

# 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** ( $\Delta H$ ). 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 <sub>rxn</sub> )		Reaction	Change in Energy (kJ/mol <sub>rxn</sub> )
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.*

# Flinn Scientific Pogil Activity Bond Energy Answers

**Aaas,Project 2061**



## **Flinn Scientific Pogil Activity Bond Energy Answers:**

Matter and Energy for Growth and Activity Aaas, Project 2061, 2019 How do our bodies manage to heal wounds build the stamina to run marathons and give us the energy even while we re sleeping to keep us alive and functioning Matter and Energy for Growth and Activity prompts high school students to explore fascinating questions like these It takes a new approach to teaching essential ideas about food human body systems matter and energy changes and chemical reactions Developed by a team of scientists and science educators and then tested in classrooms the 14 phenomena based lessons in this book follow a coherent sequence They unfold in two main sections 1 making sense of the matter changes involved in human growth and 2 making sense of the energy changes involved in human growth and activity Matter and Energy is unique because it does the following Targets important ideas about changes in both physical and biological systems within the same unit The book first engages students in seeing the usefulness of the ideas in making sense of phenomena in simple physical systems Then it shows how to apply these ideas to make sense of related phenomena in complex biological systems This interdisciplinary approach reflects the way science is practiced in the real world Supports all three dimensions of the Next Generation Science Standards Disciplinary core ideas crosscutting concepts and science practices are all integrated in this unit Emphasizes important relationships between mathematics and science Students interpret data sets and graphs to provide evidence for claims They also do simple computations to explain puzzling phenomena for example why does energy have to be added to ignite a marshmallow even though the burning marshmallow releases lots of energy Builds on the middle school unit Toward High School Biology also published by NSTA Press Together the two units help students deepen their understanding of matter and energy changes in plants and animals and the role of chemical reactions in the growth repair and activity of living organisms Matter and Energy for Growth and Activity Student Edition provides all the student handouts with the teaching tips and sample answers found in the Teacher Edition removed A set of online resources includes the interactive media videos and handouts required to use these experiential lessons Between both books you have the support you need to help your students turn abstract ideas into applicable knowledge a critical first step in learning

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