

## CONTENTS

## PART I. DYNAMICS

	PAGE
CHAPTER I	
Introductory ; fundamental units ; mathematical formulae - - -	1
CHAPTER II	
Simple measurements and measuring appliances - - - -	8
CHAPTER III	
Displacement ; velocity ; acceleration ; graphs for rectilinear motion - - - - -	19
CHAPTER IV	
Composition and resolution of velocities and accelerations ; motion in a circle · projectiles - - - - -	34
CHAPTER V	
Angular velocity and acceleration ; transmission of motion of rotation ; instantaneous centre - - - - -	46
CHAPTER VI	
Newton's laws of motion ; absolute units of force ; momentum ; impulsive forces - - - - -	58
CHAPTER VII	
Static forces acting at a point ; parallelogram and triangle of forces ; Bow's notation ; polygon of forces - - - - -	68
CHAPTER VIII	
Moments of forces ; parallel forces ; principle of moments - - -	84
CHAPTER IX	
Centre of parallel forces ; centre of gravity ; states of equilibrium	95
CHAPTER X	
Couples ; systems of uniplanar forces - - - - -	113
CHAPTER XI	
Stress ; strain ; elasticity ; Hooke's law ; elastic moduli : torsion ; bending - - - - -	127
CHAPTER XII	
Work ; energy ; power - - - - -	142

## CONTENTS

### CHAPTER XIII

PAGE

Friction - - - - - 153

### CHAPTER XIV

Simple machines ; velocity ratio ; mechanical advantage ; efficiency ; principle of work - - - - - 162

### CHAPTER XV

Motion of rotation ; moments of inertia ; angular momentum ; kinetic energy of rotation ; flywheels - - - - - 175

### CHAPTER XVI

Centrifugal force ; simple harmonic motion ; pendulums ; centrifugal governors ; torsional oscillations ; compound pendulums - - - - - 195

### CHAPTER XVII

Impact ; laws of collision ; energy wasted in impact ; conservation of momentum - - - - - 218

### CHAPTER XVIII

Hydrostatics ; pressure in liquids ; centre of pressure - - - - - 228

### CHAPTER XIX

Pressure of the atmosphere ; hydraulic machines ; pressure energy of a liquid ; hydraulic transmission of energy ; pumps - - - - - 242

### CHAPTER XX

Floating bodies ; principle of Archimedes ; specific gravity ; hydrometers - - - - - 255

### CHAPTER XXI

Liquids in motion ; total energy of a liquid ; Bernoulli's theorem ; the siphon ; discharge through an orifice ; water wheels and turbines ; centrifugal pump - - - - - 267

### CHAPTER XXII

Surface tension ; capillary elevation ; diffusion ; osmosis - - - - - 281

## PART II. HEAT

### CHAPTER XXIII

Temperature ; thermometric scales ; types of thermometers - - - - - 297

### CHAPTER XXIV

Expansion of solids ; coefficients of linear, superficial and cubical expansion ; compensation for expansion - - - - - 307

# CONTENTS

xi

## CHAPTER XXV

	PAGE
Expansion of vessels ; apparent and absolute coefficients of expansion of liquids ; density of water - - - - -	316

## CHAPTER XXVI

Calorimetry ; units of heat ; specific heat - - - - -	326
---	-----

## CHAPTER XXVII

Nature of heat ; mechanical equivalent of heat ; first law of thermodynamics ; natural sources of heat ; fuels - - - - -	336
--	-----

## CHAPTER XXVIII

Transference of heat ; conduction ; convection - - - - -	349
--	-----

## CHAPTER XXIX

Transference of heat (continued) ; radiation ; diathermancy - - - - -	367
---	-----

## CHAPTER XXX

Properties of gases ; barometers ; pressure gauges ; Boyle's law - - - - -	381
--	-----

## CHAPTER XXXI

Properties of gases (continued) ; Charles's law ; absolute temperature ; combination of Boyle's and Charles's laws ; density of gases - - - - -	392
---	-----

## CHAPTER XXXII

Kinetic theory of gases ; Avogadro's law ; work done by a gas ; specific heats of a gas - - - - -	406
---	-----

## CHAPTER XXXIII

Expansion and compression of gases in practice ; air pumps and compressors ; refrigerating machine using air - - - - -	415
--	-----

## CHAPTER XXXIV

Change of state ; melting points ; latent heat of fusion ; saturated and unsaturated vapours ; maximum vapour pressure ; boiling points - - - - -	430
---	-----

## CHAPTER XXXV

Properties of vapours (continued) ; vapour density ; latent heat of vapourisation ; Joly's steam calorimeter - - - - -	445
--	-----

## CHAPTER XXXVI

Atmospheric conditions ; hygrometry - - - - -	458
---	-----

## CHAPTER XXXVII

Expansion and compression of vapours ; critical temperature ; liquefaction of gases ; refrigerating machines using vapours - - - - -	465
--	-----

## CHAPTER XXXVIII

PAGE

Heat engines ; Carnot's cycle ; Kelvin's absolute scale of temperature ; hot-air engines	477
--	-----

## CHAPTER XXXIX

Steam engines and boilers ; thermal efficiency ; the indicator ; steam turbines	484
---	-----

## CHAPTER XL

Internal combustion engines ; four-stroke and two-stroke cycles ; gas, oil and petrol engines ; the Diesel engine	501
---	-----

## PART III. LIGHT

## CHAPTER XLI

Propagation of light ; shadows	514
--------------------------------	-----

## CHAPTER XLII

Illumination and photometry ; practical illumination	520
--	-----

## CHAPTER XLIII

Reflection ; plane mirrors ; inclined mirrors ; rotating mirrors ; the sextant	528
--	-----

## CHAPTER XLIV

Spherical mirrors ; parabolic mirror ; concave and convex mirrors ; conjugate foci	537
--	-----

## CHAPTER XLV

Refraction ; index of refraction and its determination ; atmospheric refraction	548
---	-----

## CHAPTER XLVI

Lenses ; general formulæ ; the optical bench ; the dioptré	560
--	-----

## CHAPTER XLVII

Optical instruments ; the human eye ; defects of vision and their rectification ; microscope ; telescope ; binoculars ; periscope ; range finders	579
---	-----

## CHAPTER XLVIII

Prisms ; dispersion ; spectrometer ; pure spectrum ; achromatic prisms and lenses	596
---	-----

## CHAPTER XLIX

Colour ; theory of colour vision ; complementary colours ; kinema-color ; colour photographs ; spectrum analysis ; fluorescence ; phosphorescence ; photography	609
---	-----

CONTENTS

xiii

CHAPTER L

PAGE

Interference, polarimetry and saccharimetry ; Nicol's prism ; specific rotation ; the polarimeter . . . . . 621

CHAPTER LI

Velocity of light . . . . . 628

PART IV. SOUND

CHAPTER LII

Sounding bodies ; simple harmonic motion ; frequency ; the chronograph . . . . . 635

CHAPTER LIII

Pitch ; loudness ; quality ; the siren ; compounding of vibrations ; Lissajous figures . . . . . 640

CHAPTER LIV

Wave motion ; transverse and longitudinal harmonic waves . . . . . 650

CHAPTER LV

Sound waves ; velocity of sound ; reflection of sound ; refraction of sound ; Doppler's effect . . . . . 658

CHAPTER LVI

Interference ; resonance ; manometric flames ; beats ; forced vibrations ; resonators . . . . . 676

CHAPTER LVII

Intervals ; scales ; temperament . . . . . 689

CHAPTER LVIII

Strings ; velocity of waves in strings ; reflection and interference in strings ; the monochord ; transverse vibrations of rods ; Chladni's figures . . . . . 694

CHAPTER LIX

Vibration of air in pipes ; closed pipes ; open pipes ; longitudinal vibration of rods ; Kundt's dust figures . . . . . 710

CHAPTER LX

The ear ; musical instruments ; the violin ; wind instruments ; flue pipes ; reed pipes ; the phonograph and gramophone . . . . . 724

PART V. MAGNETISM AND ELECTRICITY

CHAPTER LXI

Magnetisation ; molecular theory ; inverse-square law . . . . . 731

## CHAPTER LXII

PAGE

Magnetic fields ; lines of force ; magnetic moment ; magnetometer ; vibration of suspended magnet ; earth's magnetic field - -	738
--	-----

## CHAPTER LXIII

Terrestrial magnetism ; magnetic declination and dip ; magnetic maps ; variations in the earth's magnetic field ; the magnetic compass ; ship's magnetisation - - - - -	755
---	-----

## CHAPTER LXIV

Magnetic properties of materials ; induction ; susceptibility ; permeability ; intensity of magnetisation ; hysteresis ; Ewing's molecular theory ; the magnetic circuit - - - - -	771
--	-----

## CHAPTER LXV

The electric current ; magnetic field due to current ; unit current ; tangent galvanometer - - - - -	789
--	-----

## CHAPTER LXVI

Potential difference ; Ohm's law ; resistance ; practical units ; work - - - - -	804
--	-----

## CHAPTER LXVII

Electrical circuits ; electromotive force ; conductance ; resistivity ; maximum current from cells and dynamos - - - - -	812
--	-----

## CHAPTER LXVIII

Galvanometers ; ammeters ; voltmeters - - - - -	828
---	-----

## CHAPTER LXIX

Measurement of electromotive force and resistance ; standard resistances ; resistance boxes ; Wheatstone's bridge ; metre bridge ; potentiometer - - - - -	845
--	-----

## CHAPTER LXX

Electrolysis ; electro-chemical equivalent ; cells and batteries ; voltmeters ; electroplating - - - - -	866
--	-----

## CHAPTER LXXI

Static electricity ; electric charges ; electroscope - - - - -	889
--	-----

## CHAPTER LXXII

Potential ; equipotential surfaces ; charge on conductors ; capacity ; condensers - - - - -	896
---	-----

## CHAPTER LXXIII

The electrometer ; comparison of capacities ; dielectrics - - -	914
---	-----

CONTENTS

xv

CHAPTER LXXIV

Electrical influence machines	925
-------------------------------	-----

CHAPTER LXXV

Electromagnetics ; magnetic field in solenoids ; Kelvin current and watt balances ; Siemens' electro-dynamometer	931
--	-----

CHAPTER LXXVI

Electromagnetics (continued) ; mutual and self-induction ; Foucault or eddy currents ; Lenz's law ; induction coils ; transformers	942
--	-----

CHAPTER LXXVII

The dynamo and motor ; Gramme ring and drum armatures ; field magnets ; efficiency of dynamos and motors ; alternators	958
--	-----

CHAPTER LXXVIII

The telegraph ; the telephone ; the carbon microphone ; electric lamps	975
--	-----

CHAPTER LXXIX

Thermo-electricity ; thermo-electric couples ; Peltier effect ; Thomson effect ; the thermopile ; pyrometers	986
--	-----

CHAPTER LXXX

Current in gases ; X-rays ; radio-activity	996
--	-----

CHAPTER LXXXI

Wireless Telegraphy and Telephony	1007
-----------------------------------	------

LOGARITHMIC TABLES	1024
--------------------	------

ANSWERS	1029
---------	------

INDEX	1049
-------	------

TABLES

Average Densities of Common Materials	32
Moduli of Elasticity ( <i>Average values</i> )	130
Coefficients of Friction ( <i>Average values</i> )	154
Coefficients of Linear Expansion	308
Specific Heats	327
Properties of Saturated Aqueous Vapour	460
Critical Temperatures and Pressures	468
Boiling Points of Water at Pressures near Standard Atmospheric Pressure	512