Chapter 17 Thermochemistry Practice Problems Answers

Chapter 17 Thermochemistry Practice Problems Answers Chapter 17 Thermochemistry Practice Problems Answers This blog post provides a comprehensive guide to solving practice problems related to Chapter 17 of a typical chemistry textbook covering the fundamentals of thermochemistry It will delve into the key concepts and formulas required to tackle these problems offering detailed solutions and explanations for each question The aim is to equip students with the necessary tools to understand and apply thermochemical principles effectively Thermochemistry enthalpy entropy Gibbs free energy Hesss Law calorimetry standard enthalpy of formation standard enthalpy of reaction spontaneity equilibrium constant Thermochemistry is a crucial branch of chemistry that deals with the study of heat changes accompanying chemical reactions It explores the relationship between heat flow energy transformations and the chemical and physical properties of substances Chapter 17 of many chemistry textbooks introduces fundamental concepts like enthalpy entropy Gibbs free energy and their role in predicting the spontaneity of reactions This blog post serves as a resource for students to reinforce their understanding of these concepts through the analysis of practice problems Analysis of Current Trends Thermochemistry plays a vital role in various fields including Energy production Understanding energy changes in combustion reactions is crucial for designing efficient power plants and fuel sources Material science Thermodynamic principles guide the development of new materials with desired properties like thermal stability and reactivity Environmental chemistry Assessing the environmental impact of chemical reactions and processes involves understanding heat flow and its impact on ecosystems Biochemistry Thermochemistry is essential for understanding energy transformations within living organisms like cellular respiration and photosynthesis The increasing focus on renewable energy sources sustainable materials and environmental 2 protection underscores the growing relevance of thermochemistry in modern society Discussion of Ethical Considerations Thermochemistry while offering valuable tools for technological advancements also presents ethical considerations Energy consumption The pursuit of energy efficiency often involves the development of new technologies that can have unintended consequences on resource depletion and environmental impact Climate change The burning of fossil fuels a process governed by thermochemical principles is a significant contributor to greenhouse gas emissions and global warming Technological development The advancement of technologies based on thermochemical principles like nuclear power or biofuel production needs to be accompanied by rigorous safety measures and ethical considerations It is essential to consider the potential ethical ramifications of thermochemical applications and strive for sustainable and responsible practices Practice Problems and Solutions Problem 1 Calculate the enthalpy change for the reaction 2 H2g O2g 2 H2Ol Given the following standard enthalpy of formation values Hf H2Ol 2858 kJmol Solution The enthalpy change of a reaction can be calculated using the following equation H nHfproducts mHfreactants where H is the enthalpy change of the reaction Hf is the standard enthalpy of formation 3 n and m are the stoichiometric coefficients of the products and reactants respectively Plugging in the values H 2 2858 kJmol 2 0 kJmol 1 0 kJmol H 5716 kJmol Therefore the enthalpy change for the reaction is 5716 kJmol This negative value indicates that the reaction is exothermic meaning it releases heat to the surroundings Problem 2 A 500 g sample of iron is heated from 250 C to 1000 C Calculate the heat absorbed by the iron The specific heat capacity of iron is 0449 JgC Solution The heat absorbed by a substance can be calculated using the following equation q mCT where q is the heat absorbed m is the mass of the substance C is the specific heat capacity T is the change in temperature Plugging in the values q 500 g 0449 JgC 1000 C 250 C q 168375 J Therefore the heat absorbed by the iron is 168375 J Problem 3 A 100 g sample of glucose C6H12O6 is burned in a calorimeter containing 1000 g of water The temperature of the water increases from 250 C to 275 C Calculate the heat of 4 combustion of glucose in kJmol The specific heat capacity of water is 4184 JgC Solution First calculate the heat absorbed by the water q 1000 g 4184 JgC 275 C 250 C q 10460 J This heat is released by the combustion of glucose To find the heat of combustion per mole we need to calculate the moles of glucose burned moles of glucose 100 g 18016 gmol 000555 mol Therefore the heat of combustion of glucose is Hc 10460 J 000555 mol 1883720 Jmol 188372 kJmol The heat of combustion of glucose is 188372 kJmol Problem 4 Using Hesss Law calculate the enthalpy change for the reaction N2g 3 H2g 2 NH3g Given the following reactions and their enthalpy changes N2g O2g 2 NOg H 1805 kJmol 2 NOg O2g 2 NO2g H 1141 kJmol 4 NH3g 5 O2g 4 NOg 6 H2Og H 9062 kJmol 2 H2g O2g 2 H2Og H 4836 kJmol Solution Hesss Law states that the enthalpy change for a reaction is independent of the pathway taken as long as the initial and final conditions are the same To calculate the enthalpy 5 change for the target reaction we need to manipulate the given reactions in such a way that they add up to the target reaction 1 Reverse the first reaction 2 NOg N2g O2g H 1805 kJmol 2 Reverse the second reaction 2 NO2g 2 NOg O2g H 1141 kJmol 3 Multiply the third reaction by 12 2 NH3g 52 O2g 2 NOg 3 H2Og H 4531 kJmol 4 Multiply the fourth reaction by 32 3 H2g 32 O2g 3 H2Og H 7254 kJmol 5 Add the modified reactions 2 NOg N2g O2g H 1805 kJmol 2 NO2g 2 NOg O2g H 1141 kJmol 2 NH3g 52 O2g 2 NOg 3 H2Og H 4531 kJmol 3 H2g 32 O2g 3 H2Og H 7254 kJmol N2g 3 H2g 2 NH3g H 939 kJmol Therefore the enthalpy change for the reaction is 939 kJmol Problem 5 Predict whether the following reactions are spontaneous or nonspontaneous at 25 C 6 a 2 NO2g N2O4g b CaCO3s CaOs CO2g Given the following standard Gibbs free energy of formation values Gf NO2g 513 kJmol Gf N2O4g 979 kJmol Gf CaCO3s 11288 kJmol Gf CaOs 6040 kJmol Gf CO2g 3944 kJmol Solution The spontaneity of a reaction is determined by the Gibbs free energy change G If G is negative the reaction is spontaneous and if G is positive the reaction is nonspontaneous a For the reaction 2 NO2g N2O4g G nGfproducts mGfreactants G 1 979 kJmol 2 513 kJmol G 57 kJmol Since G is negative the reaction is spontaneous at 25 C b For the reaction CaCO3s CaOs CO2g G nGfproducts mGfreactants G 1 6040 kJmol 1 3944 kJmol 1 11288 kJmol G 1304 kJmol Since G is positive the reaction is nonspontaneous at 25 C Conclusion This blog post has provided a comprehensive overview of thermochemistry covering key concepts and their applications in solving practice problems By understanding the principles of enthalpy entropy Gibbs free energy and Hesss Law students can develop a firm grasp of this crucial area of chemistry While thermochemistry offers powerful tools for technological advancements it is equally important to consider its ethical implications and strive for 7 sustainable and responsible applications

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