22219VIC Certificate III in Science
22220VIC Certificate IV in Science

Version 2
January 2016

has been accredited under the authority of the Victorian Qualifications Authority

Accredited for the period
1 January 2013 – 31 December 2017
under Parts 4.4 and 4.6 of the Education and Training Reform Act 2006

Version History
Version 2: January 2016: 22219VIC Certificate III in Science & 22220VIC Certificate IV in Science

The following amendments have been made to Section B of the curriculum document

- Contact and copyright information has been updated
- Reference to the Training Support Network website has been removed and replaced with Department of Education and Training website
- Assessor competencies have been updated to reflect requirements for RTOs who are regulated by ASQA
- Information relating to Resources in section 7.2 has been updated
- Correction to code for MSL973001A Perform basic tests

The following imported units of competency from accredited curricula have been updated to the most current version in the 22219VIC Certificate III in Science:

Version 1		**Version 2**		
Code	**Title**	**Replaced Code**	**Replaced Title**	**Relationship**
VBQU157	Engage with a range of complex texts for learning purposes	VU21377	Engage with a range of highly complex texts for learning purposes	Not Equivalent digital literacy now an explicit outcome
VBQU161	Create a range of complex texts for learning purposes	VU21381	Create a range of highly complex texts for learning purposes	Not equivalent, digital literacy now an explicit outcome

Units imported from training packages have been updated to the most current version as follows:

Version 2	**Version 1**
MEM05 Metal and Engineering Training Package	**MEM05 Metal and Engineering Training Package**
MEM23007A Apply calculus to engineering tasks	MEM23002A Apply calculus in engineering situations
ICT Information and Communications Technology Training Package	**ICA11 Information and Communications Technology Training Package**
ICTICT101 Operate a personal computer	ICAICT101A Operate a personal computer
ICTICT105 Operate spreadsheet applications	ICAU1130B Operate a spreadsheet application
ICTICT210 Operate database applications	ICAU1131B Operate a database application

Version 2	Version 1
ICTICT103 Use, communicate and search securely on the internet	ICAICT103A Use, communicate and search securely on the internet
ICTICT102 Operate word-processing applications	Unit used in curriculum but omitted from copyright acknowledgement

The following units have been amended however vocational outcomes have not changed.

22219VIC Certificate III in Science		
Code	**Title**	**Amendment**
VU20929	Concepts in biology	"Adaptations in" PC 3.4 bolded to link to Range statement
VU20930	Concepts in chemistry	Summary of learning outcomes amended to align with learning outcomes in module. LO1.1 Amended for accuracy Knowledge clarified to support learning outcomes Range statement clarified Critical Aspects of evidence clarified to reflect learning outcomes
VU20931	Concepts in physics	Amended range statement for accuracy
22220VIC Certificate IV in Science		
VU20935	Atomic Structure and Bonding	Typo corrected in LO 3.1
VU20951	Cell biology	Correction of type in LO 2.2 Amendment of terminology in LO 3.2. Point 2 in Required knowledge clarified
VU20952	Anatomy & physiology	Range statement amended for clarification
VU20953	Introductory genetics	Range Statement item aligned to Learning Outcome Correction of typos
VU20954	Ecology	Purpose of unit clarified Summary of learning outcomes and learning outcomes aligned Range Statement item aligned to Learning Outcome Correction of typos

22219VIC Certificate III in Science

22220VIC Certificate IV in Science

Section A: Copyright and course classification information

1. Copyright owner of the course	Copyright of this document is held by the Department of Education and Training, Victoria © State of Victoria. Day to day contact: Service Industries Curriculum Maintenance Manager General Studies and Further Education Email: sicmm.generalstudies@vu.edu.au Telephone: (03) 9919 5300/5302
2. Address	Department of Education and Training Higher Education and Skills Group Executive Director Training Participation and Facilitation DivisionGPO Box 4367 Melbourne VIC 3001
3. Type of submission	The courses are submitted for reaccreditation. They replace and have equivalent outcomes to: • 21857VIC Certificate III in Science • 21858VIC Certificate IV in Science.
4. Copyright acknowledgement	Copyright of this material is reserved to the Crown in the right of the State of Victoria. © State of Victoria (Department of Education and Training) 2013. This document may be reproduced in whole or in part for study or training purposes, subject to the inclusion of an acknowledgement of the source. Units of competency from nationally endorsed training packages can be accessed from Training.gov at www.tga.gov.au Copyright of the following units of competency from nationally endorsed training packages is administered by the Commonwealth of Australia. © Commonwealth of Australia • MEM05 Metal and Engineering Training Package/MEM Manufacturing and Engineering training Package − MEM12023A Perform engineering measurements − MEM12024A Perform computations • MEM05 Metal and Engineering Training Package − MEM23007A - Apply calculus to engineering tasks − MEM30012A Apply mathematical techniques in a manufacturing, engineering or related environment • ICT Information and Communications Technology Training Package − ICTICT101 Operate a personal computer − ICTICT105 Operate spreadsheet applications

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ICTICT210Operate database applications
ICTICT103 Use, communicate and search securely on the internet
ICTICT102 Operate word-processing applications

• PSP12 Public Sector Training Package

PSPOHS201B Follow workplace safety procedures

• HLT07 Health Training Package

HLTAP301B Recognise healthy body systems in a health care context

• MSL09 Laboratory Operations Training Package

MSL973004A Perform aseptic techniques
MSL943002A Participate in laboratory/field workplace safety
MSL973002A Prepare working solutions
MSL973007A Perform microscopic examination
MSL973001A Perform basic tests

Copyright of the following units of competency from accredited curricula is held by the Department of Education and Training, Victoria © State of Victoria.
• 21774VIC Certificate III in General Education for Adults

VU21377 Engage with a range of highly complex texts for learning purposesVU21381 Create a range of highly complex texts for learning purposes

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<tr><td>5. Licensing and franchise</td><td>

</td></tr>
<tr><td>6. Course accrediting body</td><td>Victorian Registration and Qualifications Authority (VRQA)

Website : http://www.vrqa.vic.gov.au/</td></tr>
<tr><td>7.AVETMISS information</td><td>AVETMISS classification codes
<table>
<tr><td>ANZSCO [Australian and New Zealand Standard Classification of Occupations]</td><td>234000 natural and physical science professionals</td></tr>
<tr><td>ANZSIC code
(Australia and New Zealand Standard</td><td>8432 technical and further education</td></tr>
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	Industrial Classification – industry type)	
	ASCED Code – 4 digit *(Field of Education)*	1201 general education
	National course code	*22219VIC Certificate III in Science* *22220VIC Certificate IV in Science*
8. Period of accreditation	1 January 2013 to 31 December 2017	

Section B: Course Information

1. Nomenclature	*Standard 1 for Accredited Courses*
Name of the qualification	22219VIC Certificate III in Science 22220VIC Certificate IV in Science
Nominal duration of the course	22219VIC Certificate III in Science – 440 – 460 hours 22220VIC Certificate IV in Science – 750 – 840 hours
2. Vocational or educational outcomes of the course	*Standard 1 for Accredited Courses* The Certificate III in Science is primarily a preparatory qualification which will enable successful graduates to apply for vocational Certificate IV or Diploma courses in science and technology. The Certificate IV in Science is primarily a preparatory qualification which will enable successful graduates to apply for university degree or associate degree courses in science and technology. Further study in science and technology may include laboratory technology, nursing, biotechnology, information technology, food technology, environmental science, health, engineering, applied sciences and other related courses.
3. Development of the course	*Standards 1and 2 for Accredited Courses*
3.1 Industry /enterprise/ community needs	These courses are being redeveloped on behalf of the Higher Education and Skills Group, Department of Education and Training. The redevelopment of these courses is consistent with the Victorian Government's commitment to initiatives which recognise the need for, and will help facilitate, better integration between vocational education and training and the higher education sectors. Graduates of these qualifications will be able to access science related tertiary courses which allow entry into highly competitive knowledge and skills driven industries which give Victoria a competitive edge. In addition, there is widespread evidence of the importance of science and technology to Australia's future prosperity: • By fostering science and technology-led services innovation in our areas of natural competitive advantage, Australia can compete in a rapidly changing globalised knowledge based economy. (Science and Technology-led Innovation in Services for Australian Industries, A report of the Prime Minister's Science, Engineering and Innovation Council, Final Report, 3 April 2008. • Science is important not just to our material wellbeing but to every aspect of our lives – to our environment, to our health, to our understanding of ourselves and our place in the universe. Science will enable us to go on enjoying all the benefits of human ingenuity and modern industry, while conserving our resources and protecting our fragile planet. It is absolutely critical to Australia's future. (Science for Australia's Future,

	Australian Government Policy Statement, 2008) • There has been a decline in participation in science and advanced studies in mathematics across all States and Territories. Patterns of participation in technology vary with recent declines in information technology, increases in food technology and fairly constant participation in technical studies including trades related studies. • Australia faces many big challenges – in the economy, health, energy, water, climate change, infrastructure, sustainable agriculture and the preservation of our precious biodiversity. To meet these challenges, we need creative scientists and engineers drawn from many disciplines and a technologically-skilled workforce. Worryingly, Australia sits well within the bottom half of OECD countries (ranked 24th of 30) when it comes to the number of university graduates emerging with a science or engineering degree per capita. Myriad jobs - apart from the obvious research, engineering and technology careers – require a basic understanding of science and maths. (Address to the National Press Club by Suzanne Cory, president of the Australian Academy of Science on 28 September 2011) • Mathematics, engineering and science provide the enabling skills and knowledge that underpin every aspect of modern life. (NICTA Big Picture Seminar – Australia's Future in Science and Technology, 28 March 2012.) • Australia's Chief Scientist Professor Ian Chubb is reported as saying that the agricultural sciences, physics, mathematics and chemistry have been identified as 'vulnerable'. (Campus Review, 29 May 2012) A skills and knowledge survey was developed to identify and validate the essential skills and knowledge outcomes developed through the Certificate III and Certificate IV in Science. Responses were sought from higher education and TAFE institutions and other industry representatives. The survey results identified a range of skills and knowledge as critical or very important and examples include: • use general and technical vocabulary to convey ideas • produce scientific reports using appropriate terminology • prepare written or verbal presentations that structure information in a logical sequence • measure or observe and record results in simple experiments. There are no Training Package qualifications that address the needs of individuals wanting to access further education and training in science and technology. • The existing qualifications are delivered by both metropolitan and regional providers. Enrolment data for 21857VIC Certificate III in Science is as follows: – 2008 enrolments – 96 – 2009 enrolments – 175 – 2010 enrolments – 199

	– 2011 enrolments – 188 • Enrolment data for 21858VIC Certificate IV in Science is as follows: – 2008 enrolments – 22 – 2009 enrolments - 185 – 2010 enrolments – 166 – 2011 enrolments – 133 It is expected that enrolments in the new courses will continue at the same level. A course steering committee was established to advise on the development of these courses Members of the steering committee were: Peter Canavan (Chair) — Australian Industry Group Coral Campbell — Deakin University Tania Blanksby — Latrobe University Penny Halliday — Northern Melbourne Institute of TAFE Alex Bernhardt — Manufacturing and Engineering Skills Advisory Board.
3.2 Review for re-accreditation	*Standards 1 and 2 for Accredited Courses* As part of the ongoing course maintenance process a mid-cycle review was conducted in early 2010. It was agreed that the nominal hours of the core unit VPAU077 *Apply mathematical techniques to scientific contexts* in the Certificate IV in Science be increased from 50 hours to 70 hours. A range of review activities were undertaken as part of the reaccreditation process. These included: • an on-line survey circulated to all providers • telephone interviews with course coordinators • an industry skills and knowledge survey. The key findings identified through these activities are as follows: • The courses continue to meet the needs of learners to access further studies in VET and higher education. • The structure of both courses is flexible enough to create programs relevant to learners' needs. • The purpose and outcome of existing core units/modules are valid. • The purpose and outcome of existing specialist units/modules are valid • The purpose and outcome of existing elective units/modules are valid. • Some students require basic computer studies. • Although the profile of learners enrolling in the courses may include a larger proportion of exit VCE students who have not

	achieved the outcomes they require to access higher education, there appears to be a significant number of mature aged students. Recommendations arising from the review activities included: • Use a simple core and elective structure rather than core, specialisation and elective. There appears to be no rationale for requiring students to choose two specialisations rather than allowing them to select units/modules to match their specific further study destinations. • Modify the course structure so that the Certificate III in Science is no longer a prerequisite for the Certificate IV in Science. • Expand the flexibility of both courses to include units/modules from training packages or accredited courses packaged at the same or a higher level. • Review existing units and modules in both qualifications and make revisions where appropriate. • Review the range of computer units in the electives.
Transition arrangements	**22219VIC Certificate III in Science** The 22219VIC Certificate III in Science replaces and is equivalent to the 21857VIC Certificate III in Science. There can be no new enrolments in 21857VIC after 31 December, 2012. **22220VIC Certificate IV in Science** The 22220VIC Certificate IV in Science replaces and is equivalent to the 21858VIC Certificate IV in Science. There can be no new enrolments in 21858VIC after 31 December, 2012. Refer to the following table for the mapping of units in the superseded 21857VIC Certificate III in Science and 21858VIC Certificate IV in Science against units in the current courses.

Units in superseded courses	Units in current courses	Relationship
VPAM088 Anatomy and physiology	VU20952 Anatomy and physiology	VU20952 is equivalent to VPAM088 and VPAU076
MEM23002A Apply calculus in engineering situations	MEM23002A Apply calculus in engineering situation	No change
VPAU078 Apply dynamics and conservation principles	VU21079 Apply dynamics and conservation principles	Equivalent
VBQU226 Apply essential further study skills	VU20932 Apply essential further study skills for science	Outcomes are equivalent but context has changed from liberal arts to science
MEM30012A Apply mathematical techniques in a manufacturing, engineering or related environment	MEM30012A Apply mathematical techniques in a manufacturing, engineering or related environment	No change

Units in superseded courses	Units in current courses	Relationship
VPAU077 Apply mathematical techniques to scientific contexts	VU20934 Apply mathematical techniques to scientific contexts	Equivalent
VPAM082 Atomic structure and bonding	VU20935 Atomic structure and bonding	Equivalent
VPAM087 Cell biology	VU20951 Cell biology	VU20951 is equivalent to VPAM087 and VPAU075
VPAM089 Chemical reactions	VU20948 Chemical reactions	Equivalent
VPAU072 Conduct and present simple scientific research	VU21057 Conduct and present simple scientific research	Equivalent
VPAU074 Conduct routine electrical tests	VU20945 Apply principles of electricity	Equivalent
VPAU080 Conduct routine water quality tests		No equivalent unit
VPAU075 Conduct simple activities in a biological laboratory		No equivalent unit. Outcomes of VPAU075 have been incorporated into VU20951 Cell biology
VPAU076 Conduct simple dissections		No equivalent unit. Outcomes of VPAU076 have been incorporated into VU20952 Anatomy and Physiology
VBQU161 Create a range of complex texts for learning purposes	VU21381 Create a range of highly complex texts for learning purposes	Not Equivalent
VPAM091 Ecology	VU20954 Ecology	Equivalent
VBQU157 Engage with a range of texts for learning purposes	VU21377 Engage with a range of highly complex texts for learning purposes	Not Equivalent
VBQU155 Evaluate pathways options, design a learning plan and compile a portfolio	VU20928 Design a learning plan	Not equivalent
VPAM090 Introductory genetics	VU20953 Introductory genetics	Equivalent
VBN047 Job seeking		No equivalent unit
VPAM086 Kinematics	VU20950 Kinematics	Equivalent
ICAU2006A Operate computing packages		No equivalent unit

Units in superseded courses	Units in current courses	Relationship
	ICTICT102 Operate word-processing applications	No equivalent unit
ICAU1131A Operate a database application	ICTICT210 Operate database applications	Equivalent
ICAU1128A Operate a personal computer	ICTICT101 Operate a personal computer	Equivalent
ICAU1130A Operate a spreadsheet application	ICATCT105 Operate spreadsheet applications	Equivalent
VPAM084 Organic chemistry and properties of materials	VU20947 Organic chemistry and properties of materials	Equivalent
PMLOHS302A Participate in laboratory/field workplace safety	MSL943002A Participate in laboratory/field workplace safety	Equivalent
PMLTEST305B Perform aseptic techniques	MSL973004A Perform aseptic techniques	Equivalent
PMLTEST300B Perform basic tests	MSL973001A Perform basic tests	Equivalent
MEM12024A Perform computations	MEM12024A Perform computations	No change
MEM12023A Perform engineering measurements	MEM12023A Perform engineering measurements	Equivalent
PMLTEST308A Perform microscopic examination	MSL973007A Perform microscopic examination	Equivalent
PMLTEST303B Prepare working solutions	MSL973002A Prepare working solutions	Equivalent
FDFCORWCM2A Present and apply workplace information		No equivalent unit
HLTAP301A Recognise healthy body systems in a health care context	HLTAP301B Recognise healthy body systems in a health care context	Equivalent
ICAU1133A Send and receive information using web browsers and email	ICTICT103 Use, communicate and search securely on the internet	Not equivalent
VPAM083 Stoichiometry and solution chemistry	VU20946 Stoichiometry and solution chemistry	Equivalent
VPAU073 Use a range of techniques to solve mathematical problems	VU21058 Use a range of techniques to solve mathematical problems	Equivalent

Units in superseded courses	Units in current courses	Relationship
VPAM085 Waves and optics	VU20949 Waves and optics	Equivalent
VPAU081 Work mathematically with statistics and calculus	VU21081 Work mathematically with statistics and calculus	Equivalent
	VU20929 Concepts in biology	New unit no equivalent
	VU20930 Concepts in chemistry	New unit no equivalent
	VU20931 Concepts in physics	New unit no equivalent
	VU20933 Research scientific fields of study	New unit no equivalent
	PSPOHS201B Follow workplace safety procedures	New unit no equivalent

4. Course outcomes	*Standards 1, 2 and 3 for Accredited Courses*
4.1 Qualification level	**Certificate III in Science** The Certificate III in Science is consistent with the AQF as defined in the AQF Implementation Handbook. The Certificate III qualifies individuals who apply a broad range of knowledge and skills in broad contexts to undertake skilled work and as a pathway to further learning. **Knowledge** Graduates of a Certificate III will have factual, technical, procedural and theoretical knowledge in an area of work and learning such as engineering, laboratory technology or health. **Skills** Graduates of a Certificate III will have: • cognitive, technical and communication skills to interpret and act on available information such as using and communicating in mathematical language • cognitive and communications skills to apply and communicate known solutions of a variety of predictable problems and to deal with unforseen contingencies using known solutions such as researching and presenting scientific information in writing and using appropriate scientific methods • technical and communication skills to provide technical information to a variety of specialist and non-specialist audiences such as through the application of scientific experimentation, methods and theories • technical skills to undertake routine and some non-routine tasks in a range of skilled operations such as solving a range of mathematical problems using appropriate techniques **Application of Knowledge and Skills** Graduates of a Certificate III will demonstrate the application of

	knowledge and skills: • with discretion and judgement in the selection of equipment, services or contingency measures such as using computers to perform a range of activities • to adapt and transfer skills and knowledge within known routines, measures, procedures and time constraints such as applying data processing, algebra, trigonometry and indices skills • in contexts that include taking responsibility for own outputs in work and learning including participation in teams and taking responsibility for the output of others within established parameters such as applying occupational health and safety principles and procedures **Volume of learning** The volume of learning for this qualification is typically between 1 to 2 years and incorporates structured training delivery and unstructured learning activities undertaken by the learner such as reading texts, locating information, writing reports, completing assignments and projects **Certificate IV in Science** The Certificate IV in Science is consistent with the AQF as defined in the AQF Implementation Handbook. The Certificate IV qualifies individuals who apply a broad range of specialized knowledge and skills in varied contexts to undertake skilled work and as a pathway for further learning. **Knowledge** Graduates of a Certificate IV will have broad factual, technical and theoretical knowledge in a specialized field of work and learning such as applied science, engineering, or biotechnology. **Skills** Graduates of a Certificate IV will have: • cognitive skills to identify, analyse, compare and act on information from a range of sources such as assessing and evaluating the suitability of science research material • cognitive, technical and communication skills to apply and communicate technical solutions of a non-routine or contingency nature to a defined range of predictable and unpredictable problems such as presenting research findings • specialist technical skills to complete routine and non-routine tasks and functions such as applying mathematical skills in a range of scientific contexts and for different purposes • communication skills to guide activities and provide technical advice in the area of work and learning such as participating in collaborative learning **Application of knowledge and skills** Graduates of a Certificate IV will demonstrate the application of knowledge and skills:

	• to specialized tasks or functions in known or changing contexts such as presenting and applying workplace information • with responsibility for own functions and outputs, and may have limited responsibility for organisation of others such as applying computing skills to a range of tasks • with limited responsibility for the quantity and quality of the output of others in a team within limited parameters such as preparing a group presentation. **Volume of learning** The volume of learning for this qualification is typically between 0.5 to 2 years and incorporates structured training delivery and unstructured learning activities undertaken by the learner such as locating and reading scientific reports, researching a science topic, researching a topic using online library services and completing scientific calculations.
4.2 Employability skills	*Standard 4 for Accredited Courses* **Certificate III in Science** Communication • read and interpret scientific documents, including charts, laboratory reports • record data using scientific formats • make verbal presentations to a group • discuss and share information and ideas related to scientific knowledge and investigations • explain in writing and verbally procedures in a science laboratory • prepare technical documents related to scientific procedures • conduct research into areas of science • use scientific terminology • use numeracy effectively Teamwork • conduct experiments in a laboratory as part of a group • support others in group tasks • present scientific information as part of a group • assist others in responding in an emergency Problem solving • conduct tests using scientific theory • use mathematics to solve problems • develop hypotheses Initiative and enterprise • prepare specimens • conduct experiments and field work

	• discuss options with colleagues • amend own practices based on feedback • develop strategies for further study Planning and organisation • pathway planning • collect, analyse and organise information • develop research projects and complete reports • confirm the purpose and process of scientific experiments Self-management • complete tasks • compile a portfolio • evaluate and monitor own performance Learning • develop study and academic skills • access learning opportunities to extend own skills and knowledge • plan own skills development • identify own study pathway Technology • use a range of communications technology • use a range of scientific technology • operate scientific tools and equipment **Certificate IV in Science** Communication • read, analyse and interpret scientific documents, including charts, laboratory reports • record and interpret data using scientific formats • prepare and deliver verbal presentations • discuss and share information and ideas related to issues in science • explain in writing and verbally procedures in a science laboratory • prepare technical documents related to scientific procedures and experiments • conduct research into fields of science • use scientific terminology • apply mathematical skills and knowledge effectively Teamwork • conduct experiments in a laboratory as part of a group

	• support others in group tasks • present scientific information as part of a group • assist others in responding in an emergency Problem solving • conduct tests using scientific theory • apply mathematics to solve problems • develop hypotheses • show independence and initiative in identifying problems and solving them Initiative and enterprise • prepare specimens • lead experiments and field work • discuss options with colleagues • amend own practices based on feedback • develop strategies for further study Planning and organisation • collect, analyse and organise information • develop research projects and complete reports • confirm the purpose and process of scientific experiments Self-management • complete tasks • evaluate and monitor own performance Learning • develop study and academic skills • access learning opportunities to extend own skills and knowledge • plan own skills development • identify own study pathway Technology • use a range of communications technology • use a range of scientific technology • operate scientific tools and equipment
4.3 Recognition given to the course (if applicable)	*Standard 5 for Accredited Courses* Not applicable
4.4 Licensing/ regulatory requirements (if applicable)	*Standard 5 for Accredited Courses* No licensing, legislative, regulatory or certification requirements apply to any units in these courses at the time of publication.
5. Course rules	

5.1 Course structure

Standards 2, 6 and 7 for Accredited Courses

To be eligible for the award of 22219VIC Certificate III in Science, learners must successfully complete a total of 11 units / modules comprising:

- 6 core units
- 5 elective units

A minimum of three electives must be selected from those listed below. A maximum of two units may be selected from any other accredited course or endorsed training package:

- from units which are first packaged at AQF levels 3 or 4 in the source curriculum or training package;
- and which are consistent with the outcomes of the course.

A Statement of Attainment will be issued for any unit of competency/ module completed if the full qualification is not completed.

Unit of competency code	Field of Education code (6-digit)	Unit of competency title	Pre-requisite	Nominal hours
Core units				
VU21057	120105	Conduct and present simple scientific research	Nil	20
VU20928	120103	Design a learning plan	Nil	20
PSPOHS201B	N/A	Follow workplace safety procedures	Nil	20
VU21058	120183	Use a range of techniques to solve mathematical problems	Nil	110
VU21377	120103	Engage with a range of highly complex texts for learning purposes	Nil	25
VU21381	120103	Create a range of highly complex texts for learning purposes	Nil	25
Elective units (5)				
VU20929	010999	Concepts in biology	Nil	50
VU20930	010599	Concepts in chemistry	Nil	50
VU20931	010301	Concepts in physics	Nil	50
HLTAP301B	N/A	Recognise healthy body systems in a health care context	Nil	70
MSL973002A	N/A	Prepare working solutions	Nil	50
MSL973007A	N/A	Perform microscopic examination	Nil	40
MSL973001A	N/A	Perform basic tests	Nil	60
ICTICT101	N/A	Operate a personal computer	Nil	30
ICTICT103	N/A	Use, communicate and search securely on the internet	Nil	50
			Nominal duration	**440 – 460**

22220VIC Certificate IV in Science

To be eligible for the award of 22220VIC Certificate IV in Science, learners must successfully complete a total of 15 units / modules comprising:

- 5 core units
- 10 elective units.

A minimum of six electives must be selected from those listed below. A maximum of four electives may be selected from any other accredited course or endorsed training package:

- from units which are first packaged at AQF levels 4 or 5 in the source curriculum or training package;
- and which are consistent with the outcomes of the course.

A Statement of Attainment will be issued for any unit of competency/ module completed if the full qualification is not completed.

Unit of competency code	Field of Education code (6-digit)	Unit of competency title	Pre-requisite	Nominal hours
Core units				
MSL943002A	N/A	Participate in laboratory/field workplace safety	Nil	40
VU20932	120105	Apply essential further study skills for science	Nil	90
VU20933	120105	Research scientific fields of study	Nil	40
VU21058	120183	Use a range of techniques to solve mathematical problems	Nil	110
VU20934	010199	Apply mathematical techniques to scientific contexts	Nil	70
Elective units (10)				
Chemistry				
VU20935	010501	Atomic structure and bonding	Nil	50
VU20946	010501	Stoichiometry and solution chemistry	VU20935	45
VU20947	010501	Organic chemistry and properties of materials	VU20935	20
VU20948	010501	Chemical reactions	VU20935 VU20946 VU20947	45
Physics				
VU20949	010301	Waves and optics	Nil	40
VU20950	010301	Kinematics	Nil	40
VU20945	031301	Apply principles of electricity	Nil	40

VU21079	010301	Apply dynamics and conservation principles	VU20950	50
VU21080	031303	Operate simple analogue and digital electronic circuits	VU20945	40
Biology				
VU20945	010901	Cell biology	Nil	40
VU20952	010913	Anatomy and physiology	Nil	40
HLTAP301B	N/A	Recognise healthy body systems in a health care context	Nil	70
VU20953	010909	Introductory genetics	Nil	40
VU20954	010905	Ecology	Nil	30
MSL973004A	N/A	Perform aseptic techniques	Nil	40
Mathematics				
MEM30012A	N/A	Apply mathematical techniques in a manufacturing, engineering or related environment	Nil	40
MEM23007A	N/A	Apply calculus to engineering tasks	MEM30012A	80
VU21081	010101	Work mathematically with statistics and calculus	Nil	50
General Electives				
ICTICT102	N/A	Operate word-processing applications	Nil	30
ICTICT105	N/A	Operate spreadsheet applications	Nil	30
ICTICT210	N/A	Operate database applications	Nil	40
		Total nominal duration		**750 – 840**

5.2 Entry requirements	*Standard 9 for Accredited Courses* There are no entry requirements for either of the Certificates in Science. The following is a general guide to entry in relation to the language, literacy and numeracy skills of learners aligned to the Australian Core Skills Framework (ACSF), details of which can be accessed from www.deewr.gov.au/skills/Programs/LitandNum/ACSF Learners are best equipped to achieve the course outcomes in the Certificate III in Science if they have minimum language, literacy and numeracy skills that are equivalent to Level 2 of the ACSF. Indicators of ACSF Level 2 could include: • extracting key information from a simple text such as a written notification of a change to class times • writing a brief report on a previous education or training experience in legible script and using upper and lower case

	letters appropriately and consistent print or cursive script • using familiar course timetabling information to identify class locations and times and to estimate travel time Learners are best equipped to achieve the course outcomes in the Certificate IV in Science if they have minimum language, literacy and numeracy skills that are equivalent to Level 3 of the ACSF. Indicators of ACSF Level 3 could include: • identifying relevant information from a range of written texts such as a course handbook and intranet • taking coherent notes from an information session • using familiar course and public transport timetabling information to estimate travel time and cost of attending the course. Learners with language, literacy and numeracy skills at lower levels than those suggested will require additional support to successfully undertake the qualifications.
6. Assessment	
6.1 Assessment strategy	*Standard 10 for Accredited Courses* All assessment will be consistent with the AQTF Essential Conditions and Standards for Initial/Continuing Registration Standards 1.2/1.5. or Standard 1: Clauses 1.1 and 1.8 of the Standards for Registered Training Organisations (SRTOs) 2015 See http://www.nssc.natese.gov.au/vet_standards/standards_for_rtos Assessment methods should be flexible, valid, reliable and fair. Assessment of units requires evidence of satisfactory performance being sought for each element and its performance criteria and the required skills and knowledge through a variety of tasks depending on the criteria specified. The following principles should be used as a guide to the assessment approach: • assessment tasks/activities should be grounded in a relevant context and not be culturally biased • students should be assessed across a wide range of tasks integrated into practice, in order to increase reliability and validity of assessment. One-off assessment tasks do not provide a reliable and valid measure of competence • instructions for assessment tasks should be clear, explicit and ordered. Students must know what is expected and the criteria by which they will be judged • time allowed to complete a task should be reasonable and specified, and should allow for preparation and re-drafting as appropriate to the task • assessment should be validated. Moderation is likely to be a critical tool in validation. A range of validation strategies should

	be used, for example, mentoring, client satisfaction surveys, peer review and co-assessments • appropriate reference materials should be available to students during assessment, e.g. personal word lists, dictionaries, thesaurus, calculators. Assessment tools must meet the rules of evidence. To meet the rules, evidence must be: • valid, for example, address the elements and performance criteria, reflect the skills and knowledge described in the unit of competency, show application in the context described in the Range Statement • current, for example, demonstrate the candidate's current skills and knowledge • sufficient, for example, demonstrate competence over a period of time, demonstrate repeatable competence, not inflate the language, literacy and numeracy requirements beyond those required in performing the task and • authentic, for example: be the work of the learner, be corroborated / verified. A variety of assessment methods and evidence gathering techniques may be used with the overriding consideration being that the combined assessment must stress demonstrable performance by the student. Assessment tools must take into account the requirements of the unit in terms of skills, knowledge and performance. Assessment tools should also take into account the proposed destination of students. The Critical Aspects of Evidence section of each unit provides essential guidance on acceptable evidence. Assessment methods and tools may include: • oral or written questioning • verbal presentations • multi-media presentations • folios • solving problems • written reports • ongoing assessment by the teacher/s Evidence may include: • interview records/checklists • assessment records • reports • laboratory reports/field notes/observation logbooks • student folios of completed tasks The evidence collected must relate to a number of performances assessed at different points in time, and, in a learning and assessment pathway, these must be separated by further learning

	and practice. Evidence requirements are specified in units in each qualification. Where appropriate, training providers are encouraged to take a holistic approach to assessment, by assessing more than one element concurrently, or combining the final assessment for more than one unit. When assessing units of competency from Training Packages or accredited courses, the evidence gathering and assessment must be carried out in accordance with the relevant Training Package or accredited course guidelines. The assessment guidelines include the necessary qualifications for those conducting assessments and provide for situations where more than one person may contribute to the assessment and where the required technical and assessment competencies may not all be held by any one person. All participants can seek recognition for any competencies held and for any relevant qualifications or experience. Recognition decisions should be based on the principles of assessment and rules of evidence as defined in the AQTF Standards. On the completion of each assessment task, students will be provided with qualitative feedback as well as a 'competent/not competent' result for the unit being assessed. Arrangements should be made for retesting as required.
6.2 Assessor competencies	*Standard 12 for Accredited Courses* Assessor competencies for this course are consistent with the requirements of Element 1.4 of the AQTF Standards. Standard 1.4 requires trainers and assessors: • have the training and assessment competencies as determined by the National Skills Standards Council (NSSC) or its successors, and • have the relevant vocational competencies at least to the level being delivered or assessed, and • demonstrate current industry skills directly relevant to the training/assessment being undertaken and • continue to develop their VET knowledge and skills as well as their industry currency and trainer/assessor competence. • See AQTF User guides to the Essential Conditions and Standards for Initial/Continuing Registration. or Standard 1: Clauses 1.13, 1.14, 1.15, 1.16 and 1.17 of the Standards for Registered Training Organisations (SRTOs) 2015 In addition to the above it is recommended that assessors have comprehensive and current knowledge of tertiary education requirements. Assessors should also have appropriate interpersonal and communication skills. Alternatively, a panel, team or partnership approach involving assessors and technical experts whereby the assessment is conducted by a team/panel/partnership in which at least one assessor has the competencies determined by the NSSC (or its successor) and the other assessor(s) have the relevant

	competencies, at least to the level being assessed.
7. Delivery	
7.1 Delivery modes	*Standard 11 for Accredited Courses* All units of competency in the courses may be delivered in a variety of modes: classroom delivery, workplace projects, practical work, self-paced learning and case studies. It is recommended that units without science specific outcomes are contextualised to support the science based outcomes of the qualifications. Delivery options, including grouping of learners and learning activities, should recognise the varying learning needs, educational backgrounds, preferred learning styles and constraints of the individual learner and the specific requirements of each unit. Some areas of content may be common to more than one unit and therefore integration may be appropriate. Delivery strategies should actively involve the learner and learning should be experiential, relevant and age appropriate. This course is available for full or part-time study. Providers should be flexible in the way the training is delivered to ensure they meet the needs of the client group.
7.2 Resources	*Standard 12 for Accredited Courses* Physical and human resources necessary for delivery should be in accordance with AQTF Standards Physical resources for these courses should provide • fully equipped laboratory • an environment conducive to learning • computer facilities with Internet access where this is appropriate • appropriate computer software • access to a range of knowledge sources. Requirements to meet individual needs of learners should also be provided as required. These may include support services, such as language and literacy support. Any specialist resources required for delivery of individual units are listed in the specific Unit of Competency. Trainer competencies must be as specified in Element 1.4 of the AQTF Standards. The registered training organisation is responsible for ensuring that training is delivered by trainers who: • have the training and assessment competencies as determined by the National Skills Standards Council or its successors, and • have the relevant vocational competencies at least to the level being delivered or assessed, and • can demonstrate current industry skills directly relevant to the training/assessment being undertaken and • continue to develop their VET knowledge and skills as well as their industry currency and trainer/assessor competence. or Standard 1: Clauses 1.13.1.14,1.15,1.16 and 1.17 of the

	Standards for Registered Training Organisations (SRTOs) 2015 Where these competencies are not held, the trainer must be under direct supervision. Persons delivering this course should have teaching qualifications and/or postgraduate qualifications in a relevant field and/or experience in working with learners with further education needs.
8. Pathways and articulation	*Standard 8 for accredited courses* There is no formal articulation or credit transfer arrangement. Due to the bridging nature of the programs, there are a range of potential destinations for further study. Learners enrolling in other vocational qualifications will receive national recognition for any units of competency completed as part of these courses. Examples of qualifications that are potential destinations for graduates of the Certificate III in Science include: • MEM40105 Certificate IV in Engineering • MSL40109 Certificate IV in Laboratory Techniques • FDF0311 Certificate IV in Food Science and Technology • ACM40110 Certificate IV in Veterinary Nursing Examples of qualifications that are potential destination for graduates of the Certificate IV in Science: • MEM50211 Diploma of Engineering – Technical • HLT51612 Diploma of Nursing (Enrolled – Division 2) • Bachelor of Science • Bachelor of Applied Science • Bachelor of Electrical Engineering • Bachelor of Health Sciences Learners seeking articulation to or credit transfer in higher education courses will need to apply on an individual basis to institutions offering relevant courses. RTOs should be able to advise students of any relationships they have with Higher Education providers.
9. Ongoing monitoring and evaluation	*Standard 13 for accredited courses* Ongoing monitoring and evaluation of the Certificate III and IV in Science is the responsibility of the General Studies and Further Education Curriculum Maintenance Manager (CMM). The CMM will consult with key stakeholders during the accreditation period to seek and provide ongoing advice on the following: • delivery and/or assessment issues • addition or deletion of elective • addition of Training Package units. A formal review of the Certificate III in Science and Certificate IV in Science will take place midway during their period of accreditation. The review will be conducted by the CMM and will include

	practitioner feedback. All monitoring and consequent recommendations will be fully documented. Any recommended changes to the course structure, additional units or modifications to existing units will be forwarded to the Victorian Registration and Qualifications Authority for approval. Changes that would be reported to the VRQA include changes to: • the course structure, by adding or deleting units from the core or electives, whether to reflect local industry needs or to reflect changes to Training Packages and the availability of new or revised nationally endorsed units of competency • the nominal duration of the course and of units • articulation and/or credit transfer arrangements • legislation such as OHS/ licensing. Course maintenance and review procedures may indicate that the course in total should be expired if a suitable national qualification becomes available through the development or review of a Training Package.

Section C: Units of competency

Certificate III in Science - Course units of competency

VU21057 Conduct and present simple scientific research

VU20928 Design a learning plan

VU21058 Use a range of techniques to solve mathematical problems

VU21377 Engage with a range of highly complex texts for learning purposes

VU21381 Create a range of highly complex texts for learning purposes

VU20929 Concepts in biology

VU20930 Concepts in chemistry

VU20931 Concepts in physics

Certificate III in Science - Training Package units of competency

PSPOHS201B Follow workplace safety procedures

MSL973002A Prepare working solutions

HLTAP301B Recognise healthy body systems in a health care context

MSL973007A Perform microscopic examination

MSL973001A Perform basic tests

ICTICT101 Operate a personal computer

ICTICT103 Use, communicate and search securely on the internet

Certificate IV in Science - Course units of competency

VU20932 Apply essential further study skills for science

VU20933 Research scientific fields of study

VU20934 Apply mathematical techniques to scientific contexts

VU20935 Atomic structure and bonding

VU20946 Stoichiometry and solution chemistry

VU20947 Organic chemistry and properties of materials

VU20948 Chemical reactions

VU20949 Waves and optics

VU20950 Kinematics

VU20945 Apply principles of electricity

VU21079 Apply dynamics and conservation principles

VU21080 Operate simple analogue and digital electronic circuits

VU20951 Cell biology

VU20952 Anatomy and Physiology

VU20953 Introductory genetics

VU20954 Ecology

VU21081 Work mathematically with statistics and calculus

Certificate IV in Science - Training Package units of competency

MSL943002A Participate in laboratory/field workplace safety

MSL973004A Perform aseptic techniques

MEM30012A Apply mathematical techniques in a manufacturing, engineering or related environment

MEM23007A Apply calculus to engineering tasks

ICTICT102 Operate word processing packages

ICTICT105 Operate spreadsheet applications

ICTICT210 Operate database applications

Unit Code	**VU21057**
Unit Title	**Conduct and present simple scientific research**
Unit Descriptor	The purpose of this unit is to provide learners with the knowledge and skills to undertake, analyse, and report on simple scientific experiments and investigations.
Employability skills	This unit contains employability skills. Refer to the employability skills summary to identify employability skill requirements.
Application of the unit	The experiments/observations can be in a number of areas of Science (Chemistry, Physics or Biology) according to the intended destinations of the learners.

ELEMENT	**PERFORMANCE CRITERIA**
Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold/italicised test is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Conduct a simple scientific experiment	1.1 Identify a ***scientific concept/model/theory*** for investigation
	1.2 Identify a ***scientific method*** to investigate the scientific concept/model/theory
	1.3 Perform a ***simple experiment*** relating to the scientific concept/model/theory
	1.4 Record and analyse the results of the experiment
	1.5 ***Present*** the ***findings of the experiment*** using ***appropriate scientific terminology***
2 Conduct a simple investigation of a scientific issue	2.1 Identify an ***issue*** of scientific interest which has contributed to society, the environment or an individual
	2.2 Identify the ***area of science*** which underpins the issue
	2.3 ***Investigate*** the ***impact*** of the issue on society, the environment or an individual
	2.4 Record the results of the investigation using ***appropriate scientific terminology***
	2.5 Present the ***findings of the investigation*** using appropriate scientific terminology

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

- ability to use scientific keys to measure or observe and record results in simple experiments
- ability to present information in tabular and graphical form
- ability to use simple graphs or information in a table to interpret data
- ability to gather, select and organise information effectively
- communication skills to discuss and present research findings
- terminology to describe scientific issues and the impact of scientific issues

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Scientific concept/model/theory may include:	• internal combustion engine • electricity • solar system • classification of living things • astronomy • periodic classification of the elements • radioactivity
Scientific method may include:	• observation • classification • experimentation • construction of hypotheses • testing of hypotheses
Simple experiments may include:	• reading a scale and/or colour matching • reading linear scales e.g. burette or thermometer • reading dials on meters e.g. multi-range milliammeter • reading digital displays e.g. pH meter • colour matching e.g. universal indicator, nitrate tester • observing simple chemical reactions • observing biological samples using a microscope • classifying simple living things • classifying common substances using indicators or appropriate key.
Presentation may:	• be a written report following required format • incorporate graphs and tables • be an oral presentation

Findings of an experiment may:	• be a summary of issues of key issues/observations • address the impact on personal experience or the community and lessons learned • address social, cultural or ethical factors relating to the area of science underpinning the issue of scientific interest
Appropriate scientific terminology may include:	• language associated with scientific method such as evidence, observe, aim, hypothesis, results, conclusions, recommendations, ethics, field or activity report, laboratory report • terminology appropriate to the area of science being investigated • general terms such as cell, atomic, nuclear, solar, heredity, genetic, energy, ergonomic, experimental subjects, placebo
Issues may include:	• carbon dioxide, greenhouse effect and temperature rises • ergonomics in the workplace • use and abuse of medications • technology and artificial intelligence • bio-chemistry and immunisation • Minimal Intervention Models being introduced in modern medical treatment regimes • sound technology and MRI decreasing our dependence on X-rays • space stations and future travel • weapons research including biological and chemical weapons • drug testing on humans and sportspeople • transplant technologies • advancement in movie cameras or 3D virtual reality • genetic connection to an illness • cloning • stem cell research • genetic engineering • impact of diet on specific health issues.
Area of science may include:	• a branch of science such as: archaeology, astronomy, biochemistry, biology, biotechnology, chemistry, cosmology, meteorology, physics, virology • combinations of areas of science in an application such as: biological and psychological understanding of human endurance applied to occupational health and safety in working environments • principles of science such as: conservation, achievement of equilibrium/balance, transfer and transformation of energy, levers/inclined plane applied to simple machines/toys

	• applications of science:
	  − technology such as telecommunications, electricity, calculators, plastics, flight and aviation
	  − substance such as drugs (insulin, Ventolin, antibiotics, morphine) catalysts in industry
	  − processes such as desalination, water purification and waste management

Investigation:	• should not be too complex or time-consuming. The aim is to provide the learner with an opportunity to develop research, analytic and presentation skills within the context of scientific research • may be undertaken by a team
Impact include:	• cultural • economic • environmental • ethical • financial • health and well being • industrial • physical • political • psychological • religious • social • sport • technological
Findings of an investigation may include:	• summary of issues of key scientific importance • impact of the issue of scientific interest on personal experience or the community and lessons learned • impact of factors such as: ethical guidelines, which may shape or constrain the scientific development which underpins the issue of scientific interest • relevance of issue to daily lives • progression from the change in scientific knowledge to its application in practice, including possible elements which affect the implementation or application of the change • social, cultural or ethical factors relating to the area of science underpinning the issue of scientific interest

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	The learner must be able to: • perform a simple scientific (chemistry, physics or biology) experiment • record and analyse the results of the experiment • undertake a simple investigation of the impact of a scientific issue on society, the environment or an individual • record and analyse the results of the investigation • present findings using appropriate scientific terminology
Context of and specific resources for assessment	• Fully equipped laboratory
Method of assessment	• Oral or written questioning • Oral presentation • Practical demonstration • Research assignment • Written or verbal report

Unit Code	**VU20928**
Unit Title	**Design a learning plan**
Unit Descriptor	The focus of the unit is to enable learners to explore pathway options and develop a learning plan to achieve learning goals. Learners needs and expectations require a focus on individual learner objectives such as improved study skills and future education and career goals in science or science related fields
Employability skills	This unit contains employability skills. Refer to the employability skills summary to identify employability skill requirements.
Application of the unit	The skills and knowledge covered in this unit are applied when preparing for further study, specifically when studying in the science or science related disciplines

ELEMENT Elements describe the essential outcomes of a unit of competency.	**PERFORMANCE CRITERIA** Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold/italicised test is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Identify potential pathways in science	1.1 A ***broad range of options*** is considered
	1.2 ***Sources of information*** about options are identified
	1.3 Information about possible options is accessed and noted
	1.4 Options are evaluated in relation to own interests, skills and knowledge
2 Clarify learning goals	2.1 ***Learning goals*** are identified and prioritised in relation to identified options
	2.2 Current skills and knowledge are evaluated against goals
	2.3 Learning styles are explored
	2.4 Own personal learning context is discussed in relation to achieving identified goals
	2.5 Program options to support learner goals are discussed
3 Design an individual learning plan	3.1 The purpose and features of an individual learning plan are determined
	3.2 The individual learning plan is documented
	3.3 Individual learning plan is monitored and revised as necessary

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Skills

- communication skills to participate in planning process
- communication skills to participate in the assessment process
- ability to use support material effectively
- research skills to locate information relevant to own goals
- literacy skills to read and interpret a range of information
- ability to summarise ideas and information
- ability to comprehend complex relationships between ideas
- ability to understand the importance of documenting learning

Knowledge

- sources of information
- individual interests and skills
- learning goals
- individual learning style
- learning and study options

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Broad range of options may include	• further study in VET and / or higher education • employment, including seeking promotion and accessing training opportunities • industry qualifications • community participation • personal development options
Sources of information may include	• on-line data bases, e.g. for employment options • Training Support Network • career counsellors • training organisation materials and open days • education/ careers sections in newspaper • VTAC Guide
Learning goals may include	• improving reading, writing and numeracy skills for a variety of purposes • further study

- employment
- new skills and knowledge
- specific competencies
- target qualifications
- new career
- career advancement

Learning styles may include

- auditory
- visual
- kinaesthetic
- tactile
- left/right brain
- global/analytical
- theoretical
- activist
- pragmatist
- reflective

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	Learner has researched a range of pathway options, developed a learning plan in relation to identified goals, assembled a portfolio, and evaluated progress in relation to goals.
Context of and specific resources for assessment	Assessment of performance requirements in this unit is best undertaken over the course of the program access to real texts in context research facilities
Method of assessment	Appropriate assessment strategies include: direct observation, for example: real time activities questioning, for example: interviews self-assessment verbal questioning

Unit Code	**VU21058**
Unit Title	**Use a range of techniques to solve mathematical problems**
Unit Descriptor	The purpose of this unit is to provide learners with the knowledge and skills to use a range of specialist techniques and concepts to solve mathematical problems.
Employability skills	This unit contains employability skills. Refer to the employability skills summary to identify employability skill requirements.
Application of the unit	The unit may apply to a number of science streams.

ELEMENT	PERFORMANCE CRITERIA
Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold/italicised test is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Use ratio, proportion and percent to solve problems	1.1 Determine a ratio from information in a practical problem and express it in simplest form
	1.2 Divide a quantity into a given ratio
	1.3 Convert between fractions, decimals and percent forms
	1.4 Calculate a percentage increase or decrease of a quantity
2 Use trigonometry to determine lengths and angles	2.1 Use Pythagoras' Theorem to determine an unknown side of a right angled triangle
	2.2 Use Pythagoras' Theorem and trigonometric ratios to find unknown side lengths and angles in right-angled triangles
3 Use basic indices to solve problems	3.1 Evaluate simple index form expressions
	3.2 Simplify simple exponential expressions using the first two index laws
	3.3 Convert between decimal numbers and numbers expressed in Standard Notation
	3.4 Perform calculations with numbers expressed in Standard Notation, using a calculator
4 Use measurements to solve mensuration problems in two and three dimensions	4.1 Determine lengths and perimeters of rectangles, triangles, circles and simple combined shapes using appropriate and correct units
	4.2 Determine areas of rectangles, triangles, circles and simple combined shapes using appropriate and correct units

	4.3	Determine volumes of prisms and pyramids with rectangular, triangular and circular cross-sections and with simple combined shapes as cross sections using appropriate and correct units
5 Substitute into and transpose simple equations and formulae	5.1	Substitute given values into simple equations and formulae
	5.2	Write equations to solve simple problems
	5.3	Transpose simple ***formulae***
	5.4	Solve ***simple*** linear equations
6 Solve problems by plotting points	6.1	Plot given points and points determined from the general formula y = mx on the Cartesian plane
	6.2	Determine the gradient of a straight line
	6.3	Determine the equation of a ***straight line***, where the equation has the general form y = mx, y = a and x = b
	6.4	Use interpolation and extrapolation to make predictions from the line of best fit, noting limitations
7 Present and evaluate statistical information	7.1	Collect, organise and graphically represent ***statistical data***
	7.2	Interpret, analyse and describe ***statistical information***
8 Identify connections between formulae and graphical representations	8.1	Use ***graphical techniques*** to draw linear and ***simple non-linear graphs***
	8.2	Develop equations for given linear graphs, including ***lines of best fit***
9 Use algebraic techniques to analyse and solve problems	9.1	Develop formulae to describe relationships between variables and ***substitute into formulae*** to find particular values
	9.2	Use a ***range of techniques*** to solve a ***range of algebraic problems*** and perform algebraic manipulations

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Ability to:

- perform calculations involving fractions and mixed numbers
- perform calculations involving decimals and directed numbers
- round a decimal to a given number of decimal places
- use simple geometry to determine angles in triangles (including non-right angled)
- convert the unit of a quantity to a unit with a different prefix
- write a number correct to a given number of significant figures
- calculate systematic, random and percentage errors

- read off values in a table, chart or graph
- describe the general shape of a given or plotted scatter diagram
- identify general shapes and major characteristics of linear and simple non-linear graphs
- locate embedded information necessary to solve a problem or analyse quantitative information
- estimating skills to check calculations and reasonableness of outcomes
- use mathematical symbolism, charts, diagrams and graphs as appropriate to convey mathematical thinking and processing
- use specialised calculator functions relevant to mathematical needs.

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Formulae include:	• simple formulae with powers
Simple means:	• limited to one- and two-step operations
Straight line includes:	• line of best fit for empirical data
Statistical data may include:	• grouped data • using standard graphing conventions
Statistical information may include:	• using central tendencies such as mean, median, mode • percentiles • measures of spread
Graphical techniques should include:	• sketching from known main features of linear functions
Simple non-linear graphs may include:	• exponential, inverse and quadratic relationships
Lines of best fit may be:	• drawn by eye only for experimental data
Substitute into formulae should include:	• unfamiliar formulae including where the unknown is not necessarily the subject
Range of techniques should include:	• simplifying, expanding, and simple factorisation of polynomial expressions • simplification of expressions in index form including negative indices
Range of algebraic problems should include:	• linear (involving multiple operations) and simultaneous linear, and may include quadratic

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit

The learner must be able to:

- apply a wide range of strategies and techniques to solve mathematical problems including:
  - using ratio, proportion and percent
  - using trigonometry to determine lengths and angles
  - using basic indices
  - using measurements to solve mensuration problems in two and three dimensions
  - substituting into and transposing simple equations and formulae
  - solving problems by plotting points
  - presenting and evaluating statistical information
  - identifying connections between formulae and graphical representations
  - using algebraic techniques to analyse and solve problems
- demonstrate estimating skills to check calculations and reasonableness of outcomes
- use mathematical symbolism, charts, diagrams and graphs as appropriate to convey mathematical thinking and processing.

Context of and specific resources for assessment

Access to:

- calculators, computers for word processing or spreadsheets as appropriate. Calculations may be performed using pen and paper or on a calculator
- real/authentic or simulated tasks, materials and texts in context relevant to learners goals
- a computer and internet for information.

Method of assessment

- Oral or written questioning, online responses
- Pictures, diagrams, models created by the learner
- Practical demonstration
- Products or samples compiled by the learner with supporting documentation
- Records of teacher observations of learner's activities, discussions and practical tasks
- Self-assessment sheets, reflections, journal entries
- Written or verbal reports of investigations or problem-solving activities.

Unit Code	**VU21377**
Unit Title	**Engage with a range of highly complex texts for learning purposes**
Unit Descriptor	This unit develops the skills and knowledge to interpret and critically analyse highly complex texts. The focus is on interpreting and critically analysing a variety of highly complex paper based and digital texts for learning purposes. These include intricate, dense and extended texts across a broad range of contexts including specialised contexts. The required outcomes described in this unit relate directly to the Australian Core Skills Framework (ACSF), (© Commonwealth of Australia, 2012). They contribute to the achievement of ACSF indicators of competence at Level Five (Reading): 5.03, 5.04. At this level the learner is autonomous and accesses and evaluates support from a broad range of sources.
Employability Skills	This unit contains employability skills.
Application of the Unit	This unit applies to those seeking to improve their further education participation options and who need to develop a range of reading skills both in a paper based and digital context. These skills provide the foundation for future activities to extend reading skills to interpret and critically analyse highly complex texts for learning purposes and enable the learner to gain access to knowledge and skills which will assist them in future educational, employment and community activities. Where application is as part of the Certificate III in General Education for Adults, it is recommended that application is integrated with the delivery and assessment of Core Skills writing unit *VU21381 Create a range of highly complex texts for learning purposes*. The link between reading and writing across the different domains also encourages co-delivery and assessment of additional units, such as *VU21376 Engage with a range of highly complex texts for personal purposes* and *VU21380 Create a range of highly complex texts for personal purposes*.

Element	**Performance Criteria**
Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.	Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Select a range of	1.1 Clarify ***own purposes*** for engaging with texts

complex print based and digital texts for learning purposes	1.2	Locate and access a range of ***highly complex texts***
	1.3	Assess and select texts relevant to own learning purposes
2 Review selected print based and digital texts for learning purposes	2.1	Interpret the ***purpose*** of the texts
	2.2	Define **features of texts**
	2.3	Apply **reading strategies** to interpret key ideas and supporting information
	2.4	Identify and analyse main arguments and supporting evidence
	2.5	Evaluate texts for relevance and credibility
3 Critically interpret a range of print based and digital texts for learning purposes	3.1	***Analyse*** a range of texts for learning purposes
	3.2	Analyse ***devices*** used to present information
	3.3	Discuss ***similarities and / or differences*** between texts
	3.4	Discuss and support judgements about the ***effectiveness*** of the texts

Required Knowledge and Skills

This describes the essential skills and knowledge and their level required for this unit.

Required Knowledge:

- understands how language is used to make hypotheses and convey implicit meaning to influence others
- knowledge of broad vocabulary including idiom, colloquialisms, and cultural references, and specialised vocabulary as appropriate, to support comprehension
- knowledge of devices used by writers to convey meaning and achieve purpose
- understands that paper based and digital information may be represented differently
- register and its influence on expression and meaning

Required Skills:

- problem solving skills to:
- apply a repertoire of strategies to interpret and critically analyse structurally complex texts
- assess relevance of texts to own purposes and needs
- assess the validity of online information
- communication skills to review and discuss texts to establish relevance and effectiveness
- technology skills to access and navigate screen based digital text to locate and assess

information of some complexity

- planning and organising skills to gather, select and synthesise information effectively for own specific purposes by defining information requirements both before and during research

Range Statement

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold / italicised wording in the Performance Criteria is detailed below.

Own purposes may include*:*

- improving reading skills to meet current and future study demands
- accessing key information and supporting material
- comparing and evaluating information from a range of texts
- lifelong learning goals

Highly complex texts may include:

- highly complex texts with highly embedded information and specialised language
- digital, printed, handwritten and visual texts:
  - informative texts for example, text books, research material, reports, including technical information, newspaper and journal articles containing sources of knowledge and information
  - instructional materials such as learner resources to support participation in tertiary courses, classroom based learning materials
  - persuasive texts such as newspaper editorials and opinion pieces on complex subjects or issues
  - procedural manuals / learner guides
  - lecture notes about a specialist area
  - fiction texts

Purposes of texts may include:

- to present knowledge for example subject based such as scientific, environmental, historical, technical
- to develop specialised skills for example scientific methods, implementing a process or technique
- to provide options or advice for example about career pathways or further education pathways

Features of texts may include:

- dense texts with complex text structures, which use a variety of sentence structures and contain ambiguity and implicit meaning:
  - complex narrative and expressive texts with a sequence of events, different points of view and

perspectives, conflict development and resolution, different characters' point of view , multiple plot lines converging at the end, flash back or forwards, different time frames

- complex informative texts containing multiple cause and effect, compare and contrast, order of Importance, problem and solution with complex discourse markers, specialised vocabulary including technical vocabulary:
- complex procedural texts with sequential steps required to achieve goals and which may include precautions or warnings, options or alternatives, hints and advice and supporting explanations
- complex persuasive texts that use emotive and persuasive language ,may pose rhetorical questions, include facts and opinions, writer's bias may be explicit or implicit, includes supporting materials and evidence, may include opposing views on a subject and might follow a standard format such as statement of opinion, argument, summing up or recommendation

- sentences:
  - complex syntactic structures
  - highly embedded information
  - sophisticated stylistic devices such as nominalisation
- words / phrases/ abbreviations:
  - broad vocabulary including idiom, colloquialisms, cultural references as appropriate
  - vocabulary associated with personally relevant education activities and specialised areas
  - technical terms linked to learning goals / subject areas
  - abbreviations associated with further and higher education such as TAFE, VET, VCE, HE
- information and activities presented visually:
  - charts, tables, graphs of statistical data
  - demographic data
  - diagrams
  - flowcharts

Reading strategies may include:

- a broad range of meaning-making strategies to maintain understanding:
  - using a range of specialised vocabulary of relevance to further learning
  - recognising ways in which punctuation conveys a range of emotions or intentions
  - making comparisons of information contained in texts
  - interpreting linking devices accurately to make complex conceptual connections, and/or causal relationships
  - exploring how the writer's choice of language conveys mood and meaning

- reviewing the ways in which the writer's use of a range of language structures impacts on the reader
- analysing the effectiveness of the writer's choice of supporting materials

- de-coding strategies:
  - using a broad range of word identification strategies, including word derivations and meanings

Analysis may include identifying:

- misleading information
- underlying values
- subtle nuances
- quality of evidence to support judgements
- unclear meaning

Devices may include:

- nuanced language
- figures of speech
- emotive (connotative) word choice
- colloquial language
- slang
- rhythm and rhyme
- use of idioms to convey and shape meaning
- flashback/retrospective account of event or incident
- analogy (reference to…)

Similarities and / or differences may include:

- differing factual accounts of the same information by different writers
- differences in style or substance

Effectiveness may include:

- credibility
- relevance
- clarity
- currency

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence

Assessment must confirm the ability to:

required to demonstrate competency in this unit

- select, review, interpret and discuss highly complex texts for learning purposes, and critically evaluate them in a minimum of 3 different personally relevant text types at least one of which must be digitally based

In order to ensure learners achieve meaningful outcomes at the qualification level an integrated approach to assessment should be used, refer to Section B 6.1 Assessment Strategy.

Where this unit is being co-assessed with units related to another domain, such as personal, the same texts may be relevant to both domains.

Context of and specific resources for assessment

Assessment must ensure access to:

- the means to enable learners to locate and access real / authentic texts relevant to the learner's learning needs
- communication technology and software as appropriate

At this level the learner:

- operates autonomously in a broad range of contexts
- access and evaluates support from a broad range of sources

Method(s) of assessment

The following assessment methods are suitable for this unit:

- direct observation of the learner interpreting and critically analysing information in highly complex paper based and digital texts relevant to learning purposes
- oral or written questioning to assess knowledge of the devices used by writers to convey information in text types relevant to learning
- oral information from the learner analysing the effectiveness of the selected texts
- portfolios containing:
  - samples of responses and analysis of texts
  - journal / log book of reflections on texts

Unit Code	**VU21381**
Unit Title	**Create a range of highly complex texts for learning purposes**
Unit Descriptor	This unit describes the skills and knowledge to create a range of highly complex digital and paper based texts for learning purposes and to organise and apply content from texts. It will develop the written communication skills to complete a range of reflective and opinion texts as well as the skills to structure texts according to academic requirements. The required outcomes described in this unit relate directly to the *Australian Core Skills Framework (ACSF)*, (© Commonwealth of Australia, 2012). They contribute to the achievement of ACSF indicators of competence at Level Five (Writing): 5.05, 5.06. At this level the learner is autonomous and accesses and evaluates support from a broad range of sources.
Employability Skills	This unit contains employability skills.
Application of the Unit	This unit applies to those who wish to develop their literacy skills to a complex level to enable more effective participation in further study. Where application is as part of the Certificate III in General Education for Adults, it is recommended that application is integrated with the delivery and assessment of *VU21377 Engage with a range of highly complex texts for learning purposes*. The link between reading and writing across the different domains also encourages co-delivery and assessment of additional units, such as *VU21376 Engage with a range of highly complex texts for personal purposes* and *VU21380 Create a range of highly complex texts for personal purposes*.

Element	**Performance Criteria**
Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.	Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Research a range of text types for learning purposes	1.1 Select and research a range of paper based and digital ***highly complex text types***
	1.2 Determine the purpose and audience of the texts

	1.3	Analyse ***structure***, ***style*** and ***format*** requirements
2 Prepare a range of complex texts for learning purposes	2.1	Determine the purpose and audience for the texts to be created
	2.2	Gather, synthesise and arrange the content in an ***appropriate form***
	2.3	Apply structure, style and format appropriately
	2.4	Use ***content and language*** appropriate and relevant to the writing purpose
3 Produce a range of complex texts for learning purposes	3.1	Use prepared content to develop complex texts
	3.2	Proof read and edit texts prior to presentation
	3.3	Elicit and incorporate feedback on effectiveness of texts as appropriate
	3.4	Present completed texts according to ***specified requirements***

Required Knowledge and Skills

This describes the essential skills and knowledge and their level required for this unit.

Required Knowledge:

- conventions and importance of note taking in a learning context
- register and its influence on expression and meaning
- a broad and / or specialised vocabulary to accurately express content
- complex grammatical structures to accurately and effectively express content
- the main style conventions of academic writing such as referencing and footnotes

Required Skills:

- communication skills to communicate complex relationships between ideas and purposes
- planning and organising skills to:
  - gather organise and arrange content
  - revise writing to enhance meaning and effectiveness

Range Statement

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold / italicised wording in the Performance Criteria is detailed below.

Highly complex text types include:	• those highly embedded information and specialised language: – research / reflective / project reports

- essays
- journals

Structure may include:

- text structure:
  - clearly structured text displaying logical and transparent organisational structures, a range of conventions
  - variation between public and private writing
  - features of narrative and expressive texts such as chronological sequencing of events; logically sequenced and cohesive prose; identification followed by description; orientation, complication, resolution in narrative texts; use of descriptive language
  - features of informative texts such as transparent organisation using sequentially ordered dot points, numbered instructions, alphabetical, numerical listings, spacing, headings; structuring writing to move from introduction through several connected ideas / evidence / points of view to a summary / recommendation
  - features of procedural texts such as instructions: statement of the goal, requirements and steps to achieve the goal
  - navigation features such as grids, arrows, dot points, web links
  - features of transactional texts such as formal letter format: formal opening, statement of purposes, details, request, confirm, inform or clarify action, formal close
  - consistent use of highly complex sentence structure including stylistic devices such as nominalisation
  - effective use of linking devices to demonstrate complex conceptual connections and/or causal relationships appropriate to text type
- visual features:
  - complex diagrams such as flowcharts
  - charts, tables, graphs of statistical data
  - demographic data
  - photographs / illustrations

Style may include:

- appropriate register
- effective and appropriate use of words and expressions

Format may include:

- word processed / html / email
- letter format / report
- presentation
- use of footnotes, references

Appropriate form may include:	• handwritten and / or digital notes • diagrams / graphs
Content and language may include:	• incorporate a range of topics, beliefs, issues or experiences • use literary devices to convey character, setting and/or emotions • present a range of concepts and facts within a specialist field of knowledge including some abstract or technical concepts • vocabulary including idiom, colloquialisms, and cultural references as appropriate • specialist vocabulary in a variety of situations such as explanations, descriptions, debates • grammatical structures to achieve precise meaning • accurate spelling and use of standard punctuation

Specified requirements may include:	• electronic or handwritten format
	• number of copies
	• style conventions:
	  – numbered pages
	  – headers and footers
	  – referencing
	  – appendices
	• as part of a paper based or e-portfolio
	• according to set timelines, due dates

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessment must confirm the ability to: • identify the features of a range of highly complex text types relevant to a learning context • produce two learning related highly complex text types from own notes which demonstrate the ability to gather, arrange and synthesise information in both digital and paper based form In order to ensure learners achieve meaningful outcomes at the qualification level an integrated approach to

assessment should be used, refer to Section B 6.1 Assessment Strategy.

Where this unit is being co-assessed with units related to another domain, such as personal, the same texts may be relevant to both domains.

Context of and specific resources for assessment

Assessment must ensure access to:

- real / authentic highly complex texts relevant to a learning context
- online facilities, communications technology as appropriate

At this level the learner:

- operates autonomously in a broad range of contexts
- access and evaluates support from a broad range of sources

Method(s) of assessment

The following assessment methods are suitable for this unit:

- paper based or e-portfolio of highly complex text types created by the learner from their own notes showing evidence of editing
- oral or written questioning to assess knowledge of the features, purpose and audience for a range of highly complex, learning related texts

Code	**VU20929**
Title	**Concepts in biology**
Purpose	This unit covers the skills and knowledge required to investigate the major concepts in biology and their basic application.
Prerequisite	Nil
Corequisite	Nil
Summary of Learning Outcome	1. Explain the basic building blocks for life 2. Explain the classification of living things 3. Describe the interaction of living things

1 Explain the basic building blocks for life	1.1	The characteristics of living and non-living things are compared
	1.2	The structures within different ***types of cells*** are identified and their function described
	1.3	The differences between plant and animal cells are explained
	1.4	The process of ***cell reproduction*** is explained
	1.5	The ***sources*** of energy and the ***processes*** cells use to obtain and use energy are explained
2 Explain the classification of living things	2.1	The characteristics of organisms within ***kingdom*** classifications are compared
	2.2	The ***lower levels*** of classification are explained
	2.3	Keys are used to classify living things
3 Describe the interaction of living things	3.1	***Features*** of ***ecosystems*** are described
	3.2	The flow of energy through ***ecosystems*** is described
	3.3	The ***relationships*** between members of ecosystems are described
	3.4	The ***adaptations*** of living things to their surroundings is described

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Knowledge

- structure and function of cells
- sources and use of energy in cellular processes
- classification of living things
- functions of ecosystems

Skills

- using classification keys
- using scientific terminology
- summarising key information
- presenting information

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Cell types are	• eukaryotes • prokaryotes
Cell reproduction includes	• mitosis • cytokinesis • cell cycle
Sources of energy may include	• food • light
Processes include	• photosynthesis • cellular respiration
Kingdoms include	• eubacteria • archaeobacteria • protists • fungi • plants • animals
Lower levels include	• phylum • class • order • family • genus • species
Features include but are not limited to	• niche • community • population • biotic • abiotic

Ecosystems may include but are not limited to	• temperate forest • tropical forests • mountains • tundra • boreal forest • deserts • grasslands • polar
Relationships include but are not limited to	• competition • symbiosis • predation • paratism • commensalism
Adaptations may include	• physiological • behavioural • reproductive

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	The learner must be able to: • explain the structure and function of cells • explain sources and use of energy • explain the classification of living things • explain functions of ecosystems
Context of and specific resources for assessment	• Where possible, theoretical concepts should be supported by demonstrations and/or laboratory experiments to reinforce the links between theoretical knowledge and its practical applications • Research facilities eg. library, computer, internet access • Access to scientific texts • Access to scientific laboratory for practical activities
Method of assessment	• oral or written questioning • oral presentation • practical demonstration • project • written or verbal report

Code	**VU20930**
Title	**Concepts in chemistry**
Purpose	This module covers the skills and knowledge required to understand the major concepts in chemistry and their basic application.
Prerequisite	nil
Corequisite	nil
Summary of Learning Outcome	1. Explain atomic structure 2. Explain how atoms combine 3. Describe the periodic table 4. Explain chemical reactions 5. Explain the reactions between acids andbases 6. Explain solutions and solubility

1 Explain atomic structure	1.1	The particle theory view of matter is described
	1.2	***States of matter*** and their properties are explained with reference to particles
	1.3	The arrangement of ***subatomic particles*** in an atom and their electrical charge are described
	1.4	The mass and volume of atoms are explained in terms of their structure
	1.5	The structure of isotopes and ions of atoms are explained
2 Explain how atoms combine	2.1	The combination of atoms to make more stable ***formations*** are described
	2.2	Different types of chemical ***bonding*** are explained
	2.3	The concept of mole in chemistry is described
	2.4	The mass in grams of one mole of selected compounds is calculated
3 Describe the periodic table	3.1	The purpose of the periodic table is explained
	3.2	The organisation of the periodic table is explained
	3.3	The relationship amongst elements in a group is described
	3.4	The ***information*** contained in the table for each element is identified
	3.5	The general features of metals, metalloids and non-metals are described

4 Describe chemical reactions	4.1	The difference between chemical and physical changes are described
	4.2	The main classes of ***chemical reactions*** are described
	4.3	Balanced chemical equations are written for common reactions
5 Explain the reactions between acids and bases	5.1	The meaning of the terms acid and base are explained according to the Brønsted-Lowry theory
	5.2	The properties of acids and bases are explained
	5.3	The process of neutralisation is explained
	5.4	The pH of substances is explained.
6 Explain solutions and solubility	6.1	The characteristics of solutions, suspensions and other mixtures are explained
	6.2	Solubility curves are interpreted
	6.3	Solubility curves are constructed using experimental data
	6.4	The molarity of solutions is calculated

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge required for this unit.

Knowledge

- classification and properties of matter
- atomic structure
- periodic table
- chemical equations
- chemical reactions
- solutions and solubility
- acids andbases
- Brønsted-Lowry theory
- relationship between mole and mass
- basic chemical calculations

Skills

- calculating mass of various compounds
- calculating molarity
- writing balanced chemical equations
- using scientific terminology
- summarising key information

- presenting information

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

States of matter include	• gases • liquids • solids
Subatomic particles include	• protons • neutrons • electrons
Formations include	• molecules • ions • lattices
Bonding include	• covalent • ionic • metallic
Information includes	• name • symbol • atomic number • mass number
Chemical reactions include	• combination or synthesis • decomposition • simple displacement • double displacement • acid-base • combustion

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	The learner must be able to: • explain the classification and properties of matter • explain atomic structure • describe the features and characteristics of the periodic table • explain solutions and solubility,explain chemical reactions

including those involving acids

Context of and specific resources for assessment	• Where possible, theoretical concepts should be supported by demonstrations and/or laboratory experiments to reinforce the links between theoretical knowledge and its practical applications • Research facilities eg. library, computer, internet access • Access to scientific texts • Access to scientific laboratory for practical activities
Method of assessment	• oral or written questioning • oral presentation • practical demonstration • project • written or verbal report

Code	**VU20931**
Title	**Concepts in physics**
Purpose	This module covers the skills and knowledge required to investigate the major concepts in physics and their basic application.
Prerequisite	Nil
Corequisite	Nil
Summary of Learning Outcome	1. Describe and determine basic quantities in the measurement of straight line motion 2. Explain the basic concepts in Newton's laws of motion 3. Explain the basic concepts in magnetism 4. Explain the properties and behaviour of sound

1 Describe and determine basic quantities in the measurement of straight line motion	1.1	Key ***terminology*** relevant to the description of straight line motion are explained
	1.2	Measurements of displacement and time are made from observations of straight line motion
	1.3	Determinations of velocity and acceleration are made from straight line motion data
	1.4	Displacement and velocity graphs are plotted from straight line motion data
	1.5	Descriptions of motion are made from displacement and velocity graphs
2 Explain the basic concepts in Newton's laws of motion	2.1	Key terminology relevant to the laws of motion are explained
	2.2	The effect on the movement of a body in the absence of a net force is described
	2.3	The relationships between the net force, acceleration and mass are explained
	2.4	The relationship between gravity, mass and weight are explained
	2.5	Observable phenomena that illustrate the motion of an object consistent with Newton's first and second laws are explained
	2.6	Observable phenomena that illustrate reactive forces consistent with Newton's third law are explained
3 Explain the basic concepts in magnetism	3.1	Magnetic forces in relation to the north and south poles of a compass are defined
	3.2	The difference between a magnetised and non-magnetised piece

	of iron are explained
	3.3 The production of magnetic fields by an electric current are explained
	3.4 The construction of an electromagnet is described
	3.5 ***Factors*** that affect the strength of a magnetic force are explained
	3.6 The ***use*** of magnets in day to day life are identified
4. Explain the properties and behaviour of sound	4.1 The movement of sound through various ***mediums*** is explained.
	4.2 The representation of sound by the use of a wave is explained
	4.3 The meaning of intensity, its representation and measurement are explained
	4.4 The meaning of frequency, its representation and measurement are explained
	4.5 The meaning of velocity, its representation and measurement are explained
	4.6 The impact of the Doppler effect on frequency is explained

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Knowledge

- the actions of an object
- the relationship between acceleration, force and mass
- the attractive force between objects
- magnetism and magnetic force
- sound energy and its behaviour

Skills

- measuring displacement and time
- determining velocity and acceleration
- plotting graphs
- using scientific terminology
- summarising key information
- presenting information

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Terminology may include but is not limited to:	• energy • force • movement • gravity • mass • matter • velocity • acceleration • momentum • friction • inertia • direction
Factors may include but are not limited to:	• distance from magnet • distance from pole • temperature • knocks or vibrations • metal alloy used in construction of magnet
Uses may include but are not limited to:	• tools and utensils • toys and games • headphones and speakers • compasses • electricity
Mediums include	• gases • liquids • solids

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit

The learner must be able to:

- explain straight line motion
- explain the relationship between acceleration, force and mass
- explain the attractive force between objects
- explain magnetism and magnetic force
- explain the properties of sound.

Context of and specific resources for assessment	• Where possible, theoretical concepts should be supported by demonstrations and/or laboratory experiments to reinforce the links between theoretical knowledge and its practical applications • Research facilities eg. library, computer, internet access • Access to scientific texts • Access to scientific laboratory for practical activities
Method of assessment	• oral or written questioning • oral presentation • practical demonstration • project • written or verbal report • logbook of practical work/investigation/research activities

Unit Code	**VU20932**
Unit Title	**Apply essential further study skills for science**
Unit Descriptor	This unit covers the knowledge and skills required to study and participate effectively in a tertiary learning environment within a science or science related discipline.
Employability skills	This unit contains employability skills. Refer to the employability skills summary to identify employability skill requirements.
Application of the unit	The skills and knowledge covered in this unit are applied when studying at a university, specifically when studying science or science related disciplines. The unit focuses on assisting students to understand the nature of study in a tertiary education environment and the skills involved in learning in this environment.

ELEMENT	**PERFORMANCE CRITERIA**
Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold/italicised test is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Use a range of learning strategies	1.1 A range of popular views about learning are compared
	1.2 A range of ***learning strategies*** are defined
	1.3 The main ***learning contexts*** that may be experienced in a tertiary learning environment are considered
	1.4 Learning strategies are used for a range of learning contexts.
	1.5 Individual strengths, weaknesses and preferences in the use of different learning strategies in different contexts are considered.
2 Use a range of library and online sources to access information	2.1 The main ***services*** of a library are described
	2.2 The range of sources for obtaining information in a library are identified
	2.3 ***Appropriateness*** of information is assessed.
	2.4 Accurate records are made and stored appropriately
3 Use effective reading strategies for complex texts	3.1 A range of academic reading strategies are described and applied
	3.2 The significance of ***context*** for the meaning of a text is identified and discussed
	3.3 Techniques for note-taking, summarising and synthesising information are applied

	3.4	***Text structure***, technical vocabulary, wording and syntax are used to assist interpretation of meaning
	3.5	Dictionaries and other reference materials are used to assist interpretation of texts
4 Use academic writing skills to produce complex texts	4.1	Main features of different ***academic texts*** are identified
	4.2	Main phases of the academic ***writing process*** are identified
	4.3	The significance of audience and context are reflected in the conventions of academic writing
	4.4	Appropriate citation is used for references and quoted work
	4.5	Academic standards on plagiarism and collusion are observed
5 Participate effectively in collaborative learning	5.1	The key features of ***collaborative learning*** are identified
	5.2	Characteristics of effective collaborative learning are described
	5.3	Verbal, interpersonal and participatory skills necessary for effective learning collaboration are used.
	5.4	Appropriate planning processes are negotiated with fellow students to achieve agreed outcomes

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required Skills

- verbal communication such as skills in argument, participation and debate
- writing skills appropriate for the completion of complex texts including correct use of citations
- collaborative learning skills
- reading skills such as skimming, scanning, reading for meaning
- note-taking skills including summarising, synthesising and record keeping
- information access using library resources including internet and online searches
- assessing appropriateness of information for specific purposes
- ability to work in groups
- negotiation skills

Required Knowledge

- range of learning strategies
- library services
- online services
- reading strategies
- writing processes

- text structures
- usage and syntax
- conventions of academic referencing
- plagiarism and collusion

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Learning strategies may include but are not limited to :

- self-monitoring
- note-taking
- revision
- partnerships with other students
- questioning
- tracking
- research

Learning contexts may include but are not limited to:

- laboratory work
- practical activities
- lectures
- on-line learning
- tutorials
- seminars
- field work
- group work
- independent projects
- examinations

Services of a library may include but are not limited to :

- loans - long and short-term, interlibrary and counter reserve
- on-line access - catalogue, internet, email, chat facilities
- on-line resources - databases, ebooks, journals
- catalogue assistance
- binding, laminating and copying
- reader services
- reference collections
- reserve collections
- study areas

Appropriateness of information may include but is not limited to :	• relevance to topic • level of detail • nature of media • currency • authenticity • complexity or difficulty of material
Context includes but is not limited to :	• implied readers of the text • historical period of text • other texts cited or debated
Text structure includes but is not limited to:	• chapter headings • paragraph headings and sub-headings • diagrams and illustrations • tables and charts • bibliographies and references
Academic texts include but are not limited to :	• journal articles • reports • theses • monographs • archival documents • encyclopaedias • indexes
The ***writing process*** includes but is not limited to :	• planning • researching • drafting • revising • editing • proof reading
Collaborative learning may include but is not limited to :	• study groups • learning partnerships • group presentations • tutorials • workshops

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit

- ability to source information from print based sources, online sources and expert personnel
- ability to write complex documents
- ability to identify key aspects of information and summarise them effectively
- ability to work effectively in a collaborative learning environment

Context of and specific resources for assessment

Assessment of performance requirements in this unit may be undertaken in a classroom or other structure learning environment, informal study settings or workplace. Resources required include but are not limited to :

- library
- course directories
- field of study guides
- internet access and printing facilities
- computers and word processing software

Method of assessment

There can be multiple assessment tasks. These can include but are not restricted to:

- a portfolio of evidence that may include draft planning materials, research notes, written pieces, reference lists, graphs, maps and diagrams
- oral or written questioning
- verbal or written reports
- observation of presentation

Unit Code	**VU20933**
Unit Title	**Research scientific fields of study**
Unit Descriptor	This unit develops the knowledge and skills required to research a scientific field of study in a tertiary learning environment
Employability skills	This unit contains employability skills. Refer to the employability skills summary to identify employability skill requirements.
Application of the unit	The skills and knowledge covered in this unit are applied when preparing for study at a university, specifically when studying in the science or science related disciplines.

ELEMENT	**PERFORMANCE CRITERIA**
Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold/italicised test is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Research a field of study	1.1 The ***fields of study*** and areas of ***specialisation*** are described
	1.2 The core subject matter and areas of specialisation are examined
	1.3 ***Forms of enquiry*** and research methods used are described
2 Use on-line technologies for researching a field of study	2.1 Information is sourced using academic databases and search engines
	2.2 Information is cross-checked using alternative sources and accepted authorities
	2.3 Online texts are examined for reliability and quality of evidence and argument with hard copy sources
	2.4 Online resources are examined for consistency with academic discourse.
3 Use online technology to examine a journal article	3.1 Journal article abstracts are accessed using academic databases
	3.2 Peer reviewed journal articles are accessed
	3.3 The peer review process is described
	3.4 Research methods and the subject matter of the specialisation are examined
4 Deliver effective presentations	4.1 Audience and purpose of a presentation are clearly identified
	4.2 Presentations are clearly structured and organised to fit time available

4.3 Images are appropriate to purpose, clear and sequenced logically

4.4 Delivery register is appropriate to audience and communication is clear, audible and to the point

4.5 Presentations allow time for questioning and elaboration

4.6 Supporting material is available if required

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required Skills

- oral skills sufficient for presentations
- summarising and paraphrasing academic texts
- reading skills sufficient for assimilation of information
- accessing information using online technologies
- assessing reliability and quality of evidence

Required Knowledge

- fields of study available at Australian universities
- online technologies and their applications
- peer review of journals
- research practices
- presentation techniques and protocols

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Fields of study may include but is not limited to :

- biological sciences
- physical sciences
- chemical sciences
- earth sciences

Specialisations may include but are not limited to :

- aeronautics
- anatomy
- astronomy
- bacteriology
- biochemistry
- biology
- biotechnology
- botany

- chemistry
- ecology
- engineering
- environmental science
- food technology
- forestry
- genetics
- geology
- geography
- health
- information technology
- laboratory technology
- mechanics
- meteorology
- microbiology
- nursing
- nutrition
- pathology
- physics
- physiology
- renewable energy
- zoology

Forms of enquiry include but are not limited to :

- laboratory research
- text based research
- action research
- quantitative research
- qualitative research
- case-studies
- workplace/community investigation
- archaeological investigation
- longitudinal surveys
- poll sampling

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	• ability to obtain accurate information from a variety of sources • ability to use online technologies, specifically search engines and online authoring tools • ability to make an effective presentation
Context of and specific resources for assessment	Assessment of performance requirements in this unit may be undertaken in a classroom or other structure learning environment, informal study settings or workplace. Resources required include but are not limited to : • library • course directories • field of study guides • internet access and printing facilities • computers and word processing software
Method of assessment	There can be multiple assessment tasks. These can include but are not restricted to: • observation • evaluation of third party reports • portfolio of research information • written or oral questioning to establish required knowledge

Unit Code	**VU20934**
Unit Title	**Apply mathematical techniques to scientific contexts**
Unit Descriptor	The purpose of this unit is to provide learners with knowledge and skills related to basic statistics, functions and their graphs, circular functions, exponents and logarithms.
Employability skills	This unit contains employability skills. Refer to the employability skills summary to identify employability skill requirements.
Application of the unit	The unit covers mathematical skills and knowledge which apply to a number of science further study pathways, and work roles.

ELEMENT Elements describe the essential outcomes of a unit of competency.	PERFORMANCE CRITERIA Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold/italicised test is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Use unit circle definitions of trigonometric quantities, graphs of the three basic trigonometric functions and radian measure to solve mathematics problems	1.1 Sin θ, cos θ and tan θ are defined in terms of the unit circle and symmetry properties are used to convert the function of a negative angle or an angle greater than 90° to the function of an acute angle
	1.2 Angles are converted between degrees and radian measure
	1.3 The value of the three basic trigonometric ratios of any angle given in degrees or radians is determined
	1.4 The graphs of y = sin x, y = cos x and y = tan x, where x is measured in degrees or radians are sketched
	1.5 The graphs of y = a sin bx and y = a cos bx, giving amplitude and wavelength are sketched
	1.6 Problems involving simple applications of circular functions are solved
2 Use simple algebraic functions and their graphs to solve mathematics problems	2.1 Simple problems involving direct and inverse proportion are solved
	2.2 Given a graph, its general shape, rates of change, intercepts and asymptotes are described and its domain and range are given using set notation
	2.3 The graph of a quadratic function is ***sketched***
	2.4 Given its graph, the set of co-ordinates which make up the relation or its ***equation*** determine whether a relation is a function
	2.5 Quadratic equations are solved both algebraically and graphically

	2.6	Equations are determined from graphs with known quadratic rules
	2.7	***Simultaneous equations*** are solved algebraically and graphically
3 Determine non-linear laws by transforming them into a linear form	3.1	A set of non-linear data is transformed to a linear form and the line of best fit is drawn
	3.2	The corresponding non-linear formula is determined
4 Solve problems involving exponential and logarithmic functions	4.1	Exponential expressions are simplified using the laws of indices
	4.2	Exponential equations are solved without using logarithms
	4.3	Expressions are converted between exponential and logarithmic forms
	4.4	Logarithms are ***evaluated***
	4.5	Applied problems are solved using logarithms and simple exponential equations
	4.6	Graphs of exponential functions are drawn
5 Collect and process numerical data to illustrate its statistical properties	5.1	Statistical data is presented using tables and ***graphs***
	5.2	Using frequency distribution curves, determine numbers and/or percentage values which have a particular characteristic
	5.3	Using cumulative frequency curves, determine percentiles for data
	5.4	Measures of ***central tendency*** are determined for a given set of data giving limitation of their use in isolation
	5.5	Determine measures of ***spread*** giving limitation of their use in isolation
	5.6	Properties of statistical data are determined

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

- Angle Measurement and Basic Trigonometric Graphs - unit circle (3 basic trigonometric functions), negative angles, radian measure, sketch graphs of y = sin x, cos x and tan x, y = a sin bx and y = a cos bx (including amplitude and wavelength).
- Functions and their Graphs - direct and inverse proportion, sketch graphs of quadratic functions and graphs of the form:
- y = mx + c, y = , y = , y = ax, quadratics and cubics, with relation to general shapes, asymptotes, intercepts, rates of change etc., concept and definition of a function, solution of quadratic equations graphically, equations from graphs with known quadratic rules, simultaneous equations (quadratic plus linear) solution algebraically and graphically, line of best fit for non-linear empirical data to determine formula (e.g. plot x2 against y).
- Exponents and Basic Logarithms - index laws, solution of simple exponential equations, conversion between exponential and logarithmic form, evaluation of natural and base 10 logarithms, evaluation of logarithms with other bases, applications (e.g. decibels and pH), graphs of exponential functions.
- Descriptive Statistics - samples and populations, sampling and methods of data collection (random, systematic, stratified and quota), sources of bias, reliability, data presentation (e.g. pictogram, pie chart, bar graph, histogram, ogive), percentages on a frequency distribution; mean, median and mode; range, variance and standard deviation; statistics functions (including graphical representation) on a calculator/computer.
- ability to use appropriate keys on a scientific calculator

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Sketch means–	• using main features not by plotting points
Equation should be:	• of the general form y = mx + c, y = a, x = b and y = ax2 + bx + c
Simultaneous equations are:	• quadratic plus linear
Evaluate may include	• with and without a calculator
Graphs should include	• histograms • cumulative frequency ogives • box and whiskers plots
Central tendency includes	• mean, median and mode
Spread	• range, variance and standard deviation

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit

The learner must be able to:

- apply a range of strategies and techniques to solve mathematical problems including:
  - using unit circle definitions of trigonometric quantities, graphs of the three basic trigonometric functions and radian measure to solve mathematics problems
  - using simple algebraic functions and their graphs to solve mathematics problems
  - determining non-linear laws by transforming them into a linear form
  - solving problems involving exponential and logarithmic functions
  - collecting and processing numerical data to illustrate its statistical properties
- demonstrate estimating skills to check calculations and reasonableness of outcomes
- use mathematical symbolism, charts, diagrams and graphs as appropriate to convey mathematical thinking and processing
- use a scientific calculator

Context of and specific resources for assessment

- scientific calculator
- real/authentic or simulated tasks, materials and texts

Method of assessment

- Oral or written questioning, online responses
- Pictures, diagrams, models created by the learner
- Practical demonstration
- Products or samples compiled by the learner with supporting documentation
- Records of teacher observations of learner's activities, discussions and practical tasks
- Self-assessment sheets, reflections, journal entries
- Written or verbal reports of investigations or problem-solving activities

Code	**VU20935**
Title	**Atomic structure and bonding**
Purpose	The purpose of this module is to provide learners with basic knowledge of atomic structure, bonding and the periodic table.
Prerequisites	Nil
Corequisites	Nil
Summary of Learning Outcomes	1. Apply the particle theory of matter 2. Use the Bohr-Rutherford model of the atom to explain the structure of an atom 3. Use knowledge of periodicity and bonding to explain the chemical and physical properties of common elements and compounds 4. Derive systematic names and formulae for simple inorganic compounds

1 Apply the particle theory of matter	1.1	***Appropriate terminology*** is used to discuss classification and properties of matter
	1.2	The states of matter and their ***common properties*** are accounted for using the particle theory of matter
	1.3	Distinctions are made between physical and chemical changes
	1.4	The relation between properties of materials and their uses is described
	1.5	Pure substances are classified into ***elements*** and compounds on the basis of their properties and the particle theory of matter
2 Use the Bohr-Rutherford model of the atom to explain the structure of an atom	2.1	The ***principal sub-atomic particles*** are identified together with their mass, relative mass and charge
	2.2	The way shell/energy level structure of an atom relates to its electron configuration in the ground state is explained
	2.3	The ***structure*** of the modern periodic table is explained
	2.4	The relationship between the electronic configuration of an atom and its position in the periodic table is explained
	2.5	***Atomic property trends*** in the periodic table are explained
3 Use knowledge of periodicity and bonding to explain the chemical and physical properties of common elements and compounds	3.1	Stable electron configurations are identified with reference to atoms of the noble gases and used to predict likely gain or loss of electrons for main group metallic and non-metallic atoms
	3.2	Ionic, covalent and metallic bonding using common examples are explained and the likely nature of bonding in elements and binary compounds are predicted

	3.3 The concept of electronegativity is used to identify polar covalent bond
	3.4 Electron dot diagrams are used to represent the transfer of electrons in ionic bonding
	3.5 Electron dot and dash diagrams are used to represent the bonding in and structure of simple molecules
	3.6 The nature of bonding in an element or compound is used to predict or account for some of their ***physical properties***
4 Derive systematic names and formulae for simple inorganic compounds	4.1 The correct chemical formulae for binary compounds is determined using basic valency concept
	4.2 Binary, ionic and molecular compounds are identified
	4.3 The ***correct chemical formulae and names for acids, bases and salts*** are determined

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required Skills

- working safely and efficiently with common chemicals
- applying particle theory
- classifying elements and compounds
- drawing and interpreting electronic dot/dash diagrams
- writing chemical formulae

Required Knowledge

- appropriate terminology to discuss classification and properties of matter
- knowledge of the historical development of the structure of the atom
- the Bohr-Rutherford model of the atom
- periodicity and bonding
- systematic names and formulae for simple inorganic compounds

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Appropriate terminology may include:	• matter, states of matter (solid, liquid, gas or vapour) • changes of state (melting or liquefaction, vapourisation, condensation, solidification, sublimation) • element, compound, mixture • particle, atom, molecule

Common properties may include:	• conservation of mass • conservation of shape versus flow • conservation of volume versus expansion • compressibility
Elements include:	• metals, non-metals and noble gases
Principal sub-atomic particles are:	• electron, proton, neutron
Explanation of the structure should:	• concentrate on the first 20 elements • include drawing and interpreting diagrams which represent Bohr-Rutherford models of atoms and atomic ions
Atomic property trends may include:	• atomic size • electronegativity
Physical properties may include:	• electrical conductivity of solid or liquid • hardness, brittleness, malleability • qualitative estimates of melting /boiling points)
Chemical formulae and names for acids, bases and salts should be for:	• those compounds most commonly found in the laboratory and in the home

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	The learner must be able to: • use appropriate terminology to discuss classification and properties of matter • use the Bohr-Rutherford model of the atom to explain the structure of an atom • use knowledge of periodicity and bonding to explain the chemical and physical properties of common elements and compounds • derive systematic names and formulae for simple inorganic compounds.
Context of and specific resources for assessment	• Periodic table • Drawing materials • Fully equipped chemistry laboratory

Method of assessment

- Oral or written questioning
- Oral presentation
- Practical demonstration
- Research assignment
- Written or verbal report

Code	**VU20946**
Title	**Stoichiometry and solution chemistry**
Purpose	The purpose of this module is to provide learners with basic knowledge of stoichiometry and solution chemistry.
Prerequisite	VU20935 Atomic structure and bonding
Corequisite	Nil
Summary of Learning Outcomes	1. Use the mole definition and formulae to solve problems 2. Derive balanced chemical equations for simple reactions and apply stoichiometry to these equations 3 Explain solution formation and solubility 4 Solve concentration problems

1 Use the mole definition and formulae to solve problems	1.1	The relative atomic mass of an element is defined and calculated using mass spectrometric data
	1.2	The relative molecular and formula mass of molecular and ionic compounds are calculated
	1.3	The term mole is defined
	1.4	The definition of mole definition is used to solve ***problems***
	1.5	Experimental data is used to calculate the empirical formulae of compounds
	1.6	Empirical formulae and relative molecular masses are used to determine molecular formulae.
2 Derive balanced chemical equations for simple reactions and apply stoichiometry to these equations	2.1	Balanced chemical equations to represent chemical reactions are written
	2.2	The differences between types of ***chemical reactions*** are distinguished
	2.3	Stoichiometric equations are used to calculate mass-mass relationships between reactants and products.
3 Explain solution formation and solubility	3.1	Various types of mixtures are identified
	3.2	***Terminology*** relevant to solution formation is used
	3.3	Factors which affect solubility are explained
	3.4	Factors which affect the rate at which a solute dissolves are explained

	3.5	The ***types of solution*** are explained
	3.6	Solubility curves are constructed from experimental data and interpreted.
4 Solve concentration problems	4.1	***Dilution calculations*** are performed
	4.2	The ***molarity*** of solutions is calculated
	4.3	***Concentration*** is calculated in other units.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required Knowledge

- the mole definition
- solution and solubility
- chemical reactions

Required Skills

- using formulae to solve problems
- writing balanced chemical equations
- constructing solubility curves
- using experimental data to make calculations
- using chemical terminology

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Problems may include:	• mass of substance • number of particles and relative atomic mass or molecular mass
Chemical reactions may include:	• acid neutralization and combustion reactions • association, dissociation and precipitation reactions • combination and decomposition reactions
Terminology may include:	• solubility, solute, solvent, solution and dissolution
Types of solution include:	• unsaturated, saturated and supersaturated
Dilutions are calculated:	• using c?1/v
Calculate the ***molarity*** by:	• using the formula $c = \frac{n}{V}$

Calculating ***concentration*** includes:	• percentages, weight/volume, by volume (v/v) and parts per million (ppm)

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	The learner must be able to: • use the mole definition and formulae to solve problems • derive balanced chemical equations for simple chemical reactions and apply stoichiometry to them • explain solution formation and solubility • solve concentration problems
Context of and specific resources for assessment	• calculator • fully equipped chemistry laboratory
Method of assessment	• oral or written questioning • oral presentation • practical demonstration • research assignment • written or verbal report • problem solving

Code	**VU20947**
Title	**Organic chemistry and properties of materials**
Purpose	The purpose of this module is to provide learners with basic knowledge of organic chemistry.
Prerequisites	VU20935 Atomic structure and bonding
Corequisites	Nil
Summary of Learning Outcomes	1. Use simple hydrocarbons to explain structure and isomerism of organic molecules 2. Name and draw structures of simple organic molecules using IUPAC rules 3. Explain the relationship between structure and properties of organic compounds 4. Write balanced chemical equations to represent simple organic reactions

1 Use simple hydrocarbons to explain structure and isomerism of organic molecules	1.1	The structural formulae of ***simple hydrocarbons*** up to C6 are drawn
	1.2	The concept of isomerism is explained
	1.3	Common functional groups in organic molecules are identified
2 Name and draw structures of simple organic molecules using IUPAC rules	2.1	IUPAC conventions are used to name ***simple organic compounds*** on the basis of their molecular structures
	2.2	The structures of simple organic molecules are drawn based on their IUPAC names
3 Explain the relationship between structure and properties of organic compounds	3.1	The ***intermolecular bonding*** present in simple organic compounds are identified
	3.2	The structures of organic compounds are related to their ***physical properties***
4 Write balanced chemical equations to represent simple organic reactions	4.1	Balanced equations for organic reactions are written where the reactants and products are specified
	4.2	Balanced equations for the complete and/or partial combustion of hydrocarbons are written in the context of their use as fuels and their being a fire hazard
	4.3	Balanced equations are written to demonstrate the acidic nature of carboxylic acids and the alkaline nature of organic amines.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required Knowledge:

- hydrocarbons
- isomerism
- functional groups
- IUPAC naming
- physical properties of organic compounds
- simple chemical reactions of organic compounds.

Required Skills:

- writing chemical equations in the correct format
- drawing molecules using the appropriate techniques
- using correct terminology

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Simple hydrocarbons include:	• alkanes, alkenes, alkynes, benzene
Simple organic compounds may include:	• alkanes, alkenes, alkynes • aromatics as represented by benzene, alcohols, halogenated hydrocarbons, carboxylic acids and esters
Intermolecular bonds may include:	• dispersion bonds • hydrogen bonds
Physical properties may include:	• melting and boiling points • volatility • solubility in water • solubility in non-polar solvents

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit

The learner must be able to:

- demonstrate knowledge of the structure and isomerism of organic molecules
- name and draw simple organic molecules using IUPAC rules
- explain the relationship between structure and properties of organic compounds
- write balanced chemical equations to represent simple organic reactions

Context of and specific resources for assessment	• drawing materials • fully equipped chemistry laboratory
Method of assessment	• verbal or written questioning • verbal presentation • practical demonstration • research assignment • written or verbal report

Code	**VU20948**
Title	**Chemical reactions**
Purpose	The purpose of this module is to provide learners with basic knowledge of chemical reactions so that they can explain acid-base and redox theory.
Prerequisites	VU20935 Atomic structure and bonding VU20946 Stoichiometry and solution chemistry VU20947 Organic chemistry and properties of materials
Corequisites	Nil
Summary of Learning Outcomes	1 Use ionic equations to represent reactions involving ions in solution 2 Use current theories to explain acid-base behaviour 3 Explain the pH scale 4 Use titration results to complete concentration problems 5 Write ionic equations to represent redox reactions 6 Explain the operation and uses of galvanic and electrolytic cells 7 Explain the corrosion of steel and its prevention in terms of redox theory

1 Use ionic equations to represent reactions involving ions in solution	1.1	The term '***electrolyte'*** is defined
	1.2	Ionic liquids are distinguished from aqueous solutions containing ions
	1.3	Ionisation reactions are distinguished from dissociation reactions
	1.4	Electrolytes are classified into strong or weak depending on the degree of their ionisation or dissociation
	1.5	***Ionic equations*** are written
2 Use current theories to explain acid-base behaviour	2.1	The general properties of acids and bases are listed
	2.2	Common substances as acids or bases are classified using the ***Arrhenius*** and ***Lowry-Bronstead*** theories
	2.3	***Terminology*** relevant to explaining acid-base behaviour is used accurately
	2.4	The differences between strong and weak acids and bases are explained
	2.5	Stoichiometric and ionic equations for neutralisation reactions are written

	2.6	Ionic equations for the ionisation reactions of common polyprotic acids are written
3 Explain the pH scale	3.1	The ionic product of water and the pH formula are used to solve simple pH calculations
	3.2	The pH scale is used to classify aqueous solutions as acidic, alkaline or neutral
	3.3	The reason why aqueous solutions of some neutralisation salts are not pH neutral is explained
4 Use titration results to complete concentration problems	4.1	***Terminology and equipment*** for titration techniques are used correctly
	4.2	The concentration of an acid or base is calculated from titration results
	4.3	A pH titration curve (of a strong acid and base) is drawn and interpreted from experimental data
5 Write ionic equations to represent redox reactions	5.1	***Terminology*** relevant to redox reactions is used accurately
	5.2	The activity series of metals is used to predict reactions between metals and water
	5.3	Ionic equations (half and total) are written for ***simple redox reactions***
6 Explain the operation and uses of galvanic and electrolytic cells	6.1	The parts of an electrochemical (galvanic) cell are identified
	6.2	***Predictions*** as to the behaviour of electrochemical cells are made
	6.3	The parts of an electrolytic cell are identified and the differences between an electrochemical and electrolytic cell are explained
	6.4	Ionic equations (half and total) are written for simple electrolytic processes.
7 Explain the corrosion of steel and its prevention in terms of redox theory	7.1	The conditions needed for corrosion are listed
	7.2	Redox theory and ionic equations are used to explain the corrosion of steel and its prevention

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required Knowledge

- ionic equations
- acid-base theories
- strengths of acids and bases

- titration calculations
- pH scale
- redox reactions

Required Skills:

- discussing chemical concepts and processes using scientific terminology
- using chemical equipment and resources safely
- writing and solving equations
- calculating pH
- calculating acid/base concentration
- classifying aqueous solutions

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Electrolyte may be:	• liquid e.g. ionic liquids, aqueous solutions containing ions • solid e.g. ceramic fuel cell
Ionic equations may be for:	• ionisation and dissociation • precipitation (association) reactions
Arrhenius theory:	• production of H3O+(aq) or OH(aq) in water
Lowry-Bronstead theory:	• proton transfer
Terminology relevant to explaining acid-base behaviour may include:	• hydrolysis • amphoteric (amphiprotic) substance • conjugate acid and base
Terminology and equipment used in the titration technique may include:	• pipette, burette, volumetric flasks, aliquot, titre, end point, indicator , standard solution
Terminology relevant to redox reactions may include:	• oxidation, reduction, redox, reductant (reducer) and oxidant (oxidiser)
Simple redox reactions may include:	• metal displacement reactions • oxidation, reduction, redox, reductant (reducer) and oxidant (oxidiser)
Predictions may include:	• determining the anode and cathode • direction of electron and ionic flows • reactions occurring at each electrode

- total cell reaction
- polarity of the electrodes
- maximum voltage (emf) the cell may produce

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit

The learner must be able to:

- use ionic equations to represent reactions involving ions in solution
- use current theories to explain acid-base behaviour
- explain the pH scale
- use titration results to complete concentration problems
- write ionic equations to represent redox reactions
- explain the operation and uses of galvanic and electrolytic cells
- explain the corrosion of steel and its prevention in terms of redox theory

Context of and specific resources for assessment

- drawing materials
- fully equipped chemical laboratory

Method of assessment

- verbal or written questioning
- verbal presentation
- practical demonstration
- research assignment
- written or verbal report

Code	**VU20949**
Title	**Waves and optics**
Purpose	To provide the learner with knowledge of wave theory and the laws of optics.
Prerequisites	Nil
Corequisites	Nil
Summary of Learning Outcomes	1. Distinguish between transverse and longitudinal wave types 2. Explain the applications of the major bands of the electromagnetic spectrum 3. Determine the path of a light ray 4. Describe the formation of images by mirrors and lenses

1 Distinguish between transverse and longitudinal wave types	1.1	Wave theory ***terminology*** is used appropriately
	1.2	The difference between a transverse wave and a longitudinal wave is explained
	1.3	The motion of individual particles in a transverse and longitudinal wave is described
	1.4	The determination of when two particles in a wave are in phase is explained
2 Explain the applications of the major bands of the electromagnetic spectrum	2.1	The properties of the major components of the electromagnetic spectrum in relation to the aspects of source, frequency, wavelength, energy and detection are contrasted
	2.2	An example of an application for each section of the electromagnetic spectrum is provided
	2.3	Factors affecting the intensity of a source of electromagnetic radiation are described
	2.4	The wavelength or frequency of an electromagnetic wave is calculated
	2.5	The features of laser radiation are described
3 Determine the path of a light ray	3.1	The ***behaviour of light*** when it undergoes reflection and refraction is described
	3.2	The path of a light ray is determined quantitatively
4 Describe the formation of images by mirrors and lenses	4.1	Ray tracing techniques are used to describe images formed by ***mirrors*** and lenses
	4.2	The three principal rays for concave mirrors and concave lenses are identified

4.3 The optics of ***simple optical instruments*** are explained

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required Knowledge:

- definition of a wave
- behaviour of light
- relationship between velocity, frequency and wavelength
- amplitude, period and phase
- light intensity
- electromagnetic spectrum
- lasers
- reflection and refraction
- Snell's law of refraction
- critical angle and total internal reflection
- optical fibres

required Skills:

- using a scientific calculator
- using scientific equipment in a physics laboratory such as magnifying glasses, telescopes, microscopes, cameras, slide projectors
- using ray tracing techniques
- calculating paths of light rays

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Appropriate terminology may include:	• frequency, wavelength, period, amplitude and velocity of a wave • the wave equation (velocity = frequency x wavelength) to find any one quantity given the other two
Describing of the ***behaviour of light*** may include:	• distinguishing between specular and diffuse reflection • demonstrating experimentally Snell's law of refraction. • calculating angles and refractive indices using Snell's law or refraction. • explaining the dispersion of light into component colours
Mirrors may be:	• concave • plane

Simple optical instruments may include:	• magnifying glasses, telescope, microscope, cameras, slide projectors

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	The learner must be able to: • explain the differences between transverse and longitudinal wave types, including the motion of individual particles, and how to identify when two particles in a wave are in phase • explain the applications of the major bands of the electromagnetic spectrum • determine the path of a light ray • describe the formation of images by mirrors and lenses.
Context of and specific resources for assessment	• scientific calculator • physics laboratory equipped with a wave generator, slinky springs, ripple tanks, microwave generator, laser and accessories, Hodson's light box kits and optical bench, blackout facilities
Method of assessment	• verbal or written questioning • verbal presentation • practical demonstration • research assignment • written or verbal report

Code	**VU20950**
Title	**Kinematics**
Purpose	The purpose of this module is to provide the learner with the knowledge and skills to describe the motion of an object.
Prerequisites	Nil
Corequisites	Nil
Summary of Learning Outcomes	1. Use kinematic terms to explain linear motion 2. Explain the linear motion of an object 3. Draw and interpret kinematic graphs 4. Define vector and scalar quantities 5. Calculate the displacement and velocity of an object in two dimensions

1 Use kinematic terms to explain linear motion	1.1	The position, displacement and distance travelled by an object moving with linear motion are distinguished
	1.2	The velocity and speed of an object is calculated given the displacement, distance and time
	1.3	The acceleration of an object is calculated given the initial velocity, final velocity and the time
	1.4	***Data*** is presented
2 Explain the linear motion of an object	2.1	The motion of an object is described using appropriate ***terminology***
	2.2	***Problems*** related to moving objects are solved
	2.3	Data is presented
3 Draw and interpret kinematic graphs	3.1	Position-time and velocity-time graphs are drawn from experimental data
	3.2	Displacement and acceleration are calculated from a velocity-time graph
	3.3	Position-time, velocity-time and acceleration-time graphs are drawn for objects moving with constant velocity and constant acceleration
	3.4	The motion of an object is described using appropriate kinematic terms and given the velocity-time graph
	3.5	Data is presented
4 Define vector and scalar quantities	4.1	The difference between vector and scalar quantities is explained
	4.2	Vector quantities are demonstrated graphically

	4.3 A vector is resolved into two right-angled components
	4.4 Data is presented
5 Calculate the displacement and velocity of an object in two dimensions	5.1 The vector sum or subtraction of two displacement or velocity vectors that have directions parallel or perpendicular to each other are calculated
	5.2 ***Vector addition problems*** are solved
	5.3 Data is presented

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required Knowledge:

- position, displacement and distance
- velocity, speed and acceleration for linear motion
- constant velocity and constant acceleration situations
- position, velocity and acceleration versus time graphs
- vector and scalar quantities
- vector components
- addition and subtraction of vectors
- relative velocities

Required Skills:

- producing and interpreting data in graph form
- using kinematic terminology
- using a scientific calculator
- operating equipment in a physics laboratory
- presenting scientific data
- calculating velocity, speed and acceleration

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Data may be presented by using:	• appropriate S.I. units and converting where necessary • appropriate number of significant figures
Terminology should include terms such as:	• position, displacement, distance, velocity, speed, acceleration, time, constant, decreasing and increasing

Problems may include:	• those involving velocity, speed, displacement, distance and time for an object moving with constant velocity • those involving displacement, velocity, acceleration and time for an object moving with constant acceleration
Vector addition problems may include:	• those for two or more displacement or velocity vectors using the scale diagram and component methods • those involving relative velocities

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	The learner must be able to: • use kinematic terms to explain linear motion • explain the linear motion of an object • draw and interpret kinematic graphs • define vector and scalar quantities • calculate the displacement and velocity of an object in two dimensions
Context of and specific resources for assessment	• drawing materials • scientific calculator • physics laboratory equipped with ticker timers, linear air tracks and computer interfacing equipment with light gates and/or sonic ranger
Method of assessment	• verbal or written questioning • verbal presentation • practical demonstration • research assignment • written or verbal report

Unit Code	**VU20945**
Unit Title	**Apply principles of electricity**
Unit Descriptor	This unit covers the knowledge and skills to analyse and explain the operation of simple electrical circuits, motors, generators and domestic electricity supply.
Employability skills	This unit contains employability skills. Refer to the employability skills summary to identify employability skill requirements.
Application of the unit	This unit addresses the application of concepts of electromagnetism to explain the operation of simple devices such as generators, motors, measuring instruments and transformers. It includes knowledge of the main features of the domestic supply and of household circuits and safety components. The skills covered can be applied in a range of environments.

ELEMENT Elements describe the essential outcomes of a unit of competency.	**PERFORMANCE CRITERIA** Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold/italicised test is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Apply the concepts of charge and electric current	1.1 ***Calculate*** the electrical force between point charges
	1.2 Solve problems involving charge, current and time
	1.3 Use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures
2 Analyse and assemble an electric circuit comprising resistive elements	2.1 Discriminate between the conducting properties of metallic conductors, intrinsic semi-conductors and insulators
	2.2 Solve problems involving potential difference, work and charge
	2.3 Solve problems to find resistance, potential difference, current and power for circuits with resistors connected in series and parallel combinations
	2.4 OH&S requirements for assembling and measuring circuits are identified and followed
	2.5 Assemble a simple electrical extra low voltage circuit given a circuit diagram
	2.6 ***Measure*** voltage and resistance for components of an extra low voltage circuit
	2.7 Use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures
3 Apply the concepts of	3.1 Demonstrate a ***range of magnetic fields***

electromagnetism	3.2 Demonstrate the ways that a changing magnetic field can produce an electric current
	3.3 Explain the operation of ***simple devices***
	3.4 Solve problems involving voltage, current and power at both input and output of a transformer
	3.5 Use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures
4 Explain the main features of domestic supply and household circuits and safety components	4.1 Discuss the main components and stages of the transmission of electric power to the household
	4.2 Discuss the main components of household electric circuits
	4.3 Select the correct wire colours and pin and socket positions for the use of appliances
	4.4 Explain the operation of fuses, circuit breakers and safety switches in a household circuit
	4.5 Use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required Knowledge:

- elementary unit of charge
- Coulomb's law
- electrical current
- conventional current flow
- S.I. units
- difference between potential difference and electromotive force
- Ohm's law
- definition of electrical power
- difference between AC and DC
- how and why electric power is transmitted at high voltages

Required Skills:

- recording and presenting results accurately and clearly
- using a scientific calculator
- using equipment safely in a physics laboratory
- evaluating the quality of experimental data, both during the experiment and following simple error analysis

- analysing experimental data, drawing valid conclusions and critically evaluating experimental technique
- listing and classifying the possible sources of errors encountered when making a measurement
- computing the magnitude of an error in a single measurement when using an instrument with a graduated scale or digital display
- calculate the relative error in a measurement given the magnitude of a measurement and the error

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Calculate:	• using Coulomb's law
Measure:	• using a multimeter
Range of magnetic fields may be produced by:	• a magnet • current carrying wire • solenoid
Simple devices may include:	• generators • motors • measuring instruments • transformers

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	The learner must be able to: • calculate the electrical force between point charges • solve problems involving charge, current and time • use appropriate S.I. units and convert where necessary • present data with the appropriate number of significant figures • assemble a simple electrical circuit • demonstrate the ways that a changing magnetic field can produce an electric current • explain the main features of domestic supply and household circuits and safety components
Context of and specific resources for assessment	• Scientific calculator • Physics laboratory equipped with extra low voltage electrical power supplies, multimeters, various electrical components for circuit connection and electromagnetic practical kits

Method of assessment

- verbal or written questioning
- verbal presentation
- practical demonstration
- research assignment
- written or verbal report

Unit Code	**VU21079**
Unit Title	**Apply dynamics and conservation principles**
Unit Descriptor	This unit covers the knowledge and skills to apply dynamics and conservation principles to an object and/or system.
Employability skills	This unit contains employability skills. Refer to the employability skills summary to identify employability skill requirements.
Pre-requisite Unit	VU20950 Kinematics
Application of the unit	This unit addresses the application of dynamics and conservation principles including Newton's laws of motion, the work-energy principle, the conservation of energy principle, the impulse-momentum equation, conservation of momentum principle and the principle of moments.

ELEMENT	**PERFORMANCE CRITERIA**
Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold/italicised test is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Apply Newton's laws of motion	1.1 Demonstrate one proportionality from Newton's second law of motion
	1.2 Calculate using vectors the net force on an object when forces such as weight, friction and applied forces are acting
	1.3 Apply Newton's second law to determine the mass, force or acceleration of an object
	1.4 Use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures
2 Apply the work-energy principle	2.1 Calculate the kinetic energy of an object given the mass and the velocity
	2.2 Apply the work-energy equation to determine the work or change in kinetic energy of an object
	2.3 Use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures
3 Apply the ***conservation of energy principles***	3.1 Calculate gravitational potential energy given mass and height
	3.2 Demonstrate that the gain (or loss) in potential energy equals the loss (or gain) in kinetic energy when friction is negligible
	3.3 Calculate the transfer of energy to heat when friction cannot be neglected
	3.4 Apply the law of conservation of energy to determine relevant quantities

	3.5	Use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures
4 Apply the ***impulse-momentum*** equation	4.1	Calculate the impulse on an object when a force is applied for a certain time
	4.2	Calculate the momentum of an object given the mass and the velocity
	4.3	Apply the impulse-momentum equation to determine relevant quantities in one-dimensional situations
	4.4	Use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures
5 Apply the conservation of momentum principle	5.1	Apply the law of conservation of momentum to determine the mass or velocity of an object in a one-dimensional collision
	5.2	Use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures
6 Apply the principle of moments	6.1	Use ***levers*** to demonstrate the principle of moments
	6.2	Use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures
7 Investigate energy resources	7.1	List various forms of energy resources and discuss how efficient these are for commercial electricity supply
	7.2	Identify and discuss various methods of energy conservation
	7.3	Use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required Knowledge:

- Newton's three laws of motion
- ability to distinguish between the weight and mass of an object
- definition of work and energy
- definition of potential energy
- definition of impulse and momentum
- law of conservation of momentum
- definition of the moment of force
- definition of the principles of moments

Required Skills:

- ability to analyse experimental data, drawing valid conclusions and critically evaluating

experimental technique

- ability to list and classify the possible sources of errors encountered when making a measurement
- ability to compute the magnitude of an error in a single measurement when using an instrument with a graduated scale or digital display.
- ability to calculate the relative error in a measurement given the magnitude of a measurement and the error
- ability to use a scientific calculator

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Energy conservation principles may include	• everyday physical observations • human body movements • vehicle observations
Applications of the impulse-momentum may include	• everyday physical observations • human body movements • vehicle observations • sporting movements and actions
Levers may include	• human body movements • engineering equipment • construction equipment

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit

The learner must be able to:

- demonstrate one proportionality from Newton's second law of motion
- calculate using vectors the net force on an object when forces such as weight, friction and applied forces are acting
- apply Newton's second law to determine the mass, force or acceleration of an object
- calculate the kinetic energy of an object given the mass and the velocity
- apply the work-energy equation to determine the work or change in kinetic energy of an object
- calculate gravitational potential energy given mass and height
- demonstrate that the gain (or loss) in potential energy equals the loss (or gain) in kinetic energy when friction is negligible

- calculate the transfer of energy to heat when friction cannot be neglected
- apply the law of conservation of energy to determine relevant quantities
- calculate the impulse on an object when a force is applied for a certain time
- calculate the momentum of an object given the mass and the velocity
- apply the impulse-momentum equation to determine relevant quantities in one-dimensional situations
- apply the law of conservation of momentum to determine the mass or velocity of an object in a one-dimensional collision
- use levers to demonstrate the principle of moments
- use appropriate S.I. units and convert where necessary, presenting data with the appropriate number of significant figures
- identify and discuss various methods of energy conservation

Context of and specific resources for assessment

- Scientific calculator
- Physics laboratory equipped with ticker timers, linear air tracks and computer interfacing equipment with light gates and /or sonic ranger

Method of assessment

- Review of data records prepared by the candidate, such as counts, observations, results
- verbal or written questioning
- verbal presentation
- Practical demonstration
- Research assignment
- Written or verbal report

Unit Code	**VU21080**
Unit Title	**Operate simple analogue and digital electronic circuits**
Unit Descriptor	This unit provides students with knowledge and skills to assemble, analyse and explain the operation of simple analogue and digital electronic circuits.
Employability skills	This unit contains employability skills. Refer to the employability skills summary to identify employability skill requirements.
Pre-requisite Unit	VU20945 Apply principles of electricity
Application of the unit	This unit addresses the application of operating analogue and digital electronic circuits using an appropriate variety of instruments and electronic components

ELEMENT Elements describe the essential outcomes of a unit of competency.	**PERFORMANCE CRITERIA** Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold/italicised test is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Analyse an electrical signal	1.1 Use a cathode ray oscilloscope to measure peak to peak voltage, peak voltage and period of a signal
	1.2 Calculate the frequency of a signal
	1.3 Calculate the RMS voltage for a sinusoidal signal
2 Analyse the operation of a DC CR series circuit	2.1 Calculate the capacitance of a capacitor
	2.2 Calculate the potential difference and charge stored on a capacitor
	2.3 Calculate the time constant for a CR circuit and predict the extent of charging of the capacitor
	2.4 Distinguish between the operation of a CR circuit with AC and DC
3 Analyse the operation of diodes and transistors in electronic circuits	3.1 Distinguish between a diode in forward bias and reverse bias
	3.2 Determine the current and potential difference across components in a circuit containing a diode or LED
	3.3 Calculate current and voltage in parts of a common emitter circuit
	3.4 Calculate the current gain for a common emitter circuit
	3.5 Distinguish between amplifying and switching modes of a transistor circuit
4 Analyse the operation of a DC	4.1 Describe the operation of diodes in the half wave rectifier and the

power supply		full wave bridge rectifier
	4.2	Illustrate graphically the voltage signal at each stage of a DC power supply
	4.3	Discuss the effect of different size capacitors on the ripple component of a voltage
5 Analyse the logic levels in circuits made up of logic gates	5.1	Express the ***logic output of the logic gates***
	5.2	Identify the correct circuit symbols for logic gates
	5.3	Determine the logic levels at points in circuits made up of logic gates
	5.4	Determine graphically the output of a simple logic gate circuit given timing diagrams for the inputs
	5.5	Assemble logic gate circuits using ***integrated circuit packages*** and demonstrate the output
6 Analyse the operation of an adder	6.1	Identify the inputs and outputs of a half adder and a full adder
	6.2	Determine logic outputs of a half and a full adder
	6.3	Determine the logic levels at various points on a logic gate representation of a full adder
	6.4	Determine the logic levels at various points on a four-bit adder
7 Analyse the operation of the SC, JK and D flip flops as components of latches, counters and shift registers	7.1	Determine the outputs of the SC (set-clear) flip flop for a given sequence of inputs
	7.2	Differentiate between positive edge triggered and negative edge triggered flip flops
	7.3	Determine the outputs of a JK flip flop for a given sequence of inputs
	7.4	Determine the outputs of a D flip flop for a given sequence of inputs
	7.5	Determine the counting sequence of a counter made up of a particular configuration of JK or D flip flops
	7.6	Determine the logic outputs of a shift register made up of D flip flops for a given sequence of inputs and clock pulses
8 Assemble and analyse the operation of a simple electronic circuit	8.1	Assemble a ***simple electronic circuit*** and demonstrate the operation of the circuit
	8.2	Measure current, voltage, power and signal characteristics at various points of the circuit

8.3 Report the results of the analysis of the circuit

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Knowledge of:

- main components of the cathode ray oscilloscope
- operation of the main components of the cathode ray oscilloscope
- components of a bipolar junction transistor
- components of a DC power supply
- definition of the terms: rectification, filtering, voltage regulation
- how the SC flip flop can be used as a latch

Ability to

- assemble electrical components correctly in electrical circuits
- use a scientific calculator
- use equipment safely in a physics laboratory
- use computer software packages for simulations

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Logic output of the logic gates may be:	• AND, NAND, OR, NOR, NOT and XOR for all possible inputs
Integrated circuit packages may be:	• a package such as the TTL 7400 series
Simple electronic circuit may:	• comprise a number of discrete electronic components and/or integrated circuits

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit

The learner must be able to demonstrate the appropriate use of a cathode ray oscilloscope to analyse an electrical signal

The learner must be able to assemble, use and analyse the operation of:

- a DC CR series circuit
- diodes and transistors in electronic circuits
- a DC power supply
- an adder
- the SC, JK and D flip flops as components of latches,

counters and shift registers

- a simple electronic circuit

The learner must be able to assemble, use and analyse the logic levels in circuits made up of logic gates.

Context of and specific resources for assessment

- Scientific calculator
- Formula sheets
- Physics laboratory equipped with electrical power supplies, cathode ray oscilloscopes, signal generators, multimeters, soldering irons, PCB stands, solder suckers, and various electronic components for circuit connection
- Computers with software package which enables electronic circuit simulations e.g. Crocodile Clips

Method of assessment

- Verbal or written questioning
- Verbal presentation
- Practical demonstration
- Research assignment
- Written or verbal report

Code	**VU20951**
Title	**Cell biology**
Purpose	The purpose of this module is to provide participants with the knowledge and skills to identify cell organelles and structures, state their functions and outline various cellular life-supporting processes.
Prerequisite	Nil
Corequisite	Nil
Summary of Learning Outcomes	1. Outline cell theory 2. Describe the structure and function of typical eukaryotic cells 3. Describe cellular processes 4. Describe cellular reproduction 5. Prepare and stain tissue specimens for microscopic examination

1 Outline cell theory	1.1	Identify that ***living things*** are made of cells
	1.2	Distinguish between living and non-living things
	1.3	Describe the three tenets of cell theory
2 Describe the structure and function of typical eukaryotic cells	2.1	Distinguish between prokaryotes and eukaryotes
	2.2	Identify typical ***cell components*** in ***eukaryotic cells***
	2.3	Describe the function of typical cell components
	2.4	Identify the main features of cell components of plants and animals
	2.5	Describe the structures and functions of cell membranes
3 Describe cellular processes	3.1	Outline the main aspects of ***cellular processes***
	3.2	Describe diffusion, osmosis and active transport across cell membranes
	3.3	Describe the metabolic pathways of cellular respiration and photosynthesis
	3.4	Describe movement across cell membranes
4 Describe cellular reproduction	4.1	Outline aspects of the cell cycle and apoptosis
	4.2	Describe the ***stages*** of mitosis and meiosis
	4.3	Discuss the biological significance of mitosis and meiosis

5 Prepare and stain tissue specimens for microscopic examination	5.1 Specimen slides of biological materials are prepared following agreed procedures.
	5.2 Specimen slides are checked for clarity and accuracy against requirements
	5.3 Specimen slides of major tissue types are identified
	5.4 Personal protective equipment is used and established safety procedures are observed
	5.5 ***Microscopes*** are operated and maintained to obtain focussed images and to optimise performance

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Knowledge of:

- name, structure and function of cellular characteristics common to both plants and animals
- a range of the biological terms used to describe cell theory, cellular processes and reproduction
- terms used to classify in biology
- cellular processes
- function of major microscope components

Ability to

- locate and communicate information
- use a microscope
- produce slide specimens

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Living things may include:	• discussion of organisation, movement, feeding, respiration, excretion, reproduction, growth and sensitivity
Cell components may include	• cytoplasm • nucleus • cell membrane • ribosomes • vacuoles • endoplasmic reticula • lysosomes • protein microtubules

- basic structure of the macromolecules of cell structures

Eukaryotic cells may include
- plant and animal

Cellular processes may include:
- the metabolic pathways of respiration and photosynthesis
- difference between diffusion and osmosis
- active transport
- endocytosis
- exocytosis

Stages may include:
- sequence specific stages of mitosis including interphase, prophase, metaphase, anaphase and telophase - (IPMAT)

Microscopes include:
- monocular
- stereo

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit
- evidence must demonstrate that the participant has knowledge of Cell Theory, is able to use appropriate scientific terminology to describe and explain eurkaryotic cells, cellular processes and the various stages of cellular reproduction
- evidence must demonstrate that the participant is able to prepare clear slide specimens and use a microscope to view slides
- evidence requirements include the presentation of information verbally and in writing

Context of and specific resources for assessment
- Participants should have access to scientific texts, audio visual resources and access to the internet.
- Where possible, theoretical concepts should be supported by demonstrations and/or laboratory experiments to reinforce the links between theoretical knowledge and its practical applications.

Method of assessment

Assessment should include methods such as:
- direct observation of practical work and/or demonstrations
- review of logbook of practical work/investigation/research activities
- analysis of laboratory reports
- review and analysis of written reports
- verbal or written questioning
- direct observation of verbal presentations/PowerPoint presentations

Code	**VU20952**
Title	**Anatomy and physiology**
Purpose	The purpose of this module is to provide the skills and knowledge required to understand the anatomy and physiology of living organisms. Although the focus of the module is on mammals, it is not a requirement that this includes humans.
Prerequisites	Nil
Corequisites	Nil
Summary of Learning Outcomes	1. Explain the key components and functions of major mammalian anatomical and physiological systems 2. Perform a simple dissection

1 Explain the key components and functions of major mammalian anatomical and physiological systems	1.1	Anatomical components are located within an organism with reference to anatomical ***planes*** and body ***cavities***.
	1.2	The contribution of major ***organ systems*** to the working of the organism is explained
	1.3	The basic mechanical, physical and biochemical functions of organ systems are explained
	1.4	Common illnesses or injuries of the major organ systems are identified
	1.5	***Anatomic terminology*** is used accurately
2 Perform a simple dissection	2.1	Major anatomical organs and organ systems are located and identified.
	2.2	Dissection specimens and ***equipment*** are prepared and established dissection procedures are followed
	2.3	Occupational health and safety requirements and safe work requirements including the use of personal protective equipment are followed
	2.4	Scientific terminology is used accurately
	2.5	Clean up procedures are completed to ensure a safe and hygienic work environment

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Skills

- Using scientific terminology
- Locating anatomical features
- Preparing dissection specimens and equipment
- Using dissection instruments
- Clean up procedures
- Using personal protective equipment

Knowledge

- Major anatomical features of mammalian body systems
- Gross physiological functions of major anatomical structures
- Function of various organ systems
- Common illnesses and injuries
- Occupational health and safety

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Planes may include

- sagittal
  - midsagittal
  - parasagittal
- coronal
- transverse

Cavities may include

- dorsal
  - cranial
  - spinal
- ventral
- thoracic
  - pleural
  - pericardial
- abdominopelvic
  - abdominal
  - pelvic

Organ systems may include

- skeletal
- muscular
- integumentary
- nervous
- circulatory
- lymphatic

- digestive
- respiratory
- urinary
- endocrine
- reproductive

Anatomic terminology may include

- anterior or ventral
- posterior or dorsal
- cranial
- caudal
- superior
- interior
- medial
- lateral
- proximal
- distal
- internal
- external
- parietal
- visceral

Equipment may include

- Dissecting scissors
- Forceps
- Probe
- Dissecting pins
- Scalpel
-

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit

- Prepare for and perform a simple dissection safely
- Explain the physiological functions of major anatomical features of at least three body systems

Context of and specific resources for assessment

- equipped science laboratory
- personal protective equipment
- anatomical charts, models, videos or similar
- dissecting, cleaning and safety materials

Method of assessment	Learning outcomes may be assessed separately or in combination. Methods may include • verbal or written questioning • verbal presentation • practical demonstration • written or verbal reports • logbook

Code	**VU20953**
Title	**Introductory genetics**
Purpose	The purpose of this module is to provide learners with knowledge of the key elements of genetically-related phenomena including DNA structure, function and replication; chromosomes; and genes.
Prerequisites	Nil
Corequisites	Nil
Summary of Learning Outcome	1 Explain the relationship between genes, chromosomes, DNA and RNA 2 Explain gamete formation and sex determination 3 Explain types and causes of genetic mutation and chromosomal disorders 4 Analyse and explain Mendel's laws of inheritance

1 Explain the relationship between genes, chromosomes, DNA and RNA	1.1	The terms 'DNA', 'chromosome' and 'gene' are defined
	1.2	The ***functions and structure*** of DNA and RNA are described
	1.3	The process of protein synthesis and DNA replication is described
2 Explain gamete formation and sex determination	2.1	The steps involved in determining the sex of human beings are outlined
	2.2	The steps involved in genetic sex determination are outlined
	2.3	The steps involved in environmental sex determination are outlined
3 Explain types and causes of genetic mutation and chromosomal disorders	3.1	The terms genetic mutation and chromosomal disorder are defined
	3.2	***Mutation types*** are classified
	3.3	The ***causes*** of mutation and rates of variation are explained
4 Analyse and explain Mendel's laws of inheritance	4.1	***Genetic terms*** relevant to Mendelian inheritance are used accurately
	4.2	***Mendelian laws*** are outlined
	4.3	The laws of inheritance are illustrated using appropriate terminology
5 Discuss procedures and issues in current genetic engineering	5.1	K***ey terms*** related to genetic engineering are defined
	5.2	***Procedures*** used in genetic engineering are explained

techniques

5.3 Examples of ***issues*** surrounding emerging genetic technologies are discussed

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Knowledge:

- relevant scientific terminology related to genetics
- genetic processes
- laws of inheritance
- mutations
- genetic engineering

Skills:

- constructing and interpreting scientific charts and diagrams related to genetics
- analysing and discussing issues related to genetic disorders and genetic engineering
- researching topics in genetics
- using genetic terminology

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Functions and structure may include:

- the structure of DNA
- four nucleotide bases pairs ---> A-T, C-G
- biological function of DNA, chromosomes and genes
- main differences/similarities between DNA, chromosomes and genes
- steps involved in the replication of DNA
- structure and function of RNA
- major steps and ultimate outcome of the protein synthesis process
-

Mutation types may include:

- base substitution, frame shift, deletion
- chromosomal abnormalities: addition, deletion, translocation
- effects of mutations on protein synthesis
- effects of chromosomal abnormalities: Turner Syndrome, Down Syndrome, Klinefelter Syndrome etc.

Causes may include:

- spontaneous mutation
- mutagenic agents eg. radiation, chemical substances

Genetic terms may include:	• allele • phenotypes, genotypes • dominant, recessive, gene pairs • linked, autosome or sex chromosome • homozygous, heterozygous, mono and dihybrid crosses etc.
Outline of Mendelian laws may include explanation and examples of:	• Problems in Mendelian genetics for example monohybrid and dihybrid crosses, linkage and sex-linkage • Mendelian traits e.g. sickle-cell anemia, Tay-Sachs disease, cystic fibrosis and xeroderma pigmentosa. mendelian traits • the laws of segregation and independent assortment
Key stages include:	• interphase I, prophase I, metaphase I, anaphase I and telophase I - IPMAT I + (MAT II)
Key terms may include:	• restriction enzymes • PCR • gene probes • genetic engineering, genetically modified organisms • clones, gene therapy • DNA fingerprinting
Procedures may include:	• current uses of bacterial restriction enzymes • separation of DNA fragments • genetic cloning
Issues may include:	• ethical • social • legal

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	• evidence must demonstrate that the participant has knowledge of key aspects of genetics, is able to use appropriate scientific terminology to describe and present information on genetic processes, laws of inheritance, mutations and is able to present and discuss issues related to genetic engineering • evidence requirements include the presentation of information in diagrammatic form as well as verbally and in writing

Context of and specific resources for assessment	• Participants should have access to scientific texts, audio visual resources, charts and sample/models and to the internet. • Where possible, theoretical concepts should be supported by demonstrations and/or laboratory experiments to reinforce the links between theoretical knowledge and its practical applications
Method of assessment	Learning outcomes may be assessed separately or in combination with others. A range of suitable assessment methods can include: • direct observation of practical work and/or demonstrations • review of logbook of practical work/investigation/research activities • analysis of laboratory reports • review and analysis of written reports • verbal or written questioning • direct observation of verbal presentations/PowerPoint presentations

Code	**VU20954**
Title	**Ecology**
Purpose	The purpose of this module is to provide students with the knowledge and skills to be able to recall and apply key ecological principles underpinning issues of concern about any specific type of environment.
Prerequisites	Nil
Corequisites	Nil
Summary of Learning Outcome	1 Explain the levels of classification used in plant and animal taxonomy 2 Outline the general characteristics of ecosystems 3 Interpret food chains and webs 4 Discuss key issues involved in major current ecological problems caused by humans

1 Explain the levels of classification used in plant and animal taxonomy	1.1	The ***major levels of classification*** used in plant and animal classification are named
	1.2	The scientific requirements needed for two organisms to be placed into the same species are summarised
	1.3	The correct use of classification keys for both plants and animals are demonstrated
2 Outline the general characteristics of ecosystems	2.1	The ***major components and terminologies a***ssociated with any type of ecosystem are identified
	2.2	The biotic and abiotic features and other major components in specific ecosystem contexts are identified
3 Interpret food chains and webs	3.1	Specific features and major components of ***food chains and webs*** are categorised
	3.2	Energy flow through an ecosystem is described
	3.3	The different types of special symbiotic relationships that can occur within any ecosystems are listed
	3.4	Nutrient recycling through living systems is described
4 Discuss key issues involved in major current ecological problems caused by humans	4.1	The key issues surrounding an *ecological problem* caused by human activity is discussed
	4.2	A detailed description of a ***major ecological problem*** and its ***environmental impact*** is provided using appropriate scientific terminology.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Knowledge:

- levels of classification used in plant and animal taxonomy
- general characteristics of ecosystems
- features and components of food chains and webs
- terminology related to ecology

Skills:

- discussing current ecological issues
- using scientific terminology accurately
- applying classification keys

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Major levels of classification may include	• kingdom, phylum (division), class, order, family, genus and species
Major components and terminologies may include	• niche, community, population, biotic and abiotic factors, competition, symbiosis etc.
Food chains and webs may include	• aquatic, marine and terrestrial
Major current ecological problems may include	• global warming • land degradation • air, water or land pollution • biomagnification of poisons • salinity
Environmental impact may include	• horticultural / food production • water supply • disease • erosion • salination

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	• evidence must demonstrate that the participant has knowledge of the classifications used in plant and animal taxonomy, can outline the general characteristics of ecosystems including food chains and webs, and is able to discuss issues involved in current ecological problems • evidence requirements include the presentation of information in diagrammatic form as well as verbally and in writing
Context of and specific resources for assessment	• Participants should have access to scientific texts, audio visual resources, charts and sample/models and to the internet. • Where possible, theoretical concepts should be supported by demonstrations and/or laboratory experiments to reinforce the links between theoretical knowledge and its practical applications
Method of assessment	Learning outcomes may be assessed separately or in combination with others. A range of suitable assessment methods can include: • direct observation of practical work and/or demonstrations • review of logbook of practical work/investigation/research activities/fieldwork • analysis of laboratory reports • review and analysis of written reports • oral or written questioning • direct observation of verbal presentations/PowerPoint presentations

Unit Code	**VU21081**
Unit Title	**Work mathematically with statistics and calculus**
Unit Descriptor	The purpose of this unit is to provide learners with knowledge and skills related to statistical relationships between bivariate data, the normal distribution, sets applied to problems, probability and differential calculus.
Employability skills	This unit contains employability skills. Refer to the employability skills summary to identify employability skill requirements.
Application of the unit	The unit covers mathematical skills and knowledge which apply to a number of science further study pathways, and work roles.

ELEMENT Elements describe the essential outcomes of a unit of competency.	**PERFORMANCE CRITERIA** Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold/italicised test is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Determine the correlation coefficient and the equation of the regression line for bivariate data	1.1 Plot ***bivariate data*** on a scatter diagram and estimate trends and the degree of correlation by inspection
	1.2 ***Calculate*** the correlation coefficient
	1.3 Evaluate the correlation coefficient as a measure of the degree to which the association between the variables approaches a linear functional relationship
	1.4 ***Calculate the equations of regression lines*** from ***bivariate data***
	1.5 Use the equations of regression lines to make predictions in ***practical situations***
	1.6 Investigate ***practical problems*** using correlation and regression
	1.7 Describe the limitations of the use of regression lines for making predictions
2 Solve mathematics problems involving sets	2.1 Use the properties of set operations or Venn Diagrams to simplify set expressions, and to prove equivalence between set expressions
	2.2 Solve applied problems using the concepts and techniques of set algebra
3 Use probability theory to solve mathematics problems	3.1 Calculate ***theoretical probabilities*** for simple and complementary events and compare them with experimental results
	3.2 Infer probabilities from experiments for events which cannot be predicted theoretically

	3.3 Identify, describe and give examples of mutually exclusive and independent events
	3.4 Determine the probability of compound events using the addition and multiplication principles
	3.5 Define, explain and distinguish between permutations and combinations and ***evaluate*** them
	3.6 Determine the probability of events using permutations and combinations
4 Solve analytical and applied probability distribution problems	4.1 Define and explain the probability density function for a continuous random variable in terms of the distribution function
	4.2 Describe the importance, occurrence, properties and use of the normal distribution model
	4,3 Use tables and/or calculator to determine probabilities and solve problems where the variable is normally distributed
	4.4 Interpret particular normal distributions
5 Interpret the concept of derivative graphically and as a rate of change	5.1 Determine the derivative of a polynomial, giving the instantaneous rate of change of a quantity at a time t, using first principles or approximating graphically
	5.2 Determine the derivative of a polynomial, giving the instantaneous rate of change of a quantity at a time t, using 'the rule'
	5.2 Apply the process of differentiation of a function to solve problems in applied areas where the derivative has a meaning, including cases where there is a zero rate of change

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Knowledge of:

- Statistics - Relationships between Variables - bivariate data, scatter diagrams, linear relationship trend, calculation of r, with and without a calculator, properties of r; estimate from scatter diagram, lines of "best fit", regression line equations and predictions, practical problems using correlation and regression
- Properties of Sets - set notation and terminology, Venn diagrams, properties of set operations: commutative, associative, distributive, de Morgans laws, equivalence, applications
- Elementary Probability - definition of probability of an event, theoretical and relative frequency, Venn diagrams of events, sample spaces, complementary and compound events, addition and multiplication principles, conditional probability, independent and mutually exclusive events, permutations and combinations
- Statistics - Normal Distributions - probability distributions as tables and graphs, normal distribution, its properties, occurrence and use; Standard normal distribution - z scores

- Differential Calculus - gradient as a rate of change for a linear function, general rates of change on graphs, average and instantaneous rate of change, (including approximation of instantaneous rate of change) ,derivative as gradient/rate of change function, derivative by first principles and by rule, simple applications of differential calculus e.g. maxima and minima.

Ability to

- generate data using surveys, experiments and sampling procedures.
- calculate summary statistics for centrality (mode, median and mean), spread (box plot, inter-quartile range, outliers) and association (by-eye estimation of the line of best fit from a scatter plot).
- distinguish informally between association and causal relationship in bi-variate data, and make predictions based on an estimated line of best fit for scatter-plot data with strong association between two variables
- use tables and/or calculator to determine probabilities, applications
- use appropriate keys on a scientific calculator
- produce scientific information in charts, diagrams and graphs

RANGE STATEMENT

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

Bivariate data includes	• data relating to the simultaneous measurement of two variables; for example, age and income
Calculate may include	• a calculator • software package
Calculate the equations of regression lines may include	• using a calculator/software package • plotting the regression line on a scatter diagram
Practical situations and ***problems*** may include	• looking at patterns over time with different groups of people, e.g. disease in different age groups over time
Theoretical probabilities include:	• conditional probability
Evaluate may include	• using the definition and a calculator

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to assess competency in this unit	The learner must be able to: • apply a range of strategies and techniques to solve mathematical problems including: − determining the correlation coefficient and the equation of the regression line for bivariate data and making

predictions from these
  - solving mathematics problems involving sets, using the properties of sets and equivalence
  - using probability theory to solve mathematics problems
  - -solving analytical and applied probability distribution problems where the random variable is continuous and normally distributed
  - interpreting the concept of derivative graphically and as a rate of change (for polynomials only) and solving applied problems
- demonstrate estimating skills to check calculations and reasonableness of outcomes
- use mathematical symbolism, charts, diagrams and graphs as appropriate to convey mathematical thinking and processing
- use a scientific calculator

Context of and specific resources for assessment

- Scientific calculator
- Real/authentic or simulated tasks, materials and texts

Method of assessment

- verbal or written questioning, online responses
- pictures, diagrams, models created by the learner
- practical demonstration
- products or samples compiled by the learner with supporting documentation
- records of teacher observations of learner's activities, discussions and practical tasks
- self-assessment sheets, reflections, journal entries
- written or verbal reports of investigations or problem-solving activities