

MFT 00404

Basic PHYSICS

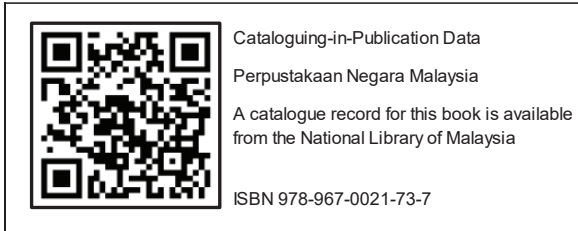
MFT 00404

Basic PHYSICS

Asanah Radhi

Copyright UMK PRESS, 2023

All rights reserved. No part of this publication may be reproduced, stored in production transmitted in any form, whether electronic, mechanical, photocopying, recording or otherwise, without having permission from the UMK Press.



Executive Producer: Azman Hashim. Copy Editor: Amirul Firdaus Zilah,
Raihana Sulaiman. Acquisition Editor: Nur Fatimah Pahazri.
Concept & Typesetting: Siti Aishah Mokhtar. Proof Reader: Zaliha Noor
Technical Assistant: Mohd Suhairi Mohamad.

Published by:
UMK Press
Universiti Malaysia Kelantan
Office of Library and Knowledge Management
16300 Bachok, Kelantan
(Member of Malaysian Scholarly Publishing Council (MAPIM))
(Member of Malaysian Book Publishers Association (MABOPA)
Membership Number : 201903)

Printed by:
RTS Typesetting
No. 14, Jalan Jemuju Empat 16/13D,
Seksyen 16, 40200 Shah Alam,
Selangor Darul Ehsan

TABLE OF CONTENTS

Preface	xi
Acknowledgement	xiii
CHAPTER 1: UNITS, TRIGONOMETRY, AND VECTORS	1
Standards of Length, Mass, and Time	1
Uncertainty in Measurement and Significant Figures	3
Conversion of Units	4
Coordinate Systems	11
Trigonometry	12
Vector	18
Components of a vector	24
Tutorial 1	29
CHAPTER 2: MOTION IN ONE DIMENSION	31
Displacement, Velocity, and Acceleration	31
Motion Diagrams and Motion Graphs	37
One-Dimensional Motion with Constant Acceleration	42
Free Fall	
Tutorial 2	65
CHAPTER 3: MOTION IN TWO DIMENSIONS	67
Displacement, Velocity, and Acceleration in Two Dimensions	67
Displacement Vector	67
Velocity Vector	68
Acceleration Vector	69
Motion in Two Dimension	72
Projectile Motion	73
Tutorial 3	89

CHAPTER 4: FORCES AND LAW OF MOTIONS	91
Forces	91
The Laws of Motion	91
Newton's First Law	91
Newton's Second Law	93
Mass and Weight	100
Newton's Third Law	101
The Normal and Friction Forces	103
Normal Forces	103
Friction Forces	104
Tension Forces	109
Applications of Newton's law	110
Objects in Equilibrium	110
Accelerating objects and Newton's Second law	111
Drawing Free-Body Diagrams	116
Tutorial 4	123
CHAPTER 5: WORK AND ENERGY	125
Work	125
Kinetic Energy and the Work–Energy Theorem	127
Work-Energy Theorem	128
Gravitational Potential Energy	136
Spring Potential Energy	139
Systems and Energy Conservation	143
Power	146
Tutorial 5	159
CHAPTER 6: MOMENTUM, IMPULSE, AND COLLISIONS	163
Linear Momentum	163
Impulse and Collisions	164
Impulse-Momentum Theorem	166
Momentum and Force	166

Conservation of Linear Momentum	169
Collisions in One Dimension	178
Elastic Collision	178
Inelastic collision	183
Tutorial 6	191
CHAPTER 7: ROTATIONAL MOTION AND THE LAW OF GRAVITY	193
Angular speed and angular acceleration	193
Rotational Motion under Constant Angular Acceleration.	197
Relations between Angular and Linear Quantities	200
The tangential speed and tangential acceleration	200
Centripetal Acceleration	206
Newtonian Gravitation	208
Tutorial 7	217
CHAPTER 8: ROTATIONAL EQUILIBRIUM AND DYNAMICS	219
Torque	219
Torque and the Two Conditions for Equilibrium	224
Relationship between Torque and Angular Acceleration	227
Torque on Rotating Object	228
Rotational Kinetic Energy	234
Angular Momentum	237
Tutorial 8	243
CHAPTER 9: FLUIDS	245
Density and Pressure	245
Variation of Pressure with Depth	247
Buoyant Forces and Archimedes' Principle	251
Archimedes' Principle	252
Fluids in Motion	259
Tutorial 9	267

CHAPTER 10: THERMAL PHYSICS	269
Temperature and the Zeroth Law of Thermodynamics	269
Thermometers and Temperature Scales	269
Thermal Expansion of Solids and Liquids	271
The Ideal Gas Law	276
The Kinetic Theory of Gases	282
Tutorial 10	285
CHAPTER 11: ENERGY IN THERMAL PROCESSES	287
Heat and Internal Energy	287
Specific Heat	287
Calorimetry	290
Latent Heat and Phase Change	293
Energy Transfer	299
Conduction	299
Convection	303
Radiation	305
Tutorial 11	309
CHAPTER 12: THE LAWS OF THERMODYNAMICS	311
Work in Thermodynamic Processes	311
The First Law of Thermodynamics	313
Thermal Processes in Gases	318
Isobaric Process	318
Adiabatic process	320
Isovolumetric process	321
Isothermal process	322
Heat Engines and the Second Law of Thermodynamics	323
Entropy	327
Tutorial 12	331

CHAPTER 13: VIBRATIONS AND WAVES	335
Hooke's Law	335
Oscillation Rate	338
Position, Velocity, and Acceleration as Functions of Time	340
Motion of a Pendulum	346
Waves	348
Frequency, Amplitude, and Wavelength	348
Tutorial 13	351
CHAPTER 14: SOUND	353
Speed of Sound	353
Energy and Intensity of Sound Waves	356
Sound Intensity Level	359
Interference of Sound Waves	362
Standing Waves	367
Stretch String	368
Resonance in a Tube Closed at one End	371
Resonance in a Tube Opened at Both End	376
The Doppler Effect	380
Tutorial 14	387
Bibliography	389
Index	391
Author's Biography	395

PREFACE

This book was developed by the physics lecturer of the Department of Preparatory Science, Universiti Malaysia Kelantan (UMK). It has been written primarily for the student of the UMK Science Foundation. It is intended to prepare students in this programme for basic physics.

It is written in a concise point to help students to have a firm grasp of concepts in Physics. This book covers 14 topics of basic physics. To help readers grasp the material and concepts in learning physics, each chapter begins with a clear explanation of the pertinent definitions, principles, and theorems. This is followed by sets of solved and supplementary problems to provide a complete review of the materials of each chapter. The solved problems illustrate and amplify the theory and provide the repetition of basic principles vital to effective teaching. We included examples and tutorial material in each chapter to fulfil the student's needs in this program. Students can perform all the calculations in the worksheet provided in this book.

The author gratefully acknowledges her indebtedness to the Department of Preparatory Science for the continuous support and encouragement in completing this work.

Asanah Radhi

ACKNOWLEDGEMENT

First and foremost, praises and thanks to Allah, the Almighty, for His showers of blessings throughout the journey to complete the writing of the Physics Module for UMK Science Foundation.

I would like to express my deep and sincere gratitude to all committees in Jabatan Persediaan Sains and The Office of Library and Knowledge Management Universiti Malaysia Kelantan (UMK) for giving me the opportunity and providing invaluable guidance throughout the completion of this module.

I really thank my husband for his support, appreciation, encouragement and keen interest in my academic achievement. Last but not least, thanks to all students of UMK Science Foundation (intake 2021 and 2022) and my friends who directly and indirectly helped me to complete this book.

CHAPTER 1

UNITS, TRIGONOMETRY, AND VECTORS

STANDARDS OF LENGTH, MASS, AND TIME

Three fundamental quantities can be used to express the physical quantities in the study of mechanics:

Physical quantities	SI units
length,	meters (<i>m</i>)
mass	kilograms (<i>kg</i>)
time	seconds (<i>s</i>)

1 Metre (m)
<ul style="list-style-type: none"> the distance traveled by light in vacuum during a time interval of 1/299 792 458 second.
1 Kilogramme (kg)
<ul style="list-style-type: none"> the mass of a specific platinum– iridium alloy cylinder kept at the International Bureau of Weights and Measures at Sèvres, France
1 Seconds
<ul style="list-style-type: none"> defined as 9 192 631 700 times the period of oscillation of radiation from the cesium atom
1 Kelvin (K)
<ul style="list-style-type: none"> 1/273.16 of the temperature of the triple point of water

Derivation of fundamental quantities through multiplying and/or dividing them generate other quantity called derived quantity.

Velocity

$$\frac{\text{displacement}}{\text{time}} = \frac{l}{t} = \frac{m}{s} = ms^{-1}$$