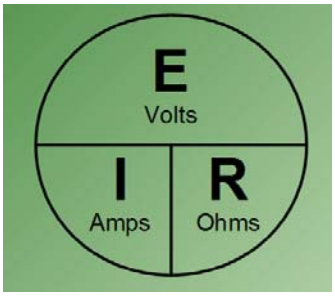
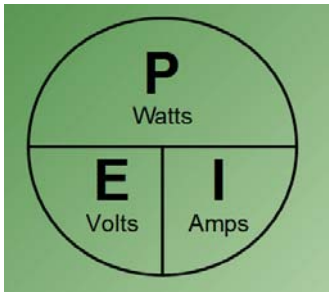
Ohm's Law and Joule's Law Review (From Element 2)[1]

There are only two relationships we must remember. We were introduced to these in the technician pool of questions. They are Ohm's law, $E = I \times R$, and Joule's electrical power law, $P = E \times I$. If your algebraic manipulation is weak you can use the the pie diagrams and cover up the unknown and use the equation that remains.



Ohm's Law



Joule's Law

From Ohm's law we get $E = I \times R$ by covering up *E*; $I = \frac{E}{R}$ by covering up *I*; and finally $R = \frac{E}{I}$ by covering up the *R*. In a similar manner from Joule's law we get $P = E \times I$, by covering up *P*; $I = \frac{P}{E}$ by covering up *I*; and $E = \frac{P}{I}$ by covering up the *E*.

Home appliance often give the voltage and power and leave it as an exercise to calculate current and equivalent resistance. As an example my toaster oven has the following values 120 volts and 1200 watts. Thus from Joule's law it draws $I = \frac{1200}{120} = 10$ amps from the outlet and from Ohm's law has a $R = \frac{E}{I} = \frac{120}{10} = 12$ ohm heating element. These laws apply everywhere, not just on the amateur licensing exams.

Questions

G5B03 (B)
How many watts of electrical power are used if 400 VDC is supplied to an 800 ohm load?
A. 0.5 watts
B. 200 watts
C. 400 watts
D. 3200 watts

The answer requested is in watts which requires us to multiply volts by amps. We are given 400 VDC but no amps through the 800 ohm load. We can use Ohm's law, $E = I \times R$ to find the current by

1 2015-2019 Element 3 Question Pool, revised 11 February 2015

solving for *I* (or cover the *I* with your thumb), $I=\frac{E}{R}=\frac{400}{800}=0.5$ amps. Now we can use Joule's electrical power law (or cover up *P* with your thumb), $P=E\times I$ or $P=400\times 0.5=200$ watts and B is the correct answer.

Or by thumb cover up the *I* to get the equation $I=\frac{E}{R}$ and continue as above. For Joule's law cover up the *P* and get the equation $P=E\times I$ and continue as above. That was a easy two step problem or a double-thumb problem.

Using an algebraic calculator you would type:

[4] [0] [0] [÷] [8] [0] [0] [=] **0.5** [×] [4] [0] [0] [=] **200**

Note quantities outside of gray box is what the display will show.

G5B04 (A)
How many watts of electrical power are used by a 12 VDC light bulb that draws 0.2 amperes?
A. 2.4 watts
B. 24 watts
C. 6 watts
D. 60 watts

We are given volts and amps and are asked for watts. Let's just use Joule's electrical power law which is, $P=E\times I=12\times 0.2=2.4$ watts. Just use your scientific calculator for the results. Therefore A is the correct answer.

For Joule's law cover up the *P* and get the equation $P=E\times I$ and continue as above. That was a easy one step problem or a single-thumb problem.

Using an algebraic calculator you would type:

[1] [2] [×] [0] [•] [2] [=] **2.4**

G5B05 (A)
How many watts are dissipated when a current of 7.0 milliamperes flows through 1.25 kilohms resistance?
A. Approximately 61 milliwatts
B. Approximately 61 watts
C. Approximately 11 milliwatts
D. Approximately 11 watts

We are given amps and ohms and asked for watts. We can use Ohm's law to calculate the voltage across the resistor, $E=I\times R=7\times 10^{-3}\times 1.25\times 10^{+3}=8.75$ volts across the resistor. Now use Joule's law, $P=E\times I=8.75\times 7\text{x}10^{-3}=0.06125=61.25\times 10^{-3}$ or 61.25 milliwatts and A is the correct

answer. Others might just substitute Ohm's law into Joule's law and use,
$P = I \times I \times R = I^2 \times R = (7.0 \times 10^{-3})^2 \times 1.25 \times 10^{+3} = 0.6125 = 61.25 \times 10^{-3}$ or 61.25 milliwatts and again A is the answer. Just use your scientific calculator for the results.

Or by thumb cover up the *E* to get the equation $E = I \times R$ and continue as above. For Joule's law cover up the *P* and get the equation $P = E \times I$ and continue as above. That was a easy two step problem or a double-thumb problem.

Using an algebraic calculator you would type:

7 Exp 3 +/- × 1 • 2 5 Exp 3 = **8.75** × 7 Exp 3 +/- = **0.06125**

F↔E **6.125-02**

Or by combining Ohm's Law and Joule's Law:

7 Exp 3 +/- x^2 × 1 • 2 5 Exp 3 = **0.06125** F↔E

Note you can press the F⇔E key and see the expoential form 6.125-02 and move the decimal point in your head one place to the right and get 61.25-03 which is 61.25 milliwatts or take 0.06125 and move the decimal point three placed to the right which is 61.25 milliwatts.