

PHYSICS 1030

Homework #1

(Due Sept. 9, 2024, 6:00 pm)

1. An Olympic-size swimming pool is 50 meters long, 25 meters wide, and 2 meters deep. How much water is this in: (a) cubic meters; (b) cubic feet; (c) gallons; (d) teaspoons?

2. The distance from New York to Los Angeles is 2445 miles. Convert this distance to: (a) kilometers; (b) inches; (c) barleycorns. (A *barleycorn* is a unit equal to $\frac{1}{3}$ inch.)

3. According to a recent story in the *Washington Post*, a package containing a pair of riding boots was mailed from South Charleston, West Virginia in 1979, and finally arrived at its destination in Laurel, Maryland in 2020 — 41 years later. The total distance traveled was 363 miles. (a) What was the average speed of the package? Give your answer in units of inches per minute. (b) A snail can travel with a speed of about 0.003 miles per hour. Convert this to inches per minute. How does the speed of the package in part (a) compare to the speed of a snail?

4. In the United States, paper thickness is often measured in units of “pounds” (e.g. “20-pound paper”). This refers to the weight, in pounds, of 1 ream (500 sheets) of 17 in \times 22 in paper, which is exactly four times the size of U.S. standard “letter-sized” paper.

In Europe, paper thickness is instead measured in grams per square meter (g/m^2 , often marked “gsm”) — the mass, in grams, of one square meter of paper.

(a) Derive formulæ for converting US “pounds” paper thickness to and from units of g/m^2 . (b) Using your formulæ, convert 20-pound paper to g/m^2 . (You may be able to check your answer by finding a package of 20-pound paper; it may have the European gsm rating on the wrapper.)

5. United States dollar bills (properly called *Federal Reserve notes*) are printed on a special type of linen paper, whose exact composition is a closely guarded secret. Federal Reserve notes have a mass of 1 gram, and measure 6.14×2.61 inches. (a) Compute the area density of a Federal Reserve note in g/m^2 . (b) Using the results of the previous problem, convert your result from part (a) to paper “pounds.”

6. True story: I was in Iceland a few years ago to attend the annual World Esperanto Congress, and noticed that the price of gasoline at the local Nesti station in Reykjavík was posted as 252.9 Icelandic krónur (kr.) per liter. I wondered what the price was in U.S. dollars per gallon. I could not remember the conversion factor between liters and gallons, but I *could* remember the following facts:

- The exchange rate: 1 kr. = 0.825764¢.
- 1 gallon = 231 cubic inches.
- 1 inch = 2.54 cm.
- $1 \text{ cm}^3 = 1 \text{ milliliter}$.
- \$1 = 100¢.

Using *only* these facts, convert 252.9 kr./liter to find the price of gas in Iceland in dollars per gallon. Compute your answer to the nearest penny per gallon. (*Do not* look up the liters-to-gallons conversion factor to work this problem.)

7. Estimate the number of teaspoons of water in the Chesapeake Bay. The Bay has an area of 4479 square miles, and an average depth of 7.7 fathoms. (Refer to Appendix N of the class notes for appropriate conversions factors.)

8. If Peter Piper picks a peck of pickled peppers per picosecond, then how many bushels of pickled peppers does Peter Piper pick per hour?

9. Which weighs more: a pound of feathers, or a pound of gold?