$I = \frac{Q}{t}$ $V = \frac{W}{Q}$ $E = VIt$ $V = IR$ $Q = Ne$ $e = 1.6 \times 10^{-19}$ C

$R_S = R_1 + R_2 + R_3 + \ldots$ $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$ $P = IV$ $P = I^2R$ $P = \frac{V^2}{R}$

List outcomes here:

Current Electricity Theory:

1. Define electric current, state its unit, list the equation defining electric current.
2. List three types of energy that may be used to produce current, and list three devices that provide this type of energy.
3. List three types of loads and list the energy conversions taking place inside each one.
4. What is the definition of voltage? What is its unit?
5. Prove that 1 J is equivalent to 1 V·A ·s.
6. How long does it take a current of 5.0 mA to deliver 15 C of charge?
7. What is the potential difference between two points if 1.0 kJ of work is required to move 0.5 C of charge between the two points?
8. What is the voltage of a source which provides 12.0 J to each Coulomb of charge present?
9. What is the energy of an electron accelerated through a potential difference of 100.0 kV? (charge of an electron given above)
10. What is the potential difference between two points when a charge of 80.0 C has 4.0×10^3 J of energy supplied to it as it moves between the two points?
11. There is a current of 0.50 A through an incandescent lamp for 5.0 min, with a voltage of 115 V. How much energy does the current transfer to the lamp? What is the power rating of the lamp?
12. If there is a current of 2.0 A through a hair dryer transferring 15 kJ of energy in 55 s, what is the potential difference across the dryer?
13. An electric drill operates at a potential difference of 120V and draws a current of 6.0 mA. If it takes 45 s for the drill to make a hole in a piece of wood, how much energy is used by the drill?
14. An electric toaster operating at a potential difference of 115 V uses 34 200 J of energy during the 20.0 s it is on. What is the current through the toaster?
15. A motor draws a current of 2.0 A for 20.0 s in order to lift a small mass. If the motor does a total of 9.6 J of work calculate the voltage drop across the motor.
16. In a lightning discharge, 30.0 C of charge moves through a potential difference 10^8 V in 20 ms. Calculate the current of the lightning bolt.
17. How much energy is gained by an $\bar{e}$ accelerated through a potential difference of 3.0×10^4 V?

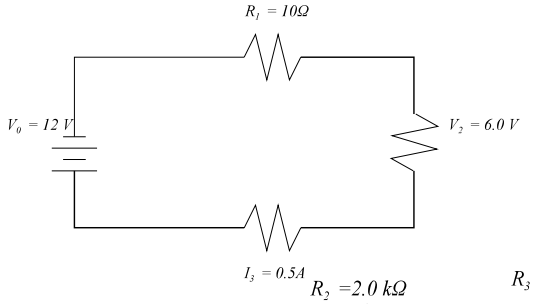
18. A 12V car battery can provide 60.0 A for 1.0 h. how much energy is stored in the battery?
19. How much energy is required to dry your hair if the hair dryer draws 12.0 A from a 110 V outlet for 12.0 min?

Electric Circuits:

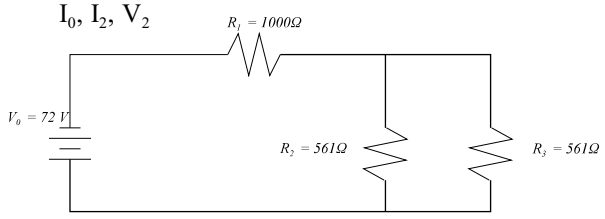
1. a) Describe the difference between current in a series circuit and current in a parallel circuit.
   b) Describe the difference between voltage in a series circuit and voltage in a parallel circuit.
2. Draw a schematic diagram of the following circuit: One power source and a resistor are connected in series with a combination of 3 light bulbs connected in parallel with each other. Include a fuse, 4 switches, a voltmeter, and an ammeter. The fuse should protect the whole circuit, one switch should shut off the whole circuit and the other switches should control the individual bulbs. The ammeter should read I_0 and the voltmeter the voltage of the resistor.
3. a) What is a short circuit?
   b) Why is it dangerous?
   c) Give two ways to protect against short circuits.
4. Describe the effect on the rest of the bulbs in problem two when one burns out. Will the remainder glow brighter? dimmer? What will be the effect on the source?
5. Describe resistance, list 4 factors affecting resistance.
6. A conductor has a length of 2.0 m and a radius of 3.0 mm. If the resistance is R = 100Ω, calculate the new resistance if the same material has:
   a) length = 6.0 m and r = 6.0 mm
   b) length = 1.0 m and r = 1.0 mm
7. List two ways to increase the current drawn by a circuit.
8. Draw a graph of V-I for 2 resistors and indicate which has the greatest resistance and why.
9. A voltmeter measures a voltage drop of 60.0 V across a heating element while an ammeter reads the current through it as 2.0 A. What is the resistance of the heating coil?
10. How much current flows through a 7.5 Ω lightbulb with a potential difference of 1.5 V?
11. What is the voltage drop across an element which draws a current of 5.0 A and has a resistance of 40 Ω?
12. A set of 6 motors is connected in series to a 120 V source drawing 1.0 A of current. Find:
    a) R_{TOT}
    b) R of each motor
    c) Voltage drop across each load.

13. Calculate R_T in each case:
    a) 3 x 8Ω resistors in series
    b) 3 x 8Ω resistors in parallel
    c) 30Ω, 50Ω in parallel with a 60Ω in series
    d) 30Ω, 40Ω, 50Ω, in parallel with a 40Ω in series.
14. What resistance must be added in series to a circuit containing 3 x 100Ω resistors in parallel in order to draw 2.0 A of current from a 120V source?
15. How much energy is dissipated in 10 minutes when a current of 4.0 A is flowing through a potential drop of 60.0 V?
16. Calculate the power dissipated in each case:
    a) 12.5 A at 120 V
    b) 1.0 mA through a 6.0 kΩ resistor
    c) 12.0 V across a 1.0 kΩ resistor
17. a) How much power can safely be used in a 240 V circuit with a 20.0 A fuse?
    b) How much more current can safely be drawn from a 120 V household circuit fused at 20A if a 1500W hair dryer and a 200W stereo are already operating?
18. A 2.0 A power saw operating from a 120V source operates for 15 min per day. Calculate the annual cost of operating this saw if electricity costs 7.2 cents / kW·h
19. Circuit analysis: Identify the unknowns in each diagram.

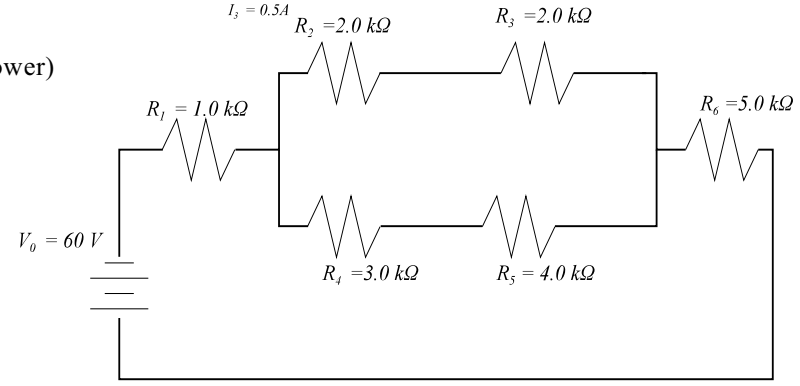
a) V_1
R_2
V_3
R_3



b) I_0, I_2, V_2



d) P_1 (Power)
P_2
P_3
P_4
P_5
P_6



Solutions:

Current Electricity Theory

1. Flow of e, Amps (A), I=Q/t
2. notes/book
3. notes/book
4. notes/book
5. 1J = 1 VAs; $1J = \frac{J}{C} \cdot \frac{C}{s} \cdot s$
6. t = 3000s
7. V = 2000V
8. V = 12V
9. 1.6 x 10^{-14}
10. V = 50V
11. 1.73 x 10^{4} J
12. V = 136V
13. E = 32.4 J
14. I = 14.9 A
15. V = 0.24 V
16. I = 1500A
17. E = 4.8 x 10^{-15}
18. E = 2.6 MJ
19. 950 kJ

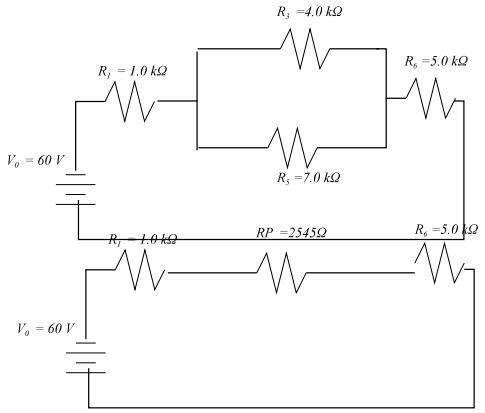
Electric Circuits

1. Notes
2. Nutso diagram, no room
3. Notes
4. glow the same; less load, I_0 smaller
5. Restricts the flow of e; 4 factors are :
   T, L, A, and ρ
6. a) 75Ω b) 450Ω
7. More R in parallel, less R in series
   More R in series, less R in parallel
8. Steeper slope = more R
10. 30Ω

10. I = 0.2 A
11. V = 200V
12. a) R_{TOT}= 120 Ω
    b) R_1 = 20 Ω
    c) V = 20V each
13. a) 24Ω
    b) 2.7Ω
    c) 78.8Ω
    d) 53.0Ω
14. 27Ω
15. 144 kJ
16. a) 1500W
    b) 6 x 10^{-3} W
    c) 0.144W
17. a) 4800W
    b) 12.5A + 1.7A
18. $157.68
19. V_1 = 5V
    R_2 = 12Ω
    V_3 = 1.0 V
    R_3 = 2.0Ω

b) I_0 = 0.056A
   I_2 = 0.028A
   V_2 = 15.75V

c) Equivalent circuits:



R_T = 8545 Ω; I_0 = 7.0 x 10^{-3} A, Thus, $I_P = I_0$, so
$V_{Branch}=I_0 R_B$ = 17.82V; $I_2 = V_B/ 4000$
$I_3 = V_B/ 7000$; I_2 = 4.45 x 10^{-3} A; I_4 = 2.54 x 10^{-3}

P_1 = 7.02 W
P_2 = 0.0396 W
P_3 = 0.0396 W
P_4 = 0.0194 W
P_5 = 0.0258 W
P_6 = 35.11 W