CHM_159
Worksheet_Chapter_E
(Measurements, Significant figures, Density, Dimensional Analysis)

1. Give the answer to the following calculation in scientific notation:

$$\frac{(9.66 \times 10^{-1}) + (5.1 \times 10^{2}) - 8.77 + 2.8}{(8.333 \times 10^{-2})(3.001)}$$

2. Determine the number of significant figures in each of the following:

a) 0.5080 meters
b) 10 students
c) 12 inches in a foot
d) 2.0×10^3 kg
e) 810. mm
f) 0.00040 m^3

3. Do the following conversions:
a. 1.0 in^2 to m^2
b. 45.0 mi/h to m/s
c. 512 lb/ft^3 to g/cm^3
d. 16.0 gal/h to L/min
[1 in =2.54 cm, 1 mi = 1.609 km, 1 lb = 454 g, 1 gal = 3.785 L]

4. Convert 13.6 g/mL to ng/m^3.

5. Copper can be drawn into thin wires. How many meters of 34-gauge wire (diameter = 6.304×10^{-3} in) can be produced from the copper in 5.01 lb of covelite, an ore of copper that contains 66% copper by mass.(Density of copper is 8.95 g/cm^3, volume of cylinder = $\pi r^2 h$).

6. A steel ball bearing with a circumference of 32.5 mm weighs 4.20 g. What is the density of steel in g/cm^3. (V of sphere = $4/3\ \pi r^3$, circumference of a circle = $2\pi r$)

7. If a raindrop weighs 0.52 mg on an average and 5.1×10^5 drops fall on a lawn every minute, what mass (in kg) of rain will fall on the lawn in 1.5 h ?

8. According to the lore of ancient Greece, Archimedes discovered the method of determining density by the water displacement method, while bathing and used it to find the density of the kings crown. If the crown weighing 4 lb 13 oz displaces 186 mL of water, is the crown made of pure gold? (density of gold is 19.3 g/cm^3)

9. An empty 3.00-L bottle weighs 1.70 kg. Filled with homemade wine, the bottle weighs 4.72 kg. The wine contains 11.0% ethyl alcohol by mass. How many ounces of ethyl alcohol are present in 275 mL of this wine? (1 ounce = 28.35 g; density of ethyl alcohol is 0.789 g/mL)

10. Three apprentice tailors (X, Y, and Z) are assigned the task of measuring the seam of a pair of trousers. Each one makes three measurements. The results in inches are X (31.5, 31.6, 31.4); Y (32.8, 32.3, 32,7); Z (31.9, 32.2, 32.1). The true length is 32.0 in. Comment on the precision and the accuracy of each tailor's measurements.

11. A graduated cylinder is filled to the 40.00-mL mark with a mineral oil. The masses of the cylinder before and after the addition of the mineral oil are 124.966 g and 159.446 g, respectively. In a separate experiment, a metal ball bearing of mass 18.713 g is placed in the cylinder and the cylinder is again filled to the 40.00-mL mark with the mineral oil. The combined mass of the ball bearing and mineral oil is 50.952 g. Calculate the density and radius of the ball bearing (volume of a sphere of radius r is $^4/_3\pi r^3$).

12. One gallon of gasoline in an automobile's engine produces on the average 9.5 kg of carbon dioxide, which is a greenhouse gas; that is, it promotes the warming of Earth's atmosphere. Calculate the annual production of carbon dioxide in kilograms if there are 40 million cars in the United States and each car covers a distance of 5000 mi at a consumption rate of 20 miles per gallon.

13. Fluoridation is the process of adding fluorine compounds to drinking water to help fight tooth decay. A concentration of 1 ppm of fluorine is sufficient for the purpose (1 ppm means one part per million, or 1 g of fluorine per 1 million g of water). The compound normally chosen for fluoridation is sodium fluoride, which is also added to some toothpastes. Calculate the quantity of sodium fluoride in kilograms needed per year for a city of 50,000 people if the daily consumption of water per person is 150 gal.

14. A small hole in the wing of a space shuttle requires a 20.7 cm^2 patch.
    a. What is the area of the patch in square kilometers.
    b. If the patching material costs NASA \$3.25/ in^2, what is the cost of the patch.

15. An empty Erlenmeyer flask weighs 241.3 g. When filled with water, (d = 1.00 g/cm^3), the flask and its contents weigh 489.1 g.
    a. What is the volume of the flask?
    b. How much does the flask weigh when filled with chloroform (d = 1.48 g/cm^3),