

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.



Answer Key Pogil Bond Energy

Suzanne M. Ruder, The POGIL Project



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

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