PHYS 162 It's About Time SPRING 2016

Assignment 2 (due: Tuesday, September 20, 9 AM; total of 100 points)

Reading: You can find all items on Moodle, though you may not need all suggested sources.

- Kuhn, *The Copernican Revolution*, ch1
- Shipman et al, *Introduction to Physical Science*, ch. 15, sections 1-3 and 5 and ch. 16
- Holbrook, *Modern Introductory Physics*, ch2 – contains basic material such as units (section 2.3), volume of a sphere (p22), angles (section 2.4) etc.

Office Hours: Lutz Hüwel – Mondays, 2:30-4:00 PM, Exley 241, email: lhuwel
Julia Zachary – Fridays, 2:50-4:30 PM, basement Van Vleck Observatory, email: jzachary

General Remarks:

- You may submit your work either electronically or on paper (in the latter case, feel free to bring your work to class).
- Be as *neat* as you can manage.
- Where applicable, show important steps, not just the final answer, i.e. explain how you derived a number and/or provide the essential formulas.
- If you work together with others (highly encouraged), you must still hand in your own work – composed and written by you.
- Quantitative assignments will be graded partly for effort and partly for correctness. Initially, the weight

In general, I expect you to know and follow Wesleyan's **Honor Code**. For written work such as homework and reading journals assigned in PHYS 162, I expect you specifically to abide by **The Pledge:**

In accordance with the Honor Code, I affirm that this work is my own and all content taken from other sources has been properly acknowledged.

Since the reading is assigned and expected, you do not need to acknowledge anything taken from these sources. Because the CA help session is an integral part of homework, labs, and reading journals, you also do not need to mention any help from that source. Anything else is governed by above pledge.

For this set, assignment tasks are spelled out on the following page.

Assignment: Tasks 1 and 2 (and to some extent 5) are exercises in order of magnitude estimates, scientific notation, significant digits, precision, and conversion. If you get stuck (but first give it a serious attempt), there are a few hints after the questions. Questions 3 to 5 (on next page) can be answered after doing the assigned reading.

1. How many hours pass from the time a "typical" Wesleyan student arrives on campus and then graduates, eight semesters later? Discuss the role of leap years. Give an estimate for the uncertainty of your answer and express the implied precision as something like 3 parts in 100 etc. (which is equivalent to a precision of 0.03).

2. In module III, we will see that atomic clocks can measure time spans with a precision of better than 1 part in 10^{15} (one quadrillion or one million billion). To get a feeling for this remarkable precision, consider the task of filling an Olympic size swimming pool (50 m long, 25 m wide, 4 m deep) with an eye dropper which dispenses uniform, spherical drops of 4 mm diameter. Assuming that the given dimensions are exact. **(a)** How many drops are needed to fill the pool? **(b)** What is therefore the precision that you can boast when the pool volume is measured with an exactness of plus or minus one drop? **(c)** Provided no evaporation takes place, how long would you need to fill the pool when you can dispense drops at a rate of one per second?

3. As mentioned in class, currently a few thousand exo-planets (planets orbiting stars other than our sun) have been discovered. Imagine you are visiting one of them. The locals have sophisticated means of astronomical observations and their calendar and clocks are precise and accurate. They also speak English and call their host star *Verever*. Here is what their chief astronomer and keeper of time tells you: "The length of one of our sidereal days is, in your units of time, 2000 minutes and is 2 minutes longer than the period between two sequential noon-time positions of *Verever*. During the year, there is no noticeable change in the proportion of light and dark periods during one day." **(a)** What does that tell you qualitatively about the motion of the planet around its central star and around its own axis? *Briefly* explain and compare to corresponding quantities for earth. Can you say *anything* about where (latitude, longitude) on the planet the observations were made? **(b)** How long does it take the planet to revolve once around *Verever*? Express your answer in units of *our* days (1 d = 24 h etc.) as well as theirs.

4. In your own words, describe the Scientific Method. Kuhn argues that the development of the Two Sphere Model, is one example of this approach. Explain why this view is / is not justified in your mind. Give a second example and briefly explain your choice. A length of at least one page is expected.

5. On one to two pages, explain in your own words how the Copernican model of the solar system explains the observed retrograde motion of planets. Take the specific case of Mars. You may start with the appropriate slide of Notes_04 on Moodle. This task is assigned to everyone. In addition, you can earn an additional 50 points maximum for an oral presentation, not to exceed about five minutes, of their answer at the next seminar (Tuesday, 9/20). I will put the first two responders into contact for a team-of-two presentation. If you miss out now, don't worry – there will be additional opportunities.