UNIT 2 HOMEWORK AFTER SESSION ONE

- Read the following (or equivalent) to review how to convert units of measurement, scientific notation and significant figures.
  - http://oakroadsystems.com/math/convert.htm
  - http://en.wikipedia.org/wiki/Scientific_notation
  - http://en.wikipedia.org/wiki/Significant_figures
- Read Appendix C of the Activity Guide

- *Do Problem SP2-1,* in which you must calculate a standard deviation by hand using the theoretical formula. This is the last time you'll have to do it the hard way in this course. Just in case you get stuck on a desert island with no computer, you'll know how to do it!

SP2-1) Suppose you made the following five length measurements (N=5) of the width of a piece of letter size paper which has been cut carefully by a manufacturer using an unfamiliar centimetre rule: 21.3 cm, 21.5 cm, 21.4. cm, 21.2 cm, 21.4 cm. (a) Use the procedures on pages C-5 through the top of page C-9 of Appendix C find the average and standard deviation of the measurements to four significant figures. **Beware:** N is neither 12 nor 8. (b) Is there any evidence of uncertainty in the measurements or are they precise? Explain. (c) Is there any evidence of *systematic* error in the measurements? If so, what might cause this? Explain

- Do Problems SP2-2 below:

a) Here are some antiquated units of measurement. Assume all conversions are exact.
- 1 chain = 66 feet
- 1 foot =12 inches
- 1 inch = 25.4 mm (exact)
- 1 acre = 10 square chains
- 1 hectare = 10×10^3 m^2

Find the area of a 40-acre farm in hectares to 4 significant figures. You must show your method to get credit.

b) Calculate the following and report the final answer with the correct number of significant figures using scientific notation:
   i. $(1.3269\times10^{15})\,(1.06\times10^{-4})$
   ii. $(1.3269\times10^{15})\,(0.96\times10^{-4})$
   iii. $(1.3269\times10^{15})/(0.96\times10^{-4})$
   iv. $(1.06\times10^{-4})/(1.3269\times10^{15})$
   v. $3.6593\times10^{5} + 5.1742\times10^{2}$
   vi. $3.6593\times10^{-5} + 5.1742\times10^{-2}$
   vii. Calculate $\beta = \hbar c/k_e e^2$ to the correct number of significant figures given the values below.

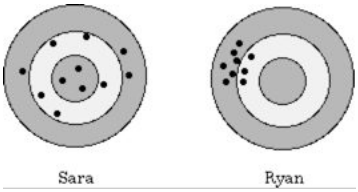
   Include the units in the calculation.

   $e = 1.602176565\times10^{-19}$ coulombs
   $\hbar = 1.054571726\times10^{-34}$ joule-seconds
   $k_e = 8.98744\times10^{9}$ newton-metre^2/coulomb^2
   $c = 2.99792\times10^{8}$ metres/second

UNIT 2 HOMEWORK AFTER SESSION TWO

• *Do Problems SP2-3, SP2-4 and SP2-5 below*

SP2-3) Suppose Sara and Ryan each throw darts at targets as shown here. Each of them is trying very hard to hit the bulls-eye each time. Discuss in essay form which of the two students has the least *uncertainty* associated with his or her throws and is thus *more precise*. Is one of the students *less accurate* is the sense of having a *systematic error* associated with his or her throws? What factors like eyesight and co-ordination might cause one to be more precise and another more accurate?



SP2-4) Make a table showing the probabilities that the sum of the roll of 3 dice are 3, 4, 5, 6, 7, ...18. You have already done 11 in the activity guide. Explain your method of calculation. Hint: You can use a symmetry argument to shorten the calculations. The probability for getting 3 is the same as for 18, the probability of getting 4 is the same as for 17, etc. Be sure to show your method.

SP2-5) Instead of measuring the background level in one run of 80 1-minute intervals you do 2 experiments, measuring 30 1-minute intervals and then 50 1-minute intervals. The results are as follows:

30 intervals: average = 11.8 counts/minute, SD = 4.2 counts/minute

50 intervals: average = 12.2 counts/minute, SD = 3.8 counts/minute

Use the formulas for the average and Standard Deviations to determine what the average and SDs would have been if you had done this experiment as a single experiment of 80 1-minute intervals.