College Physics Summer Assignment for GSIP Juniors 2018/19

The assignment is based on *Chapter 1: Introduction, Measurement, Estimating* from the college physics textbook *Physics: Principles with Applications* by Giancoli. It is organized into the following five sections:
- Questions
- Misconceptual Questions
- Problems
- General Problems
- Search and Learn

Please read through Chapter 1 before answering the questions and solving problems below. Note that the due date for this assignment is August 31.

Section One: Questions
1. (1 pt.) What is wrong with this road sign: Memphis 7 mi (11.263 km)?
2. (1 pt.) Why is it incorrect to think that the more digits you include in your answer, the more accurate it is?
3. (1 pt.) For an answer to be complete, the units need to be specified. Why?
4. (1 pt.) You measure the radius of a wheel to be 4.16 cm. If you multiply by 2 to get the diameter, should you write the result as 8 cm or as 8.32 cm? Justify your answer.
5. (1 pt.) Express the sine of 30.0° with the correct number of significant figures.

Section Two: Misconceptual Questions
1. (1 pt.) A student's weight displayed on a digital scale is 117.2 lb. This would suggest her weight is
   (*a*)   within 1% of 117.2 lb.
   (*b*)   exactly 117.2 lb.
   (*c*)   somewhere between 117.18 and 117.22 lb.
   (*d*)   somewhere between 117.0 and 117.4 lb.
2. (1 pt.) Four students use different instruments to measure the length of the same pen. Which measurement implies the greatest precision?
   (*a*)   160.0 mm.
   (*b*)   16.0 cm.
   (*c*)   0.160 m.
   (*d*)   0.00016 km.
   (*e*)   Need more information.
3. (1 pt.) Accuracy represents
   (*a*)   repeatability of a measurement, using a given instrument.
   (*b*)   how close a measurement is to the true value.
   (*c*)   an ideal number of measurements to make.
   (*d*)   how poorly an instrument is operating.
4. (1 pt.) Which is not true about an order-of-magnitude estimation?
   (*a*)   It gives you a rough idea of the answer.
   (*b*)   It can be done by keeping only one significant figure.

(c)   It can be used to check if an exact calculation is reasonable.

(d)   It may require making some reasonable assumptions in order to calculate the answer.

(e)   It will always be accurate to at least two significant figures.

5. $[L^2]$ represents the dimensions for which of the following?

(a) cm^2.

(b)   square feet.

(c) m^2.

(d)   All of the above.

Section Three: Problems

1. (2 pts.) How many significant figures do each of the following numbers have: (a) 214, (b) 81.60, (c) 7.03, (d) 0.03, (e) 0.0086, (f) 3236, and (g) 8700?

2. (2 pts.) Write the following numbers in powers of 10 notation: (a) 1.156, (b) 21.8, (c) 0.0068, (d) 328.65, (e) 0.219, and (f) 444.

3. (2 pts.) What is the percent uncertainty in the measurement 5.48 ± 0.25 m?

4. (2 pts.) One hectare is defined as 1.000×10^4 m^2. One acre is 4.356×10^4 ft^2. How many acres are in one hectare?

5. (2 pts.) Determine the conversion factor between (a) km/h and mi/h, (b) m/s and ft/s, and (c) km/h and m/s.

6. (2 pts.) (a) How many seconds are there in 1.00 year? (b) How many nanoseconds are there in 1.00 year? (c) How many years are there in 1.00 second?

7. (2 pts.) Estimate how many books can be shelved in a college library with 3500 m^2 of floor space. Assume 8 shelves high, having books on both sides, with corridors 1.5 m wide. Assume books are about the size of this one, on average.

8. (2 pts.) Estimate the number of gallons of gasoline consumed by the total of all automobile drivers in the U.S., per year.

9. (2 pts.) The speed v of an object is given by the equation $v = At^3 - Bt$, where t refers to time. (a) What are the dimensions of A and B? (b) What are the SI units for the constants A and B?

10. (2 pts.) Three students derive the following equations in which x refers to distance traveled, v the speed, a the acceleration (m/s^2), t the time, and the subscript zero ($_0$) means a quantity at time $t = 0$. Here are their equations: (a) $x = vt^2 + 2at$, (b) $x = v_0 t + 1/2\ at^2$, and (c) $x = v_0 t + 2at^2$. Which of these could possibly be correct according to a dimensional check, and why?

Section Four: General Problems

1. (2 pts.) Global positioning satellites (GPS) can be used to determine your position with great accuracy. If one of the satellites is 20,000 km from you, and you want to know your position to $\pm$ 2 m, what percent uncertainty in the distance is required? How many significant figures are needed in the distance?

2. (2 pts.) Estimate how many days it would take to walk around the Earth, assuming 12 h walking per day at 4 km/h.

3. (2 pts.) An angstrom (symbol A) is a unit of length, defined as 10^{-10} m, which is on the order of the diameter of an atom. (a) How many nanometers are in 1.0 angstrom? (b) How many femtometers or fermis (the common unit of length in

nuclear physics) are in 1.0 angstrom? (*c*) How many angstroms are in 1.0 m? (*d*) How many angstroms are in 1.0 light-year?

4. (2 pts.) The following formula estimates an average person's lung capacity V (in liters, where 1 L = 10^3 cm^3), V = 4.1 H – 0.018 A –2.7, where H and A are the person's height (in meters) and age (in years), respectively. In this formula, what are the units of the numbers 4.1, 0.018, and 2.7?

5. (2 pts.) Recent findings in astrophysics suggest that the observable universe can be modeled as a sphere of radius R = 13.7 × 10^9 light-years = 13.0 × 10^{25} m with an average total mass density of about 1 × 10^{-26} kg/m^3. Only about 4% of total mass is due to "ordinary" matter (such as protons, neutrons, and electrons). Estimate how much ordinary matter (in kg) there is in the observable universe.

Section Five: Search and Learn

1. (2 pts.) Explain this analogy: Galileo is to Aristotle as Copernicus is to Ptolemy.
2. (2 pts.) Estimate the ratio (order of magnitude) of the mass of a human to the mass of a DNA molecule.
3. (2 pts.) To the correct number of significant figures, determine the ratio of (*a*) the surface area of Earth compared to the surface area of the Moon; (*b*) the volume of Earth compared to the volume of the Moon.

Good luck!