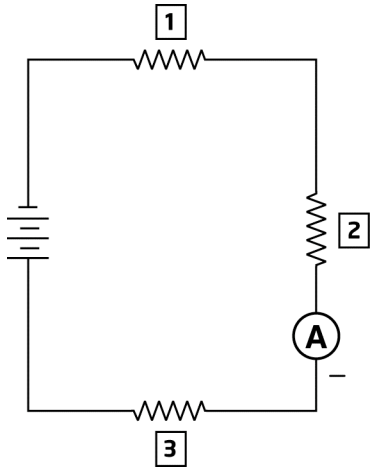
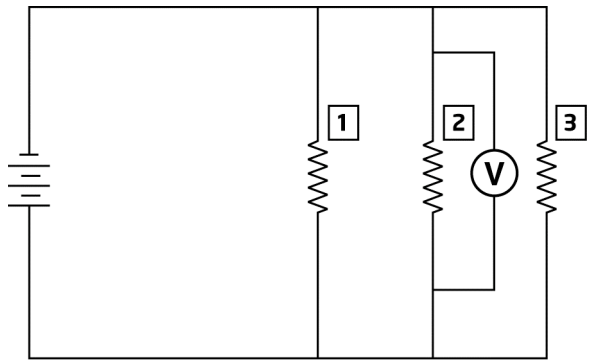
Unit 4 Electrical Applications

Using Your Appendices, page 121

1. **a)** voltmeter
   b) ammeter
   c) ammeter
   d) voltmeter
2. The rule “positive to positive, and negative to negative” means you should be able to trace the connection from the positive terminal on the meter to the positive terminal on the source, and the negative terminal on the meter leads to the negative terminal on the source.
3. **a)**



b)



Topic 4.1 Sources of Electrical Energy

Reading Check, pages 122–123

1. Hydroelectric, thermoelectric, nuclear
2. A renewable energy source can be replaced within a human lifetime, or less. A non-renewable energy source can never be replaced.

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Cloze Activity, page 124

1. kinetic
2. nuclear
3. generator
4. turbine, shaft, generator
5. fossil fuels
6. hydroelectric, thermoelectric, nuclear
7. nuclear, thermoelectric
8. renewable
9. wind, Sun, biomass, tides, heat below Earth's surface; fossil fuels, uranium

Interpreting Illustrations, page 125

1. See Figure 4.2 on student textbook page 247 for proper labelling of diagrams.
2.

Characteristic	Sources of Energy		
	Hydroelectric	Thermoelectric	Nuclear
The process of generating electrical energy using these resources involves spinning turbines, which spin a generator.	✓	✓	✓
These resources convert the kinetic energy of moving water to spin giant turbines.	✓		
Using these resources produces lots of heat that boils water into steam.		✓	✓
Using these resources involves burning fossil fuels.		✓	
The process of generating electrical energy using these resources involves circulating water through a closed system of pipes.		✓	✓

Comprehension, page 126

1. renewable
2. non-renewable

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3. renewable

4. renewable

5. both

6. non-renewable

7. non-renewable

8. both

Assessment, page 127

1. B

2. E

3. A

4. F

5. H

6. D

7.

Hydroelectric	Thermoelectric	Nuclear
• uses water • converts kinetic energy to electrical energy • falling water spins giant turbines	• uses fossil fuels • converts chemical energy to electrical energy • steam spins giant turbines	• uses uranium • converts nuclear energy to electrical energy • steam spins giant turbines

8. a) generator

b) turbine, shaft, generator

9. a) A renewable energy source is an energy source that can be replaced within a human lifetime, or less. A non-renewable energy source is an energy source that can never be replaced.

b) water, wind, the Sun, biomass, tides, or heat from below the Earth's surface

c) fossil fuels, uranium

10. Answers could include impact on ecosystems, impact on society, technological considerations, and economic considerations.

Topic 4.2 Charges and How They Behave

Reading Check, pages 128–129

1. In a charged object, the numbers of positive and negative charges are unequal.

2. A conductor allows electrical charges to move through it. An insulator does not.

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Cloze Activity, page 130

1. static electricity
2. atoms
3. electrons, protons
4. electrons
5. positive
6. negative
7. electrically neutral
8. attract, repel
9. attract
10. conductivity
11. conductors, insulators

Applying Knowledge, page 131

1. charge on comb: negative;
   charge on hair: positive
2. charge on socks: positive;
   charge on skirt: negative
3. charge on window: positive;
   charge on paper towel: negative
4. charge on balloon: negative;
   charge on cat's fur: positive

Interpreting Illustrations, page 132

1. attract
2. attract
3. attract
4. repel
5. repel
6. attract

Assessment, page 133

1. E
2. D
3. F
4. A

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5. B

6. The Law of Electric Charge states that “opposite charges attract each other, and like charges repel each other.”

7. **a)** positive
b) negative
c) negative
d) positive
e) negative
f) positive
g) positive
h) negative

8. **a)** A conductor allows electrical charges to move through it. An insulator does not.
b) Examples of conductors include metals such as gold, silver, copper, etc.
c) Examples of insulators include non-metals such as paper, plastic, rubber, etc.

Topic 4.3 Charging and Discharging Objects

Reading Check, pages 134–135

1. The main parts of the electroscope are all conductors to allow negative charges to move easily through them.

2. In charging by contact, the charged object touches the neutral object. In charging by induction, the charged object is brought near the neutral object, without touching it.

3. An object can be discharged by sparking or by grounding.

Cloze Activity, page 136

1. electroscope

2. contact

3. induction

4. conductor

5. leaves

6. repel

7. discharged

8. spark

9. grounding

10. conductor, charges

11. spark, grounding

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Comprehension, page 137

1. a) charging by induction

b) charging by contact

c) charging by induction

2. a) charging by induction

b) charging by induction

c) charging by contact

Applying Knowledge, page 138

1. repel; negative; the same repel; apart

2. attract; negative; the same repel; apart

3. negative; attracted to; closer together

Assessment, page 139

1. C

2. D

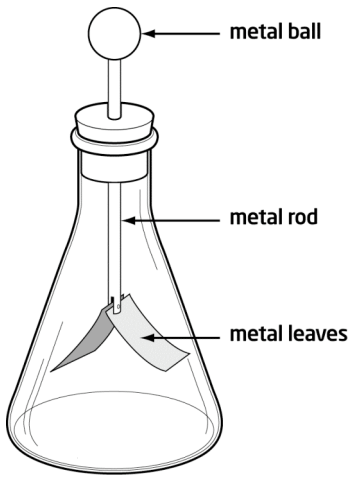
3. A

4. E

5. B

6. G

7. a)



b) When a negatively-charged ebonite rod is brought near the metal sphere of the electroscope, the negative charges on the charged rod repel negative charges in the metal ball. The negative charges in the metal ball move down into the metal leaves, causing the leaves to become negatively charged, which repel each other and move apart.

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8. **a)** by contact
   b) a conductor
   c) by sparking
9. When lightning strikes a lightning rod, the lightning rod and metal conductor which connects the rod to the ground will carry the charges down to the ground, preventing the building from catching on fire.

Topic 4.4 Electrical Circuits

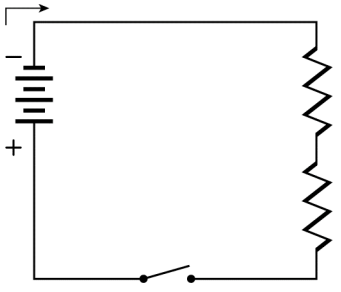
Reading Check, pages 140–141

1. Potential difference describes the energy change of each unit of charge as it passes through the source or a load. Current refers to the moving charges in an electric circuit.
2. A voltmeter is used to measure potential difference. An ammeter is used to measure current.
3. source (battery), conducting wires, load (resistor), switch, voltmeter

Cloze Activity, page 142

1. current
2. load
3. potential difference
4. voltmeter, ammeter
5. resistance
6. volts, amperes, ohm
7. switch
8. circuit diagram

Applying Knowledge, page 143

1. C, III
2. B, IV
3. D, I
4. A, II
5. 

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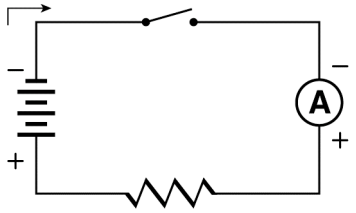
6.



Comprehension, page 144

1. F; A load in a circuit transforms electrical energy into another form of energy.

2. T

3. F; A source supplies the energy in a circuit.

4. T

5. F; Current is measured in amperes. (Potential difference is measured in volts.)

6. F; An ammeter is used to measure the current in a circuit.

7. T

8. F; Curent is the flow of charges in a circuit.

9. T

10. F; With the resistance in the circuit remaining the same, the current will *increase* if the potential difference increases.

Assessment, page 145

1. H

2. B

3. D

4. F

5. A

6. C

7. E

8. G

9.

Quantity	Symbol	Unit
potential difference	*V*	volts (V)
current	*I*	amperes (A)
resistance	*R*	ohms (Ω)

10. **a)** The negative charges begin to flow through the circuit.

b) The negative charges lose energy.

c) The negative charges gain energy.

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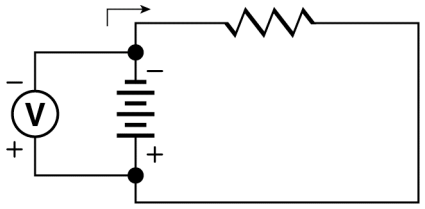
11.



12. If the resistance of the load remains the same while the potential difference across the source increases, then the current increases. If the potential difference across the sources stays the same while the resistance in the circuit increases, then the current decreases.

Topic 4.5 Series and Parallel Circuits

Reading Check, page 146

1. A series circuit has only one path for the current to flow, while a parallel circuit has two or more paths.

Comprehension, page 148

1. series circuit

2. parallel circuit

3. series circuit

4. parallel circuit

5. parallel circuit

6. series circuit

7. parallel circuit

8. series circuit

9. parallel circuit

10. series circuit

11. series circuit

Illustrating Concepts, page 149

1. D

2. A

3. B

4. C

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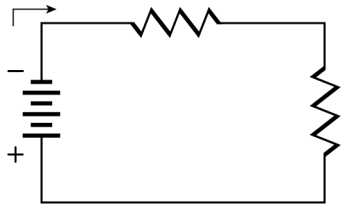
5.



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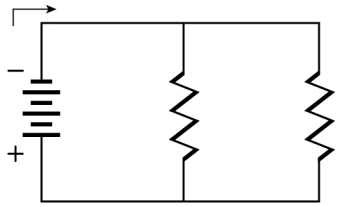


Applying Knowledge, page 150

1. 8 A

2. 7 V

3. 10 A

4. 12 V, 12 V

Assessment, page 151

1. A

2. B

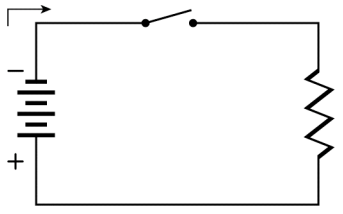
3. B

4. A

5. B

6. A

7.



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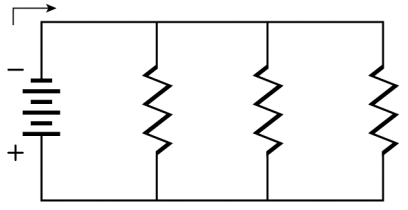

9. a) 5 V

b) 12 A

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Topic 4.6 Making Circuits Safe

Reading Check, pages 152–153

1. The practical way to wire a building is to use many parallel circuits.
2. A strip of metal in the circuit breaker bends when it gets too hot. This causes a switch to open, which causes the current to stop flowing.
3. A small wire in the fuse burns and breaks apart when the current gets too high. This causes the current to stop flowing.
4. Features could include higher-voltage circuits, larger cords and cables, grounding, special outlets, surge protectors, and power bars.

Cloze Activity, page 154

1. parallel
2. opening
3. fuse, circuit breaker
4. larger
5. 240 V outlet
6. three-hole outlet
7. ground fault interrupter (GFI)
8. opening
9. fuse, circuit breaker

Comprehension, page 155

1. both
2. both
3. fuse
4. circuit breaker
5. circuit breaker
6. fuse
7. circuit breaker
8. fuse

Comprehension, page 156

1. A
2. D
3. C

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4. B

5. B

6. A

7. ground fault interrupter (GFI); three-hole outlet; 240 V outlet

8. There are too many electrical cords plugged into one outlet, which will cause the wires in the outlet to overheat. This could cause an electrical fire.

Assessment, page 157

1. C

2. F

3. A

4. B

5. D

6. Similarities: prevents fire when the wire becomes too hot, opens circuit to stop current from flowing

Differences: circuit breakers: strip made of two metals bends, can be reset

fuses: small wire melts, must be replaced

7.

Safety device	**How it improves safety**
high voltage circuits (240 V outlet)	By doubling the potential energy to 240 V, a circuit can provide the same amount of energy while using half as much current.
larger cords or cables	Their size allows them to carry more current without becoming too hot.
grounded wire	The grounded wire directs any excess current to the ground.
three-hole outlet	The third hole in a three-hole outlet grounds the third prong on the plug which is connected to the metal parts of an electrical device.
ground fault interrupter	The GFI immediately opens the circuit when it detects a difference between the current entering one hole and leaving the other.

8. An electric heater needs more current to work than a clock radio. The larger cord allows more current to travel through the wires without becoming too hot.

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Topic 4.7 Conserving Energy

Reading Check, pages 158–159

1. kilowatt hours (kWh)
2. The “time-of-use” price depends on the time of day that the electrical energy is used. Different rates are charged during on-peak, mid-peak, and off-peak periods.
3. The large number on an EnerGuide label indicates how much energy the appliance uses in one year of normal use.
4. A phantom load refers to the use of electrical energy by a device that is in stand-by mode.

Cloze Activity, page 160

1. kilowatt hours
2. smart meters
3. old-style meters
4. smart meters
5. smart meters
6. time-of-use prices
7. EnerGuide label
8. ENERGY STAR* label
9. EnerGuide label
10. phantom load

Applying Knowledge, page 161

1. House A:

   Total Cost = 600 kWh x 6.6¢ per kWh
   = $39.60

   House B:

   Cost during off-peak hours = 100 kWh x 4.0¢ per kWh
   = $4.00

   Cost during mid-peak hours = 125 kWh x 7.2¢ per kWh
   = $9.00

   Cost during on-peak hours = 375 kWh x 8.8¢ per kWh
   = $33.00

   Total Cost = $4 + $9 + $33
   = $46

2. House B

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3. To save more money on its energy bill, House B should use more of its energy during off-peak hours.

Analyze the Information, page 162

1. a) 460 kWh

b) Least efficient model

c) The lower the number of kilowatt hours, the more energy-efficient the appliance.

2. a) EER of 10.5

b) Most efficient model

c) The higher the EER, the more energy-efficient the air conditioner.

Assessment, page 163

1. F

2. A

3. E

4. G

5. C

6. D

7. Total Cost = 525 kWh x 6.6¢ per kWh
= $34.65

8. a) 484 kWh

b) 372 kWh

c) 390 kWh

d) This appliance is energy-efficient because it shows the ENERGY STAR* label.

9. a) Buying an appliance with an ENERGY STAR* label on it helps conserve energy because it indicates that the appliance meets or exceeds the standards of efficiency set by the Government of Canada.

b) Unplugging an electrical device that has already been turned off helps conserve energy because some electrical devices remain in stand-by mode and continue to use electrical energy even when they are switched off.

Literacy Test Preparation, pages 164–165

1. B

2. A

3. D

4. B”

5. C

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6. A

7. Answers may vary. Students should use evidence from the text to justify their answers.

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