GUIDELINES AND STANDARDS FOR HOMEWORK SUBMISSIONS

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ROSE-HULMAN INSTITUTE OF TECHNOLOGY

TERRE HAUTE, INDIANA

Summer 2005

Homework Submission Guidelines

Practice is an important part of an engineer's education. Without it, the engineering student does not learn technical material well enough to use it. Homework allows not only for the practice of principles and computation, but also for organization and presentation. The following guidelines will assist in making the processes of preparing, submitting, and grading of homework run more smoothly, as well as help you organize your work.

Requirements

This section lists the requirements for homework submitted in ECE courses. While not all courses may require that homework be turned in, all that do will follow the requirements listed below.

1. A Cover Page shall be the first page of the homework submission.
2. Each page of the assignment, including plots and code, shall include the student’s name, problem number, and page number in the header of the page.
3. All work shall be orderly and neat, with results clearly indicated with a box or underlined.
4. All answers shall be given in proper engineering number format, with correct units specified.
5. The homework submission shall be assembled in correct order and stapled together in the upper left-hand corner.

The cover page must contain the student's name, mail box number, course number and section, assignment number, due date for the assignment, and a vertical list of all problems assigned with a blank for the score for that problem. An example homework assignment following the required format is included in Appendix A1 [1].

Recommendations

The following items are either suggestions for better results or optional formats. However, certain of these items may also be required by your instructor.

Presentation

Your work should be done in a presentable manner, so it can be easily read and understood by the grader. You should write on one side of the sheet, using a dark, sharp pencil or pen. Do not write in the margins. Use characters of size similar to that of the lines on the paper. Do not present more than one problem per page.

Paper

The homework shall be submitted on lined paper, preferably green engineering paper. This will help organize your work and keep it legible.

Honor Statement

An honor statement may be required to be included on the cover page, indicated that the work was performed by the student alone, or indicating the students with whom the student worked. A signature accompanies the honor statement.

Computer Code

In most cases, there is no need to submit computer code. If it is expressly requested, be sure to submit only the relevant content, and highlight and annotate the code for the grader's benefit. Avoid submitting large numbers of pages of code, especially if you expect the grader to search through it for the relevant information.

Solution Format

In some cases, a specific format for solving problems is preferred. The standard format used in the Sophomore Curriculum courses is presented in Appendix A2 [2], and may be required in certain ECE courses.

An abbreviated form of that format is appropriate as an option, and is illustrated in the example of Appendix A1. It is discussed briefly here.

In the ***Known or Given*** section you should state the provided information for the problem in clear, concise, and mathematical terms. In this section you also need to draw the diagrams describing the problem. It is sometimes appropriate to paste a copy of the problem statement on the page for easy reference.

In the ***Find*** section you need to indicate the physical or mathematical quantities that should be determined.

In the ***Analysis or Solution*** section you should first indicate the process you will use to solve the problem or design a solution. You should provide enough information to make the logic understandable for the grader, and yourself when you review prior to examinations. When using equations to solve for an unknown, first write the appropriate equations. Then substitute the corresponding numerical values in the equation and solve for the unknowns. Do all of your work in a logical and sequential manner until you have obtained the final results. Remember to draw a box around each of your results that matches a ***FIND*** in the problem statement.

References

[1] Professor Ed Doering
[2] D.E. Richards, *Basic Engineering Science – A Systems, Accounting, And Modeling Approach*, Fall 2004.

Summer 2005
ECE Technical Communications Committee
with many suggestions and contributions from the ECE faculty

Appendices

Appendix A1 Example Homework Assignment Displaying Requirements

Appendix A2 Sophomore Curriculum Homework Standard

My Name
CM 123
ES203 - 03

Campus mail box number is critical!

Section number is important

Homework Set #1
Due: Thursday, 12/4

1.1 ___
1.2 ___

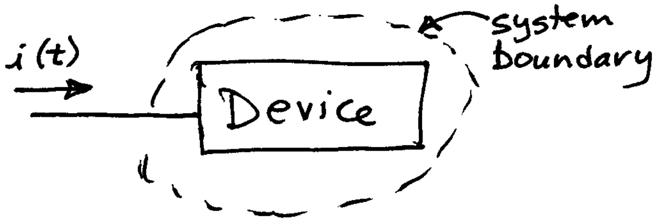
Use blanks for grader to write scores

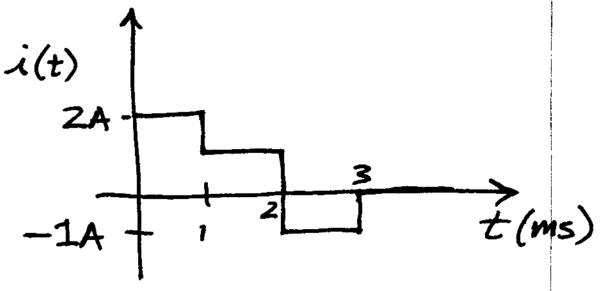
ES203-03 | 1.1 | My Name | 1/3

This is page one of three total pages

GIVEN

Device with input current $i(t)$:





- zero charge stored in device at time zero

Graphs and plots (even those produced by Maple) must include: axis labels, axis units, and axis scale (tick marks and numbers)

FIND

Plot of stored charge in the device as a function of time.

SOLUTION

Include brief comments to explain your solution process

Numerical results must include units and be written in engineering prefix (not scientific) notation. For example, write "23.8 mV" instead of "0.0238 V" or "2.38x10^-2 V".

Draw a box around your finished result

APPENDIX A

SOLVING ENGINEERING PROBLEMS -- A PROBLEM SOLVING HEURISTIC

Engineering problem solving is based on the study of models that describe real systems. In every case, the real system must be modeled by making simplifying assumptions before any mathematical or empirical analysis can be performed. Realistic and useful answers can only be obtained if the modeling assumptions "catch" the important features of the problem. The behavior of any model is constrained by the physical laws it incorporates and the modeling assumptions used in its development. Two different models for the same system may behave in entirely different ways. The engineer's job is to develop the "best" model for the problem at hand.

Because most mistakes are made in the process of developing the model,

SUMMARY OF PROBLEM SOLVING STEPS

KNOWN: In your own words, state briefly what is known. (Step #1)

FIND: State concisely what you are trying to find. (Step #2)

GIVEN: Translate the problem word statement into sketches and symbolic notation. All pertinent information given explicitly in the problem statement should listed here. (Step #3)

ANALYSIS: Develop a model and solve for desired information.
- Develop a strategy. (STRATEGY) (Step #4)
- Make modeling assumptions. (Clearly identified.) (Step #5)
- Develop and solve the model. (Step #6)
  - Develop symbolic solutions.
  - Calculate numerical values.
  - Check the reasonableness of your answers.

COMMENT: Discuss your results. (Step #7)

Figure A-1

it is essential that you learn to solve problems in a methodical fashion that documents your solution process including your modeling assumptions. Engineering calculations are part of the archival record of any engineering project and are frequently referred to years after the original work is completed. Many a junior engineer begins a new job by reviewing engineering calculations performed by others.

To help you develop your engineering problem solving skills, a multi-step process is proposed to help you (1) organize your thoughts, (2) document your solution, <u>and</u> (3) improve your ability to solve <u>new</u> problems. A summary of the steps is presented in Figure A-1. A sample problem showing the format can be found at the end of this appendix. As with any heuristic, this one does not guarantee a solution; however, its usefulness has been proven so frequently that we want you to use it in this course.

A more detailed discussion[1] of each step is presented in the following sections.

KNOWN: In your own words, state briefly what is known. Read the problem statement <u>and</u> think about what it says. Do not just blindly copy the problem statement over again or list every detail of the problem. Construct a short sentence that summarizes the situation.

FIND: State concisely what you are trying to find. (If you don’t know what you are looking for, how do you know when you’ve found it?) Do not just copy (a)....., (b)...., etc. from the problem and do not assume that you must find things in the order implied in the problem statement.

GIVEN: Translate the word statement of the problem into engineering sketches and symbolic notation. When completed, you should be able to throw away the original problem statement because you have recorded all of the pertinent information.

Draw and label a sketch of the physical system or device. (If you cannot visualize the problem, you probably can’t solve it!) If you anticipate using a conservation or accounting principle, identify the boundaries (control surfaces) of the system you select for your analysis <u>and</u> identify the interactions between this system and the surroundings, e.g. forces, work, mass flow, etc.

Define symbols for the important variables and parameters of the problem. Record the numerical values given for the important variables and parameters.

Label the diagram with all relevant information from the problem statement. This is where you record all of the information explicitly given in the problem statement.

Be especially wary of making implicit assumptions as you prepare this section. Recognize the difference between information that is given explicitly the problem and your interpretation of the information.

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[1] Based on material in *Fundamentals of Engineering Thermodynamics* by M. J. Moran and H. N. Shapiro, J. Wiley & Sons, Inc., New York, 1988.

ANALYSIS: It is in this section that an appropriate mathematical model is developed and used to find the desired information. As you prepare this section, carefully annotate your solution with words that describe what you are doing. This commentary is invaluable in exposing your thought processes and if need be in recreating it at a later time.

- **Develop a strategy.** Every solution should include some initial statements that reveal your plan for solving the problem. As a starting point, clearly state what you believe to be the physical laws or concepts that will be important in solving this problem. What's the property to be counted? What's the appropriate system? What's the appropriate time period? What constitutive relationships may be required?

  Your initial strategy may not be the best approach or the only approach. It may not even be correct approach, but as you proceed through the analysis process your plans may change. As they do just document them.

  To stress the importance of consciously thinking about the problem, every analysis section should start with a brief subsection labeled STRATEGY.

- **Make modeling assumptions.** Every problem solution requires that you make modeling assumptions. These assumptions are based on the information given in the problem statement, your interpretation of the given information, and your understanding of the underlying phenomena. Every model begins with universally accepted natural laws, and the assumptions provide the traceable link between the fundamental laws and problem-specific model you have developed. *All assumptions should be clearly identified as they are applied.* You should be able to give a logical reason for every modeling assumption you make. If you cannot, it probably is an incorrect assumption.

  Some problem solving formats call for a separate section listing all assumptions before you begin your analysis. There are two problems with this approach. First, experience shows that it is often difficult to know exactly what assumptions to make until you are building the model. Secondly, separating the assumptions from their application in the model makes tends to hide how they influence the modeling process. If a summary list is desired, it should be prepared after the analysis is completed.

- **Develop symbolic solutions.** Symbolic solutions are critical in engineering analysis and should always be developed and examined <u>before</u> you insert numerical values. The physics is in the symbolic solution, not the numerical answer. If the symbolic solution is incorrect, there's no hope for the numbers. If possible, solve an equation for the unknown quantity and isolate it on one side of the equal sign. *It is desirable to work with symbolic equations as long as possible before substituting in numbers for many reasons.* Symbolic solutions are especially useful when you are looking for errors, for solving parametric problems where certain parameters change, and are much easier to modify as your model develops. Look for groups of terms or ways to rearrange you symbolic answer that simplify the equation and allow you to check for dimensional consistency. Groups of terms with physical meaning or logical intermediate values should be assigned a unique symbol. Numerical values for these intermediate answers can then be calculated and checked separately.

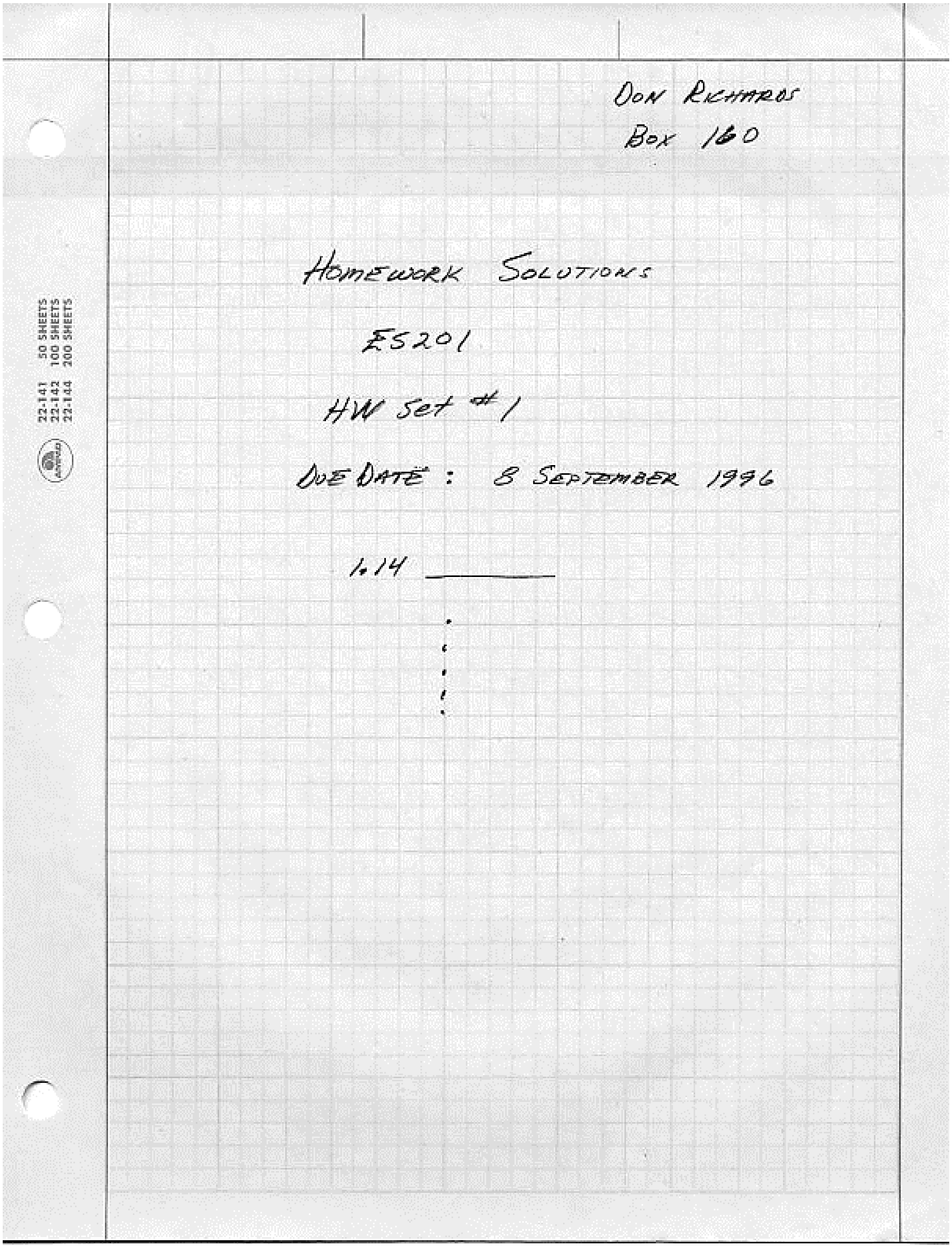
- **Calculate numerical values.** Examine your symbolic solution and see if it makes sense. Once you are satisfied with the symbolic solution, substitute in the numbers and calculate the numerical answer. It is good practice to identify the source, e.g. table, chart, or book, of all numerical data used in the solution, especially if it is not common knowledge. It is also good practice to calculate intermediate or partial numerical answers when you are faced with a very long computation or complicated equation. This prevents calculator errors from creeping into a problem and gives you an opportunity to check the answers against your physical intuition.

- **Check the reasonableness of your answers.** Once you have a numerical answer, consider the magnitude and sign of all values and decide whether they are reasonable. One way to do this is to compare your answer against the results of a simpler model or models that would be expected to bracket your answer. Try different units for the answer, say gallons per minute instead of liters per second, to match you experience.

As you prepare the analysis, *do not waste time recopying the solution over again if you reach a dead end or make a mistake*, Just cross out the error, clearly identify the mistake, and keep going. Textbook examples and professors' notes give the mistaken impression that problem solving is a linear process that follows a single path with no mistakes and no side trips. *Everyone makes mistakes, takes unexpected side trips, and forgets to make an important assumption.*

Successful problem solvers acknowledge these diversions and learn from them. You should never start a problem more than once; however, your solution may take several turns before you are satisfied with the answer. The record of your journey is important. Don't "clean up" the solution. Clean up your standard problem solving method because a sloppy solution is usually the result of sloppy thinking. Get in the habit of attacking every problem in the same way. Scrap paper is meant for doodles not engineering calculations.

COMMENTS: Discuss your results briefly. Comment on what you learned, identify key aspects of the solution, and indicate how your model might be improved by changing assumptions. Consciously check the validity of your answer by considering simpler models. Don't wait for someone else (like your boss or instructor) to find an error in your work by performing a five minute "back-of-the-envelope" calculation you could have performed before submitting your answer.



Don Richards
Box 160

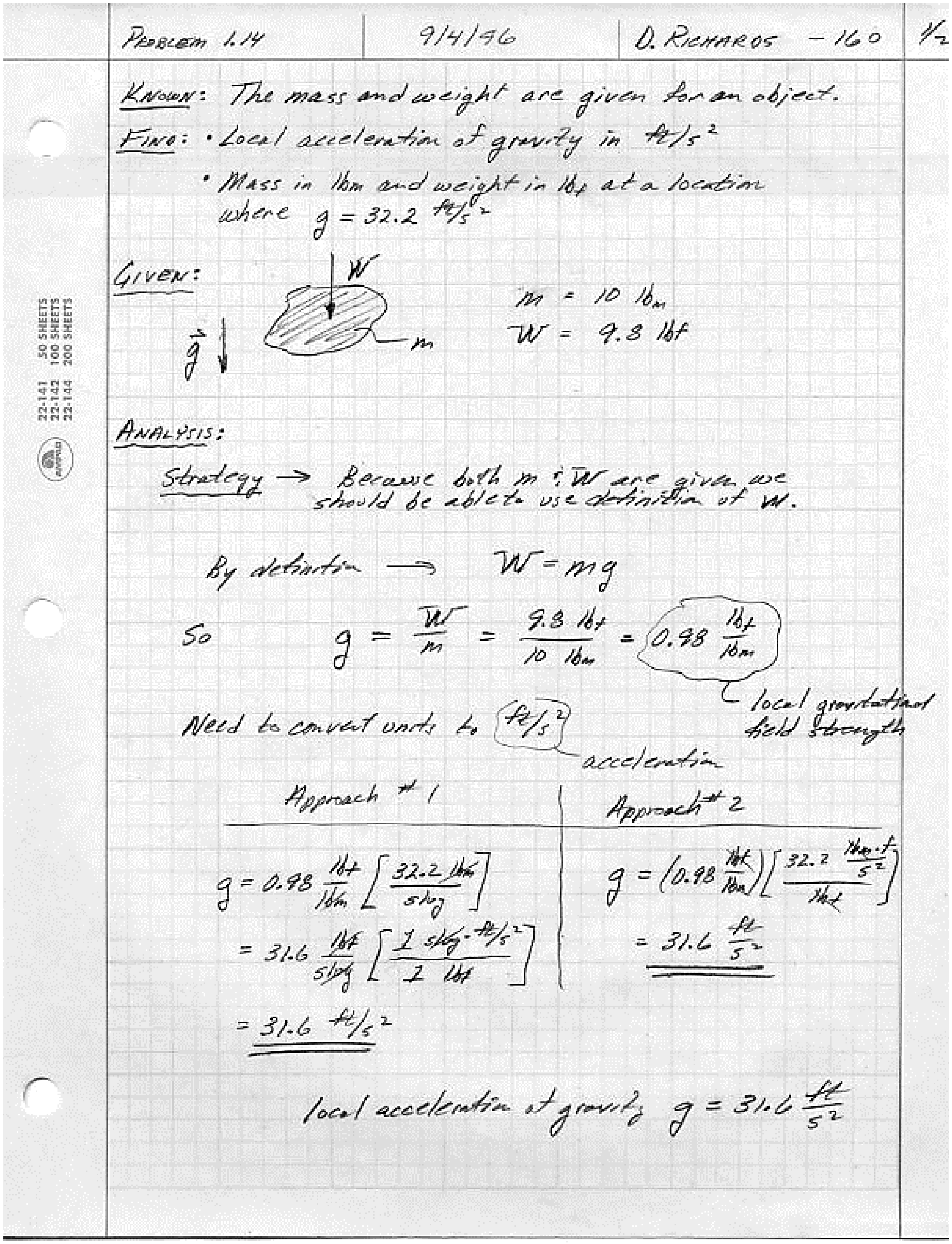
Homework Solutions

ES201

HW Set #1

Due Date : 8 September 1996

1.14 ______



PROBLEM 1.14 | 9/4/96 | D. RICHARDS -160 | 1/2

KNOWN: The mass and weight are given for an object.

FIND:
- Local acceleration of gravity in ft/s^2
- Mass in lbm and weight in lb_f at a location where $g = 32.2\ ft/s^2$

GIVEN:

$m = 10\ lb_m$

$W = 9.8\ lbf$

ANALYSIS:

Strategy → Because both m & W are given we should be able to use definition of W.

By definition ⟶ $W = mg$

So $g = \dfrac{W}{m} = \dfrac{9.8\ lb_f}{10\ lb_m} = \boxed{0.98\ \dfrac{lb_f}{lb_m}}$ — local gravitational field strength

Need to convert units to $\boxed{ft/s^2}$ — acceleration

Approach # 1

$$g = 0.98\ \frac{lbf}{lbm}\left[\frac{32.2\ lbm}{slug}\right]$$

$$= 31.6\ \frac{lbf}{slug}\left[\frac{1\ slug \cdot ft/s^2}{1\ lbf}\right]$$

$$= \underline{\underline{31.6\ ft/s^2}}$$

Approach # 2

$$g = \left(0.98\ \frac{\cancel{lbf}}{\cancel{lbm}}\right)\left[\frac{32.2\ \frac{\cancel{lbm} \cdot ft}{s^2}}{\cancel{lbf}}\right]$$

$$= \underline{\underline{31.6\ \frac{ft}{s^2}}}$$

local acceleration of gravity $g = 31.6\ \dfrac{ft}{s^2}$

1.14 cont'd | Don Richards -160 | 2/2

Now it same object with $g = 32.2\ \text{ft}/\text{s}$

Mass is unchanged, because mass is independent of gravity.

Solving for weight

Approach #1

$$W = mg$$
$$= (10\ \text{lbm})(32.2\ \text{ft}/\text{s}^2)$$
$$= 322\ \frac{\text{lbm}\cdot\text{ft}}{\text{s}^2}\left[\frac{1\ \text{lbf}}{32.2\ \frac{\text{lbm}\cdot\text{ft}}{\text{s}^2}}\right]$$
$$= \underline{\underline{10.0\ \text{lbf}}}$$

Approach #2

$$m = \frac{W_1}{g_1} = \frac{W_2}{g_2}$$
$$\therefore W_2 = \frac{g_2}{g_1} W_1$$
$$= \left(\frac{32.2\ \frac{\text{ft}}{\text{s}^2}}{31.6\ \frac{\text{ft}}{\text{s}^2}}\right) 9.8\ \text{lbf}$$
$$= \underline{\underline{9.99\ \text{lbf}}}$$

Comment:

- Unit conversions are very important
- Mismatch in last error due to round-off error.
- No assumptions required.