

ENJOY CHEMISTRY FURAHIA KEMIA



T. TIBAIJUKA
M.R. MJEMA
R. KIWANGA

W. HILDENHAGEN
H.C. KUONGA
G. HAUG

M. SCHIESS
L. NDAR'LU

Make Sense of
SCIENCE
FOR FORM 1



FURAHIA KEMIA – KITABU CHA KWANZA

Kwa Wanaoanza Kujifunza

ENJOY CHEMISTRY – BOOK ONE

A Textbook for Beginners

FURAHIA KEMIA – KITABU CHA KWANZA

Kwa Wanaoanza Kujifunza

ENJOY CHEMISTRY – BOOK ONE

A Textbook for Beginners

R. Kiwanga

M. R. Mjema

W. Hildenhagen

H. C. Kuonga

T. Tibaijuka

M. Schiess

G. Haug

L. Ndar’lu

FIRST PUBLISHED IN 1993 BY:

Mzumbe Book Project

BILINGUAL EDITION PUBLISHED BY:

Mkuki na Nyota Publishers Ltd

P.O. Box 4246

Dar es Salaam, Tanzania

www.mkukinanyota.com

© L. Ndar'lu, R. Kiwanga, M. R. Mjema, W. Hildenhagen,
H. C. Kuonga, T. Tibaijuka, M. Schiess, G. Haug, 2011

Printed 2011

ISBN 9987-552-14-5 (10 digits)

ISBN 978-9987-08-059-5 (13 digits)

This edition is sponsored by Haki Elimu and Faire Welt Rastatt e. V.



Haki zote zimehifadhiwa. Hairuhusiwi kunakili, kutafsiri, kupiga chapa au kutoa kitabu hiki
kwa jinsi yoyote ile bila kupata kwanza idhini ya maandishi kutoka Mkuki na Nyota Publishers.

All rights are reserved. No part of this publication may be reproduced, stored in a retrieval system,
or transmitted in any form or by any means without the prior written permission from Mkuki na
Nyota publishers.

YALIYOMO

Dibaji	xii
Jinsi ya kutumia kitabu hiki	xvi
1. Utangulizi kuhusu Kemia	2
1.1 Umuhimu wa Kemia	2
1.2 Kemia ni nini?	10
1.3 Fanya Mwenyewe	10
1.4 Kemia na Mazingira	14
1.5 Muhtasari	14
1.6 Maswali ya Marudio	16
2. Kufanya Kazi Kwenye Maabara ya Kemia	18
2.1 Alama za Onyo	20
2.2 Kanuni na Alama za Usalama	20
2.3 Matumizi Bora Kwenye Maabara	26
2.4 Huduma ya Kwanza na Sanduku la Huduma ya Kwanza	28
2.5 Vifaa vya Msingi vya Maabara na Namna Vinavyotumiwa	38
2.6 Fanya Mwenyewe	42
2.7 Maswali ya Marudio	44
3. Vyanzo vya Joto na Miali	46
3.1 Nishati-Uwezo wa Kufanya Kazi	46
3.2 Jiko la Bunsen	50
3.3 Mshumaa	60
3.4 Majiko ya Mafuta ya Taa	60
3.5 Jiko la Mkaa	64
3.6 Bomba la Kupulizia	64
3.7 Fanya Mwenyewe	66
3.8 Muhtasari	72
3.9 Maswali ya Marudio	72
4. Maada na Mbinu za Kisayansi	76
4.1 Maada ni nini?	76
4.2 Mbinu za Kisayansi	82

CONTENTS

Preface	xvii
How to use this book	xiii
1. Introduction to Chemistry	3
1.1 The Importance of Chemistry	3
1.2 What is Chemistry	11
1.3 Do It Yourself	11
1.4 Chemistry and the Environment	15
1.5 Summary	15
1.6 Revision Questions	17
2. Working in a Chemistry Laboratory	19
2.1 Warning Signs	21
2.2 Safety Rules and Signs	21
2.3 Economy in the Laboratory	27
2.4 First Aid and First Aid Kit	29
2.5 Basic Laboratory Apparatus and their Uses	39
2.6 Do It Yourself	43
2.7 Revision Questions	45
3. Heat Sources and Flames	47
3.1 Energy – the Capacity of Doing Work	47
3.2 The Bunsen Burner	51
3.3 The Candle	61
3.4 Kerosene Burners	61
3.5 The Charcoal Burner	65
3.6 The Blow Pipe	65
3.7 Do It Yourself	67
3.8 Summary	73
3.9 Revision Questions	73
4. Matter and the Scientific Procedure	77
4.1 What is Matter?	77
4.2 The Scientific Procedure	83

4.3	Nadharia Tete ya Chembe za Maada	86
4.4	Fanya Mwenyewe	90
4.5	Muhtasari	92
4.6	Maswali ya Marudio	94
5.	Hali za Maada	96
5.1	Maji na Hali Zake	96
5.2	Hali Tatu za Maada	98
5.3	Mabadiliko ya Hali	100
5.4	Kipimajoto	104
5.5	Vizingiti Visivyobadilika	106
5.6	Kuelezea Hali za Maada na Mabadiliko yao kwa Nadharia Tete ya Chembe	108
5.7	Fanya Mwenyewe	114
5.8	Muhtasari	118
5.9	Maswali ya Marudio	120
6.	Dutu Halisi na Michanganyiko	124
6.1	Dutu Halisi na Michanganyiko	124
6.2	Michanganyiko Katika Maisha Yetu ya Kila Siku	128
6.3	Mimumunyo	128
6.4	Vielei	132
6.5	Dutu Halisi	134
6.6	Fanya Mwenyewe	138
6.7	Muhtasari	146
6.8	Maswali ya Marudio	148
7.	Kutenganisha Michanganyiko	150
7.1	Ugidaji	150
7.2	Kuchuja	152
7.3	Uvukizaji Hadi Kukauka na Ufuweleshaji	156
7.4	Kutenganisha Michanganyiko kwa Njia ya Utoneshaji	162
7.5	Kutenganisha Michanganyiko kwa Njia ya Ukenekaji	164
7.6	Utenganishaji kwa Michanganyiko kwa Usablimi	170
7.7	Uziduaji wa Kimumunyi	172
7.8	Utenganishaji wa Tabaka	174

4.3	The Particle Hypothesis of Matter	87
4.4	Do It Yourself	91
4.5	Summary	93
4.6	Revision Questions	95
5.	States of Matter	97
5.1	Water and Its States	97
5.2	The Three States of Matter	99
5.3	Changes of State	101
5.4	The Thermometer	105
5.5	Fixed Points	107
5.6	Explaining the States of Matter and their Changes by Particle Hypothesis	109
5.7	Do It Yourself	115
5.8	Summary	119
5.9	Revision Questions	121
6.	Pure Substances and Mixtures	125
6.1	Pure Substances and Mixtures	125
6.2	Mixtures in Our Daily Life	129
6.3	Solutions	129
6.4	Suspensions	133
6.5	Pure Substances	135
6.6	Do It Yourself	139
6.7	Summary	147
6.8	Revision Questions	149
7.	Separating Mixtures	151
7.1	Decantation	151
7.2	Filtration	153
7.3	Evaporation to Dryness and Crystallization	157
7.4	Separation of Mixtures by Condensation	161
7.5	Separation of Mixtures by Distillation	161
7.6	Separation of Mixtures by Sublimation	171
7.7	Solvent Extraction	173
7.8	Layer Separation	175

7.9	Kromatografia	176
7.10	Dutu Halisi	178
7.11	Fanya Mwenyewe	178
7.12	Muhtasari	184
7.13	Maswali ya Marudio	186
8.	Mabadiliko ya Kiumbo na Kikemikali – Elementi na Mimumunyo	188
8.1	Mabadiliko ya Kiumbo na Kikemikali	188
8.2	Utendanaji wa Kikemikali na Kanuni ya Hifadhi ya Masi	196
8.3	Uboshokaji kwa Kupashamoto	198
8.4	Elementi na Jedwali la Elementi	202
8.5	Muungano na Mimumunyo	204
8.6	Fanya Mwenyewe	210
8.7	Muhtasari	216
8.8	Maswali ya Marudio	218
9.	Hewa na Oksijeni – Mwako, Kushika Kutu na Kuzima Moto	220
9.1	Muundo wa Hewa	220
9.2	Oksijeni na Mwako	236
9.3	Upumuaji na Mzunguko wa Oksijeni – Kaboni Dioksidi	246
9.4	Chuma Kupata Kutu na Uzuiaji Wake	250
9.5	Moto na Uzimaji Moto	256
9.6	Fanya Mwenyewe	268
9.7	Muhtasari	270
9.8	Maswali ya Marudio	274
	Faharasa	276
	Vifaa	290

7.9	Chromatography	177
7.10	Pure Substances	179
7.11	Do It Yourself	179
7.12	Summary	185
7.13	Revision Questions	187
8.	Physical and Chemical Changes – Elements and Compounds	189
8.1	Physical and Chemical Changes	189
8.2	Chemical Reactions and the Law of Conservation of Mass	197
8.3	Decomposition by Heating	199
8.4	Elements and the Periodic Table	203
8.5	Combination and Compounds	205
8.6	Do It Yourself	211
8.7	Summary	217
8.8	Revision Questions	219
9.	Air and Oxygen – Combustion, Rusting and Fire Fighting	221
9.1	The Composition of Air	221
9.2	Oxygen and Combustion	237
9.3	Respiration and the Oxygen – Carbon Dioxide Cycle	247
9.4	Rusting of Iron and its Prevention	251
9.5	Fires and Fire Fighting	257
9.6	Do It Yourself	269
9.7	Summary	271
9.8	Revision Questions	275
	Glossary	283
	Apparatus	290
	Index	300

Dibaji

Kitabu hiki kimeandikwa maalumu kwa ajili ya wanafunzi wanaozungumza lugha ya Kiswahili wanaotaka kujifunza Kemia na wakati huohuo wapate kumudu lugha ya Kiingereza ili kufanya majaribio na mitihani ya kufuzu elimu ya sekondari, kwa kuwa lugha ya kufundishia katika ngazi hiyo ya elimu ni Kiingereza. Kwa hiyo, katika Afrika Mashariki hiki ndicho kitabu cha kiada cha kwanza kilichoandikwa kwa lugha mbili.

Kwa kuwa shule nyingi za sekondari (Kidato cha 1-4) katika nchi zinazoendelea zina uhaba mkubwa wa vifaa vya maabara maalumu kwa ajili ya somo la sayansi lenye majaribio mengi kama ilivyo Kemia, kitabu hiki pia kinaweka mkazo kwenye mbinu ya fanya-mwenyewe. Mbinu hii itawasaida wanafunzi kuelewa Kemia kwa kina na wakati huohuo kulifurahia somo. Njia hii itawapatia wanafunzi walio kwenye shule zisizo na vifaa vya kutosha fursa sawa ya kufanya majaribio ya Kemia kama waliyonayo wanafunzi walio na bahati ya kuwa katika shule yenye vifaa vingi vya maabara. Majaribio haya ya vitendo ni muhimu kwasababu Kemia isiyo na majaribio si Kemia hata kidogo, wala haitasaidia watu kuishi maisha bora zaidi.

Ni kwa sababu hii kwamba kitabu hiki, pamoja na kile cha *Sourcebook for Teaching, Learning and Enjoying Chemistry* (ISBN 9987 552 09 9, Mzumbe Book Project, P.O. Box. 113, Mzumbe, Morogoro)

kinajaribu kuwashajiisha walimu kujitengenezea Beseni lao la Sayansi. Kwa kutumia beseni hilo inawezekana kufanya karibu majaribio yote ya kufanywa na wanafunzi yaliyopendekezwa katika kitabu hiki.

Pamoja na kitabu hiki tunaambatanisha **CD** inayoendana nacho, **CD** inawaonesha wanafunzi Watanzania wakifanya baadhi ya majaribio muhimu yaliyo kwenye kitabu. Utaikuta **CD** hiyo upande wa ndani wa jalada la nyuma la kitabu.

Mwongozo wa Furahia Kemia kwa Kidato cha I (ISBN 978-9987-08-059-5) unatoa vidokezo vya ufundishaji na ujifunzaji wenye ufanisi wa sura zote zilizo kwenye kitabu hiki. Pia unatoa vidokezo vya mazoezi na majaribio yote, na majibu na ufafanuzi kwa maswali yaliyo kwenye kitabu hiki.

Kwanza kabisa, kitabu hiki kinakuonyesha kikamilifu jinsi ya kutumia kitabu hiki ili kufikia malengo yaliyotajwa hapo juu. Kisha kinasisitiza umuhimu wa Kemia katika maisha ya kila siku (Sura ya 1) na kuelezea kanuni muhimu na vifaa vya majaribio na Huduma ya Kwanza endapo kutatokea ajali (Sura ya 2 na 3). Kuanzia Sura ya 4 hadi ya 8, kitabu hiki kinampa mwanafunzi umahiri wa kufafanua dhana kama vile maada, nguvu (kani), utaratibu wa kisayansi, nadharia ya chembe, dutu za asili na mimumunyo, mabadiliko ya

Preface

This book has been specifically written for Kiswahili speaking students who want to learn Chemistry and at the same time learn enough English to pass their tests and examinations in Secondary School where English is the only language of instruction. Thus, this is the first bilingual textbook in East Africa.

Since many O-level schools in developing countries have too little laboratory equipment for an experimental science like Chemistry, this textbook also uses the Do It Yourself approach. This will help students to understand Chemistry more in depth and to enjoy it at the same time. It will also give students of a badly equipped school a similar chance to practice Chemistry as those students who are so lucky to be at a school whose laboratory is well equipped.

This practice is indispensable because Chemistry without practice is no Chemistry at all and will never help people to live a better life.

This is why this textbook together with the *Chemistry Source Book for Teaching, Learning and Enjoying* (ISBN 9987 552 09 9, Mzumbe Book Project, P.O.Box 113, Mzumbe, Morogoro) tries to stimulate students as well as teachers to make their own Science Tray. With this almost all Students' experiments suggested in this textbook can be performed.

We have also added a **CD** to this Guide on which Tanzanian students show how to carry out some key experiments of this textbook. You will find it attached to the Guide.

The Guide to Enjoy Chemistry for Form I (ISBN 978-9987-08-059-5) gives hints for effective teaching and studying of all the chapters of this textbook. It also gives hints for all the exercises and experiments and worked answers to questions in this textbook.

This book first shows you thoroughly how to use it in order to achieve the aims mentioned above. Then it stresses the importance of Chemistry in daily life (Chapter 1) and introduces the most important rules and equipment for practicals and First Aid in case of an accident (Ch. 2 & 3). In Chapters 4 to 8, this book makes the students conversant with terms like matter, energy, scientific procedure, particle hypothesis, pure substances and mixtures, physical and chemical changes, elements and compounds, the periodic table, metals and non-metals. In Ch. 9, the students learn about the composition of pure air and its pollutants, rusting and its prevention, combustion and fires, the various methods of fire fighting and the Oxygen – Carbon Dioxide Cycle.

A glossary follows which contains all the most important terms in both Kiswahili and English.

kiumbo na kikemikali, elementi na mimumunyo, jedwali la elementi, metali na si metali. Katika Sura ya 9, wanafunzi watajifunza kuhusu muundo wa hewa na vichafuzi vyake, utoekaji wa kutu na namna ya kuzuia, uwakaji na myoto, njia mbalimbali za kukabili moto na Mduara wa Oksijeni-Kaboni dioksidi.

Mwishoni mwa kitabu kuna Sherehe/Faharasa ambayo ina msamiati muhimu – hii ipo kwa lugha ya Kiingereza.

Ili kukurahisishia, tumeweka Jedwali la Elementi lililorahisishwa na alama, majina, na namba za atomi za elementi 109.

Hatimaye kuna Faharasa inayofuata abjad (alfabeti) kwa lugha zote mbili – Kiswahili na Kiingereza.

Waandishi wanapenda kumshukuru Tapiwa Muchechemera na timu nzima ya Mkuki na Nyota Publishers, Dar es Salaam, kwa ufanisi na ushirikiano mkubwa katika hatua mbalimbali za maandalizi ya kitabu hiki, mwongozo wake na **CD**: kutafsiri (Kiswahili), ushughulikiaji michoro, uhariri na usanifu wa kurasa. Pia tunawashukuru Bw. Hans Schmidt,

Erzhausen (Ujerumani) na Prof. Ricardo Sanchez (La Paz, Bolivia) ambao walitoa mawazo mazuri sana katika sehemu za fanya-mwenyewe. Tunamshukuru Dkt. Micaela Kaendler (Rastatt, Ujerumani) kwa kutoa ushauri wa kidaktari katika sehemu ya Huduma ya Kwanza. Pia tunamshukuru Bibi Sibylle Riedmiller (Tanga, Tanzania) ambaye ndiye aliyetupatia kwanza wazo la uchapishaji kitabu chenye lugha mbili. Vilevile tunamshukuru sana Dkt. Irmtraud Herms (Halle, Ujerumani) ambaye anaandika kamusi ya Kijerumani-Kiswahili. Dkt. Herms alijitolea kupitia na kusahihisha tafsiri ya Kiswahili.

Kwa namna ya pekee tunazishukuru asasi na taasisi zifuatazo kwa msaada wao katika uchapishaji wa kitabu hiki:

Baraza la Kiswahili la Taifa (BAKITA), (Tanzania), Fair World Rastatt (FWRA, Ujerumani), na vilevile HakiElimu (Tanzania).

G. H., L. N., M. S.
Dar es Salaam, Agosti 2010

For easy reference, we have included a simplified Periodic Table of Elements and the symbols, names and atomic numbers of 109 elements.

Finally, there is an alphabetical index in English.

The authors would like to thank Tapiwa Muchechemera and his team of Mkuki na Nyota Publishers, Dar es Salaam, for the very efficient and enjoyable cooperation in translating (into Kiswahili), illustrating and editing this book, its Guide and its **CD**. We are also highly indebted to Mr. Hans Schmidt, Erzhausen (Germany) and Prof. Ricardo Sanchez (La Paz, Bolivia) who contributed very valuable ideas to the do it yourself sections of this book. We thank Dr Micaela Kaendler (Rastatt, Germany) for providing medical advice for the First Aid section. We are also grateful to Mrs. Sibylle Riedmiller (Tanga, Tanzania) who first introduced the idea

of a bilingual textbook to us. Last but not least, we are very thankful to Dr Irmtraud Herms (Halle, Germany) who is the author of a Swahili - German dictionary. Dr. Herms volunteered to look through the Kiswahili translation of this book and took a lot of time and efforts to find printing mistakes etc. Without her dedication, this book would be much less valuable since we authors are unable to do this very important job.

We are particularly thankful to the following organisations and institutions for their various assistance in producing this book:

BAKITA (Tanzania), Fair World Rastatt (FWRA, Germany), and last but not least, Haki Elimu (Tanzania).

G. H., L. N., M. S.
Dar es Salaam, August 2010

Jinsi ya Kutumia Kitabu Hiki

Mwanafunzi mpendwa,

Hiki ni kitabu chako cha Kemia. Kimeandikwa na walimu kwa ajili yako. Lengo la kitabu hiki ni kukusaidia ujifunze Kiingereza na Kemia kwa kiwango cha kutosha ili ulifurahie somo hili na kufaulu mitihani yenu.

Ili kunufaika vya kutosha kutokana na kitabu hiki, hebu fuata utaratibu huu:

1. Elewa maana katika lugha ya Kiingereza

Kwanza kabisa soma sentensi, kifungu cha maneno au mada nzima kwa Kiingereza. Pale tu unapona kwamba huelewi kila kitu ndiyo usome sentensi, kifungu cha maneno au mada hiyo kwa Kiswahili. Sasa, hebu jiulize kwa nini hukuelewa uliposoma kwanza kwa Kiingereza. Huenda hukuelewa maana ya baadhi ya maneno ya Kiingereza. Kwa hiyo, kama nakala ya kitabu hiki ni mali yako binafsi, basi wekea alama maneno hayo usiyoyaelewa pamoja na yale ya Kiswahili yanayoendana nayo. Tumia penseli ili kujifunza maana kwa urahisi. Kama nakala ya kitabu hiki ni mali ya maktaba, k.m. ya shule, basi andika neno hilo la Kiingereza na lile linaloendana nalo la Kiswahili katika daftari maalumu kwa kazi hiyo ambalo utalitumia kujifunza Kiingereza kupitia somo la Kemia.

Hata hivyo, kama huelewi maana ya muundo mzima wa sentensi ya Kiingereza, basi iwekee alama katika lugha zote mbili, yaani, kama kitabu ni mali yako. Ama sivyo, andika jambo hili kwenye daftari lako.

Unapomaliza kujisomea sehemu fulani ya kazi ya Kemia uliyopewa kufanya nyumbani kwa siku hiyo, jaribu kuelewa maana za maneno au sentensi za Kiingereza usizozielewa.

Kisha fanya kazi ya somo lingine uliyopewa kufanyia nyumbani kama vile Hisabati n.k. Unapoimaliza hiyo, rejea kwenye kazi ya nyumbani ya Kemia. Funika ukurasa wa Kiswahili kwa karatasi. Sasa, soma polepole ukurasa wa Kiingereza. Je, sasa unaelewa maana ya kila neno? Basi kama ndivyo, hiyo ni vema sana. Kama hapana, basi rejea kusoma upande ule wa Kiswahili ili kupata maana. Unapofikiri kwamba umeelewa maana iliyokusudiwa, basi funika tena upande ule wa Kiswahili na sasa soma upande ule wa Kiingereza tu.

Rudia utaratibu huu mpaka uhakikishe kwamba umeelewa vema mada inayohusika katika lugha ya Kiingereza pasipo kuhitaji kusoma upande ule wa Kiswahili.

Kama inawezekana, hebu soma pamoja na mmoja wa wanafunzi wenzako wa darasani. Jaribu kumweleza kuhusu mada hiyo ya kemia ukitumia maneno yako mwenyewe kwa lugha ya Kiingereza. Kisha mwombe naye akueleze kuhusu mada hiyo kwa Kiingereza. Kama mnaelewana vema kwa utaratibu huu, basi mnaweza kuutumia katika kipindi chote mtakachokuwa mkisoma masomo ya sekondari ya kiwango cha Kidato cha 1 – 4. Bila shaka utaratibu huu utawasaidia kupata uwezo wa lugha ya Kiingereza kwa kiwango cha kuwawezesha kujiunga na masomo ya ngazi ya Kidato cha 5 na 6

How to Use This Book

Dear student,

This is your Chemistry book. It has been written for you by teachers. The aim of this book is to help you to learn enough English and Chemistry so that you will enjoy this subject and pass your examinations.

To get the best out of this book you should proceed as follows:

1. Understand the meaning in English

Read through a sentence, paragraph or a topic in English first. Only if you do not understand everything should you read the same sentence, paragraph or topic in Kiswahili too. Now find out why you did not understand the English. Probably you did not know the meaning of some English words. So, if this book belongs to you, then you may mark the unknown English and the corresponding Kiswahili words with a pencil so that you may learn their meaning easily. If this book belongs to a library, e.g. of your school, write the English and the corresponding Kiswahili word in a special exercise book which you use to learn English in the subject of Chemistry.

However, if you do not understand the meaning of the whole setup of an English sentence, then mark the whole sentence in both languages if the book belongs to

you. Otherwise write this in your exercise book.

When you are through the Chemistry section of your homework for that day, learn and understand the meaning of the unknown English words or sentences.

Now go to the homework in another subject like Mathematics, etc. When you are through with this, return to your Chemistry homework. Cover the Kiswahili page with a sheet of paper. Now slowly read the English page. Do you now understand the meaning of everything? If so, then it is marvelous. If not, look at the corresponding Kiswahili again in order to get the meaning. When you've got it, cover the Kiswahili again and read only the English text.

Repeat this procedure until you get the meaning of the topic in English without the need to look at the corresponding Kiswahili.

If possible, study with a classmate. Try to explain to him or her this Chemistry topic in your own words using only English. Then ask him or her to explain this topic in English to you. If you both understand each other fully in this way, you may proceed throughout the O-Level Chemistry studies. This may lead you to gain an English language capability which enables you to proceed to A-Level and University studies later on. To help you

hapo baadaye. Hili ndiyo lengo hasa la kuwaletea kitabu hiki chenye kutumia lugha mbili.

2. Kujifunza Kemia

Zingatia sana vidokezo vilivyo katika rangi ya **hudhurungi**. Hivyo ni hasa *vichwa vya habari* au *maneno muhimu*. Huwezi kuelewa mada fulani vema pasipo kwanza kuelewa maneno hayo. Mara nyingi maneno haya ni msamiati muhimu wa kikemikali na ambayo huna budi kuyakumbuka kwa Kiswahili na vilevile kwa Kiingereza. Ukisoma matini na kuchunguza michoro kwa umakini, bila shaka utaweza kuelewa maneno haya. Pia unaweza kuyajadili na wanafunzi wenzako na hata mwalimu wako pia.

Maneno na sentensi tunazokazia zimeandikwa kwa *hati mlalo* au **hati yenye wino mzito**. Yamewekewa alama inayofanana kwa lugha zote mbili. Lengo ni uweze kuyabaini kwa urahisi.

Baadhi ya maneno yamewekewa alama ya **S**. Maneno haya yamefafanuliwa katika sherehe iliyo mwishoni mwa kitabu. Sherehe hiyo nayo ina sehemu mbili ile ya Kiswahili na ile ya Kiingereza. Sehemu zote mbili zimepangwa kwa kufuata mtiririko wa alfabeti kama ilivyo kwenye kamusi. Mara nyingi haya ni yale maneno muhimu ambayo huna budi kufanya juhudi kuyaelewa. Kwa hiyo, tumefafanua maneno hayo kwa Kiswahili na Kiingereza. Hakikisha unaelewa maana ya maneno hayo katika lugha zote mbili. Kama ikibidi basi uyajadili na wanafunzi wenzako pamoja na mwalimu wenu.

Mara nyingine utaona maneno au vifungu vya maneno vikiwa vimewekwa kwenye majedwali.

Hizi ni kweli **muhimu za kisayansi** ambazo huna budi kujifunza na kuzielewa. Zielewe, wala usizikariri.

Hapa na pale utakuta alama hii ►. Alama hii inaashiria jambo muhimu. Hakikisha unalielewa na kujifunza kabla ya kuendelea mbele. Tumia mbinu tulizozieleza hapo juu ili kuelewa kujifunza jambo hilo kikamilifu.

Huwezi kuelewa Kemia kama hufanyi **majaribio** yanayoendana nalo. Kwa hiyo, kwenye kitabu hiki tumeweka majaribio mengi kadiri inavyowezekana. Pia tunaambatanisha **CD** kwa ajili ya Kitabu cha Mwongozo ambacho kinaonyesha majaribio yaliyo katika kitabu hiki na ambayo yamewekewa maelekezo **CD**. Kama huna kompyuta (tarakilishi) basi unaweza kuitumia **CD** hii kwenye sehemu yoyote inayotoa huduma ya Intaneti.

- Tunapendekeza kwamba ufanye majaribio yote yaliyowekewa alama ya **S**. Alama hii inaelekeza kwamba hili ni jaribio linalopaswa kufanywa na wanafunzi. Utaona kwamba yenyewe ni mepesi kufanya na pia yanavutia na yanakusaidia sana kuelewa mada inayohusika. Unaweza kuyafanya majaribio haya kwa vifaa maalumu au kwa kutumia kifurushi kile cha jifanyie wewe mwenyewe.
- Tunakushauri ujitengenezee **kifurushi chako cha jifanyie mwenyewe** (au **kasha la vifaa vya sayansi** kwa sababu jambo hilo litakupa fursa ya kufanya majaribio hayo hata nyumbani. Ili kukusaidia jinsi ya kutengeneza, tumetayarisha hapa sehemu ya jifanyie mwenyewe mwishoni mwa kila sura.

to this end is the final aim of this bilingual textbook.

2. Learning Chemistry

Pay attention to expressions in **magenta**. These are *headlines* or *key words*. You cannot understand the topic well unless you understand these words. Very often these words are important chemical terms which you should remember in Kiswahili as well as in English. Reading the text and carefully looking at the figures may help you to understand these words. You can also discuss them with other students and with your teacher.

Words and sentences which we want to stress are in *italics* or **bold**. They are also marked in both languages in the same manner, so you can recognize them easily.

Some words are marked with a **S** sign. These words are explained in the *glossary* at the end of this book. The glossary has a Kiswahili and an English section. Both are arranged in alphabetical order, just like in a dictionary. Very often, these are *key words* which you must understand by any means. Therefore, we have explained these terms in Kiswahili and in English. Make sure that you understand the meaning of these words in both languages. If necessary, discuss them with your fellow students and with your teacher.

Sometimes you will see phrases enclosed in a box.

These are **important scientific facts** which you should learn and understand. Learn them by understanding only, not by memorisation!

Often you will meet the ► sign. This sign marks an important point. Make sure that you understand and learn it before you move on. Use the methods which we have explained above in order to understand and learn these points thoroughly.

You cannot enjoy Chemistry unless you do **practicals**. Thus, in this book we have included as many practicals as possible. We also attach a **CD** to the Guide Book which shows those experiments in this book marked with **CD**. If you do not have access to a PC you may look at this **CD** in any Internet Café.

- We suggest that you carry out all practicals marked with **S**. This sign tells you that these are practicals for students. Although they are easy to do, you should find them interesting as well as helping you to understand the topic. You can do these experiments with either standard equipment or the do-it-yourself kit.
- We encourage you to make your own **do-it-yourself kit** (or **science tray**) because this will give you the chance to do experiments at home. To help you to make one, we have included a do-it-yourself section at the end of every chapter. If you want to make the complete science tray, look at the *Chemistry Source Book* of Mzumbe Book Project which may be found in your school library. With the science

Kama unataka kuandaa beseni la sayansi lililokamilika, tazama Kitabu cha Rejea cha Kemia (*Chemistry Source Book*) cha Mradi wa Vitabu wa Mzumbe ambacho bila shaka utakipata katika maktaba ya shule yako. Kwa kutumia kasha la vifaa vya sayansi, utakuwa na maabara yako mwenyewe inayobebeka. Utaweza kuitumia kufanya majaribio mengi uwapo shuleni na vilevile nyumbani. Kama unashindwa kutengeneza chochote kati ya vifaa vinavyotakiwa, basi mwulize mwalimu wako ambaye bila shaka atakupa msaada.

- Kitabu hicho cha Rejea pia kinaelezea majaribio mengi zaidi ambayo unaweza kuyafanya kwa kasha la vifaa vya sayansi. Kwa mfano, kuna *majaribio ya mshumaa* ili kukupa staid za kuchunguza, kuhoji na kutoa maelezo ya kisayansi. Na kuna *majaribio ya kutumia majivu* ambayo kwayo unajifunza mbinu muhimu kabisa za kikemikali kwenye maabara.
- Majaribio yaliyowekewa alama ya **T** ni kwa ajili ya mwalimu tu. Ni majaribio ya hatari sana kwa wewe kujaribu kuyafanya.
- Kama hujui jina la kifaa unachotaka kutumia, tafadhali rejea kwenye kurasa za 290 hadi 298 za majalada ya kitabu hiki. Humo tumeweka michoro ya vifaa vyote maalumu na hata vile ambavyo ni vya kujitengenezea mwenyewe.
- Unapofanya jaribio, daima zingatia alama za maonyo ya hatari na alama za usalama. Utapata maana za **alama za maonyo** kwenye ukurasa wa 21. **Alama za usalama** zinakupa vidokezo vya

namna ya kujihami dhidi ya ajali. Hizo utazipata kwenye ukurasa wa 22 na 24. Ni alama muhimu sana kwani zitakusaidia kuepuka ajali na kulinda mazingira yako ili yasipate uchafuzi wa kikemikali.

- Baada ya kwisha kusoma maelezo ya mada na umekwishafanya majaribio, jipime ili kuona kama kweli umeelewa mada inayohusika. Ili kufikia azma hii tumejumuisha **maswali** mwishoni mwa kila sura.

Unapofanya maswali haya:

- Yasome kwa umakini.
- Hakikisha kuwa unaelewa nini kinaulizwa.
- Andika jibu lako kwenye daftari lako la mazoezi.
- Pitia maelezo kitabuni ili kuona kama umetoa majibu yaliyo sahihi. Kama huna uhakika kuhusu majibu yako, basi mwulize mwalimu wako au takama *Kitabu cha Mwongozo kwa ajili ya kitabu hiki cha Furahia Kemia kitabu cha Kidato cha I*.

Tunakaribisha kwa furaha ukosoaji wenu, maoni na ushauri wenu kuhusu kitabu hiki. Tafadhali mjisikie huru kutuandikia. Tungependa kitabu hiki kitoke kikiwa bora zaidi katika toleo lifuatalo!

“Furahia Kemia”

Mradi wa Vitabu Mzumbe

S.L.P. 113 Mzumbe

Morogoro – Tanzania.

ndarluloth@gmail.com

cc. Manfred.Schiess@gmx.de

tray, you will have your own portable minilab. With this you can perform many experiments in the school and at home. If you have a problem in making any of the apparatus, please ask your teacher who may be able to assist you.

- The Source Book also describes more experiments which you can perform with the science tray. For example, there are *experiments with a candle* to train your ability to observe, reason and explain scientifically. And there are *experiments with ash* in which you easily learn the most important chemical laboratory techniques.
- The experiments marked with the sign **T** should be done by your teacher only. They are too dangerous for you to carry them out.
- In case you do not know the name of the apparatus which you want to use, please refer to the page 290 up to 298 of this book. There we have included the drawings of the standard as well as the do-it-yourself equipment.
- When you carry out an experiment, always observe the **hazard warning signs** and the **safety signs**. You find the meaning of the hazard warning signs on page 21. The safety signs give you hints on how to prevent the hazards. You find them on page 23 and 25. They are very important since they help you to prevent accidents and to

safeguard your environment against chemical pollution.

- After you have read the text of a topic and you have done the experiments, test yourself in order to check if you have really understood the topic. For this purpose, we have included **questions** at the end of each chapter.

When attempting these questions:

- Read them carefully.
- Make sure that you understand what is being asked.
- Write your answer in your exercise book.
- Check with the text whether your answers are right. If you are unsure ask your teacher or check with the *Guide Book for Enjoy Chemistry for Form I*.

We warmly welcome your criticism, suggestions and opinions on this book. Please, feel free to write to us. We want to make this book even better in the next edition!

“Enjoy Chemistry”

Mzumbe Book Project

P.O.Box 113 Mzumbe

Morogoro – Tanzania

ndarluloth@gmail.com

cc. Manfred.Schiess@gmx.de

1

Utangulizi kuhusu Kemia

Katika shule ya msingi mlifunza Sayansi. Katika shule ya sekondari pia mtajifunza Sayansi. Hata hivyo, hamtajifunza Sayansi kama somo moja kama mlivyofanya katika shule ya msingi. Katika shule ya sekondari sasa Sayansi imegawanyika katika masomo matatu, Biolojia, Kemia na Fizikia. Katika kitabu hiki mtajifunza Kemia. Katika sura hii, mtajifunza Kemia ni nini, inafanya nini na ina umuhimu gani katika maisha yetu ya kila siku.

1.1 Umuhimu wa Kemia

Kemia ni muhimu sana katika maisha yetu ya kila siku. Hatuwezi kumaliza siku bila kutumia vitu vilivyotengenezwa kwa kutumia mbinu za Kemia.

1. Katika **viwanda vya chakula**, Kemia ni muhimu sana. Kemia inatumika katika uzalishaji wa mafuta ya kupikia, chumvi, sukari, magadi ya kuokea n.k. Pia **vinywaji** baridi, kwa mfano soda, huzalishwa kwa kutumia Kemia.



Mchoro wa 1.1 Bidhaa za vyakula za viwanda

Watu waliojifunza na kutumia Kemia wanaitwa **Wakemia**. Kwa mfano, Wakemia wanaofanya kazi katika migodi ya chumvi ya Uvinza karibu na Kigoma. Wengine wanazalisha sukari kwenye kiwanda cha Kakira karibu na Jinja. Baadhi huzalisha soda kwenye viwanda vya vinywaji baridi jijini Dar es Salaam na Nairobi. Wengine hutengeneza kahawa kwenye kiwanda huko Bukoba wakati wengine wengi wanafanya kazi kwenye viwanda vya mafuta kote Afrika Mashariki.

Zoezi la 1

Taja bidhaa nyingine za vyakula ambazo uzalishaji wake unahusisha Kemia na taja mahali zinapozalishwa bidhaa hizo za vyakula.

- 2 Katika **tiba**, Kemia ina umuhimu mkubwa. Dawa nyingi hutengenezwa au huziduliwa kutoka kwenye mimea kwa kutumia Kemia. Dawa hutumiwa kwenye *hospitali* na kuuzwa kwenye *maduka ya dawa*.

1

Introduction to Chemistry

In primary school you studied Science. In secondary school you will also study Science. However, you will not study it as one subject as you did in primary school. In secondary school Science is divided now into three subjects: Biology, Chemistry and Physics. In this book you will study Chemistry. In this chapter, you will learn what Chemistry is, what it does and how important it is in our daily life.

1.1 The Importance of Chemistry

Chemistry is very important in our daily life. We can hardly spend a day without using things produced by Chemistry.

1. In the **food industry**, Chemistry is very important. Chemistry is involved in the production of cooking oil, salt, sugar, baking powder, etc. Also **beverages**, for example, sodas, are produced by using Chemistry.



Fig. 1.1 Industrial food products

People who have studied and apply Chemistry are called **Chemists**. For example, Chemists work with Uvinza salt mines near Kigoma. Others produce sugar at the Kakira factory near Jinja. Some produce sodas in soft drink plants in Dar es Salaam and Nairobi. Others make instant coffee at the factory in Bukoba while many work in the oil industries throughout East Africa.

Exercise 1

Name other food products in whose production Chemistry may be involved and state where the food products are produced.

2. In **medicine**, Chemistry is very important. Many drugs or medicines are made or extracted from plants by using Chemistry. The drugs are used in *hospitals* and sold in *pharmacies*.



Mchoro wa 1.2 Dawa

Baadhi ya Wakemia katika maisha yao hufanya kazi ya kutengeneza na kuuza dawa. Hawa wanajulikana kama Wakemia wa dawa. Utawapata katika kila mji Afrika Mashariki. Wakemia katika Kiwanda cha Dawa cha Keko Pharmaceuticals cha jijini Dar es Salaam na Welcome Industries huko Nairobi hufanya kazi ya kutengeneza dawa. Wengine hutumia muda wa maisha yao katika kutafuta kugundua dawa mpya. Kwa mfano, Wakemia katika Kitengo cha Dawa za Asili pale Muhimbili, Dar es Salaam, huchunguza dawa mpya.

Zoezi la 2

- Taja njia za asili za kutibu ugonjwa wowote unaojulikana.
 - Je, dawa ya kwinini ambayo hutibu ugonjwa wa malaria huziduliwa kutoka kwenye nini?
3. Kwa shughuli za usafi Kemia ni muhimu. Kemia huzalisha sabuni, sabuni za unga, dawa za meno, sabuni za unga za kusafishia, n.k., tazama Mchoro wa. 1.3



Mchoro wa 1.3 Kemikali za kufanyia usafi

Baadhi ya Wakemia wanafanya kazi kwenye kiwanda cha Lake Soap huko Mwanza. Wengine wanatengeneza dawa za meno katika kiwanda cha Alfi Industries huko Arusha na Colgate Industries huko Nairobi. Sabuni za unga na maji kwa mfano hutengenezwa kwenye kiwanda cha Sabuni Industries huko Tanga na East African Industries huko Nairobi, tazama Mchoro wa. 1.3.

4. Kwa kaya, vifaa vya plastiki vinaweza kuwa na manufaa. Kemia imewezesha kuzalisha vitu hivi kutokana na petroliamu, tazama Mchoro wa. 1.4.



Mchoro wa 1.4 Vyombo vya plastiki



Fig. 1.2 Medicines

Some Chemists spend their lifetime making and selling medicines. They are known as pharmaceutical Chemists. You can find them in every town in East Africa. Chemists at Keko Pharmaceuticals in Dar es Salaam and Welcome Industries in Nairobi make medicines. Others spend their lifetime searching for new medicines. For example, Chemists at the Traditional Medicine Research Unit at Muhimbili, Dar es Salaam, search for new medicines.

Exercise 2

- Name a traditional method of curing any named disease.
 - Out of what is quinine extracted which is used to cure malaria?
3. For cleaning purposes Chemistry is important. Chemistry provides soap, detergents, toothpastes, cleaning powder, etc., see Fig. 1.3.

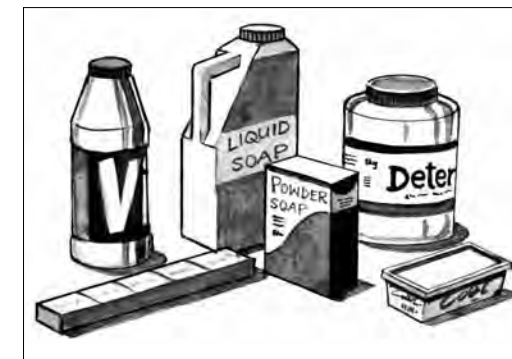


Fig. 1.3 Detergents

Some Chemists work at Lake Soap in Mwanza. Others make toothpastes at Alfi Industries in Arusha and Colgate Industries in Nairobi. Detergents for example are made at Sabuni Industries in Tanga and East African Industries in Nairobi, see Fig. 1.3.

4. For households, plastic articles can be useful. Chemistry made it possible to produce these things from petroleum, see Fig. 1.4.



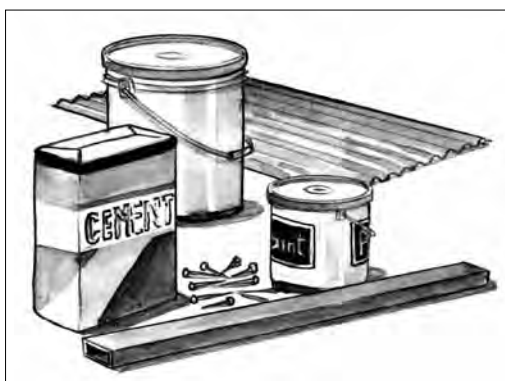
Fig. 1.4 Plastic articles in a household

Zoezi la 3

Andika majina ya vifaa vitano vya plastiki unavyotumia katika maisha ya kila siku

5. Kemia ni muhimu kwa ajili ya uzalishaji wa **vifaa vya ujenzi** kama vile **saruji**, **chokaa**, **kemikali** kwa ajili ya kuhifadhi mbao, hata mabati, misumari, matofali, vioo na rangi. Tazama Mchoro wa. 1.5.

Baadhi ya Wakemia hufanya kazi katika kiwanda cha Saruji cha Wazo Hill cha jijini Dar es Salaam, wengine wapo katika viwanda vya saruji vya Tororo na Thika. Pia viwanda vya chuma huko Tanga, Nairobi na Jinja huajiri Wakemia. Vingine huzalisha vioo na vifaa vya vioo.



Mchoro wa 1.5 Vifaa vya ujenzi

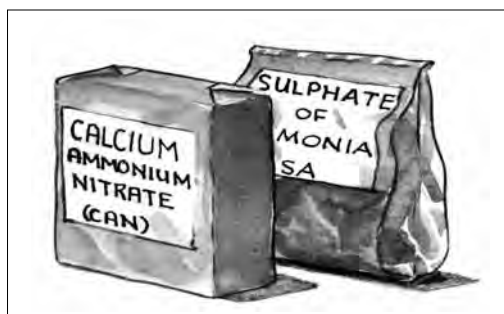
6. Katika **kilimo**, Kemia imekuwa na umuhimu mkubwa katika zama hizi. Kwa kutumia **mbolea za viwandani** wakulima wanaweza kuzalisha mazao mengi zaidi kwenye mashamba yao. Kemikali zinazoitwa **viuatilifu** zinaweza kutumiwa kuua wadudu

waharibifu na zile zinazoitwa **sumu** ya majani hutumika kuua magugu.

Mbolea za viwandani huzalishwa na viwanda huko Tanga na Tororo. Twiga Industries huko Nairobi huzalisha viuatilifu na sumu ya majani.

Zoezi la 4

Katika shamba lako la mahindi umekuta mashina machache ya mahindi yana wadudu wala nafaka. Hutatumia kemikali za kuua wadudu mara moja. Je, ni viuatilifu gani vya kiasili unaweza kuvitumia kwanza?



Mchoro wa 1.6 Mbolea za viwandani

7. **Fueli** za kisasa haziwezi kuzalishwa bila Kemia.



Mchoro wa 1.7 Kwenye kituo cha mafuta

Exercise 3

Write down five plastic articles which you use in daily life.

5. Chemistry is important for the production of **building materials** like **cement**, **lime**, chemicals for wood **preservation**, even corrugated iron sheets, nails, bricks, glass and paints. See Fig. 1.5.

Some Chemists work at Wazo Hill cement factory in Dar es Salaam, others at Tororo and Thika cement factories. Also the steel mills in Tanga, Nairobi and Jinja employ Chemists. Others produce glass and glassware.

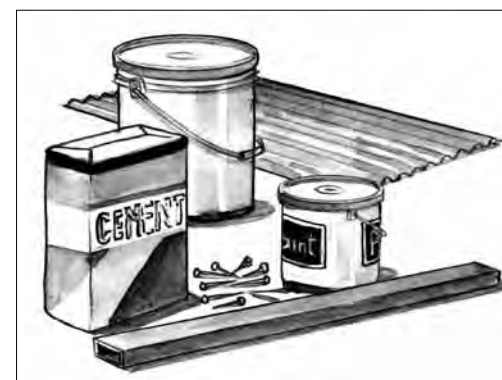


Fig. 1.5 Building materials

6. In **agriculture**, Chemistry has become very important nowadays. By applying chemical **fertilizers** farmers can produce more crops on their fields. Chemicals called **pesticides** may be used to kill pests and those called **herbicides** are used to kill weeds.

Chemical fertilizers are produced by industries in Tanga and Tororo. Twiga Industries in Nairobi produce pesticides and herbicides.

Exercise 4

On your maize shamba you have found a few maize stems with weevils. You will not use chemical pest killers immediately. What natural pesticides may you use first?

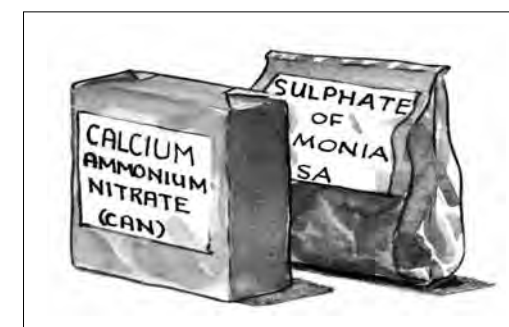


Fig. 1.6 Chemical fertilizers

7. Modern **fuels** cannot be produced without Chemistry.



Fig. 1.7 At a petrol station



Courtesy of Miro, Karlsruhe, Germany

Mchoro wa 1.8 Kiwanda cha kusafishia mafuta

Fueli kama vile kiowevu cha gesi, petroli, dizeli, mafuta ya taa na mafuta ya Jatropha hutupatia nishati nyingi zaidi kuliko kuni na mkaa, tazama Mchoro wa. 1.7. Petroli, dizeli na mafuta ya taa hutenganishwa kutoka katika petroliamu kwenye viwanda vya kusafisha mafuta huko Dar es Salaam na Mombasa, tazama Mchoro wa. 1.8 na Mchoro wa. 1.11.

8. Kemia ni muhimu katika kutengeneza nguo na viatu. Tazama Mchoro wa. 1.9. Baadhi ya Wakemia wanatengeneza ngozi kutokana na ngozi za wanyama. Viwanda vya kemikali huzalisha nyuzi (sanisi) zilizotengenezwa na binadamu, kwa mfano polista, nailoni n.k. kutokana na petroliamu. Kiwanda cha nyuzi huko Morogoro huzalisha vitambaa kwa kutumia nyuzi hizo. Viwanda vilivyo Eldoret, Mbale na

Mwanza hutumia rangi za kikemikali ili kuziwekea nguo rangi nzuri.

9. Viwanda hutengeneza bidhaa nyingine ambazo zinatumia michakato ya kikemia: kwa mfano, matairi ya magari na baiskeli na tyubu, karatasi, vanishi, rangi za viatu, vipodozi, n.k. Tazama Mchoro wa. 1.10. Spiriti (ethanol) kwa ajili ya kutumia katika dawa au majiko pia hutengenezwa kwa kutumia Kemia.



Mchoro wa 1.9 Nguo, viatu, n.k.



Courtesy of Miro, Karlsruhe, Germany

Fig. 1.8 A petroleum refinery

Fuels like liquid gas, petrol, diesel, kerosene and Jatropha oil give us much more energy than wood and charcoal, see Fig. 1.7. Petrol, diesel and kerosene are refined from petroleum at the oil refineries in Dar es Salaam and Mombasa, see Fig. 1.8 and Fig. 1.11.

8. Chemistry is important in making clothes and shoes. See Fig. 1.9. Some Chemist make leather from hides and skins of animals. Chemical industries produce man-made (synthetic) fibres, for example, polyester, nylon, etc. from petroleum. The polyester factory in Morogoro makes fabrics using such fibres. Factories in Eldoret, Mbale and Mwanza use chemical dyes to give clothes nice colours.

9. Industries make many other products which involve chemical processes: for example, car and bicycle tires and

tubes, paper, varnishes, shoe polishes, cosmetics, etc. See Fig. 1.10. Spirit (ethanol) for use in medicines or burners too is made by applying Chemistry.



Fig. 1.9 Clothes, shoes, etc.

Wakati wa kutengeneza bia, mvinyo na pombe kali kwa ajili ya kunywa, ni muhimu kuwa na maarifa ya kutosha. Usinywe pombe haramu ya moshi “gongo” au “chang’aa”, anayeinywa huweza kuwa kipofu au anaweza hata kufa kama sumu ya pombe (methanol) haikuondolewa kikamilifu!



Mchoro wa 1.10 Bidhaa zaidi za kemikali

Zoezi la 5

Katika mchoro wa 1.8 na 1.11 unaona kiwanda cha kusafishia mafuta. Angalia minara mirefu ya kukeneka mafuta. Katika minara hii petroliamu hutenganishwa katika bidhaa kuu za mafuta zilizosafishwa.

- Taja bidhaa tano kuu za usafishaji huu.
- Bidhaa hizi zinatumiwa kwa ajili ya nini?

Zoezi la 6

- Taja angalau vitu vitano ambavyo unavitumia katika maisha yako ya kila siku ambavyo uzalishaji wake unatumia Kemia.
- Eleza angalau viwanda vitano nchini mwako ambavyo vinatumia Kemia katika uzalishaji wao.

1.2 Kemia ni nini?

Kama ulivyoona katika sehemu iliyotangulia,

- Kemia hutengeneza dutu mpya. Kwa madhumuni haya, *inachunguza sifa na tabia za dutu* ambazo zinapatikana kwenye hewa, maji, udongo, miamba na pia kwenye viumbe hai kama wanyama, binadamu na mimea. Hivyo, Kemia ni Sayansi.

Kemia hutengeneza dutu mpya kwa njia mbili:

- Dutu mbalimbali zinaweza *kuunganishwa* kuunda dutu moja au kadhaa mpya. Mchoro wakato huu tunauita uunganishaji.
- Dutu moja inaweza *kugawanyika* katika dutu kadhaa. Mchoro wakato huu huitwa msambaratiko kutokana na uvunjikaji.

Kemia ni Sayansi. Inachunguza sifa na tabia za dutu. Inatengeneza dutu nyingine kwa uunganishaji au uvunjaji.

Moja kati ya viwanda muhimu vya kikemia ni *kiwanda cha kusafishia mafuta*. Bila kiwanda hiki, Kemia ya sasa na maisha ya kisasa yangeshindikana.

1.3 Fanya Mwenyewe

Matumaini yetu ni kwamba utafurahia somo la Kemia na siku zijazo utaweza kuunda dutu mpya au kuboresha zile za zamani.

When making beer, wine and spirits for drinking, thorough chemical knowledge is necessary. Never drink illegal “gongo” or “chang’aa” because many people, who drink it, become blind or may even die if the poisonous part of the alcohol (methanol) has not been properly removed!



Fig. 1.10 More chemical products

Exercise 5

In Fig. 1.8 and 1.11 you see an oil refinery. Notice the tall distillation towers. In these towers petroleum is separated into the main products of the refinery.

- Name five main products of the refinery.
- What are these products used for?

Exercise 6

- Name at least five things that you use in your daily life in whose production Chemistry is involved.
- State at least five industries in your country which use Chemistry in their production.

1.2 What is Chemistry?

As you have seen in the previous section,

- Chemistry makes new substances. For this aim, *it studies the properties and the behaviour of substances* which are found in air, water, soil, rocks and also in living things like animals, human beings and plants. Thus, it is a Science.

Chemistry makes new substances in two ways:

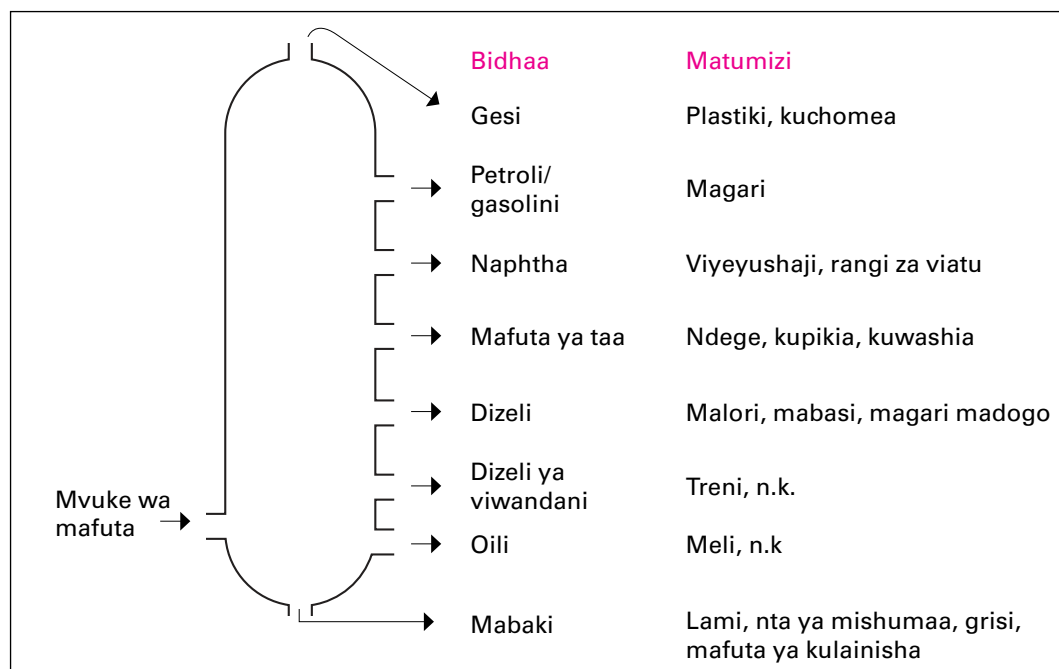
- Different substances may *combine* to form one or several new substances. We call this process composition.
- One substance may *break up* into several new substances. This is called decomposition.

Chemistry is a Science. It studies the properties and the behaviour of substances. It produces new substances by composition or decomposition.

One of the most important chemical industries is *petroleum refinery*. Without it, modern Chemistry and modern life would be impossible.

1.3 Do It Yourself

Our hope is that you will enjoy the study of Chemistry and in the future you will be able to create new substances or to improve old ones.



Mchoro wa 1.11 Mnara wa ukenekaji unaoonyesha bidhaa zinazotokana na usafishaji petroliamu na matumizi yake

Tunajua, unaweza kuunda vitu vipya. Iwapo hutuamini, jaribu kufanya majaribio yafuatayo:

Jaribio la 1: Kuchachusha Maziwa

- Chukua maziwa yaliyo kwenye glasi, kisha yaonje.
- Weka glasi hiyo ya maziwa kabatini.
- Iache kwa siku 1 au 2.
- Onja tena maziwa hayo.
- Je, maziwa yana ladha tofauti? Fafanua.
- Rekodi matokeo uliyoyaona.

Jaribio la 2: Kutengeneza Dutu Mpya kwa Kuchoma

- Choma karatasi, mbao, pamba au washa njiti ya kibiriti.
- Umeona nini?
- Elezea dutu mpya iliyobaki baada ya

kuchoma. Zilinganishe na zile ambazo hujazichoma. Rekodi matokeo uliyoyaona.

Jaribio la 3: Kupasha Moto Bila Kuchoma

- Weka kijiko cha chai cha chokaa kwenye glasi (Usiguse chokaa kwa vidole vyako!).
- Miminia maji kidogo.
- Unasikiaje unapogusa glasi? Rekodi matokeo uliyooona.

Jaribio la 4: Kubadili Rangi

- Twanga petali za maua mekundu au ya pinki kwenye kasha lenye ukuta mgumu kama kinu kwa mtwangio.
- Kwenye dutu zilizotwangwa, mimina spiriti isiyo na rangi (iwapo haipo, miminia maji).
- Twanga tena.

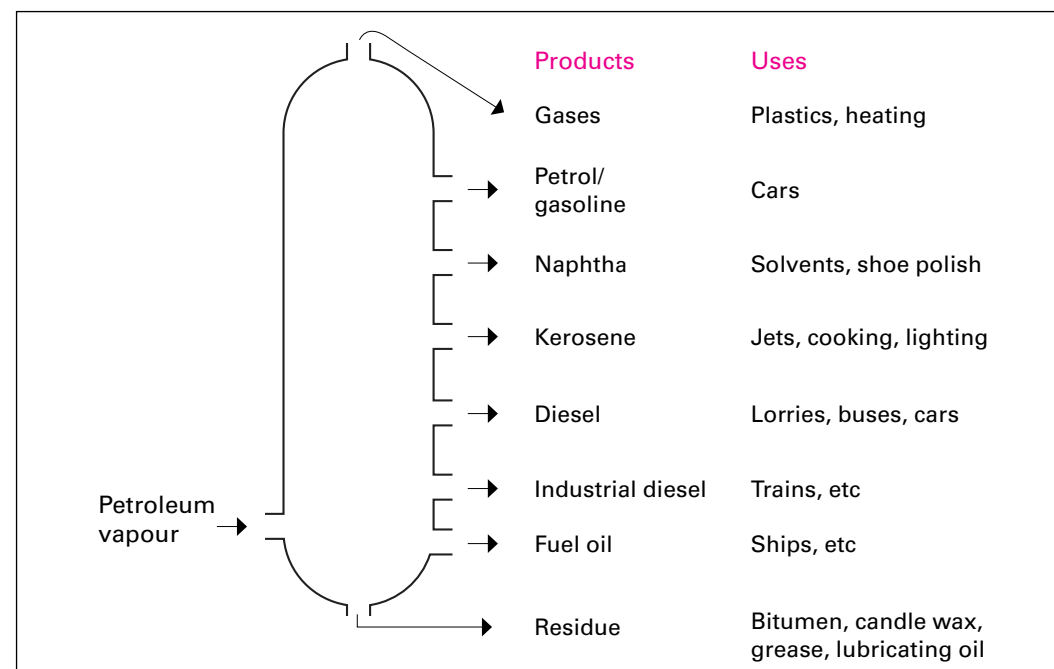


Fig. 1.11 Distillation tower showing products of petroleum refinery and their uses

We know, you are able to create new things. If you do not believe us, try the following experiments:

Experiment 1: Making sour milk

- Take a glass of milk and taste the milk.
- Put the glass of milk in a cupboard.
- Leave it for 1 or 2 days.
- Taste the milk again.
- Does the milk taste differently? Explain.
- Record your observations.

Experiment 2: Making new substances by burning

- Burn some paper, wood, cotton or ignite a matchstick.
- What do you observe?
- Describe the new substances left after burning. Compare them with those

which you have not burnt. Record your observations.

Experiment 3: Heating without burning

- Put one teaspoonful of quicklime into a glass (Do not touch the quicklime with your fingers!).
- Add some water to it.
- What do you feel when you touch the glass? Record what you observed.

Experiment 4: Change in colour

- Grind petals of red or pink flowers in a hard walled container like a mortar and pestle.
- To the crushed substances, add colourless spirit (if this is not available; add water).
- Grind again.

- d) Sasa dondoshea matone kadhaa ya maji ya limau au siki.
- e) Umeona nini? Rekodi.

Utaona kuwa unaweza kutengeneza dutu mpya. Utakapokuwa umesoma Kemia katika ngazi ya Sekondari, utajua, kwa mfano, jinsi chumvi, saruji, mbolea na sukari zinavyozalishwa. Utaweza kutengeneza sabuni yako ya kufulia.

Hata hivyo, hautakuwa Mkemia mpaka upate shahada katika Kemia kutoka chuo kikuu. Kisha unaweza kufanya kazi kama Mkemia.

1.4 Kemia na Mazingira

Hata kama hutaki kuwa Mkemia, utafaidika na mengi kutokana na kujifunza Kemia.

Kwa mfano, utajifunza kuhusu hewa, maji, udongo n.k. yaani, kuhusu **mazingira** ambamo unaishi. Utajua maji yapi yanafaa kwa ajili ya kufulia nguo kwa sabuni na yapi hayafai. Utajua jinsi ya kufanya maji machafu yafae kwa ajili ya kunywa. Pia utaelewa kwa nini watu ambao hupumua mara kwa mara kwenye moshi wa moto au moshi unaotoka kwenye injini ya dizeli hupatawa na magonjwa.

Hivyo, kwa kuelewa mazingira yako utaweza kuishi kwa afya bora na kwa raha zaidi.

Pia utaweza kutambua na huenda kuzuia uchafuzi wa **hewa kwa kemikali** katika mazingira yako. Dutu fulani za Kikemikali zinaweza kuchafua hewa, maji au udongo. Hii ina maana zinafanya hewa isifae kwa

ajili ya kupumua, maji yawe hayafai kunywa au kwa ajili ya samaki na udongo usifae kupanda mazao.



Mchoro wa 1.12 Uchafuzi wa hali ya hewa kwa uchomaji wa taka

Zoezi la 7

- Zungumza na watu wanaochafua hewa kwa kuchoma taka. Waeleze kuwa masizi na harufu za plastiki au mipira inayoungua husababisha saratani na magonjwa ya mapafu. Waombe tafadhali wasichome taka bali wafukie taka kwenye shimo na kuzifunika kwa udongo.
- Zungumza na watu wanaochafua mto kwa sabuni au kemikali kwa kufulia. Waeleze kuwa wanafanya maji yawe hayafai kunywa.

1.5 Muhtasari

Kemia ina umuhimu mkubwa kwa maisha ya kila siku. Bidhaa za Kemia hutusaidia kupata chakula bora, kuoga na kufua nguo zetu, kutibu magonjwa, kuvuna mazao zaidi, kujenga nyumba bora, kuwasha taa zetu, kusafiri kwa basi au ndege, n.k.

Kemia ni Sayansi. Inachunguza sifa na tabia za dutu. Inatengeneza dutu mpya kwa kuunganisha na **kuvunja** dutu.

- d) Now add a few drops of lemon juice or vinegar.
- e) What do you observe? Record it.

You see that you are able to make new substances. When you have studied O-Level Chemistry, you will know, for example, how salt, cement, fertilizers and sugar are made. You will be able to make your own washing soap.

However, you will not be a Chemist until you have got a degree in Chemistry from a university. Then you may work as a Chemist.

1.4 Chemistry and the Environment

Even if you do not want to be a Chemist, you will gain a lot by studying Chemistry.

For example, you will learn about air, water, soil, etc. that means about the **environment** in which you live. You will know which water is suitable for washing clothes with soap and which is not. You will know how to make dirty water suitable for drinking. You will also understand why people who frequently breathe in smoke from a fire or the exhaust of a diesel engine get sick.

Thus, by understanding your environment you will be able to live in better health and more comfortably.

You will also be able to recognise and perhaps prevent **chemical pollution** of your environment. Certain chemical substances can pollute air, water or soil. That means they make the air unfit for breathing, the water unsuitable for

drinking or for fish to live in and the soil unfit for growing food crops.



Mchoro wa 1.12 Uchafuzi wa hali ya hewa kwa uchomaji wa taka

Exercise 7

- Talk to people who pollute the air by burning rubbish. Explain to them that soot and fumes of burning plastic or rubber cause cancer and lung diseases. Ask them kindly not to burn the waste but to bury the waste in a pit and cover it with soil.
- Talk to people who pollute a river with soap or detergents by washing. Explain to them that they make the water unfit for drinking.

1.5 Summary

Chemistry is very important for daily life. Chemical products help us to have better food, wash ourselves and our clothes, cure diseases, to harvest more crops, to build better houses, to light our lamps, to travel by bus or aeroplane, etc.

Chemistry is a Science. It studies the properties and the behaviour of substances. It produces new substances by composition or **decomposition**.

Hata hivyo, *dutu za kikemikali zikitumiwa ovyo zinaweza pia kuchafua vibaya mazingira.*

- Usichome taka. Hasa kuchoma plastiki na mipira huchafua hewa kwa dutu za sumu!

- Usioge au kufua nguo mtoni na kufanya maji yawe hayafai kunywewa na watu.

However, *chemical substances carelessly used can also severely pollute the environment.*

- Never burn rubbish. Especially burning plastics and rubber pollute

the air with very poisonous substances!

- Never wash yourself or your clothes in a river, this makes the water unfit for people to drink.

1.6 Maswali ya Marudio

1. Eleza Kemia ni nini na inafanya nini.
2. Elezea angalau maeneo matano ambapo Kemia inatumika.
3. Orodhesha shughuli za kila siku ambazo unaweza kutumia bidhaa za kemia na kwa kila shughuli, taja bidhaa.
4. Andika maelezo ya umuhimu wa usafishaji wa mafuta katika maisha ya sasa. Taja vitu ambavyo visingekuwepo au visingefanya kazi, kama kusingekuwa na usafishaji wa mafuta.
5. Masomo gani mengine ya Sayansi yanafundishwa shuleni kwenu?
6. Kwa nini si vizuri kunywa pombe haramu ya “gongo” au “chang’aa”?
7. Eleza neno mazingira lina maana gani.
8. Kwa nini hatutakiwi kuchoma taka?
9. Kwa nini hatutakiwi kuoga mtoni?
10. Utafanya nini ili kuzuia uchafuzi wa hewa kwenye kijiji au mji wenu?

1.6 Revision Questions

1. Explain what Chemistry is and what it does.
2. State at least five areas where Chemistry is applied.
3. List daily activities in which you may use chemical products and for each activity, name the products.
4. Write an account of the importance of petroleum refinery in modern life. Name things which would not be there or would not be working, if there would be no petroleum refining.
5. What other Sciences are taught at your school?
6. Why should one never drink illegal “gongo” or “chang’aa”?
7. Explain what the word *environment* means.
8. Why should one never burn rubbish?
9. Why should one not wash in a river?
10. What can you do to prevent air pollution in your village or town?

Faharasa

-a ajali: Jambo lolote linalotokea bila kutarajia na ni baya.

-a kung'aa: Kung'aa wazi, k.m. mshumaa au balbu.

-a kusanidiwa: Imetengenezwa kwa usanidi wa kikemikali.

-a kuvuja: Kuwa na matundu madogo ambapo kiowevu au gesi inaweza kupita, k.m. karatasi ya kuchujia.

Alamakipimo: Alama kwenye kifaa au chombo inayoonyesha wingi wa kiumbo, k.m. digrii, ujazo, n.k.

Alkali: Dutu ambayo husawazisha asidi na kuunda mmumunyo babushi au unaoungua katika maji, k.m. soda babushi.

Aloi: Mmumunyo wa mango katika mango, k.m. shaba nyeusi ni mmumunyo wa bati katika shaba. (Ili kuzichanganya lazima ziwe katika hali ya kiowevu.)

Asidi: Dutu yoyote yenye ladha ya uchachu; hata hivyo asidi nyingi inachakaza sana vitu na haifai kuonjwa, k.m. asidi salfariki.

Babushi: Inaweza kuunguza au kuharibu vitu kwa utendanaji wa kikemikali, k.m. soda babushi.

Badiliko la kikemikali: Badiliko ambalo angalau dutu moja mpya imetengenezwa yenye sifa tofauti, k.m. maziwa kuwa chachu au chuma + salfa kutendana kuwa salfedi ya chuma(II) ikipashwa moto.

Badiliko la kiumbo: Badiliko ambapo hakuna dutu mpya inayotengenezwa, k.m. majikubadilika kuwa mvuke. Tazama Sura ya 8.1.

Bakteria: Viumbe wadogo walio kwa idadi kubwa kwenye hewa, maji, udongo na viumbe hai, wakati mwingine husababisha magonjwa.

Barafu: Hali ya maji yaliyogeuka kuwa mango wakati joto likiwa 0 °C au chini.

Cheche: Chembe ndogo sana zinazorushwa kutokana na dutu zinazoungua; au wakati dutu mbili ngumu kama jiwe, metali, mawe magumu yanapogongana; au kimweko cha mwanga unaozalishwa kwa kukatika kwa mkondo wa umeme.

Chokaa: Oksidi ya kalisi.

Chujo: Kiowevu kilichokusanywa baada ya uchujaji.

Chupa ya Winchester: Chupa ya ujazo mkubwa inayotumika kuhifadhi kemikali, tazama kurasa za jalada la mbele ndani (40).

Data: Taarifa zinazotumika katika kujadili au kuamua.

Dawa za kusafishia: Dutu zinazotumiwa kwa ajili ya kusafishia vyombo, nguo, n.k. Zimetengenezwa na viwanda vya kemikali na zina sifa bora za kusafishia kuliko sabuni.

Dutu: Aina fulani ya maada.

Elementi bandia: Elementi zenye idadi ya atomu zaidi ya 92 ambazo hazipo kiasili. Zimetengenezwa na wanasayansi.

Elementi: Dutu ambayo haiwezi kubosholewa na utendanaji wa kikemikali kupata dutu rahisi.

Elementi muunganisho: Zile elementi ambazo zipo katika safu ya kati kwenye Jedwali la Mirudio na haiingii katika kundi lolote kati ya makundi makuu nane.

Emalshani: Kuelea kwa kiowevu katika kiowevu kingine (viowevu viwili hivyo si changanyifu), k.m. oili ikitikiswa na maji. Tazama Sura ya 6.4.

Famasia: Inajumuisha maandalizi na utoaji wa kemikali kama dawa.

Flaski ya ujazo: Flaski kubwa yenye shingo ndefu nyembamba inayotumiwa kupima ujazo unaojulikana wa mmumunyo. Tazama kurasa za jalada la nyuma (127).

Fueli: Dutu yoyote ambayo inaunguzwa kuzalisha nishati (kawaida kama joto na mwanga).

Fuwele: Vipande kama vioo vya mango vyenye umbo la kawaida, k.m. fuwele za sukari au chumvi ya kawaida. Fuwele zote za dutu menyu zina umbo linalofanana.

Gesi za thamani: Elementi katika Kundi la VIII la Jedwali la Mirudio, tazama Sura ya 8.4.

Gido: kiowevu kilichopatikana baada ya kutenganisha kwa njia ya ugidaji.

Hadubini: Kifaa kinachotumiwa kufanya vitu vidogo sana visivyoonekana kwa macho vionekane.

Hali ya gesi: Hali ya maada ambapo chembechembe ndogo zinakuwa huru kuzunguka bila kani yoyote inayozishikanisha pamoja. Gesi haina ujazo au umbo maalumu.

Hali ya maada: Moja kati ya hali tatu kuu za maada (gesi, kiowevu, mango) ambapo dutu inaweza kuwa nazo.

Hifadhi: Kuweka dutu kwenye kitu ili kuzuia kisioze au kupunguza kasi ya kuoza kwake.

Hitimisha/hitimisho: Fikia matokeo ya kufikiri; au amua baada ya majadiliano au kufikiri.

Idadi ya Atomu: Katika kitabu hiki, idadi hii hutoa tu nafasi ya elementi kwenye Jedwali la Mirudio.

Injini ya Mwako: injini ambapo mwako unafanyika.

Isong'aa: haina mng'ao, hutoa mwanga duni.

Jaribio: Jaribio la kuonyesha au kuchunguza kitu fulani kina tabia gani.

Jedwali la Mirudio: hupanga elementi zote kulingana na sifa zao katika mirudio na makundi. Angalia Sura ya 8.4.

Joto: Kipimo cha jinsi kitu kilivyo moto au baridi.

Joto la mwako: Joto ambapo dutu huanza kuungua yenyewe

inapopashwa moto hewani. Tazama Sura ya. 8.2.

Kani: Kiathiri kinachopimika kinachoelekea kusababisha mwendo wa 🍷masi.

Kanuni: Tamko la kisayansi au kihesabu ambalo ni sahihi kwa seti ya masharti, k.m. kanuni ya hifadhi ya 🍷masi.

Kechu: Kuvunjika kirahisi kikipindwa au kugongwa, k.m. kioo.

Kemikali: Elementi 🍷yoyote au 🍷mmumunyo ambao unaweza kutumiwa au kuzalishwa katika utendanaji wa kikemikali au jaribio.

Kichujo: Dutu 🍷ambayo 🍷kiowevu au gesi hupenya kirahisi ili kuondoa chembe za ukubwa zaidi ya vitundu vya kichujo.

Kielei: Mchanganyiko 🍷anuwai ambapo chembe za chengachenga zimeachwa zituame kwa muda fulani.

Kikaboni: Imepatikana au kuundwa kwa viumbehai.

Kimia: Mpangilio mahususi wa chembechembe katika 🍷mango.

Kimumunyika: Mango yoyote au gesi ambayo inamumunyika ikiwekwa kwenye kiowevu, k.m. kaboni dioksidi kwenye maji soda.

Kiowevu: 🍷Hali ya maada ambapo chembechembe ndogo sana huunganishwa pamoja kwa kani 🍷ndogo; huunda matone kikimiminwa taratibu, kina ujazo maalumu lakini hakina umbo maalumu.

Kipimajoto: Kifaa kinachotumika kupima 🍷joto.

Kisababisha saratani: Husababisha saratani, ugonjwa unaosababisha kifo.

Kitendanaji: Dutu inayoshiriki kwenye 🍷utendanaji wa kikemikali: vitendanaji 🍷mazao.

Kitendanishi: Dutu 🍷ambayo hufanya 🍷utendanaji wa kikemikali na 🍷kemikali fulani na kinaweza kutumiwa kuhakiki kama kuna kemikali hiyo, k.m. 🍷maji ya chokaa ni kitendanishi cha kuhakiki kuwepo kwa kaboni dioksidi.

Kitoneshi cha Liebig: Kifaa 🍷kinachotumika kupoza gesi ya moto na 🍷kuitonesha. Tazama Sura ya 7.5.

Kitoneshi: Vifaa vinavyotumiwa kutonesha gesi.

Kiuamagugu: Dutu 🍷yoyote inayoua mimea (magugu) isiyohitajika.

Kiuatilifu: Dutu 🍷yoyote ambayo huua wadudu na wanyama wadogo.

Kiwanda cha kusafisha: Kiwanda cha kusafisha, k.m. mafuta, sukari, n.k.

Kromatografia: Mchakato unaotumika kutenganisha mchanganyiko wa vimumunyika kwa kuviruhusu kupita sehemu inayopitisha kiowevu kwa urahisi, k.m., utenganishaji wa rangi za maji katika wino kwa kutumia karatasi chujio.

Kromatogramu: Karatasi (au kitu kinachoruhusu kiowevu kupita kwa urahisi) chenye mimumunyo tofauti baada ya 🍷kromatografia: kawaida

mpangilio wa vinukta au vistari vya rangi, tazama Sura ya. 7.9.

Kufanya Chapwa: Kufanya 🍷mmumunyo (au 🍷dutu) kupungua ukali kwa kujazia 🍷kimumunyi, k.m. kuongeza maji zaidi kwenye mmumunyo wa chumvi ili kufanya ipungue ukali.

Kushika kutu: Utendanaji wa oksijeni na chuma katika maji na kuunda 🍷oksidi ya chuma(III) inayopenyeka.

Kuyeyuka: Badiliko la maada kutoka hali ya mango linalosababishwa na mango kufyonza nishati joto.

Maabara Chumba chenye 🍷vifaa na 🍷vitendanishi kwa ajili ya kufanya majaribio ya 🍷kisayansi.

Mabadiliko ya hali: Mabadiliko baina ya hali 🍷tatu za maada: mango, kiowevu na gesi, k.m. badiliko kutoka barafu hadi kiowevu maji. Tazama Sura ya 5.

Mabaki: Mango inayobaki kwenye karatasi ya kuchujia baada ya 🍷kuchuja.

Madini: Dutu 🍷ambayo si mmea wala mnyama, k.m. jiwe, chumvi.

Mafuta ya kipetroli: Madini ya mafuta ambayo hufanyika ardhini na hupatikana kwenye visima vilivyo chini ya ardhi. Ni 🍷mchanganyiko ambao petroli, dizeli, oili, mafuta ya taa, n.k., hutenganishwa.

Maji ya chokaa: Mmumunyo angavu 🍷usio na rangi ambao hubadilika kuwa rangi ya maziwa wakati kaboni dioksidi inapopitishwa ndani yake.

Makapi: Mango isiyomumunyika ambayo huonekana kama chembe katika kiowevu angavu.

Mango: Dutu 🍷yenye umbo na ujazo maalumu ambapo chembe ndogo sana hushikiliwa pamoja kwa 🍷kani kubwa. Tazama Sura ya 5.2.

Masi: Wingi wa maada katika chombo; hupimwa katika gramu. Masi ya kitu haibadiliki kamwe kama kitu hicho hakikubadilika wakati uzito 🍷wake unaweza kubadilika kulingana na mahali kilipo kitu hicho.

Mazingira: Masharti yote ambayo yanafanya kazi kwa viumbehai mahali wanapoishi. Haya ni pamoja na hali ya hewa, maji, n.k. na athari za viumbe wengine. Mazingira yana athari kubwa katika ukuaji wa viumbehai.

Mbolea: Dutu 🍷yoyote inayowekwa kwenye udongo ili kuboresha ukuaji wa mazao au mimea.

Mchanganyiko anuwai: Mchanganyiko 🍷usiofanana ambapo vijalizo 🍷mbalimbali vinaweza kuonekana angalau kwa hadubini 🍷ndogo.

Mchanganyiko: Kitu chochote kilichotengenezwa kwa kuchanganya dutu mbalimbali bila utendanaji wa kikemikali kufanyika, k.m. mchanganyiko wa mchele na maharage.

Mchanganyiko wa aina moja: Mchanganyiko 🍷unaofanana ambapo hakuna vijalizo 🍷tofauti vinavyoweza kuonekana hata kwa kutumia hadubini 🍷ndogo.

Mgando: Badiliko kutoka hali ya ④mango ya maada inayosababishwa na kupoa kwa kiowevu.

Mkeneko: Kiowevu menyu kilichokusanywa baada ya ④ukenekaji.

Mlinganyo wa kikemikali: Mwandiko unaotumika kufafanua ④utendanaji wa kikemikali, k.m. vitendanaji ④mazao.

Mlipuko: Kuachia nishati ghafla, kwa nguvu kutoka kwenye nafasi ndogo kawaida kama joto, sauti, mwanga na cheche zinazoruka.

Mmumunyo: Matokeo ya kumumunya ④kimumunyika kwenye ④kimumunyi na kutoa ④mchanganyiko wa aina moja, k.m. mmumunyo wa chumvi au sukari.

Modeli: Hutumika kuelezea matokeo kwenye ④majaribio. Modeli picha ya kitu tunachotaka kuelezea, si kitu chenyewe. Inaweza kuwa na kasoro kubwa lakini wakati wote inaweza kuelezea mambo yaliyoonekana.

Moshi: Kielei ④cha chembe mango za gesi, k.m. chembe za masizi kutokana na ④mwako usiokamili.

Mrija wa kupulizia: Neli ndogo ambayo hupitisha hewa ikipulizwa ili kusambaza oksijeni kwenye moto kuongeza joto. Tazama Mchoro wa 3.6.

Mmumunyo: Zao la ④muungano wa elementi ④mbili au zaidi, k.m. salfedi ya chuma (II). Hauwezi kuvunjwa kwa njia za kifizikia.

Mtonesho: Kiowevu kinachotokana na ④upoaji wa gesi au mvuke.

Muundo: Dutu mbalimbali huungana na kuunda dutu moja au zaidi mpya.

Muungano: Utendanaji wa ④kikemikali ambapo dutu mbili au zaidi huungana kufanya zao, k.m. chuma + salfa → salfedi ya chuma(II).

Mwako: Uoksidishaji wa ghafla wa ④dutu, pia unaitwa kuungua; kawaida ikifuatiwa na mwali moto na joto jingi. Tazama Sura ya 9.2.

Nafaka: Punje zinazoliwa za majani, k.m. mahindi, ngano, shayiri.

Nyetifu: Uwezo wa kupima mabadiliko kidogo sana, k.m. katika ④masi.

Oksidi: Mmumunyo ④wa elementi ④zilizochanganyika na oksijeni, k.m. kaboni dioksidi.

Panuka: Kuwa kubwa, kutawanyika.

Pasipochafuka: Hali ya kiasili ya ④mazingira kabla ya kutupa dutu zenye madhara ndani yake.

Pembe mraba: Pembe ya 90°.

Povu: Kielei ④cha gesi katika kiowevu katika muundo mwepesi wa masi ndogo sana ya mapovu, (mara nyingi juu ya maji) k.m. inayofanywa na sabuni ya unga ya kufulia. Tazama Sura ya 6.4.

Rangi: ④Dutu inayotumiwa kupaka rangi nguo, nywele, n.k.

Rejevu: Inayoweza kubadilika kinyume au kwenda mwelekeo wa kinyume au kurudi nyuma.

Respiresheni: Mchakato wakati ambapo oksijeni inatendana mwilini na dutu za chakula (kawaida mimumunyo ya ④kikaboni) kuzalisha nishati, kaboni dioksidi na maji.

Safisha: Kutakasa ④dutu.

Saruji: Kifaa cha ujenzi kilichotengenezwa kutokana na unga wa chokaa na udongo wa mfinyanzi ambayo huunda unga ambao ukichanganywa na maji hugeuka kuwa masi ngumu kama jiwe.

Sayansi: Maarifa yenye mpangilio yaliyopatikana kwa kuchunguza na kuhakiki kuhusu ulimwengu wa kimaumbile, kanuni ④za kiasili na jamii.

Sehemu: Katika ukenekaji ④kisehemu, hii ni sehemu fulani ya vijalizo ambayo imetenganishwa na kiowevu ④mchanganyiko, k.m. oili ya dizeli ni sehemu ya ④bidhaa za petroli.

Sumu: Husababisha kifo au ugonjwa ikimezwa mwilini.

Tasisha: Ondoa ④bakteria.

Tetema: Nenda haraka na kuendelea mbele na nyuma.

Uboshokaji: Utendanaji ④wa kikemikali ambapo kitendanaji kimoja ④kinavunjika katika elementi ④mbili au zaidi.

Uchafuzi: Uchafuzi wa udongo, maji au hewa kwa kutoa ④dutu zenye madhara, k.m. ④moshi huchafua hewa.

Uchujaji: Mchakato wa kuondoa chembe mango kutokana na ④kuelea au kutokana na ④moshi. Tazama Sura ya 7.2.

Ufuweleshaji: Uundaji wa ④fuwele kutokana na mmumunyo wa chumvi ④wenye joto, kifu, k.m. baada ya uvukizaji.

Ugidaji: Kumimina kiowevu taratibu kutoka kwenye chombo ambacho mango zimeachwa zituame chini. Tazama Sura ya 7.1.

Ukapishaji: Uundaji wa ④makapi wakati wa ④utendanaji wa kikemikali wa ④dutu mbili, k.m. wakati vipovu vya kaboni dioksidi vinapopita kwenye ④maji ya chokaa.

Ukenekaji: Mchakato wa kutenganisha k.m. ④kimumunyi kutoka kwenye kimumunyika cha mmumunyo wa chumvi kutokana na tofauti katika vizingiti vya mchemko, tazama Sura ya 7.5.

Ukungu: Kielei ④cha matone ya kiowevu katika gesi.

Uoksidishaji: Utendanaji wa ④dutu na oksijeni.

Usanidimwanga: Hufanyika katika mimea ya kijani. Nishati ya mwanga wa jua hufyonzwa na kutumiwa kutengeneza ④mimumunyo ya ④kikaboni kutokana na maji na kaboni dioksidi.

Usanisi: Utendanaji wa ④kikemikali ambapo ④vitendanaji vinaungana na kuunda zao ④au zaidi.

Ushahidi Taarifa ambazo zinathibitisha jambo fulani au zinatoa sababu za kuamini jambo fulani.

Ushaposhaji: Wakati ④dutu ambayo ④inasublimi baada ya kuipasha moto inapopozwa, hubadilika moja kwa moja kutoka gesi hadi mango. Tazama Sura ya 5.3.

Ushirikina: Woga usio na sababu wa jambo lisilojulikana; au imani kuwa baadhi ya matukio hayawezi kuelezewa kwa fikira za mwanadamu au kisayansi.

Usublimi/sublimi: Kubadilika moja kwa moja kwa hali ya maada kutoka mango hadi gesi ikipashwa moto.

Utaratibu: Hatua zinazofuatwa kufikia matokeo bora (yanayotakiwa).

Utendanaji wa kikemikali: ni badiliko la kikemikali.

Utonesaji: Kubadilika kutoka hali ya gesi hadi hali ya kiowevu ya maada. Tazama Sura ya 5.3.

Uvukizaji: Mabadiliko kutoka kiowevu hadi gesi katika joto chini ya kizingiti cha mchemko.

Uwasilishaji juu: Kukusanya gesi kwa kuiacha itoe vipovu kupitia kwenye maji kwenda kwenye mtungi wa gesi.

Uwazi: Nafasi inayochukuliwa na kitu kutokana na ujazo wake. Kiasi cha uwazi unaochukuliwa na kitu ni ujazo wake.

Uziduaji wa Kimumunyi: Mchakato wa kutenganisha mchanganyiko kwa kutumia kimumunyi ambacho humumunya kiambata kimoja na si vingine. Tazama Sura ya 7.7.

Uzito: masi kwa idadi ya ujazo mara nyingi hupimwa katika g/sm^3 . Kila dutu menyu ina uzito wa kipekee. Uzito ni muhimu katika kubainisha dutu. Uzito wa gesi mara nyingi hulinganishwa na uzito wa hewa; na wa viowevu kwa ule wa maji.

Uzito: Kipimo cha kani mvutano inayolemea masi; hupimwa katika

Newton. Uzito wa kitu hubadilika kutegemea mahali unapopimia.

Vanishi: Kitu kigumu, kinachong'aa, angavu kinachopakwa juu ya mbao au metali.

Vifaa: Zana zozote au vitu, k.m. bika, mpare tunganishi, flaski, viimo vya ritoti, vinavyotumika katika shughuli za kisayansi.

Vijalizo: Dutu mbalimbali katika mchanganyiko, k.m. vijalizo vya mmumunyo wa sukari ni sukari na maji.

Vipodozi: Dutu za kupaka mwili kuufanya upendeze, k.m. rangi za mdomo, dawa za nywele.

Vitendanaji → Mazao

Vitendanishi: Ni dutu inayosababisha utendanaji wa kikemikali na kemikali fulani na inaweza kutumika kupima kama kemikali hiyo ipo, kwa mfano, maji ya chokaa ni kitendanishi cha kupima uwepo wa kaboni dioksidi.

Wakala wa kuoksidisha: Dutu ambayo husababisha uoksidishaji, k.m. oksijeni.

Yenye Kubabua: Sifa ya dutu ambayo huharibu polepole metali au kuharibu tishu za wanyama na kusababisha uharibifu wa kudumu, k.m. kwenye ngozi.

Zao: Dutu iliyoundwa kutokana na utendanaji wa kikemikali.

Ziduo: Mmumunyo uliopatikana kwa kuzidua kimumunyi, k.m. kupika chai kutokana na majani ya chai. Tazama Sura ya. 7.7.

Glossary

Accident: Anything that happens unexpectedly and is bad.

Acid: Any sour tasting substance; most acids are very corrosive and cannot be tasted, e.g. sulphuric acid.

Alkali: A substance that neutralizes acids and forms a caustic or corrosive solution in water, e.g. caustic soda.

Alloy: A solution of a solid in a solid, e.g. bronze is a solution of tin in copper. (In order to mix them they must be in the liquid state.)

Apparatus: Any instrument(s) or object(s), e.g. beakers, filter funnels, flasks, retort stands, used for work in science.

Artificial elements: Elements with atomic numbers above 92 which do not exist naturally. They have been made by scientists.

Atomic number: In this book, this number gives only the position of an element in the Periodic Table.

Bacteria: Tiny organisms existing in great number in air, water, soil and living things, sometimes causing diseases.

Blow pipe: A small tube through which air is blown to supply extra oxygen to a flame in order to increase its temperature. See Ch.3.6.

Brittle: Breaking easily when being bent or knocked, e.g. glass.

Carcinogenic: Causing cancer, a very often deadly disease.

Caustic: Able to burn or destroy things by chemical action, e.g. caustic soda.

Cement: A building material made of powdered limestone and clay that forms a paste when mixed with water which sets after some time as a solid mass hard like stone.

Cereal: Edible grains of grasses, e.g., maize, wheat, barley.

Change of state: The change between the three states of matter: solid, liquid and gas, e.g. the change from ice to liquid water. See Ch.5.

Chemical equation: The notation used to describe a chemical reaction, e.g. reactant(s) → product(s)

Chemical change: A change in which at least one new substance is made with different properties, e.g. milk turning sour or iron + sulphur reacting to iron(II) sulphide when heated.

Chemical reaction: is a chemical change.

Chemical: Any element or compound that may be used or produced in a chemical reaction or experiment.

Chromatogram: The paper (or porous material) containing the separated solutes after chromatography: usually a pattern of coloured dots or lines, see Ch. 7.9.

Chromatography: The process used to separate a mixture of coloured solutes by allowing them to move through a porous support, e.g. the separation of water based colours from ink using filter paper.

Combination: A chemical reaction in which two or more substances combine to form a product, e.g.

iron + sulphur $\rightarrow$ iron(II) sulphide

Combustion: The rapid oxidation of a substance, also called burning; usually accompanied by a flame and a lot of heat. See Ch.9.2.

Combustion engine: An engine in which a combustion takes place.

Conclude/conclusion: Come to a result of reasoning; or decide after a discussion or reasoning.

Composition: Different substances combine to form one or more new substances.

Compound: The product of the combination of two or more elements, e.g. iron(II) sulphide. It cannot be decomposed by physical means.

Condensate: The liquid resulting from condensation of a gas or vapour.

Condensation: The change from the gaseous to the liquid state of matter. See Ch. 5.3.

Condenser: Apparatus used to condensate gases.

Corrosive: Property of a substance which slowly destroys a metal

or attacks animal tissues causing permanent damage, e.g. on skin.

Cosmetics: Substances for putting on the body to make it beautiful, e.g. lipstick, hair conditioner.

Crystallisation: The formation of crystals from a warm, saturated solution of a salt, e.g. after evaporation.

Crystals: Glass-like pieces of solids with a regular shape, e.g. sugar or common salt crystals. All crystals of a given pure substance have the same shape.

Data: Information used in discussing or deciding.

Decantate: the liquid obtained after separation by decantation.

Decantation: To pour a liquid slowly out of a container in which the solids have been allowed to settle at the bottom. See Ch.7.1.

Decomposition: A chemical reaction in which one reactant is broken down into two or more elements.

Density: mass per unit volume often measured in g/cm^3 . Each pure substance has a particular density. Density is important in identifying substances. Densities of gases are often compared to the density of air; and of liquids to that of water.

Deposition: When a substance which sublimates on heating is cooled, it changes directly from a gas to a solid. See Ch. 5.3.

Detergents: Substances used for cleaning dishes, clothes, etc. They are made by chemical industries and have better cleaning properties than soap.

Dilute: To make a solution (or substance) less concentrated by adding more solvent, e.g. adding more water to a strong salt solution to make it weaker.

Distillate: The pure liquid collected after distillation.

Distillation: A process for separating, e.g. the solvent from the solute of a salt solution due to difference in boiling points, see Ch. 7.5.

Dye: Substance used for colouring clothes, hair, etc.

Element: A substance which cannot be decomposed by chemical reaction into simpler substances.

Emulsion: A suspension of a liquid in another liquid (the two liquids are not miscible), e.g. oil shaken with water. See Ch. 6.4.

Environment: All the conditions which act on an organism in the place it lives. These include both the conditions of air, water, etc. and the effects of other organisms. The environment has a large influence on the growth of living things.

Evaporation: The change from a liquid to a gas at a temperature below the liquid's boiling point.

Evidence: Information that proves something or gives us a reason for believing something.

Expand: Become greater in size, spread out.

Experiment: A test to show or explore how something behaves.

Explosion: A sudden, violent release of energy from a small space usually in the form of heat, sound, light and flying debris.

Extract: The solution obtained by solvent extraction, e.g. making tea from tea leaves. See Ch. 7.7.

Fertiliser: Any substance added to the soil to improve the growth of crops or plants.

Filter: A porous substance through which a liquid or gas is passed in order to remove particles of a size larger than the pores of the filter.

Filtrate: The liquid collected after filtration.

Filtration: The process of removing solid particles from a suspension or from a smoke. See Ch. 7.2.

Foam: A suspension of gas in a liquid in the form of a light frothy mass of bubbles (usually on top of a liquid), e.g. produced by washing powder. See Ch. 6.4.

Force: Measurable influence tending to cause motion of a mass.

Fraction: In a fractional distillation, this is a certain part of the ingredients which is separated from a liquid mixture, e.g. diesel oil is a fraction of petroleum.

Freezing: The change from the liquid to the solid state of matter caused by cooling of the liquid.

Fuel: Any substance that is burnt to produce energy (usually in the form of heat and light).

Gaseous state: The state of matter in which the tiny particles are free to move about with almost no forces holding them together. A gas has no definite volume or shape.

Graduation: A mark on a container or instrument indicating a physical quantity, e.g. degrees, volume, etc.

Herbicide: Any substance used to destroy unwanted plants (weeds).

Heterogeneous mixture: A Non-uniform mixture in which the various ingredients can be seen at least with a microscope.

Homogeneous mixture: A uniform mixture in which no different ingredients can be seen even using a microscope.

Ice: The solid state of water formed when the temperature is 0 °C or below.

Ignition temperature: The temperature at which a substance starts burning by itself when being heated in air. See Ch. 8.2.

Ingredients: The various substances in a mixture, e.g. the ingredients of a sugar solution are sugar and water.

Laboratory: A room equipped with apparatus and reagents for doing scientific experiments.

Lattice: The orderly arrangement of particles in a solid.

Law: A scientific or mathematical statement that is true for a given set of conditions, e.g. the law of conservation of mass.

Liebig condenser: An apparatus used for cooling a hot gas and condensing it. See Ch. 7.5.

Lime: Calcium oxide.

Lime water: A clear colourless solution which turns milky when carbon dioxide is bubbled through it.

Liquid: State of matter in which the tiny particles are held together by weak forces; forms drops when slowly poured, has a definite volume but no definite shape.

Luminous: Shining brightly, e.g. a candle flame or a light bulb.

Mass: Quantity of matter in a body; measured in grams. The mass of an object is not changed while its weight might change according to the place where the object is.

Melting: The change from the solid to the liquid state of matter caused by the solid absorbing heat energy.

Microscope: An apparatus used to make things visible which are too small to be seen by the eye.

Mineral: A substance that is not vegetable nor animal, e.g. stone, salt.

Mist: A suspension of droplets of a liquid in a gas.

Mixture: Anything made by mixing different substances without a

chemical reaction taking place, e.g. a mixture of rice and beans.

Model: It is used to explain observations in experiments. A model is just a picture of the thing we want to explain, not the thing itself. It might have severe shortcomings but it can always explain some observations.

Noble gases: The elements in Group VIII of the Periodic Table, see Ch. 8.4.

Non-luminous: not shining, glowing dimly.

Organic: Found in or formed by living things.

Oxidation: The reaction of a substance with oxygen.

Oxide: A compound of an element combined with oxygen, e.g. carbon dioxide.

Oxidising agent: A substance which causes oxidation, e.g. oxygen.

Periodic table: arranges all the elements according to their properties in periods and groups. See Ch. 8.4.

Pesticide: Any substance that kills insects or small animals.

Petroleum: Mineral oil that forms underground and is obtained from wells sunk into the ground. It is a mixture from which petrol, diesel oil, kerosene, etc. are separated.

Pharmaceutical: Involving the preparation and dispensing of chemicals as medicine.

Photosynthesis: Taking place in green plants. Sunlight energy is absorbed and used to make organic compounds from water and carbon dioxide.

Physical change: A change in which no new substance is made, e.g. water turning into steam. See Ch. 8.1.

Poisonous: Causing death or illness when taken into the body.

Pollution: The contamination of soil, water or air by the discharge of harmful substances, e.g. smoke pollutes the air.

Porous: Having small holes through which a liquid or gas can move, e.g. filter paper.

Precipitate: An insoluble solid that appears as particles in a previously clear liquid.

Precipitation: The formation of a precipitate during a chemical reaction of two substances, e.g. when carbon dioxide bubbles through lime water.

Preservation: To add a substance to a material in order to stop its decay or to slow down the rate of decay.

Procedure: The steps followed to achieve the best (or required) result.

Product: A substance formed as a result of a chemical reaction.

Reactant: A substance taking part in a chemical reaction:
reactants → products

Reagent: A substance that produces a chemical reaction with a certain chemical and can be used to test whether that chemical is present, e.g. lime water is the reagent for testing for the presence of carbon dioxide.

Refine: To purify a substance.

Refinery: An industrial plant for purifying, e.g. oil, sugar, etc.

Residue: The solid that remains on the filter paper after filtration.

Respiration: The process during which oxygen reacts in the body with food substances (usually carbon compounds) to produce energy, carbon dioxide and water.

Reversible: Able to turn the other way round or to move in the opposite direction or to go back.

Right angle: Angle of 90°.

Rusting: The reaction of oxygen with iron in the presence of water to form porous iron(III) oxide.

Science: Organised knowledge obtained by observation and testing about the physical world, natural laws and society.

Sensitive: Able to measure very small changes, e.g. in mass.

Smoke: A suspension of solid particles in a gas, e.g. soot particles as a result of incomplete combustion.

Solid: A substance having a definite shape and volume in which the tiny particles are held together by strong forces. See Ch. 5.2.

Solute: Any solid or gas which dissolves when added to a liquid, e.g. carbon dioxide in soda water.

Solution: The result of dissolving a solute in a solvent to give a homogeneous mixture, e.g. salt or sugar solution.

Solvent extraction: The process of separating a mixture by using a solvent which dissolves one ingredient and not the others. See Ch. 7.7.

Space: What an object occupies as the result of its volume. The amount of space occupied by an object is its volume.

Spark: Tiny glowing particle thrown off from burning substances; or when two hard substances like stone, metal, flint are struck together; or a flash of light produced by the breaking of an electric current.

State of matter: One of the three main conditions (gas, liquid, solid) in which a substance can exist.

Sterilize Make free from bacteria.

Sublimation/sublime: To change directly from the solid into the gaseous state of matter when heated.

Substance: A particular type of matter.

Superstition: Irrational fear of what is unknown; or belief that some events cannot be explained by human or scientific reasoning.

Suspension: A heterogeneous mixture in which coarse particles settle when allowed to stand for some time.

Synthesis: A chemical reaction in which elements combine to form one compound.

Synthetic: Made by chemical synthesis.

Temperature: A measure of how hot or cold something is.

Thermometer: An instrument used to measure temperature.

Transition elements: Those elements which are in the middle of a row in the Periodic Table and do not belong to any of the eight main groups.

Unpolluted: The natural state of the environment before the disposal of harmful substances into it.

Upward delivery: Collecting a gas by allowing it to bubble through water into a gas jar.

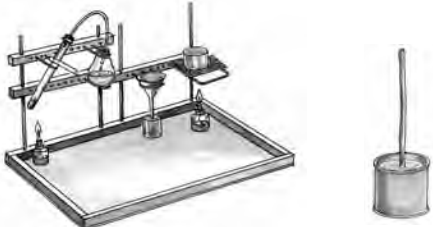
Varnish: A hard, shiny, transparent coating on the surface of wood or metal.

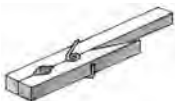
Vibrate: Move rapidly and continuously forwards and backwards.

Volumetric flask: A large flask with a long thin neck used for making a known volume of a solution. See (127) on page 298.

Weight: The measurement of the force of gravity acting on a mass; measured in Newtons. The weight of an object changes depending on where you measure it.

Winchester bottle: A large capacity bottle used for storing chemicals. See (40) on page 292.

Vifaa vya Kibiashara Commercial Apparatus	Vifaa vya kujitengenezea Self-made Apparatus
Bunsen burner  Jiko la bunsen 1	Candle  Mshumaa 2 Jiko la Spiriti  Spirit burner 3 Jiko la mafuta ya taa lililoboreshwa  Improved kerosene burner 4 Jiko la mkaa  Charcoal burner 5
Mithili ya ritoti  Retort stands 6 7	Science tray stands  Mithili ya sinia la sayansi 8 9
Wire gauze  Waya 10 Deflagrating spoon  Kijiko 11	Tin lid with holes  Mfuniko wa bati wenye matundu 12 Stiff wire holding a soda bottle top  Waya mgumu ulioshikilia kizibo cha chupa ya soda 13
Test tubes  Nelijaribio 14	Opened light bulb, ideal for heating purposes  Balbu iliyofunguliwa, maalumu kwa kuongeza joto 15

Vifaa vya Kibiashara Commercial Apparatus	Vifaa vya kujitengenezea Self-made Apparatus
Test tube holder  Kishikizo cha nelijaribio 16 Test tube rack  Kibebela nelijaribio 17	Bent stiff wires, ideal holders for test tubes, bulbs, and funnels  Waya ngumu zilizokunjwa maalumu kwa kushikilia nelijaribio, balbu na bika 18 Wooden test tube rack  Kibebela nelijaribio cha mbao 19
Beaker  Bika 20	Jam Jar  Jagi la jamu 21 Glass  Glasi 22 Tea cup  Kikombe cha chai 23
Round bottomed flask  Flaski yenye kitako cha mviringo 24 Flat bottomed flask  Flaski yenye kitako bapa 25 Conical flask  Flask ya pembe tatu 26	Open bulb  Balbu iliyo wazi 27 Tin can  Debe 28 Kitchen pan  Sufuria 29
Evaporating basin  Sinia la kuvukishia 30	Cut wide tin  Debe lilipasuliwa kwa mapana 31 Big or small spoon  Kijiko kikubwa au kidogo 32 Saucer  Kisahani 33 Plate  Sahani 34

Index

For example, 5f means: page 5 and the following English page i.e. p.7; 9ff means: page 9 and the following English pages i.e. p.11, 13, and 15...

Accident 21, 25, 263f, 283
Acid 283
Aerosol 135
Air 81, 221ff, 233ff
- properties 235
Alcohol 11, 63, 139, 167f
Alcohol burner 67
Alkali 283
Alloy 133, 257
Aloe vera 43
Aluminium 203, 213, 215
Apparatus 39ff
Atomic number 283
Bacteria 283
Baking powder 265f
Balance 211ff, 295
Basin 291
Beaker 291
Beehive shelf 297
Bleeding 33f
Blow pipe 65f
Boiling 113
Boiling point 109, 139, 145, 157, 205
Bottle 292
Breathing 221, 227f, 247ff
Brittle 283
Bromine 203
Bulb 69f, 290
Bunsen burner 51ff, 290
Burette 296
Burning 221ff, 257ff
Burns 33, 43
Calcium chloride 251f
Cancer 15, 135, 181, 195, 283
Candle 61
Capillary tube 141f
Carbon 247, 251
- monoxide 233f
- dioxide 227ff, 233ff, 243ff, 259ff
Carbon dioxide properties 267f
Carcinogenic 15, 135, 283
Caustic 283
CD-ROM 115, 167, 183, 197, 205
Cement 283
Cereal 283
Chalk 177f
Change of state 101, 121
Charcoal 235
- burner 65
Chemical change 189ff
Chemical energy 49

Chemical equation 197ff
Chemical reaction 189ff, 197ff
Chemical symbol 203
Chemist 5ff, 15
Chemistry 11
Chromatogram 177f
Chromatography 177ff
Chromium 255
Cigarette 135
Clamp 294
Coffee 173
Combination 205ff
Combustion 49, 229, 239ff, 245, 257ff
- engine 49, 233, 245
Composition 11
Compound 209f, 284
Conclusion 83ff
Condensation 163
Conductor 205
Copper(II) sulphate 231f
Cork 293
Corrosive 21, 284
Crucible 298
Crystallisation 157ff
Crystals 159
Cuts 31

Data 284
Decantate 151, 161
Decantation 151f, 161
Decomposition 199ff
Deflagrating spoon 269, 290
Density 43, 284
Deposition 103f
Detergents 5,
Diesel 9, 13f, 49, 273
Dilute 167, 285
Distillate 163
Distillation 163ff, 179f
Distillation tower 11f
Drink 11, 129, 169
Drop 113, 297
Dropping funnel 296
Ductile 205
Dust 235
Dye 285
Electricity 47, 205, 259
Element 203f
Emulsion 135
Energy 47f, 123, 195
Environment 15, 285
Ethanol 139
Evaporation 101f, 115, 157ff
Evidence 285
Expansion 109f
Experiment 85f
Explosion 21, 241
Extract 285

Eye burns 33
F at 175
First Aid 29ff
First Aid Kit 29ff
Fertilizer 7, 285
Filter 153f, 294
Filter paper 179, 294
Filtrate 153f, 161
Filtration 153ff, 161
Fire 15, 235, 257ff
- classification 259ff
- extinguisher 259ff
- fighting 257ff
Fixed point 107ff, 137f
Flame 55ff, 61ff
Flammable 21, 157f, 199
Flask 291
Foam 135, 145, 261, 267
Food 3, 15, 129, 195, 247ff
Force 77, 285
Fractional distillation 167ff
Fractionating column 167ff
Freezing 101
Freezing point 107f
Fuel 7f, 13, 49, 241ff, 247 - **oil** 13
Fungus 181, 195
Funnel 295, 296
Gas 79, 99ff, 115ff, 133f
Gauze 143f
Global warming 233, 251

Goggles 23, 71
Gold 173
Graduation 105, 286
Grease 255
Group 205
Harmful 21
Heat 47ff, 205
Herbicide 286
Heterogeneous mixture 127ff
Homogeneous mixture 127ff
Hydrogen 259
- oxide 245, 259
- peroxide 237
- sulphide 209f, 235
Hypothesis 83ff, 109ff
Ice 97ff
Ignition temperature 199, 257, 263f
Impurity 135f
Inertia 79
Inert gases 229, 233
Ingredients 151ff, 286
Ink 177f
Iodine 171
Iron 205f, 241, 245, 251ff
- corrugated 255
- (III) oxide 245, 253
- sulphide 207ff
Irritant 21
Jar 292
Jet 141f

Kerosene 9, 13, 127, 135, 175f

Kerosene burner 61ff, 290

Kipp’s apparatus 297

Laboratory 19ff, 269

Lattice 111f

Law of conservation of mass 199

Layer separation 175f

Liebig condenser 165f

Light 47f

Lime 286

Lime water 227f

Liquid 79, 99ff, 113ff, 117ff, 133ff

Luminous 55ff

Magnesium 245, 249

- **oxide** 245

Magnifying glass 93, 295

Malleable 205

Mass 41f, 77ff, 197f

Matter 77ff, 83, 121

Measuring 39ff

Medicine 3f, 129, 173

Melting 101, 109

Melting point 107f, 137, 145, 205

Mercury 105, 173, 203

Metal 203f

Microscope 286

Mineral 286

Mist 135

Mixture 125ff, 151ff, 209f, 223

Model 87ff, 119, 287

Mortar 294

Naphthalene 137

Nitrogen 223f, 233f

- **oxide** 235

Noble gases 229, 233, 287

Non-luminous 55ff

Non-metal 203f

Observation 83ff

Oil 135, 173, 255

Organic 287

Oxidation 241ff

Oxide 243ff

Oxidizing agent 21, 287

Oxygen 225ff, 233f

- **carbon dioxide cycle** 247ff

- **preparation** 237f, 269

- **properties** 245f

- **uses** 247

Paint 133, 255

Paper chromatography 177f, 183

Particle 87, 127

Particle hypothesis 87, 109ff

Period 205

Periodic table 203f, 299

Pesticide 287

Petri dish 139f

Petrol 7f, 13, 49, 241

Petroleum 9ff, 13, 171, 287

Pharmaceutical 287

Phosphorus 225, 245

- **(V) oxide** 245

Photosynthesis 249ff, 287

Physical change 189ff

Pipette 296

Plastic 5f, 13f

Poisonous 21, 287

Pollution 15, 21, 135, 273, 287

Potassium manganate(VII) 239

- **permanganate** 239

Porous 287

Precipitation 287

Prediction 83ff

Preservation 287

Procedure 287

Product 197

Pure substance 125ff, 135f, 179f

Purification 155, 161, 165f

Reactant 197

Reaction 197ff

Reagent 288

Recovery position 35f

Refine 288

Refinery 9ff, 171

Residue 153

Respiration 229, 247ff

Resuscitation 35f

Retort Stand 143f, 290

Reversible 193f, 288

Right angle 288

Rocket 247, 269f

Rust 253ff

Rusting 247, 251ff

Safety rules 21ff

Safety signs 21ff

Safety glasses 23, 71

Salt 161

Sand 261, 269

- **bath** 157

Saturated solution 130

Science 3, 11, 87

- **tray** 290

Scientific procedure 83ff, 95, 271

Scrapes 31

Sensitive 288

Separating funnel 175, 179, 298

Shock 33

Smoke 135

Sodium hydrogen carbonate 265f

Solar still 181f

Solid 99f, 105ff, 111ff, 117ff, 130ff

Solubility 130f, 145, 161, 245

Solute 130f, 159

Solution 129ff

Solvent 130

Solvent extraction 173f, 183

Space 77ff, 81f, 288

Spark 288

Spatula 292

Spinach 177

Spirit burner 67f

States of matter 97ff, 115ff, 121f

Steel 133, 257

Sterilize 288

Stirrer 295

Stopper 293

Sublimation 103f, 171f

Sublimation point 109

Substance 11

Sulphur 205f, 241, 245

- **dioxide** 235, 245

Superstition 83f, 288

Suspension 133f

Synthesis 209

Synthetic 289

Tea 173

Temperature 41, 105ff, 123, 288

Test

- **carbon dioxide** 227

- **fat** 175

- **oxygen** 239

- **vegetable oil** 175

- **water** 231f

Test tube 290

Thermometer 105ff, 297

Threads 53

Time 39

Titanium 259

Tong 292

Toxic 21

Transition elements 205, 289

Tray 292

Tree 251

Triangle 298

Tripod 143, 295

Tube 293

Unconsciousness 35f

Uniform 127

Unpolluted 289

Upward delivery 289

Vapour 103ff

Varnish 289

Vegetable oil 175

Volcano 235

Volume 41

Volumetric flask 289, 298

Warnings sign 21

Wash bottle 297

Water 97ff, 123, 155, 165, 229f, 243ff, 259

- **bath** 157

- **vapour** 229, 233, 249

Weight 77f, 215, 289, 295

Winchester bottle 289, 292

Winnowing 151f

Wire gauze 290

Zinc 255, 259

This book covers all the requirements of the 2007 Secondary Schools Chemistry syllabus.

IMPORTANT FEATURES OF THIS BOOK:

- ▶ Chapter introduction and highlighted key terms to guide the student through each chapter.
- ▶ Content in English and Swahili on opposite pages; English, because it is the official language of instruction and Kiswahili to ensure that students understand all ideas and concepts in the book using the language that they best understand. It also helps students to improve their command of the English language.
- ▶ Pioneering use of Kiswahili in the scientific world.
- ▶ Use of simple language and helpful diagrams.
- ▶ Real life examples that allow students to relate chemistry to the world around them.
- ▶ End of chapter questions to test understanding and reinforce learning.
- ▶ Glossary of most important terms.
- ▶ Descriptions of do-it-yourself kits with which all the suggested experiments can be carried out.
- ▶ A companion Teacher's Guide that gives worked solutions to all questions set in the textbook and a CD with videos that describe key experiments and provide guidelines for efficient teaching and learning using this textbook.

**LEARN USING
BOTH ENGLISH
AND SWAHILI.
COVERS 2007
SYLLABUS.**

Kitabu hiki kinakidhi mahitaji yote ya Muhtasari wa Kemia kwa Shule za Sekondari wa mwaka 2007.

SIFA KUU ZA KITABU HIKI:

- ▶ Utangulizi kwa kila sura sanjari na ufafanuzi wa msamiati muhimu ili kumsaidia mwanafunzi kuelewa vema kila sura.
- ▶ Matumizi ya lugha mbili, Kiingereza na Kiswahili; Kiingereza ili kuzingatia sera ya lugha kwa elimu ya sekondari, na Kiswahili ili kumwezesha mwanafunzi kuelewa dhana zote katika lugha anayoimudu vyema. Vilevile itamsaidia mwanafunzi kuongeza uelewa wake wa Kiingereza.
- ▶ Kukuza matumizi ya Kiswahili katika ulimwengu wa sayansi.
- ▶ Lugha nyepesi na michoro mingi ili kurahisisha uelewa wa mafunzo.
- ▶ Mifano kutoka katika maisha halisi inayomsaidia mwanafunzi kuhusisha elimu ya Kemia na mazingira ya kawaida.
- ▶ Maswali kila mwisho wa sura ya kuimarisha stadi mwanafunzi alizojifunza.
- ▶ Faharisi mwishoni mwa kitabu ya msamiati muhimu uliotumika.
- ▶ Mafunzo ya kutengeneza vifaa rahisi na salama vinavyoweza kutumika kufanya kila jaribio lililomo kwenye kitabu.
- ▶ Kiongozi cha Mwalimu kinachotoa majibu kamili ya maswali yaliyoulizwa katika kitabu cha mwanafunzi kikiambatana na CD yenye video zinazofafanua majaribio muhimu pamoja na vidokezo vya kuongeza ufanisi katika kufundisha na kujifunza kwa kutumia kitabu cha mwanafunzi.