BioResource & Agricultural Engineering Department

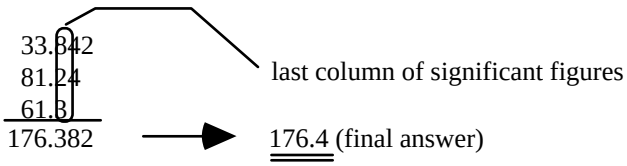
GUIDELINES FOR TECHNICAL PROBLEM SOLVING

The ability to present drawings and calculations clearly and systematically is the mark of a professional engineer or technician. Neatness, clarity and conciseness of presentation are professional habits that the student should strive to achieve. This guideline has been prepared by the Agricultural Engineering Department to assist students to develop good problem solving habits and to establish a uniform format to be used in this department for homework problems.

Some general rules are as follows:

1. Use engineering computation paper for all homework except certain graphs and drawings where graph or vellum paper is preferred.
2. Use a well sharpened H or 2H pencil for all calculations. Press hard for clarity.
3. Standard printing or lettering should be used for all words, units, and abbreviations.
4. A full heading as shown in the example should appear on the first page. The student's name and page number should be shown on each subsequent sheet. Staple all sheets together. Fold or submit flat as requested by the instructor.
5. The "style" of the solution should follow the model problems shown in this handout. The <u>given data</u>, <u>problem requirements</u>, and <u>problem solution</u> should be shown for each problem.
6. Use a sketch to show key data and to clarify the problem whenever possible. A short scale or ruler will insure straight lines and a neater looking paper.
7. If a particular formula is used in the solution of a problem, it should be shown. Always show <u>numerical substitution</u> and <u>units of data</u> on your paper. Do this even though you "punch" the data into your calculator to obtain the final answer.
8. Indicate the final answer and its units near the right margin of your paper and under score it with double lines or a colored line.
9. Draw a solid line completely across the page before starting the next problem.
10. A fundamental principle is that calculations should not be crowded and all steps of the solution should be shown. On the other hand, do not stretch simple problems out excessively but try to make the best use of your paper.
11. The answer obtained by solving any problem can never be more accurate than the information used. The rules for significant figures are as follows:

<u>Adding or Subtracting</u> - digits can be retained only as far right as the least accurate number.



<u>Multiplication and Division</u> - the answer should not have more significant figures than the minimum possessed by the entering numbers.

$$\frac{31.45 \times 62.711}{7.05} = 279.7533 \cong \overline{280} \text{ or } 2.80 \times 10^2$$

(4) (5) (3) (3)

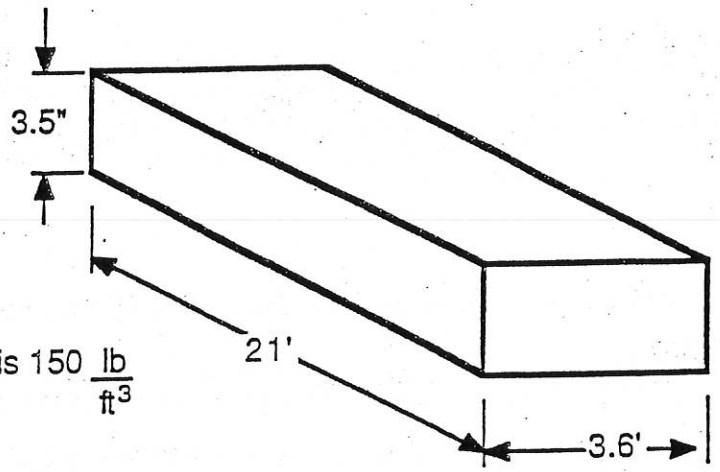
(calculator)

Since the number 7.05 has but <u>three</u> significant digits, the final answer must be rounded to <u>three</u> significant digits. The bar extending over the last digit indicates significance and is an alternative to scientific notation.

The number 280 (bar omitted) would imply only 2 significant figures.

1. Given:

A volume of concrete has dimensions as shown to the right.



The density of concrete is 150 $\frac{lb}{ft^3}$

Req'd: Find the weight of the concrete.

Sol'n:

$$\text{Weight} = \text{Volume} \times \text{Density} = 3.5\,\cancel{in} \times 21\,\cancel{ft} \times 3.6\,\cancel{ft} \times \frac{\cancel{ft}}{12\,\cancel{in}} \times \frac{150\ lb}{\cancel{ft^3}} = 3308\ lb$$

$$= \underline{3300\ lb}$$

2. Given: A winch moves an obstacle a distance of 298 ft in 2.11 minutes. A tension scale indicates the tension in the cable is 2500 lb (measured to the nearest 100 lb).

$$1\ hp = 33000\ \frac{ft\text{-}lb}{min}$$

Req'd: a. Find the amount of work done by the winch on the obstacle.
b. Find the amount of power developed.
c. Convert the result in b) to horsepower.
Show final answers with proper significant figures.

Sol'n:

a. $\text{Work} = \text{force} \times \text{distance} = 25 \times 10^2\ lb \times 298\ ft = 745000\ ft\text{-}lb$

$$= \underline{75 \times 10^4\ ft\text{-}lb}$$

b. $\text{Power} = \frac{\text{work}}{\text{time}} = \frac{745000^*\ ft\text{-}lb}{2.11\ min} = 353081\ \frac{ft\text{-}lb}{min}$

$$= \underline{35 \times 10^4\ \frac{ft\text{-}lb}{min}}$$

c. $\text{Horsepower} = 353081^*\ \frac{\cancel{ft\text{-}lb}}{\cancel{min}} \times \frac{1\,hp}{33000\ \frac{\cancel{ft\text{-}lb}}{\cancel{min}}} = 10.70\ hp$

$$= \underline{11\ hp}$$

* In chain type calculations, carry all figures to avoid rounding errors. Truncate the final answer to the correct number of figures.