



**Tshwane University  
of Technology**  
*We empower people*

# Faculty of Sciences



*Live your life. Create your destiny.*



# A – Z Careers

**The following programmes are offered in the Faculty**

Agriculture  
Analytical Chemistry  
Animal production  
Biokinetics  
Biomedical Technology  
Biotechnology  
Chemistry  
Chemistry & Physics  
Clinical Technology  
Crop Science  
Dental Assisting  
Dental Technology  
Ecotourism Management  
Environmental Health  
Environmental Management  
Environmental Sciences  
Equine Sciences  
Fire Technology  
Food Technology  
Foundation Programme in Natural Science  
Game Ranch Management  
Geology  
Golf Academy  
Horticulture  
Laboratory Management  
Landscape Technology  
Mathematical Technology  
Medical Orthotics and Prosthetics  
Nature Conservation  
Occupational Therapy Assistant  
Nursing  
Pharmacy  
Physical Science  
Quality  
Radiography (Diagnostic)  
Somatology  
Sport and Exercise Technology  
Sport Coaching and Officiating Sciences  
Turfgrass Management  
Veterinary Technology  
Water Technology

**For more information:**

Tel no: 012 382 5533/4

086 110 2421

[www.tut.ac.za](http://www.tut.ac.za)

## The Faculty of Science

Programmes in the Faculty of Science are career-focused and aim to educate and train the next generation of technological leaders, while research and development in all these programmes are directly linked to the needs of industry and South African communities.

### Department of Animal Sciences

- **Animal Production** (N Dip, B Tech)
- **Equine Science** (N Dip, B Tech)

If you wish to pursue a career in the production of animals and horses, the Department of Animal Sciences at the Tshwane University of Technology should be the higher institution of learning of your choice. This Department has an excellent record of training manpower for the different animal production industries for almost thirty years. This institution is the only of its kind that has been offering training in equine management in South Africa for more than fifteen years.

Qualifications from diploma up to doctorate level in both *Animal Production* and *Equine Science* can be obtained. All students enter at the three-year diploma level, the first two years of which consist of theory thoroughly blended with appropriate practical exposure. The third year, which comprises compulsory work-integrated learning, is completed at a suitable place of work over a twelve-month period.

On completion of the B Tech in either Animal Production or Equine Science, a learner may apply for admission to an M Tech: Agriculture followed by a D Tech: Agriculture.

#### *Admission requirements*

The following are the minimum academic requirements to enroll for the National Diploma programme. In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

#### *Specific requirements are:*

English (1st or 2nd language) with a pass rating of 4 and Mathematics or Mathematical Literacy (3). Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

#### *Recommended subjects:*

Physical Science and Life Sciences are strongly recommended.

## Department of Biotechnology and Food Technology

- **Biotechnology** (N Dip, B Tech, M Tech, D Tech)  
Biotechnology deals with the science and technology of utilizing organisms (macro- and micro-) to create new processes or to modify existing processes. The student obtains a sound knowledge of: Microbiology; Biochemistry; Fermentation technology and Genetics

### *Admission requirements*

The following are the minimum academic requirements to enroll for the National Diploma programmes in either Biotechnology or Food Technology

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

### *Specific requirements are:*

Adequate achievement (i.e. a rating of 4 or more) in English and a moderate achievement (3) in: Mathematics and Physical Science.

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

### *Recommended subject is:*

Life Sciences

### *Recognised subject is:*

Information Technology

- **Food Technology** (N Dip, B Tech, M Tech, D Tech)  
Food Technology deals with science and technology of processing and manufacturing food products from raw materials for local and international markets. The student obtains a sound knowledge of: Food technology; Microbiology and Biochemistry

### *Admission requirements*

The following are the minimum academic requirements to enroll for the National Diploma programmes in either Biotechnology or Food Technology

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

### *Specific requirements are:*

Adequate achievement (i.e. a rating of 4 or more) in English and a moderate achievement (3) in: Mathematics and Physical Science.

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

### *Recommended subject is:*

Life Sciences

### *Recognised subject is:*

Information Technology

## Department of Biomedical Sciences

The Department has three fields of specialisation within the broader health sciences spectrum:

- **Biomedical Technology**

Biomedical Technology involves the analysis of human blood, sputum, urine and histological samples within a diagnostic medical laboratory environment. Medical technologists work in different disciplines and usually specializes in one of his/her preferences e.g. Clinical Pathology, Chemical Pathology, Cellular Pathology, Haematology, Blood Transfusion, Microbiology, Virology, etc.

- **Clinical Technology**

Clinical technologists use modern medical technology to gather clinical information from patients with physiological dysfunctions in fields such as Cardiology, Pulmonology, Cardiovascular Perfusion, Reproductive Biology, and Critical Care. Completion of the qualification will enable the learner to be a registered Clinical Technologist in one or more of the following categories: - Nephrology, Neurophysiology, Cardiology, Pulmonology, Reproductive Biology and Critical Care.

- **Veterinary Technology**

Veterinary medicine has grown rapidly in sophistication. Consumers expect (and are entitled to) first-class medical care and state-of-the art diagnostic testing for their pets and livestock.

To achieve a high level of health care, the veterinarian is reliant on the Veterinary Technologist who carries out laboratory-orientated research and development in support of the veterinary industry. Day to day activities includes the collection and processing of samples, diagnostic work, and research and vaccine production.

- **Radiography**

Top quality X-ray images are taken during various types of radiographical procedures. Other duties include a broad range of procedures by means of contrast agents, as well as procedures such as theatre, mobile units in wards and intensive care units, specialized procedures such as computerised scanning and magnetic resonance imaging are also applicable.

### *Admission requirements*

The following are the minimum academic requirements to enroll for the National Diploma programme

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

### *Specific requirements are:*

English (1st or 2nd, rating 4) and a pass (rating 3) in Mathematics, Life Sciences and Physical Science.

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

### *Recommended subject is:*

Information Technology

## Department of Chemistry

- **Analytical Chemistry** (N Dip)

Analytical Chemistry involves separating, identifying and determining amounts of components in a sample of matter. Chemistry, as the central science, involves most of the articles that we use every day; chemistry involves the study of matter.

*Admission requirements*

The following are the minimum academic requirements to enroll for the National Diploma programme. In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

*Specific requirements are:*

Adequate achievement (i.e. a rating of 4 or more) in English and a moderate achievement (3) in: both Mathematics and Physical Science.

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

- **Chemistry** (B Tech, M Tech, D Tech)

Chemistry consists of four sections, Analytical, Inorganic, Organic and Physical Chemistry.

*Admission requirement(s):*

A National Diploma: Analytical Chemistry with Mathematics II and Physics II or an equivalent qualification. Depending on the equivalent qualification, completion of certain additional subjects may be required.

- **Laboratory Management** (B Tech)

This two year course which follows on any appropriate 3 year diploma or degree will equip laboratory managers with the necessary skills and expertise to enable them to lead their coworkers and to manage other resources in the laboratory.

*Admission requirement(s):*

Any relevant three-year tertiary qualification

- **Ceramics Technology** (M Tech, D Tech)

Ceramics Technology is concerned with the research, development and manufacturing of nonmetallic, inorganic materials, such as porcelain, glass and cement, as well as with the industrial processes that convert raw materials into products with a higher economic value.

*Admission requirement(s):*

A Bachelor's Degree in Technology: Ceramics Technology or an equivalent qualification. Depending on the equivalent qualification, completion of certain additional subjects may be required.

## Department of Crop Sciences

- **Agriculture** (N Dip, B Tech, M Tech, D Tech)
- **Agriculture Management** (B Tech)

The department of Crop Sciences is a career focused academic department training agricultural practitioners and entrepreneurs that can participate directly in agricultural crop production, research, extension and agricultural service industries. The diploma course in Agriculture and Agriculture Management offered by the Department consists of three years: two years (four semesters) of day classes followed by one year (two semesters) of work-integrated learning. The B Tech degree is offered as a block course spread over one year full time or two years part time.

### *Admission requirements*

The following are the minimum academic requirements to enroll for the National Diploma programme

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

### *Specific requirements are:*

English (1st or 2nd language with a pass rating of 4 and Mathematics or Mathematical Literacy (3),

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

### *Recommended subjects are:*

Physical Science and Life Sciences

## Department of Environmental Health

- **Environmental Health**

After completion of this programme, a graduate can practice as an environmental health practitioner in the following areas: occupational health and safety, food and meat hygiene, epidemiology, environmental pollution control, environmental management and community development and public health control.

The department presents 23 industry-driven short courses, fifteen of which are unique to South Africa and has delivered many leaders in industry, including health advisors, environmental managers, food safety auditors, occupational hygienists and safety and loss control managers.

### *Admission requirements*

The following are the minimum academic requirements to enroll for the National Diploma programme

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

### *Specific requirements are:*

Adequate achievement (i.e. a rating of 4 or more) in English and a moderate achievement (3) in: Mathematics or Mathematical literacy, Life Sciences and Physical Science

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

### *Recommended subjects are:*

Geography and Agricultural Sciences

## Department of Environmental, Water and Earth Sciences

- **Environmental Sciences** (N Dip, B Tech)
- **Environmental Management** (M Tech, D Tech)  
Environmental Sciences involves the application of basic scientific principles and processes to identify assess and solve technical and operational environmental problems. As a multi-disciplinary study field, it also involves environmental-impact assessments, life-cycle analyses, environmental auditing, rehabilitation and pollution-prevention technology. The postgraduate studies on masters and doctorate levels on science and management to equip the students with the knowledge and skills to solve environmental problems.
- **Geology** (N Dip, B Tech, M Tech, D Tech) (Arcadia Campus)  
Geology is part of a historical science that investigates what the planet Earth was like at different times in the past, but more so a specific science that concerns itself with the origin, characterization, exploration, exploitation and responsible management of Earth materials. A geologist can therefore be regarded as an essential role player within the global community who serves it with advice as to the availability, quantity and usefulness of Earth materials.
- **Water Care** (N Dip, B Tech, M Tech, D Tech)  
Water Technology is the study of the processes that are used in the treatment and purification of drinking water, wastewater and industrial effluents. This also includes the study of chemistry, physics, hydraulics, microbiology and various management aspects.

### *Admission requirements*

The following are the minimum academic requirements to enroll for the National Diploma programme

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

### *Specific requirements are:*

Adequate achievement (i.e. a rating of 4 or more) in English and a moderate achievement (3) in: Physical Science and Mathematics.

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

### *Highly recommended subject:*

Life Sciences

### *Recommended subject:*

Geography.

## Department of Horticulture

The Department of Horticulture has built a solid track record in training entrepreneurs in the fields of *Landscape Technology, Horticulture and Turfgrass Management* for a number of years.

In the field of Horticulture students are equipped with the relevant knowledge and skills to become competent ornamental horticulturists. The programme is offered up to D Tech level. The BTech degree in Landscape Technology enables the graduate to be competent in both landscape design and landscape construction. The unique BTech programme in Turfgrass Management was designed especially to provide the turfgrass and related industries with greenkeepers and facility managers able to competently establish, maintain and manage turfgrass facilities at sports fields.

Course offered by the department include National diplomas and BTech degrees in:

Horticulture; Landscape Technology and Turfgrass Management

### *Admission requirements*

The following are the minimum academic requirements to enroll for the National Diploma programme

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

### *Specific requirements are:*

Adequate achievement (i.e. a rating of 4 or more) in English and a moderate achievement (3) in Mathematics or Mathematical Literacy.

Candidates should have, at least, a moderate achievement (i.e. a rating of 3) in any one of the following subjects; Agricultural Sciences, Physical Science, Life Sciences

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

### *Recommended subjects are:*

Business Studies and Visual Arts

## Department of Mathematics and Statistics

- **Mathematical Technology** (M Tech, D Tech)  
Mathematical Technology may be described as the blending of strong computing and visualization capabilities with theoretical considerations that permits one to do new and deeper investigations into the mathematical sciences. TUT only offers a M Tech degree in Mathematical Technology and a Doctorate in Mathematical Technology. A (fourth year only) B Tech program is currently being developed.
- **Quality** (B Tech, M Tech, D Tech)  
B Tech Quality is only offered in the fourth year. This programme consists of the full spectrum of quality technologies, the tools and techniques of quality assurance, the philosophies and techniques of Total Quality Management, self- assessment, bench marking, and world class organizations. Implementation and use of ISO 9000, ISO 14 000, SPC programmes, FMES's, Quality Function Deployment.  
Arcadia Campus

## Department of Nature Conservation

- **Ecotourism Management;** (N Dip, B Tech, M Tech)
- **Game Ranch Management;** (N Dip; B Tech, M Tech, D Tech)
- **Nature Conservation;** (N Dip; B Tech, M Tech, D Tech)

The Department of Nature Conservation has been training diplomats and graduates over the past years to excel in a variety of fields and careers including Ecotourism Management (Guides, Eco-destination planners, and Tour operators), Game Ranch Management (Professional Hunting, Game Capturing) and Nature Conservation (Protected area managers, Rangers, Specialist Services, Environmental education etc.) Research focus includes a number of programmes within Best Management Practices in the Wildlife Industry.

### *Admission requirements*

The following are the minimum academic requirements to enroll for the National Diploma programme

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

### *Specific requirements are:*

English as 1st or 2nd language with a minimum pass rate of 4, Mathematics or Mathematical Literacy with a minimum pass rate of 3.

At least one of the following subjects: Life Sciences, Physical Science, Geography, Agricultural Sciences, Agricultural Management or Agricultural Technology.

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

### *Highly recommended subjects are:*

Any other second official language. In the above list of specific requirements, it is highly recommended that potential candidates should have passed at least one of Physical and/or Life Science

## Adelaide Tambo School of Nursing Science

The Adelaide Tambo School of Nursing Science is the only department of its kind at a University of Technology and is accredited by the South African Nursing Council to offer the *B Tech degree in Nursing Science*. Obtaining this qualification will enable candidates to register and practice as a nurse and midwife

### *Admission requirements*

The following are the minimum academic requirements to enroll for the National Diploma programme In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

### *Specific requirements are:*

English (as first language or as additional language)  
Mathematics or Mathematical Literacy

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

Plus any TWO of the following four subjects (but it must include at least one of Physical Science and/or Life Sciences):

Physical Science  
Life Sciences  
Computer Application Technology  
Information Technology

*Post basic learning programs offered are:*

BTech Community Nursing (Advanced)  
B Tech Nursing: Community (Advanced community nursing)  
Registration as community nurse is a requirement to enter this learning programme.  
BTech Nursing (Occupational Health)  
BTech Nursing (Oncology)

*Admission requirements*

Basic Degree  
M Tech Nursing  
D Tech Nursing

## Department of Pharmaceutical Sciences

The Department of Pharmaceutical Science offers a *B Pharm* degree in partnership with the University of Limpopo. This degree is unique in South Africa in that it makes use of a learning strategy known as Problem Based Learning. The programme extends over four years, with additional internship and community service years to be completed before registration as a pharmacist. The Department also offers a *B Tech degree in Pharmaceutical Sciences* for non-pharmacists in possession of a related three-year degree or National Diploma in order to acquire more knowledge and skills in this field.

*Admission requirements*

Senior Certificate with University exemption.

Compulsory Grade 12 subjects: Mathematics, plus two subjects in the Natural Sciences field.

- **The Division Somatology** in the Department of Pharmaceutical Science strives to create a learning environment where students are equipped with multi-level skills and expertise in the field of skin and body care, massage therapy, reflexology, aromatherapy and stress management. The *B Tech in Somatology* equips a student to become a member of a multi-disciplinary team that works together with medical doctors, pharmacists, plastic surgeons, dieticians, physiotherapists and dermatologists. Graduates are also highly sought after for placement in skin care clinics, on cruise liners and health spa's.

The following are the minimum academic requirements to enroll for the National Diploma programme in Somatology

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

*Specific requirements are:*

English (1st or 2nd language) with a rating of at least 4 and Mathematical Literacy or Mathematics with a rating of at least 3.

Life Sciences and/or Physical Science with a rating of at least 3,

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

*Recommended subject:*

Business Economics

## Department of Sport, Rehabilitation and Dental Sciences

There are three broad fields of specialisation in sport sciences in the department namely:

- *Sport and Exercise Technology* that qualifies a learner to become a health and fitness instructor/ sport and exercise scientist. The sport and exercise scientists will be trained to understand the physiological, biochemical, biomechanical/kinesiological, and physiological mechanisms involved in sport and exercise and maintain and enhance specific functional capacities for elite and recreational sports and exercise participants. A Sport and Exercise Scientist can work collaboratively with the sport medicine team including sport physicians, physiotherapists, biokineticists, coaches, educators and exercise professionals to ensure the transfer of safe and effective scientific training principles to athletes/clients.
- *Officiating and Coaching Science* gives students an opportunity to follow a professional career as official, qualified provincial and national coach, coaching manager or sport director. Students focus on the following coaching practices, the development of training programs for novices and elite athletes, sports nutrition, biomechanics of sport, physiology and sports performance, medical considerations in sport, sport psychology and risk management. The major subjects being coaching science, sport psychology and coaching, and athlete management.
- *Biokinetics* - A qualified *Biokineticist* will be able to safely perform advanced evaluation techniques for musculoskeletal injuries, special conditions within the normal population and conditions within special populations in order to apply physical rehabilitation techniques in the management of these conditions
- Within the department, the division of **Medical Orthotics and Prosthetics** resides. An Orthotist & Prosthetist is a medical practitioner who specializes in the field of orthopaedic rehabilitation and work directly with patients by providing orthosis and prostheses to treat both able and disabled patients.
- Moreover, the department houses the **Golf Academy**, unique in its kind, which prepares learners for a career in golf with the added advantage of obtaining a degree in any of the related programmes offered by the department.

*Admission requirements:*

The following are the minimum academic requirements to enrol for the National Diploma programme

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

*Specific Requirements:*

A pass mark of 4 for English (1st or 2nd language) and a pass mark of 3 for Mathematical Literacy or Mathematics.

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

*Recommended Subjects:*

Life Sciences

*Admission requirement for Biokinetics:*

A National Diploma: Sport and Exercise Technology or an equivalent qualification.

- **Dental Technology**

After completion of the programme in Dental Technology, a graduate possesses the necessary theoretical knowledge and practical skills to work in all the different areas of the field including the preparation of dentures, restoration of oral function and the conservation and maintenance of remaining oral structures.

*Admission requirement*

The following are the minimum academic requirements to enrol for the National Diploma programme

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

*Specific requirements are:*

Adequate achievement (i.e. a rating of 4 or more) in English and a moderate achievement (3) in: Mathematics or Mathematical Literacy plus at least one of the following subjects: Life Sciences or Physical Science.

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

According to the Dental Technicians Act. (Act No 19 of 1979), Training regulation 6 "Before an approved institution accepts a person for admission as a student dental technician, such a person shall be tested by the institution by means of an aptitude test approved by the council."

- **Dental Assisting**

The dental assistant is responsible for assisting dentists in dental practices or clinics and plays an important role in infection control, mixing and preparing dental materials, providing patients with information on oral hygiene and developing and mounting X-rays. Furthermore, the role of the assistant is extended to keeping record of patients, dealing with appointments, assist with stock control and accounts.

The following are the minimum academic requirements to enroll for the National Certificate programme

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

*Specific requirements are:*

Adequate achievement (i.e. a rating of 4 or more) in English and a moderate achievement (3) in:

Mathematics or Mathematical Literacy plus at least one of the following subjects: Life Sciences or Physical Science.

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

- **Occupational Therapy Assistant**

The graduate of this programme will be employable as a health worker, to work with occupational therapists in the rendering of occupational therapy services in different health sectors and the community.

*Admission requirements*

National Senior Certificate or an equivalent qualification, with English, Life Sciences, Mathematics or Mathematical Literacy and any other second language.

## Department of Physics

- **Fire Technology** (N Dip, B Tech, M Tech)

Fire Technology deals with the cause, prevention and suppression of any fire, rescuing of people and handling of emergency situations and the management of staff.

### **Admission requirements**

The following are the minimum academic requirements to enrol for the National Diploma programme

In addition to the senior certificate - general and vocational certificate a candidate must adhere to the specific requirements for the programme.

We do offer limited spaces to new National Senior Certificate holders with above 4 ratings in English, Physical Science and Mathematics. These students will have to pass a medical fitness test administered by the Tshwane Metro.

### **Specific requirements are:**

A minimum rating of 4 for English (1st or 2nd language) and 4 for Mathematical Literacy (or Mathematics) and Physical Science.

Applicants who score 49 or more points according to the Admission Points Score (APS) will be considered for enrolment subject to the availability of space in the programme.

## ENQUIRIES

**Department of Animal Science**  
(012) 382-5332

**Department of Biomedical Sciences**  
(012) 382-6265/7

**Department of Biotechnology and Food Technology**  
(012) 382-6240

**Department of Chemistry**  
(012) 382-6285/6284

**Department of Crop Science**  
(012) 382-5333

**Department of Environmental Health**  
(012) 382-5281

**Department of Water, Earth & Environmental Sciences**  
(012) 382-6379/6115

**Department of Horticulture**  
(012) 382-5300

**Department of Mathematical Technology**  
(012) 382-6358

**Department of Nature Conservation**  
(012) 382-5306

**Department of Physics**  
(012) 382-6280

**Department of Pharmaceutical Sciences**  
(012) 382-6228 or 382-6303  
(012) 382-6113 or 382-5728 (Somatology)

**Department of Sport, Rehabilitation & Dental Sciences**  
(012) 382-5806 or 382-5807

**The Adelaide Tambo School of Nursing Science**  
(012) 382-5197 or 382-5285

## MULTIPLICATION TABLE

<b>X</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
<b>0</b>	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>1</b>	0	1	2	3	4	5	6	7	8	9	10	11	12
<b>2</b>	0	2	4	6	8	10	12	14	16	18	20	22	24
<b>3</b>	0	3	6	9	12	15	18	21	24	27	30	33	36
<b>4</b>	0	4	8	12	16	20	24	28	32	36	40	44	48
<b>5</b>	0	5	10	15	20	25	30	35	40	45	50	55	60
<b>6</b>	0	6	12	18	24	30	36	42	48	54	60	66	72
<b>7</b>	0	7	14	21	28	35	42	49	56	63	70	77	84
<b>8</b>	0	8	16	24	32	40	48	56	64	72	80	88	96
<b>9</b>	0	9	18	27	36	45	54	63	72	81	90	99	108
<b>10</b>	0	10	20	30	40	50	60	70	80	90	100	110	120
<b>11</b>	0	11	22	33	44	55	66	77	88	99	110	121	132
<b>12</b>	0	12	24	36	48	60	72	84	96	108	120	132	144

## COMMONLY USED METRIC SYSTEM UNITS AND SYMBOLS

Quantity measured	Unit	Symbol	Relationship	
Length, width, distance, thickness, girth, etc.	millimeter	mm	10 mm	= 1 cm
	centimeter	cm	100 cm	= 1 m
	meter	m		
	kilometer	km	1 km	= 1000 m
Mass ("weight")*	milligram	mg	1000 mg	= 1 g
	gram	g		
	kilogram	kg	1 kg	= 1000 g
	metric ton	t	1 t	= 1000 kg
Time	second	s		
Temperature	degree Celsius	°C		
Area	square meter	m <sup>2</sup>		
	hectare	ha	1 ha	= 10 000 m <sup>2</sup>
	square kilometer	km <sup>2</sup>	1 km <sup>2</sup>	= 100 ha
Volume	milliliter	mL	1000 mL	= 1 L
	cubic centimeter	cm <sup>3</sup>	1 cm <sup>3</sup>	= 1 mL
	liter	L	1000 L	= 1 m <sup>3</sup>
	cubic meter	m <sup>3</sup>		
Speed, velocity	meter per second	m/s		
	kilometer per hour	km/h	1 km/h	= 0.278 m/s
Density	kilogram per cubic meter	kg/m <sup>3</sup>		
Force	newton	N		
Pressure, stress	kilopascal	kPa		
Power	watt	W		
	kilowatt	kW	1 kW	= 1000 W
Energy	kilojoule	kJ		
	megajoule	MJ	1 MJ	= 1000 kJ
	kilowatt hour	kW·h	1 kW·h	= 3.6 MJ
Electric current	ampere	A		





# Periodic Table of the Elements

1	<b>H</b> 1.0079	2	<b>He</b> 4.00260
3	<b>Li</b> 6.941	4	<b>Be</b> 9.01218
11	<b>Na</b> 22.98977	12	<b>Mg</b> 24.305
19	<b>K</b> 39.0983	20	<b>Ca</b> 40.08
37	<b>Rb</b> 85.4678	38	<b>Sr</b> 87.62
55	<b>Cs</b> 132.9054	56	<b>Ba</b> 137.33
87	<b>Fr</b> (223)	88	<b>Ra</b> 226.0254
23	<b>V</b> 50.9415	24	<b>Cr</b> 51.996
41	<b>Nb</b> 92.9064	42	<b>Mo</b> 95.94
73	<b>Ta</b> 180.9479	74	<b>W</b> 183.85
105	<b>S</b> (262)	106	<b>S</b> (263)
22	<b>Ti</b> 47.88	23	<b>V</b> 50.9415
40	<b>Zr</b> 91.224	41	<b>Nb</b> 92.9064
72	<b>Hf</b> 178.49	73	<b>Ta</b> 180.9479
104	<b>S</b> (261)	105	<b>S</b> (262)
21	<b>Sc</b> 44.9559	22	<b>Ti</b> 47.88
39	<b>Y</b> 88.90585	40	<b>Zr</b> 91.224
57	<b>*La</b> 138.9055	58	<b>Ce</b> 140.12
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
25	<b>Mn</b> 54.9380	26	<b>Fe</b> 55.847
43	<b>Tc</b> (98)	44	<b>Ru</b> 101.07
75	<b>Re</b> 186.207	76	<b>Os</b> 190.2
107	<b>S</b> (264)	108	<b>S</b> (265)
27	<b>Co</b> 58.9332	28	<b>Ni</b> 58.70
45	<b>Rh</b> 102.9055	46	<b>Pd</b> 106.4
77	<b>Ir</b> 192.22	78	<b>Pt</b> 195.09
29	<b>Cu</b> 63.546	30	<b>Zn</b> 65.38
47	<b>Ag</b> 107.8682	48	<b>Cd</b> 112.411
79	<b>Au</b> 196.9665	80	<b>Hg</b> 200.59
111	<b>S</b> (266)	112	<b>S</b> (267)
28	<b>Ni</b> 58.70	29	<b>Cu</b> 63.546
46	<b>Pd</b> 106.4	47	<b>Ag</b> 107.8682
78	<b>Pt</b> 195.09	79	<b>Au</b> 196.9665
106	<b>S</b> (264)	107	<b>S</b> (265)
31	<b>Ga</b> 69.723	32	<b>Ge</b> 72.6305
49	<b>In</b> 114.818	50	<b>Sn</b> 118.710
81	<b>Tl</b> 204.377	82	<b>Pb</b> 207.2
113	<b>S</b> (268)	114	<b>S</b> (269)
33	<b>As</b> 74.9216	34	<b>Se</b> 78.96
51	<b>Sb</b> 121.757	52	<b>Te</b> 127.603
83	<b>Bi</b> 208.9804	84	<b>Po</b> (209)
115	<b>S</b> (268)	116	<b>S</b> (269)
35	<b>Br</b> 79.904	36	<b>Kr</b> 83.8
53	<b>I</b> 126.905	54	<b>Xe</b> 131.3
85	<b>At</b> (210)	86	<b>Rn</b> (222)
5	<b>B</b> 10.81	6	<b>C</b> 12.011
13	<b>Al</b> 26.98154	14	<b>Si</b> 28.0855
31	<b>Ga</b> 69.723	32	<b>Ge</b> 72.6305
49	<b>In</b> 114.818	50	<b>Sn</b> 118.710
81	<b>Tl</b> 204.377	82	<b>Pb</b> 207.2
113	<b>S</b> (268)	114	<b>S</b> (269)
7	<b>N</b> 14.0067	8	<b>O</b> 15.9994
15	<b>P</b> 30.97376	16	<b>S</b> 32.06
33	<b>As</b> 74.9216	34	<b>Se</b> 78.96
51	<b>Sb</b> 121.757	52	<b>Te</b> 127.603
83	<b>Bi</b> 208.9804	84	<b>Po</b> (209)
115	<b>S</b> (268)	116	<b>S</b> (269)
9	<b>F</b> 18.998403	10	<b>Ne</b> 20.1797
17	<b>Cl</b> 35.453	18	<b>Ar</b> 39.948
35	<b>Br</b> 79.904	36	<b>Kr</b> 83.8
53	<b>I</b> 126.905	54	<b>Xe</b> 131.3
85	<b>At</b> (210)	86	<b>Rn</b> (222)
65	<b>Tb</b> 158.92534	66	<b>Dy</b> 162.50
71	<b>Lu</b> 174.967	72	<b>Hf</b> 178.49
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
107	<b>S</b> (266)	108	<b>S</b> (267)
63	<b>Eu</b> 151.96	64	<b>Gd</b> 157.25
71	<b>Ho</b> 164.9304	72	<b>Er</b> 167.26
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
107	<b>S</b> (266)	108	<b>S</b> (267)
67	<b>Ho</b> 164.9304	68	<b>Er</b> 167.26
75	<b>Tm</b> 168.9342	76	<b>Yb</b> 173.04
93	<b>*Ac</b> 227.0278	94	<b>Pu</b> 244
101	<b>Fm</b> (257)	102	<b>No</b> (259)
69	<b>Tm</b> 168.9342	70	<b>Yb</b> 173.04
87	<b>*Ac</b> 227.0278	88	<b>Ra</b> 226.0254
105	<b>Fm</b> (258)	106	<b>Md</b> (258)
97	<b>Bk</b> (247)	98	<b>Cf</b> (251)
105	<b>Fm</b> (257)	106	<b>No</b> (259)
95	<b>Am</b> (243)	96	<b>Cm</b> (247)
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
91	<b>Pa</b> 231.0369	92	<b>U</b> 238.029
101	<b>Fm</b> (257)	102	<b>No</b> (259)
87	<b>*Ac</b> 227.0278	88	<b>Ra</b> 226.0254
105	<b>Fm</b> (258)	106	<b>Md</b> (258)
93	<b>*Ac</b> 227.0278	94	<b>Pu</b> 244
101	<b>Fm</b> (257)	102	<b>No</b> (259)
91	<b>Pa</b> 231.0369	92	<b>U</b> 238.029
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
99	<b>Cf</b> (251)	100	<b>Fm</b> (257)
107	<b>S</b> (266)	108	<b>S</b> (267)
95	<b>Am</b> (243)	96	<b>Cm</b> (247)
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
93	<b>*Ac</b> 227.0278	94	<b>Pu</b> 244
101	<b>Fm</b> (257)	102	<b>No</b> (259)
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
107	<b>S</b> (266)	108	<b>S</b> (267)
61	<b>Pm</b> (145)	62	<b>Sm</b> 150.4
79	<b>*Ac</b> 227.0278	80	<b>Er</b> 167.26
97	<b>Bk</b> (247)	98	<b>Cf</b> (251)
105	<b>Fm</b> (257)	106	<b>No</b> (259)
59	<b>Pr</b> 140.9077	60	<b>Nd</b> 144.24
67	<b>Ho</b> 164.9304	68	<b>Er</b> 167.26
85	<b>At</b> (210)	86	<b>Rn</b> (222)
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
91	<b>Pa</b> 231.0369	92	<b>U</b> 238.029
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
107	<b>S</b> (266)	108	<b>S</b> (267)
63	<b>Eu</b> 151.96	64	<b>Gd</b> 157.25
71	<b>Ho</b> 164.9304	72	<b>Er</b> 167.26
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
107	<b>S</b> (266)	108	<b>S</b> (267)
65	<b>Tb</b> 158.92534	66	<b>Dy</b> 162.50
73	<b>Lu</b> 174.967	74	<b>Hf</b> 178.49
91	<b>Pa</b> 231.0369	92	<b>U</b> 238.029
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
87	<b>*Ac</b> 227.0278	88	<b>Ra</b> 226.0254
105	<b>Fm</b> (257)	106	<b>No</b> (259)
93	<b>*Ac</b> 227.0278	94	<b>Pu</b> 244
101	<b>Fm</b> (257)	102	<b>No</b> (259)
69	<b>Tm</b> 168.9342	70	<b>Yb</b> 173.04
87	<b>*Ac</b> 227.0278	88	<b>Ra</b> 226.0254
105	<b>Fm</b> (257)	106	<b>No</b> (259)
97	<b>Bk</b> (247)	98	<b>Cf</b> (251)
105	<b>Fm</b> (257)	106	<b>No</b> (259)
95	<b>Am</b> (243)	96	<b>Cm</b> (247)
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
93	<b>*Ac</b> 227.0278	94	<b>Pu</b> 244
101	<b>Fm</b> (257)	102	<b>No</b> (259)
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
107	<b>S</b> (266)	108	<b>S</b> (267)
61	<b>Pm</b> (145)	62	<b>Sm</b> 150.4
79	<b>*Ac</b> 227.0278	80	<b>Er</b> 167.26
97	<b>Bk</b> (247)	98	<b>Cf</b> (251)
105	<b>Fm</b> (257)	106	<b>No</b> (259)
63	<b>Eu</b> 151.96	64	<b>Gd</b> 157.25
71	<b>Ho</b> 164.9304	72	<b>Er</b> 167.26
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
107	<b>S</b> (266)	108	<b>S</b> (267)
65	<b>Tb</b> 158.92534	66	<b>Dy</b> 162.50
73	<b>Lu</b> 174.967	74	<b>Hf</b> 178.49
91	<b>Pa</b> 231.0369	92	<b>U</b> 238.029
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
87	<b>*Ac</b> 227.0278	88	<b>Ra</b> 226.0254
105	<b>Fm</b> (257)	106	<b>No</b> (259)
93	<b>*Ac</b> 227.0278	94	<b>Pu</b> 244
101	<b>Fm</b> (257)	102	<b>No</b> (259)
69	<b>Tm</b> 168.9342	70	<b>Yb</b> 173.04
87	<b>*Ac</b> 227.0278	88	<b>Ra</b> 226.0254
105	<b>Fm</b> (257)	106	<b>No</b> (259)
97	<b>Bk</b> (247)	98	<b>Cf</b> (251)
105	<b>Fm</b> (257)	106	<b>No</b> (259)
95	<b>Am</b> (243)	96	<b>Cm</b> (247)
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
93	<b>*Ac</b> 227.0278	94	<b>Pu</b> 244
101	<b>Fm</b> (257)	102	<b>No</b> (259)
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
107	<b>S</b> (266)	108	<b>S</b> (267)
63	<b>Eu</b> 151.96	64	<b>Gd</b> 157.25
71	<b>Ho</b> 164.9304	72	<b>Er</b> 167.26
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
107	<b>S</b> (266)	108	<b>S</b> (267)
65	<b>Tb</b> 158.92534	66	<b>Dy</b> 162.50
73	<b>Lu</b> 174.967	74	<b>Hf</b> 178.49
91	<b>Pa</b> 231.0369	92	<b>U</b> 238.029
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
87	<b>*Ac</b> 227.0278	88	<b>Ra</b> 226.0254
105	<b>Fm</b> (257)	106	<b>No</b> (259)
93	<b>*Ac</b> 227.0278	94	<b>Pu</b> 244
101	<b>Fm</b> (257)	102	<b>No</b> (259)
69	<b>Tm</b> 168.9342	70	<b>Yb</b> 173.04
87	<b>*Ac</b> 227.0278	88	<b>Ra</b> 226.0254
105	<b>Fm</b> (257)	106	<b>No</b> (259)
97	<b>Bk</b> (247)	98	<b>Cf</b> (251)
105	<b>Fm</b> (257)	106	<b>No</b> (259)
95	<b>Am</b> (243)	96	<b>Cm</b> (247)
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
93	<b>*Ac</b> 227.0278	94	<b>Pu</b> 244
101	<b>Fm</b> (257)	102	<b>No</b> (259)
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
107	<b>S</b> (266)	108	<b>S</b> (267)
63	<b>Eu</b> 151.96	64	<b>Gd</b> 157.25
71	<b>Ho</b> 164.9304	72	<b>Er</b> 167.26
89	<b>*Ac</b> 227.0278	90	<b>Th</b> 232.0381
107	<b>S</b> (266)	108	<b>S</b> (267)
65	<b>Tb</b> 158.92534	66	<b>Dy</b> 162.50
73	<b>Lu</b> 174.967	74	<b>Hf</b> 178.49
91	<b>Pa</b> 231.0369	92	<b>U</b> 238.029
103	<b>Am</b> (243)	104	<b>Pu</b> (244)
87	<b>*Ac</b> 227.0278	88	<b>Ra</b> 226.0254
105	<b>Fm</b> (257)	106	<b>No</b> (259)
93	<b>*Ac</b> 227.0278	94	<b>Pu</b> 244
101	<b>Fm</b> (257)	102	<b>No</b> (259)
69	<b>Tm</b> 168.9342	70	<b>Yb</b> 173.04