

Van der Waals Forces

**A HANDBOOK FOR BIOLOGISTS, CHEMISTS,
ENGINEERS, AND PHYSICISTS**

V. Adrian Parsegian

National Institutes of Health

 **CAMBRIDGE**
UNIVERSITY PRESS

CONTENTS

<i>List of tables</i>	<i>page</i>	vii
<i>Preface</i>		xiii
PRELUDE	1	
Pr.1. The dance of the charges	4	
Pr.2. How do we convert absorption spectra to charge-fluctuation forces?	24	
Pr.3. How good are measurements? Do they really confirm theory?	30	
Pr.4. What can I expect to get from this book?	37	
LEVEL 1: INTRODUCTION	39	
L1.1. The simplest case: Material A versus material B across medium m	41	
L1.2. The van der Waals interaction spectrum	61	
L1.3. Layered planar bodies	65	
L1.4. Spherical geometries	75	
L1.5. Cylindrical geometries	95	
LEVEL 2: PRACTICE	99	
L2.1. Notation and symbols	101	
L2.1.A. Geometric quantities	101	
L2.1.B. Force and energy	102	
L2.1.C. Spherical and cylindrical bodies	102	
L2.1.D. Material properties	102	
L2.1.E. Variables to specify point positions	104	
L2.1.F. Variables used for integration and summation	104	
L2.1.G. Differences-over-sums for material properties	105	
L2.1.H. Hamaker coefficients	105	
L2.1.I. Comparison of cgs and mks notation	106	
L2.1.J. Unit conversions, mks–cgs	107	
L2.2. Tables of formulae	109	
L2.2.A. Tables of formulae in planar geometry	110	
L2.2.B. Tables of formulae in spherical geometry	149	
L2.2.C. Tables of formulae in cylindrical geometry	169	

L2.3. Essays on formulae	181
L2.3.A. Interactions between two semi-infinite media	182
L2.3.B. Layered systems	190
L2.3.C. The Derjaguin transform for interactions between oppositely curved surfaces	204
L2.3.D. Hamaker approximation: Hybridization to modern theory	208
L2.3.E. Point particles in dilute gases and suspensions	214
L2.3.F. Point particles and a planar substrate	228
L2.3.G. Line particles in dilute suspension	232
L2.4. Computation	241
L2.4.A. Properties of dielectric response	241
L2.4.B. Integration algorithms	261
L2.4.C. Numerical conversion of full spectra into forces	263
L2.4.D. Sample spectral parameters	266
L2.4.E. Department of tricks, shortcuts, and desperate necessities	270
L2.4.F. Sample programs, approximate procedures	271
LEVEL 3: FOUNDATIONS	277
L3.1. Story, stance, strategy	278
L3.2. Notation used in level 3 derivations	280
L3.2.A. Lifshitz result	280
L3.2.B. Layered systems	281
L3.2.C. Ionic-fluctuation forces	281
L3.2.D. Anisotropic media	282
L3.2.E. Anisotropic ionic media	282
L3.3. A heuristic derivation of Lifshitz' general result for the interaction between two semi-infinite media across a planar gap	283
L3.4. Derivation of van der Waals interactions in layered planar systems	292
L3.5. Inhomogeneous media	303
L3.6. Ionic-charge fluctuations	313
L3.7. Anisotropic media	318
<i>Problem sets</i>	325
Problem sets for Prelude	325
Problem sets for level 1	332
Problem sets for level 2	337
<i>Notes</i>	349
<i>Index</i>	375