ABE – 201 Fall 2016

**DUE Wednesday 08/31/16**

Homework Set 1 (20 pts total) Pay attention to significant figures

1. (3pts) Use a single dimension equation for each conversion:
a) 760 miles per hour -> meters per second
b) 921 kg/$m^3$ -> $lb_m/ft^3$
c) 5.37 x $10^3$ kJ/min -> hp

2. (3pts) A frustrated professor once claimed that if all the reports she had graded in her career were stacked on top of one another, they would reach from the Earth to the moon. Assume that an average report is the thickness of about 10 sheets of printer paper and use a single dimensional equation to estimate the number of reports the professor would have had to grade for his claim to be valid. Please explicitly state any engineering assumptions you make.

3. (2pts) A waste treatment pond is 50 m long and 15 m wide, and has an average depth of 2 m. The density of the waste is 85.3 $lb_m/ft^3$. Calculate the weight of the pond contents in $\mathbf{lb_f}$ using a single dimensional equation for your calculations.

4. (2pts) Two thermocouples (temperature measurement devices) are tested by inserting their probes in boiling water, recording the readings, removing and drying the probes, and then repeating. The results are as follows:

| | | | | | |
|---|---|---|---|---|---|
| T(°C) – Thermocouple A | 72.4 | 73.1 | 72.6 | 72.8 | 73.0 |
| T(°C) – Thermocouple B | 97.3 | 101.4 | 98.7 | 103.1 | 100.4 |

(a) for each thermocouple, calculate the i) mean, ii) range, and iii) standard deviation
(b) Which thermocouple is more precise? Which is more accurate?

5. (5pts) It is known that for a bushel of soybeans (60. $lb_m$ of soybeans = 1.0 bu.) 1.0 pound is hulls, 11 pounds are soybean oil and the rest is soybean meal. If you average 37 bu/acre for a 40. acre field:
   (a) how many $lb_m$ do you have?
   (b) U.S. tons?
   (c) Metric tons?
   (d) What weight in grams do you have in hulls, oil and meal?

6. (5pts) The specific gravity of fuel ethanol is approximately 0.79. Determine the following (list all of your assumptions)
   a) determine the mass (kg) of 50.0 liters of ethanol
   b) the mass flow rate of ethanol from a biorefinery tank is 1150 kg/min. Estimate the volumetric flow rate in L/s.
   c) Ethanol is blended with gasoline (specific gravity 0.70) to obtain a mixture with a specific gravity of 0.71. Calculate the volumetric ratio (volume of

ethanol/volume of gasoline) of the two compounds assuming $V_{blend} = V_{ethanol} + V_{gasoline}$.

d) What is the mass ratio of the above ethanol/gasoline blend?