

## AP Chemistry POGIL: Bond Energy

**Driving Question:** 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> )
<b>A</b>	$\text{PCl}_{5(g)} \rightarrow \text{P}_{(g)} + 3\text{Cl}_{(g)}$	+ 966.7 <i>Broken</i>		<b>E</b>	$\text{P}_{(g)} + 3\text{Cl}_{(g)} \rightarrow \text{PCl}_{5(g)}$	- 966.7 <i>Formed</i>
<b>B</b>	$\text{PCl}_{5(g)} \rightarrow \text{P}_{(g)} + 5\text{Cl}_{(g)}$	+ 1297.9 <i>Broken</i>		<b>F</b>	$\text{P}_{(g)} + 5\text{Cl}_{(g)} \rightarrow \text{PCl}_{5(g)}$	- 1297.9 <i>Formed</i>
<b>C</b>	$\text{PF}_{5(g)} \rightarrow \text{P}_{(g)} + 3\text{F}_{(g)}$	+ 1470.4 <i>Broken</i>		<b>G</b>	$\text{P}_{(g)} + 3\text{F}_{(g)} \rightarrow \text{PF}_{5(g)}$	- 1470.4 <i>Formed</i>
<b>D</b>	$\text{PF}_{5(g)} \rightarrow \text{P}_{(g)} + 5\text{F}_{(g)}$	+ 2305.4 <i>Broken</i>		<b>H</b>	$\text{P}_{(g)} + 5\text{F}_{(g)} \rightarrow \text{PF}_{5(g)}$	- 2305.4 <i>Formed</i>

- 1). **Identify** four reactions in Model 1 where bonds are being **broken**. Write “broken” in the Change in Energy box **below the numerical value** 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 **below the numerical value** in the table for each reaction you identify.

# Batteries Pogil Answers

**Victoria G. Christensen**



## Batteries Pogil Answers:

**Challenges in Physical Science: Batteries** TG ,2001      **Elementary Treatise on Electric Batteries** Alfred Niaudet,1882      **Batteries** Stefano Passerini,Dominic Bresser,Arianna Moretti,Alberto Varzi,2020-07-24 Part of the Encyclopedia of Electrochemistry this comprehensive two volume handbook offers an up to date and in depth review of the battery technologies in use today It also includes information on the most likely candidates that hold the potential for further enhanced energy and power densities It contains contributions from a renowned panel of international experts in the field Batteries are extremely commonplace in modern day life They provide electrochemically stored energy in the form of electricity to automobiles aircrafts electronic devices and to smart power grids Comprehensive in scope Batteries covers information on well established battery technologies such as charge carrier based lead acid and lithium ion batteries The contributors also explore current developments on new technologies such as lithium sulfur and oxygen sodium ion and full organic batteries Written for electrochemists physical chemists and materials scientists Batteries is an accessible compendium that offers a thorough review of the most relevant current battery technologies and explores the technology in the years to come      *How Batteries Work* Victoria G. Christensen,2016-08-01 Have you ever wondered how a set of batteries power the remote for your TV Or have you ever wanted to examine the battery inside a car Without batteries we would not be able to power many of the electronics we use every day But how does a battery store energy and provide electricity to these devices What are the parts that make a battery work Discover the history of batteries and how scientists and engineers figured out ways to store electricity Explore what makes up a battery including an anode a cathode and an electrolyte and learn how batteries power all kinds of electronics from a cell phone to a bus      *Dry Cell Batteries: Chemistry and Design* Louis F. Martin,1973      **storage batteries** Harry Morse,1912      *Understanding Batteries* R M Dell,D A J Rand,2007-10-31 Batteries are becoming increasingly important in today s world of portable electronic devices along with the need to store electricity derived from solar and other renewable forms of energy and the desire to introduce electric and hybrid electric vehicles to reduce emissions Understanding Batteries is a must for all those seeking a straightforward explanation of how batteries are constructed their operation and the factors determining their performance and life Beginning with a brief history of the development of batteries and a discussion of their applications and markets the book goes on to outline the basic terminology and science of batteries The different types of primary non rechargeable and secondary rechargeable batteries are then described and emphasis is given to the importance of matching the battery to the intended application Examples are given to demonstrate how to define and prioritise the various criteria which comprise the battery specification Throughout the chemistry is kept as simple as possible Understanding Batteries will appeal to a wide range of readers including electrical equipment manufacturers and users engineers and technicians chemistry and materials science students teachers and the interested battery user      *Advanced Batteries* Robert Huggins,2008-11-09 Storage and

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Primary Batteries Robert W. Graham,1978 *Modern Batteries* C. Vincent,Bruno Scrosati,1997-09-26 Based on the successful first edition this book gives a general theoretical introduction to electrochemical power cells excluding fuel cells followed by a comprehensive treatment of the principle battery types covering chemistry fabrication characteristics and applications There have been many changes in the field over the last decade and many new systems have been commercialised Since the recent advent of battery powered consumer products mobile phones camcorders lap tops etc advanced power sources have become far more important This text provides an up to date account of batteries which is accessible to anyone with a basic knowledge of chemistry and physics

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environmental impact Coverage includes Electricity electrochemistry and batteries Raw materials Battery components Principles of electrochemical cell operations Battery product overview Electrochemical cell designs platform technologies Primary batteries Secondary batteries Miscellaneous and specialty batteries Battery applications Battery industry infrastructure

Primary Batteries (1891) Henry Smith Carhart, 2008-10-01 This scarce antiquarian book is a facsimile reprint of the original Due to its age it may contain imperfections such as marks notations marginalia and flawed pages Because we believe this work is culturally important we have made it available as part of our commitment for protecting preserving and promoting the world s literature in affordable high quality modern editions that are true to the original work

*Batteries* International Symposium on Batteries, 1978

**Precise Energy** Kai Peter Birke, Julian Grimm, 2025 Achievable energy densities dominate important future research activities on battery technology This book deduces in detail the future options for energy density enhancement of rechargeable battery cells and complete batteries It connects rechargeability to energy density limits and gives a detailed argumentation on how and when battery energy densities will achieve their inherent limits This work provides key insights for the future market for modern batteries and points readers towards future battery cell designs highlighting their limitations and potential advancements and discusses which battery cell technologies will survive and dominate It identifies the most promising candidates for achieving higher energy densities and explores the trade offs between energy density power density lifetime safety and costs It also investigates the influence of raw materials on energy densities and provides an overview of progress made in battery energy densities Lastly it expands the discussion to alternative energy storage systems revealing a compelling vision for the future of energy storage Precise Energy is a valuable resource for researchers and students of related fields engineers and other professionals with corresponding background and decision and policymakers interested in the evolving landscape of energy storage and its profound impact on our future

Battery Technology Alexander Börger, Heinz Wenzl, 2025-12-15 Understand the technology that will power our future with this comprehensive guide Energy supply is perhaps the most challenging engineering problem and social and economic issue of the modern age Energy storage technologies and in particular batteries are an important option to optimize energy supply systems both technically and economically They help to drive down costs make new products and services possible and can reduce emissions Batteries are now key components for vehicles portable products and the electricity supply system Understanding batteries in particular the two dominant battery technologies lead acid and lithium ion has therefore never been more essential to technological developments for these applications Battery Technology Fundamentals of Battery Electrochemistry Systems and Applications offers a comprehensive overview of how batteries work why they are designed the way they are the technically and economically most important systems and their applications The book begins with background information on the electrochemistry the structure of the materials and components and the properties of batteries The book then moves to practical examples often using field data of battery usage It can serve both as an

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**Galvanic Batteries, Their Theory, Construction and Use, Comprising Primary, Single and Double Fluid Cells, Secondary and Gas Batteries** Selimo Romeo Bottone,1902 [Battery Reference Book](#)

Thomas Roy Crompton,2000-05-11 Introduction to battery technology Guidelines to battery selection Battery characteristics Lead acid secondary batteries Nickel batteries Silver batteries Alkaline manganese batteries Carbon zinc and carbon zinc chloride primary batteries Mercury batteries Lithium batteries Manganese dioxide magnesium perchlorate primary batteries Magnesium organic electrolyte primary batteries Metal air cells High temperature thermally activated primary reserve batteries Zinc halogen secondary batteries Sodium sulphur secondary batteries Other fast ion conducting solid systems Water activated primary batteries Battery theory and design Lead acid secondary batteries Nickel batteries Silver batteries Alkaline manganese batteries Carbon zinc and carbon zinc chloride batteries Mercury zinc batteries Lithium batteries Manganese dioxide magnesium perchlorate primary batteries Metal air batteries High temperature thermally activ [New Technology Batteries Guide](#) William J. Ingram,1998

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