

Energy and Chemical Change

Section 15.1 Energy

pages 516–522

Practice Problems

pages 519–521

1. A fruit and oatmeal bar contains 142 nutritional Calories. Convert this energy to calories.

$$142 \text{ Calories} = 142 \text{ kcal}$$

$$142 \text{ kcal} \times \frac{1000 \text{ cal}}{1 \text{ kcal}} = 142,000 \text{ cal}$$

2. An exothermic reaction releases 86.5 kJ. How many kilocalories of energy are released?

$$86.5 \text{ kJ} \times \frac{1 \text{ kcal}}{4.184 \text{ kJ}} = 20.7 \text{ kcal}$$

3. **Challenge** Define a new energy unit, named after yourself, with a magnitude of one-tenth of a calorie. What conversion factors relate this new unit to joules? To Calories?

$$\text{Unit X} = 0.1 \text{ cal}$$

$$1 \text{ cal} = 4.184 \text{ J}$$

$$\text{X} = (0.1 \text{ cal})(4.184 \text{ J/cal}) = 0.4184 \text{ J}$$

$$1 \text{ cal} = 0.001 \text{ Calorie}$$

$$\text{X} = (0.1 \text{ cal})(1 \text{ Cal}/1000 \text{ cal}) = 0.0001 \text{ Calorie}$$

4. If the temperature of 34.4 g of ethanol increases from 25.0°C to 78.8°C, how much heat has been absorbed by the ethanol? Refer to Table 15.2.

$$q = c \times m \times \Delta T$$

$$q = 2.44 \text{ J/(g}\cdot\text{°C)} \times 34.4 \text{ g} \times 53.8\text{°C} = 4.52 \times 10^3 \text{ J}$$

5. A 155-g sample of an unknown substance was heated from 25.0°C to 40.0°C. In the process, the substance absorbed 5696 J of energy. What is the specific heat of the substance? Identify the substance among those listed in Table 15.2 on page 520.

$$q = c \times m \times \Delta T$$

$$c = \frac{q}{m\Delta T} = \frac{(5696 \text{ J})}{(155 \text{ g})(40.0 - 25.0\text{°C})} = 2.45 \text{ J/(g}\cdot\text{°C)}$$

The specific heat is very close to the value for ethanol.

6. **Challenge** A 4.50-g nugget of pure gold absorbed 276 J of heat. The initial temperature was 25.0°C. What was the final temperature?

$$q = c \times m \times \Delta T$$

$$\Delta T = \frac{q}{cm} = \frac{(276 \text{ J})}{(0.129 \text{ J/g}\cdot\text{°C})(4.50 \text{ g})} = 475\text{°C}$$

$$\Delta T = T_f - T_i = T_f - 25.0\text{°C} = 475\text{°C}$$

$$T_f = 5.00 \times 10^2\text{°C}$$

Section 15.1 Assessment

page 522

7. **Explain** how energy changes from one form to another in an exothermic reaction. In an endothermic reaction.

Chemical potential energy changes to heat in exothermic reactions and the heat is released. In endothermic reactions, heat is absorbed and changed to chemical potential energy.

8. **Distinguish** between kinetic and potential energy in the following examples: two separated magnets; an avalanche of snow; books on library shelves; a mountain stream; a stock-car race; separation of charge in a battery.

Two separated magnets illustrate potential energy. In a snow avalanche, positional potential energy is changing to kinetic energy. Books on a shelf illustrate positional potential energy. As water races down a mountain stream, positional potential energy is changing to kinetic energy. In a stock-car race, chemical potential energy is being changed to kinetic energy. The separation of charge in a battery illustrates electrical potential energy.

9. **Explain** how the light and heat of a burning candle are related to chemical potential energy.

Chemical potential energy, contained in the candle, is changed to energy in the form of light and heat and released as the chemical combustion reaction takes place.

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Table of Contents Chemistry Matter And Change Chapter 3 Study Guide Answer Key

1. Understanding the eBook Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - The Rise of Digital Reading Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - Advantages of eBooks Over Traditional Books
2. Identifying Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - User-Friendly Interface
4. Exploring eBook Recommendations from Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - Personalized Recommendations
 - Chemistry Matter And Change Chapter 3 Study Guide Answer Key User Reviews and Ratings
 - Chemistry Matter And Change Chapter 3 Study Guide Answer Key and Bestseller Lists

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5. Accessing Chemistry Matter And Change Chapter 3 Study Guide Answer Key Free and Paid eBooks
 - Chemistry Matter And Change Chapter 3 Study Guide Answer Key Public Domain eBooks
 - Chemistry Matter And Change Chapter 3 Study Guide Answer Key eBook Subscription Services
 - Chemistry Matter And Change Chapter 3 Study Guide Answer Key Budget-Friendly Options
6. Navigating Chemistry Matter And Change Chapter 3 Study Guide Answer Key eBook Formats
 - ePub, PDF, MOBI, and More
 - Chemistry Matter And Change Chapter 3 Study Guide Answer Key Compatibility with Devices
 - Chemistry Matter And Change Chapter 3 Study Guide Answer Key Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - Highlighting and Note-Taking Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - Interactive Elements Chemistry Matter And Change Chapter 3 Study Guide Answer Key
8. Staying Engaged with Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Chemistry Matter And Change Chapter 3 Study Guide Answer Key
9. Balancing eBooks and Physical Books Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Chemistry Matter And Change Chapter 3 Study Guide Answer Key
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - Setting Reading Goals Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - Fact-Checking eBook Content of Chemistry Matter And Change Chapter 3 Study Guide Answer Key
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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