

Chm 151 exam 1a fall 2005 MWF

Created: 12:44:34 PM GMT-07:00

Student: Key

1. Calculate the molar mass of  $(\text{NH}_4)_3\text{AsO}_4$ .

- A. 417.80 g/mol
  - B. 193.03 g/mol
  - C. 165.02 g/mol
  - D. 156.96 g/mol
  - E. 108.96 g/mol
- $4 \times 16.00$   
 $1 \times 74.92$   
 $12 \times 1.008$   
 $3 \times 14.01$   


---

 193.32

2. Calculate the number of moles in 17.8 g of the antacid magnesium hydroxide,  $\text{Mg}(\text{OH})_2$ .

- A. 3.28 mol
  - B. 2.32 mol
  - C. 0.431 mol
  - D. 0.305 mol
  - E. 0.200 mol
- $17.8 \text{ g} \div 58.32 \text{ g/mol} = 0.3052$

3. Sulfur trioxide can react with atmospheric water vapor to form sulfuric acid that falls as acid rain. Calculate the mass in grams of  $3.65 \times 10^{20}$  molecules of  $\text{SO}_3$ .

- A.  $6.06 \times 10^{-4}$  g
  - B.  $2.91 \times 10^{-2}$  g
  - C.  $4.85 \times 10^{-2}$  g
  - D. 20.6 g
  - E. 1650 g
- $3.65 \times 10^{20} \text{ molecules } \times \frac{1 \text{ mol } \text{SO}_3}{6.02 \times 10^{23} \text{ molecules}} \times \frac{80.07 \text{ g } \text{SO}_3}{1 \text{ mol } \text{SO}_3} = 4.85 \times 10^{-2} \text{ g}$

4. The number of hydrogen atoms in 0.050 mol of  $\text{C}_3\text{H}_8\text{O}_3$  is

- A.  $3.0 \times 10^{22}$  H atoms
  - B.  $1.2 \times 10^{23}$  H atoms
  - C.  $2.4 \times 10^{23}$  H atoms
  - D.  $4.8 \times 10^{23}$  H atoms
  - E. none of these choices is correct
- $0.050 \text{ mol } \text{C}_3\text{H}_8\text{O}_3 \times \frac{8 \text{ mol H}}{1 \text{ mol } \text{C}_3\text{H}_8\text{O}_3} = 0.4 \text{ mol H} \times 6.02 \times 10^{23} \text{ atoms/mol} = 2.4 \times 10^{23} \text{ atoms}$

5. Household sugar, sucrose, has the molecular formula  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ . What is the % of carbon in sucrose, by mass?

- A. 26.7 %
  - B. 33.3 %
  - C. 41.4 %
  - D. 42.1 %
  - E. 52.8 %
- $11 \times 16.00 = 176.0$   
 $22 \times 1.01 = 22.22$   
 $12 \times 12.01 = 144.12$   


---

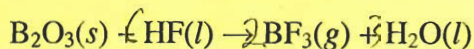
 $342.34$   
 $\frac{144.12}{342.34} \times 100 = 42.1\%$

6. Hydroxylamine nitrate contains 29.17 mass % N, 4.20 mass % H, and 66.63 mass % O. Determine its empirical formula.

- A.  $\text{HNO}$
  - B.  $\text{H}_2\text{NO}_2$
  - C.  $\text{HN}_6\text{O}_{16}$
  - D.  $\text{HN}_{16}\text{O}_7$
  - E.  $\text{H}_2\text{NO}_3$
- Assume 100 g  
 $\text{N: } \frac{29.17 \text{ g}}{14.01 \text{ g/mol}} = 2.082 \div 2.082 = 1$   
 $\text{H: } \frac{4.20 \text{ g}}{1.01 \text{ g/mol}} = 4.158 \div 2.082 = 2$   
 $\text{O: } \frac{66.63 \text{ g}}{16.00 \text{ g/mol}} = 4.164 \div 2.082 = 2$   
 Empirical formula:  $\text{H}_2\text{NO}_2$

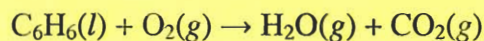
Key

7. Balance the following equation:

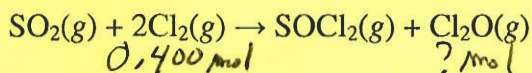


- A.  $B_2O_3(s) + 6HF(l) \rightarrow 2BF_3(g) + 3H_2O(l)$
- B.  $B_2O_3(s) + H_6F_6(l) \rightarrow B_2F_6(g) + H_6O_3(l)$
- C.  $B_2O_3(s) + 2HF(l) \rightarrow 2BF_3(g) + H_2O(l)$
- D.  $B_2O_3(s) + 3HF(l) \rightarrow 2BF_3(g) + 3H_2O(l)$
- E.  $B_2O_3(s) + 6HF(l) \rightarrow 2BF_3(g) + 6H_2O(l)$

8. Balance the following equation for the combustion of benzene:



- A.  $C_6H_6(l) + 9O_2(g) \rightarrow 3H_2O(g) + 6CO_2(g)$
  - B.  $C_6H_6(l) + 9O_2(g) \rightarrow 6H_2O(g) + 6CO_2(g)$
  - C.  $2C_6H_6(l) + 15O_2(g) \rightarrow 6H_2O(g) + 12CO_2(g)$
  - D.  $C_6H_6(l) + 15O_2(g) \rightarrow 3H_2O(g) + 6CO_2(g)$
  - E.  $2C_6H_6(l) + 9O_2(g) \rightarrow 6H_2O(g) + 12CO_2(g)$
9. Sulfur dioxide reacts with chlorine to produce thionyl chloride (used as a drying agent for inorganic halides) and dichlorine oxide (used as a bleach for wood, pulp and textiles).

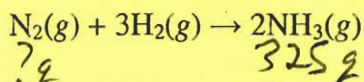


If 0.400 mol of  $Cl_2$  reacts with excess  $SO_2$ , how many moles of  $Cl_2O$  are formed?

- A. 0.800 mol
- B. 0.400 mol
- C. 0.200 mol
- D. 0.100 mol
- E. 0.0500 mol

$$\frac{0.400 \text{ mol } Cl_2}{2 \text{ mol } Cl_2} \times \frac{1 \text{ mol } Cl_2O}{1 \text{ mol } Cl_2} = \text{mol } Cl_2O$$

10. Ammonia, an important source of fixed nitrogen that can be metabolized by plants, is produced using the Haber process in which nitrogen and hydrogen combine.



How many grams of nitrogen are needed to produce 325 grams of ammonia?

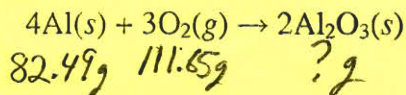
- A. 1070 g
- B. 535 g
- C. 267 g
- D. 178 g
- E. 108 g

$$\frac{325 \text{ g } NH_3}{17.04 \text{ g}} \times \frac{1 \text{ mol } N_2}{2 \text{ mol } NH_3} \times \frac{28.02 \text{ g } N_2}{1 \text{ mol } N_2} =$$



# Key

11. Aluminum oxide (used as an adsorbent or a catalyst for organic reactions) forms when aluminum reacts with oxygen.



A mixture of 82.49 g of aluminum ( $M = 26.98 \text{ g/mol}$ ) and 117.65 g of oxygen ( $M = 32.00 \text{ g/mol}$ ) is allowed to react. What mass of aluminum oxide ( $M = 101.96 \text{ g/mol}$ ) can be formed?

- A. 155.8 g  
 B. 200.2 g  
 C. 249.9 g  
 D. 311.7 g  
 E. 374.9 g

Based on Al:  $\frac{82.49 \text{ g Al}}{26.98 \text{ g/mol Al}} \times \frac{2 \text{ mol Al}_2\text{O}_3}{4 \text{ mol Al}} \times 101.96 \text{ g Al}_2\text{O}_3 = 155.87 \text{ g Al}_2\text{O}_3$

Based on O<sub>2</sub>:  $\frac{117.65 \text{ g O}_2}{32.00 \text{ g/mol O}_2} \times \frac{2 \text{ mol Al}_2\text{O}_3}{3 \text{ mol O}_2} \times 101.96 \text{ g Al}_2\text{O}_3 = 237.16 \text{ g Al}_2\text{O}_3$

12. Sodium chlorate is used as an oxidizer in the manufacture of dyes, explosives and matches. Calculate the mass of solute needed to prepare 1.575 L of 0.00250 M NaClO<sub>3</sub> ( $M = 106.45 \text{ g/mol}$ ).

- A. 419 g  
 B. 169 g  
 C. 0.419 g  
 D. 0.169 g  
 E. 0.00394 g

$$\frac{1.575 \text{ L} \times 0.00250 \text{ mol NaClO}_3}{1 \text{ L}} \times 106.45 \text{ g/mol} = 0.4191 \text{ g}$$

13. Hydrochloric acid is widely used as a laboratory reagent, in refining ore for the production of tin and tantalum, and as a catalyst in organic reactions. Calculate the number of moles of HCl in 62.85 mL of 0.453 M hydrochloric acid.

- A. 28.5 mol  
 B. 1.04 mol  
 C. 0.139 mol  
 D. 0.0285 mol  
 E. 0.00721 mol

$$\frac{62.85 \text{ mL} \times 0.453 \text{ mol}}{1000 \text{ mL}} = 0.0285 \text{ mol}$$

14. Calcium chloride is used to melt ice and snow on roads and sidewalks and to remove water from organic liquids. Calculate the molarity of a solution prepared by diluting 165 mL of 0.688 M calcium chloride to 925.0 mL.

- A. 3.86 M  
 B. 0.743 M  
 C. 0.222 M  
 D. 0.123 M  
 E. 0.114 M

$$M_1 V_1 = M_2 V_2$$

$$(0.688 \text{ M})(165 \text{ mL}) = M_2 (925.0 \text{ mL})$$

$$M_2 = 0.1227 \text{ M}$$

15. Select the best statement.

- A. Chemical changes provide the only valid basis for identification of a substance.  
 B. Chemical changes are easily reversed by altering the temperature of the system.  
 C. Chemical changes always produce substances different from the starting materials.  
 D. Chemical changes are associated primarily with extensive properties.  
 E. Chemical changes are accompanied by changes in the total mass of the substances involved.

# Key

16. The average distance from Earth to the Sun is 150 megameters. What is that distance in meters?

- A.  $1.5 \times 10^8$  m
- B.  $1.5 \times 10^6$  m
- C.  $1.5 \times 10^5$  m
- D.  $1.5 \times 10^3$  m
- E.  $1.5 \times 10^{-6}$  m

$$150 \times 10^6 = 1.50 \times 10^8 \text{ m}$$

17. The average distance between the Earth and the Moon is 240,000 miles. Express this distance in kilometers.

- A.  $6.1 \times 10^5$  km
- B.  $5.3 \times 10^5$  km
- C.  $3.9 \times 10^5$  km
- D.  $1.5 \times 10^5$  km
- E.  $9.4 \times 10^4$  km

$$\frac{240,000 \text{ miles} \times 5280 \text{ ft} \times 12 \text{ in} \times 2.54 \times 10^{-2} \text{ m}}{1 \text{ mile} \times 1 \text{ ft} \times 1 \text{ in} \times 10^3} = 386242 \text{ km}$$

18. A flask has a mass of 78.23 g when empty and 593.63 g when filled with water. When the same flask is filled with concentrated sulfuric acid,  $\text{H}_2\text{SO}_4$ , its mass is 1026.57 g. What is the density of concentrated sulfuric acid? (Assume water has a density of  $1.00 \text{ g/cm}^3$  at the temperature of the measurement.)

- A.  $1.992 \text{ g/cm}^3$
- B.  $1.840 \text{ g/cm}^3$
- C.  $1.729 \text{ g/cm}^3$
- D.  $1.598 \text{ g/cm}^3$
- E.  $0.543 \text{ g/cm}^3$

$$\begin{aligned} 593.63 - 78.23 &= 515.4 \text{ g H}_2\text{O} \\ \frac{515.4 \text{ g}}{1.00 \text{ g/cm}^3} &= 515.4 \text{ cm}^3 \\ D_{\text{H}_2\text{SO}_4} &= \frac{(1026.57 - 78.23) \text{ g}}{515.4 \text{ cm}^3} = 1.8400 \text{ g/cm}^3 \end{aligned}$$

19. Select the answer that expresses the result of this calculation with the correct number of significant figures.

$$\frac{13.602 \times 1.90 \times 3.06}{4.2 \times 1.4097} =$$

- A. 13.3568
- B. 13.357
- C. 13.36
- D. 13.4
- E. 13

2 sig. figs



# Key

20. Select the answer that expresses the result of this calculation with the correct number of significant figures and with correct units.

$$16.18 \text{ cm} \times 9.6114 \text{ g} \div 1.4783 \text{ cm}^2 =$$

- A. 105.2 g/cm<sup>3</sup>
- B. 105.2 g/cm<sup>2</sup>
- C. 105.2 g/cm
- D. 72.13 g/cm<sup>2</sup>
- E. 72.13 g/cm

4 sig figs

$$\frac{g \cdot cm}{cm^2} = \frac{g}{cm}$$

21. Which measurement is expressed to 4 significant figures?

- A. 0.00423 kg 3
- B. 24.049 cm 5
- C. 1300 K 2
- D. 82,306 m 5
- E. 62.40 g 4

22. Select the answer with the correct number of decimal places for the following sum:

$$13.914 \text{ cm} + 243.1 \text{ cm} + 12.00460 \text{ cm} =$$

- A. 269.01860 cm
- B. 269.0186 cm
- C. 269.019 cm
- D. 269.02 cm
- E. 269.0 cm

↑  
1/10 place limits calculation

23. Bromine is the only nonmetal that is a liquid at room temperature. Consider the isotope bromine-81,

<sup>81</sup><sub>35</sub>Br

. Select the combination which lists the correct atomic number, neutron number, and mass number, respectively.

- A. 35, 46, 81
- B. 35, 81, 46
- C. 81, 46, 35
- D. 46, 81, 35
- E. 35, 81, 116

35 protons, 81 - 35 = 46 neutrons

Key

24. Silicon, which makes up about 25% of Earth's crust by mass, is used widely in the modern electronics industry. It has three naturally occurring isotopes,  $^{28}\text{Si}$ ,  $^{29}\text{Si}$ , and  $^{30}\text{Si}$ . Calculate the atomic mass of silicon.

Isotope	Isotopic Mass (amu)	Abundance %	
$^{28}\text{Si}$	27.976927	0.9223	= 25.8031
$^{29}\text{Si}$	28.976495	9.0467	= 1.3532
$^{30}\text{Si}$	29.973770	9.0310	= 0.9219
			<hr/>
			28.0855

- A. 29.2252 amu
- B. 28.9757 amu
- C. 28.7260 amu
- D. 28.0855 amu
- E. 27.9801 amu

25. Which of the following is a metal?

- A. nitrogen, N,  $Z = 7$
- B. phosphorus, P,  $Z = 15$
- C. arsenic,  $Z = 33$
- D. thallium, Tl,  $Z = 81$
- E. silicon, Si,  $Z = 14$