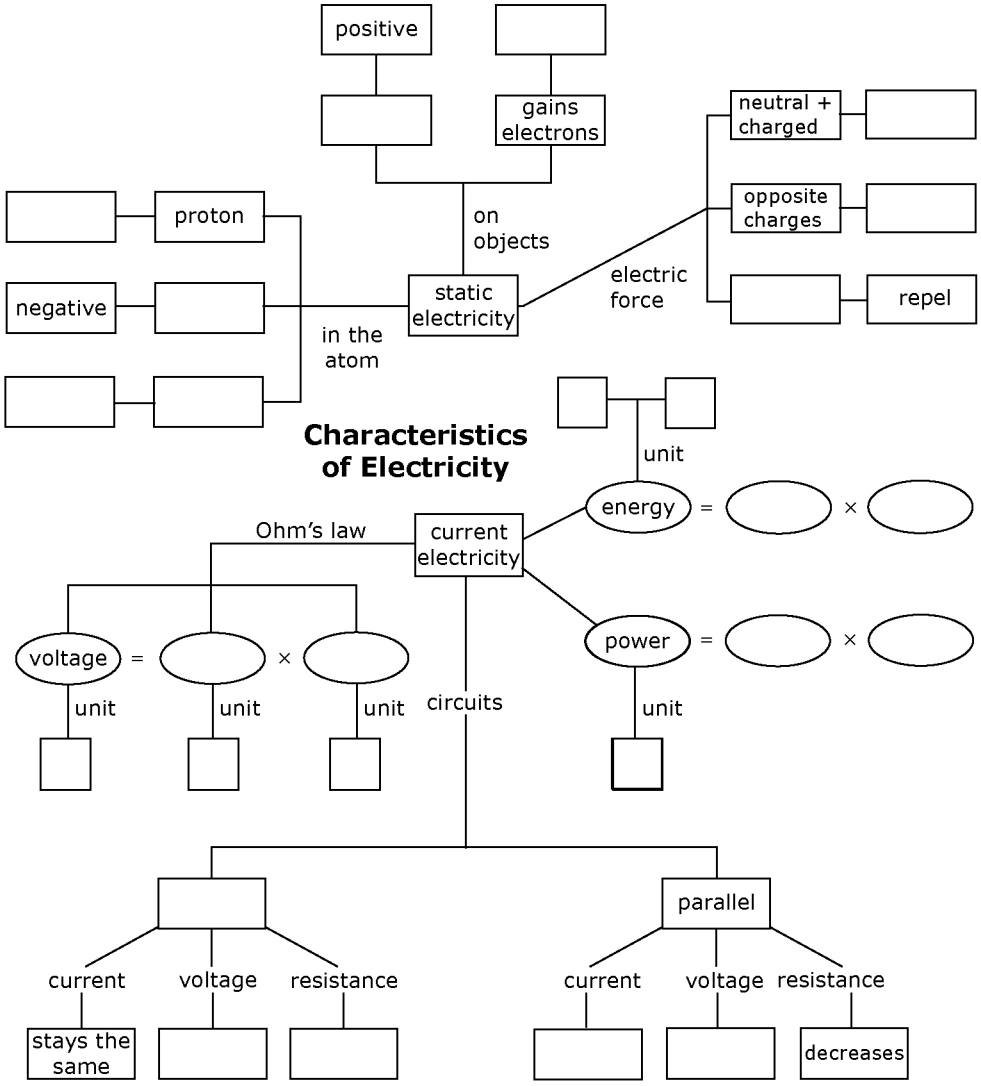
DATE: NAME: CLASS:

UNIT 3

Unit 3 Review Concept Map

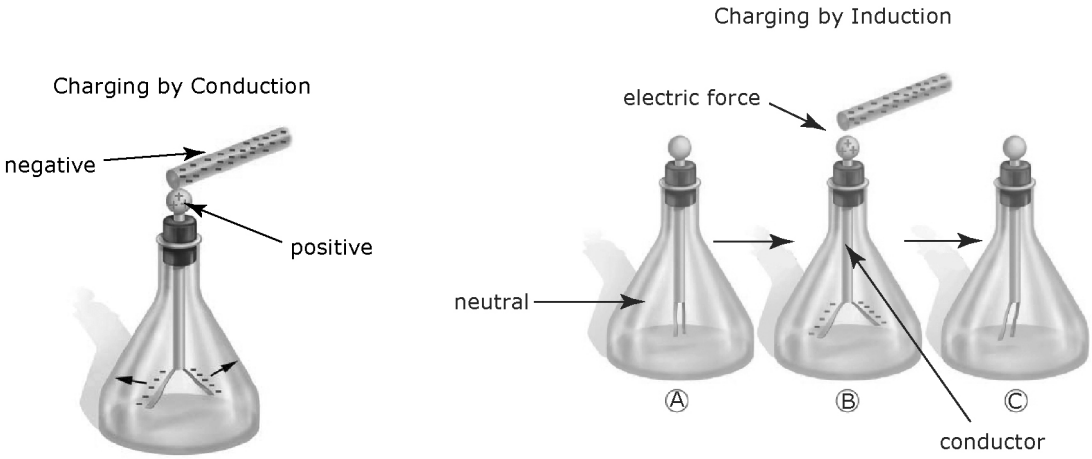
BLM 3-57

Goal • Use this concept map to complete question 1, Unit 3 Review, page 342 of *Discovering Science 9*.



Unit 3 BLM Answers

BLM 3-3, Chapter 7 Key Terms



BLM 3-4, Chapter 8 Key Terms

1. ampere
2. circuit diagram
3. electric circuit
4. electric load
5. electrodes
6. energy
7. Ohm's law
8. electric potential
9. resistance
10. voltage

BLM 3-5, Chapter 9 Key Terms

Riddles will vary.
circuit breaker: a switch and safety device that can cut off all power coming into your home to prevent the wires from overheating.
efficiency: the percentage of energy converted into a useful form compared to the total amount of energy consumed.
electrical energy: potential energy transformed into a useful form.
electrical power: the rate at which electric potential energy is being transformed.
EnerGuide: a label that tells you how much energy an appliance uses in a typical year of use.
fuel cell: a battery whose chemical components are not consumed over time and are not stored inside the cell
fuse: a device that contains a metallic conductor that melts when excessive current heats it up.
generator: a device that converts mechanical energy into electrical energy
grounding terminal: the round prong in a plug that allows excess current to flow through the metal frame of a building and into the ground instead of producing a shock.
hydroelectric: uses the energy of falling or flowing water to spin a turbine:
joule: a small unit for measuring energy; symbol is J
junction point: the location at which a circuit divides into multiple paths or where multiple paths combine
kilowatt-hour: a large unit for measuring energy; symbol is KW•h
non-renewable: something that cannot be replaced
nuclear energy: uses the heat released from a nuclear reaction to boil water. The resulting steam is used to spin a turbine.

parallel circuit: a circuit that is a closed pathway that has several different paths for current to travel
power: the rate of change in energy or the rate at which work is done or energy is transformed
power rating: a measurement of how much electrical energy an electrical device consumes for every second it is in use
renewable: something that can be replaced
series circuit: a circuit that has only one path for current to travel
thermal energy: uses the heat produced from the burning of fossil fuels, including coal, gas, and diesel, to boil water. The resulting steam is used to spin a turbine.
transformer: a simple electrical device that changes voltage.
turbine: a cylinder outfitted with paddles or blades that rotates to supply energy to a generator
watt: a measure equal to one joule (J) of energy transformed in one second (s); symbol is W

BLM 3-6, Charge Transfer Diagrams

1. They must be equal.
2. (a) Diagrams should show 15 (+) and fewer than 15 (–).
   (b) The number of positive charges is the same.
   (c) The number of negative charges is fewer.
3. (a) Diagrams should show 15 (+) and more than 15 (–).
   (b) The number of positive charges is the same.
   (c) The number of negative charges is more.

BLM 3-8, Obeying the Laws of Static Charge

1. (a) negative
   (b) attracts
   (c) attracts
   (d) positive, neutral
   (e) repels
2. Diagrams should show that the object attracts the negative and neutral charges and repels the positive charges.
3. (a) decreased
   (b) increased
   (c) increased
   (d) decreased

BLM 3-9, Conduction/Induction Venn Diagram

Charging by conduction: electrons transfer from one object to another.
Charging by induction: the electrons are rearranged in the object but no electrons actually transfer from one object to another.
Both are methods of charging objects.

BLM 3-10, Conduction/Induction Charge Diagrams

1. In induction, the electrons relocate within the object but do not transfer from one object to the other. In conduction, electrons physically transfer from one object to the other.
2. (a) Equal numbers of (+) and (–). The (–) should be grouped toward the left side of the object.
   (b) More (+) than (–).
   (c) More (–) than (+).
   (d) Equal numbers of (+) and (–). The (–) should be grouped toward the right side of the object.
3. (a) diagrams (b) and (c)
   (b) diagrams (a) and (d).

BLM 3-11, Forces and Electrical Charges

1. conductor
2. insulator
3. insulator
4. insulator
5. insulator
6. conductor
7. conductor
8. insulator
9. conductor
10. conductor
11. insulator
12 opposite
13. negative, positive
14. opposite
15. positively, negatively
16. negatively
17. (a) positive (+)
    (b) positive (+)
    (c) negative (–)

BLM 3-12, Pop Can Race

For this activity, there are no right and wrong solutions to the problem, only more and less effective solutions. The groups that try a variety of strategies should discover that the plastic golf tubes, when rubbed vigorously with plastic (clear plastic oven-roasting bags are best for this) will produce the greatest charge and hold the charge for the longest time.

BLM 3-14, Chapter 7 Review

1. A
2. C
3. B
4. B
5. A
6. C
7. B
8. A
9. A
10. B
11. F
12. C
13. G
14. A
15. D
16. B
17. (a) The force increases.
    (b) The force decreases.
    (c) The force decreases.
18. The number and position of (+) signs should remain the same in both (a) and (b).
    (a) The electrons in the object should be grouped toward the right side.
    (b) Some of the electrons from the object should have transferred to the rod.

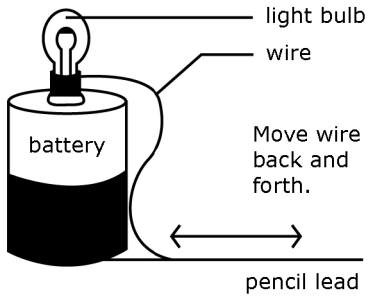
19. Rub the acetate with a paper towel so that the acetate becomes negatively charged. Bring the charged acetate near the Styrofoam™ chips. If the chips repel, then the chips are negatively charged. If the chips attract, then the chips are positively charged.

BLM 3-16, Making Light Bulbs Glow

1. Problem: Bulb attached to only one terminal. Solution: Attach side of the bulb's base to positive terminal.
2. Problem: Bulb attached to only one terminal. Solution: Remove wire from side of battery and attach it to negative terminal.
3. Problem: Both terminals on bulb attached to positive terminal of battery. Solution: Remove one wire connecting base of bulb to positive terminal and touch base of bulb to negative terminal.
4. Problem: Bulb attached to only one terminal. Solution: Attach side of bulb's base to the negative terminal.
5. Problem: Bulb attached to only one terminal. Solution: Attach bulb's base (not side of base) to negative terminal.
6. Problem: Metal part of bulb only attached to one terminal. Solution: Move bulb so its metal part is touching positive terminal.
7. Problem: Bulb only connected to one terminal. Solution: Move wire connected to negative terminal so it is also attached to metal part of bulb.
8. Problem: Bulb attached to only one terminal of battery. Solution: Use a wire to attach bulb to positive terminal of battery as well.

BLM 3-17, Make Your Own Dimmer Switch

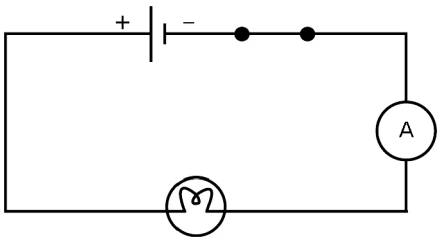
1. Answers may vary. The following shows one successful design.



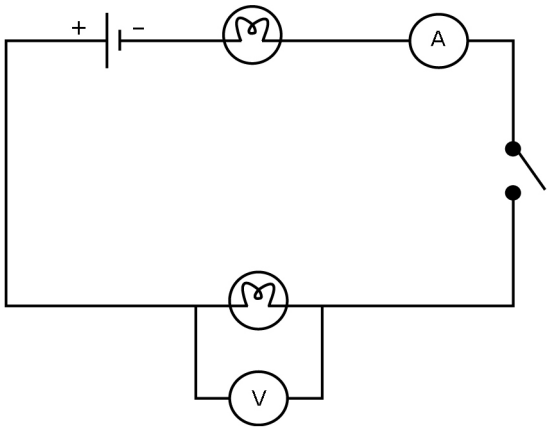
2. Move the wire back and forth along the lead to dim or brighten the light.

BLM 3-18, Drawing Circuit Diagrams

1. (a)
   (b) closed
   (c) battery, light bulb

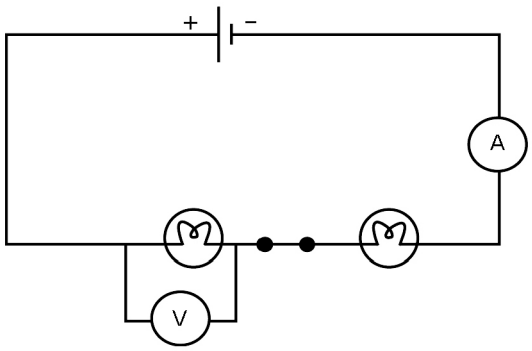


2. (a)



(b) open

3. (a)



(b) closed
(c) battery, light bulbs

BLM 3-19, Circuit Symbols

1. conducting wire
2. bulb
3. V voltmeter
4. open switch
5. + – cell
6. close switch
7. + – battery
8. A ammeter
9. resistor

10. (a) the source of electrical energy, such as a battery
    (b) the wire through which electric current flows
    (c) a device that transforms electrical energy into other forms of energy
    (d) a device that can turn the circuit on or off by closing or opening the circuit

BLM 3-20, Calculate the Current

1. $I_2 = 6$ A
2. $I_3 = 4.0$ A
3. $I_1 = 6.0$ A
   $I_2 = 6.0$ A
   $I_3 = 2.0$ A

BLM 3-21, Calculate the Potential Difference

1. $V_1 = 35$ V
2. $V_S = 110$ V
3. $V_1 = 9.0$ V

BLM 3-24, Ohm's Law

1. 9.6 Ω
2. 1.3 A
3. 9.0 V
4. 0.75 A
5. 15 V
6. 30 Ω
7. (a) 5.0 A
   (b) 2.5 A
8. 7.5 V

BLM 3-25, Resistor Colour Code (optional)

1. (a) 6500 Ω
   (b) 700 000 Ω
   (c) 560 Ω
   (d) 12 Ω
   (e) 87 000 Ω
   (f) 2100 Ω
2. (a) 230 W
   (b) red, orange, brown
3. (a) 6400 W
   (b) blue, yellow, red

BLM 3-26, Practising Calculating Resistance

1. $R = 3600\ \Omega$ or $3.6 \times 10^3\ \Omega$
2. $I = 0.50$ A or 5.0×10^{-1} A
3. $V = 9.0$ V
4. $I = 18.3$ A or 1.83×10^1 A
5. 3.0 Ω
6. 11 Ω
7. 220 Ω or $2.20 \times 10^2\ \Omega$
8. 0.30 A or 3.0×10^{-1} A
9. 4×10^{-4} A or 0.0004 A or 0.4 mA
10. 120 V or 1.20×10^2 V

BLM 3-27, Electricity Crossword Puzzle

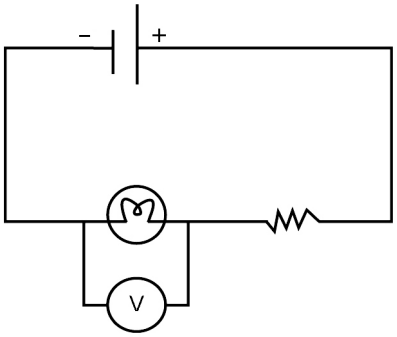
Across

2. ohm
5. volt
6. ampere
8. ammeter
10. voltmeter
15. potential difference

Down

1. coulomb
3. circuit
4. watt
7. battery
9. electric current
11. power
12. switch
13. load
14. resistance

BLM 3-30, Chapter 8 Review

1. C
2. A
3. A
4. A
5. A
6. C
7. C
8. C
9. D
10. D
11. B
12. A
13. G
14. E
15. C
16. 

17. (a) 30 Ω
    (b) 0.0064 A, 6.4 mA
18. Connect the battery to the resistor using the connecting wires. Using an ammeter and the voltmeter, measure the current through the resistor and the voltage across the resistor. Calculate the resistance using Ohm's law ($R = V/I$).

BLM 3-31, Series Circuits

1. only one
2. equal to
3. different from
4. increases
5. equal to
6. voltage = 10 V, current = 3.0 A
7. voltage = 12 V, current = 4.0 A

BLM 3-32, Parallel Circuits

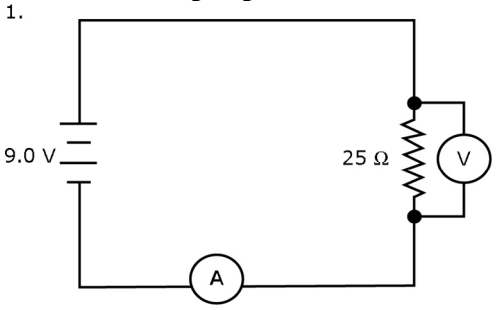
1. more than one
2. different from
3. equal to
4. decreases
5. equal to
6. voltage = 12 V, current = 6.0 A
7. voltage = 90 V, current = 1.0 A

BLM 3-33, Comparing Series Circuits and Parallel Circuits

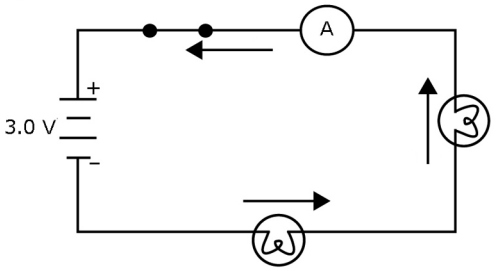
Question	Series Circuit	Parallel Circuit
Number of paths for electron flow	**one**	**multiple**
Effect of removing a load from the circuit	The circuit is opened. Electrons **cannot** flow.	The circuit is not opened. Electrons **continue to** flow through the remaining paths.
Voltage or potential drop	The sum of the voltage lost in the loads or resistors in the ENTIRE circuit is **equal to** the total voltage supplied by the battery.	The sum of the voltage lost in the loads or resistors in EACH BRANCH of the circuit is **equal to** the total voltage supplied by the battery.
Current	• The current **is the same** throughout the circuit. • The current **in the only path** is dependent on the total resistance in the circuit.	• The total current entering or leaving a junction point is **the sum of the current in all of the paths.** • The current **in each of the paths** is dependent on the total resistance in that path.
Resistance	• When resistors or loads are placed in series, the total resistance of the circuit is **increased**, since the total resistance is the sum of the resistances of each of the resistors or loads. • When the total resistance is **increased**, the total current will **decrease** since $V = IR$.	• When resistors or loads are placed in parallel, the total resistance of the circuit is **decreased**. • When the total resistance is **decreased,** the total current will **increase** since $V = IR$.
Connecting cells to form a battery	• The effective voltage is the **sum of** the voltages of each of the individual cells. • The maximum overall lifespan of the battery is **the same as** the lifespan of each of the individual cells.	• The effective voltage is the **same as the voltage of a single cell.** • The maximum overall lifespan of the battery is t**he sum of the lifespans of all the cells.**

BLM 3-34, Designing Circuits

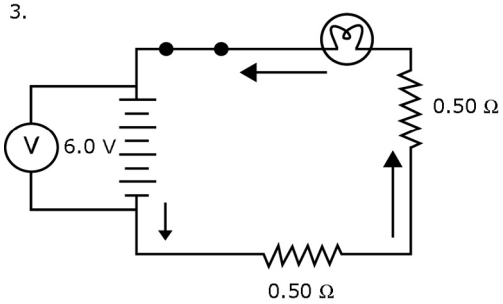
1.



2.

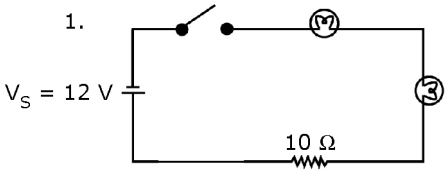


3.

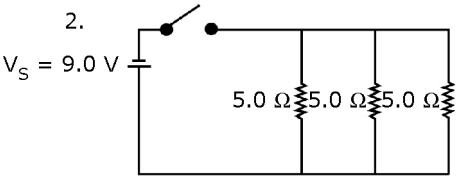


BLM 3-35, Drawing Series and Parallel Circuit Diagrams

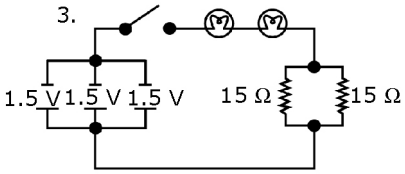
1.



2.



3.



BLM 3-36, Understanding Circuit Diagrams

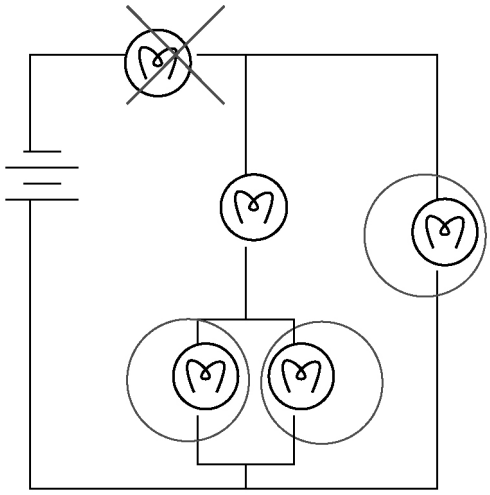
1. (a) Current flows through whole circuit.
   (b) No current flows in the circuit.
   (c) Current flows through rest of circuit, bypassing fifth bulb.
2. (a) No bulbs will be lit.
   (b) No bulbs will be lit.
   (c) Bulbs 1, 2, 4, 6, and 7 will be lit.
   (d) Bulbs 1, 2, 3, 5, 6, and 7 will be lit.
   (e) Bulbs 1, 2, 4, 6, and 7 will be lit.
   (f) Bulbs 1, 2, 3, 4, 5, and 7 will be lit.
   (g) No bulbs will be lit.
3. $V_1 = 7.5$ V; $R_1 = 5.0\ \Omega$; $R_2 = 3.0\ \Omega$

BLM 3-37, Calculate Voltage and Current

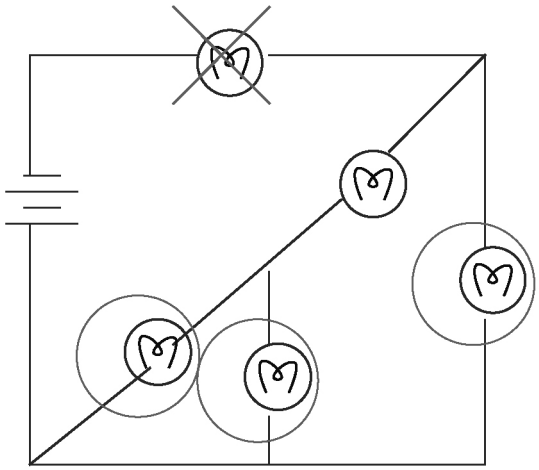
1. $V_2 = 6.0$ V; $V_4 = 2.0$ V
2. $I_1 = 20$ A; $I_5 = 14$ A

BLM 3-38, Compound Circuits

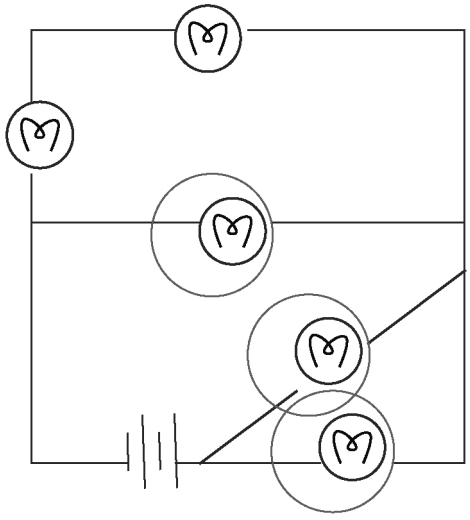
1. (a)



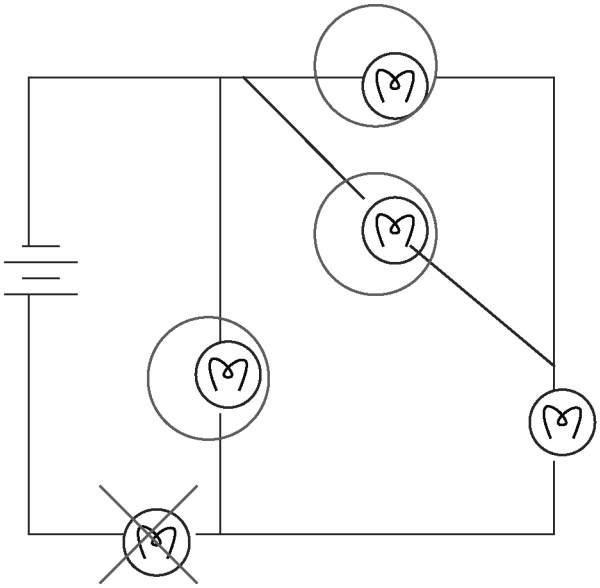
(b)



(c)



(d)



2. (a) Answers will vary, for example, any two of A, B, C, E, H, I, and J; or any two of A, B, C, D, G, I, or J
   (b) Answers will vary, for example, any three of A, B, C, E, H, I, and J; or any three of A, B, C, D, G, I, or J
   (c) and (d) Answers will vary, for example, D and F, D and E, G and H, or F and I

BLM 3-43, Calculating Power

1. 12 W
2. 12 W
3. 0.5 A

4. 3.0 A
5. 0.30 W
6. 144 W
7. 10 A
8. 18 W

BLM 3-44, Electrical Power and Energy

1. 30 W
2. 5.0 A
3. 40 V
4. 4.0 A
5. (a) 53 V
   (b) 1.9 A
6. 0.11 W
7. 1.1×10^5 J
8. 8.4×10^5 J
9. 2.9×10^6 J

BLM 3-45, Power Problems

1. 1100 W or 1.1×10^3 W
2. 55 W or 5.5×10 W
3. 660 W or 6.6×10^2 W
4. (a) 150 W or 1.5×10^2 W
   (b) 45 kJ or 4.5×10^4 J

BLM 3-46, Calculating Energy Consumption

1. 1440 W
2. 1500 W
3. 77 000 J or 7.7×10^4 J
4. 540 000 J or 5.4×10^5 J
5. 6.48×10^7 J or 18 kW•h
6. 252 J
7. 2.5 kW•h

BLM 3-47, The Price of Energy

1. $355.00
2. $7.92
3. $3.09
4. $4.22

BLM 3-51, Calculating Energy Efficiency

1. 5.14%
2. (a) 19.52%
   (b) 20.09%
3. (a) 81.25% efficient
   (b) 76.67% efficient
4. useful energy = 83 952 J; wasted energy = 15 048 J

BLM 3-52, Calculating Energy Input or Output

1. 67%
2. 13.5%
3. (a) useful energy: 166 680 J
   (b) waste energy: 193 320 J

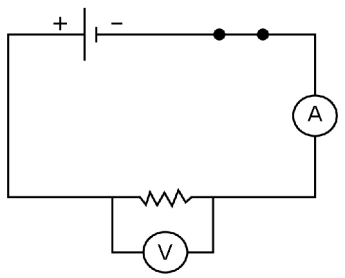
BLM 3-54, The Efficiency of Producing and Transmitting Electrical Energy

1. 91%
2. about 489 MW or 489 million watts
3. (a) 20 panels
   (b) 27 panels
4. (a) 3 MW
   (b) 10 MW or 10 million watts
5. fuel cell

BLM 3-55, Chapter 9 Review

1. C
2. C
3. C
4. B
5. C
6. C
7. C
8. B
9. B
10. A
11. C
12. C
13. B
14. G
15. E
16. A
17. B
18. D
19. F
20. C
21. The second bulb stays lit. This is because there still is a complete circuit through the second bulb and battery. Current will still be able to travel through the second bulb.
22. (a) (i) 1.3×10^6 J; (ii) 0.35 kW•h
    (b) $0.03
23. (a) 3.0 A
    (b) 6.0 V
    (c) 18 W
24. Answers may include using energy-efficient light bulbs and appliances, turning off lights and electrical devices when not in use, reducing the amount of heat loss by insulating walls and water pipes, and change our behaviour so that we use electrical devices less often.
25. A hydroelectric generating station uses a renewable energy source (falling water) but often requires a dam to be built, which changes the landscape of an area. A thermal generating station uses a non-renewable energy source (fossil fuels), which pollutes the air when burned. A nuclear generating station uses nuclear reactions as the energy source, which produces dangerous radioactive material.

BLM 3-56, Unit 3 Test

1. C
2. A
3. C
4. B
5. D
6. C
7. C
8. D
9. C
10. D
11. J
12. H
13. C
14. I
15. D
16. K
17. A
18. G
19. B
20. E
21. (a) equal number of (+) and (–)
    (b) more (–) than (+)
    (c) more (+) than (–).
22. (a) An insulator does not allow electrons to move freely. A conductor allows electrons to move freely.
    (b) plastic, glass, cloth
    (c) any type of metal
23. In conduction, electrons transfer from one object to the other. When charging by induction, the electrons relocate within the material but do not transfer from one object to the other.
24. (a) increases
    (b) decreases
    (c) increases
25. A charged object will attract both an oppositely charged object and a neutral object. A like-charged object would repel and the neutral object would still attract.
26. 

27. (a) 20 Ω
    (b) 200 A or 200 000 mA
28. (a) parallel
    (b) voltage = 6.0 V, current = 2.0 A
29. (a) series
    (b) voltage = 4.0 V, current = 2.0 A
30. (a) 1.5 A
    (b) 2.2 kW·h
    (c) $0.15

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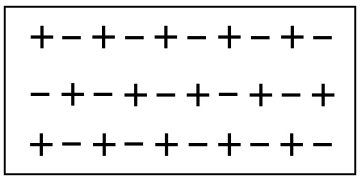
UNIT 3 # Charge Transfer Diagrams **BLM 3-6**

Goal • Review your understanding of charge transfer.

What to Do

Use the diagram to answer the questions. Use (–) to represent negative charges and (+) to represent positive charges.



1. The diagram represents a neutral solid object. What is the relationship between the number of positive and negative charges in a neutral object?

_____

2. When the neutral object is rubbed with a material, it becomes positively charged.
   (a) Draw a new diagram that represents the object with a positive charge.

   (b) How do the number of positive charges compare to the original diagram?

_____

   (c) How do the number of negative charges compare to the original diagram?

_____

3. When the neutral object is rubbed with a different material, it becomes negatively charged.
   (a) Draw a new diagram that represents the object with a negative charge.

   (b) How do the number of positive charges compare to the original diagram?

_____

   (c) How do the number of negative charges compare to the original diagram?

_____

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UNIT 3

Charging Insulators and Conductors

BLM 3-7

Goal • Use these pages to complete Find Out Activity 7-1C, Charging Insulators and Conductors.

What to Do

1. Write the names of the materials you are testing in the first two columns.

Solid Material	Soft Material	Number of Puffed Rice Grains Attracted

2. Follow steps 2 to 7 on page 235 of *Discovering Science 9*. Record your observations in the table.

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BLM 3-7 continued

What Did You Find Out?

1. Which combination of objects attracted the most puffed rice?

_____

_____

_____

2. Why do you think it is important to rub each material in a similar way?

_____

_____

_____

3. What was the purpose of wiping the object with your bare hand before performing the next test?

_____

_____

_____

4. List the solid materials that you think are conductors.

_____

_____

What observations did you use in your decision?

_____

_____

_____

5. List the solid materials that you think are insulators.

_____

_____

What observations did you use in your decision?

_____

_____

_____

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UNIT 3

Obeying the Laws of Static Charge

BLM 3-8

Goal • Review your understanding of the laws of static charge.

Questions

1. Complete the sentences using the terms below. Terms may be used more than once.

   attracts, *negative*, *neutral*, *positive*, *repels*

   (a) A negative charge is repelled by a _____ charge.

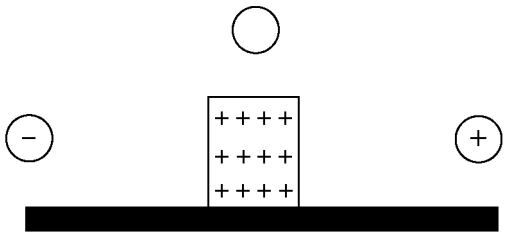
   (b) A positive charge _____ a negative charge.

   (c) A charged object _____ a neutral object.

   (d) A negative object attracts an unknown object. The unknown object could be _____ or _____.

   (e) A positive object _____ a positive object.

2. A positively charged object is attached to a table as shown.



   Use an arrow to indicate the direction of the force on the negative (–), positive (+), and neutral (no sign) charges placed near the object on the table.

3. Use the words "increased" or "decreased" to complete each of the following statements.

   (a) To increase the electric force between two charged objects, the distance separating the two charges should be _____.

   (b) To increase the electric force between two charged objects, the amount of charge on one or both objects should be _____.

   (c) To decrease the electric force between two charged objects, the distance separating the two charges should be _____.

   (d) To decrease the electric force between two charged objects, the amount of charge on one or both objects should be _____.

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UNIT 3

Conduction/Induction Venn Diagram

BLM 3-9

Goal • Compare and contrast conduction and induction.

What to Do

Complete the Venn diagram. List points that are true of induction on the left side. List points that are true of conduction on the right side. List points that are true of both induction and conduction in the middle.