What are Kirchhoff's Laws?

Worksheet

Kirchhoff's Current Law (KCL) states the sum of currents entering a node equals the sum leaving it. Kirchhoff's Voltage Law (KVL) states the sum of voltage drops around any closed loop equals zero.

$$\sum I_{\text{in}} = \sum I_{\text{out}}$$

Questions

1. Two currents enter a node: 3A and 5A. One current leaves the node. What is its value?

A) 2 A
B) 8 A
C) 15 A
D) 1.67 A

2. A loop contains one EMF source of 10V and one resistor. What is the voltage drop across the resistor?

A) 0 V
B) 10 V
C) 5 V
D) 20 V

3. KCL is based on conservation of...

A) Energy
B) Charge
C) Momentum
D) Mass

4. KVL is based on conservation of...

A) Charge
B) Momentum
C) Energy
D) Mass

5. At a node, currents I1 = 4A and I2 = 6A enter, and one current I3 leaves. Find I3.

6. A loop has a 12V battery and two resistors dropping 5V and 7V. Verify KVL around the loop.

7. A loop has an EMF of 9V, one resistor drops 3V, another drops 2V, and a third resistor R2 has an unknown drop. Find R2's voltage drop.

8. Define: What does KCL state?

9. Define: What does KVL state?

10. Define: What conservation law underlies KCL?

Answer Key

1. B) 8 A - KCL: Iin = Iout, so 3 + 5 = 8 A leaves.
2. B) 10 V - KVL: V = 0, so the resistor drop must equal the EMF, 10 V.
3. B) Charge - KCL follows from the conservation of electric charge at a node.
4. C) Energy - KVL follows from the conservation of energy around a closed loop.
5. KCL: Iin = Iout 4 + 6 = I3 I3 = 10 A
6. V = 0 12 5 7 = 0 0 = 0 KVL confirmed
7. V = 0 9 3 R2 2 = 0 R2 = 9 3 2 = 4 V
8. The sum of currents entering a node equals the sum of currents leaving it (charge is conserved).
9. The sum of voltage drops around any closed loop equals zero (energy is conserved).
10. Conservation of electric charge.