

Matter and Motion Fall 2015 Chemistry Workshop 1

The workshop is intended to be a low-pressure setting where we get to practice problems, ask any questions, and discuss concepts and problem solving methods. Have fun! We suggest working on scratch paper and then neatly writing your solutions in the notebook where you keep chemistry class notes. This will be useful for you as you study for quizzes and exams and should be included in your portfolio.

1. Fill out the following chart for SI prefixes.

Prefix	Symbol	Meaning	Decimal	Exponential
Giga	G	Billion	1000000000	1×10^9
femto				
deci				
nano				
micro				
kilo				

2. How many significant figures are in each of the following measurements?

- a. 0.00429 mL b. 1508.00 m c. 39800 g

3. Order the following measurements from smallest to largest

- a. 12.03 kg, 30601.2 mg, 53201.1 g, 29050345663 ng

- b. 8.5×10^{-5} cm, 5.128×10^{-4} cm, 1.5×10^{-1} cm, 4.52×10^{-1} cm

4. Convert:

- a. .00000765 kilometers to millimeters

- b. 39,700 picograms to micrograms

- c. 0.0006948 km/hr to cm/ms

- d. 56.48 mg/cm^3 to ng/mm^3

5. 1 mole of atoms is approx. 6.022×10^{23} atoms.

- a. How many atoms are in 10 grams of potassium (atomic mass 39.10 g/mol)?

- b. What is the mass of 4.5 mol of Al (atomic mass 26.98)?

- c. If we had a mole of \$1 bills split evenly among the 7 billion people on earth, how many dollars would each person have?

6. $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$, solve for V_2

7. Solve the following

a. The density of canola oil is 0.920 g/mL. What is the mass of 58.4 mL of oil?

b. A clean, dry graduated cylinder has a mass of 159.62 g. The density of ethanol is 0.89 g/mL. If 47.0 mL of ethanol are placed in the cylinder, what will be the total mass of the cylinder and ethanol?

c. What is the value of a 92.53 kg nugget of gold if the market value of gold is \$921.51 per ounce? (1 ounce = 28.35 g).

d. A large ferry burns about 240 gallons of fuel per hour and cruises at 18 knots (1 knot = one nautical mile per hour). How many gallons of fuel will the ferry burn if it travels a distance of 98 nautical miles?

e. A children's pain relief medicine contains 80. mg acetaminophen per 0.50 teaspoon. The recommended dosage for a child who weighs between 24 and 35 lb is 1.5 teaspoons. What is the range of acetaminophen dosages, expressed in mg acetaminophen/kg body weight, for children who weigh between 24 and 35 lb?

8. Carbon monoxide (CO) detectors sound an alarm when peak levels of carbon monoxide reach 100 parts per million (ppm). This level roughly corresponds to a composition of air that contains 400,000 μg carbon monoxide per cubic meter of air. Assuming the dimensions of a room are 18 ft x 12 ft x 8 ft, estimate the mass of carbon monoxide in the room that would register 100 ppm on a carbon monoxide detector.

9. Ethylene glycol is the main component in automobile antifreeze. To monitor the temperature of an auto cooling system, you devise a new temperature scale based on the approximate melting and boiling points of a typical antifreeze solution (-45°C and 115°C). You wish these points to correspond to 0°A and 100°A , respectively.

a. Derive an expression for converting between $^{\circ}\text{A}$ and $^{\circ}\text{C}$ and for between $^{\circ}\text{F}$ and $^{\circ}\text{A}$

b. At what temperature would your thermometer and a Celsius thermometer give the same numerical reading?

c. Your thermometer reads 86°A . What is the temperature in $^{\circ}\text{C}$, $^{\circ}\text{F}$, and K?

d. What is 45°C in $^{\circ}\text{A}$?

10. Imagine you have traveled through time to help Dalton with some experiments. Consider the following data:

0.602 g gas A reacts with 0.292 g gas B

0.171 g gas B reacts with 0.401 g gas C

0.320 g gas A reacts with 0.374 g gas C

a. Assuming the simplest formulas (AB, BC, and AC), construct a table of relative masses.

b. Knowing some history of chemistry, you tell Dalton that if he determines the volumes of the gases reacted at constant temperature and pressure, then he doesn't need to assume simplest formulas.

Consider the data:

6 volumes gas A + 1 volume gas B \rightarrow 4 volumes product

1 volume gas B + 4 volumes gas C \rightarrow 4 volumes product

3 volumes gas A + 2 volumes gas C \rightarrow 6 volumes product

Write the simplest balanced equations, and find the actual relative masses of the elements. Explain your reasoning.