Name: Solutions                                      Date: 

Quiz name: Circuits

1. Which of the following light bulbs has the largest current through it when operated at the voltage for which it's rated?
   - A 4.0 W, 7.5 V $I = \frac{P}{V} = \frac{4.0}{7.5} = 0.53 A$
   - B 30 W, 15 V $I = \frac{P}{V} = \frac{30}{15} = 2 A$
   - C 20 W, 23 V $I = \frac{P}{V} = \frac{20}{23} = 0.87 A$
   - D 40 W, 30 V $I = \frac{P}{V} = \frac{40}{30} = 1.33 A$

2. Which of the following light bulbs has the largest resistance when operated at the voltage for which it's rated?
   - A 6.4 W, 12 V $R = \frac{P}{I^2} = \frac{6.4}{(1.2)^2} = 4.52 \Omega$
   - B 48 W, 24 V $R = \frac{P}{I^2} = \frac{48}{(1.5)^2} = 12 \Omega$
   - C 32 W, 36 V $R = \frac{P}{I^2} = \frac{32}{(1.8)^2} = 7.45 \Omega$
   - D 64 W, 48 V $R = \frac{P}{I^2} = \frac{64}{(1.8)^2} = 14 \Omega$

3. A copper wire is stretched so that its length increases and its diameter decreases.
   - A The wire's resistance decreases, but its resistivity stays the same.
   - B The wire's resistivity decreases, but its resistance stays the same.
   - C The wire's resistance increases, but its resistivity stays the same.
   - D The wire's resistivity increases, but its resistance stays the same.

4. The potential difference (voltage) across a length of wire is increased. Which of the following does not increase as well?
   - A The power dissipated in the wire.
   - B The resistance of the wire.
   - C The current in the wire.

5. A stereo amplifier creates a 7.0 V potential difference across a speaker. To double the power output of the speaker, the amplifier's potential difference (voltage) must be increased to
   - A 9.9 V
   - B 20 V
   - C 14 V
   - D 49 V

6. A resistor connected to a 3.0 V battery dissipates 1.0 W. If the battery is replaced by a 6.0 V battery, the power dissipated by the resistor will be
   - A 1 W
   - B 2 W
   - C 3 W
   - D 4 W
7. The figure shows a side view of a wire of varying circular cross section. Rank in order the currents flowing in the three sections:

- A: $I_1 > I_2 > I_3$
- B: $I_3 > I_2 > I_1$
- C: $I_1 = I_2 = I_3$
- D: $I_1 > I_3 > I_2$

Since they are in series with each other, current must be the same.

8. A person gains weight by adding fat - and therefore adding girth - to his body and his limbs, with the amount of muscle remaining constant. How will this affect the electrical resistance of his limbs?

- A: The resistance will increase
- B: The resistance will decrease
- C: The resistance will stay the same

9. What is the current through $I_C$?

- A: 2 A
- B: 3 A
- C: 5 A
- D: 7 A
- E: 12 A

Whatever current goes into the node must split into parts which add up to original. So if 7 A goes into the node, 7 A must come out.

10. What is the current through $I_B$?

- A: 2 A
- B: 3 A
- C: 5 A
- D: 7 A
- E: 12 A

11. What is the current through section B?

- A: 1 A
- B: 2 A
- C: 3 A
- D: 4 A
- E: 5 A

12. What is the current through section C?

- A: 1 A
- B: 2 A
- C: 3 A
- D: 4 A
- E: 5 A

Note that $1 + 2 + 2 = 5$

13. Which of these has the most current?
14. What is the current in the circuit of the figure?
- A) 1.0 A
- B) 1.7 A
- C) 2.5 A
- D) 4.2 A

I = \frac{\Delta V}{R} = \frac{10}{10} = 1 A

15. Which resistor in the figure dissipates the most power?
- A) The 4 Ω resistor
- B) The 6 Ω resistor
- C) Both dissipate the same power

P = I^2 R
\text{Current is the same in both and Resistance is set by each, so look at } P = I^2 R

16. A metal wire of length L and resistance R is cut into two pieces of equal length. The two pieces are connected together side by side. What is the new resistance?
- A) R/4
- B) R/2
- C) R
- D) 2R
- E) 4R

R = \frac{A}{A}

17. Does the bulb light?
- A) Yes
- B) No

18. The three bulbs are identical and the two batteries are identical. Compare the brightnesses of the bulbs.
- A) A > B > C
- B) A > C > B
- C) A > B = C
- D) A < B = C
- E) A = B = C

19. The potential difference across the 10 resistor is
20. The diagram below shows a circuit with two batteries and three resistors. What is the potential difference across the 200 Ω resistor?

- A. 2.0 V
- B. 3.0 V
- C. 4.5 V
- D. 7.5 V
- E. There is not enough information to decide.

21. What things about the resistors in this circuit are the same for all three?

- A. Current I
- B. Potential difference ΔV
- C. Resistance R
- D. A & B
- E. B & C

22. Which resistor dissipates more power?

- A. The 9 Ω resistor
- B. The 1 Ω resistor
- C. The dissipate the same power

23. When the switch closes the battery current

- A. increases
- B. stays the same
- C. decreases

The lightbulbs are identical. Initially both bulbs are glowing. What happens when the switch is closed?
25. What does the ammeter read?

- A. 6 A
- B. 3 A
- C. 2 A
- D. Some other value
- E. Nothing because this will fry the meter.

26. Every minute, 120 C of charge flow through this cross section of the wire.

- A. 240 A
- B. 120 A
- C. 60 A
- D. 2 A
- E. Some other value

27. The wires shown next carry currents as noted. Rate the currents $I_A$, $I_B$, and $I_C$.

- A. $I_A > I_B > I_C$
- B. $I_B > I_A > I_C$
- C. $I_C > I_A > I_B$
- D. $I_A > I_C > I_B$
- E. $I_C > I_B > I_A$

28. Consider the junction: The current in the fourth wire is

- A. 16 A to the right.
- B. 4 A to the left.
- C. 2 A to the right.
- D. 2 A to the left.
- E. Not enough information to tell

29. A battery is connected to a wire, and creates a current in the wire. Which of the following changes would increase the current?

- A. Increasing the length of the wire
- B. Keeping the wire the same length, but making it thicker
- C. Using a battery with a lower emf (voltage)
- D. Making the wire into a coil, but keeping its dimensions the same
- E. Changing the wire material from copper to nichrome

\[ R = \frac{A}{L} \]
30. The current through a wire is measured as the potential difference \( \Delta V \) is varied. What is the wire's resistance?

- A. 0.01 \( \Omega \)
- B. 0.02 \( \Omega \)
- C. 50 \( \Omega \)
- D. 100 \( \Omega \)
- E. Some other value

\[ \Delta V = I R \]

So on an I vs. \( \Delta V \) graph, the slope \( I = \frac{1}{R} (\Delta V) \) would be \( \frac{1}{R} \)

\[ \text{Slope} = \frac{50}{0.004} \rightarrow R = \frac{1}{50} = 0.02 \Omega \]

31. Wire 2 is twice the length and twice the diameter of wire 1. What is the ratio \( R_2/R_1 \) of their resistances?

- A. 1/4
- B. 1/2
- C. 1
- D. 2
- E. 4

If you double length you double \( r \) but if you double \( r \), you decrease \( R \) by a factor of \( \frac{1}{4} \), so overall \( R_2 = \frac{1}{4} R_1 \)

32. Several light bulbs, different rated voltages, powers. Which one has highest resistance?

- A. \[ P = \frac{(\Delta V)^2}{R} \]
- B. \[ R = \frac{(\Delta V)^2}{P} \]

<table>
<thead>
<tr>
<th>Bulb</th>
<th>Voltage across Bulb</th>
<th>Power Dissipated by Bulb</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10 V</td>
<td>1 W</td>
</tr>
<tr>
<td>B</td>
<td>5 V</td>
<td>1 W</td>
</tr>
<tr>
<td>C</td>
<td>12 V</td>
<td>2 W</td>
</tr>
<tr>
<td>D</td>
<td>0 V</td>
<td>2 W</td>
</tr>
<tr>
<td>E</td>
<td>3 V</td>
<td>3 W</td>
</tr>
</tbody>
</table>

33. Which has a larger resistance, a 60 W lightbulb or a 100 W lightbulb, assuming they are both rated for a 120 V socket.

- A. The 60 W bulb
- B. The 100 W bulb
- C. Their resistances are the same.
- D. There's not enough information to tell.

\[ P = \frac{(\Delta V)^2}{R} \]

\[ R_1 = \frac{120^2}{60} = 240 \Omega \]

\[ R_2 = \frac{120^2}{100} = 144 \Omega \]

34. What would the slope of a Current (y-axis) vs Voltage (x-axis) represent?

- A. \( R \)
- B. \( 1/R \)
- C. \( P \)
- D. \( 1/P \)

The slope of a Voltage vs. Current graph is resistance. So the slope of a current vs. voltage graph would be \( \frac{1}{R} \)

35. What would the area under a Voltage (y-axis) vs Current (x-axis) represent?

- A. \( R \)
- B. \( 1/R \)
- C. \( P \)
- D. \( 1/P \)

Power is the product of Voltage and current.
36. What would the slope of a Power (y-axis) vs. Current (x-axis) represent?

- V
- 1/V
- R
- 1/R

\[ P = I \Delta V \]
\[ y = m \cdot x + b \]
or \[ P = \Delta V \cdot I \]