Unit 4: The Mole and the Chemical Composition

Chapter 7: The Mole and Chemical Composition

7.1: Avogadro's Number and Molar Conversion

(Practice on pg. 228)

1. 1.13×10^{23} ions Na^+
2. 8.73×10^{6} atoms As
3. 2.544×10^{24} molecules $C_2H_4O_2$
4. 3.6×10^{24} formula units NaOH

(Practice on pg. 229)

1. 0.940 mol Xe
2. 4.796×10^{-9} mol $AgNO_3$
3. 4.5×10^{-7} mol termites
4. 94.0 mol Li^+
5. **(a)** 1.050×10^{-2} mol O **(b)** 5.249×10^{-3} mol C **(c)** 3.690 mol O
(d) 8.841×10^{-8} mol K^+ **(e)** 3.321×10^{-10} mol Cl^- **(f)** 6.642×10^{-10} mol N
(g) 6.641×10^{2} mol O

(Practice on pg. 231)

1. 223 g Cu **2.** 29.2 g NaCl **3.** 1063 g CH_4 **4.** 237 g Ti

(Practice on pg. 232)

1. 2.25×10^{24} atoms Cu **2.** 3.00×10^{23} ions Ca^{2+} **3.** 9.33×10^{25} atoms As

(Section Review on pg. 229)

6. **(a)** 1.20×10^{24} ions Fe^{3+} **(b)** 2.7×10^{24} molecules BCl_3
(c) 1.5×10^{23} ions K^+ **(d)** 3.626×10^{24} molecules O_2
7. **(a)** 3.61×10^{24} ions Na^+ ions **(b)** 7.23×10^{24} Na^+ ions **(c)** 3.08×10^{24} Na^+ ions
8. **(a)** 0.500 mol H_2O **(b)** 0.1661 mol C **(c)** 0.09316 mol Na^+
9. **(a)** 2.86×10^{-7} g He **(b)** 15.22 g CH_4 **(c)** 200.5 g Ca^{2+}
10. **(a)** 4.745×10^{21} ions I^- **(b)** 3.3×10^{22} ions Cu^{2+} **(c)** 3.97×10^{22} molecules SO_2
11. 206.3 g ibuprofen
12. **(a)** 26.7 g Ca **(b)** 50. g boron-11 **(c)** 7.032×10^{-4} g Na^+
13. **(a)** 1.204×10^{24} molecules H_2 **(b)** 1.21×10^{23} molecules HF **(c)** 2.7×10^{24} molecules $C_6H_{12}O_6$

7.2: Relative Atomic Mass and Chemical Formulas

(Practice on pg. 236)

1. 69.73 amu **2.** 15.99 amu

(Practice on pg. 239−240)

1. **(a)** 259.80 g/mol **(b)** 136.06 g/mol **(c)** 342.34 g/mol
(d) 253.80 g/mol **(e)** 60.06 g/mol **(f)** 262.84 g/mol
2. **(a)** $NaHCO_3$, 84.01 g/mol **(b)** CeB_6, 204.98 g/mol **(c)** $Mg(ClO_4)_2$, 223.20 g/mol
(d) $Al_2(SO_4)_3$, 342.17 g/mol **(e)** $Fe(OH)_3$, 106.88 g/mol **(f)** $SnCl_2$, 189.61 g/mol
(g) P_4O_{10}, 283.88 g/mol **(h)** ICl, 162.35 g/mol
3. **(a)** 92.15 g/mol **(b)** 0.0815 g/mol $C_6H_5CH_3$
4. **(a)** 300.06 g/mol **(b)** 2.050 g $PtCl_2(NH_3)_2$

(Section Review on pg. 240)

8. 51.99 amu **9.** 10.80 amu, boron
10. **(a)** 168.35 g/mol **(b)** 122.55 g/mol **(c)** 180.18 g/mol
(d) 132.08 g/mol **(e)** 75.08 g/mol
11. **(a)** SrS, 119.69 g/mol, 1.76×10^{-2} mol SrS **(b)** PF_3, 87.97 g/mol, 2.40×10^{-2} mol PF_3
(c) $Zn(CH_3COO)_2$, 183.49 g/mol, 1.15×10^{-2} mol $Zn(CH_3COO)_2$
(d) $Hg(BrO_3)_2$, 456.39 g/mol, 4.62×10^{-3} mol $Hg(BrO_3)_2$
(e) $Ca(NO_3)_2$, 164.10 g/mol, 1.29×10^{-2} mol $Ca(NO_3)_2$
16. **(a)** 8 H atoms **(b)** 4.818×10^{24} H atoms

7.3: Formulas and Percentage Composition

(Practice on pg. 243)

1. Mn_2O_3 **2.** Cl_2O_7 **3.** Fe_3O_4 **4.** $C_2H_3Cl_3$

(Practice on pg. 245)

1. C_6H_6 **2.** $C_3H_6O_3$ **3.** NO_2

(Practice on pg. 248)

1. 93.311% Fe, 6.689% C **2.** 50.05% S, 49.95% O **3.** 35.00% N, 5.05% H, 59.96% O

4. **(a)** 35.41% Sr, 64.59% Br **(b)** 29.44% Ca, 23.55% S, 47.01% O
(c) 31.83% Mg, 31.46% C, 36.70% N **(d)** 63.70% Pb, 14.77% C, 1.86% H, 19.67% O

5. **(a)** Both are 39.99% C, 6.73% H, and 53.28% O
(b) The percentage composition of the empirical formula is the same as that of the molecular formulas.

(Section Review on pg. 248)

2. C_4H_9 **4.** **(a)** BCl_3 **(b)** SO_2 **(c)** $NaNO_3$ **5.** SO_2

6. **(a)** $CaSO_4$, 29.44% Ca, 23.55% S, and 47.01% O **(b)** SiO_2, 46.75% Si and 53.25% O
(c) $AgNO_3$, 63.50% Ag, 8.247% N, and 28.26% O **(d)** NO, 46.68% N and 53.32% O

7. **(a)** 64.62% Ag, 14.39% C, 1.82% H, and 19.17% O **(b)** 55.39% Pb, 18.95% Cl, and 25.66% O
(c) 27.93% Fe, 24.06% S, and 48.01% O **(d)** 39.81% Cu, 20.09% S, and 40.10% O

9. $C_2H_5NO_2$

10. No. The given experimental mass is not a whole number multiple of the molar mass of CH_2O – 30.03 g/mol

(Chapter Review on pg. 251 to 254)

19. 1.20×10^{24} ions Na^+ **20.** 1.20×10^{24} molecules $C_{12}H_{22}O_{11}$ **21.** 7.53×10^{21} atoms Hg

22. **(a)** 1.88×10^{24} formula units $MgCl_2$ **(b)** 3.76×10^{24} ions Cl^- **23.** 41.5 mol MgO

24. 12.5 mol C_6H_6 **25.** 1.553×10^{-10} mol **26.** 6.82×10^{-2} mol Na^+

27. 0.60 mol O_2 **28.** 420.8 g NaCl **29.** 1.46×10^{-8} g CO_2 **30.** 79.5 g $Fe_2(SO_4)_3$

31. 81.6 g O_2 **32.** 160 g NaCl

33. **(a)** 127 g I_2 **(b)** 675 g PbS **(c)** 233 g C_4H_{10}

34. **(a)** 58.44 g NaCl **(b)** 36.04 g H_2O **(c)** 260 g $Ca(OH)_2$ **35.** 3.24×10^{22} atoms Au

36. 1.337×10^{24} formula units $ZnCl_2$ **37.** 9.396×10^{21} molecules naphthalene

38. **(a)** 4.99×10^{-2} mol $(NH_4)_2SO_4$ **(b)** 61 mol $Ca(OH)_2$ **39.** 0.16 mol $C_{13}H_{18}O_2$ **40.** 7.25 mol $NaNO_2$

41. 57.8 mol C_3H_8 **42.** 107.88 amu **43.** 79.90 amu **44.** 55.84 amu

45. **(a)** LiCl, 42.39 g/mol **(b)** CuCN, 89.57 g/mol **(c)** $K_2Cr_2O_7$, 294.20 g/mol
(d) $Mg(NO_3)_2$, 148.32 g/mol **(e)** S_4N_4, 184.32 g/mol **46.** 94.97 g/mol

47. 60.12 g/mol **48.** 75.08 g/mol **49.** $AgNO_3$ **50.** P_2O_3

51. $C_9H_{18}N_6$ **52.** C_6H_6 **53.** $Co_2C_8O_8$ **54.** $C_{18}H_{34}O_2$

55. **(a)** 35.00% N, 5.05% H, and 59.96% O **(b)** 21.23% O and 78.77% Sn

56. 37.56% NH_4^+ **57.** $CaCO_3$, 40.04% Ca, 12.00% C, and 47.96% O

58. **(a)** 0.050 mol Na_3PO_4 **(b)** 0.0406 mol $Ca(NO_3)_2$ **(c)** 0.128 mol SO_2

59. **(a)** 0.00152 mol Na^+ **(b)** 0.0072 mol Ca^{2+} **60.** 40 mol H

61. 27.2% Na, 16.4% N, and 56.4% O; $NaNO_3$ **62.** 28.09 amu **63.** 3 atoms Fe; 3 mol Fe

64. **(a)** 180.18 g/mol **(b)** 180.18 g/mol **65.** 3.00 mol Cl_2

66. $AlPO_4$ is 22.12 % Al, while $AlCl_3$ is 20.23% Al, so aluminium phosphate has more aluminium per gram.

(Standardize Test Prep on pg. 256 & 257)

1. B **2.** H **3.** C **4.** 7.23×10^{-3} mol

5. Avogadro's number is the number of particles in a mole. **6.** 121.8 amu **7.** G

8. D **9.** Both formulas are the same, H_2O **10.** I

11. Although there are twice as many oxygen atoms in carbon dioxide, the percentage composition is based on the same mass, not the number of atoms. **12.** D **13.** H