

Stoichiometry Worksheet #1

1. Aluminum chloride, AlCl_3 , is used as a catalyst in various industrial reactions. It is prepared from hydrogen chloride gas and aluminum metal shavings.



1A. How many moles of AlCl_3 can be prepared from 3.5 moles of hydrogen chloride gas with an excess of aluminum?

$$3.5 \text{ mol HCl} \times \frac{2 \text{ mol AlCl}_3}{6 \text{ mol HCl}} = 1.2 \text{ mol AlCl}_3$$

Ans: 1.2 mol AlCl_3

1B. How many moles of hydrogen gas would be produced from the use of 8.5 moles of aluminum with an excess of hydrogen chloride?

Ans: 13 mol H_2

$$8.5 \text{ mol Al} \times \frac{3 \text{ mol H}_2}{2 \text{ mol Al}} = 13 \text{ mol H}_2$$

2. When dinitrogen pentoxide, N_2O_5 , a white solid, is heated, it decomposes to nitrogen dioxide and oxygen.



2A. How many moles of nitrogen dioxide can be formed from the decomposition of 1.25 g of N_2O_5 ?

$$1.25 \text{ g N}_2\text{O}_5 \times \frac{1 \text{ mol N}_2\text{O}_5}{108.02 \text{ g N}_2\text{O}_5} \times \frac{4 \text{ mol NO}_2}{2 \text{ mol N}_2\text{O}_5} = 0.0231 \text{ mol NO}_2$$

Ans: 0.0231 mol NO_2

2B. How many grams of oxygen can be formed from the decomposition of 2.3 g of N_2O_5 ?

$$2.3 \text{ g N}_2\text{O}_5 \times \frac{1 \text{ mol N}_2\text{O}_5}{108.02 \text{ g N}_2\text{O}_5} \times \frac{1 \text{ mol O}_2}{2 \text{ mol N}_2\text{O}_5} \times \frac{32.00 \text{ g O}_2}{1 \text{ mol O}_2} = 0.34 \text{ g O}_2$$

Ans: 0.34 g O_2

3. Chlorine is prepared from sodium chloride by electrochemical decomposition. Formerly chlorine was produced by heating hydrochloric acid with pyrolusite [manganese dioxide or manganese(IV) oxide, MnO_2], a common manganese ore. Small amounts of chlorine may be prepared in the laboratory by the same reaction.



3A. How many grams of HCl react with 5.00 g of MnO_2 , according to the equation?

$$5.00 \text{ g MnO}_2 \times \frac{1 \text{ mol MnO}_2}{86.94 \text{ g MnO}_2} \times \frac{4 \text{ mol HCl}}{1 \text{ mol MnO}_2} \times \frac{36.46 \text{ g HCl}}{1 \text{ mol HCl}} = 8.39 \text{ g HCl}$$

Ans: 8.39 g HCl

3B. If a chemist wanted to prepare 100. g of chlorine, how many grams of MnO_2 are needed, assuming there is more than enough hydrochloric acid?

Ans: 123 g MnO_2

$$100. \text{ g Cl}_2 \times \frac{1 \text{ mol Cl}_2}{70.90 \text{ g Cl}_2} \times \frac{1 \text{ mol MnO}_2}{1 \text{ mol Cl}_2} \times \frac{86.94 \text{ g MnO}_2}{1 \text{ mol MnO}_2} = 123 \text{ g MnO}_2$$

3C. How many molecules of water are produced from the reaction of 5.0 g of HCl?

Ans: 4.1×10^{23} molec. H_2O

$$5.0 \text{ g HCl} \times \frac{1 \text{ mol HCl}}{36.46 \text{ g HCl}} \times \frac{2 \text{ mol H}_2\text{O}}{4 \text{ mol HCl}} \times \frac{6.02 \times 10^{23} \text{ molecules H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 4.1 \times 10^{23} \text{ molecules H}_2\text{O}$$

4. Sodium is a soft, reactive metal that instantly reacts with water to give hydrogen gas and a solution of sodium hydroxide,



4A. How many grams of sodium metal are needed to give 7.81 g of hydrogen by this reaction?

Ans: 178 g Na

$$7.81 \text{ g H}_2 \times \frac{1 \text{ mol H}_2}{2.02 \text{ g H}_2} \times \frac{2 \text{ mol Na}}{1 \text{ mol H}_2} \times \frac{22.99 \text{ g Na}}{1 \text{ mol Na}} = 178 \text{ g Na}$$

4B. How many sodium atoms are needed to react with 1.25×10^{24} molecules of water?

Ans: 1.25×10^{24} atoms Na

$$1.25 \times 10^{24} \text{ molecules H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{6.02 \times 10^{23} \text{ molecules H}_2\text{O}} \times \frac{2 \text{ mol Na}}{2 \text{ mol H}_2\text{O}} \times \frac{6.02 \times 10^{23} \text{ atoms Na}}{1 \text{ mol Na}} =$$

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Unit Operations in Environmental Engineering Louis Theodore, R. Ryan Dupont, Kumar Ganesan, 2017-08-29 The book presents the principles of unit operations as well as the application of these principles to real world problems The authors have written a practical introductory text exploring the theory and applications of unit operations for environmental engineers that is a comprehensive update to Linvil Rich s 1961 classic work Unit Operations in Sanitary Engineering The book is designed to serve as a training tool for those individuals pursuing degrees that include courses on unit operations Although the literature is inundated with publications in this area emphasizing theory and theoretical derivations the goal of this book is to present the subject from a strictly pragmatic introductory point of view particularly for those individuals involved with environmental engineering This book is concerned with unit operations fluid flow heat transfer and mass transfer Unit operations by definition are physical processes although there are some that include chemical and biological reactions The unit operations approach allows both the practicing engineer and student to compartmentalize the various operations that constitute a process and emphasizes introductory engineering principles so that the reader can then satisfactorily predict the performance of the various unit operations equipment This is a definitive work on Unit Operations one of the most important subjects in environmental engineering today It is an excellent reference well written easily read and comprehensive I believe the book will serve well those working in engineering disciplines including those beyond just environmental and chemical engineering Bottom line A must for any technical library Kenneth J Skipka CCM

Resources in Education , 1995

Stoichiometry Unit Project Luann Marie Decker, 1998 *Chemistry for the IB Diploma* Geoff Neuss, 2001 This concise guide provides the content needed for the Chemistry IB diploma at both Standard and Higher Level It follows the structure of the IB Programme exactly and includes all the options Each topic is presented on its own page for clarity Higher Level material is clearly indicated and there are plenty of practice questions The text is written with an awareness that English might not be the reader s first language

Teaching Chemistry - A Studybook

Ingo Eilks, Avi Hofstein, 2013-04-20 This book focuses on developing and updating prospective and practicing chemistry teachers pedagogical content knowledge The 11 chapters of the book discuss the most essential theories from general and science education and in the second part of each of the chapters apply the theory to examples from the chemistry classroom Key sentences tasks for self assessment and suggestions for further reading are also included The book is focused on many different issues a teacher of chemistry is concerned with The chapters provide contemporary discussions of the chemistry curriculum objectives and assessment motivation learning difficulties linguistic issues practical work student active pedagogies ICT informal learning continuous professional development and teaching chemistry in developing environments This book with contributions from many of the world's top experts in chemistry education is a major publication offering something that has not previously been available Within this single volume chemistry teachers teacher educators and prospective teachers will find information and advice relating to key issues in teaching such as the curriculum assessment and so forth but contextualised in terms of the specifics of teaching and learning of chemistry and drawing upon the extensive research in the field Moreover the book is written in a scholarly style with extensive citations to the literature thus providing an excellent starting point for teachers and research students undertaking scholarly studies in chemistry education whilst at the same time offering insight and practical advice to support the planning of effective chemistry teaching This book should be considered essential reading for those preparing for chemistry teaching and will be an important addition to the libraries of all concerned with chemical education Dr Keith S Taber University of Cambridge Editor Chemistry Education Research and Practice The highly regarded collection of authors in this book fills a critical void by providing an essential resource for teachers of chemistry to enhance pedagogical content knowledge for teaching modern chemistry Through clever orchestration of examples and theory and with carefully framed guiding questions the book equips teachers to act on the relevance of essential chemistry knowledge to navigate such challenges as context motivation to learn thinking activity language assessment and maintaining professional expertise If you are a secondary or post secondary teacher of chemistry this book will quickly become a favorite well thumbed resource Professor Hannah Sevian University of Massachusetts Boston

A Problem-Solving Approach to Aquatic Chemistry James N. Jensen, 2023-01-05 A Problem Solving Approach to Aquatic Chemistry Enables civil and environmental engineers to understand the theory and application of aquatic equilibrium chemistry The second edition of A Problem Solving Approach to Aquatic Chemistry provides a detailed introduction to aquatic equilibrium chemistry calculation methods for systems at equilibrium applications of aquatic chemistry and chemical kinetics The text directly addresses two required ABET program outcomes in environmental engineering chemistry including stoichiometry equilibrium and kinetics and material and energy balances fate and transport of substances in and between air water and soil phases The book is very student centered with each chapter beginning with an introduction and ending with a summary that reviews the chapter's main points To aid in reader comprehension important terms are defined in context and

key ideas are summarized Many thought provoking discussion questions worked examples and end of chapter problems are also included Each part of the text begins with a case study a portion of which is addressed in each subsequent chapter illustrating the principles of that chapter In addition each chapter has an Historical Note exploring connections with the people and cultures connected to topics in the text A Problem Solving Approach to Aquatic Chemistry includes Fundamental concepts such as concentration units thermodynamic basis of equilibrium and manipulating equilibria Solutions of chemical equilibrium problems including setting up the problems and algebraic graphical and computer solution techniques Acid base equilibria including the concepts of acids and bases titrations and alkalinity and acidity Complexation including metals ligands equilibrium calculations with complexes and applications of complexation chemistry Oxidation reduction equilibria including equilibrium calculations graphical approaches and applications Gas liquid and solid liquid equilibrium with expanded coverage of the effects of global climate change Other topics including chemical kinetics of aquatic systems surface chemistry and integrative case studies For advanced senior undergraduates and first year graduate students in environmental engineering courses A Problem Solving Approach to Aquatic Chemistry serves as an invaluable learning resource on the topic with a variety of helpful learning elements included throughout to ensure information retention and the ability to apply covered concepts in practical settings

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