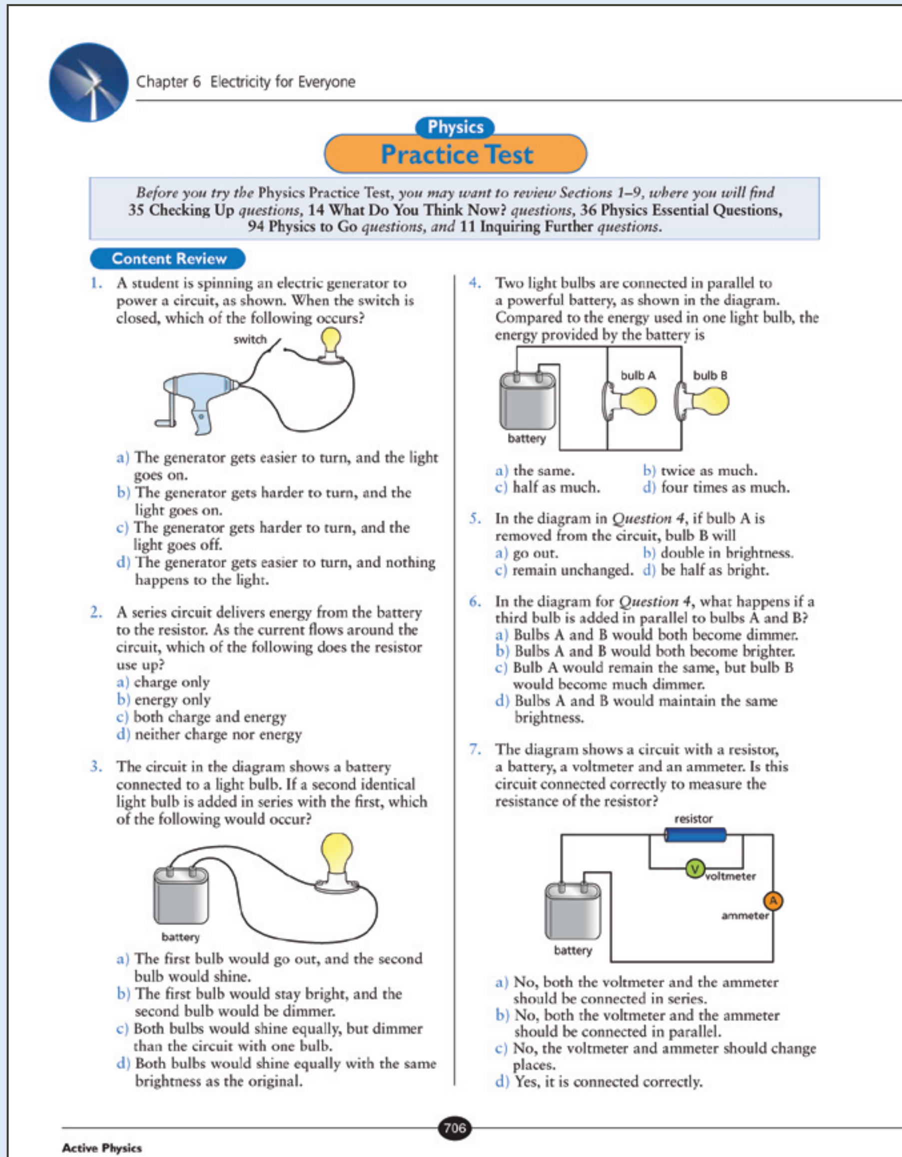
Physics Practice Test

Have students take the practice test to evaluate their understanding. Students should use their results in conjunction with the checklist to evaluate and review their understanding of the physics concepts. The *Physics Practice Test* is provided as a Blackline Master in your *Teacher Resources CD*.

6b **Blackline Master**



Chapter 6 Electricity for Everyone

Physics
Practice Test

Before you try the Physics Practice Test, *you may want to review Sections 1–9, where you will find* 35 Checking Up *questions,* 14 What Do You Think Now? *questions,* 36 Physics Essential Questions, 94 Physics to Go *questions, and* 11 Inquiring Further *questions.*

Content Review

1. A student is spinning an electric generator to power a circuit, as shown. When the switch is closed, which of the following occurs?
   a) The generator gets easier to turn, and the light goes on.
   b) The generator gets harder to turn, and the light goes on.
   c) The generator gets harder to turn, and the light goes off.
   d) The generator gets easier to turn, and nothing happens to the light.
2. A series circuit delivers energy from the battery to the resistor. As the current flows around the circuit, which of the following does the resistor use up?
   a) charge only
   b) energy only
   c) both charge and energy
   d) neither charge nor energy
3. The circuit in the diagram shows a battery connected to a light bulb. If a second identical light bulb is added in series with the first, which of the following would occur?
   a) The first bulb would go out, and the second bulb would shine.
   b) The first bulb would stay bright, and the second bulb would be dimmer.
   c) Both bulbs would shine equally, but dimmer than the circuit with one bulb.
   d) Both bulbs would shine equally with the same brightness as the original.
4. Two light bulbs are connected in parallel to a powerful battery, as shown in the diagram. Compared to the energy used in one light bulb, the energy provided by the battery is
   a) the same. b) twice as much.
   c) half as much. d) four times as much.
5. In the diagram in *Question 4*, if bulb A is removed from the circuit, bulb B will
   a) go out. b) double in brightness.
   c) remain unchanged. d) be half as bright.
6. In the diagram for *Question 4*, what happens if a third bulb is added in parallel to bulbs A and B?
   a) Bulbs A and B would both become dimmer.
   b) Bulbs A and B would both become brighter.
   c) Bulb A would remain the same, but bulb B would become much dimmer.
   d) Bulbs A and B would maintain the same brightness.
7. The diagram shows a circuit with a resistor, a battery, a voltmeter and an ammeter. Is this circuit connected correctly to measure the resistance of the resistor?
   a) No, both the voltmeter and the ammeter should be connected in series.
   b) No, both the voltmeter and the ammeter should be connected in parallel.
   c) No, the voltmeter and ammeter should change places.
   d) Yes, it is connected correctly.

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Active Physics

Content Review

1.b)

The generator gets harder to turn, and the light goes on. A closed circuit is required for electricity to flow to light the bulb. More energy is required when the circuit is closed and the bulb lights causing it to be harder to turn the generator.

2.b)

energy only. Charge is conserved, it does not get used by the resistor, rather the energy it carries is transferred to the resistor and this is then transformed into other types of energy.

3.c)

Both bulbs would shine equally, but dimmer than the circuit with one bulb. Since the bulbs are identical they share the energy supplied from the battery or generator equally. The energy supplied by the battery does not change, and the current drawn decreases. This results in the bulbs shining less brightly than when only one bulb was in the circuit.

4.b)

twice as much. Both bulbs have the same voltage across them. Since the bulbs are identical, this parallel circuit draws twice as much current as if there were one bulb, therefore twice as much energy is delivered by the battery to the bulbs as if there were one bulb.

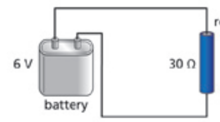
5.c)

remain unchanged. The single bulb still has the same voltage across it, and the same current going through it. The bulb's brightness will be unchanged.

6.d)

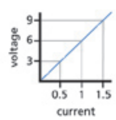
Bulbs A and B would maintain the same brightness. The voltage across all three bulbs would be the same. The current drawn from the battery would be greater, and the current would be split equally through each branch since each bulb is identical. The overall energy delivered would be the same.

8. In the circuit shown in the diagram, what current is flowing through the resistor when the battery is connected?



a) 5 A
b) 5 V
c) 0.2 A
d) 0.2 V

9. The graph shows the current through a resistor when different amounts of voltage are applied. The resistance of the resistor is closest to

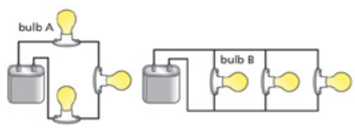


a) 1.5 Ω.
b) 18 Ω.
c) 6 Ω.
d) 4 Ω.

10. An electric clothes dryer requires 5000 W of power. Which combination of circuit voltage and maximum circuit current below would be sufficient to power the dryer?
a) 110 V and 30 A
b) 220 V and 20 A
c) 110 V and 40 A
d) 220 V and 30 A

11. A mass of 100 g of water at 80°C is added to 200 g of water at 50°C. Which of the statements below best describes the result of this process and the final temperature of the mixture?
a) The final temperature is 60°C and the entropy of the system increases.
b) The final temperature is 65°C and the entropy of the system increases.
c) The final temperature is 60°C and the entropy of the system decreases.
d) The final temperature is 65°C and the entropy of the system decreases.

12. Two identical batteries are each connected to identical light bulbs in two different circuits as shown in the diagram. Bulb A is connected in a series circuit, and bulb B is connected in a parallel circuit. Compared to the current flowing in bulb A, the current flowing in bulb B is



a) three times greater.
b) one third as great.
c) the same.
d) No current comparison can be made between two different circuit types.

13. In *Question 12*, if the resistance of each bulb is 6 Ω, what is the ratio of resistance in the series circuit to the resistance in the parallel circuit?
a) 1 : 1
b) 3 : 1
c) 6 : 1
d) 9 : 1

14. A heater that uses 120 V and 2 A is placed in a cup of water for 30 s. The temperature of the water rises 20°C during this process. How much electrical energy does the heater use in this time?
a) 7200 J
b) 240 J
c) 144,000 J
d) 360 J

15. A microwave oven that is rated at 1000 W increases the energy of 800 g of water by 24,000 J in 30 s. What is the efficiency of the oven?
a) 80%
b) 75%
c) 60%
d) 100%

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7.d)

Yes, it is connected correctly. Voltmeters should be hooked parallel to the resistors and ammeters should be hooked in series.

8.c)

0.2 A. Students should apply Ohm's law: $I = V/R = 6\ \text{V}/30\ \Omega = 0.2\ \text{A}$.

9.c)

6 Ω. From the graph students should obtain the linear (ohmic) relationship between voltage and current ($R = V/I$).

10.d)

220 V and 30 A. Using the relationship $P = IV$, students should find that the other choices are all below the 2000 W needed to run the dryer.

11.a)

The final temperature is 60˚C and the entropy of the system increases. Students should realize that entropy naturally increases, that the temperature of the mixture should be somewhere between the two temperatures, and use the conservation of energy to find final temperature as shown.

$$\Delta Q_1 + \Delta Q_2 = 0$$
$$m_1 c_{\text{water}} \Delta T_1 + m_2 c_{\text{water}} \Delta T_2 = 0$$
$$(100\ \text{g})\left(4.18\ \frac{\text{J}}{\text{g°C}}\right)(T_{\text{final}} - 80°\text{C}) + (200\ \text{g})\left(4.18\ \frac{\text{J}}{\text{g°C}}\right) \times (T_{\text{final}} - 50°\text{C}) = 0$$
$$T_{\text{final}} = \frac{18{,}000}{300}\ °\text{C} = 60°\text{C}$$

12.a)

three times greater. The parallel circuit draws more current than the series circuit, since the resistance in the parallel circuit is 1/3 as much the total current drawn is nine times greater, with 1/3 of this current going down each branch, resulting in each bulb in the parallel circuit having three times the current of the bulbs in the series circuit.

13.d)

9:1. The total resistance of each circuit can be found by applying the rules for parallel and series circuits.

Parallel

$$\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{3}{R}$$
$$R_{\text{eq}} = R/3$$

Series

$$R_{\text{T}} = R_1 + R_2 + R_3 = 3R$$
$$\text{Ratio}: \frac{R_{\text{T}}}{R_{\text{eq}}} = 9$$

CHAPTER 6

14.a)

7200 J.

$E = Pt = VIt$

$E = (120\text{ V})(2\text{ A})(30\text{ s})$

$E = 7200\text{ J}$

15.a)

80%. The efficiency is found by dividing the useful energy by the total energy.

Efficiency =

$$\frac{(24{,}000\text{ J})}{(1000\text{ W})(30\text{ s})} \times 100\% = 80\%$$

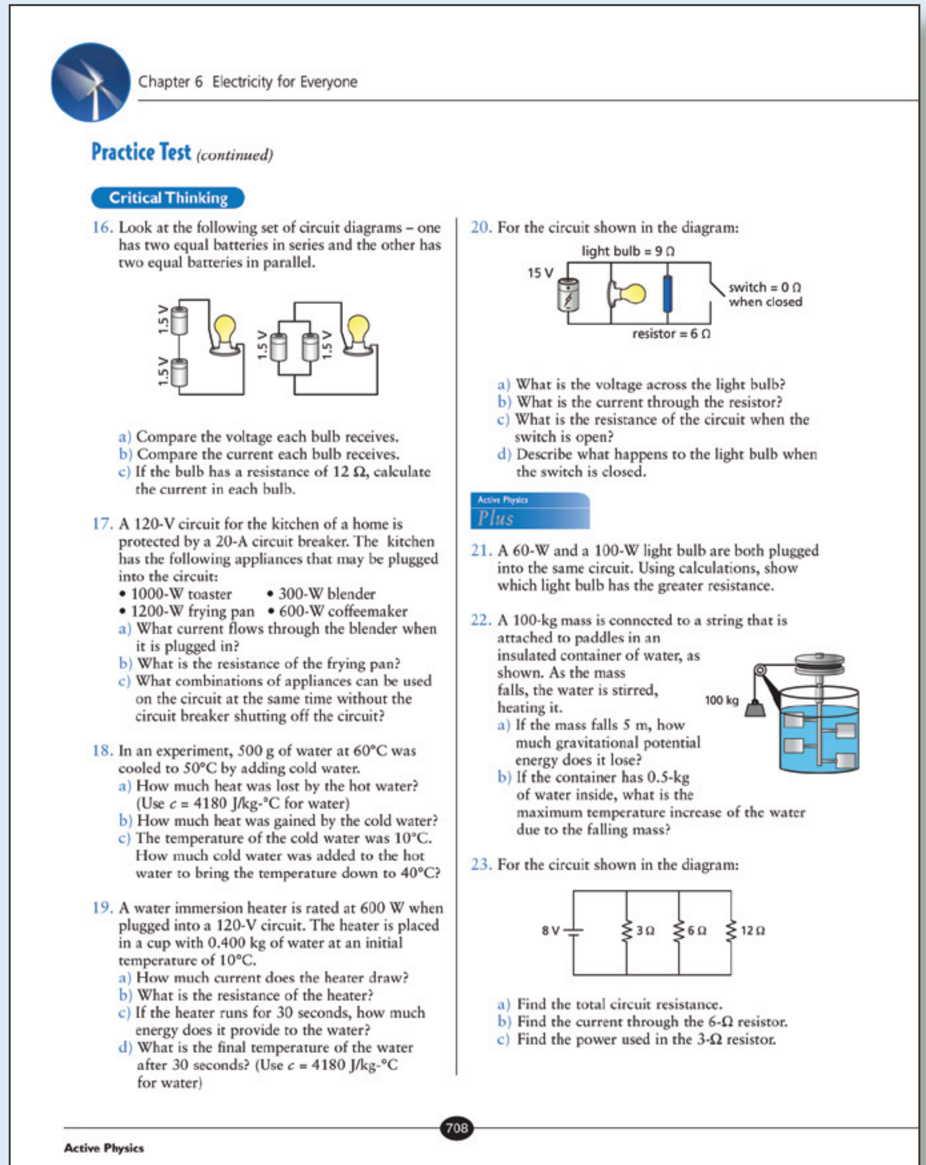
Critical Thinking

16.a)

The voltage of the two batteries in series is found by summing the voltage of each battery, or $V_T = V_1 + V_2 = 3\text{ V}$, and this is the voltage dropped across the bulbs. The voltage supplied by the two batteries in parallel is 1.5 V, and this is the voltage dropped across the bulb. The Electron-Shuffle model can help students further their understanding. For the batteries in parallel, each unit of charge goes through one branch and picks up 1.5 V. For the batteries in series each unit of charge picks up 1.5 V from each battery.

16.b)

Ideally, the current through the bulb with the batteries in series receives twice the current as that of the bulb with the batteries in parallel, since the voltage is twice as much. The resistance stays the same, so if the voltage doubles the current doubles.



Chapter 6 Electricity for Everyone

Practice Test *(continued)*

Critical Thinking

16. Look at the following set of circuit diagrams – one has two equal batteries in series and the other has two equal batteries in parallel.

a) Compare the voltage each bulb receives.
b) Compare the current each bulb receives.
c) If the bulb has a resistance of 12 Ω, calculate the current in each bulb.

17. A 120-V circuit for the kitchen of a home is protected by a 20-A circuit breaker. The kitchen has the following appliances that may be plugged into the circuit:
• 1000-W toaster • 300-W blender
• 1200-W frying pan • 600-W coffeemaker
a) What current flows through the blender when it is plugged in?
b) What is the resistance of the frying pan?
c) What combinations of appliances can be used on the circuit at the same time without the circuit breaker shutting off the circuit?

18. In an experiment, 500 g of water at 60°C was cooled to 50°C by adding cold water.
a) How much heat was lost by the hot water? (Use c = 4180 J/kg-°C for water)
b) How much heat was gained by the cold water?
c) The temperature of the cold water was 10°C. How much cold water was added to the hot water to bring the temperature down to 40°C?

19. A water immersion heater is rated at 600 W when plugged into a 120-V circuit. The heater is placed in a cup with 0.400 kg of water at an initial temperature of 10°C.
a) How much current does the heater draw?
b) What is the resistance of the heater?
c) If the heater runs for 30 seconds, how much energy does it provide to the water?
d) What is the final temperature of the water after 30 seconds? (Use c = 4180 J/kg-°C for water)

20. For the circuit shown in the diagram:

a) What is the voltage across the light bulb?
b) What is the current through the resistor?
c) What is the resistance of the circuit when the switch is open?
d) Describe what happens to the light bulb when the switch is closed.

Active Physics Plus

21. A 60-W and a 100-W light bulb are both plugged into the same circuit. Using calculations, show which light bulb has the greater resistance.

22. A 100-kg mass is connected to a string that is attached to paddles in an insulated container of water, as shown. As the mass falls, the water is stirred, heating it.
a) If the mass falls 5 m, how much gravitational potential energy does it lose?
b) If the container has 0.5-kg of water inside, what is the maximum temperature increase of the water due to the falling mass?

23. For the circuit shown in the diagram:

a) Find the total circuit resistance.
b) Find the current through the 6-Ω resistor.
c) Find the power used in the 3-Ω resistor.

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Active Physics

16.c)

Using Ohm's law we have:

$I = V/R =$
$(3\text{ V})/(12\ \Omega) = 0.25\text{ A},$

for the circuit with the batteries in series.

$I = V/R =$
$(1.5\text{ V})/(12\ \Omega) = 0.125\text{ A},$

for the circuit with the batteries in parallel.

17.a)

The current flowing through the blender is

$I = P/V =$
$(300\text{ W})/(120\text{ V}) = 2.5\text{ A}.$

17.b)

The resistance of the frying pan can be found from $P = V^2/R$.

$R = V^2/P =$
$(120\text{ V})^2/(1200\text{ W}) = 12\ \Omega$

17.c)

With a circuit breaker of 20 A, the maximum power drawn must be less than or equal to
$P_{max} = VI_{max} =$
$(120\ V)(20\ A) = 2400\ W$.

This requirement allows the following combination: toaster and frying pan (2200 W); toaster, blender, and coffee maker (1900 W); frying pan, blender, and coffeemaker (2100 W).

18.a)

The heat transferred from the hot water can be calculated using:

Given:
$m = 500\ g;\ T_{initial} = 60°C$
$T_{final} = 50°C;\ c = 4180\ J/kg°C$

$$\Delta Q_{hot\ water} = mc\Delta T =$$
$$(0.500\ kg)\left(4.80\ \frac{J}{kg°C}\right)\times$$
$$(50°C - 60°C) = -20,900\ J$$

Check that students have either converted the mass to kilograms or the specific heat to grams. The value should be negative because the heat energy is transferred away from the hot water.

18.b)

Ideally, the cold water should gain all the heat energy transferred away from the hot water, or 20,900 J. This is provided that no energy is transferred to the surroundings (container, atmosphere, etc.).

18.c)

The equation of heat energy transferred should be used:

Given:
$T_{cold} = 10°C;\ T_{final} = 40°C;$
$T_{hot} = 60°C;\ m_{hot} = 0.5\ kg$

$$m_{hot}c\Delta T_{hot} + m_{cold}c\Delta T_{cold} = 0$$
$$(0.5\ kg)\left(\frac{4180\ J}{kg°C}\right)(40°C - 60°C) +$$
$$m_{cold}\left(\frac{4180\ J}{kg°C}\right)(40°C - 10°C) = 0$$
$$(0.5\ kg)(-20°C) = -m_{cold}(-30°C)$$
$$m_{cold} = 0.33\ kg$$

19.a)

The current is found from

$I = P/V =$
$(600\ W)/(120\ V) = 5\ A$.

19.b)

The resistance of the heater is found using Ohm's law or the relationship between power and voltage. If students did not calculate the current correctly and used Ohm's law to find the resistance, then they will obtain an incorrect value for the resistance.
$R = V^2/P =$
$(120\ V)^2/(600\ W) = 24\ \Omega$.
or
$R = V/I =$
$(120\ V)/(5\ A) = 24\ \Omega$

19.c)

The energy is calculated using
$E = Pt =$
$(600\ W)(30\ s) = 18,000\ J$.

19.d)

The final temperature is calculated assuming that there is no energy transferred to the surroundings. This means that the heat energy transferred to the water is 18,000 J.

$$\Delta Q = mc\Delta T$$
$$T_{final} = \frac{\Delta Q}{mc} + T_{initial} =$$
$$\frac{18,000\ J}{(0.400\ kg)(4180\ J/kg°C)} + 10°C =$$
$$20.8°C$$

20.a)

The voltage across the bulb is the same as the voltage supplied by the battery, or 15 V.

20.b)

The current through the resistor be found using Ohm's law.
$I = V/R =$
$(15\ V)/(6\ \Omega) = 2.5\ A$

20.c)

When the switch is open the resistance of the circuit is

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6\ \Omega} + \frac{1}{9\ \Omega}$$
$$R_{eq} = 3.6\ \Omega$$

Students might also calculate this by finding the total current and then applying Ohm's law to find the total or equivalent resistance of the circuit.

20.d)

When the switch is closed, the light bulb will go out because all the current will go through the zero ohm-resistance switch, leaving nothing for the light bulb.

21. Active Physics *Plus*

Use the relationship for power to show that the 60-W bulb has the greater resistance.

$P = V^2/R$

$R = V^2/P$

$R_{60} = (120\ \text{V})^2/(60\ \text{W}) = 240\ \Omega$

$R_{100} = (120\ \text{V})^2/(100\ \text{W}) = 144\ \Omega$

22.a) Active Physics *Plus*

If the mass falls 5 m the change in its potential energy is

$\Delta U_g = mg\Delta h =$

$(100\ \text{kg})(9.8\ \text{m/s}^2)(-5\ \text{m}) =$

$-4900\ \text{J}$

where the negative sign indicates a reduction of potential energy.

22.b) Active Physics *Plus*

The maximum temperature increase would occur if all the potential energy were transferred away from the falling mass and to heating the water.

$$\Delta T = \frac{\Delta Q}{mc} = \frac{4900\ \text{J}}{(0.5\ \text{kg})(4180\ \text{J/kg°C})} = 2.3\text{°C}$$

23.a) Active Physics *Plus*

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} =$$

$$\frac{1}{3\ \Omega} + \frac{1}{6\ \Omega} + \frac{1}{12\ \Omega} =$$

$$\frac{1}{R_T} = \frac{7}{12\ \Omega}$$

$$R_T = 1.7\ \Omega$$

23.b) Active Physics *Plus*

The voltage across each resistor in parallel is equal to the total voltage supplied by the battery or 8 V. Using this and Ohm's law you have

$I = V/R = (8\ \text{V})/(6\ \Omega) = 1.3\ \text{A}.$

23.c) Active Physics *Plus*

$$P = \frac{V^2}{R} = \frac{(8\ \text{V})^2}{3\ \Omega} = 21\ \text{W}$$

NOTES