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Chemistry chapter 4 answer key

The molecular formula is B2H6. In solution, the HCO2H exists primarily as HCO2H molecules because the ionization of the weak acid is suppressed by the strong acid. (e) The added CH3CO2H will increase its concentration, causing more of it to dissociate and producing more [CH3CO2−][CH3CO2−] and H3O+ in the process. Electron-pair geometry considers the placement of all electrons. (c) The added NaCl will have no effect on the concentration of the ions. Check Your Understanding. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . 56. (d) PH3; in binary compounds of hydrogen with nonmetals, the acidity increases for the element lower in a group. 33. (a) (b) (c) (d) (e) 58. (a) (b) (c) (d) 70. (a) NaHSeO3 < NaHSO3 < NaHSO4; in polyoxy acids, the more electronegative central element—S, in this case—forms the stronger acid. Cl is more electronegative than Br, and I is the least electronegative of the three. The oxidation state of the sulfur in H2SO4 is greater than the oxidation state of the sulfur in H2SO3. Share — copy and redistribute the material in any medium or format for any purpose, even commercially. 4.5 Quantitative Chemical Analysis 79. This value is less than 5% of 0.0784, so the assumption that it can be neglected is valid. P, I, Cl, and O would form anions because they are nonmetals. The limiting reactant is Cl2. [H2O] > [CH3CO2H] > [H3O+][H3O+] ≈ [CH3CO2−][CH3CO2−] > [OH−] 31. An example is H2O. [C6H4(CO2H)2] 7.2 ×× 10−3 M, [C6H4(CO2H)(CO2)−] = [H3O+] 2.8 ×× 10−3 M, [C6H4(CO2)22−][C6H4(CO2)22−]3.9 ×× 10−6 M, [OH−] 3.6 ×× 10−12 M 76. The placement of the two sets of unpaired electrons in water forces the bonds to assume a tetrahedral arrangement, and the resulting HOH molecule is bent. (a) H2O(l)+H+(aq)⟶H3O+(aq);H2O(l)+H+(aq)⟶H3O+(aq); (b) OH−(aq)+H+(aq)⟶H2O(l);OH−(aq)+H+(aq)⟶H2O(l); (c) NH3(aq)+H+(aq)⟶NH4+(aq);NH3(aq)+H+(aq)⟶NH4+(aq); (d) CN−(aq)+H+(aq)⟶HCN(aq);CN−(aq)+H+(aq)⟶HCN(aq); (e) S2−(aq)+H+(aq)⟶HS−(aq);S2−(aq)+H+(aq)⟶HS−(aq); (f) H2PO4−(aq)+H+(aq)⟶H3PO4(aq)H2PO4−(aq)+H+(aq)⟶H3PO4(aq) 7. Positive charges form when electrons are lost. Thus, the concentrations of solute species at equilibrium are: [(CH3)3NH+] = [OH−] = 2.6 ×× 10−3 M [(CH3)3N] = 0.11 M [H3O+] = 3.8 ×× 10−12 M; (e) [Fe(H2O)5(OH)+][H3O+][Fe(H2O)62+]=(x)(x)(0.120−x)≈(x)(x)0.120=1.6×10−7[Fe(H2O)5(OH)+][H3O+][Fe(H2O)62+]=(x)(x)(0.120−x)≈(x)(x)0.120=1.6×10−7 Solving for x gives 1.39 ×× 10−4 M. 54. (c) HOI < HOBr < HOCl; in a series of the same form of oxyacids, the acidity increases as the electronegativity of the central atom increases. (a) HSO4−;HSO4−; higher electronegativity of the central ion. Adapt — remix, transform, and build upon the material for any purpose, even commercially. 40. (c) pH = 5.220 92. Br is to the left and below S, so HBr is the stronger acid. 105. The structures are very similar. In the “real” mode, the lone pairs are larger, causing the hydrogens to be compressed. (a) (b) CO has the strongest carbon-oxygen bond because there is a triple bond joining C and O. (a) 0.435 mol Na, 0.217 mol Cl2, 15.4 g Cl2 (b) 0.005780 mol HgO, 2.890 × 10−3 mol O2, 9.248 × 10−2 g O2 (c) 8.00 mol NaNO3, 6.8 × 102 g NaNO3 (d) 1665 mol CO2, 73.3 kg CO2 (e) 18.86 mol CuO, 2.330 kg CuCO3 (f) 0.4580 mol C2H4Br2, 86.05 g C2H4Br2 45. ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. Mg (OH) 2 (s) + 2HCl (a q) ⟶ Mg 2+ (a q) + 2 Cl − (a q) + 2H 2 O (l) BB BA CB CA Mg (OH) 2 (s) + 2HCl (a q) ⟶ Mg 2+ (a q) + 2 Cl − (a q) + 2H 2 O (l) BB BA CB CA 35. 84. SiO2 + 3 C → SiC + 2 CO 4.50 kg SiO2 53. This value is less than 5% of 0.120, so the assumption that it can be neglected is valid. No warranties are given. NF3; 74. Thus, PH3 is weaker than HI. Only the outer electrons move. (a) Kb=1.8×10−5;Kb=1.8×10−5; (b) Ka=4.5×10−4;Ka=4.5×10−4; (c) Kb=6.4×10−5;Kb=6.4×10−5; (d) Ka=5.6×10−10Ka=5.6×10−10 56. 89. The stronger base or stronger acid is the one with the larger Kb or Ka, respectively. (b) The added KCH3CO2 will increase the concentration of [CH3CO2−][CH3CO2−] which will react with H3O+ and produce CH3CO2 H in the process. mol Cr → mol H3PO2 Then compare the amount of Cr to the amount of acid present. Percent yield = 31% 65. 48. In the model mode, each electron group occupies the same amount of space, so the bond angle is shown as 109.5°. 4.1 Writing and Balancing Chemical Equations 1. (a) 2 MnO4– (aq) + 3 NO2– (aq) + H2O (l)→ 2 MnO2 (s) + 3 NO3– (aq) + 2 OH– (aq) (b) 3 MnO42- (aq) + 2 H2O (l) → 2 MnO4– (aq) + 4 OH– (aq) + MnO2 (s) (in base) (c) Br2 (l) + SO2 (g) + 2 H2O (l) → 4 H+ (aq) + 2 Br- (aq) + SO42- (aq) 4.3 Reaction Stoichiometry 43. 2. The HBeH molecule (in which Be has only two electrons to bond with the two electrons from the hydrogens) must have the electron pairs as far from one another as possible and is therefore linear. (a) (b) (c) (d) (e) (f) 38. One example for NH3 as a conjugate acid: NH2−+H+⟶NH3;NH2−+H+⟶NH3; as a conjugate base: NH4+(aq)+OH−(aq)⟶NH3(aq)+H2O(l)NH4+(aq)+OH−(aq)⟶NH3(aq)+H2O(l) 3. 50. Percent yield = 91.3% 69. Only ClF5, ClO2−,ClO2−, PCl3, SeF4, and PH2−PH2− have dipole moments. 54. When two elements combine with each other to form two or more compounds, other are simple whole numbers. This value is less than 5% of 0.0092, so the assumption that it can be neglected is valid. Two valence electrons per Pb atom are transferred to Cl atoms; the resulting Pb2+ ion has a 6s2 valence shell configuration. (a) acid-base (b) oxidation-reduction: Na is oxidized, H+ is reduced (c) oxidation-reduction: Mg is oxidized, Cl2 is reduced (d) acid-base (e) oxidation-reduction: P3− is oxidized, O2 is reduced (f) acid-base 21. Assume we can neglect the contribution of water to the equilibrium concentration of H3O+. Space must be provided for each pair of electrons whether they are in a bond or are present as lone pairs. 1. Convert moles of ether to grams; divide the actual grams of ether (determined through the density) by the theoretical mass to determine the percent yield; 87.6% 71. (a) H2O, O2−; (b) H3O+, OH−; (c) H2CO3, CO32−;CO32−; (d) NH4+,NH4+, NH2−;NH2−; (e) H2SO4, SO42−;SO42−; (f) H3O2+,H3O2+, HO2−;HO2−; (g) H2S; S2−; (h) H6N22+,H6N22+, H4N2 9. Two electrons are shared in a single bond; four electrons are shared in a double bond; and six electrons are shared in a triple bond. (a) HNO3(BA), H2O(BB), H3O+(CA), NO3−(CB);NO3−(CB); (b) CN−(BB), H2O(BA), HCN(CA), OH−(CB); (c) H2SO4(BA), Cl−(BB), HCl(CA), HSO4−(CB);HSO4−(CB); (d) HSO4−(BA),HSO4−(BA), OH−(BB), SO42−SO42−(CB), H2O(CA); (e) O2−(BB), H2O(BA) OH−(CB and CA); (f) [Cu(H2O)3(OH)]+(BB), [Al(H2O)6]3+(BA), [Cu(H2O)4]2+(CA), [Al(H2O)5(OH)]2+(CB); (g) H2S(BA), NH2−(BB),NH2−(BB), HS−(CB), NH3(CA) 11. (a) Ca(OH)2 (s) + H2S (g) → CaS (s) + 2 H2O (l) (b) Na2CO3 (aq) + H2S (g) → Na2S (aq) + CO2 (g) + H2O (l) 35. (a) RbBr; (b) MgSe; (c) Na2O; (d) CaCl2; (e) HF; (f) GaP; (g) AlBr3; (h) (NH4)2SO4 27. An equation is balanced when the same number of each element is represented on the reactant and product sides. Thus, the concentrations of solute species at equilibrium are: [H3O+] = [CN−] = 6.3 ×× 10−6 M [HCN] = 0.0810 M [OH−] = 1.6 ×× 10−9 M; (d) [(CH3)3NH+][OH−][(CH3)3N]=(x)(x)(0.11−x)≈(x)(x)0.11=6.3×10−5[(CH3)3NH+][OH−][(CH3)3N]=(x)(x)(0.11−x)≈(x)(x)0.11=6.3×10−5 Solving for x gives 2.63 ×× 10−3 M. 9.6 × 10−3 M Cl− 83. 75. NaCl consists of discrete ions arranged in a crystal lattice, not covalently bonded molecules. (f) BrO4− [H +] 0 > [C 6 H 4 OH (CO 2) −] ≫ [C 6 H 4 O (CO 2 H) −] > [OH −] 47. 13. Only four molecules can be made. Rearrange d = m/ V t V = m/ d; V = 62.9 g/ 2.33 g/ cm3; Chapter 4: Atomic Structure 4.1 Democritus’ Idea of the Atom Practice Questions a Chemistry 233 Chapter 4 Problem Set 1) Determine the systematic (IUPAC) name for each alkane compound below. (a) pH = 2.50; (b) pH = 4.01; (c) pH = 5.60; (d) pH = 8.35; (e) pH = 11.08 Answer key for Chemistry 12 Chapter 4 on acid-base equilibrium. 87. 82. What … High school chemistry study guide covering atomic theory, subatomic particles, isotopes, and nuclear reactions. The larger number of oxygen atoms on the central atom (giving it a higher oxidation state) also creates a greater release of hydrogen atoms, resulting in a stronger acid. 73. (a) Sn4+ (aq) + 2 e– → Sn2+ (aq) (b) [Ag(NH3)]+ (aq) + e– → Ag (s) + 2 NH3 (aq) (c) Hg2Cl2 (s) + 2 e– → 2 Hg (l) + 2 Cl– (aq) (d) 2 H2O (l) → O2 (g) + 4 H+ (aq) + 4 e– (e) 6 H2O (l) + 2IO3- (aq) + 10 e– → I2 (s) + 12 OH– (aq) (f) H2O (l) + SO32- (aq) → SO42- (aq) + 2 H+ (aq) + 2 e– (g) 8 H+ (aq) + MnO4– (aq) + 5 e– → Mn2+ (aq) + 4 H2O (l) (h) Cl– (aq) + 6 OH– (aq) → ClO3– (aq) + 3 H2O (l) + 6 e– 39. This free textbook is an OpenStax resource written to increase student access to high-quality, peer-reviewed learning materials. The equilibrium will shift to the right, increasing the concentration of HNO2, and decreasing the concentration of NO2−NO2− ions. 176 g TiO2 4.4 Reaction Yields 61. Assume that the change in initial concentration of the acid as the equilibrium is established can be neglected, so this concentration can be assumed constant and equal to the initial value of the total acid concentration. Thus, the concentrations of solute species at equilibrium are: [C6H5 NH3+][C6H5 NH3+] = [OH−] = 5.8 ×× 10−6 M [C6H5NH2] = 0.0784 M [H3O+] = 1.7×× 10−9 M; (c) [H3O+][CN−][HCN]=(x)(x)(0.0810−x)≈(x)(x)0.0810=4.9×10−10[H3O+][CN−][HCN]=(x)(x)(0.0810−x)≈(x)(x)0.0810=4.9×10−10 Solving for x gives 6.30 ×× 10−6 M. 37. Includes Arrhenius, conjugate pairs, and acid/base strength solutions. (a) Ka2=1.5×10−11;Ka2=1.5×10−11; (b) Kb=4.3×10−12;Kb=4.3×10−12; (c) [Te2−][H3O+][HTe−]=(x)(0.0141+x)(0.0141−x)≈(x)(0.0141)0.0141=1.5×10−11[Te2−][H3O+][HTe−]=(x)(0.0141+x)(0.0141−x)≈(x)(0.0141)0.0141=1.5×10−11 Solving for x gives 1.5 ×× 10−11 M. 22.4% 85. (a) Complete: 2 K+ (aq) + C2O42- (aq) + Ba2+ (aq) + 2 OH- (aq) → 2 K+ (aq) + 2 OH- (aq) + BaC2O4 (s) Net: Ba2+ (aq) + C2O42- (aq) → BaC2O4 (s) (b) Complete: Pb2+ (aq) + 2 NO3- (aq) + 2 H+ (aq) + SO42- (aq) → PbSO4 (s) + 2 H+ (aq) + 2 NO3- (aq) Net: Pb2+ (aq) + SO42- (aq) → PbSO4 (s) (c) Complete: CaCO3 (s) + 2 H+ (aq) + SO42- (aq) → CaSO4 (aq) + CO2 (g) + H2O (l) Net: CaCO3 (s) + 2 H+ (aq) + SO42- (aq) → CaSO4 (aq) + CO2 (g) + H2O (l) 4.2 Classifying Chemical Reactions 13. (a) 2 HCl (g) + Ca(OH)2 (s) → CaCl2 (s) + 2 H2O (l) (b) Sr(OH)2 (aq) + 2 HNO3 (aq) → Sr(NO3)2 (aq) + 2 H2O (l) 23. (a) electron-pair geometry: octahedral, molecular structure: square pyramidal; (b) electron-pair geometry: tetrahedral, molecular structure: bent; (c) electron-pair geometry: octahedral, molecular structure: square planar; (d) electron-pair geometry: tetrahedral, molecular structure: trigonal pyramidal; (e) electron-pair geometry: trigonal bypyramidal, molecular structure: seesaw; (f) electron-pair geometry: tetrahedral, molecular structure: bent (109°) 85. As long as the polar bonds are compensated (for example. [C10H14N2] = 0.049 M; [C10H14N2H+] = 1.9 ×× 10−4 M; [C10H14N2H22+][C10H14N2H22+] = 1.4 ×× 10−11 M; [OH−] = 1.9 ×× 10−4 M; [H3O+] = 5.3 ×× 10−11 M 66. Amphiprotic species may either gain or lose a proton in a chemical reaction, thus acting as a base or an acid. (a) H, C, N, O, F; (b) H, I, Br, Cl, F; (c) H, P, S, O, F; (d) Na, Al, H, P, O; (e) Ba, H, As, N, O 21. 81. (a) Ba(NO3)2, KClO3 (b) 2 KClO3 (s) → 2 KCl (s) + 3 O2 (g) (c) 2 Ba(NO3)2 (s) → 2 BaO (s) + 2 N2 (g) + 5 O2 (g) (d) 2 Mg (s) + O2 (g) → 2 MgO (s) 4 Al (s) + 3 O2 (g) → 2 Al2O3 (s) 4 Fe (s) + 3 O2 (g) → 2 Fe2O3 (s) 9. 1. Thus, the concentrations of solute species at equilibrium are: [Fe(H2O)5(OH)+] = [H3O+] = 1.4 ×× 10−4 M [Fe(H2O)62+][Fe(H2O)62+] = 0.120 M [OH−] = 7.2 ×× 10−11 M 64. 95. (a) HF; (b) CO; (c) OH; (d) PCl; (e) NH; (f) PO; (g) CN 23. Each bond includes a sharing of electrons between atoms. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. As an acid: H2O(aq)+NH3(aq)⇌NH4+(aq)+OH−(aq).H2O(aq)+NH3(aq)⇌NH4+(aq)+OH−(aq). SeS2, CCl2F2, PCl3, and ClNO all have dipole moments. (b) Adding HNO2 increases the concentration of HNO2 and shifts the equilibrium to the left, increasing the concentration of NO2−NO2− ions and decreasing the concentration of OH− ions. This value is less than 5% of 0.0810, so the assumption that it can be neglected is valid. (a) (b) (c) (d) (e) 52. In a periodic group, the more electronegative element has the more basic anion. (a) H: 0, Cl: 0; (b) C: 0, F: 0; (c) P: 0, Cl 0; (d) P: 0, F: 0 64. This amount cannot be weighted by ordinary balances and is worthless. This is a case in which the solution contains a mixture of acids of different ionization strengths. (a) Both the electron geometry and the molecular structure are octahedral. (a) In this case, the Lewis structure is inadequate to depict the fact that experimental studies have shown two unpaired electrons in each oxygen molecule. The Lewis structure is made from three units, but the atoms must be rearranged: 103. (c) HI; PH3 is weaker than HCl; HCl is weaker than HI. (a) cesium chloride; (b) barium oxide; (c) potassium sulfide; (d) beryllium chloride; (e) hydrogen bromide; (f) aluminum fluoride 25. The license may not give you all of the permissions necessary for your intended use. The licensor cannot revoke these freedoms as long as you follow the license terms. amphiprotic: (a) NH3+H3O+⟶NH4OH+H2O,NH3+H3O+⟶NH4OH+H2O, NH3+OCH3−⟶NH2−+CH3OH;NH3+OCH3−⟶NH2−+CH3OH; (b) HPO42−+OH−⟶PO43−+H2O,HPO42−+OH−⟶PO43−+H2O, HPO42−+HClO4⟶H2PO4−+ClO4−;HPO42−+HClO4⟶H2PO4−+ClO4−; not amphiprotic: (c) Br−; (d) NH4+;NH4+; (e) AsO43−AsO43− 15. Thus, [CH3CO2H] decreases slightly and [CH3CO2−][CH3CO2−] increases. (a) pH = 3.587; pOH = 10.413; (b) pOH = 0.68; pH = 13.32; (c) pOH = 3.85; pH = 10.15; (d) pOH = −0.40; pH = 14.4 21. K a = 1.2 × 10 −2 K a = 1.2 × 10 −2 68. (a) acidic; (b) basic; (c) acidic; (d) neutral 72. (a) 4 HF (aq) + SiO2 (s) → SiF4 (g) + 2 H2O (l) (b) Complete ionic equation: 2 Na+ (aq) + 2 F– (aq) + 2 Ca2+ (aq) + 2 Cl– (aq) → CaF2 (s) + 2 Na+ (aq) + 2 Cl– (aq) Net ionic equation: 2 F– (aq) + Ca2+ (aq) → CaF2 (s) 11. This value is less than 5% of 0.11, so the assumption that it can be neglected is valid. x = 3.051 ×× 10−7 M = [H3O+] = [OH−]; pH = −log3.051 ×× 10−7 = −(−6.5156) = 6.5156; pOH = pH = 6.5156 19. 41. Excess H3O+ is removed primarily by the reaction: H3O+(aq)+H2PO4−(aq)⟶H3PO4(aq)+H2O(l)H3O+(aq)+H2PO4−(aq)⟶H3PO4(aq)+H2O(l) Excess base is removed by the reaction: OH−(aq)+H3PO4(aq)⟶H2PO4−(aq)+H2O(l)OH−(aq)+H3PO4(aq)⟶H2PO4−(aq)+H2O(l) 80. 79. (a) The added HCl will increase the concentration of H3O+ slightly, which will react with CH3CO2−CH3CO2− and produce CH3CO2H in the process. (e) Adding KNO2 adds NO2−NO2− ions and shifts the equilibrium to the right, increasing the HNO2 and OH− ion concentrations. (a) Sn2+ (aq) + 2 Cu2+ (aq) → Sn4+ (aq) + 2 Cu+ (aq) (b) H2S (g) + Hg22+ (aq) + 2 H2O (l) → 2 Hg (l) + S (s) + 2 H3O+ (l) (c) 5 CN– (aq) + 2 ClO2 (aq) + 3 H2O (l) → 5 CNO– (aq) + 2 Cl– (aq) + 2 H3O+ (l) (d) Fe2+ (aq) + Ce4+ (aq) → Fe3+ (aq) + Ce3+ (aq) (e) 2 HBrO (aq) + 2 H2O (l) → 2 H3O+ (l) + 2 Br– (aq) + O2 (g) 41. No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. [H3O+] and [HCO3−][HCO3−] are practically equal 74. 50. (d) Both the electron geometry and the molecular structure are trigonal planar. The stronger acid, HCl, is the dominant producer of hydronium ions because it is completely ionized. Thus, the concentrations of solute species at equilibrium are: [H3O+] = [ClO–] = 1.6 ×× 10−5 M [HClO–] = 0.0092 M [OH−] = 6.1 ×× 10−10 M; (b) [C6 H5NH3 +][OH−][C6H5NH2]=(x)(x)(0.0784−x)≈ (x)(x)0.0784=4.3×10−10[C6 H5NH3 +][OH−][C6H5NH2]=(x)(x)(0.0784−x)≈ (x)(x)0.0784=4.3×10−10 Solving for x gives 5.81 ×× 10−6 M. (e) HTe−

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