Answers to Selected Numerical Problems

CHAPTER 1

25. $\Delta E = 4.0852 \times 10^{-19}$ J $\lambda = 4.866 \times 10^{-7}$ m = 487 nm

26. $\lambda = 9.98 \times 10^{-10}$ m

27. Total number of electrons = 18 (2 3*s*, 6 3*p*, 10 3*d*)

29. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$

31. 26 protons, 31 neutrons

33. **a.** 20.18005 amu **b.** 108.97 g

c. 3.252×10^{24} atoms **d.** 3.35098×10^{-23} g

35. 50.9436 amu

36. 258.16 g

37. **a.** 0.0214 mol **b.** 0.0214 mol L^{-1} **c.** 1.289×10^{22} atoms (ions)

40. Mole fraction $MgCO_3$ = 0.12

43. **a.** Empirical formula: $AlSiO_{4.5}H_2$

b. Molecular formula: $Al_2Si_2O_5(OH)_4$

46. 2.452×10^{6}mol

47. 3.97 mol

48. 584.8 cal g^{-1}

49. **a.** 3549 y **b.** 108 d

50. 0.143×10^{17} kg

CHAPTER 2

23. **a.** 295 or 823 **d.** 9.3 or 26.3

24. **a.** 9.0×10^{-6} **b.** 4.978×10^{-3} mol L^{-1} (1.66X)

c. 8.5×10^{-3} mol L^{-1} (2.7X)

25. b. Positive (0.000165), negative (0.000161)

c. Ca^{2+} = 0.93, SO_4^{2-} = 0.93 **d.** $10^{-4.02}$

28. a. TCE: log K_{eq} = −1.977 **b.** TCE: 0.01 g kg^{-1}

d. TCE: log K_t = −2.005

29. a. $10^{30.4}$ **b.** AP = 1482 **c.** AP = 411

30. a. 6.94×10^{-7} atm

31. Microcline: dissolution time = 933 ky

32. 272 d

33. 3970 m

34. a. 3.63×10^{-10} mol m^{-2} s^{-1} **b.** 36.38 y **c.** $k = 8.15 \times 10^{-10}$mol $m^{-2}s^{-1}$

35. a. 14.5% **b.** 4.1%

36. b. A = 0.13, E_a = 49.8 kJ mol^{-1}

38. c. log A = 12.81 **d.** $k = 3.39 \times 10^{-8}$ s^{-1}

e. At 25°C: $t_{½}$ = 10.3 d

CHAPTER 3

21. $10^{-7.934}$ mol L^{-1}

23. 1.40×10^{-3}mol L^{-1}

24. 5.13

27. $H_2CO_{3\,(aq)} = 1.81 \times 10^{-3}$ mol L^{-1}

HCO_3^- = 1.19×10^{-3} mol L^{-1}

CO_3^{2-} = 7.88×10^{-8} mol L^{-1}

29. 43 times more abundant

31. 8.3

32. log P_{CO_2} = −3.40 (HCO_3^-) and −3.38 (Ca^{2+})

34. a. $10^{-6.9}$ mol L^{-1} **b.** $10^{-12.9}$ mol L^{-1}

35. $C_A = 4.81 \times 10^{-3}$eq L^{-1}

36. 5.36 meq L^{-1} pH^{-1}

38. 3.44×10^{-2} meq L^{-1} pH^{-1}

40. 0.657 meq L^{-1} pH^{-1}

42. 120.7 meq L^{-1} pH^{-1}

45. 115.56 kg $CaCO_3$-equivalent ton^{-1}

CHAPTER 4

35. a. −93.9 kJ mol^{-1} **b.** 0.32 V **c.** $10^{16.45}$

37. a. 0.21V **b.** $10^{10.64}$ **c.** $10^{4.64}$ mol L^{-1}

38. a. 0.83 V

39. b. $10^{-20.9}$ mol L^{-1}

42. Acid mine drainage, Eh = 0.98 V

43. a. 0.55 V **b.** 6.31×10^{-32} mol L^{-1} **c.** 730 m V

46. b. −15.18

47. a. 0.69 V **b.** 0.41 V

49. Initial Eh = 1.28 V   Final Eh = 1.13 V

50. 5.5×10^{-3} mol electrons L^{-1}

CHAPTER 5

51. a. H/C = 1.59 O/C = 0.77

55. 1.13

56. 71

57. Aerobic—2.7 d Anaerobic—1151 d

58. 44.6 ppm

59. 22.9 ppb

60. 4.12×10^{-4} mol L^{-1}

61. 698 d

62. 113 h

CHAPTER 6

37. 2 mrem

38. b. 9050 years before present

c. 1471 years before present

40. c. 542 m y^{-1}

41. 22,715 years before present

42. a. 1.1 cm y^{-1} **b.** Deposited in 1969

43. a. 0.14 cm/1000 y **b.** 0.5 dpm g^{-1}

44. c. Nainital Lake: 1.27 cm y^{-1}

45. 22%

46. a. At 0°C, $\delta^{18}O_v = -35.2‰$

b. At −30°C, $\delta^{18}O = -29.9‰$

47. −7.29‰

48. b. 40%

50. 20%

51. 42%

52. 39%

54. 51% feedlot runoff

55. b. 10.2°C

57. a. 18.6‰

CHAPTER 7

36. a. 14% **d.** 32%

38. Eightfold

40. Sixfold

44. 2.32 Å

48. 1.1 sites nm^{-2}

49. l0 meq/100 g

50. 120.4 $m^2\ g^{-1}$

52. b. $K = 0.176$, $n = 1$

54. d. $K = 1.3$

55. 2.93 $cm^3\ g^{-1}$

57. Quartz solubility = 9.7 ppm

CHAPTER 8

62. a. Sun: E = 6.28×10^7 W m^{-2} $\lambda_M = 0.50\ \mu m$

b. 61.6×10^4 J m^{-2} min^{-1}

63. 4.31 μm

65. Late Eocene otolith: $T_{min} = 12.49$°C $T_{max} = 17.05$°C

66. $P_{CO_2} = 10^{-3.20}$ atm

67. $\lambda = 309.7$ nm

68. For first reaction:

rate = 5.26×10^{6} molecules cm^{-3} s^{-1}

69. Summer: 1.4×10^{-2} Bq L^{-1}

72. 126 BqL^{-1}

75. pH = 5.10

77. a. pH = 3.49 **c.** 3.02×10^{-5} mol L^{-1}

79. a. Dust particle: 0.063 m s^{-1} **b.** 43.4 μm

80. a. Cr: EF_{crust} =1.1 **b.** Cr: $X_{noncrustal}$ = 0.1 μg m^{-3}

81. a. Fe: $X_{noncrustal}$ = 97 ppm

b. Sample 1: Mn/Fe = 0.009

84. 50% Boston, 30% New York

85. $^{206}Pb/^{207}Pb$ = 1.192

86. 22% coal, 71% gasoline, 7% soil

87. Oslo air filters—59% gasoline-derived lead

89. 89% biogenic

90. b. CPI = 1.3

CHAPTER 9

65. Quartz at pH = 5.7, 6.06 ppm

66. 9611 ppm

69. a. 3.80×10^{-9} mol L^{-1}

72. a. 1.40×10^{-6} mol L^{-1}

82. a. Monoun, p = 9.28 atm **d.** $K_{sp} = 10^{-10.49}$

f. 181.7 mg L^{-1} **g.** 11% modern C

83. 145,000 mg s^{-1}

85. a. 26.4 μg L^{-1}

86. a. For Al, τ_{rel}, = 0.17

88. a. 8.91 × 10^{-7} mol g^{-1}

b. C_{soln} = 4.77 × 10^{-5} mol L^{-1}

90. a. 1.0 × 10^{-7}molg^{-1}

91. 0.61 meq

93. 0.01 meq L^{-1}

96. d. 212.6 mg L^{-1}

97. 6.45 m

101. 4 m, 1000 m

CHAPTER 10

54. d. 88% deep water

55. c. 62% deep water

56. 34.51‰

57. For N: f = 0.030, g = 0.917, τ = 57,600 y

58. 0.64 mol charge kg^{-1}

61. a. log K_{si} = −9.49 **b.** 6.06 μmol kg^{-1}

62. a. log K_{HSO_4} = 0.44 **b.** 1.03 × 10^{-10} mol kg^{-1}

e. 1.01 × 10^{-10}mol kg^{-1}

64. a. log $K_{NH_4^+}$ = −9.42 **b.** 1.47 × 10^{-6} mol kg^{-1}

e. 4.44 × 10^{-7} mol kg^{-1}

69. IC = 24.5%

70. $9.4 \times l0^{-4}$ mol kg^{-1}

71. 7.6%

74. Plankton: 1.20×10^{-6} g kg^{-1}

Brown algae: 1.17×10^{-6} g kg^{-1}

81. As: 2583 y

82. Chemical half-life: 22.3 y

83. Scavenging turnover time: 0.31 y

84. Pyrene: 40.1 pmol m^{-2} d^{-1}

85. 5.8

87. 2.92×10^{6} m^{3} d^{-1}

89. 12 d

94. 0.16 y

97. c. In $K_D = 7.64$

99. c. 105,830

103. a. −9.69 nmol cm^{-2}y^{-1}

106. 0.0858 g cm^{-2} y^{-1}

107. 0.124 g cm^{-2} y^{-1}