

# Physics

### Student Textbook Grade 12

Authors: Graham Bone Tim Greenway

Advisers: Tilahun Tesfaye Deressu (PhD) Endeshaw Bekele Buli

**Evaluators: Yosef Mihiret** 

Gebremeskel Gebreegziabher

Yusuf Mohamed





#### Acknowledgments

The development, printing and distribution of this student textbook has been funded through the General Education Quality Improvement Project (GEQIP), which aims to improve the quality of education for Grades 1–12 students in government schools throughout Ethiopia.

The Federal Democratic Republic of Ethiopia received funding for GEQIP through credit/financing from the International Development Associations (IDA), the Fast Track Initiative Catalytic Fund (FTI CF) and other development partners – Finland, Italian Development Cooperation, the Netherlands and UK aid from the Department for International Development (DFID).

The Ministry of Education wishes to thank the many individuals, groups and other bodies involved – directly and indirectly – in publishing the textbook and accompanying teacher guide.

The publisher would like to thank the following for their kind permission to reproduce their photographs:

(Key: b-bottom; c-centre; l-left; r-right; t-top)

**Alamy Images:** 2tl, 13c, 13cl, 37r, 38t, 46cl, 53br, 56cl, 70cl, 73cr, 80bl, 92tl, 100tl, 102tl, 104cl, 110tl, 111c (Circular waves), 111cr (Plane waves), 114tl, 114cl, 115c, 115cl (water waves), 117br, 118tl, 125cr, 135tr, 135br, 144tl, 285t; **Rex Features:** 72bl; **Science Photo Library Ltd:** 6bl, 111br, 118cl, 118bl, 121tr, 121br, 123br, 124tl, 147br, 153tr, 191c, 317cl, 324bl;

Cover images: Front: Science Photo Library Ltd: cl/lce, waves;

All other images © Pearson Education

Every effort has been made to trace the copyright holders and we apologise in advance for any unintentional omissions. We would be pleased to insert the appropriate acknowledgement in any subsequent edition of this publication.

© Federal Democratic Republic of Ethiopia, Ministry of Education

First edition, 2002 (E.C.) ISBN: 978-99944-2-022-3

Developed, Printed and distributed for the Federal Democratic Republic of Ethiopia, Ministry of Education by:

Pearson Education Limited

Edinburgh Gate

Harlow

Essex CM20 2JE

England

In collaboration with Shama Books P.O. Box 15 Addis Ababa Ethiopia

All rights reserved; no part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise without the prior written permission of the copyright owner or a licence permitting restricted copying in Ethiopia by the Federal Democratic Republic of Ethiopia, Federal Negarit Gazeta, *Proclamation No. 410/2004 Copyright and Neighboring Rights Protection Proclamation, 10th year, No. 55, Addis Ababa, 19 July 2004.* 

#### Disclaimer

Every effort has been made to trace the copyright owners of material used in this document. We apologise in advance for any unintentional omissions. We would be pleased to insert the appropriate acknowledgement in any future edition

Printed in Malaysia, CTP-PJE

## Contents

Unit 1 Thermodynamics 1				
1.1	Thermal equilibrium and definition of temperature	3		
1.2	Work, heat and the first law of thermodynamics	9		
1.3	Kinetic theory of gases	21		
1.4	Second law of thermodynamics, efficiency			
	and entropy	31		
1.5	Heat engines and refrigerators	37		
Hei	La Oscillations and wayes	( ``\\ ``		
	t 2 Oscillations and waves	51		
2.1	Periodic motion (basic concepts)	53		
	Wave motion	80		
2.3	Sound, loudness and the human ear	97		
Unit 3 Wave optics 108				
	A \ \ / / /	100		
3.1	Wave fronts and Huygens's principle	109		
3.2 3.3	Reflection and refraction of plane wave fronts  Proof of the laws of reflection and refraction	113		
3.3	using Huygens's principle	116		
3.4	Interference	120		
3.5				
	for fringe width	128		
3.6	Coherent sources and sustained interference			
2 7	of light	131		
3./	Diffraction due to a single slit and a diffraction grating	133		
	diffidetion glating	133		
Unit 4 Electrostatics				
4.1	Electric charge and Coulomb's law	143		
4.2	Electric potential	162		
4.3	Capacitors and dielectrics	173		

Grade 12

Uni	Unit 5 Steady electric current and			
	circuit properties	198		
5.1	Basic principles	199		
5.2	Kirchoff's rules	214		
5.3	Measuring instruments	220		
5.4	The Wheatstone bridge and the potentiometer	226		
Unit 6 Magnetism		234		
6.1	Concepts of a magnetic field	235		
6.2	The Earth and magnetic fields	238		
6.3	Motion of charged particles in a magnetic field	240		
6.4	Magnetic force on current-carrying	37		
	conductors (long, staight, circular loop)	247		
6.5	Ampere's law and its application	256		
6.6	Earth's magnetism	260		
Uni	t 7 Electromagnetic induction and a.c. circuits	266		
7.1 7.2	Phenomena of electromagnetic induction Alternating current (a.c.) generator	268		
	and transformers	281		
7.3	Alternating current (a.c.)	287		
7.4	Power in a.c. circuits	304		
Uni	t 8 Atomic physics	311		
8.1	Dual nature of matter and radiation	312		
8.2	Atoms and nuclei	322		
Inde		348		