These problems are intended to ***supplement*** the problems in the textbook, not ***replace*** them.

Questions – Stoichiometry Only

I. Phosphine gas is produced when calcium phosphide reacts with water:

$$Ca_3P_2(s) + H_2O(l) \rightarrow PH_3(g) + Ca(OH)_2(aq)$$

1. Balance the equation.
2. How many kilograms of phosphine are formed if 16.43 kg of water reacts ?
3. What volume of phosphine does this correspond to at STP ?
4. How many grams of calcium hydroxide are produced if 262 mL of phosphine are also produced at 39.6 °C and 794 mm Hg ?

II. Sulfur dioxide is a product of the combustion of diarsenic trisulfide:

$$As_2S_3(s) + O_2(g) \rightarrow As_4O_6(s) + SO_2(g)$$

5. Balance the equation.
6. If the pressure and temperature remain constant at 102.6 kPa and 23.46 °C, then what volume of sulfur dioxide will be produced from 5.350 liters of oxygen ?
7. If the volume and temperature remain constant at 100.0 mL and 31.6 °C, then how many grams of diarsenic trisulfide are needed to produce a sulfur dioxide pressure of 1.56 bar ?

Questions – Stoichiometry And Limiting Reactant

III. Suppose 57.5 L of hydrogen gas at STP is bubbled through 6.40 L of 0.168 M gold(III) iodide solution.

8. Write a balanced chemical equation for the reaction that occurs.
9. Which is the limiting reactant ?
10. How many moles of the excess reactant will be left over ?
11. What is the theoretical yield (grams) of gold ?

IV. 142 liters of nitrogen dioxide gas combine with 100.0 mL of water at 60.0 °C and 444 mm Hg:

$$NO_2(g) + H_2O(l) \rightarrow HNO_3(aq) + NO(g)$$

12. Balance the equation.
13. What volume of nitrogen monoxide will be produced at this temperature and pressure ?

V. The fizz produced when Alka-Seltzer tablets are dissolved in water is due to the reaction between sodium bicarbonate and citric acid:

$$NaHCO_3(aq) + H_3C_6H_5O_7(aq) \rightarrow CO_2(g) + H_2O(l) + Na_3C_6H_5O_7(aq)$$

A typical tablet contains 1916 mg sodium bicarbonate and 1000 mg citric acid (assume 4 SF).

14. Balance the equation.

15. If this tablet is added to a glass of water which is then sealed, what is the maximum pressure of carbon dioxide that can be achieved, assuming the gas volume remains a constant 150.0 mL and the temperature is 62.3 °F ?

16. What volume of water is produced during this reaction ?

17. If there was originally 250.0 mL of water in the glass, then what is the final concentration of sodium citrate ?

18. How many milligrams of each reactant will be left over ?

VI. A 10.0 L vessel contains hydrogen gas at 1.25 atm and 12 °C. Nitrogen is introduced to a partial pressure of 0.500 atm. The following reaction occurs:

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

19. Balance the equation.

20. Which is the limiting reactant ?

21. How many grams of ammonia will be produced in theory ?

22. What is the theoretical final total pressure in the vessel ?

Answers

If you cannot figure out how to get the correct answer, go to your instructor, the Science Tutoring Center, SI, etc.

NOTE: if your answer is different only in the last decimal place, then you probably rounded off at different points during the calculations. Don't be concerned about this.

NOTE: molar mass values were taken from the CHE 111 Lab Manual and used without rounding, the gas constant used was 0.08206 atm·L/mol·K, and standard temperature was 273.15 K

1. $Ca_3P_2(s) + 6\ H_2O(l) \rightarrow 2\ PH_3(g) + 3\ Ca(OH)_2(aq)$
2. 10.33 kg PH_3
3. 6.810×10^3 L
4. 1.18 g $Ca(OH)_2$
5. $2\ As_2S_3(s) + 9\ O_2(g) \rightarrow As_4O_6(s) + 6\ SO_2(g)$
6. 3.567 L SO_2
7. 0.505 g As_2S_3
8. $3\ H_2(g) + 2\ AuI_3(aq) \rightarrow 6\ HI(aq) + 2\ Au(s)$
9. gold(III) iodide
10. 0.96 mol H_2
11. 212 g Au
12. $3\ NO_2(g) + H_2O(l) \rightarrow 2\ HNO_3(aq) + NO(g)$
13. 47.3 L NO
14. $3\ NaHCO_3(aq) + H_3C_6H_5O_7(aq) \rightarrow 3\ CO_2(g) + 3\ H_2O(l) + Na_3C_6H_5O_7(aq)$
15. 2.478 atm CO_2
16. 0.2815 mL H_2O
17. 0.02080 M $Na_3C_6H_5O_7$
18. 604 mg $NaHCO_3$ and 0 mg $H_3C_6H_5O_7$
19. $N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$
20. hydrogen
21. 6.06 g NH_3
22. 0.917 atm