

**PHYSICAL  
CHEMISTRY  
FOR SCHOOLS**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649670925

Physical Chemistry for Schools by Henry John Horstman Fenton

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd.  
Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

[www.triestepublishing.com](http://www.triestepublishing.com)

**HENRY JOHN HORSTMAN FENTON**

**PHYSICAL  
CHEMISTRY  
FOR SCHOOLS**



**PHYSICAL CHEMISTRY**  
**FOR SCHOOLS**

CAMBRIDGE UNIVERSITY PRESS

C. F. CLAY, MANAGER

London: FETTER LANE, E.C.

Edinburgh: 100 PRINCES STREET



London: H. K. LEWIS AND CO., LTD., 136 GOWER STREET, W.C.  
London: WILLIAM WESLEY AND SON, 28 ESSEX STREET, STRAND  
New York: G. P. PUTNAM'S SONS  
Bombay, Calcutta and Madras: MACMILLAN AND CO., LTD.  
Toronto: J. M. DENT AND SONS, LTD.  
Tokyo: THE MARUZEN-KABUSHIKI-KAISHA

*All rights reserved*

# PHYSICAL CHEMISTRY FOR SCHOOLS

NEW YORK  
CALIFORNIA

by

HENRY JOHN HORSTMAN FENTON,  
M.A., Sc.D., F.R.S. "

University Lecturer in Chemistry  
Hon. Fellow of Christ's College, Cambridge

Cambridge:  
at the University Press  
1916

2-15-53  
F4

BY VISIT  
APPROVED

Cambridge:  
PRINTED BY JOHN CLAY, M.A.  
AT THE UNIVERSITY PRESS



## PREFACE

**T**HIS little book is intended to serve as a brief introductory outline of Physical Chemistry for the use of students who have been through the very elementary courses of descriptive Chemistry and Physics.

The subject-matter is given, as far as possible, in the form of concise, direct statements; long detailed explanations, historical introductions and mathematical formulæ being avoided as far as possible. It is hoped that by introducing the subject in this way it may be possible to fix the attention and to stimulate interest in the case of many students who, as experience shows, are liable to be scared away from the subject when it is presented in the more elaborate and mathematical form.

It will be understood, of course, that in the study of Physical Chemistry many important problems and theories occur which are, perhaps, beyond the capabilities of elementary students. Matters of this kind have been only briefly sketched and are given in sections printed in smaller type, so that they can be used at the discretion of the teacher.

The author desires to express his sincere thanks to Mr W. H. Mills, M.A., Ph.D., for his kindness in reading the proof-sheets and in making many useful suggestions; and to Dr Shillington Scales for executing the diagrams.

H. J. H. F.

*October, 1915.*

357279

# CONTENTS

## CHAPTER I

### ELEMENTS, COMPOUNDS AND MIXTURES

Chemical individuals. *Hylotropic substances*. Mixtures. Elements. Chemical compounds. Equivalent weights. Homogeneous and heterogeneous mixtures. Polymorphism. Allotropy. Isomerism. Transformation of allotropic forms. Transition point. Pages 1—10

## CHAPTER II

### GASES

The gas laws. The gas constant, *R*. Liquefaction of gases. Critical temperature and pressure. *Deviations from the gas laws*. *van der Waals' theory*. *Corresponding states*. Laws of combination of gaseous substances by volume. Molecules. Avogadro's hypothesis. *Kinetic theory of gases*. Density and molecular weight of gases. *Work done by a gas expanding against pressure*. Molecular formulæ. The so-called abnormal vapour densities. Diffusion of gases. Graham's law. 11—30

## CHAPTER III

### SOLUTIONS

Concentration of solutions. Solutions of solids in liquids. Solubility. Influence of temperature on solubility. Supersaturated solutions. Freezing point and vapour pressure of solutions. Cryohydrates. Solutions of liquids in liquids. Non-miscible, partially miscible and completely miscible liquids. Constant boiling point mixtures. Solutions of gases in liquids. Henry's law. Partition or distribution law. Solutions of gases in solids. *Adsorption*. Solutions of solids in solids. *Disperse systems*. *Colloidal solutions*. *Electrophoresis*. *Brownian movements*. Alloys. The Phase rule. Osmotic pressure. Determination of the molecular weights of dissolved substances. Lowering of the freezing point. Lowering of the vapour pressure. *Molecular weights of pure liquids*. 31—31

## CHAPTER IV

## ATOMIC WEIGHTS

Methods of fixing the atomic weights of the elements. Dulong and Petit's law. Neumann's extension. Law of isomorphism. Gaseous density and atomicity of the elements. Molecular heats of gases. Relation between atomic weight and equivalent weight. Valency. Unsaturated compounds. Molecular compounds. Space formulae. Asymmetric carbon atoms. Relation between atomic weight and density in liquids and solids. Molecular and atomic volumes. *Volume and valency. Refractive power.* Relations between atomic weight and properties. Periodic classification. 82—111

## CHAPTER V

## CHEMICAL CHANGE

Chemical and physical changes. Reversibility of chemical changes. Chemical equilibrium. Balanced actions. Dissociation. Conditions and circumstances which influence chemical change. Influence of concentration. Law of "mass action." Rate of chemical change or "reaction velocity." Distinction between initial rate and final equilibrium. Influence of temperature. Exothermic and endothermic reactions. van't Hoff's principle of mobile equilibrium. Influence of pressure. Rule of le Chatelier. *Relation between equilibrium constant, heat of reaction and temperature.* Catalysis. Examples. Influence of light. Photographic processes. 112—134

## CHAPTER VI

## THERMO-CHEMISTRY

Berthelot's principle. Chemical "affinity." Exothermic and endothermic compounds. Heat of formation. Law of constant heat summation. *Calorific power and calorific intensity.* Determination of heat of reaction. 135—140