CHAPTER-1 PROBLEM SET

1. **(a)** Read the following description of the element zinc and indicate which are physical properties and which are chemical properties.
    Zinc melts at 420 °C. When zinc granules are added to dilute sulfuric acid, hydrogen is given off and the metal dissolves. Zinc has a hardness on the Mohs scale of 2.5 and a density of 7.13 g/cm^3 at 25 °C. It reacts slowly with oxygen gas at elevated temperatures to form zinc oxide, ZnO.
    (b) Which properties of zinc can you describe from the photo? Are these physical or chemical properties?

2. Use appropriate metric prefixes to write the following measurements without use of exponents: **(a)** 2.3 x 10^{-10} L, **(b)** 4.7 x 10^{-6} g, **(c)** 1.85 x 10^{-12} m, **(d)** 16.7 x 10^6 s, **(e)** 15.7 x 10^3 g, **(f)** 1.34 x 10^{-3} m, **(g)** 1.84 x 10^2 cm. (Answer: a) 0.23 nL, b) 4.7 µg, c) 1.85 pm, d) 16.7 Ms, e) 15.7 kg, f) 1.34 mm)

3. **(a)** The temperature on a warm summer day is 87 °F. What is the temperature in °C? **(b)** Many scientific data are reported at 25 °C. What is this temperature in kelvins and in degrees Fahrenheit? **(c)** Suppose that a recipe calls for an oven temperature of 400 °F. Convert this temperature to degrees Celsius and to kelvins. **(d)** Liquid nitrogen boils at 77 K. Convert this temperature to degrees Fahrenheit and to degrees Celsius. (Answer: a) 30.6 °C, b) 298.15 K, c) 477.6 K, d) -321.07 °F)

4. **(a)** A cube of osmium metal 1.500 cm on a side has a mass of 76.31 g at 25 °C. What is its density in g/cm^3 at this temperature? **(b)** The density of titanium metal is 4.51g/cm^3 at 25 °C. What mass of titanium displaces 125.0 mL of water at 25 °C? **(c)** The density of benzene at 15 °C is 0.8787g/mL. Calculate the mass of 0.1500 L of benzene at this temperature. (Answer: a) 22.61 g/cm^3, b) 563.75 g, c) 131.8 g)

5. Carry out the following operations and express the answer with the appropriate number of significant figures.
    (a) 320.5 – (6104.5/2.32) (Answer: -231x10^1)
    (b) [(285.3 x 10^5) – (1.200 x 10^3)] x 2.8954 (Answer: 8.260)
    (c) (0.0045 x 20,000.0) + (2813 x 12)   (Answer: 3.4x10^4)
    (d) 863 x [1255 – (3.45 x 108)]   (Answer: 76.2x10^4)

6. Using your knowledge of metric units, English units, and the information on the back inside cover, write down the conversion factors needed to convert **(a)** µm to mm, **(b)** ms to ns, **(c)** mi to km, **(d)** ft^3 to L. (Answer: a) 10^{-3} mm, b)10^6 ns, c) 1.6093 km, d) 28.3 L)

7. Carry out the following conversions: (a) 0.105 in. to mm, (b) 0.650 qt to mL, (c) 8.75 mm/s to km/hr, (d) 1.955 m^3 to yd^3, (e) $3.99/lb to dollars per kg, (f) 8.75 lb/ft^3 to g/mL. (Answer: a) 2.67 mm, b) 615 mL, c) 0.0315 km/hr, d) 2.557 yd^3, e) $ 8.80/kg, f) 0.140 g/mL)

8. The concentration of carbon monoxide in an urban apartment is 48 mg/m^3. What mass of carbon monoxide in grams is present in a room measuring 10.6 ft x 14.8 ft x 20.5 ft? (Answer: 4.4 g)

9. Ethyl chloride is sold as a liquid under pressure for use as a local skin anesthetic. Ethyl chloride boils at 12 °C at atmospheric pressure. When the liquid is sprayed onto the skin, it boils off, cooling and numbing the skin as it vaporizes. (**a**) What changes of state are involved in this use of ethyl chloride? (**b**) What is the boiling point of ethyl chloride in degrees Fahrenheit? (**c**) The bottle shown contains 103.5 mL of ethyl chloride. The density of ethyl chloride at 25 °C is 0.765 g/cm^3. What is the mass of ethyl chloride in the bottle? (Answer: a) liquid to gas b) 53.6 °F, c) 79.2 g)

10. Water has a density of 0.997 g/cm^3 at 25 °C; ice has a density of 0.917 g/cm^3 at -10 °C. (**a**) If a soft-drink bottle whose volume is 1.50 L is completely filled with water and then frozen to -10 °C, what volume does the ice occupy? (**b**) Can the ice be contained within the bottle? (Answer: a)1631 cm^3, b) No)

11. Gold is alloyed (mixed) with other metals to increase its hardness in making jewelry. (**a**) Consider a piece of gold jewelry that weighs 9.85 g and has a volume of 0.675 cm^3. The jewelry contains only gold and silver, which have densities of 19.3 and 10.5 g/cm^3, respectively. If the total volume of the jewelry is the sum of the volumes of the gold and silver that it contains, calculate the percentage of gold (by mass) in the jewelry. (**b**) The relative amount of gold in an alloy is commonly expressed in units of carats. Pure gold is 24 carat, and the percentage of gold in an alloy is given as a percentage of this value. For example, an alloy that is 50% gold is 12 carat. State the purity of the gold jewelry in carats. (Answer: a) 61 %, b) 14.6 carat)