EAS 199A Engineering Solution Format

Problem solving is perhaps the most important skill practiced by engineers. Problem solving requires knowledge of the relevant content, logical reasoning, common sense, a persevering attitude, and way of communicating what you have achieved. This document focuses on the last aspect, namely the presentation of your homework solutions using a standard format.

A homework solution presented in the standard format is a concise, hand-written document that combines verbal description, mathematical analysis, schematics and plots. It is not a formal document like a published paper. It is a neat, legible, and mathematically correct presentation of your thought process from start to finish. It is extremely unlikely that you will be able to create a high quality homework solution document in a single draft. Good problems usually do not have immediately obvious solutions. Therefore, it is important to work all or at least parts of your homework assignment on scrap paper. The scrap versions allow you to test out ideas, and do sample calculations that help you refine your thinking. After you have worked out the solution on scrap paper, you are ready to write your solution in the standard format.

The presentation of your solution in standard format does not necessarily present the solution in the chronological order in which it was first developed. In finding the solution, it is quite likely that you took some logical wrong turns or made computational errors. The final version of the solution presented is free of errors and distractions. It is the *clean* version of the solution that you worked out on your scrap paper.

Standard Engineering Format

For typical engineering problems, the standard format consists of at least four sections: Given, Find, Solution/Analysis, Discussion/Conclusion.

Given

- Restate what is known. *Do not* repeat the assignment statement.
- Make a sketch of the physical features or a symbolic diagram of the masses, energy flows, and forces acting on the system being analyzed
- List the known values of system parameters or physical constants that will be used in the solution.

Find

- Briefly and concisely state the desired result. Do not repeat the assignment

Solution/Analysis

- Draw additional sketches to aid in the solution (if needed)
- List material properties, physical parameters, or other data that is not given in the problem statement, but is necessary to solve the problem. Cite published references for any physical property data.
- Identify the fundamental principles used in the solution, and start with a general mathematical equation or formula that is the starting point for your analysis.
- Use algebra, calculus, and other mathematical analysis to convert the starting formula into a form used to compute the solution (or parts of it).
- After an algebraic solution is obtained, substitute the known parameters, constants, etc. into the formula(s), Waiting until the end to substitute numerical values is a good idea, but is not an absolute rule. Use common sense. Using symbols instead of numbers makes it easier to read and debug an analysis. If a formula becomes too long or cumbersome, it may be acceptable to substitute numerical values and simplify.

Discussion/Conclusion

- Comment on the solution. Is it reasonable?
- Is the solution consistent with the assumptions made at the start of the analysis? Would a small but reasonable change in the assumptions or the input parameters have a drastic effect on the solution.

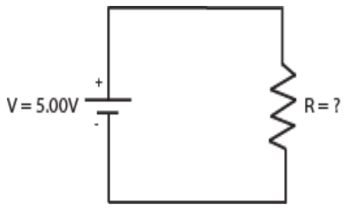
General Requirements:

The following general requirements apply to the solutions in the Engineering Format.

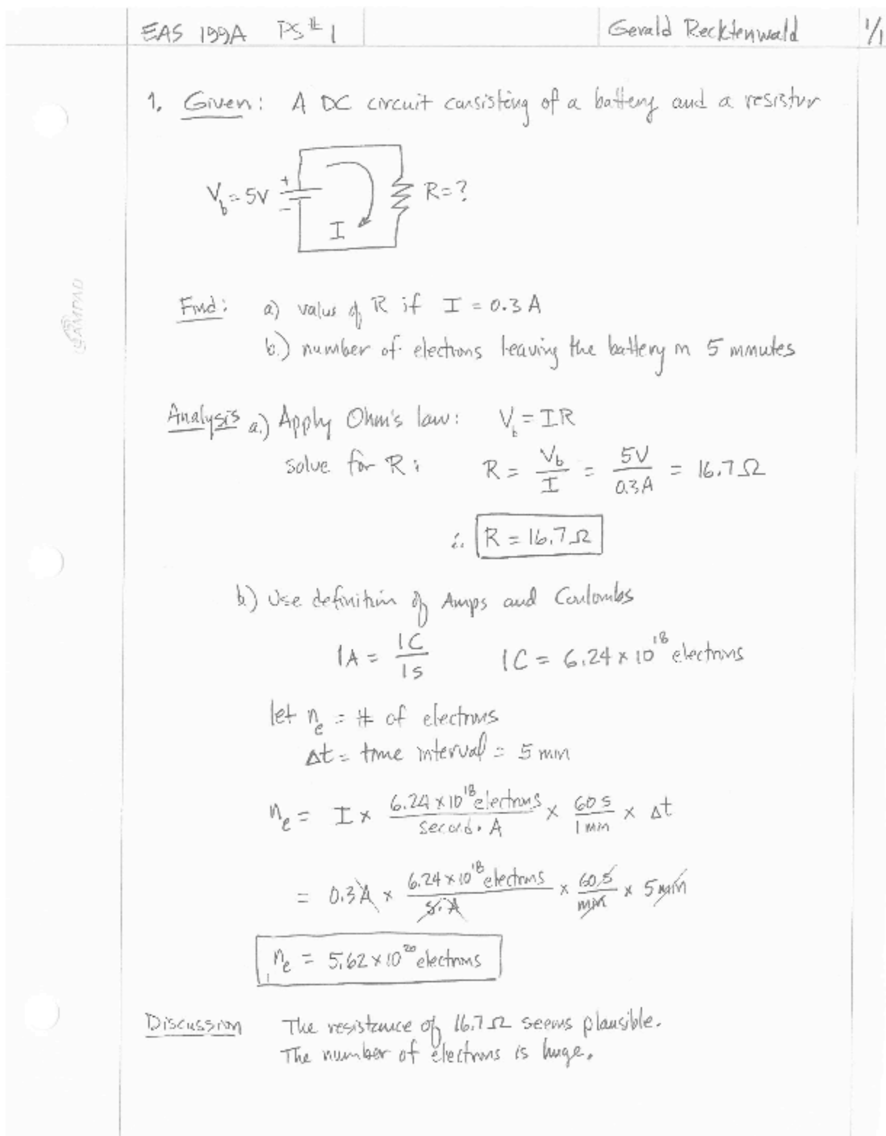
1. Solutions should be NEAT. Do not cross out text or formulas except to indicate an algebraic cancelation. Make sure erasures are complete, i.e., that the previous text does not show through.
2. Use engineering paper (yellow, green or white) or plain white paper (with no lines).
3. NEVER turn in solutions on paper that is ripped out of a notebook.
4. Staple pages of an assignment together. NEVER turn in an assignment on loose sheets of paper. Folding over the corner of a stack of loose sheets is unacceptable.
5. Present the problems in the order they are assigned. If you run out of time and skip a problem, you can indicate that by including the problem number and "skipped" or "Could not solve" or some other note to the grader. The note is not required, but it saves the grader from scanning through your solution packet to look for your missing solutions.
6. Number all pages in the upper right hand corner of the paper. For a 5 page assignment, the first page would be numbered 1/5, the second page would be numbered 2/5, and so on.
7. Use of MathCAD, Excel or MATLAB to complete all or part of a homework assignment is encouraged. Some assignments will explicitly require use of software.
8. Use the proper units throughout the solution.
9. If a solution fills one half page or more, begin the solution to the next problem on a new page.
10. If the solution to more than one problem is included on a single sheet:
    - Do not crowd the solutions. Leave at least 2 cm blank space between each solution.
    - Draw a horizontal line in the space between solutions. The line should at least be as long as one third of the width of the sheet of paper.
11. Long problems can span multiple pages. Do not crowd a solution so that it will fit on a single page.

Assume the following problem was assigned for homework assignment #1.

5. For the circuit shown below, determine
   a. The resistance R if the current supplied by the battery is 0.300 A.
   b. The number of electrons that leave the battery over a 5 minute period assuming the current is constant.



A hand-worked example of the solution in the Engineering Format is shown below.



EAS 199A PS #1 | Gerald Recktenwald | 1/1

1. Given: A DC circuit consisting of a battery and a resistor

$V_b = 5V$, $R = ?$, I

Find: a) value of R if $I = 0.3$ A
b.) number of electrons leaving the battery in 5 minutes

Analysis a.) Apply Ohm's law: $V_b = IR$

solve for R: $R = \frac{V_b}{I} = \frac{5V}{0.3A} = 16.7\,\Omega$

$\therefore$ $\boxed{R = 16.7\,\Omega}$

b.) Use definition of Amps and Coulombs

$1A = \frac{1C}{1s}$ $\quad 1C = 6.24 \times 10^{18}$ electrons

let n_e = # of electrons

Δt = time interval = 5 min

$n_e = I \times \frac{6.24 \times 10^{18}\ \text{electrons}}{\text{second} \cdot A} \times \frac{60\,s}{1\,min} \times \Delta t$

$= 0.3A \times \frac{6.24 \times 10^{18}\ \text{electrons}}{s \cdot A} \times \frac{60\,s}{min} \times 5\,min$

$\boxed{n_e = 5.62 \times 10^{20}\ \text{electrons}}$

Discussion The resistance of $16.7\,\Omega$ seems plausible.
The number of electrons is huge.