

LESSON
104

ACTIVITY

Make It or Break It Bond Energy

Name _____

Date _____ Period _____

Purpose

To explore bond energies and calculate the net energy exchange for several reactions.

Part I: Understanding Bond Energies

Average Bond Energies (per mole of bonds)

Bond	H-H	C-H	C-C	C=C	O-H	C-O	C=O	O=O	O-O
Bond energy (kJ/mol)	432	413	347	614	467	358	799*	495	146

*C=O in CO₂: 799; C=O in organic molecules: 745.

- Describe at least two patterns you notice in the table of average bond energies.
- Use the table to determine which would take more energy to break apart, a molecule of carbon dioxide, CO₂; a molecule of water, H₂O; or a molecule of oxygen, O₂.

Part 2: Net Energy Exchange for Reactions

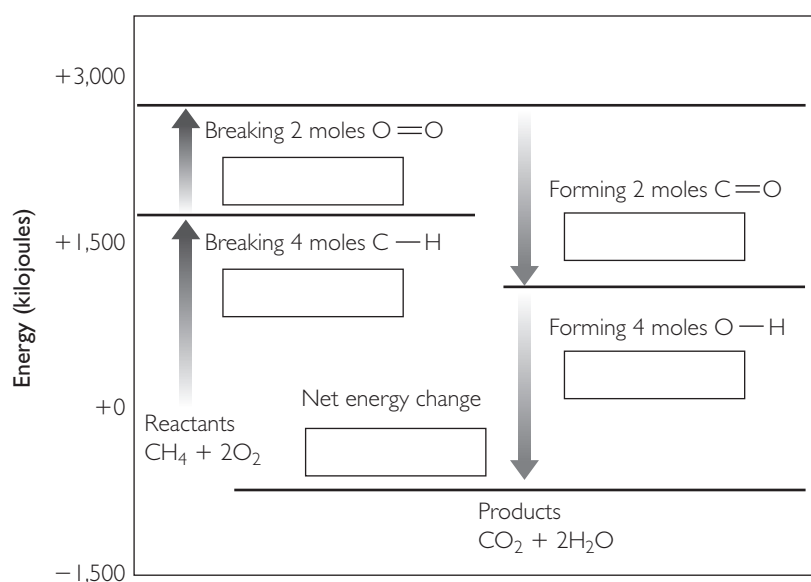
- Build the reactants in this reaction with the ball-and-stick models.
Burning methane: $\text{CH}_4(l) + 2\text{O}_2(g) \longrightarrow \underline{\hspace{1cm}}\text{CO}_2(g) + \underline{2}\text{H}_2\text{O}(l)$
- Rearrange the reactant models into carbon dioxide and water. Count how many of each type of bond you must break for this reaction and record answers in the table.
- Use the table of average bond energies from Part 1 to calculate the total energy transferred in to break all these bonds.

Bonds broken	C-H	O=O	Total energy transferred in
Bond energy (kJ/mol)			
Number of bonds broken (moles)			
Energy required (kJ)			

4. While rearranging the models, count how many of each type of bond you must make in order to form the products. Use the average bond energies from Part 1 to determine the total energy transferred out when all these new bonds are formed. (Energy transferred out is written as a negative number.)

Bonds made	C=O	O-H	
Bond energy (kJ/mol)			
Number of bonds formed (moles)			Total energy transferred out
Energy released (kJ)			

5. This energy diagram describes the energy changes that occur in the reaction of 1 mole of methane, CH_4 , and 2 moles of oxygen, O_2 . Fill in the blank boxes.



6. Based on the energy diagram, what net energy do you expect to be transferred per mole of methane? Is the energy transferred in or out?
7. **Making Sense** When a substance combusts, energy is transferred to the surroundings as heat and light. Where does that energy come from?
8. **If You Finish Early** What is the energy of reaction in kilocalories per gram, for 1 g of methane burned?