ADDITIONAL FOLLOW-UP MATERIAL, EXAMPLES AND PROBLEMS RELATED TO THE RIVER CITY AMATUER RADIO SOCIETY MEETING PRESENTATION

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POWER AND THE WATT

Power is the rate of electricity working, and is measured in WATTS. Power is represented in electrical calculations by the Letter P. Let take this one step further and say this about power;
When we multiply the voltage (E) x Current (I) we get Power (P) which is equal to Watts (W)

Thus, power P is watts W. One and the same...

The unit of power is the WATT, named after James Watt (1738-1819) and is symbolized by the letter W. One watt equals the work done in 1 second by 1 volt of potential difference in moving 1 coulomb of charge. Because 1 coulomb per second equals 1 ampere, power in watts is equal to voltage (in volts) time current flown (in amperes)

Power is an instantaneous measure, measures in watts or horsepower.

Another unit is Work Done (W. D.), which is power times "time", or power applied for a given amount of time. Electrically speaking, watt seconds is a measure of work done. As this is a very small unit, this is usually multiplied up in the form of watt-hours, or more commonly, kilowatt-hours.

Now for our basic examples were currently going to speak as though power (watts) is instantaneous.

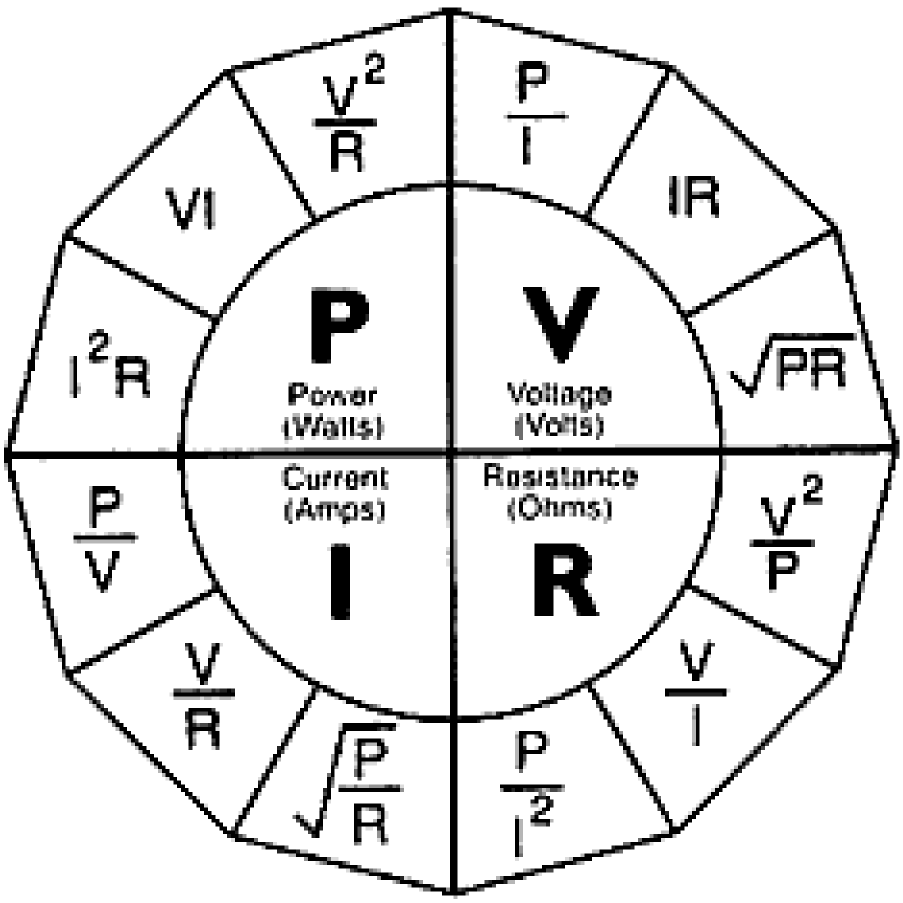
It can be rated in time also or as the power, company uses (KWH) kilowatt-hours.
Thus if we turn a 1000 watt (1KW) light bulb on for 30 min. we can say were consuming 1000 watts while its on. (Instantaneous) However, if we rate it in Kilowatt hours (such as our houses are metered in) and the other part of the hour the light is off... we then represent the power companies KWH usage as only one half KWH (or 0.5 kwh)

Be careful, "kilowatt hours" is technically not "power" consumed (kilowatts), but work done (kilowatt-hours).

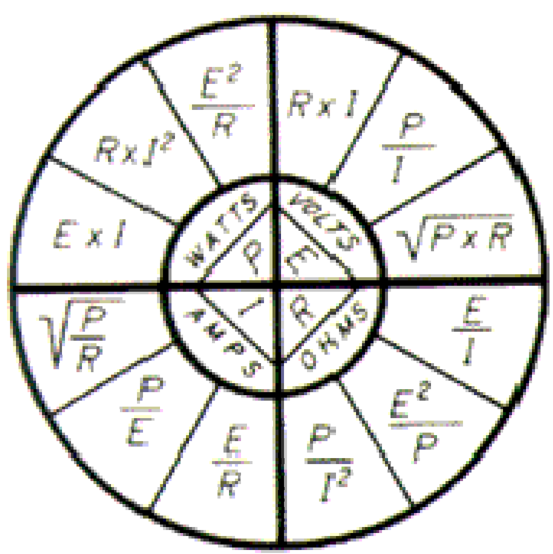
Before we leave this area... I want to take our topic one step further... by making this statement Watts/Power in the end of its usage or productions basic unit... is HEAT. Any form of work that is being done is directly related to the amount of heat produced by it.

Even we while doing work get hot... that is why we try not to do too much work too fast as we can OVERHEAT.

Ok as promised we include here our calculation wheel that now has power added to our simple triangle outline. Let’s try some simple problems on it.



P
Power (Watts)
V
Voltage (Volts)
I
Current (Amps)
R
Resistance (Ohms)
$\frac{P}{I}$
IR
$\sqrt{PR}$
$\frac{V^2}{P}$
$\frac{V}{I}$
$\frac{P}{I^2}$
$\sqrt{\frac{P}{R}}$
$\frac{V}{R}$
$\frac{P}{V}$
I^2R
VI
$\frac{V^2}{R}$



WATTS
P
VOLTS
E
AMPS
I
OHMS
R
$R \times I$
$\frac{P}{I}$
$\sqrt{P \times R}$
$\frac{E}{I}$
$\frac{E^2}{P}$
$\frac{P}{I^2}$
$\frac{E}{R}$
$\frac{P}{E}$
$\sqrt{\frac{P}{R}}$
$E \times I$
$R \times I^2$
$\frac{E^2}{R}$

HOW CAN WE CALCULATE OUR BILL

If you think your electric usage has increased in certain months, first check to see what new electric items you may be using. Run some calculations on how much energy a certain item may use. Your question, *"how did I use so much electricity"* may be answered with a few simple calculations.

By using **OHM'S LAW**, electric customers can calculate electrical usage of their electrical products. The nameplate on your tool has key information needed to calculate its electrical usage. In **OHM'S LAW**, there are four electrical factors to use.

Voltage or Power = E
Amps or Current = I
Ohms or Resistance = R
Watts = P

Use watts to calculate electric usage. Your electric meter measures your electric consumption in kWh, or Kilo Watt Hours. Every time an electric meter measures One thousand Watts of electric use in one hour, the meter will record one kilo watt-hour. This may sound complicated but after calculating a few products, it will become easy. Remember, it takes one thousand watts in one hour, for the electric meter to record one kWh. Check out the examples of some electric products below. Remember 1000 watts equals ONE kilowatt.

Examples:

If the nameplate specifies wattage:

- 100 watt light bulb = 10 hours of use to equal one kilo watt-hour.
  100 watts x 10 hours = 1000 watts or one kWh
- One plug in electric heater rated at 1000 watts = 1 hour of use equals one kilo watt-hour.
  1000 watts x 1 hour = 1000 watts or one kWh

If the nameplate does not specify wattage, it must be calculated:
The nameplate on an electric tool rates it at 110 volts drawing 10 amps at full load. Use the following example to calculate watts.

110 volts x 10 amps = 1,100 watts = this tool would use 1.1 kWh per hour of use.

If the nameplate states that, a tank heater appliance is rated at 220 volts and will draw 10 amps at full load.

- 220 volts x 10 amps = 2,200 watts = this appliance would use 2.2 kWh per hour of use.

If the nameplate states that, a tank heater appliance is rated at 220 volts and will draw 10 amps at full load. Use the following examples to calculate watts:

- 500 watts x 12 hours = 6,000 watts per day or 6 kWh per day.

- **6 kWh x .08272 cents per kWh = .49632 cents per day.**
  .49632 cents per day x 30 days = $14.89 per month cost to use this tank heater

This calculation can be used in this way for anything we use in our homes and businesses.

***REAL LIFE PROBLEM USING OUR RADIOS*.**

Ok let's do a real time real life problem… I want you to use the formulas that we have given you previous to work through the problem along with me… Now some can say.. Ok I will read it and yep your right… but I want each of you to actually show the work you have done by using the formulas and prove that I am right… I may be wrong… you never know…

So the two formulas are **Ohms Law… E=IR** and our **Power formula P=IE**

We're going to hook up our Whizzer all bands all pro radio to the 12 volt power supply. The Whizzer spec says that it can not operate full power with anything less than 11.8 V DC at its rated current or 20 amps full power. . (So first off what power can we expect from our existing power supply to radio neglecting any losses? (___) watts

Our question is.. On field day what is the distance, how far can we get from the power source to the radio, and what effect does the wire size have on the Whizzer performance, and what amount of power is lost when we extend the length of the wire in the example (____) watts possible, (____) watts lost, (____) watts after length of wire.

Voltage drop becomes a real issue if you need to carry the 12-volt power very far. For wiring lets used the 12 AWG wires which came with the Whizzer Pro all bands all mode radio from a switching power supply. We are given that according to the wire table in the ARRL Handbook, No. 12 AWG wire has a resistance of 1.6 milliohms per foot, which may not seem like much, but which adds up in a hurry. The cable length back and forth, to supply the Whizzer Pro all band all mode radio totals nearly eight feet (round trip), and simple math shows that the resistance is thus (1.6 milliohms/foot) X (8 feet) = 0.0128 ohms. At a 20 amp draw (full power transmit) the voltage drop = (0.0128 ohms) X (20 amps) = 0.256 volts. So then, on transmit, if the power supply is supplying 13.8 volts, the amount reaching the radio is (13.80 volts) - (0.256 volts) = 13.544 volts. ***That much of a voltage drop is acceptable***. And the power of our radio will be? (___) watts?

However, let's say that we choose to power the Whizzer Pro all band all mode radio from a 12.6 volt gel cell battery, and the battery is 15 feet away, and we use that same 12 AWG wire.
For a 15 foot cable, the round trip is twice that or 30 feet. So the resistance is (1.6 milliohms/foot) X (30 feet) = 0.048 ohms. The voltage drop on transmit will be (20 amps) X (0.048 ohms) = 0.96 volts. So the voltage from that 12.6 volt battery drops to (12.6 volts) - (0.96 volts) = 11.64 volts, which is too low to operate the Whizzer Pro all band all mode radio. Our power from the radio would be? (___) watts?.

The answer is to use larger wire (less resistance) , or shorter cable runs. This has to be considered before you take your Whizzer Pro all band all mode radio into the field.

By the way for some of you… what is the ohms per foot of No. 10 AWG wire from the ARRL Handbook? (_______) ohms per ft.

Ok… if you want to try this out… take a look at your own radio and do the math... Find out how far you can go with the No. 12 or No. 10 wire before you drop below the magic number of 11.8 volts DC. (Even if it's a hand held.. what size wire would be best for the 8 ft you want to be from the power supply or battery?

Believe me… you will be using this type of problem throughout your ham career… and beyond… in just about everything you hook up or try to run extension cords too…