

1. State the number of significant figures in each of the following numbers.

a. 6.4157 m 5

b.  $4.57700 \times 10^{-5}$  s 6

c. 0.0003445 g 4

d. 0.0122 km 3

e. 15 books  $\infty$

2. Perform the following calculations (work in this problem need not be shown). **Give your answer with the correct number of significant figures.**

a.  $(14.5 \times 123) - 2.20 \times 10^1$   $1.76 \times 10^3$

b.  $(55.6 - 22.5) \times (12.3 \div 0.56)$   $7.3 \times 10^2$

c.  $1201 + 1.3 \times 10^3 + 1 \times 10^2$   $2.6 \times 10^3$

d.  $\frac{4(15.6)^3(3.1415)}{3}$  (4 and 3 are exact)  $1.59 \times 10^4$

e.  $2.334 \times 10^4 \div 5.668 \times 10^3$  4.118

3. Convert the following. **SHOW ALL WORK FOR FULL CREDIT.** (Conversion factors are on the last page.)

a. The volume of the Houston Astrodome is  $8.235 \times 10^8 \text{ ft}^3$ . What is this volume in L?

$$? \text{ L} = 8.235 \times 10^8 \text{ ft}^3 \times \left( \frac{12 \text{ in}}{1 \text{ ft}} \right)^3 \times \left( \frac{2.540 \text{ cm}}{1 \text{ in}} \right)^3 \times \frac{1 \text{ mL}}{1 \text{ cm}^3} \times \frac{10^{-3} \text{ L}}{1 \text{ mL}} = 2.332 \times 10^{10} \text{ L}$$

b. The temperature on the moon in daylight is about  $265 \text{ }^\circ\text{F}$ . What is this temperature in K?

$$(265 \text{ }^\circ\text{F} - 32 \text{ }^\circ\text{F}) \left( \frac{5 \text{ K}}{9 \text{ }^\circ\text{F}} \right) + 273.15 \text{ K} = 403 \text{ K}$$

c. The average sedan has a fuel capacity of 17 gal. What is the volume in mL?

$$? \text{ mL} = 17 \text{ gal} \times \frac{4 \text{ qt}}{1 \text{ gal}} \times \frac{0.9463 \text{ L}}{1 \text{ qt}} \times \frac{1 \text{ mL}}{10^{-3} \text{ L}} = 6.4 \times 10^4 \text{ mL}$$

d. A NASCAR race car travels around the track at 132.9 kilometers per hour. What is this speed in feet per second?

$$? \frac{\text{ft}}{\text{s}} = \frac{132.9 \text{ km}}{\text{h}} \times \frac{1 \text{ h}}{3600 \text{ s}} \times \frac{1 \text{ mi}}{1.609 \text{ km}} \times \frac{5280 \text{ ft}}{1 \text{ mi}} = 121.1 \text{ ft s}^{-1}$$

4. What is the density of a substance (in g/mL) if it has a mass of 1.367 lb. and a volume of 3.2 gal?

$$? \frac{\text{g}}{\text{mL}} = \frac{1.367 \text{ lb}}{3.2 \text{ gal}} \times \frac{1 \text{ gal}}{4 \text{ qt}} \times \frac{1 \text{ qt}}{0.9463 \text{ L}} \times \frac{10^{-3} \text{ L}}{1 \text{ mL}} \times \frac{453.6 \text{ g}}{1 \text{ lb}} = 0.051 \text{ g/mL}$$

5. A sample of a compound containing only C, H, and S was burned in oxygen, and 6.60 g of CO<sub>2</sub>, 5.41 g of H<sub>2</sub>O, and 9.61 g of SO<sub>2</sub> were obtained. What is the empirical formula of the compound?

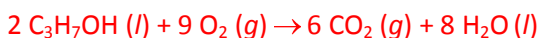
$$6.60 \text{ g CO}_2 \times \frac{1 \text{ mol CO}_2}{44.0098 \text{ g CO}_2} \times \frac{1 \text{ mol C}}{1 \text{ mol CO}_2} = 0.149965 \text{ mol C} / 0.149965 \text{ mol} = 1$$

$$5.41 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.0153 \text{ g H}_2\text{O}} \times \frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}} = 0.6006006 \text{ mol H} / 0.149965 \text{ mol} = 4$$

$$9.61 \text{ g SO}_2 \times \frac{1 \text{ mol SO}_2}{64.064 \text{ g SO}_2} \times \frac{1 \text{ mol S}}{1 \text{ mol SO}_2} = 0.15006 \text{ mol S} / 0.149965 \text{ mol} = 1$$

The empirical formula is CH<sub>4</sub>S.

6. Calculate the **mass of water produced** when 25.00 g of liquid butanol (C<sub>3</sub>H<sub>7</sub>OH) reacts with 70.00 g of oxygen gas. The products are gaseous carbon dioxide and liquid water. Include phase labels in your balanced chemical equation.

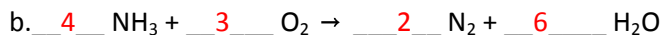


$$25.00 \text{ g C}_3\text{H}_7\text{OH} \times \frac{1 \text{ mol C}_3\text{H}_7\text{OH}}{60.0950 \text{ g C}_3\text{H}_7\text{OH}} \times \frac{8 \text{ mol H}_2\text{O}}{2 \text{ mol C}_3\text{H}_7\text{OH}} \times \frac{18.0153 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 29.98 \text{ g H}_2\text{O}$$

$$70.00 \text{ g O}_2 \times \frac{1 \text{ mol O}_2}{31.9988 \text{ g O}_2} \times \frac{8 \text{ mol H}_2\text{O}}{9 \text{ mol O}_2} \times \frac{18.0153 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 35.03 \text{ g H}_2\text{O}$$

29.98 g of water are produced.

7. **Balance** the following chemical equations:



8. 24.55 g of Barium Nitrate reacts with Cesium Phosphate to produce Cesium Nitrate and solid Barium Phosphate. Calculate the **mass of Barium Phosphate** produced if there is an 87.66 % yield.



$$24.55 \text{ g Ba}(\text{NO}_3)_2 \times \frac{1 \text{ mol Ba}(\text{NO}_3)_2}{261.35 \text{ g Ba}(\text{NO}_3)_2} \times \frac{1 \text{ mol Ba}_3(\text{PO}_4)_2}{3 \text{ mol Ba}(\text{NO}_3)_2} \times \frac{601.96 \text{ g Ba}_3(\text{PO}_4)_2}{1 \text{ mol Ba}_3(\text{PO}_4)_2} \\ \times \frac{87.66 \text{ g Ba}_3(\text{PO}_4)_2 \text{ actual}}{100 \text{ g Ba}_3(\text{PO}_4)_2 \text{ theoretical}} = 16.52 \text{ g Ba}_3(\text{PO}_4)_2$$

9. Calculate the following:

a. The number of oxygen atoms in 100.00 g of Iron(III) Oxalate.

$$100.00 \text{ g Fe}_2(\text{C}_2\text{O}_4)_3 \times \frac{1 \text{ mol Fe}_2(\text{C}_2\text{O}_4)_3}{375.747 \text{ g Fe}_2(\text{C}_2\text{O}_4)_3} \times \frac{12 \text{ mol O}}{1 \text{ mol Fe}_2(\text{C}_2\text{O}_4)_3} \times \frac{6.0221 \times 10^{23} \text{ at O}}{1 \text{ mol O}} \\ = 1.9232 \times 10^{24} \text{ atom of O}$$

c. Calculate the **number of atoms** in a cube of Aluminum that has an edge length of 5.00 cm and a density of 2.70 g mL<sup>-1</sup>. Volume of a cube = (edge length)<sup>3</sup>

$$(5.00 \text{ cm})^3 \times \frac{1 \text{ mL}}{1 \text{ cm}^3} \times \frac{2.70 \text{ g Al}}{1 \text{ mL}} \times \frac{1 \text{ mol Al}}{26.981538 \text{ g Al}} \times \frac{6.0221 \times 10^{23} \text{ at Al}}{1 \text{ mol Al}} = 7.53 \times 10^{24} \text{ at Al}$$

### Conversion Factors

$$1 \text{ qt} = 0.9463 \text{ L}$$

$$1.609 \text{ km} = 1 \text{ mi}$$

$$2 \text{ c} = 1 \text{ pt}$$

$$1 \text{ lb.} = 453.6 \text{ g}$$

$$2 \text{ pt} = 1 \text{ qt}$$

$$8 \text{ fl. oz.} = 1 \text{ c}$$

$$1 \text{ mi} = 5280 \text{ feet}$$

$$1 \text{ gal} = 4 \text{ qt}$$

$$8 \text{ furlongs} = 1 \text{ mi}$$