Name _____Key_____ Per _____

1. What is the correct description of this reaction: $Cu_{(s)} + 2HCl_{(aq)} \rightarrow CuCl_{2(aq)} + H_{2(g)}$

    a. Hydrogen gas reacts with a solution of copper chloride to produce solid copper metal in a solution of hydrochloric acid.
    b. A solution of copper metal reacts with solid hydrochloric acid to produce a solution of copper chloride and hydrogen gas.
    c. Hydrogen gas reacts with solid copper chloride to produce solid copper metal in a solution of hydrochloric acid.
    d. Solid copper reacts with a solution of hydrochloric acid to produce a solution of copper chloride and hydrogen gas.

2. Which of these chemical equations correctly represents the reaction: solid copper metal, Cu, reacts with a solution of silver nitrate, AgNO3, to produce a solution of copper nitrate, Cu(NO3)2, and silver metal, Ag?

    a. $2Ag(s) + Cu(NO_3)_2(l) \rightarrow 2AgNO_3(l) + Cu(s)$
    b. $2Ag(s) + Cu(NO_3)_2(aq) \rightarrow 2AgNO_3(aq) + Cu(s)$
    c. $2AgNO_3(l) + Cu(s) \rightarrow 2Ag(s) + Cu(NO_3)_2(l)$
    d. $2AgNO_3(aq) + Cu(s) \rightarrow 2Ag(s) + Cu(NO_3)_2(aq)$

3. Which of these chemical reactions would not produce a <u>visual</u> change?

    a. $2H_2(g) + O_2(g) \rightarrow H_2O(l)$
    b. $2Li(s) + 2H_2O(l) \rightarrow 2LiOH(s) + H_2(g)$
    c. $Cu(NO_3)_2(aq) + Zn(s) \rightarrow Cu(s) + Zn(NO_3)_2 (aq)$
    d. $N_2(g) + H_2(g) \rightarrow N_2H_4(g)$

4. What would you expect to see if you performed this chemical reaction? $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

    a. solid precipitate forming in   b liquid b. no detectable change
    c. bubbles forming in a liquid   d. color change in a liquid

5. Which information can you determine about a chemical reaction from a balanced chemical equation?

    a. color of the products   b. how fast the reaction occurs
    c. how much energy is released as heat   d. formation of a solid precipitate

6. $H_2O(s) \rightarrow H_2O(g)$ is an example of _____.

    a. a combination reaction   b. a decomposition reaction
    c. a physical change   d. a chemical change

7. Which term correctly describes the interaction shown by the equation?
         $Cu(NO_3)_2(aq) + 2KI(aq) \rightarrow CuI_2(s) + 2KNO_3(aq)$

    a. a combination reaction   b. a decomposition reaction
    c. a chemical change   d. a physical change
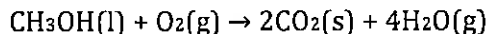
8. Does the chemical equation below demonstrate the law of conservation of mass?
$$CH_3OH(l) + O_2(g) \rightarrow 2CO_2(s) + 4H_2O(g)$$
  a. No, because the products are a different phase than the reactants.
  b. Yes, because the elements are the same on either side of the arrow.
  c. No, because there are a different number of atoms of each element in reactants and products.
  d. Yes, because there are the same number of molecules of reactants and products.
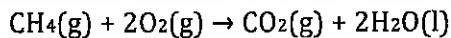
9. Does the chemical equation below demonstrate the law of conservation of mass?
$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$
  a. Yes, because there are the same number of molecules of reactants and products.
  b. Yes, because there are the same number of atoms of each element in reactants and products.
  c. No, because one of the products is a liquid, not a gas.
  d. No, because there are different compounds on the two sides of the arrow.

10. In which of the following reactions will the measured mass of the reactants be greater than the mass of the products because some matter has escaped the container? Assume the reactions occur in open containers.
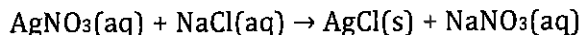 a. $NaCl(s) \rightarrow NaCl(aq)$
  b. $Na_2CO_3(aq) + CaCl_2(aq) \rightarrow 2NaCl(aq) + CaCO_3(s)$
  c. $Na_2CO_3(aq) + 2C_2H_4O_2(aq) \rightarrow 2NaC_2H_3O(aq) + H_2O(l) + CO_2(g)$
  d. $AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$

11. Suppose you mixed solid calcium metal, Ca with hydrochloric acid, HCl(aq) in an open container. If the mass of the reactants were measured and then the mass of the products in the container were measured after the reaction has completed, what would be the result?
$$Ca(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2(g)$$
  a. The mass will stay the same.
  b. The mass will increase.
  c. The mass will decrease.
  d. There is not enough information to answer the question.

12. Suppose you mix solutions of silver nitrate, $AgNO_3$, with sodium chloride, NaCl, in an open container. How does the mass of the reactants compare to the mass of the products in the container after the reaction is complete?
$$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$
  a. The mass will stay the same.
  b. The mass will increase.
  c. The mass will decrease.
 d. There is not enough information to answer the question.

13. When water boils to create steam, which of these quantities will change?
  a. the number of atoms   b. its mass
  c. its volume   d. all of the above

14. Which chemical equation is correctly balanced?
  a. $Al(OH)_3(s) \rightarrow Al_2O_3(s) + 2H_2O(g)$
  b. $KI(aq) + Pb(NO_3)_2(aq) \rightarrow KNO_3(aq) + 4PbI_2(aq)$
  c. $2Na_3PO_4(aq) + 3CaCl_2(aq) \rightarrow 6NaCl(aq) + Ca_3(PO_4)_2(aq)$
  d. $C_5H_{12}(l) + 6O_2(g) \rightarrow 5CO_2(g) + 6H_2O(g)$

15. When the chemical equation below is correctly balanced, what coefficient is placed in front of water?

$$2 \, C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(g)$$
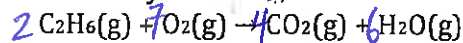
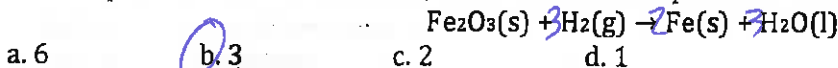   a. 3   b. 4   (c.) 6   d. 12

16. To balance a chemical equation, you can change _____.
   (a.) the coefficients   b. the number of reactants
   c. chemical formulas   d. the subscripts and the coefficients

17. When the equation below is balanced, what coefficient is placed in front of H_2?

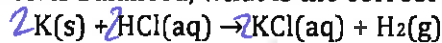$$Fe_2O_3(s) + 3H_2(g) \rightarrow 2Fe(s) + 3H_2O(l)$$

   a. 6   (b.) 3   c. 2   d. 1

18. According to the balanced equation, how many atoms of Cu are required to produce 10 atoms *(moles)* of Ag?

$$Cu(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Cu(NO_3)_2(aq)$$
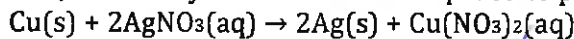
   a. 1 atom   (b.) 5 atoms   c. 10 atoms   d. 20 atoms

19. When the following chemical equation is balanced, what is the correct order of coefficients?
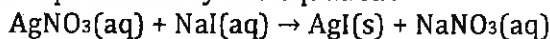
$$2K(s) + 2HCl(aq) \rightarrow 2KCl(aq) + H_2(g)$$

   (a.) 2, 2, 2, 1   b. 1, 2, 1, 1   c. 3, 3, 3, 1   d. 1, 6, 1, 3

20. Which equation below indicates a single exchange reaction?
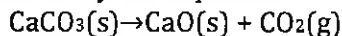   a. $Hg(NO_3)_2(s) + H_2O(l) \rightarrow Hg(NO_3)_2(aq)$
   b. $H_2O(g) \rightarrow H_2O(l)$
   c. $KCl(aq) + AgNO_3(aq) \rightarrow KNO_3(aq) + AgCl(s)$
   (d.) $2K(s) + 2HCl(aq) \rightarrow 2KCl(aq) + H_2(g)$

21. What type of chemical reaction is represented by this equation?

$$AgNO_3(aq) + NaI(aq) \rightarrow AgI(s) + NaNO_3(aq)$$

   a. decomposition   (b.) double replacement   c. synthesis   d. single replacement

22. What type of chemical reaction is represented by this equation?

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

   (a.) decomposition   b. synthesis   c. double replacement   d. single replacement

23. Which equation below indicates a combination reaction?
   a. $NaCl(aq) + AgNO_3(aq) \rightarrow NaNO_3(aq) + AgCl(s)$
   b. $2Na(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2(g)$
   (c.) $2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$
   d. $H_2O(g) \rightarrow H_2O(l)$

24. How many grams of sodium chloride ($LD_{50} = 3.00$ g/kg) would be lethal to a 154-pound person? (2.2lb = 1 kg)
   a. 5.80 g   b. 12.8 g   (c.) 210 g   d. 1850 g

$$154 \, lb \left(\frac{1 \, kg}{2.2 \, lb} \right) = 70 \, kg$$

$$\frac{3.00}{1 \, kg} = \frac{210}{70}$$

25. The LD_{50} for aspirin is 200 mg/kg. How many 250-mg aspirin tablets would a 175-pound person need to consume to get a lethal dose? (1 kg = 2.2 lb)
   a. 50   (b.) 64   c. 241   d. 280

$$175 \, lb \left(\frac{1 \, kg}{2.2} \right) = 80$$

$$\frac{200 \, mg}{1 \, kg} = \frac{16000}{80}$$

$$\frac{16000}{250} = 64$$

26. Which substance is the least toxic?
   a. table salt (LD_{50} = 3000 mg/kg)   b. aspirin (LD_{50} = 200 mg/kg)
   c. cola (LD_{50} = 127 mg/kg)   d. vitamin A (LD_{50} = 1510 mg/kg)

27. Which number is equivalent to 2.4×10^{-5}?
   a. 0.000024   b. 0.0000024   c. 240,000   d. 2,400,000

28. Which number is equivalent to 7.3×10^4?
   a. 0.00073   b. 0.000073   c. 73,000   d. 730,000

29. If you have 1 mol of aluminum, 1 mol of iron, 1 mol of zinc, and 1 mol of tin, which has the most mass?
   26.98   *55.85*   *65-38*   *118*
   a. aluminum   b. iron   c. zinc   d. tin

30. Which element has a molar mass of 19 g/mole?
   a. nitrogen   b. potassium   c. fluorine   d. neon

31. Which contains the least atoms: 10 g of copper, 10 g of gold, 10 g of platinum, or 10 g of silver?
   157   *.0507*   *.051*   *.09*
   a. copper   b. gold   c. platinum   d. silver

32. Which is more toxic?
   a. 1 mol of mercury   b. 2 mol of mercury   c. 100 g of mercury   d. 500 g of mercury
   200.59   *<1*   *>1*   *2.49 mol*

33. Which has the greatest number of moles?
   a. 5 g of NaCl *.085*   b. 5 g of KCl *.067*   c. 5 g of HCl *.137*   d. 5 g of $CaCl_2$ *.045*

34. Which has the greatest mass?
   a. 2 mol of NaCl   b. 2 mol of KCl   c. 2 mol of HCl   d. 2 mol of $CaCl_2$
   116.8   *149.1*   *72.91*   *221*

35. Which of these has the least chlorine atoms?
   a. 20 g of NaCl   b. 20 g of KCl   c. 20 g of RbCl   d. 20 g of CsCl

36. What is the molar mass of aluminum carbonate, $Al_2(CO_3)_3$, to the nearest gram per mole?
   a. 97 g/mol   b. 114 g/mol   c. 207 g/mol   d. 234 g/mol

37. Calculate the molar mass of ammonium phosphate $(NH_4)_3PO_4$.
   a. 149 g/mol   b. 113 g/mol   c. 242 g/mol   d. 121 g/mol

38. Cyanide, CN^-, is a toxin. Which is the most toxic?
   a. 5 g of NaCN   b. 5 g of KCN   c. 5 g of $KAu(CN)_2$ d. 5 g of $Mg(CN)_2$

39. How can you convert the mass of a substance to moles?
   a. Divide the mass of the substance in grams by its molar mass.
   b. Divide the molar mass of the substance by the mass of the substance in grams.
   c. Multiply the molar mass of the substance by the mass of the substance in grams.
   d. Multiply the mass of the substance in grams by its molar mass.

$$g\left(\frac{1\,mole}{g}\right)$$

40. A can of cola contains about 39 grams of sucrose, $C_{12}H_{22}O_{11}$. How many moles of sucrose does this represent?
   a. 0.11 mol of sucrose   b. 8.8 mol of sucrose   c. 340 mol of sucrose   d. 13,000 mol of sucrose

$$39g\left(\frac{1\,mol}{342.296\,g}\right) = .1139$$

PCl_3

38. How many phosphorus trichloride molecules are there in an 80.0 gram sample?

   a. 0.085 mol   b. 0.583 mol   c. 1.72 mol   d. 137.5 mol

$$80.0g \left(\frac{1 mol}{137.32g} \right) = 0.58$$

39. How many moles of potassium iodide, KCl, are there in 50. grams?

   a. 0.67 mol   b. 1.49 mol   c. 2.35 mol   d. 74.6 mol

$$50g \left(\frac{1 mol}{74.55 g} \right) = 0.67$$

40. How many grams of aluminum are contained in 100.0 g of aluminum chloride, $AlCl_3$?

   a. 18.6 g   b. 20.2 g   c. 25.0 g   d. 41.5 g

$$100g \left(\frac{1 mol}{133.33g} \right) = 0.$$

41. Nitric acid is formed by the reaction of nitrogen dioxide with water. How many moles of water are needed to react completely with 8.4 mol of nitrogen dioxide?
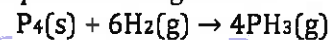
$$3NO_2(g) + H_2O(l) \rightarrow NO(g) + 2HNO_3(aq)$$

   a. 2.8   b. 3.0   c. 8.4   d. 25 $\frac{3}{1} = \frac{8.4}{x}$
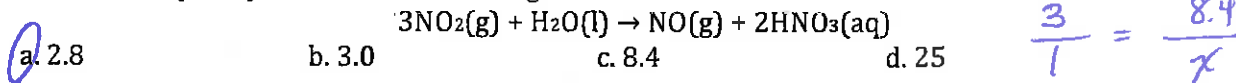
42. How many moles of Na would you need to produce 4 mol of NaCl?

$$2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$$

   a. 1   b. 2   c. 4   d. 8
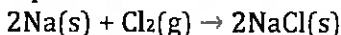
43. According to this balanced equation, how many moles of bromine are required to produce 30 mol of aluminum bromide?
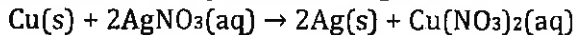
$$2Al(s) + 3Br_2(g) \rightarrow 2AlBr_3(s)$$

   a. 20 mol   b. 30 mol   c. 45 mol   d. 60 mol $\frac{3}{2} = \frac{x}{30}$
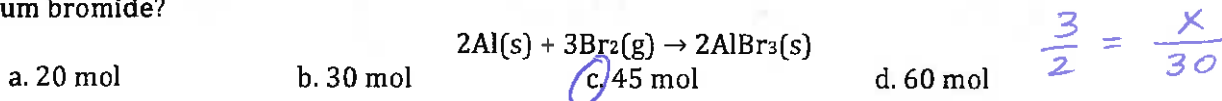
44. How many moles of P_4 would you need to produce 34 g of PH_3?

$$P_4(s) + 6H_2(g) \rightarrow 4PH_3(g)$$

   a. 0.25 mol   b. 0.50 mol   c. 1.0 mol   d. 4.0 mol $34g \left(\frac{1 mol}{33.99g} \right) = 1$
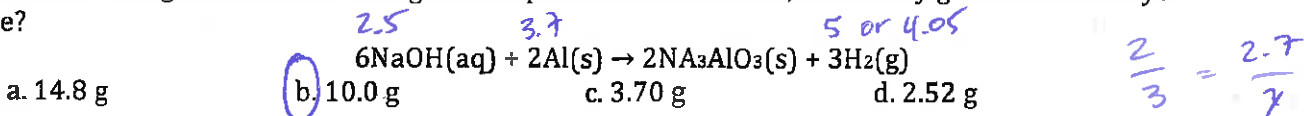
45. How many grams of copper would you need to produce 90.0 g of silver?

$$Cu(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Cu(NO_3)_2(aq)$$

   a. 26.5 g   b. 106 g   c. 180 g   d. 45.0 g

Hard
*

46. If you have 100. g of NaOH and 100. g of Al to perform the reaction, how many grams of H_2 will you produce?

                       2.5   3.7   5 or 4.05

$$6NaOH(aq) + 2Al(s) \rightarrow 2NA_3AlO_3(s) + 3H_2(g)$$

   a. 14.8 g   b. 10.0 g   c. 3.70 g   d. 2.52 g $\frac{2}{3} = \frac{2.7}{x}$

Hard
*

47. If you have 125 g of $AlCl_3$ and 65.0 g of NaOH in solution to perform the reaction, how many grams of aluminum hydroxide will you produce?

$$AlCl_3(aq) + 3NaOH(aq) \rightarrow Al(OH)_3(s) + 3NaCl(aq)$$

   a. 23.1g   b. 42.3 g   c. 127 g   d. 361 g
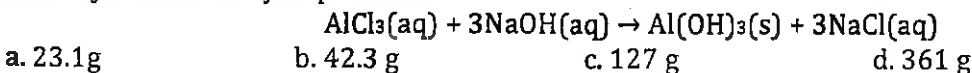
48. Find how many molecules are in 3.56 moles of MgO.

$$3.56 \text{ mol} \left(\frac{6.02 \times 10^{23}}{1 \text{ mol}} \right) = 2.143 \times 10^{24}$$

49. How many grams are in 2.98 moles of NaCl?

$$2.98 \text{ mol} \left(\frac{58.44 \text{ g}}{1 \text{ mol}} \right) = 174.15 \text{ g NaCl}$$

Using the following lab data, answer the following questions:

Mass of empty test tube (g)	31.822
Mass of test tube and baking soda ($NaHCO_3$) (g)	32.933
Mass of test tube and sodium carbonate (Na_2CO_3) (g)	32.308

50. How much baking soda was originally heated? (show work)

$$32.933 - 31.822 = 1.111 \text{ g } NaHCO_3$$

51. Complete and balance the reaction:

$$2 \, NaHCO_3 \text{ (s)} \rightarrow \underline{\quad CO_2 \quad}_{(g)} + \underline{\quad H_2O \quad}_{(g)} + \underline{\quad Na_2CO_3 \quad}_{(s)}$$

52. Using the value in #50, how much sodium carbonate should you be able to produce in this reaction if it all reacted perfectly with no error? (there are 3 steps to this problem)

a.
$$1.111 \text{ g } NaHCO_3 \left(\frac{1 \text{ mol } NaHCO_3}{84.0 \text{ g}} \right) = 0.013 \frac{\text{mol}}{NaHCO_3}$$

b.
$$0.013 \frac{\text{mol}}{NaHCO_3} \left(\frac{1 \text{ mol } Na_2CO_3}{2 \text{ mol } NaHCO_3} \right) = 0.0066 \frac{\text{mol}}{Na_2CO_3}$$

c.
$$0.0066 \frac{\text{mol}}{Na_2CO_3} \left(\frac{105.998 \text{ g}}{1 \text{ mol } Na_2CO_3} \right) = 0.70 \text{ g } Na_2CO_3$$

53. How much sodium carbonate did you make in the experiment? (use data to find this answer)

$$32.308 \text{ g} - 31.822 \text{ g} = 0.486 \text{ g } Na_2CO_3$$

54. Compare your answers to #52 and #53. Did you make the amount you expected to be able to make?

No

55. If the values are exactly the same, suggest a reason why they are different.