Dr. Zellmer | Chemistry 1210 | M, W, F
Time: due 11:59 PM Sat. | Autumn Semester 2022 | August 27, 2022
30 min | Pre-quiz

Name KEY Rec. TA/time _____

1. (2 pts) Which of the following must true before and after a chemical reaction?

a) The sum of the masses of the reactants equals the sum of the masses of the products.
b) The number of molecules of all substances involved does not change.
c) The number of atoms of each type involved remains the same.
d)* Both a) and c) must be true.
e) Each of a), b), and c) must be true.

In chemical reactions the number of each type of atom in the products equals the number of each type of atom in the reactants. Atoms are just rearranged in reactions. Thus, if there's 10 C atoms in the reactants there has to be 10 C atoms in the products. Since this is true, the masses of products has to equal the mass of the reactants. This is the Law of Conservation of Mass.

2. (2 pts) Write the number **620** in ***scientific notation***, with 2 significant figures:

a) 6.2×10^1
b)* 6.2×10^2
c) 6.2×10^3
d) 62×10^0
e) 62×10^2

In the number 620 the last zero should not be considered significant w/o any other information. Trailing zeros to the left of a decimal point are generally not considered significant. The proper way to take care of this is to use scientific notation.

3. (2 pts) What is $(5.00 \times 10^4) - (3.0 \times 10^2)$ expressed to the correct number of significant figures? **Show work!**

a) 5.00×10^4
b) 2.00×10^4
c)* 4.97×10^4
d) 5.0×10^4
e) 2.00×10^2

For addition and subtraction the number of sig. fig. in the answer can't have anymore decimal places than the number with the fewest decimal places. Another way to state this is, when adding or subtracting the last place in the answer is the last place common to the numbers being added or subtracted. To do this though the numbers must be the same power of 10.

$$\begin{array}{r} 5.00 \times 10^4 \\ -\ 0.03 \times 10^4 \\ \hline 4.97 \times 10^4 \end{array}$$

The last place common to both numbers is the 2nd decimal place so the answer is known to the 2nd decimal place.

4. (2 pts) Iron combines with oxygen and water from the air to form rust. If an iron nail were allowed to rust completely how does the weight of the rust compare to that of the nail? **Explain!**

a) less than the nail it came from.
b) the same as the nail it came from.
c)* more than the nail it came from.
d) It is impossible to predict.

This deals with the conservation of mass. The iron reacts with oxygen to form iron oxides (compounds of iron and oxygen). Since the iron is combining with oxygen the product (rust - iron oxides) has to weigh more than the original iron.

5. (2 pts) Given: $\mathbf{b = c^2 d}$ If c is doubled and d is unchanged, how does the value of b change? **Explain!**

a) b halves
b) b doubles (that is, it increases by a factor of 2)
c)* b quadruples (that is, it increases by a factor or 4)
d) b increases by a factor of 8
e) b decreases by a factor of 8

This is understanding how variables are related and what happens to one variable when another changes. This is math. Believe it or not, success in chemistry actually correlates better with one's math abilities than the chemistry they know coming into freshman chemistry.

Double "c" and "b" goes up 4 times.

$b_1 = c_1^2 * d$ where the subscripts "1" refer to initial conditions

Double "c", $c_2 = 2\ c_1$ where the subscripts "2" refer to final conditions

$$b_2 = c_2^2 * d = (2\ c_1)^2 * d = 4\ c_1^2 * d = 4\ b_1$$

6. (3 pts) The following is the balanced equation for the reaction of nitrogen gas with hydrogen gas to make ammonia (NH_3). How many moles of ammonia are formed if 4.50 moles of hydrogen gas reacts completely with an excess of nitrogen gas? **Show work!**

$$N_2\ (g) + 3\ H_2\ (g) \rightarrow 2\ NH_3\ (g)$$

a) 1.50
b) 2.00
c)* 3.00
d) 4.50
e) 6.75

$$? \text{ mol } NH_3 = 4.50 \text{ mol } H_2 \times \frac{2 \text{ mol } NH_3}{3 \text{ mol } H_2} = 3.00 \text{ mol } NH_3$$

7. (2 pts) Which is an INCORRECT formula for the compound named?

a) Sodium sulfate	Na_2SO_4	
b) Potassium chloride	KCl	
c) Ammonium sulfide	$(NH_4)_2S$	
d) Barium nitrate	$Ba(NO_3)_2$	
e)* Calcium oxide	Ca_2O	correct formula is CaO

You'll learn how to name compounds in ch 2. All of these are ionic compounds and their formulas represent the smallest whole number ratio of ions to balance positive and negative charges. Calcium has a charge of +2 in compounds and oxide has a charge of -2 in compounds. The formula should be CaO.

8. (3 pts) Given: $d = \frac{a*b}{c^2}$ Solve for c. **Show work!**

Multiply both sides by c^2:

$$c^2 * d = a * b$$

Divide both sides by "d":

$$c^2 = \frac{a * b}{d}$$

Take the squar root of both sides:

$$c = \{ (a * b) / d \}^{1/2}$$

9. (5 pts) The average speed of a nitrogen molecule in air at 25 °C is 322 m/s. Convert this speed to miles per hour. Recall that 1 hr = 60 min, 1 mi = 1.6093 km, 1 km = 10^3 m, 1 min = 60 s. (Hint: do the series of calculations in one line, i.e. one single setup.) **Show all work!**

$$? \ \frac{\text{mi}}{\text{hr}} = \frac{322 \text{ m}}{\text{s}} \times \frac{1 \text{ km}}{10^3 \text{ m}} \times \frac{1 \text{ mi}}{1.6093 \text{ km}} \times \frac{60 \text{ s}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} = 720.31 \text{ mi/hr} = 7.20 \times 10^2 \text{ mi/hr}$$

I solved this using dimensional analysis, one single setup. This is better than using ratios in several steps. You're ultimately less likely to make a mistake. I also used significant figures. The 322 m has 3 sig. fig. The 60 s/1min, 60 min/1 hr and 1 km/10^3 m are exact by definition and thus don't affect the number of s.f. in the final answer. The 1 mi = 1.6093 km is not exact. However, the 1.6093 has 5 s.f. This means the final answer should have 3 s.f. based on the 3 s.f. in the 322 m and the multiplication rules for s.f. Do NOT report the number as 720 (this implies the last zero is not significant). Also, do NOT add a decimal as in 720. That is technically not correct (did the period mean the zero is sig. or does it indicate the period at the end of the sentence). You should use scientific notation in these cases.

10. (6 pts) Balance the following ***unbalanced*** equation (careful!) and use the result to determine the number of water molecules resulting from the complete reaction of 1.00 mole of N_2O_4 with excess N_2H_4. Recall that Avogadro's number is 6.02 x 10^{23}. **Show all work!**

$N_2H_4 + N_2O_4 \rightarrow H_2O + N_2$

$N_2H_4 + N_2O_4 \rightarrow 4\ H_2O + N_2$ (Balance O atoms)

$2\ N_2H_4 + N_2O_4 \rightarrow 4\ H_2O + N_2$ (Balance H atoms next)

$2\ N_2H_4 + N_2O_4 \rightarrow 4\ H_2O + 3\ N_2$ (Balance the N atoms) - balanced eqn

$$? \text{ mol } H_2O = 1 \text{ mol } N_2O_4 \times \frac{4 \text{ mol } H_2O}{1 \text{ mole } N_2O_4} \times \frac{6.02 \times 10^{23} \ H_2O \text{ molecules}}{1 \text{ mol } H_2O}$$

$= 2.4\underline{0}8 \times 10^{24}$ H_2O molecules

$= 2.41 \times 10^{24}$ H_2O molecules

(3 s.f. because of the 3 s.f. in 6.02 x 10^{23})