Name: ______________________

Period: ______________________

Electrical Power

Power Basics: The basic equation for power is P = W/t. Power is in watts or joules/sec. Power is how fast energy is produced or used. Batteries produce the power. Resistors use power. In a circuit P = VI = (J/C)(C/s) = J/s = watts.

1. A 400Ω resistor has 0.5 A flowing thru it. How much power does it dissipate (release into its surroundings)?
   $V=IR=.5(400)=200\,V$ $\quad P=VI=200(.5)=100\,W$

2. A 12V battery has 3 amperes flowing thru it. How much time is necessary for it to produce 60J of energy?
   $P=VI=12(3)=36\,W$ $\quad 36\,W=\frac{J}{s}$ OR $\frac{1\,sec}{36\,J}\left(\frac{60J}{1}\right)=$ $\quad s=\frac{60J}{36W}=1.67\,sec$

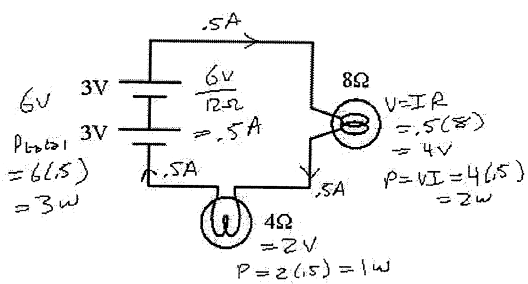
3. Given that V = IR and P = VI. Combine these equations to make a new equation that:
   A. does not have voltage in it.
   $V=IR$, so: $P=(IR)I=I^2R$
   B. does not have current in it.
   $I=\frac{V}{R}$, so: $P=V\left(\frac{V}{R}\right)=V^2/R$

4. Using your three equations for power, how does the power change if: $P=VI=V^2/R=I^2R$
   A. The voltage is doubled (something else will change, too). $P=V^2/R$, so $\times 4$
   B. The current is doubled and the resistance is doubled.
   $I^2R=(2)^2(2)=4(2)=\times 8$
   C. The voltage is doubled and the resistance is halved.
   $\frac{V^2}{R}=\frac{(2)^2}{1/2}=\frac{4}{1/2}=4\left(\frac{2}{1}\right)=\times 8$

5. A 4Ω resistor has 300mA flowing thru it. How much power does it use?
   $P=I^2R=(.3)^2(4)=.36\,W$

6. A 12kΩ (~~1200Ω~~ 12000) resistor uses 1.5V. How much power does it dissipate?
   $P=\frac{V^2}{R}=\frac{1.5^2}{12000}=.0001875\,W$ $\quad 1.875\times10^{-4}\,W$

Let's discover how power works in circuits.



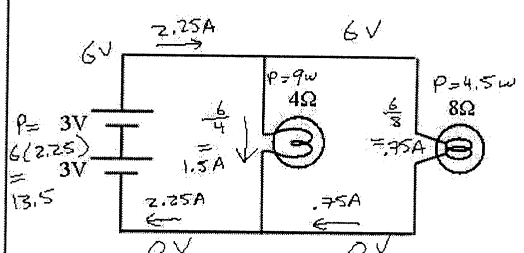
7. Two light bulbs are in the circuit shown.
   A. Are the bulbs in parallel or series? series
   B. Calculate the current flowing thru each bulb.
   $6V/12\Omega=.5A$
   C. Calculate the voltage used by each bulb.
   see diagram
   D. Which light bulb has the most current? same
   E. Calculate the power used by each.
   $P=VI$ for each OR could use $P=I^2R$

F. Brightness is about power. So which bulb is brighter?
8Ω (larger one)

G. Calculate the power generated by the batteries.
$P=3W$

In series resistors have the same current, but the bigger resistor uses more voltage and more power.

Notice that the power generated by the battery equals the power used by the resistors.



8. The circuit is then reconfigured as shown.
   A. Are the bulbs in (parallel) or series?
   B. What is the voltage across each bulb?
   6V
   C. Which light bulb has the most current?
   4Ω (smaller one)
   D. Calculate the power used by each bulb.
   $P_4=VI=6(1.5)=9\,W$ $\quad P_8=6(.75)=4.5\,W$

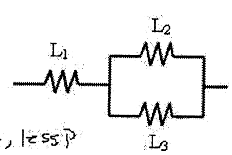
E. Brightness is about power. So which bulb is brighter?
4Ω (smaller one)

F. Calculate the power generated by the batteries.
$P=VI=6(2.25)=13.5\,W$ (or 4.5+9=13.5)

In parallel, the resistors have the same voltage, but the smaller resistor has more current and more power.

So, the power generated by the battery equals the power used by the resistors in both parallel and series.

9. Three light bulbs of equal resistance are configured as shown. Which one is brightest and why?
   $I_1=I_2+I_3$, so $I_1=2I_2$ so by $P=I^2R$, L_1 is brightest.
   OR – since L_2 is par with L_3, $R_{2,3}$ is $\frac{R_1}{2}$, so less voltage. $P=V^2/R$, less V, same R, less P



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