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Background/Summary:

Current is the flow of electric charge through a conductor (amperes A). A voltage difference across the conductor drives it and follows Ohm's law, stating current is directly proportional to voltage and inversely proportional to resistance. Resistance measures how much a material opposes the flow of electric current (ohms Ω).

Major Topics:

Electric current: Rate at which the charge flows through the conductor.

- I = dQ/dT
- Amperes = Coulombs/Seconds

Resistivity: A material's intrinsic property that quantifies how strongly it resists the flow of electric current.

- Denoted by the symbol ρ (rho) and measured in ohm-meters (Ω·m)

Resistance: Measure of opposition to the flow of electric current in a material. It is denoted by the symbol R and is measured in ohms (Ω).

- $R = \rho(L/A)$
- Resistance = Resistivity(Length/Cross-Sectional Area)

Ohm's Law: States the current flowing through a conductor between two points is directly proportional to the voltage and inversely proportional to the resistance.

- I = V/R or V = IR
- Voltage (V), Current (I), Resistance (R)

Power: Rate at which electrical energy is transferred, converted, or dissipated and measured in Watts (W).

- P = IV or $P = I^2R$ or $P = V^2/R$
- Power (P), Voltage (V), Current (I), Resistance (R)

Diagrams:

Resistor Code:

Color	Number	Multiplier	Tolerance
Black	0	10^0	
Brown	1	10^1	
Red	2	10^2	+/- 2%
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	
Blue	6	10^6	
Violet	7	10^7	
Gray	8	10^8	
White	9	10^9	
Gold		10^-1	+/- 5%
Silver		10^-2	+/- 10%
No color			+/- 20%

(From CrashWhite)

Questions:

(Easy) A 12.0V battery is connected to a resistor. If a current of 2.0 amperes flows through the resistor, what is its resistance?

Solution:

List of known values:

V =12.0V, I = 2.0A, R = ?

Using Ohm's Law (V = IR), rearrange it to solve for resistance (R):

R = V/I

Plug in the known values listed above:

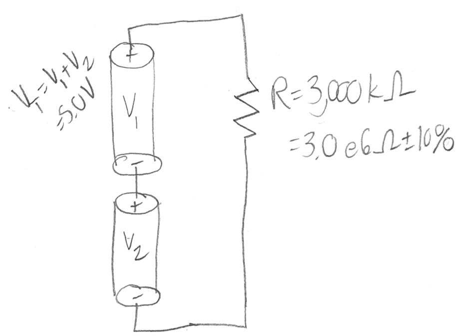
R = 12.0/2.0 = 6Ω

So, the resistance of the resistor is 6Ω.

(Medium) In series, a 3,000 kΩ resistor is connected across two controller batteries (each having 2.5V). On the batteries, it states that the resistors are within 10% of the voltage. Create a drawing of the situation. What are the minimum and maximum possible currents through the resistor?

Solution:

Drawing:



R(min) = 3.0e6 x .9 = 2700000Ω

R(max) = 3.0e6 x 1.1 = 3300000Ω

Now, plug the known values into Ohm's Law (I = V/R) to find both the maximum current and the minimum current:

I(max) = V/R(min)

I(max) = 5.0V/2,700,000Ω

I(max) = 1.85e-6 A

I(min) = V/R(max)

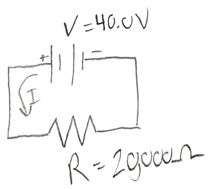
I(min) = 5.0V/3,300,000Ω

I(min) = 1.51e-6 A

(Hard) A 40.0V battery supplies a current to a 20kΩ resistor. Assume there is no voltage drop. Create a drawing of the situation. (A) What is the current through the resistor? (B) What is the power input from the battery, assuming that the resistor dissipates all power? (C) What is the power dissipated by the resistor?

Solution:

Drawing:



Part (A): Plug known values into Ohm's Law to find the current through the resistor:

I = V/R

I = 40.0V/20,000Ω

I = 2.0e-3A

Part (B): Use the power equation to solve:

$P = V^2/R$

$P = (40.0V)^2/20{,}000\Omega$

P = 0.08 W

(For this part, you can use any of the three power equations; all will give you the correct answer.)

Part (C): Plug in known values into the power equation (P = IV):

P = IV

P = 2.0e-3A (40.0V)

P = 0.08 W

Answers in parts B and C should be the same, as there are no additional energy sources in the circuit. We assume that only the resistor dissipates all energy/power, and there is conversion to heat energy as it flows through the wires.