

General Properties of Aqueous Solutions (Section 4.1)

4.13 State whether each of the following statements is true or false. Justify your answer in each case.

- (a) Electrolyte solutions conduct electricity because electrons are moving through the solution.
- (b) If you add a nonelectrolyte to an aqueous solution that already contains an electrolyte, the electrical conductivity will not change.

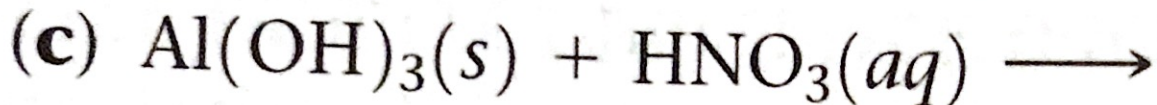
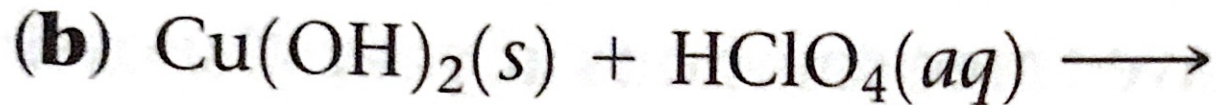
4.15 We have learned in this chapter that many ionic solids dissolve in water as strong electrolytes; that is, as separated ions in solution. Which statement is most correct about this process? **(a)** Water is a strong acid and therefore is good at dissolving ionic solids. **(b)** Water is good at solvating ions because the hydrogen and oxygen atoms in water molecules bear partial charges. **(c)** The hydrogen and oxygen bonds of water are easily broken by ionic solids.

4.17 Specify what ions are present in solution upon dissolving each of the following substances in water: **(a)** FeCl_2 , **(b)** HNO_3 , **(c)** $(\text{NH}_4)_2\text{SO}_4$, **(d)** $\text{Ca}(\text{OH})_2$.

4.35 Label each of the following substances as an acid, base, salt, or none of the above. Indicate whether the substance exists in aqueous solution entirely in molecular form, entirely as ions, or as a mixture of molecules and ions. **(a)** HF, **(b)** acetonitrile, CH_3CN , **(c)** NaClO_4 , **(d)** $\text{Ba}(\text{OH})_2$.

4.37 Classify each of the following substances as a nonelectrolyte, weak electrolyte, or strong electrolyte in water: **(a)** H_2SO_3 , **(b)** $\text{CH}_3\text{CH}_2\text{OH}$ (ethanol), **(c)** NH_3 , **(d)** KClO_3 , **(e)** $\text{Cu}(\text{NO}_3)_2$.

4.39 Complete and balance the following molecular equations, and then write the net ionic equation for each:



Oxidation-Reduction Reactions (Section 4.4)

4.45 *True or false:*

- (a) If a substance is oxidized, it is gaining electrons.*
- (b) If an ion is oxidized, its oxidation number increases.*

4.49 Determine the oxidation number for the indicated element in each of the following substances: **(a)** S in SO_2 , **(b)** C in COCl_2 , **(c)** Mn in KMnO_4 , **(d)** Br in HBrO , **(e)** P in PF_3 , **(f)** O in K_2O_2 .

4.53 Write balanced molecular and net ionic equations for the reactions of (a) manganese with dilute sulfuric acid, (b) chromium with hydrobromic acid, (c) tin with hydrochloric acid, (d) aluminum with formic acid, HCOOH .

4.61 (a) Calculate the molarity of a solution that contains 0.175 mol ZnCl_2 in exactly 150 mL of solution. (b) How many moles of protons are present in 35.0 mL of a 4.50 *M* solution of nitric acid? (c) How many milliliters of a 6.00 *M* NaOH solution are needed to provide 0.350 mol of NaOH?

4.69 (a) Which will have the highest concentration of potassium ion: 0.20 M KCl , $0.15\text{ M K}_2\text{CrO}_4$, or $0.080\text{ M K}_3\text{PO}_4$?

(b) Which will contain the greater number of moles of potassium ion: 30.0 mL of $0.15\text{ M K}_2\text{CrO}_4$ or 25.0 mL of $0.080\text{ M K}_3\text{PO}_4$?

- CALCULATE the pH of the following solutions:
- 0.003 M HCl, 0.20 M HNO₃, 0.005 M NaOH.