

PHYSICS 1030

Homework #1

(Due Sept. 6, 2023, 6:00 pm)

1. (Serway 1-2) The former standard kilogram was a platinum-iridium cylinder 39.0 mm in height and 39.0 mm in diameter. What is the density of the material?

2. (Serway 1-3) An automobile company displays a die-cast model of its first automobile, made from 9.35 kg of iron. To celebrate its hundredth year in business, a worker will recast the model in solid gold from the original dies. What mass of gold is needed to make the new model?

3. (Serway 1-6) What mass of a material with density ρ is required to make a hollow spherical shell having inner radius r_1 and outer radius r_2 ?

4. 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 cm³ = 1 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.)

5. 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.)

6. (Serway 1-18) Suppose your hair grows at the rate of $1/32$ inch per day. Find the rate at which it grows in nanometers per second. Because the distance between atoms in a molecule is on the order of 0.1 nm, your answer suggests how rapidly layers of atoms are assembled in this protein synthesis.

7. The nearest star to the Earth is the red dwarf star Proxima Centauri, at a distance of 4.218 light-years. Convert this distance to barleycorns. (1 barleycorn = $1/3$ inch.)

8. Estimate the mass of the Great Pyramid of Giza, in tons. You may use of the following information: the Great Pyramid is in the shape of a pyramid with a square base. The length of each side of the base is 230.34 meters, and the pyramid is 146.7 meters high. The volume V of a pyramid is given by $V = \frac{1}{3}Ah$, where A is the area of the base, and h is the height. The pyramid is mostly made of limestone, with a density of roughly 2.1 g cm^{-3} . Give your answer in short tons, where 1 short ton = 2000 lb, and $1 \text{ lb} = 0.45359237 \text{ kg}$.

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