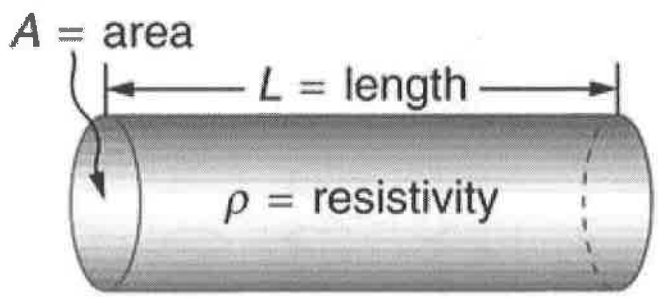
Physics 200 Name: KEY

Notes: Chapter Sections 20.3, 20.4, and 21.1

Notes – 20.3 Resistance and Resistivity

1. The resistance of an object depends on its shape/size and the material of which it is composed.

2. $R = \frac{\rho L}{A}$



3. Resistivity ρ is an intrinsic property of the material, independent of its shape or size.

4. In home wiring, currents are limited and minimum wire thicknesses are specified because, as current and resistance increase, more heat (thermal energy, actually) is produced in the wires,

Notes – 20.4 Electric Power and Energy

5. Power (P) is the rate of energy use or energy conversion.

6. Voltage (electric potential) can be expressed as J/C, and Current (Amperes) can be expressed as C/s. Therefore, P= IV

7. The unit for power is watts (W).

8. 1 W = 1 $\frac{J}{s}$

9. Given that V = IR, alternate expressions for power include:

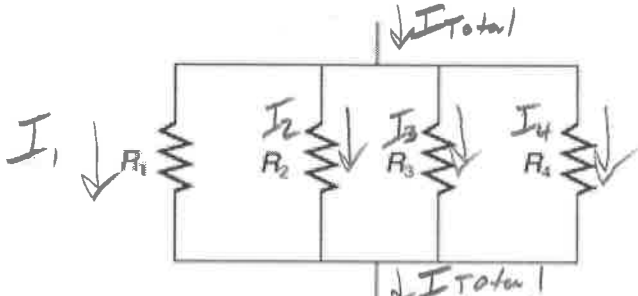
$$P = IV = I(IR) = I^2R = \frac{V^2}{R^2}R = \frac{V^2}{R}$$

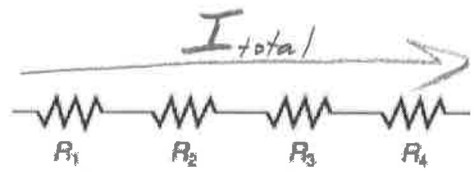
10. The more electric appliances you use and the longer they are left on, the higher your electric bill. This familiar fact is based on the relationship between energy and power. You pay for the energy used.

Notes – 21.1 Resistors in Series and Parallel

11. Most circuits have more than one component, called a resistor that limits the flow of charge in the circuit. A measure of this limit on charge flow is called resistance

12. Label which resistors are in series and which are in parallel.





parallel

series

13. **Resistors in Series**:

A. Series resistances add. $R_{series} = R_1 + R_2 + R_3 + R_4$

B. The current flowing through resistors in series is

the same through every resistor

C. Individual resistors divide the overall source voltage. drop.

14. **Resistors in Parallel**: all

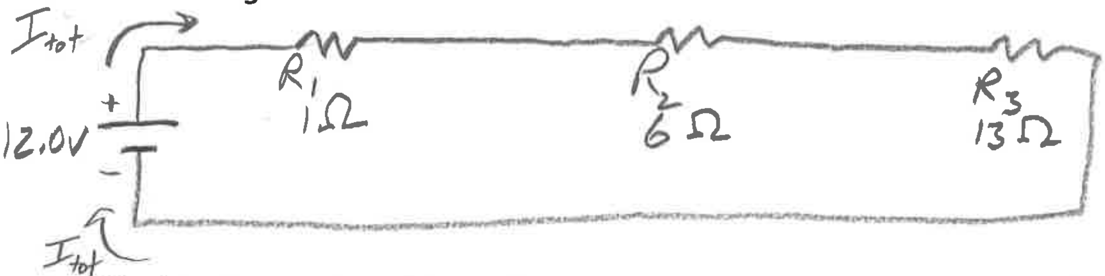
A. Individual resistors have voltage drops equal to the overall source voltage. drop

B. Resistors in parallel divide the overall source current.

C. Parallel resistances are found from $\frac{1}{R_{parallel}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$

15. Suppose the voltage output of a battery is 12.0 V, and the resistances for 3 resistors connected in **series** with the battery are R_1 = 1.00 Ω, R_2 = 6.00 Ω and R_3 = 13.0 Ω.

A. Draw a diagram of the circuit.



B. What is the total resistance?

$R_{eq} = R_1 + R_2 + R_3 = 1 + 6 + 13 = 20\,\Omega$

C. Find the current.

$I_{Tot} = \frac{V}{R_{eq}} = \frac{12.0V}{20.0\,\Omega} = 0.6A$

D. Calculate the voltage drop in each resistor, and show these add to equal the voltage output of the source.

$V = IR$

$V_1 = 0.6A\,(1\Omega) = 0.6V$

$V_2 = 0.6A\,(6\Omega) = 3.6V$

$V_3 = 0.6A\,(13\Omega) = 7.8V$

total = 12.00V

E. Calculate the power dissipated by each resistor.

$P = IV$

$P_1 = 0.6A\,(0.6V) = 0.36W$

$P_2 = 0.6A\,(3.6V) = 2.16W$

$P_3 = 0.6A\,(7.8V) = 4.68W$

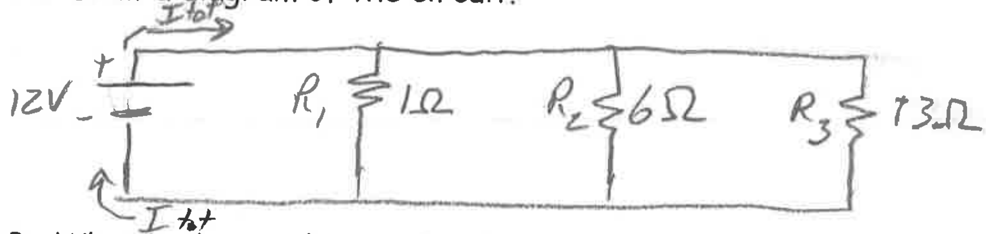
total = 12W

F. Find the power output of the source, and show that it equals the total power dissipated by the resistors.

$P_{Tot} = I_{tot} V_{tot} = 0.6A(12V) = 7.2W$

16. Suppose the voltage output of a battery is 12.0 V, and the resistances for 3 resistors connected in **parallel** with the battery are $R_1 = 1.00\ \Omega$, $R_2 = 6.00\ \Omega$ and $R_3 = 13.0\ \Omega$.

A. Draw a diagram of the circuit.



B. What is the total resistance?

$$\frac{1}{R_{eq}} = \frac{1}{1\Omega} + \frac{1}{6\Omega} + \frac{1}{13\Omega} \quad R_{eq} = 0.804\Omega$$

C. Find the total current.

$$I_{tot} = \frac{V}{R_{tot}} = \frac{12V}{0.804\Omega} = 14.9A$$

D. Calculate the currents in each resistor, and show these add to equal the total current output of the source.

$$I = \frac{V}{R} \qquad I_1 = \frac{12V}{1\Omega} = 12A \qquad A_3 = \frac{12V}{13\Omega} = 0.923A$$

$$I_2 = \frac{12V}{6\Omega} = 2A \qquad Total = 14.9A$$

E. Calculate the power dissipated by each resistor.

$$P = IV \qquad P_1 = 12V(12A) = 144W$$

$$P_2 = 12V(2A) = 24W$$

$$P_3 = 12V(0.923A) = 11.1W$$

Total $= 179W$

F. Find the power output of the source, and show that it equals the total power dissipated by the resistors.

$$P_{Tot} = I_{Tot}V = 14.9A(12V) = 179W$$