

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)	$\text{PCl}_3(\text{g}) \rightarrow \text{P}(\text{g}) + 5\text{Cl}(\text{g})$	+ 1,297.9 <i>broken</i>	F)	$\text{P}(\text{g}) + 5\text{Cl}(\text{g}) \rightarrow \text{PCl}_3(\text{g})$	- 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)	$\text{PF}_3(\text{g}) \rightarrow \text{P}(\text{g}) + 5\text{F}(\text{g})$	+ 2,305.4 <i>broken</i>	H)	$\text{P}(\text{g}) + 5\text{F}(\text{g}) \rightarrow \text{PF}_3(\text{g})$	- 2,305.4 <i>formed</i>

1. 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.

2. 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.

3. 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.

4. 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?

Same absolute value, opposite sign

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

amount of energy required to break is same as amount released when formed

30 Bond Energy Answer Key

Chemical Society (Great Britain)

30 Bond Energy Answer Key:

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Journal of the Chemical Society Chemical Society (Great Britain), 1965. Titles of chemical papers in British and foreign journals included in Quarterly journal v 1-12. *Holt Chemistry* Ralph Thomas Myers, 2004. *Journal of the Physical Society of Japan* Nihon Butsuri Gakkai, 1984. *Journal of the American Chemical Society* American Chemical Society, 1959. Proceedings of the Society are

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Journal Chemical Society (Great Britain), 1966 **Canadian Journal of Chemistry**, 1990

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Robert S. Bauer, American Physical Society, 1982 *Quarterly Journal of the Chemical Society of London* Chemical Society (Great Britain), 1966

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