

PHYSICS 2020

Homework #1

(Due Sept. 3, 2025, 6:00 pm)

1. (Serway 1-3) Two spheres are cut from a certain uniform rock. One has radius 4.50 cm. The mass of the other is five times greater. Find its radius.
2. (Serway 1-4) 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 ?
3. (Serway 1-13) One cubic meter (1.00 m^3) of aluminum has a mass of 2.70×10^3 kg, and the same volume of iron has a mass of 7.86×10^3 kg. Find the radius of a solid aluminum sphere that will balance a solid iron sphere of radius 2.00 cm on an equal-arm balance.
4. (Serway 1-14) Now generalize the previous problem. Let ρ_{Al} represent the density of aluminum and ρ_{Fe} that of iron. Find the radius of a solid aluminum sphere that balances a solid iron sphere of radius r_{Fe} on an equal-arm balance.
5. 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.
 - $1 \text{ cm}^3 = 1$ 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.)

6. The Chesapeake Bay has an area of 4479 square miles, and an average depth of 7.7 fathoms. (a) Estimate how many gallons of water there are in the Chesapeake Bay. (b) Convert your answer in part (a) to teaspoons. (Refer to Appendix 15 of the course notes for appropriate conversions factors.)
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 lb = 0.45359237 kg.
9. The time machine shown in the movie *Back to the Future* was made from a 1982 DeLorean DMC-12 automobile and required 1.21 gigawatts (GW) of power. Convert this amount of power to (a) erg/sec, and (b) horsepower. (Refer to Appendix 15 of the course notes.)
10. If Peter Piper picks a peck of pickled peppers per picosecond, then how many bushels of pickled peppers does Peter Piper pick per year?