

CHAPTER THREE

Classifying Chemical Reaction

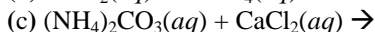
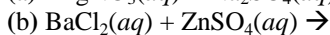
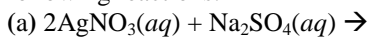
4.13 What is the difference between an ionic equation and a molecular equation?

4.14 What is the advantage of writing net ionic equations?

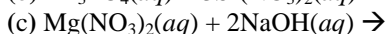
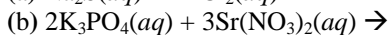
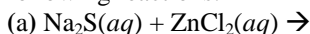
4.15 Characterize the following compounds as soluble or insoluble in water: (a) $\text{Ca}_3(\text{PO}_4)_2$, (b) $\text{Mn}(\text{OH})_2$, (c) AgClO_3 , (d) K_2S .

4.16 Characterize the following compounds as soluble or insoluble in water: (a) CaCO_3 , (b) ZnSO_4 , (c) $\text{Hg}(\text{NO}_3)_2$, (d) HgSO_4 , (e) NH_4ClO_4 .

4.17 Write ionic and net ionic equations for the following reactions:



4.18 Write ionic and net ionic equations for the following reactions:



4.19 Which of the following processes will likely result in a precipitation reaction? (a) Mixing a NaNO_3 solution with a CuSO_4 solution. (b) Mixing a BaCl_2 solution with a K_2SO_4 solution. Write a net ionic equation for the precipitation reaction.

4.20 With reference to Table 4.2, suggest one method by which you might separate (a) K^+ from Ag^+ , (b) Ag^+ from Pb^{2+} , (c) NH_4^+ from Ca^{2+} , (d) Ba^{2+} from Cu^{2+} . All cations are assumed to be in aqueous solution, and the common anion is the nitrate ion.

4.31 Give an example of a combination redox reaction, a decomposition redox reaction, and a displacement redox reaction.

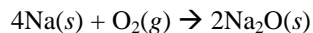
4.32 All combustion reactions are redox reactions. True or false? Explain.

4.33 What is an oxidation number? How is it used to identify redox reactions? Explain why, except for ionic compounds, oxidation number does not have any physical significance.

4.34 (a) Without referring to Figure 4.10, give the oxidation numbers of the alkali and alkaline earth metals in their compounds. (b) Give the highest oxidation numbers that the Groups 3A–7A elements can have.

4.35 How is the activity series organized? How is it used in the study of redox reactions?

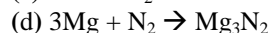
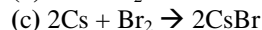
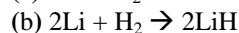
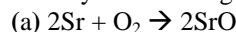
4.36 Use the following reaction to define redox reaction, half-reaction, oxidizing agent, reducing agent:



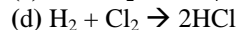
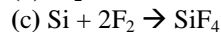
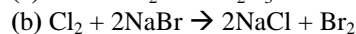
4.37 Is it possible to have a reaction in which oxidation occurs and reduction does not? Explain.

4.38 What is the requirement for an element to undergo disproportionation reactions? Name five common elements that are likely to take part in such reactions.

4.39 For the complete redox reactions given below, (i) break down each reaction into its half-reactions; (ii) identify the oxidizing agent; (iii) identify the reducing agent.



4.40 For the complete redox reactions given below, write the half-reactions and identify the oxidizing and reducing agents:



4.41 Arrange the following species in order of increasing oxidation number of the sulfur atom: (a) H_2S , (b) S_8 , (c) H_2SO_4 , (d) S^{2-} , (e) HS^- , (f) SO_2 , (g) SO_3 .

4.42 Phosphorus forms many oxoacids. Indicate the oxidation number of phosphorus in each of the following acids: (a) HPO_3 , (b) H_3PO_2 , (c) H_3PO_3 , (d) H_3PO_4 , (e) $\text{H}_4\text{P}_2\text{O}_7$, (f) $\text{H}_5\text{P}_3\text{O}_{10}$.

4.43 Give the oxidation number of the underlined atoms in the following molecules and ions: (a) $\underline{\text{C}}\text{IF}$, (b) $\underline{\text{I}}\text{F}_7$, (c) $\underline{\text{C}}\text{H}_4$, (d) $\underline{\text{C}}_2\text{H}_2$, (e)

C₂H₄, (f) K₂CrO₄, (g) K₂Cr₂O₇, (h) KMnO₄, (i) NaHCO₃, (j) Li₂, (k) NaIO₃, (l) KO₂, (m) PF₆, (n) KAuCl₄.

4.44 Give the oxidation number for the following species:

H₂, Se₈, P₄, O, U, As₄, B₁₂.

4.45 Give oxidation numbers for the underlined atoms in the following molecules and ions: (a)

CS₂O, (b) CaL₂, (c) Al₂O₃, (d) H₃AsO₃, (e) TiO₂, (f) MoO₄²⁻, (g) PtCl₄²⁻, (h) PtCl₆²⁻, (i) SnF₂, (j) ClF₃, (k) SbF₆⁻.

4.46 Give the oxidation numbers of the underlined atoms in the following molecules and ions: (a) Mg₃N₂, (b) CsO₂, (c) CaC₂, (d) CO₃²⁻, (e) C₂O₄²⁻, (f) ZnO₂²⁻, (g) NaBH₄, (h) WO₄²⁻.

4.47 Nitric acid is a strong oxidizing agent. State which of the following species is *least* likely to be produced when nitric acid reacts with a strong reducing agent such as zinc metal, and explain why: N₂O, NO, NO₂, N₂O₄, N₂O₅, NH₄⁺.

4.48 Which of the following metals can react with water? (a) Au, (b) Li, (c) Hg, (d) Ca, (e) Pt.

4.49 On the basis of oxidation number considerations, one of the following oxides would not react with molecular oxygen: NO, N₂O, SO₂, SO₃, P₄O₆. Which one is it? Why?

4.50 Predict the outcome of the reactions represented by the following equations by using the activity series, and balance the equations.

- (a) Cu(s) + HCl(aq) →
(b) I₂(s) + NaBr(aq) →
(c) Mg(s) + CuSO₄(aq) →
(d) Cl₂(g) + KBr(aq) →

4.51 Classify the following redox reactions:

- (a) 2H₂O₂ → 2H₂O + O₂
(b) Mg + 2AgNO₃ → Mg(NO₃)₂ + 2Ag
(c) NH₄NO₂ → N₂ + 2H₂O
(d) H₂ + Br₂ → 2HBr

4.52 Classify the following redox reactions:

- (a) P₄ + 10Cl₂ → 4PCl₅
(b) 2NO → N₂ + O₂
(c) Cl₂ + 2KI → 2KCl + I₂
(d) 3HNO₂ → HNO₃ + H₂O + 2NO

4.91 Classify the following reactions according to the types discussed in the chapter:

- (a) Cl₂ + 2OH⁻ → Cl⁻ + ClO⁻ + H₂O

