1. What conservation law is stoichiometry based upon – conservation of mass or conservation of energy?
2. Is the mass of the products greater than, less than, or equal to the mass of the reactants?
3. What is conserved in a chemical reaction – mass, molecules, moles, liters, or atoms?
4. Balance the equation and write the mole ratio of CH₄ to O₂: \( \text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} \)
5. How many moles of carbon dioxide is produced when 4.56 mol of propane (C₃H₈) is burned in excess of oxygen?
6. \( \text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O} \)
7. How many grams of water are produced when 8.93 mol of oxygen reacts with hydrogen?
8. \( 2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O} \)
9. What is the mass of potassium chloride when 2.34 g of potassium reacts with excess chlorine gas?
10. \( 2\text{K} + \text{Cl}_2 \rightarrow 2\text{KCl} \)
11. What is the maximum number of grams of \( \text{PH}_3 \) that can be formed when 3.5 g of phosphorus (\( \text{P}_4 \)) reacts with 2.0 g of hydrogen to form \( \text{PH}_3 \)?
12. \( \text{P}_4(g) + 6\text{H}_2(g) \rightarrow 4\text{PH}_3(g) \)
13. Why is a gas easier to compress than a liquid?
14. Why does the pressure inside a container of gas increase if more gas is added to the container?
15. If the volume of a container of gas is reduced, what will happen to the pressure inside the container?
16. How does the Kelvin temperature of an enclosed gas doubles, what happens to the particles of the gas?
17. The volume of a gas is doubled while the temperature is held constant. How does the gas pressure change?
18. If a balloon is heated, what happens to the pressure if the volume remains constant?
19. A sample of gas occupies 35.0 mL at 45.0°C. What volume does the sample occupy at 95.0°C?
20. Convert the pressure 1.35 atm to mm Hg.
21. When using the gas laws – Boyle’s Law, Charles’s Law, Gay-Lussac Law, and the Combined Gas Law is temperature in Kelvin or degrees Celsius?
22. A 765 mL sample of gas is collected at 765. mm Hg. If the temperature remains constant and the pressure falls to 124. mm Hg, what is the new volume?
23. The pressure of a sample of gas at a constant volume is 3.00 atm at 50.0°C. What is the pressure at 95.0°C?
24. The volume of a sample of oxygen is 250.0 mL when the pressure is 3.4 atm and the temperature is 37.0°C. At what temperature is the volume 2.50L and the pressure 0.750 atm?
25. What is standard temperature and pressure (STP) in kPa and °C?
26. At what temperature does the motion of particles theoretically cease?
27. What makes a substance dissolve faster in a solvent?
28. What is the maximum amount of KCl that can dissolve in 300 g of water? The solubility of KCl is 24 g/ 100 g of H₂O?
29. What is the solubility of silver nitrate in 100. grams of water if only 15.1 g can dissolve in 5.0 g of water?
30. What factors affect the solubility of a particular substance?
31. What is the molarity of a solution that contains 5 moles of solute in 2 liters of solution?
32. What is the molarity of 200. mL of solution in which 3.0 moles of sodium bromide is dissolved?
33. What is the number of moles of solute in 350 mL of 0.3 M solution?
34. What mass of sucrose, C₁₂H₂₂O₁₁ is needed to make 600. mL of a 0.200M solution?
35. If 2.0 mL of 6.0M HCl is used to make a 600.0 mL solution, what is the molarity of the dilute solution?
36. If the percent by volume is 3.0% and the volume of solution is 300.0 mL, what is the volume of solute in solution?
37. What is the percent by mass formula?
38. How many milliliters of alcohol are in 177 mL of a 75.0% (v/v) alcohol solution?
39. What is the percent by volume formula?
40. What is the formula for mole fraction?
41. Which is bigger a calorie or a Joule?
42. What would likely happen if you were to touch the flask in which an endothermic reaction was occurring?
43. If heat is released by a chemical system, what will happen to the surroundings?
44. How many joules are in 248 calories?
45. What is the amount of heat required to raise the temperature of 200.0 g of aluminum by 15°C (specific heat of aluminum = 0.21 cal/g°C)?

46. When 55 g of an alloy at 35°C is dropped into 150.0 g of water, the alloy absorbs 1056 J of heat. If the final temperature of the alloy is 47°C, what is the specific heat of the alloy?

47. What does the symbol ΔH stand for?

48. What is the standard heat of reaction for the following reaction? Is this reaction endothermic or exothermic?

\[ \text{Zn} + \text{Cu}^2+ \rightarrow \text{Zn}^{2+} + \text{Cu} \]
\[ \Delta H_{\text{r}} \text{for Cu}^2+ = 64.4 \text{ kJ/mol}; \Delta H_{\text{r}} \text{ for Zn}^{2+} = -152.4 \text{ kJ/mol} \]

49. What expresses a reaction rate?

50. At what stage of a reaction do atoms have the highest energy?

51. What is activation energy?

52. Why does a higher temperature cause a reaction to go faster?

53. Why does a higher concentration make a reaction faster?

54. Why does a catalyst cause a reaction to proceed faster?

55. What happens to a catalyst in a reaction?

56. Identify the parts of the exothermic graph on the right hand side of the page.

57. In the reaction \( \text{N}_2(g) + 3\text{H}_2(g) \rightleftharpoons 2\text{NH}_3(g) \). What effect does decreasing the volume on the contained gases?

58. What happens to a reaction at equilibrium when more reactant is added to the system?

59. What is the effect of adding more water to the following equilibrium reaction?

\[ \text{CO}_2(g) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_2\text{CO}_3(aq) \]

60. What is the equilibrium constant, \( K_{eq} \) expression for the following reaction?

\[ \text{C}_2\text{H}_5(g) + 5\text{O}_2(g) \rightleftharpoons 3\text{CO}_2(g) + 4\text{H}_2\text{O}(g) \]

61. If a reaction has an equilibrium constant just greater than 1, what type of reaction is it?

62. If the equilibrium constant is large are the products or reactants favored?

63. When an acid reacts with a base, what compounds are formed? This is a neutralization reaction.

64. What are the properties of an acid?

65. What are the properties of a base?

66. What is an acid according the Arrhenius?

67. What is a base according to Arrhenius?

68. What is a Bronsted-Lowry acid and base?

69. If the hydrogen ion concentration is \( 10^{-13} \), is the solution acidic, alkaline, or neutral?

70. What is the hydrogen ion concentration of a neutral solution?

71. What is the hydroxide ion concentration if the pH is 7.56?

72. What is the pH if the hydrogen ion concentration is \( 5.67 \times 10^{-6} \) ?

73. What characterizes a strong acid or base?

74. Would a substance with a \( K_a = 1 \times 10^{-5} \) be a strong or weak acid?

75. In titration, when the number of moles of hydrogen ions equals the number of moles of hydroxide ions, what is said to have happened?

76. In a titration 35.0 mL of 0.225 M Ba(OH)_2 solution is added to a 15.0 mL sample of HCl solution of unknown concentration. What is the molarity of the acid solution?

77. What type of reaction is involved in titration?

78. Define oxidation-reduction reactions.

79. Identify the oxidation numbers for each element in Cu(NO_3)_2.

80. If an atom is reduced in a redox reaction, what must happen to another atom in the system?

81. In which type of reaction are electrons gained?

82. What is oxidation?

83. What is reduction?

84. In the following unbalanced reaction, which atom is oxidized?

\[ \text{HNO}_3 + \text{HBr} \rightarrow \text{NO} + \text{Br}_2 + \text{H}_2\text{O} \]

85. Which element increases its oxidation number in the following reaction?

\[ 2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2 \]
1. Law of conservation of mass
2. The mass of the reactants is **equal** to the mass of the products.
3. Mass and atoms
4. \( \text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} \); mole ratio 1 mol \( \text{CH}_4 \) / 2 mol \( \text{O}_2 \)
5. 13.7 mol \( \text{CO}_2 \)
6. 322 grams \( \text{H}_2\text{O} \)
7. 4.46 grams \( \text{KCl} \)
8. 1.30 moles of \( \text{H}_3\text{PO}_4 \)
9. 3.84 g \( \text{PH}_3 \)
10. The volume of the gas's molecules is small compared to the overall volume of the gas
11. There is an increase in the number of collisions between particles and the walls of the container.
12. Pressure will increase
13. Temperature will increase
14. The kinetic energy decreases
15. Pressure decreases
16. The particles speed up
17. The pressure is halved.
18. The pressure increases
19. 40.5 mL
20. 1030 mmHg
21. Kelvin
22. 4720 mL
23. 3.42 atm
24. 683 K or 411°C
25. 101.3 kPa and 0°C
26. 0 Kelvin or -273°C
27. Agitating the solution, increasing the surface area, increasing temperature
28. 72 grams
29. 302 grams
30. Temperature and the nature of solvent and solute
31. 2.5 M
32. 15 M
33. 0.1 moles
34. 41.1 grams
35. 0.020 M
36. 9.0 mL
37. (Mass of solute / mass of solution) x 100
38. 133 mL
39. (Volume of solute / volume of solution) x 100
40. number of moles of solute / (number of moles of solute + number of moles of solvent)
41. a calorie is larger than a joule
42. flask would feel cool
43. the heat is absorbed by the surroundings
44. 1040 Joules
45. 630 calories
46. 1.6 J/°C
47. Heat of reaction
48. -217 kJ
49. Δ concentration/Δ time
50. Transition state stage
51. The minimum amount of energy required for a reaction to take place.
52. There are more collisions and more molecules have sufficient energy at a higher temperature
53. There are more collisions only.
54. A catalyst lowers the activation energy
55. The catalyst remains unchanged in a reaction.
56. A Reactant, B. Heat of reaction, C. Activation Energy, D. Activated complex, E. Products
57. Shifts right, more products will be formed
58. More product will be formed
59. Shifts right producing more product
60. [CO₂][H₂O]⁴⁺ / [C₃H₈][O₂]⁻⁵
61. The reaction favors the products
62. The products are favored
63. Salt and water
64. Sour taste, turns blue litmus paper pink, electrolyte
65. Bitter taste, turns pink litmus paper blue, electrolyte
66. An acid produces hydrogen ions in solution
67. A base produces hydroxide ions in solution
68. A Bronsted-Lowry acid is a hydrogen ion donor. A Bronsted Lowry base is a hydrogen ion acceptor.
69. Alkaline
70. Equal to the hydroxide ion concentration (1 x 10⁻⁷)
71. 2.75 x 10⁸
72. pH = 5.25
73. A strong acid and base completely ionize in solution and have a large Ka or Kb
74. Weak acid
75. Reached the equivalence point
76. 1.05 M
77. Neutralization
78. Oxidation reduction reactions are when electrons are transferred.
79. Cu = +1, N = +5, O = -2
80. Another atom is oxidized
81. Reduction reaction
82. A loss of electrons
83. A gain of electrons
84. Br
85. Na
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5. \( \frac{4.56 \text{ mol C}_3\text{H}_8}{1 \text{ mol C}_3\text{H}_8} \times \frac{3 \text{ mol CO}_2}{1 \text{ mol CO}_2} \approx 13.7 \text{ g CO}_2 \)

2 \( \text{H}_2 \) + 1 \( \text{O}_2 \) \( \rightarrow \) 2 \( \text{H}_2\text{O} \)

6. \( \frac{8.93 \text{ mol O}_2}{1 \text{ mol O}_2} \times \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol H}_2\text{O}} \approx 322 \text{ g H}_2\text{O} \)

2 \( \text{K} \) + 1 \( \text{Cl}_2 \) \( \rightarrow \) 2 \( \text{KCl} \)

7. \( \frac{2.34 \text{ g K}}{1 \text{ mol K}} \times \frac{2 \text{ mol KCl}}{39.10 \text{ g K}} \times \frac{74.55 \text{ g KCl}}{2 \text{ mol KCl}} = 4.46 \text{ g KCl} \)

8. \( \frac{92.0 \text{ g P}_4\text{O}_{10}}{1 \text{ mol P}_4\text{O}_{10}} \times \frac{4 \text{ mol H}_3\text{PO}_4}{1398.80 \text{ g P}_4\text{O}_{10}} \approx 0.263 \text{ mol H}_3\text{PO}_4 \)

9. \( \frac{3.5 \text{ g P}_4}{1 \text{ mol P}_4} \times \frac{4 \text{ mol PH}_3}{123.88 \text{ g P}_4} \times \frac{34.00 \text{ g PH}_3}{1 \text{ mol PH}_3} = 3.8 \text{ g PH}_3 \)

\( \text{P}_4 \) + 6 \( \text{H}_2 \) \( \rightarrow \) 4 \( \text{PH}_3 \)

\( \frac{2.0 \text{ g H}_2}{1 \text{ mol H}_2} \times \frac{4 \text{ mol PH}_3}{2.02 \text{ g H}_2} \times \frac{34.00 \text{ g PH}_3}{1 \text{ mol PH}_3} = 2.2 \text{ g PH}_3 \)

The max grams of PH\(_3\) that can be formed is 3.8 g PH\(_3\)

19. \( \frac{V_1}{T_1} = \frac{V_2}{T_2} \)

\( T_1 = 45.0^\circ \text{C} + 273 = 318 \text{ K} \)

\( T_2 = 95.0^\circ \text{C} + 273 = 368 \text{ K} \)

\( \frac{35.0 \text{ mL}}{318 \text{ K}} = \frac{V_2}{368 \text{ K}} \)

\( 40.5 \text{ mL} = V_2 \)
20. \[ \frac{1.35 \text{ atm}}{1 \text{ atm}} \times 760 \text{ mm Hg} = 1030 \text{ mm Hg} \]

22. \[ V_1 = 765 \text{ mL} \quad V_2 = ? \quad P_1 V_1 = P_2 V_2 \]
\[ P_1 = 765 \text{ mm Hg} \quad P_2 = 124 \text{ mm Hg} \]
\[ (765 \text{ mm Hg})(765 \text{ mL}) = (124 \text{ mm Hg})V_2 \]
\[ 4720 \text{ mL} \approx V_2 \]

23. \[ P_1 = 3.00 \text{ atm} \quad P_2 = ? \]
\[ T_1 = 50.0 \degree \text{ C} \quad T_2 = 95.0 \degree \text{ C} \]
\[ = 323 \text{ K} \quad = 368 \text{ K} \]
\[ \frac{P_1}{T_1} = \frac{P_2}{T_2} \]
\[ \frac{3.00 \text{ atm}}{323 \text{ K}} = \frac{P_2}{368 \text{ K}} \]
\[ 3.42 \text{ atm} \approx P_2 \]

24. \[ V_1 = 250.0 \text{ mL} \quad V_2 = 2.50 \text{ L} \quad P_1 V_1 = P_2 V_2 \]
\[ P_1 = 3.4 \text{ atm} \quad P_2 = 0.75 \text{ atm} \]
\[ T_1 = 37.0 \degree \text{ C} = 310 \text{ K} \quad T_2 = ? \]
\[ \frac{(3.4 \text{ atm})(250.0 \text{ mL})}{(310 \text{ K})} = \frac{(0.75 \text{ atm})(250.0 \text{ mL})}{T_2} \]
\[ 0.68 \text{ K} \approx T_2 \]

28. \[ \frac{? \text{ g KCl}}{300 \text{ g H}_2\text{O}} = \frac{24 \text{ g KCl}}{100 \text{ g H}_2\text{O}} \]
\[ ? = 72 \text{ g KCl} \]

29. \[ \frac{15.1 \text{ g AgNO}_3}{5.0 \text{ g H}_2\text{O}} = \frac{?}{100 \text{ g H}_2\text{O}} \]
\[ ? = 302 \text{ g AgNO}_3 \approx 300 \text{ g AgNO}_3 \]
31. \( \frac{5 \text{ mol solute}}{2 \text{ L solution}} = 2.5 \text{ M} \approx 3 \text{ M} \)

32. \( 3.0 \text{ mol NaBr} \cdot 200 \text{ L soln} = 15 \text{ M} \approx 20 \text{ M} \)

33. \( \frac{350 \text{ mL}}{1 \text{ L}} \cdot \frac{0.3 \text{ mol}}{1000 \text{ mL}} = 0.105 \text{ mol} \cdot \frac{0.1 \text{ mol}}{1 \text{ L}} \)

34. \( \frac{600 \text{ mL sucrose}}{1 \text{ L}} \cdot \frac{0.2 \text{ mol}}{1000 \text{ mL}} = \frac{202.159 \text{ g C}_{12} \text{H}_{22} \text{O}_{11}}{41.08} = 242.6 \text{ g C}_{12} \text{H}_{22} \text{D}_{11} \)

35. \( m_1 V_1 = m_2 V_2 \)
\( (2.0 \text{ mL}) (6.0 \text{ M}) = m_2 (600.0 \text{ mL}) \)
\( 0.020 \text{ M} = m_2 \)

36. \( 3.0\% = \frac{V_{\text{solute}}}{300.0 \text{ mL}} \times 100 \)
\( 9.0 \text{ mL} = V_{\text{solute}} \)

38. \( 75.0\% = \frac{V_{\text{solute}}}{177 \text{ mL}} \times 100 \)
\( 133 \text{ mL} = V_{\text{alcohol}} \)

41. \( \frac{248 \text{ cal}}{1 \text{ Joule}} \approx 59.3 \text{ J} \)
\( \frac{4.184 \text{ cal}}{1 \text{ Joule}} \)
45. \[ Q = C \Delta T_m \]
\[ Q = (0.21 \text{ cal/g}) (15^\circ C) (200 \text{ g}) \]
\[ Q = 630 \text{ cal} \]

46. \[ \frac{105.6 \text{ J}}{C} = C \frac{(47 - 35^\circ C)}{(150 \text{ g})} \]
\[ 0.59 \text{ J/g} \cdot ^\circ C \]
\[ \frac{1.6 \text{ J}}{\text{g} \cdot ^\circ C} \]

48. \[ \sum \text{ products} - \sum \text{ reactants} = \Delta H_f \]
\[ (-152.4 \text{ KJ/mol}) - (64.4 \text{ KJ/mol}) \]
\[ -216.8 \text{ KJ} = \Delta H_f \] exothermic

71. \[ [\text{H}^+] = \text{inv} \log (-7.56) \]
\[ [\text{H}^+] = \]

72. \[ \text{pH} = -\log (5.67 \times 10^{-6}) \]
\[ \text{pH} = \]

76. \[ \begin{array}{c}
35.0 \text{ mL Ba(OH)}_2 \\
1 \text{ L}
\end{array} \]
\[ \text{Ba(OH)}_2 + 2\text{HCl} \rightarrow 2\text{H}_2\text{O} + \text{BaCl}_2 \]
\[ \begin{array}{c}
1000 \text{ mL} \\
1 \text{ L}
\end{array} \]
\[ 0.01575 \text{ mol HCl} \]
\[ 1000 \text{ mL} = 1.05 \text{ M HCl} \]
\[ 15 \text{ mL} \]

84. \[ \begin{array}{c}
\text{H}^+ \quad +1 \\
t1 \\
t2 \\
t1 \quad -2 \\
0 \\
\text{Br}_2 \quad \text{is oxidized}
\end{array} \]
\[ \text{HNO}_3 + \text{HBr} \rightarrow \text{NO} + \text{Br}_2 + \text{H}_2\text{O} \]

85. \[ \begin{array}{c}
0 \\
t1 \\
t2 \\
t1 \quad -2 \\
t1 \quad 2 \quad t1 \\
0 \\
\text{Na} \quad \text{ox } \# \text{ increased}
\end{array} \]
\[ \text{2Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2 \]