

## Units 7, 8, 9 - Answers

- Balance the following equation:  $3 \text{ CCl}_4 + 2 \text{ SbF}_3 \rightarrow 3 \text{ CCl}_2\text{F}_2 + 2 \text{ SbCl}_3$
- How many moles of carbon dioxide are in the following chemical reaction if 2 moles of  $\text{C}_4\text{H}_{10}$  are reacting?  $2 \text{ C}_4\text{H}_{10}(\text{g}) + 13 \text{ O}_2(\text{g}) \rightarrow 8 \text{ CO}_2(\text{g}) + 10 \text{ H}_2\text{O}(\text{g})$  **8 moles  $\text{CO}_2$**
- How many moles of water are being produced from 4 moles  $\text{C}_4\text{H}_{10}$  and 26 moles of  $\text{O}_2$  reacting?  
 $\text{C}_4\text{H}_{10}(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$  **20. Mol  $\text{H}_2\text{O}$**
- How many moles of oxygen are in the following chemical reaction?  
 $\text{Na}_2\text{CO}_3(\text{aq}) + \text{HNO}_3(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g}) + \text{NaNO}_3(\text{aq})$  **9 mol  $\text{O}_2$**
- According to the following reaction:  $\text{WO}_3 + \text{H}_2 \rightarrow \text{W} + \text{H}_2\text{O}$   
How many moles of tungsten are produced by the reaction of 0.00761 mole of  $\text{WO}_3$  with hydrogen? **0.00761 mol W**
- According to the following reaction:  $\text{Mg}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{MgO}(\text{s})$   
How many moles of  $\text{MgO}$  are produced of 4.60 moles of oxygen react? **9.20 mol  $\text{MgO}$**
- According to the following reaction:  $\text{N}_2 + \text{O}_2 \rightarrow \text{NO}$   
How many moles of  $\text{NO}$  produced by the reaction of 26.8 grams of nitrogen? **1.91 mol  $\text{NO}$**
- According to the following reaction:  $\text{CH}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$   
How many moles of  $\text{CH}_4$  are required to produce 36.0 grams  $\text{H}_2\text{O}$ ? **1.00 mol  $\text{CH}_4$**
- According to the following reaction:  $\text{Al}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{Al}_2\text{O}_3(\text{s})$   
How many grams of oxygen react with 108 grams aluminum? **384 g  $\text{O}_2$**
- According to the following reaction:  $\text{CCl}_4 + \text{SbF}_3 \rightarrow \text{CCl}_2\text{F}_2 + \text{SbCl}_3$   
If 4.36 grams of Freon-12 ( $\text{CCl}_2\text{F}_2$ ) is produced in the reaction, how many grams of  $\text{SbCl}_3$  are also produced? **5.48g  $\text{SbCl}_3$**
- Calculate the number of moles of  $\text{Fe}_3\text{O}_4$  produced from 0.75 moles of  $\text{Fe}$  by the following reaction.  $\text{Fe} + \text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + \text{H}_2$  **0.25 mol  $\text{Fe}_3\text{O}_4$**
- Calculate the number of moles of  $\text{NO}$  produced from 0.25 moles of  $\text{O}_2$  by the following reaction.  $\text{NH}_3 + \text{O}_2 \rightarrow \text{NO} + \text{H}_2\text{O}$  **0.20 mol  $\text{NO}$**
- The following process can be used to obtain iodine from oil field brine containing  $\text{NaI}$ . How many moles of  $\text{AgNO}_3$  are required per mole of  $\text{I}_2$  produced?  
 $\text{NaI} + \text{AgNO}_3 \rightarrow \text{AgI} + \text{NaNO}_3$   
 $\text{AgI} + \text{Fe} \rightarrow \text{FeI}_2 + \text{Ag}$   
 $\text{FeI}_2 + \text{Cl}_2 \rightarrow \text{FeCl}_3 + \text{I}_2$  **2 mol  $\text{AgNO}_3$**
- What mass of  $\text{CaO}$  could be obtained from the thermal decomposition of 2.00 moles of  $\text{CaCO}_3$ ?  
 $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$  **112g  $\text{CaO}$**
- How many grams of aluminum bromide are formed by the reaction of 1.50 moles of  $\text{HBr}$  according to the following equation?  $\text{Al} + \text{HBr} \rightarrow \text{AlBr}_3 + \text{H}_2$  **733g  $\text{AlBr}_3$**
- How many grams of  $\text{H}_2$  are produced by the reaction of 0.256 mol of  $\text{H}_3\text{PO}_4$  according to the following equation?  $\text{Cr} + \text{H}_3\text{PO}_4 \rightarrow \text{CrPO}_4 + \text{H}_2$  **0.768g  $\text{H}_2$**
- Reaction of 1.00 mole  $\text{CH}_4$  with excess  $\text{Cl}_2$  yields 96.8 g  $\text{CCl}_4$ . What is the percent yield of the reaction?  $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CCl}_4 + \text{HCl}$  **62.9%  $\text{CCl}_4$**
- Toluene is oxidized by air under carefully controlled conditions to benzoic acid which is used to prepare the food preservative sodium benzoate. What is the yield of a reaction in which 1.00 kg of toluene is converted to 1.21 kg of benzoic acid?  $2 \text{ C}_6\text{H}_5\text{CH}_3 + 3 \text{ O}_2 \rightarrow 2 \text{ C}_6\text{H}_5\text{CO}_2\text{H} + 2 \text{ H}_2\text{O}$  **91.2%**
- The reaction of 6.8 g of  $\text{H}_2\text{S}$  with excess  $\text{SO}_2$  according to the following reaction yields 8.2 g of  $\text{S}$ . What is the percent yield?  $\text{H}_2\text{S} + \text{SO}_2 \rightarrow \text{S} + \text{H}_2\text{O}$  **85.4%  $\text{S}$**
- Freshly exposed aluminum surfaces react with oxygen to form a tough oxide coating that protects the metal from further corrosion. How many grams of  $\text{O}_2$  are required to react with 8.09 g of  $\text{Al}$ ?  $\text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3$  **7.19g  $\text{O}_2$**
- Which is the best percent yield? a) 0% b) 10% c) 50% d) 75% e) **100%**

22. In a general chemistry laboratory experiment, a student produces 2.73 grams of a compound. She calculates the theoretical yield as 3.40 grams. What is the percent yield? **80.3%**
23. Barium chloride was used to precipitate silver chloride from a solution of silver nitrate. What mass of barium chloride had to react if 0.635 grams of silver chloride formed?  
 $\text{BaCl}_2(\text{aq}) + \text{AgNO}_3(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{Ba}(\text{NO}_3)_2(\text{aq})$  **0.461g BaCl<sub>2</sub>**
24. According to the following reaction:  $\text{Sb} + \text{Cl}_2 \rightarrow \text{SbCl}_3$   
 If Sb is completely consumed in the reaction, it is the (limiting or excess) reactant. **Limiting**
25.  $\text{Cu}_2\text{HgI}_4$  is prepared according to the equation:  $2 \text{CuI} + \text{HgI}_2 \rightarrow \text{Cu}_2\text{HgI}_4$  **HgI**
26. When 2.00 grams of each reactant are used, which one is the limiting reactant?
27. If the reaction:  $\text{N}_2 + 3 \text{H}_2 \rightarrow 2 \text{NH}_3$   
 is carried out using 1.40 grams of  $\text{N}_2$  and 0.400 grams of  $\text{H}_2$ , what mass of excess reactant will remain? **0.100 g H<sub>2</sub>**
28. The mass of  $\text{Li}_2\text{O}$  formed when 2.00 g of lithium reacts with 2.00 g of oxygen is 3.02 g. What is the percent yield?  $\text{Li} + \text{O}_2 \rightarrow \text{Li}_2\text{O}$  **81.1% Li<sub>2</sub>O**
29. The mass of  $\text{S}_2\text{Cl}_2$  formed when 6.00 g of sulfur reacts with 6.00 g of chlorine is 9.5 g. What is the percent yield?  $\text{S}_8 + \text{Cl}_2 \rightarrow \text{S}_2\text{Cl}_2$
30. The mass of iron produced by the reaction of 7.00 kg of  $\text{Fe}_2\text{O}_3$  and 3.00 kg of CO is 3.55 kg. What is the percent yield?  $\text{Fe}_2\text{O}_3 + 3 \text{CO} \rightarrow 2 \text{Fe} + 3 \text{CO}_2$  **89.1%**
31. What mass of  $\text{PbSO}_4$  is produced when 1.94 g  $\text{Pb}(\text{NO}_3)_2$  reacts with 0.83 g  $\text{Al}_2(\text{SO}_4)_3$ ?  
 $\text{Pb}(\text{NO}_3)_2 + \text{Al}_2(\text{SO}_4)_3 \rightarrow \text{PbSO}_4 + \text{Al}(\text{NO}_3)_2$  **1.78g PbSO<sub>4</sub>**
32. The pressure of nitrogen in a cylinder is  $2.00 \times 10^3$  psi. What is the pressure in atmospheres?  
**136 atm**
33. The vapor pressure of mercury is 0.0012 torr at 20 C. What is this pressure in atmospheres?  
 **$1.58 \times 10^{-6}$  atm**
34. Consider a cylinder fitted with a movable piston. The initial pressure inside the cylinder is  $P_i$  and the initial volume is  $V_i$ . What is the new pressure in the system when the piston decreases the volume of the cylinder by half?  
 a)  $2 V_i P_i$       b)  $(1/4) P_i$       c)  $P_i^2$       d)  **$2 P_i$**       e)  $(1/2) P_i$
35. The pressure of a combustible mixture in a cylinder of a motorcycle engine is 0.980 atm when the volume is 246 mL. The piston decreases the volume to 24.1 mL. What is the pressure (atm) at that point assuming no change in temperature occurs? **10.0 atm**
36. What would be the volume (mL) of a sample of ethane ( $\text{C}_2\text{H}_6$ ) at 467 K and 1.2 atm if it occupied 405 mL at 298 K and 1.2 atm? **258 mL**
37. A balloon is filled with air and has a volume of 3.25 L at 30°C. The balloon is placed in a freezer at -10°C. What is the volume of the balloon at this temperature? **2.82 L**
38. A sample of a gas at -91°C and 1 atm occupies 2.0 L. What volume, L, will the gas occupy at 0°C at the same pressure? **3.0 L**
39. A spray can is used until only the propellant gas remains at a pressure of 1.1 atm at 23°C. If the can were thrown into a fire at 475°C, what would be the pressure (atm) in the hot can? **2.78atm**
40. Gas evolved in the fermentation of sugar in wine making occupies a volume of 0.75 L at 20°C at 720 mm Hg. What volume (L) would the gas occupy at 39°C and 1.00 atm? **0.76 L**
41. A gas occupies 1.0 L at 27°C and 0.50 atm. At what temperature (°C) will the gas occupy at 0.50 L at 1.0 atm? **27°C**
42. A 25 L cylinder contains 128 g of nitrogen gas at 10°C. How many grams of nitrogen must be added to increase the pressure to 5.00 atm assuming ideal gas behavior? **151g**
43. A balloon is filled with 48.3 g of helium at 31°C and 2.12 atm. What is the volume of the balloon in liters? **142 L**
44. A 40.0 gram sample of helium is introduced into a 2.24 L cylinder which is heated until the pressure is 200 atm. What is the temperature (in °C) of the gas? **273°C**

45. An incandescent light bulb with a volume of  $125 \text{ cm}^3$  contains  $2.5 \times 10^{-3}$  moles of argon. What is the pressure of argon (atm) at  $25^\circ\text{C}$ ? **0.489 atm**
46. The pressure in a 2.0 L container is  $1.5 \times 10^{-4}$  torr at 1115 K. How many moles are in the container?  **$4.3 \times 10^{-9}$  mol**
47. What is the density (g/L) of nitrogen at STP? **1.25 g/L**
48. The Goodyear blimp has  $5.12 \times 10^6$  liters of helium at  $25^\circ\text{C}$  and 1.00 atm. What mass, g, of helium is in the blimp?  **$8.37 \times 10^5$  g**
49. A 725 gram sample of neon is introduced into a 4.5 L cylinder which is then heated until the pressure is 225 atm. What is the temperature ( $^\circ\text{C}$ ) of the gas?  **$70.^\circ\text{C}$**
50. What is the density in g/L of  $\text{BrF}_3$  at 425 torr and  $77^\circ\text{C}$ ? **2.66 g/L**
51. What volume of hydrogen (in L) at STP would be required to react with 0.100 mole of nitrogen to form ammonia?  
 $\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \rightarrow 2 \text{NH}_3(\text{g})$  **6.72 L  $\text{H}_2$**
52. Calculate the density of neon at  $32^\circ\text{C}$  and 0.676 atm. **0.545 g/L**
53. What volume is occupied by 0.0100 mole of carbon monoxide at  $9^\circ\text{C}$  and 0.973 atm? **0.238 L**
54. What is the temperature of 0.0250 mole of hydrogen gas if it occupies 665 mL at 715 torr? **305K**
55. Calculate the density of nitrogen dioxide at STP. **2.05 g/L**
56. Identify the incorrect statement about events that occur between the time a solute is first introduced to a solvent and the time when the solution becomes saturated.
- The rate of concentration change is zero when the solution is saturated
  - The net rate of concentration change is greatest at the beginning of the process
  - The rate of dissolving is greater than the rate of crystallization when the solution is one-half saturated
  - If temperature remains constant, the rate of dissolving is constant
  - If temperature remains constant, the rate of crystallization remains constant
57. Calculate the grams of alcohol,  $\text{C}_2\text{H}_5\text{OH}$ , in 440 grams of a 23.0% solution. **101g**
58. 75.0 mL of water is added to 12.9 mL of 0.250 M  $\text{KMnO}_4$ . What is the concentration of the diluted solution? **0.0367 M**
59. Consider a solid solute being dissolved into a liquid solvent. The combined processes of reducing temperature, agitating the solution and pulverizing (crushing into small pieces) the solute will...
- increase dissolving time
  - reduce dissolving time
  - minimize dissolving time
  - have no effect on dissolving time
  - have an unpredictable effect on dissolving time
60. If 2.54 g of sodium benzoate is dissolved in 75.00 g  $\text{H}_2\text{O}$ , what is the percentage concentration of sodium benzoate? **3.28%**
61. If 45.5 g of  $\text{BaCl}_2$  is dissolved in water to produce 2.74 L of solution, what is the molarity of the solution? **0.0797 M  $\text{BaCl}_2$**
62. When a saturated solution is in equilibrium with undissolved solute,...
- the solution separates into layers
  - dissolving and crystallization stop
  - the quantity of dissolved solute equals the quantity of undissolved solute
  - the concentration of the solution remains constant
  - the temperature increases until more solute dissolves
63. Nitric acid is commercially available at a concentration of 15.9 M. What volume of this solution must be diluted to a final volume of 1.00 L to prepare a 4.00 M solution? **0.25 L**
64. The citric acid in a lemon juice sample was neutralized by titration with NaOH solution. If 5.00 mL of lemon juice required 47.8 mL of 0.121 M NaOH for neutralization, what was the molarity of the citric acid in the lemon juice? **0.386 M**

The reaction is  $\text{___NaOH} + \text{___H}_3\text{C}_6\text{H}_5\text{O}_7 \rightarrow \text{___H}_2\text{O} + \text{___Na}_3\text{C}_6\text{H}_5\text{O}_7$

65. Which of the following is a strong acid?

- a.  $\text{H}_2\text{CO}_3$    b.  $\text{HC}_2\text{H}_3\text{O}_3$    c. HF   **d. HCl**   e. HClO

66. Which of the following is a characteristic property of a traditional acid?

- a. Turns litmus indicator blue  
b. Feels slippery  
c. Tastes bitter  
**d. Sour taste**  
e. Contain  $\text{OH}^-$  ions

67. Which one is a common indicator used in acid base titrations?

- a) sodium chloride   b) propylene   **c) phenolphthalein**   d) bronsted-lowry   e) arrhenius

68. According to Arrhenius theory, what is an acid?

- a. A substance which contains a high concentration of hydrogen ions in solutions with water**  
b. A substance which will lower the hydrogen ion concentration when placed in water  
c. A substance that has an H in its formula  
d. An electron pair donor  
e. An electron pair acceptor

69. A Brønsted-Lowry acid is defined as a(n)...

- a. proton acceptor  
b. electron donor  
**c. proton donor**  
d. electron pair acceptor  
e. electron pair donor

70. What is a Brønsted-Lowry base?

- a. An electron pair donor  
b. A hydroxide ion donor  
c. A metal ion  
d. A proton donor  
**e. A proton acceptor**

71. What kind of substance is water in the following reaction?



- a) A Brønsted-Lowry base      **b) A Brønsted-Lowry acid**