# A Guide to Calculations

Success on electrical theory calculations comes down to many factors. Most of which are related to the ability to learn how electrical components relate to each other through electrical laws, proportional relativities and measured values. Grasping those ideas is one component and likely the most important component. Of equal value to successful lesson scores is the understanding of the ground rules by which the lesson questions were written. There is only one correct answer to lesson questions and with that, it is warranted that you follow some simple guidelines expressed in this article.
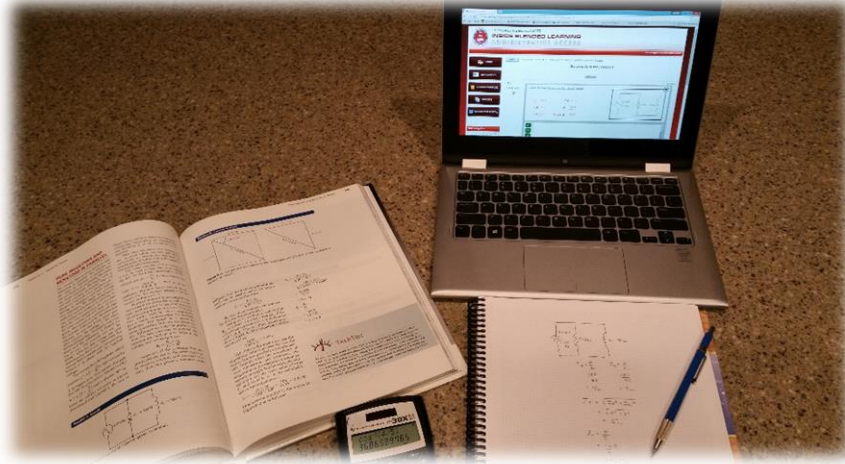
1. **Breaking Down The Introduction Statement**
2. **To Round or Not To Round....that is a question.**
3. **Constantly Using Constants**

# Breaking Down the Intro Statement

*Be prepared to show your work. All calculations must be completed on paper and taken with you to class. All calculations must be completed using your TI-30X IIS Solar Calculator. Questions that require a keyed numerical answer must be answered in the form of a decimal, as opposed to a fraction. Answers for some problems might be needed to answer later questions. For all mathematical calculations that use pi (other than the formula builder questions), use pi calculated out to two decimal places only. For example, π = 3.14 and 2π = 6.28. Rounding errors will occur if you use your calculator's π button to solve these equations. For the formula builder questions, please use the pi button, which carries out the number to 15 places.*

Let's break this statement down.  It or a shorter version appears on the introductory pages to AC and DC theory lessons.   There is a lot going on within this statement that is vitally important to your success…or at least your **sanity** when it comes to calculations.

1. *Be prepared to show your work. All calculations must be completed on paper and taken with you to class.*
   a. Paper?  Yes, paper…have we mentioned the new notebooks? (link Bill's Blog) These will come in very handy while working through circuit calculations.  Behind your AC or DC theory tab, get to work drawing the circuits on the graph paper and then working out the formulas.  Do remember to always begin with the formula, substitute the variables with given values, solve and label your answer.

2. *Questions that require a keyed numerical answer must be answered in the form of a decimal, as opposed to a fraction.*
   a. No need to search for some fancy keystrokes or secondary programs to answer in the form of a fraction.  This allows a standard form of answering though raises some rounding thoughts.  Those are covered later

3. *Answers for some problems might be needed to answer later questions.*
   a. You will need to keep track of what the final answer was for a previous question in order to use that value on the next.

This is an important sentence that comes with a caveat. Often times in the past a circuit was shown and multiple variables were calculated. Maybe a parallel circuit began with the need to find the total resistance. Then, with the total resistance calculated and knowing the source voltage, the total current needs calculated. This concept now is broken into two separate questions where the first question asks you to solve for total resistance and includes the above sentence. When this is the case, it is the final answer (which may incorporate a rounding component described later) that *must* be used for the second and any succeeding questions.
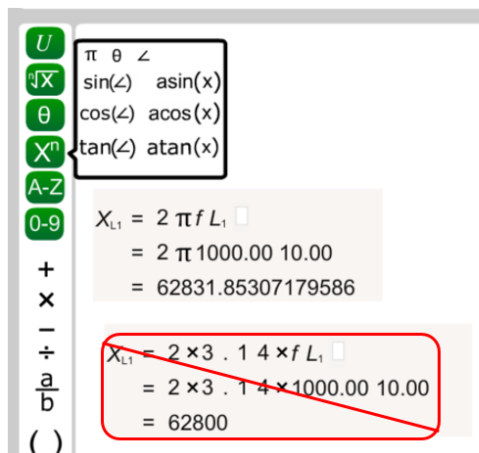
4. *For all mathematical calculations that use pi (other than the formula builder questions), use pi calculated out to two decimal places only. For example, π = 3.14 and 2π = 6.28. Rounding errors will occur if you use your calculator's π button to solve these equations.*

   a. The value used when using your TI30XIIS calculator must be inputted as 3.14 *NOT* the pi button on the calculator. This can sometimes make a person a bit queasy. I, myself have had to take a few timeouts in order to accept this. Since then however, I am a new person and feel that I once again am ok with the world about me. I have even stored 3.14 in the calculator.

5. *For the formula builder questions, please use the pi button, which carries out the number to 15 places.*

   a. When using the formula builder style of question you must use the pi symbol found

   when clicking the green θ button  instead of dragging in 3.14 from the green 0-9

   button.  The answers will be different and cause you to miss the question. See an example below. Note the difference in solutions. The top formula is correct and the bottom one is wrong.

# To Round or Not To Round...
## *that is A question*

There are some considerations to think through here.

- Rounding to a specified number of decimal places with no unit specified
- Rounding to a specified number of decimal places with a unit specified
- No rounding is specified
- Multiple step calculations

## 1. Rounding to a specified number of decimal places with no unit specified

In the circuit and question below, note the last sentence, "***Round your final answer to three decimal places.***"

Solve for the unknown value in the circuit. Round your final answer to three decimal places.

144 V

66 Ω

To complete the question there are a few acceptable answers

First, the unknown is the Amps in the circuit. So, using the three step process to solve you get,

$$I = \frac{E}{R}$$

$$I = \frac{144}{66}$$

$$I = 2.181818181818.......$$

Here are three valid answers you could input for this question.

- 2.182 Amps
- 2182 mA
- .002182 kA

Each of the above answers are rounded to three decimal places.  When you think of decimal places, understand a whole milli value is really out to 3 decimal places and so on. This is something to keep in mind every time you are to round to a specific decimal place.

## 2. Rounding to a specified number of decimal places with no unit specified

Follow along with this example question.

Determine the total capacitance of three 2 µF capacitors connected in series.  Round your FINAL answer to two decimal places of the unit shown.

☐ micro F

$$C_T = \cfrac{1}{\cfrac{1}{C_1} + \cfrac{1}{C_2} + \cfrac{1}{C_3}}$$

$$C_T = \cfrac{1}{\cfrac{1}{.000002} + \cfrac{1}{.000002} + \cfrac{1}{.000002}}$$

$$C_T = \cfrac{1}{1,500,000}$$

$$C_T = .000000667$$
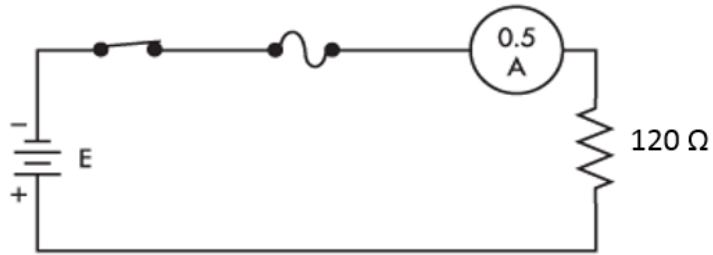
$$Rounding = .67\,\mu F$$

Here rounding to 2 decimal places of the unit shown results in an answer of .67

## 3. No rounding is specified

If a question requires a calculation and makes no mention of rounding, then give the complete answer shown on your calculator.  This is also a clue the answer does not calculate to needing any rounding which can head off many clerical errors.  Two example questions follow.

Example 1

In this example solving for voltage there is no need to include a rounding statement.  The answer resolves to a whole number.

$$E = I \times R$$
$$E = .5 \times 120$$
$$E = 60$$

Three valid solutions to this question are:

- 60 V
- .06 kV
- 60000 mV
  While all three above would be and are considered correct, I am a fan of the first one.


Example 2

How much power is required by a 1/8-hp motor? (Neglect $I^2R$ losses)


In this example question, again there is no need to include a rounding statement.  While the answer does indeed include decimal values, the number does have a stopping point on its own.

There are 746 watts per horse power therefore;

$$746 \times \frac{1}{8} = 93.25$$


Three valid solutions to this question are

- 93.25 W
- .09325 kW
- 93250 mW

While all of the above are correct, it's likely easier to think in whole numbers so 93.25 W would be a nice choice.

## 4. Multiple step calculations

Where a calculation is a multiple step procedure, do not round intermediate steps. An example follows.

<span style="color:red">A series circuit contains 40 ohms of resistance and 60 ohms of capacitive reactance. When 100 volts AC is applied, how much current flows? (Round the FINAL answer to two decimal places.)</span>

This question requires two steps. First solve for the total impedance and then solve for current as shown below.

$$Z = \sqrt{R^2 + X_c^{\,2}}$$
$$Z = \sqrt{40^2 + 60^2}$$
$$Z = 72.11102551....$$

$$I = \frac{E}{Z}$$
$$I = \frac{100}{72.11102551....}$$
$$I = 1.386750491...$$
$$Rounded = 1.39A$$

# *Constantly Using Constants*

In the electrical field there are many constants that need to be memorized.  Conduit multipliers, RMS and average values of a Sine wave, the square root of 2 and the square root of 3 are just a few of these constants.  Each of these numbers used in our field has been rounded for our use and accepted as having plenty of resolution.  The values used in the references are the values to use in calculations.

Some examples relative to electrical theory

$$RMS = .707 \times Peak$$
$$AVG = .637 \times Peak$$
$$\sqrt{3} = 1.73$$
$$\sqrt{2} = 1.414$$

Keep watching for more tips and guides to completion of the online quizzes within the LMS.  Check back here often and good luck calculating!