Chapter 1 Supplemental Problems

1. In the process of attempting to characterize a substance, a chemist makes the following observations: this substance is a silvery white, lustrous metal. It melts at 649°C and boils at 1105°C. Its density at 20°C is 1.738 g/cm^3. The substance burns in air, producing an intense white light. It reacts with chlorine to give a brittle white solid. The substance can be pounded into thin sheets or drawing into wires. It is a good conductor of electricity. Which of these characteristics are physical properties and which are chemical properties?

2. A piece of aluminum foil, measuring 12.0 in by 15.5 in has a mass of 5.175 g. Aluminum has a density of 2.70 g/cm^3. What is the thickness of the foil in millimeters?

3. Neon is used to make electronic signs. It has a melting point of -248.6°C and a boiling point of -246.1 °C. What are these temperatures in Kelvin?

4. What is the number of sig figs in:
   a) 1282 kg
   b) 0.00296 s
   c) 9.7750 X 10^{4-} cm.

5. Carry out the following operations and express the answer with the appropriate number of sig figs.
   a) 320.55 in/s – (6104.5 in/2.3 s)
   b) (0.0045 m X 20,000.0 m) +(2813 m X 12 m)
   c) [(285.3 X 10^5 J) – (1.200 ´ 10^3kJ)] X 2.8954 s

6. In March 1989, the *Exxon Valdez* ran aground off the cost of Alaska and spilled 240,000 barrels of crude oil. One barrel of oil contains 42 gal. How many liters of crude oil were spilled?

7. The diameter of chromium atom is about 2.4 Å. Express this distance in nanometers. How many chromium atoms would have to be lined up to span 1.0 cm?

8. The diameter of metal wire is often referred to by its American wire gauge number. A 16-gauge wire has the diameter of 0.05082 in. What length of wire, in meters, is there in a 1.00 lb spool of 16 gauge copper wire?

9. The density of copper is 8.92g/mL.A copper penny has a mass of 3.015 g and contains 95.0% Cu. What is the mass of the copper present in one penny? If Cu costs 80¢ per

pound, what is the value of the Cu in 100 pennies ($1.00)? How many pennies contain one dollars worth of Cu?

10. The unit the furlong is used in horse racing. The units chain and link, are used in surveying. There are 8 furlongs in one mile, 10 chains in 1 furlong, and 100 links in a chain. To three significant figures, what is the length of 1 link in inches?

Answer key

1. **P,** this substance is a silvery white, lustrous metal. **P,** It melts at 649°C and boils at 1105°C. **P**, Its density at 20°C is 1.738 g/cm^3. **C,** The substance burns in air, producing an intense white light. **C,** It reacts with chlorine to give a brittle white solid. **P,** The substance can be pounded into thin sheets or drawing into wires. **P,** It is a good conductor of electricity.

2. The underlined digits are not significant.

Volume of foil = 5.175 g Al X $\frac{1 \text{ cm}^3 \text{ Al}}{2.70 \text{ g Al}}$ = 1.91$\underline{7}$

Area of the foil = 12.0 in X 15.5 in X $\frac{1 \text{ in}^2}{2.54^2 \text{ cm}^2}$ = 1199.$\underline{9976}$ cm^2

Volume = L ´ W ´ H = area X thickness; thickness = $\frac{\text{thickness}}{\text{area}}$ = $\frac{1.91\underline{7} \text{ cm}^3}{1199.\underline{9976} \text{ cm}^2}$ = 0.00160 cm X $\frac{10 \text{ mm}}{1 \text{ cm}}$ = 0.0160 mm thick.

3. Plug and chug. 24.4 K, 27.1 K

4. 4 (all integers count), 3 (preceding zeros don't count), 5 (zeros after a decimal, which are not holding place count)

5. Carry out the following operations and express the answer with the appropriate number of sig figs.

a) – 2.3 X10^3 in/s.
b) 3.4 X 10^4 m^2
c) 8.260 X 10^7 s

6. 240,000 barrels ´ $\frac{42 \text{ gal}}{1 \text{ barrel}}$ X $\frac{4 \text{ qt}}{1 \text{ gal}}$ X $\frac{1 \text{ L}}{1.06 \text{ qt}}$ = 3.8 ´ 10^7 L

7. 1.0 cm ´ $\frac{1 \text{ m}}{100 \text{ cm}}$ X $\frac{10^9 \text{nm}}{1 \text{ m}}$ = 1.0 ´ 10^7 nm

1.0 cm ´ $\frac{1 \text{ m}}{100 \text{ cm}}$ X $\frac{10^9 \text{nm}}{1 \text{ m}}$ X $\frac{1 \text{ Å}}{0.100 \text{ nm}}$ X $\frac{1 \text{ atom Cr}}{2.4 \text{ Å}}$ = 4.2 ´ 10^7 atoms.

Type of problem: density problem.

8 Information you will need for this problem:

- Conversion of lb → g
- Density of wire
- Conversion of in → cm → m
- Conversion of mL → cm^3
- $V = \pi r^2 h$ $r = d/2$

$$1.00 \text{ lb} \times \frac{453.592 \text{ g}}{1 \text{ lb}} \times \frac{1 \text{ mL}}{8.92 \text{ g}} \times \frac{\text{cm}^3}{1 \text{ mL}} = 50.8\underline{5} \text{ cm}^3$$

$$50.8\underline{5} \text{ cm}^3 = \pi \, (0.02541 \text{ in})^2 \times \left(\frac{2.54 \text{ cm}}{1 \text{ in}}\right)^2 \times \text{h}$$

$$\text{h} = 38\underline{8}5.66 \text{ cm} \times \frac{1 \text{ m}}{100 \text{ cm}} = 38.9 \text{ m}$$

9 Type of problem: Mass percentage problem

Information you will need for this problem:

- Mass of 1 penny
- Number of pennies in 1 dollar
- Conversion of grams of copper in 1 penny
- conversion of g → lb

$$\frac{3.015 \text{ g}}{1 \text{ penny}} \times \frac{95.0 \text{ g Cu}}{100 \text{ g penny}} = \frac{2.86 \text{ g Cu}}{1 \text{ penny}}$$

$$100 \text{ penny} \times \frac{2.86 \text{ g Cu}}{1 \text{ penny}} \times \frac{1 \text{ 1b}}{453.592 \text{ g}} \times \frac{80¢}{1 \text{ lb Cu}} = 50.4 ¢ \text{ worth of Cu}$$

$$\$1.00 \text{ worth of copper} \times \frac{100 \text{ penny}}{50.4¢ \text{ worth Cu}} = 198 \text{ penny}$$

10 Type of problem: Unit conversion/dimensional analysis

Information you will need for this problem:

- Conversion of in → mi

$$1 \text{ link} \times \frac{1 \text{ chain}}{100 \text{ link}} \times \frac{1 \text{ furlong}}{10 \text{ chains}} \times \frac{1 \text{ mile}}{8 \text{ furlongs}} \times \frac{5280 \text{ ft}}{1 \text{ mi}} \times \frac{12 \text{ in}}{1 \text{ ft}} = 7.92 \text{ in}$$