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A Solution Manual for:
COMBUSTION, 4th Ed.

by

I. Glassman, and R.A. Yetter

CHAPTER 1

Problem 1

Calculate the heat of reaction when methane and air in stoichiometric proportions are brought into a calorimeter at 500 K. The product composition is brought to the ambient temperature (298 K) by the cooling water. The pressure in the calorimeter is assumed to remain at 1 atm, but the water formed has condensed.

Solution: The heat of reaction can be calculated using Eqn. (10) in the text. However, as also suggested in the textbook, this equation can be simplified for the general case when $H_{T_2}^o = H_{T_{amb}}^o$. The modified equation becomes:

$$-Q = \Delta H = \sum_{i \in \text{prod}} n_i \left[(H_{T_2}^o - H_{T_{amb}}^o) + (\Delta H_f^o)_{T_{amb}} \right] - \sum_{i \in \text{react}} n_i \left[(H_{T_1}^o - H_{T_{amb}}^o) + (\Delta H_f^o)_{T_{amb}} \right] \quad (1)$$

In this Equation, T_2 and T_1 are the temperatures of the products and reactants respectively. The general equation for the complete combustion of one mole of methane in air is:



where a_{air} is a coefficient describing how much air is needed for stoichiometric combustion. Balancing the above reaction one has:



In order to apply Eqn. (1) to the above reaction, the following properties from Tables in the textbook are needed (note that for this problem $T_2 = 298 \text{ K}$ and $T_1 = 500 \text{ K}$):

gases	ΔH_f^o (kJ/mol)	$H_{T_1}^o - H_{T_{amb}}^o$ (kJ/mol)	$H_{T_2}^o - H_{T_{amb}}^o$ (kJ/mol)
CH ₄	-74.90	8.21	0.0
O ₂	0.0	6.09	0.0
N ₂	0.0	5.92	0.0
H ₂ O _(liq)	-286.04	0.0	0.0
CO ₂	-393.77	0.0	0.0

Equation (1) then becomes:

2

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Glassman Combustion Solution Manual

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Table of Contents Glassman Combustion Solution Manual

1. Understanding the eBook Glassman Combustion Solution Manual
 - The Rise of Digital Reading Glassman Combustion Solution Manual
 - Advantages of eBooks Over Traditional Books
2. Identifying Glassman Combustion Solution Manual
 - 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 Glassman Combustion Solution Manual
 - User-Friendly Interface
4. Exploring eBook Recommendations from Glassman Combustion Solution Manual

- Personalized Recommendations
- Glassman Combustion Solution Manual User Reviews and Ratings
- Glassman Combustion Solution Manual and Bestseller Lists
- 5. Accessing Glassman Combustion Solution Manual Free and Paid eBooks
 - Glassman Combustion Solution Manual Public Domain eBooks
 - Glassman Combustion Solution Manual eBook Subscription Services
 - Glassman Combustion Solution Manual Budget-Friendly Options
- 6. Navigating Glassman Combustion Solution Manual eBook Formats
 - ePub, PDF, MOBI, and More
 - Glassman Combustion Solution Manual Compatibility with Devices
 - Glassman Combustion Solution Manual Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Glassman Combustion Solution Manual
 - Highlighting and Note-Taking Glassman Combustion Solution Manual
 - Interactive Elements Glassman Combustion Solution Manual
- 8. Staying Engaged with Glassman Combustion Solution Manual
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Glassman Combustion Solution Manual
- 9. Balancing eBooks and Physical Books Glassman Combustion Solution Manual
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Glassman Combustion Solution Manual
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Glassman Combustion Solution Manual
 - Setting Reading Goals Glassman Combustion Solution Manual
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Glassman Combustion Solution Manual

-
- Fact-Checking eBook Content of Glassman Combustion Solution Manual
 - 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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