

Bond Energy

What makes a reaction endothermic or exothermic?

Why?

Chemical reactions can be a lot like playing with Legos®—you must take apart part of your last creation before you can replace it with something new. For many chemical reactions, we have to first break bonds in the reactants before we can put the atoms back into a new arrangement to form the products. Both of these processes involve changes in energy. The net energy change for a reaction is called the **heat of reaction** or the **change in enthalpy** (ΔH). In this activity we will look at one way energy changes can be approximated for chemical reactions.

Model 1 – Breaking and Forming Bonds

	Reaction	Change in Energy (kJ/mol _{rxn})		Reaction	Change in Energy (kJ/mol _{rxn})
A)	$\text{PCl}_3(\text{g}) \rightarrow \text{P}(\text{g}) + 3\text{Cl}(\text{g})$	+ 966.7 <i>broken</i>	E)	$\text{P}(\text{g}) + 3\text{Cl}(\text{g}) \rightarrow \text{PCl}_3(\text{g})$	- 966.7 <i>formed</i>
B)	$\text{PCl}_5(\text{g}) \rightarrow \text{P}(\text{g}) + 5\text{Cl}(\text{g})$	+ 1,297.9 <i>broken</i>	F)	$\text{P}(\text{g}) + 5\text{Cl}(\text{g}) \rightarrow \text{PCl}_5(\text{g})$	- 1,297.9 <i>formed</i>
C)	$\text{PF}_3(\text{g}) \rightarrow \text{P}(\text{g}) + 3\text{F}(\text{g})$	+ 1,470.4 <i>broken</i>	G)	$\text{P}(\text{g}) + 3\text{F}(\text{g}) \rightarrow \text{PF}_3(\text{g})$	- 1,470.4 <i>formed</i>
D)	$\text{PF}_5(\text{g}) \rightarrow \text{P}(\text{g}) + 5\text{F}(\text{g})$	+ 2,305.4 <i>broken</i>	H)	$\text{P}(\text{g}) + 5\text{F}(\text{g}) \rightarrow \text{PF}_5(\text{g})$	- 2,305.4 <i>formed</i>

- Identify four reactions in Model 1 where bonds are being broken. Write "broken" in the Change in Energy box in the table for each reaction you identify.
- Identify four reactions in Model 1 where bonds are being formed. Write "formed" in the Change in Energy box in the table for each reaction you identify.
- Circle the correct word to complete each sentence below.
 - When bonds are (broken/formed) there is a positive energy change.
 - Breaking bonds is (endothermic/exothermic).
 - When bonds are (broken/formed) there is a negative energy change.
 - Forming bonds is (endothermic/exothermic).
- Find two reactions in Model 1 that are exact opposites of each other, that is, one reaction is the reverse of the other reaction.

- How do the changes in energy for the reverse reactions compare?

The changes in energy for these reactions are the same, but opposite in sign.

- Explain your answer to part a considering what you learned from Questions 1–3 about bond breaking and bond formation.

If a given amount of energy is required to break a bond, then the same amount of energy will be released when the bond is formed.

Bond Energy Pogil Answer Key

Richard S. Moog, John J. Farrell



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Table of Contents Bond Energy Pogil Answer Key

1. Understanding the eBook Bond Energy Pogil Answer Key
 - The Rise of Digital Reading Bond Energy Pogil Answer Key
 - Advantages of eBooks Over Traditional Books
2. Identifying Bond Energy Pogil 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 Bond Energy Pogil Answer Key
 - User-Friendly Interface
4. Exploring eBook Recommendations from Bond Energy Pogil Answer Key
 - Personalized Recommendations
 - Bond Energy Pogil Answer Key User Reviews and Ratings
 - Bond Energy Pogil Answer Key and Bestseller Lists
5. Accessing Bond Energy Pogil Answer Key Free and Paid eBooks

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