References and Questions

LITERATURE CITED

1. Manahan, Stanley E., *Environmental Chemistry*, 9th ed., Taylor & Francis/CRC Press, Boca Raton, FL, 2010.

2.Anastas, Paul T., and John C. Warner, *Green Chemistry Theory and Practice*, Oxford University Press, 1998.

3. Manahan, Stanley E., *Fundamentals of Sustainable Chemical Science*, Taylor & Francis/CRC Press, Boca Raton, FL, 2009.

SUPPLEMENTARY REFERENCES

Allen, David T., and David R. Shonnard, *Green Engineering: Environmentally Conscious Design of Chemical Processes*, Prentice Hall, Upper Saddle River, NH, 2002.

Brown, Lawrence S., and Thomas A. Holme, *Chemistry for Engineering Students*, 2nd ed., Brooks/Cole Cengage Learning, Belmont, CA, 2011.

Brown, Theodore L., H. Eugene Lemay, Bruce E. Bursten, Catherine J. Murphy, and Patrick Woodward, Chemistry: The Central Science, 11th ed., Prentice Hall, Upper Saddle River, NJ, 2008.

Anastas, Paul, Ed., *Handbook of Green Chemistry*, Wiley-VCH, New York, 2010.

Clark James and Duncan MacQuarrie, *Handbook of Green Chemistry and Technology*, Blackwell Science, Malden, MA, 2002.

Denniston, Katherine J., Joseph J. Topping, and Robert L. Caret, *General, Organic, and Biochemistry*, 7th ed., McGraw-Hill, New York, 2011.

Doble, Mukesh, and Anil Kumar Kruthiventi, *Green Chemistry and Processes*, Elsevier, Amsterdam, 2007.

Frost, Laura D., S. Todd Deal, and Karen C. Timberlake,*General, Organic, and Biological Chemistry: An Integrated Approach*, Prentice Hall, Upper Saddle River, NJ, 2010.

Guinn, Denise, and Rebecca Brewer, *Essentials of General, Organic, and Biochemistry: An Integrated Approach*, W. H. Freeman and Co., New York, 2009.

Hill, John W., and Doris Kolb, *Chemistry for Changing Times*, 11th ed, Prentice Hall, Upper Saddle River, NJ, 2006.

Horvath, Istvan T., and Paul T. Anastas, "Innovations and Green Chemistry," *Chemical Reviews*, **107**, 2169-2173 (2007).

Lancaster, Mike, *Green Chemistry*, Royal Society of Chemistry, London, 2002.

Li, Chao-Jun, and Barry M. Trost, "Green Chemistry for Chemical Synthesis," *Proceedings of the National Academy of Sciences of the United States of America*, **105**, 13197-13202 (2008).

Matlack, Albert, *Introduction to Green Chemistry*, 2nd ed., CRC Press, Boca Raton, FL, 2010.

McMurry, John, David S. Ballantine, Carl A. Hoeger, Virginia E. Peterson, and Mary E. Castellion, *Fundamentals of General, Organic, and Biological Chemistry*, 6th ed., Prentice-Hall, Upper Saddle River, NJ, 2009.

Mickulecky, Peter J., Katherine Brutlag, Michelle Gilman, and Brian Peterson, *Chemistry Workbook for Dummies*, Wiley, Hoboken, NJ, 2008.

Middlecamp, Catherine, Steve Keller, Karen Anderson, Anne Bentley, Michael Cann, *Chemistry in Context*, 7th ed., McGraw-Hill, Dubuque, IA, 2011.

Roesky, Herbert W., Dietmar Kennepohl, and Jean-Marie Lehn, *Experiments in Green and Sustainable Chemistry*, Wiley-VCH, Weinheim, Germany, 2009.

Moore, John W., Conrad L. Stanitski, and Peter C. Jurs, *Chemistry: The Molecular Science*, 4th ed., Brooks/Cole Cengage Learning, Belmont, CA, 2011.

Smith, Janice G.,*Principles of General, Organic, and Biochemistry*, McGraw-Hill, New York, 2011.

Viegas, Jennifer, Ed., *Critical Perspectives on Planet Earth*, Rosen Publishing Group, New York, 2007.

QUESTIONS AND PROBLEMS

Access to and use of the internet are assumed in answering all questions including general information, statistics, constants, and mathematical formulas required to solve problems. These questions are designed to promote inquiry and thought rather than just finding material in the text. So in some cases there may be several "right" answers. Therefore, if your answer reflects intellectual effort and a search for information from available sources, your answer can be considered to be "right."

1. What is chemistry? Why is it impossible to avoid chemistry?

2. What is green chemistry?

3. Match the following pertaining to major areas of chemistry:

    A. Analytical chemistry 1. Occurs in living organisms

    B. Organic chemistry 2. Underlying theory and physical phenomena

    C. Biochemistry 3. Chemistry of most elements other than carbon

    D. Physical chemistry 4. Chemistry of most carbon-containing compounds

    E. Inorganic Chemistry 5. Measurement of kinds and quantities of chemicals

4. What are the five environmental spheres? Which of these did not exist before humans evolved on Earth?

5. Discuss why you think the very thin "skin" of Earth ranging from perhaps two or three kilometers in depth below the surface to several kilometers (several miles) in altitude in the atmosphere has particular environmental importance.

6. What is environmental chemistry?

7. Which event may be regarded as the beginning of the modern environmental movement?

8. What is the command and control approach to pollution control?

9. What is the Toxics Release Inventory, TRI. How does it reduce pollution?

10. Why are incremental increases in regulations under the command and control approach to pollution control much less effective now than they were when pollution control laws were first enacted and enforced?

11. What is the special relationship of green chemistry to synthetic chemistry?

12. What does Figure 2.1 show with respect to environmental chemistry, green chemistry, and other topics discussed in this chapter?

13. In which important respects is green chemistry sustainable chemistry?

14. With respect to raw materials, what are two general and often complementary approaches to the practice of green chemistry?

15. What is the distinction between yield and atom economy?

16. For a chemical synthesis of a pharmaceutical compound, 100 kilograms (kg) of reactants mixed in the exact proportions that would give a 100% theoretical yield of product would give 65.2 kg of product, the rest being byproduct. In an actual chemical synthesis, an excess of 10kg of one of the reactants was added to the 100 kg of mixture to help push the reaction to completion. After the total of 110 kg of reactants was put through the process, an actual yield of 59.5 kg of product was obtained. What was the percent yield? What was the percent atom economy?

17. What are two factors that go into assessing risk?

18. What are the risks of no risks?

19. What are the major basic principles of green chemistry?

20. What is shown by the formula O_3? What about H_2O_2?

21. How does a covalent bond differ from an ionic bond?

22. What is the name given to a kind of material in which two or more different elements are bonded together?

23. Considering the compound shown in Figure 2.8, what is the name of the compound formed when a magnesium atom transfers two electrons to an oxygen atom giving a compound consisting of Mg^{2+} cations and O^{2-} anions?

24. Summarize the information given by $3H_2 + O_3 \rightarrow 3H_2O$.

25. In addition to showing the correct reactants and products, a correct chemical equation must be_____.

26. Name three kinds of matter based upon purity. Which of these is extremely rare?

27. In terms of molecules, how are gases, liquids, and solids distinguished?

28. Describe gas pressure and temperature in terms of molecular motion.

29.What is the Presidential Green Chemistry Challenge? What have been some of the winning ideas in this challenge?

30. Which elemental species mentioned in this chapter is present in photochemical smog?
