22441VIC Certificate III in Science

22442VIC Certificate IV in Science

This course has been accredited under Part 4.4 of the Education and Training Reform Act 2006.

Accredited for the period: 1 January 2018 to 31 December 2022

VICTORIA State Government | Education and Training

Section A: Copyright and course classification information

1. Copyright owner of the course	Copyright of this course is held by the Department of Education and Training, Victoria © State of Victoria (Department of Education and Training) 2017.
2. Address	Executive Director Industry Engagement and VET Systems Higher Education and Skills Group Department of Education and Training (DET) GPO Box 4367 Melbourne VIC 3001 **Organisational Contact:** Manager Training Products Higher Education and Skills Group Telephone: (03) 9637 3092 Email: course.enquiry@edumail.vic.gov.au **Day to day contact:** Service Industries Curriculum Maintenance Manager Victoria University PO Box 14428 Melbourne, Vic 8001 Email: sicmm.generalstudies@vu.edu.au cheryl.bartolo@vu.edu.au Telephone: (03) 9919 5300/5302
3. Type of submission	Re-accreditation
4. Copyright acknowledgement	Copyright of the following units of competency from nationally endorsed training packages is administered by the Commonwealth of Australia and can be accessed from www.training.gov.au © Commonwealth of Australia • 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 – ICTICT210 Operate database applications – ICTICT103 Use, communicate and search securely on the internet

	– ICTICT102 Operate word-processing applications • MSL Laboratory Operations Training Package – MSL973004 Perform aseptic techniques – MSL943002 Participate in laboratory/field workplace safety – MSL973002 Prepare working solutions – MSL973007 Perform microscopic examination – MSL973001 Perform basic tests • BSB Business Services Training Package – BSBWHS201 Contribute to health and safety of self and others Copyright of the following units of competency from accredited curricula is held by the Department of Education and Training, Victoria © State of Victoria. The following curricula can be downloaded free of charge from the Victorian Department of Education and Training website at: *http://www.education.vic.gov.au/training/providers/rto/Pages/courses.aspx 2* • 22236VIC Certificate I in General Education for Adults – VU21326 Engage with texts of limited complexity for learning purposes – VU21330 Create texts of limited complexity for learning purposes
5. Licensing and franchise	
6. Course accrediting body	**Victorian Registration and Qualifications Authority**
7. AVETMISS information	***ANZSCO** [Australian and New Zealand Standard Classification of Occupations]*: 234 Natural and physical science professionals ***ASCED Code – 4 digit***: 1201 General Education

	(Field of Education)	Programmes
	National course code 22441VIC Certificate III in Science 22442VIC Certificate IV in Science	
8. Period of accreditation	*1 January 2018 – 31 December 2022*	

Section B: Course information

1. Nomenclature	Standard 1 AQTF Standards for Accredited Courses
1.1 Name of the qualification	22441VIC Certificate III in Science 22442VIC Certificate IV in Science
1.2 Nominal duration of the course	Certificate III in Science: 440 – 480 Certificate IV in Science: 710 – 830
2. Vocational or educational outcomes	Standard 1 AQTF Standards for Accredited Courses
2.1 Purpose of the course	The Certificates III and IV in Science are preparatory programs which provide a re-entry pathway to enable graduates to develop foundational skills and knowledge in Science, Technology, Engineering and/or Maths (STEM) areas. The Certificate III in Science is primarily a preparatory qualification which introduces key science concepts and enables access to vocational courses in STEM related areas. The Certificate IV in Science consolidates and extends science concepts to enable access to higher level VET courses or higher education degree or associate degree courses in STEM related areas 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. STEM education and training covers the specific knowledge and skills found in science, technology, engineering and mathematics disciplines. It also covers the interrelationship between these areas.
3. Development of the course	Standards 1 and 2 AQTF Standards for Accredited Courses
3.1 Industry / enterprise/ community needs	Significant changes in Victoria's economy mean there is a greater need for STEM capabilities. Employers are increasingly looking for workers who are creative problem solvers, innovative and critical thinkers and able to use new technologies. STEM skills are also integral to Victoria's priority sectors. These have the potential for remarkable growth, driving up economic output and creating over 400,000 jobs for Victorians by 2025.As a result of this, there is an increasing focus on Science, Technology, Engineering and Mathematics (STEM) by both national and state governments. The Victorian government's STEM in the Education State plan brings together actions and initiatives to deliver the vision for improved learning and outcomes in STEM by equipping all Victorian learners with STEM capabilities. Ensuring Victoria's Higher Education and training sectors are creating a STEM-skilled workforce is a key focus of the plan. The national initiative, Science, Technology, Engineering and Mathematics: Australia's Future strategy reinforces that individuals having STEM skills and knowledge will be crucial to their ability to access the jobs which

will be needed in a modern economy. Industry groups such as AIG are also raising the profile of STEM skills identifying an imperative for the growth of STEM skills in the economy by developing more engaging curriculum and pedagogy to attract students to STEM: The Australian Industry Group: Progressing STEM Skills in Australia (2015). Over the next five years, employment in professional, scientific, and technical services is predicted to increase.

The above initiatives may result in an increase in future demand for these preparatory courses in science. The courses have been designed to support the needs of a diverse group of learners including:

- learners returning to study who wish to access further study in a science field
- learners wishing to change work direction
- learners who did not receive a high enough ATAR score

Information to support the continuing need for the courses was collected through a number of activities:

- Analysis of enrolment figures between 2013 and 2016
- Provider focus group
- Student feedback provided via focus group and written feedback
- Desktop review of literature and government policy
- Review of Training Packages and accredited courses

Enrolments

Course Enrolments in 2013-2016	**2013**	**2014**	**2015**	**2016**
22219VIC Certificate III in Science	67	74	68	55
22220VIC Certificate IV in Science	121	135	128	124

Course enrolments by age group	**Age Group**	**2013**	**2014**	**2015**	**2016**
22219VIC Certificate III in Science	15-19	28	29	28	19
	20-24	28	30	25	25
	25-29	8	9	6	7

Course enrolments by age group	**Age group**	**2013**	**2014**	**2015**	**2016**

22220VIC Certificate IV in Science	15-19	53	59	53	56
	20-24	42	46	34	42
	25-29	15	13	20	18
	30-34	5	12	13	4

The number of providers of the Certificates in Science has decreased slightly between 2013 and 2016. In 2016 there were 2 providers of the 22219VIC Certificate III in Science and 2 providers of the 22220VIC Certificate IV in Science. During this period of time, enrolments have remained consistent across both qualifications. Please note that 2016 figures are not complete.

As shown in the above age group table, most government funded course enrolments between 2013 and 2016 fell into 3 main age groups for the Certificate III with more mature aged students enrolled in the Certificate IV.

A Skills and Knowledge Profile was developed following discussion with and advice from the PSC. The profile was then validated and used to guide the redevelopment of the curriculum.

The reaccreditation was guided by a Project Steering Committee comprised of:

Judy Taylor (Chair)	Bridging Science, Melbourne Polytechnic
Michael Taylor	AiGroup
Catherine Devlin	Adult Learning Australia
Dinah van Ruyven	RMIT School of Vocational Engineering, Health and Sciences
Soula Bennett	Quantum Victoria
Julian Hill	Food Plant and Animal Industries, Melbourne Polytechnic
Daniel Eldridge	Course Director, Bachelor of Science, Swinburne University of Technology

3.2 Review for re-accreditation

A mid cycle review for the 22219VIC Certificate III in Science and the 22220VIC Certificate IV in Science was conducted in July 2015 by the CMM General Studies and Further Education as per the AQTF Standards for Accredited courses. Feedback was sought from providers with the course on their scope of registration.

The following amendments were made to the 22219VIC Certificate III in Science as a result of the mid cycle review. These amendments did not affect the vocational outcomes of the course.

- Update imported training package units
- Align summary of learning outcomes to learning outcomes
- Amend Range Statement
- Correct typographical errors

	The following amendments were made to the 22220VIC Certificate IV in Science as a result of the mid cycle review. These amendments did not affect the vocational outcomes of the course. • Align summary of learning outcomes to learning outcomes • Amend Range Statement • Amend terminology where this reflects accepted terminology in the field and does not affect the outcome • Align highlighted terms in learning outcomes/performance criteria and range statement • Correct typographical errors Other feedback provided as part of the mid-cycle review has been taken into account as part of the reaccreditation process and includes the following: **22219VIC Certificate III in Science** • Replace identified imported units with more appropriate units to make them more suitable (to be addressed at reaccreditation of curriculum). The following units were identified: – HLTAP301B Recognise healthy body systems in a health care context – PSPOHS201B Follow workplace safety procedures **22220VIC Certificate IV in Science** • Duplication of information across units/modules • Introductory unit in each of the major science fields of chemistry, physics and biology in the core • Addition of a unit covering basic investigative, scientific approach as a core unit • A new elective unit in emerging technologies • Import an environmental/ sustainability unit • Review VU21058 Use a range of techniques to solve mathematical problems to ensure skills and knowledge are linked to performance The 22441VIC Certificate III in Science replaces and is equivalent to the 22219VIC Certificate III in Science The 22442VIC Certificate IV in Science replaces and is equivalent to the 22220VIC Certificate IV in Science The following table identifies the relationship between units from the 22441VIC Certificate III in Science with units from 22219VIC VIC Certificate III in Science and units from the 22442VIC Certificate IV in Science with units from the 22220VIC Certificate IV in Science.

Units from 22219VIC Certificate III in Science		Units from 22441VIC Certificate III in Science		Relationship
VU21057	Conduct and present simple scientific research	VU22065	Conduct and present simple scientific research	Equivalent
VU20928	Design a learning plan	VU22066	Develop study skills for science	New unit Not equivalent
PSPOHS201B	Follow workplace safety procedures	BSBWHS201	Contribute to health and safety of self and others	Newly imported unit Not equivalent
VU21377	Engage with a range of highly complex texts for learning purposes	VU21326	Engage with texts of limited complexity for learning purposes	Not equivalent
VU21381	Create a range of highly complex texts for learning purposes	VU21330	Create texts of limited complexity for learning purposes	Not equivalent
VU20929	Concepts in biology	VU22068	Examine concepts in biology	Equivalent
VU20930	Concepts in chemistry	VU22069	Examine concepts in chemistry	Equivalent
VU20931	Concepts in physics	VU22070	Examine concepts in physics	Equivalent
HLTAP301B	Recognise healthy body systems in a health care context	VU22071	Examine body systems	New unit
MSL973002A	Prepare working solutions	MSL973002	Prepare working solutions	Equivalent
MSL973007A	Perform microscopic examination	MSL973007	Perform microscopic examination	Equivalent
MSL973001A	Perform basic tests	MSL973001	Perform basic tests	Equivalent
ICTICT101	Operate a personal computer	ICTICT101	Operate a personal computer	Equivalent
ICTICT103	Use, communicate and search securely on the internet	ICTICT103	Use, communicate and search securely on the internet	Equivalent
VU21058	Use a range of	VU22067	Work with mathematical	New unit

Units from 22219VIC Certificate III in Science		Units from 22441VIC Certificate III in Science		Relationship
	techniques to solve mathematical problems		techniques	

Units from 22220VIC Certificate IV in Science		Units from 22442VIC Certificate IV in Science		Relationship
MSL943002A	Participate in laboratory/field workplace safety	MSL943002	Participate in laboratory/field workplace safety	Equivalent
VU20932	Apply essential further study skills for science	VU22072	Apply essential further study skills for science	Equivalent
VU20933	Research scientific fields of study	VU22073	Research scientific fields of study	Equivalent
VU21058	Use a range of techniques to solve mathematical problems	VU22074	Use a range of techniques to solve mathematical problems	Equivalent
VU20934	Apply mathematical techniques to scientific contexts	VU22075	Apply mathematical techniques to scientific contexts	Equivalent
VU20935	Atomic structure and bonding	VU22076	Investigate atomic structure and bonding	Equivalent
VU20946	Stoichiometry and solution chemistry	VU22077	Investigate stoichiometry and solution chemistry	Equivalent
VU20947	Organic chemistry and properties of materials	VU22078	Investigate organic chemistry and properties of materials	Equivalent
VU20948	Chemical reactions	VU22079	Investigate chemical reactions	Equivalent
VU20949	Waves and optics	VU22080	Investigate waves and optics	Equivalent
VU20950	Kinematics	VU22081	Apply principles of kinematics	Equivalent
VU20945	Apply principles of electricity	VU22082	Apply principles of electricity	Equivalent
VU21079	Apply dynamics and conservation principles	VU22083	Apply dynamics and conservation principles	Equivalent
VU21080	Operate simple analogue and digital electronic	VU22084	Operate simple analogue and digital electronic circuits	Equivalent

Units from 22220VIC Certificate IV in Science		Units from 22442VIC Certificate IV in Science		Relationship
	circuits			
VU20945	Cell biology	VU22085	Investigate cell biology	Equivalent
VU20952	Anatomy and physiology	VU22086	Investigate anatomy and physiology	Equivalent
VU20953	Introductory genetics	VU22087	Investigate introductory genetics	Equivalent
VU20954	Ecology	VU22088	Investigate ecology	Equivalent
MSL973004A	Perform aseptic techniques	MSL973004	Perform aseptic techniques	Equivalent
MEM30012A	Apply mathematical techniques in a manufacturing, engineering or related environment	MEM30012A	Apply mathematical techniques in a manufacturing, engineering or related environment	Equivalent
MEM23007A	Apply calculus to engineering tasks	MEM23007A	Apply calculus to engineering tasks Prerequisite: MEM30012A	Equivalent
VU21081	Work mathematically with statistics and calculus	VU22089	Work mathematically with statistics and calculus	Equivalent
ICTICT102	Operate word-processing applications	ICTICT102	Operate word-processing applications	Equivalent
ICTICT105	Operate spreadsheet applications	ICTICT105	Operate spreadsheet applications	Equivalent
ICTICT210	Operate database applications	ICTICT210	Operate database applications	Equivalent

4. Course outcomes	Standards 1, 2, 3 and 4 AQTF Standards for Accredited Courses
4.1 Qualification level	*Standards 1, 2 and 3 AQTF Standards for Accredited Courses* The following broad outcomes apply at Australian Qualifications Framework (AQF) level 3: • Certificate III outcomes focus on the development of factual, technical, procedural and some theoretical knowledge of a specific area in the field of science for further learning • Graduates develop a range of cognitive, technical and communication skills to select and apply a specialised range of methods, tools and materials to complete routine science activities and provide and transmit solutions to predictable and sometimes unpredictable problems **Knowledge** Graduates at this level will have factual, technical, procedural and some theoretical knowledge of techniques and concepts to solve a range of mathematical problems related to the science field **Skills** Graduates of a Certificate III will have: • cognitive, technical and communication skills to source, interpret and present data using appropriate mathematical and scientific terminology • cognitive and communications skills to apply and communicate known solutions of a variety of predictable problems and to deal with unforeseen contingencies using known solutions such as undertaking simple scientific experiments and investigations • technical and communication skills to provide technical information to a variety of audiences such as presenting scientific information using appropriate scientific methods • 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 autonomy and judgement in undertaking a range of calculations and investigations in known maths and science contexts • to adapt and transfer skills and knowledge within known routines, measures, procedures and time constraints such as applying techniques and methods to solve a range of problems • in contexts that include taking responsibility for own outputs in work and learning including participation in simple scientific

	research and the development of own study skills **Volume of learning** The volume of learning for this qualification is typically between 1 to 2 years and incorporates: • structured activities to undertake and present outcomes of simple investigations and develop problem solving techniques to solve a range of problems • unstructured activities such as conducting simple scientific research and complete assignments and projects **Certificate IV** The Certificate IV in Science is consistent with the AQF Level 4 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 in Science will have broad factual, technical and theoretical knowledge in a specialized field of work and learning such as mathematics, chemistry, physics and biology. **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 undertaking calculations and 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 apply methods to participate in collaborative research and 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 undertaking research in scientific fields of study and analysing and presenting data • 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 using problem solving techniques to conduct scientific investigations • Volume of learning The volume of learning for this qualification is typically between 0.5 to 2 years and incorporates • structured activities to access, analyse and compare a range of scientific information and theories across scientific and mathematics areas • unstructured activities such as researching a science topic, using online library services to source scientific journals and completing scientific calculations.
4.2 Employability skills	*Standard 4 AQTF Standards for Accredited Courses* The following summary reflects the Employability Skills required for the 22441VIC Certificate III in Science and the 22442VIC Certificate IV in Science **22441VIC Certificate III in Science** Communication skills to: • read scientific documents such as charts, laboratory reports • record and record data using scientific formats • make verbal presentations to a group • discuss and share information and ideas related to scientific knowledge and investigations • prepare documents related to scientific results • conduct simple investigations into areas of science • use scientific terminology • use numeracy effectively Teamwork skills to: • support others in group tasks • collaborate with other learners to achieve task outcomes Problem solving skills to: • use techniques to solve mathematical problems • identify simple scientific concepts and issues for investigation • recognise unexpected outcomes Initiative and enterprise skills to • undertake simple investigations • respond to feedback • develop strategies for further study

	Planning and organisation skills to: • collect, analyse and organise information • plan and conduct simple scientific experiments and investigations • follow scientific protocols and Standard Operating procedures(SOPs) Self-management skills to: • apply time management strategies to prioritise tasks Learning skills to: • use a range of research strategies to source scientific information • apply a range of learning strategies to own learning • organise and prioritise work tasks • identify own study pathway Technology skills to: • access online information related to scientific investigations • assess online information related to scientific investigations • use scientific calculator functions • operate tools and equipment to complete tasks **22442VIC Certificate IV in Science** Communication skills to: • read, analyse and interpret scientific documents • record and interpret data using scientific method • prepare and deliver verbal presentations • discuss and share information and ideas related to issues in science • prepare documents related to scientific results • conduct research into fields of science • use scientific terminology • assess reliability and quality of scientific evidence • represent scientific information and data in a range of ways Teamwork skills to: • present scientific information as part of a group • collaborate with other learners to achieve task outcomes Problem solving skills to: • conduct investigations based on scientific theory • develop hypotheses and test relationships

	• compare and assess sources of scientific research • select techniques to solve a range of mathematical problems • use techniques and functions to solve mathematical problems • apply scientific concepts and theories to investigations • select and apply appropriate forms of scientific enquiry • apply theories and concepts to perform a range of calculations • classify concepts and their components • interpret scientific data in a variety of forms • recognise unexpected outcomes Initiative and enterprise skills to: • develop strategies for further study Planning and organisation skills to: • plan and conduct scientific research into identified fields of study • plan and deliver presentations on scientific research • apply safety procedures when conducting scientific investigations and tasks • follow scientific protocols and Standard Operating procedures(SOPs) Self-management skills to: • complete tasks • evaluate and monitor own performance • apply time management strategies to prioritise tasks Learning skills to: • develop study and academic skills • plan own skills development • identify own study pathway • use a range of research strategies to source scientific information • apply a range of learning strategies to own learning • organise and prioritise work tasks Technology skills to: • access and use online technology to research a field of scientific study • assess online information related to scientific investigations • use scientific calculator functions • use a range of scientific technology • operate scientific tools and equipment to complete tasks

4.3 Recognition given to the course (if applicable)	*Standard 5 AQTF Standards for Accredited Courses* *Not applicable*
4.4 Licensing/ regulatory requirements (if applicable)	*Standard 5 AQTF Standards for Accredited Courses* *Not applicable*
5. Course rules	Standards 2, 6,7 and 9 AQTF Standards for Accredited Courses

5.1 Course structure

To be eligible for the award of 22441VIC Certificate III in Science, learners must successfully complete a total of 11 units comprising:

- 6 core units
- 5 elective units

At least one elective must be selected from the Science stream. 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 completed if the full qualification is not completed.

Unit code	Field of Education code	Unit title	Pre-requisite	Nominal hours
Core units				
VU22065	120105	Conduct and present simple scientific research	Nil	20
VU22066	120103	Develop study skills for science	Nil	30
BSBWHS201	N/A	Contribute to health and safety of self and others	Nil	20
VU22067	010101	Work with mathematical techniques	Nil	100
VU21326	120103	Engage with texts of limited complexity for learning purposes	Nil	25
VU21330	120103	Create texts of limited complexity for learning purposes	Nil	25
Science Stream				

VU22068	010999	Examine concepts in biology	Nil	50
VU22069	010501	Examine concepts in chemistry	Nil	50
VU22070	010301	Examine concepts in physics	Nil	50
VU22071	010913	Examine body systems	Nil	50
Elective units				
MSL973002	N/A	Prepare working solutions	Nil	50
MSL973007	N/A	Perform microscopic examination	Nil	40
MSL973001	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
		Total nominal duration	**440 – 480**	

22442VIC Certificate IV in Science

To be eligible for the award of 22442VIC Certificate IV in Science, learners must successfully complete a total of 15 units 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 completed if the full qualification is not completed.

Unit code	Field of Education code	Unit title	Pre-requisite	Nominal hours
Core units				
MSL943002	N/A	Participate in laboratory/field workplace safety	Nil	40
VU22072	120105	Apply essential further study skills for science	Nil	90
VU22073	120105	Research scientific fields of study	Nil	40
VU22074	010101	Use a range of techniques to solve mathematical problems	Nil	110
VU22075	010199	Apply mathematical techniques to scientific contexts	Nil	70
Electives (10)				
Chemistry				
VU22076	010501	Investigate atomic structure and bonding	Nil	50
VU22077	010501	Investigate stoichiometry and solution chemistry	VU22076	45
VU22078	010501	Investigate organic chemistry and properties of materials	VU22076	20
VU22079	010501	Investigate chemical reactions	VU22076 VU22077 VU22078	45
Physics				
VU22080	010301	Investigate waves and optics	Nil	40

VU22081	010301	Apply principles of kinematics	Nil	40
VU22082	031301	Apply principles of electricity	Nil	40
VU22083	010301	Apply dynamics and conservation principles	VU22081	50
VU22084	031303	Operate simple analogue and digital electronic circuits	VU22082	40
Biology				
VU22085	010901	Investigate cell biology	Nil	40
VU22086	010913	Investigate anatomy and physiology	Nil	40
VU22087	010909	Investigate introductory genetics	Nil	40
VU22088	010905	Investigate ecology	Nil	40
MSL973004	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
VU22089	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	**710 – 830**

5.2 Entry requirements	*Standard 9 AQTF Standards 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 align to Level 2 of the ACSF. 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 align to Level 3 of the ACSF. Learners with language, literacy and numeracy skills at lower levels than those suggested will require additional support to successfully undertake the qualifications.
6. Assessment	Standards 10 and 12 AQTF Standards for Accredited Courses
6.1 Assessment strategy	*Standard 10 AQTF Standards 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.asqa.gov.au/about/australias-vet-sector/standards-for-registered-training-organisations-(rtos)-2015.html or or relevant Standards for Registered Training Organisations in effect at the time of assessment The assessment strategy should include a variety of assessment methods and evidence gathering techniques Wherever possible an integrated approach to assessment should be used to: • maximise opportunities for holistic skill development • reduce atomisation and duplication of evidence collection • support authentic assessment by reflecting activities that are personally relevant to the learner. The following strategies 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 • assessment should utilise a variety of different processes/sources, such as written, oral, observation, projects appropriate to assess knowledge and performance

	• assessment should gather sufficient evidence to judge achievement of progress towards determining 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 • feedback of individual progress toward, and achievement of competencies should be incorporated • 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 methods may include: • oral or written questioning • verbal presentations • multi-media presentations • folios • written reports • ongoing assessment by the teacher/s Appropriate assessment methods are suggested in each unit. Units of competency imported from accredited curriculum or endorsed training packages must reflect the assessment requirements specified in the accredited curriculum or

	endorsed training package.
6.2 Assessor competencies	*Standard 12 AQTF Standards for Accredited Courses* Assessor competencies are consistent with the Australian Quality Training Framework Essential Conditions and Standards for Continuing (or Initial) Registration, Standard 1.4 states the requirements for the competence of persons assessing the course. See AQTF User guides to the Essential Conditions and Standards for Continuing (or Initial) Registration: http://www.vrqa.vic.gov.au/registration/Pages/vetqualitydef.aspx or Standard 1: Clauses 1.13, 1.14, 1.15, 1.16 and 1.17 of the Standards for Registered Training Organisations (SRTOs) 2015 or relevant Standards for Registered Training Organisations in effect at the time of assessment Assessors of the imported units of competency must meet the requirements of the relevant Training Package and/or accredited Course Documentation.
7. Delivery	Standards 11 and 12 AQTF Standards for Accredited Courses
7.1 Delivery modes	*Standard 11 AQTF Standards for Accredited Courses* Teaching and learning strategies must be selected to reflect the varying learning needs, educational backgrounds and preferred learning styles 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. In keeping with effective practice all units should be appropriately contextualised. Further education learners may come from a wide variety of backgrounds with greatly varying life experiences. Where appropriate these experiences may be useful in group discussions and presentations.
7.2 Resources	*Standard 12 AQTF Standards for Accredited Courses* Resources include teachers/trainers who meet the Australian Quality Training Framework Essential Conditions and Standards for Initial / Continuing Registration Standard 1.4. or Standard 1: Clauses 1.13.1.14,1.15,1.16 and 1.17 of the

	Standards for Registered Training Organisations (SRTOs) 2015 or relevant Standards for Registered Training Organisations in effect at the time of assessment Units of competency imported from accredited curriculum or endorsed training packages must comply with the requirements for teachers/trainers specified in the accredited curriculum or endorsed training package. Physical resources for these courses include: • equipment and resources to complete tasks • computer facilities with Internet access where this is appropriate • appropriate computer software • access to a range of science based knowledge sources. Resources required for delivery of individual units are listed in the specific Unit of Competency.
8. Pathways and articulation	Standard 8 AQTF Standards for Accredited Courses
	There are no formal articulation arrangements in place, however the courses are designed to provide a pathway into VET qualifications and undergraduate higher education courses by developing the science and maths knowledge and skills required to participate effectively in learning within such qualifications. A range of potential pathways are possible when Training Package or accredited curriculum units of competency are utilised as electives. Successful completion of these units within these Certificates will provide credit into other endorsed or accredited qualifications. RTOs may design courses which contain a number of elective units from a particular Training Package or accredited course qualification to provide a specific pathway to that qualification on completion. Examples of qualifications that are potential destinations for graduates of the Certificate III in Science include: • MEM40105 Certificate IV in Engineering • MSL40116 Certificate IV in Laboratory Techniques • FDF40311 Certificate IV in Food Science and Technology Examples of qualifications that are potential destination for graduates of the Certificate IV in Science: • MEM50212 Diploma of Engineering – Technical • MSL50116 Diploma of Laboratory Technology • HLT54115 Diploma of Nursing • Bachelor of Science

	• Bachelor of Applied Science • Bachelor of Electrical Engineering • Bachelor of Health Sciences • Refer to link below for information on AQF pathways policy. • *AQF Second Edition 2013 Pathways Policy*
9. Ongoing monitoring and evaluation Standard 13 AQTF Standards for Accredited Courses	
	The Curriculum Maintenance Manager General Studies and Further Education, has responsibility for the ongoing monitoring and maintenance of these qualifications. A formal review will take place once during the period of accreditation and will be informed by feedback from users of the curriculum and will consider any changes required to meet emerging or developing needs Any significant changes to the course resulting from course monitoring and evaluation procedures will be notified to the VRQA.

Section C: Units of Competency

Curriculum units of competency:	
VU22065	Conduct and present simple scientific research
VU22066	Develop study skills for science
VU22067	Work with mathematical techniques
VU22068	Examine concepts in biology
VU22069	Examine concepts in chemistry
VU22070	Examine concepts in physics
VU22071	Examine body systems
VU22072	Apply essential further study skills for science
VU22073	Research scientific fields of study
VU22074	Use a range of techniques to solve mathematical problems
VU22075	Apply mathematical techniques to scientific contexts
VU22076	Investigate atomic structure and bonding
VU22077	Investigate stoichiometry and solution chemistry
VU22078	Investigate organic chemistry and properties of materials
VU22079	Investigate chemical reactions
VU22080	Investigate waves and optics
VU22081	Apply principles of kinematics
VU22082	Apply principles of electricity
VU22083	Apply dynamics and conservation principles
VU22084	Operate simple analogue and digital electronic circuits
VU22085	Investigate cell biology
VU22086	Investigate anatomy and physiology
VU22087	Investigate introductory genetics
VU22088	Investigate ecology
VU22089	Work mathematically with statistics and calculus

Imported units of competency from training packages

MEM23007A	Apply calculus to engineering tasks
MEM30012A	Apply mathematical techniques in a manufacturing, engineering or related environment
ICTICT101	Operate a personal computer
ICTICT105	Operate spreadsheet applications
ICTICT210	Operate database applications
ICTICT103	Use, communicate and search securely on the internet
ICTICT102	Operate word-processing applications
MSL973004	Perform aseptic techniques
MSL943002	Participate in laboratory/field workplace safety
MSL973002	Prepare working solutions
MSL973007	Perform microscopic examination
MSL973001	Perform basic tests
BSBWHS201	Contribute to health and safety of self and others
Imported units of competency from accredited courses	
VU21326	Engage with texts of limited complexity for learning purposes
VU21330	Create texts of limited complexity for learning purposes

Unit Code	**VU22065**
Unit Title	**Conduct and present simple scientific research**
Unit Descriptor	This unit describes the skills and knowledge to undertake and report on simple scientific experiments and investigations.
Employability Skills	This unit contains employability skills.
Application of the Unit	This unit applies to learners who are undertaking experiments/observations in different areas of Science (Chemistry, Physics or Biology) according to their intended destinations.

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 Conduct a simple scientific experi*ment*	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
	2.2 Identify the ***area of science*** which underpins the issue
	2.3 Investigate the ***impact*** of the issue on society
	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 Knowledge and Skills

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

Required Knowledge:

- terminology to describe scientific issues and the impact of scientific issues
- basic scientific research methods
- impact of science on different areas of society

Required Skills:

- communication skills to discuss and present research findings
- problem solving skills to use scientific method to measure, record and explain results in simple experiments
- literacy skills to present information in tabular and graphical form
- numeracy skills to interpret data in simple graphs or information in a table
- planning and organising skills to gather, select and organise information effectively

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.

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 include:

- a written report following required format
- graphs and tables
- 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, microbiology
- 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

Impact may 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
- social, cultural or ethical factors underpinning the issue of scientific interest

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:

- 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

Where possible, theoretical concepts should be supported by demonstrations and/or laboratory experiments to reinforce the links between theoretical knowledge and its practical applications

Assessment must ensure access to:

- resources and equipment

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- oral or written questioning to assess knowledge of methods used in scientific research
- oral presentation of an investigation
- practical demonstration to illustrate a concept
- research assignment based on a scientific issue
- written or verbal report of an investigation

Unit Code
VU22066

Unit Title
Develop study skills for science

Unit Descriptor
This unit describes the skills and knowledge to establish a range of study strategies and develop specific study skills for science.

Employability Skills
This unit contains employability skills.

Application of the Unit
This unit applies to learners who are seeking to re-engage with learning in the science field as a pathway to entering or re-entering formal study in science related disciplines.

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 Develop effective study strategies for science	1.1 Source information about ***effective study strategies***
	1.2 Apply study strategies and techniques to science tasks
	1.3 Identify and use ***tools*** to aid study
	1.4 Investigate available study support services
	1.5 Apply ***study skills and techniques*** to relevant study tasks
2 Develop note-taking skills	2.1 Use a range of techniques to highlight key information
	2.2 Use a ***range of note-taking techniques and methods***
	2.3 Take accurate notes
3 Apply critical thinking skills to respond to study tasks	3.1 Determine the purpose and audience for the **study *task***
	3.2 Identify key science terms and concepts for the task
	3.3 Determine ***types of input*** needed to complete the task
	3.4 Examine science concepts using ***critical thinking skills***

	3.5	Seek advice from others in determining response to the task
4 Participate in group activity to complete study tasks	4.1	Apply ***collaborative techniques*** to analyse task
	4.2	Allocate roles and responsibilities
	4.3	Produce a timeline for stages of completion
	4.4	Establish group work protocols
	4.5	Complete collaborative tasks

Required Knowledge and Skills

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

- Required knowledge:
- sources of information on effective study strategies
- study support services
- Required Skills:
- communication skills to collaborate with other learners
- organisational skills to identify and apply effective study strategies
- literacy skills to take accurate notes
- problem solving skills to manage time and prioritise tasks and 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. Bold / italicised wording in the Performance Criteria is detailed below.

Effective study strategies may include:	• time management • prioritising work loads • listening and reading techniques • record keeping, organizing information
Tools may include:	• study diary • weekly planner • online organising tools, file management methods
Study skills and techniques may include	• writing up experiment results • brainstorming, mind maps • interpreting data/statistics

- skimming and scanning information
- evaluating evidence
- organizing information
- synthesizing information
- identifying key questions

Range of note-taking techniques and methods may include:

- note-taking from workshops and text references
- highlighting, underlining, abbreviations, acronyms and short cuts, paraphrasing, skimming and summarising, key words

Study task may include:

- report writing
- verbal presentations / talks
- experiments
- research

Types of input may include:

- notes from workshops
- discussions and activities
- collaboration with peers
- drafting and planning
- collection of data
- planning time frames

Critical thinking skills may include:

- evaluation of statements and claims
- comparing and contrasting
- investigating application of a theory to a context
- investigating validity of statements
- identifying strengths and weaknesses
- analysing data
- problem, solution
- determining type of response required

Collaborative techniques may include:

- brainstorming topic and task
  - listing any ideas triggered by the question and questions you need to answer
  - possible lines of thought, research or argument
  - any evidence you are aware of to support possible arguments

  - agreeing on words you must define.
- listening to others
- asking questions
- allowing others time to respond
- rewording questions
- problem solving
- supporting others
- team based learning
- peer assisted study sessions

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 and apply study strategies and use tools and techniques to aid effective study for a range of study tasks in the science field
- complete study tasks by applying collaborative techniques

Context of and specific resources for assessment

Assessment must ensure:

- allowance of sufficient time for learners to develop and apply their study skills to a range of tasks
- access to sources of information on study strategies

Method(s) of assessment

The following methods of assessment are suitable for this unit:

- portfolio of notes used to complete study tasks
- oral or written questioning to assess knowledge of effective study strategies
- third party reports from teachers confirming the learner's ability to apply study skills relevant to specific outcomes

Unit Code VU22067

Unit Title Work with mathematical techniques

Unit Descriptor This unit describes the skills and knowledge to work with key mathematical concepts and apply them in a scientific context

Employability Skills This unit contains employability skills.

Application of the Unit This unit applies to learners who wish to develop mathematical knowledge and skills which can be applied to a number of science streams.

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 Work with whole numbers, fractions, percentages and ratio	1.1 Perform ***basic functions*** using whole numbers and directed numbers
	1.2 Determine and simplify ratios from information in a practical problem
	1.3 Apply ratios to quantities
	1.4 Convert between fractions, decimals and percentages
	1.5 Perform ***simple calculations*** involving fractions, decimals, mixed numbers and percent.
2 Work with measurement to solve problems	2.1 Identify ***measurements*** using the metric system
	2.2 Use the metric system of measurement to solve problems
	2.3 Identify two-dimensional and three-dimensional shapes and their properties
	2.4 Calculate perimeters and areas of ***basic shapes*** using appropriate and correct units
	2.5 Calculate volumes of ***prisms*** using appropriate and correct units
3 Work with Pythagoras' Theorem and	3.1 Use Pythagoras' Theorem to determine unknown sides of right angled triangles

	trigonometry	3.2 Use Pythagoras' Theorem to find unknown lengths and angles in right-angled triangles
4	Work with basic indices	4.1 Evaluate simple index form expressions
		4.2 Apply the first two index laws to simplify simple exponential expressions
		4.3 Apply Scientific Notation to large and small decimal numbers
		4.4 Perform simple calculations with numbers expressed in Standard Notation
5	Work with 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***
		5.5 Solve simultaneous linear equations
6	Work with simple line graphs	6.1 Identify ***parts*** of a graph
		6.2 Plot ***points*** and points determined from the general formula y = mx on the Cartesian plane
		6.3 Determine the gradient of a straight line
		6.4 Determine the equation of a straight line with the general formula y = mx + c, y = a and x = b
		6.5 ***Interpret*** graphical information
		6.6 Draw and make ***predictions*** based on a line of best fit
7	Work with formulae and their graphical representations	7.1 Sketch linear and ***simple non-linear*** graphs
		7.2 Determine equations for given linear graphs, including ***lines of best fit***
8	Work with statistical information	8.1 Collect, organise and produce ***representations*** of ***statistical data***
		8.2 Interpret **representations** of **statistical data**
		8.3 Calculate ***measures of central tendency***

Required Knowledge and Skills

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

Required Knowledge:

- fractions and mixed numbers
- whole numbers, decimals and directed number
- terminology for metric units
- features of general shapes
- main characteristics of linear and simple non-linear graphs

Required Skills:

- Problem solving skills to:
  - perform calculations involving fractions and mixed numbers
  - perform calculations involving whole numbers, decimals and directed number
  - round a decimal to a given number of decimal places
  - use simple geometry to determine right angles in triangles
  - convert quantities between different metric units
- Numeracy and literacy skills to:
  - read off values in a table, chart or graph
  - describe the general shape of a given or plotted scatter diagram
  - represent information in a graphical form
  - locate information necessary to solve a problem
  - estimate to check calculations and reasonableness of outcomes
  - use mathematical symbols, 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. Bold / italicised wording in the Performance Criteria is detailed below.

Basic functions may include:	• addition and subtraction • multiplication and division
Simple calculations may include:	• addition and subtraction • multiplication and division • percentage of

Measurements must include:	• length • mass • volume
Basic shapes should include:	• rectangles • triangles • circles • simple combined shapes
Prisms should include:	• rectangular cross-sections • triangular cross-sections • circular cross-sections • cross-sections combining simple shapes
Formulae include:	• simple formulae with powers
Simple linear equations refers to:	• one and two-step operations
Parts should include:	• axes • origin • scale • x and y intercepts
Points should include:	• given co-ordinates • points determined from a formula in the $y = mx$ format
Straight line includes:	• line of best fit for empirical data
Interpret may include	• line of best fit • identifying the purpose of a graph • applying a graph to practical situations
Predictions may include:	• extrapolation • interpolation
Simple non-linear graphs may include:	• exponential • inverse and quadratic relationships

Lines of best fit may be:	• drawn by eye only for experimental data
Representations may include:	• tables • bar graphs • histograms • line graphs • pie charts
Statistical data may include:	• grouped data • individual data
Measures of central tendency may include:	• mean • median • mode

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:

- work with a number of mathematical concepts to perform simple calculations and solve simple problems
- sketch graphs from a given formula to:
  - represent statistical information
  - identify connections between formulae and graphical representations
  - use simple algebraic techniques to solve problems
- use 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

- Calculations should be performed using a combination of pen and paper and calculator as appropriate to the calculation

Assessment must ensure access to:

- materials and texts to support completion of tasks

- computer and internet to access relevant mathematical information/data to complete tasks.

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- oral or written questioning, online responses to assess knowledge of mathematical concepts such as numbers and percentages
- pictures, diagrams or models to demonstrate mathematical concepts
- records of teacher observations of learner's activities, discussions and practical problem solving tasks
- self-assessment tasks and journal entries
- written or verbal reports of investigations or problem-solving activities.

Unit Code VU22068

Unit Title Examine concepts in biology

Unit Descriptor This unit describes the skills and knowledge to examine the major concepts in biology such as cell biology and ecology and their basic application.

Employability Skills This unit contains employability skills.

Application of the Unit This unit applies to learners who wish to develop basic knowledge and skills in the area of biology.

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 Explain the basic building blocks for life	1.1 Compare the characteristics of living and non-living things.
	1.2 Identify the structures within different ***types of cells*** and describe their function
	1.3 Explain the differences between plant and animal cells
	1.4 Explain the process of ***cell reproduction***
	1.5 Explain the ***sources*** of energy and the ***processes*** cells use to obtain and use energy
2 Explain the classification of living things	2.1 Compare the characteristics of organisms within ***kingdom*** classifications
	2.2 Explain the ***lower levels*** of classification
	2.3 Use keys to classify living things
3 Describe the interaction of living things	3.1 Identify ***ecosystems*** and their ***features***
	3.2 Describe the flow of energy through ***ecosystems***
	3.3 Describe the ***relationships*** between members of ecosystems
	3.4 Describe the ***adaptations*** of living things to their surroundings

Required Knowledge and Skills

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

Required Knowledge:

- structure and function of cells
- sources and use of energy in cellular processes
- classification of living things
- functions of ecosystems
- scientific terminology related to the area of biology

Required Skills:

- literacy skills to interpret and convey information about key concepts in biology
- problem solving skills to identify relationships and compare concepts
- planning and organising skills to compare and classify information and concepts

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.

Cell types include:
- eukaryotes
- prokaryotes

Cell reproduction includes:
- mitosis
- cytokinesis
- cell cycle

Sources of energy may include:
- food
- light

Processes include:
- photosynthesis
- cellular respiration

Kingdoms include:
- eubacteria
- archaebacteria
- protists
- fungi
- plants
- animals

Lower levels include:

- phylum
- class
- order
- family
- genus
- species

Ecosystems may include:

- aquatic
- marine
- terrestrial
  - forests
  - grasslands
  - deserts
  - tundra

Features include:

- niche
- community
- population
- biotic
- abiotic

Relationships include:

- competition
- symbiosis
- predation
- parasitism
- commensalism

Adaptations may include

- structural
- physiological
- behavioural
- reproductive

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 must confirm the ability to:

assessment and evidence required to demonstrate competency in this unit

- Apply the basic concepts of biology to explain:
  - the structure and function of cells
  - sources and use of energy
  - the classification of living things
  - functions and relationships 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.

Assessment must ensure access to:

- research facilities such as library, computer and internet
- scientific texts

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- oral or written questioning to assess knowledge of concepts such as structure and function of cells
- oral presentation to demonstrate knowledge of concepts in biology such as the features of living things
- practical demonstration to assess application of concepts such as classification of living things
- written report to assess knowledge of concepts such as ecosystems and their features

Unit Code VU22069

Unit Title Examine concepts in chemistry

Unit Descriptor

This unit describes the skills and knowledge to examine the major concepts in chemistry such as atomic structure, chemical reactions and solution chemistry and their basic application.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit applies to learners who wish to develop basic knowledge and skills in the area of chemistry.

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 Explain atomic structure	1.1 Describe the particle theory view of matter
	1.2 Explain ***states of matter*** and their properties with reference to particles
	1.3 Describe the arrangement of ***subatomic particles*** in an atom and their electrical charge
	1.4 Explain the mass and volume of atoms in terms of their structure
	1.5 Explain the structure of isotopes and ions of atoms
2 Explain how atoms combine	2.1 Describe the combination of atoms to make more stable ***formations***
	2.2 Explain different types of chemical ***bonding***
	2.3 Describe the concept of mole in chemistry
	2.4 Calculate the mass in grams of one mole of selected compounds
3 Describe the periodic table	3.1 Explain the purpose of the periodic table
	3.2 Explain the structure of the periodic table
	3.3 Describe the relationship between elements in a group

	3.4	Identify the ***information*** contained in the table for each element
	3.5	Describe the general features of metals, metalloids and non-metals
4 Describe chemical reactions	4.1	Describe the difference between chemical and physical changes
	4.2	Describe the ***main classes of chemical reactions***
	4.3	Write balanced chemical equation for common reactions
5 Explain the reactions between acids and bases	5.1	Explain the meaning of the terms acid and base according to the Brønsted-Lowry theory
	5.2	Explain the properties of acids and bases
	5.3	Explain the process of neutralisation
	5.4	Explain the pH of substances.
6 Explain solutions and solubility	6.1	Explain the characteristics of solutions, suspensions and other mixtures
	6.2	Interpret solubility curves
	6.3	Construct solubility curves using experimental data
	6.4	Calculate the molarity of solutions

Required Knowledge and Skills

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

Required Knowledge:

- classification and properties of matter
- using scientific terminology
- atomic structure
- periodic table
- chemical equations
- chemical reactions
- solutions and solubility
- acids and bases
- Brønsted-Lowry theory

- relationship between mole and mass
- basic chemical calculations

Required Skills:

- numeracy skills to:
  - calculate mass of various compounds
  - calculate molarity
- problem solving skills to:
  - write balanced chemical equations
  - identify relationships between elements
- literacy skills to:
  - interpret and summarise key information
  - follow instructions
  - record results

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.

States of matter include:
- gases
- liquids
- solids

Subatomic particles include:
- protons
- neutrons
- electrons

Formations include:
- molecules
- ions
- lattices

Bonding includes:
- covalent
- ionic
- metallic

Information includes
- name
- symbol
- atomic number

- mass number

Main classes of 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 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:

- apply the basic concepts in chemistry 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

Assessment must ensure access to:

- research facilities such as a library, computer and internet access
- relevant scientific texts

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- oral or written questioning to assess knowledge of concepts and theories such as atomic structure
- oral presentation to assess knowledge such as the structure and purpose of the periodic table
- practical demonstration to demonstrate application of knowledge of chemical reactions

- project based on a concept of chemistry
- written report based on activity outcomes

Unit Code VU22070

Unit Title Examine concepts in physics

Unit Descriptor This unit describes the skills and knowledge required to examine the major concepts in physics such as motion, magnetism and sound and their basic application.

Employability Skills This unit contains employability skills.

Application of the Unit This unit applies to learners who wish to develop basic knowledge and skills in the area of physics

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 Describe and determine basic quantities in the measurement of straight line motion	1.1 Explain key ***terminology*** relevant to the description of straight line motion
	1.2 Make measurements of displacement and time from observations of straight line motion
	1.3 Make determinations of velocity and acceleration from straight line motion data
	1.4 Plot displacement and velocity graphs from straight line motion data
	1.5 Make descriptions of motion from displacement and velocity graphs
2 Explain the basic concepts in Newton's laws of motion	2.1 Explain key terminology relevant to the laws of motion
	2.2 Describe the effect on the movement of a body in the absence of a net force
	2.3 Explain the relationships between the net force, acceleration and mass
	2.4 Explain the relationship between gravity, mass and weight
	2.5 Explain observable phenomena that illustrate the motion of an object consistent with Newton's first and second laws

	2.6 Explain observable phenomena that illustrate reactive forces consistent with Newton's third law
3 Explain the basic concepts in magnetism	3.1 Describe magnetic forces in relation to the north and south poles of a compass
	3.2 Explain the difference between a magnetised and non-magnetised piece of iron
	3.3 Explain the production of magnetic fields by an electric current
	3.4 Describe the construction of an electromagnet
	3.5 Describe ***factors*** that affect the strength of a magnetic force
	3.6 Identify the ***use of magnets*** in day to day life
4 Explain the properties and behaviour of sound	4.1 Explain the movement of sound through various ***mediums***.
	4.2 Explain the representation of sound by the use of a wave
	4.3 Explain the meaning of intensity, its representation and measurement
	4.4 Explain the meaning of frequency, its representation and measurement
	4.5 Explain the meaning of velocity, its representation and measurement

Required Knowledge and Skills

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

Required 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
- scientific terminology related to physics

Required Skills:

- numeracy skills to:

  - measure displacement and time
  - determine velocity and acceleration
  - plot graphs from data
- problem solving skills to:
  - use data to determine and plot information
  - identify relationships between concepts of motion
- literacy skills to interpret and convey information about key concepts in physics

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.

Terminology may include::

- energy
- force
- movement
- gravity
- mass
- matter
- velocity
- acceleration
- momentum
- friction
- inertia
- direction

Factors may include:

- distance from magnet
- distance from pole
- temperature
- knocks or vibrations
- metal alloy used in construction of magnet

Use of magnets may include:

- 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 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:

- Apply basic concepts in physics to explain:
  - straight line motion
  - the relationship between acceleration, force and mass
  - the attractive force between objects
  - magnetism and magnetic force
  - 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.

Assessment must ensure access to:

- research facilities such as library, computer, internet resources
- relevant scientific texts

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- oral or written questioning to assess knowledge of concepts such as motion and velocity
- oral presentation of the outcomes of a problem solving task
- practical demonstration to assess knowledge of concepts such as acceleration and velocity
- project based on a problem solving task
- logbook of practical work/investigation/research activities

Unit Code VU22071

Unit Title Examine body systems

Unit Descriptor This unit describes the skills and knowledge to examine the major body systems, the organs which belong to them and their functions.

Employability Skills This unit contains employability skills.

Application of the Unit This unit applies to learners who wish to develop their knowledge and skills in the area of anatomy and physiology and related science disciplines.

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 Identify major body systems	1.1 Identify the ***major body systems*** and their **major *organs***
	1.2 Identify the functions of major body systems
2 Examine a body system	2.1 Select a ***body system for examination***
	2.2 Determine the parts of the body system being examined
	2.3 Examine the structure and function of the organs within the system
	2.4 Identify ***disorders*** affecting the body system
	2.5 Compare disorders with the normal function of the body system

Required Knowledge and Skills

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

Required Knowledge:

- terminology related to the anatomy and physiology of major body systems
- location of major body systems
- functions of major organs

Required Skills:

- literacy skills to access and interpret information about the major body systems and their

parts

- problem solving skills to locate organs within the appropriate body system

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.

Major body systems may include:	• circulatory • respiratory • skeletal • muscular • digestive • nervous
Major organs may include:	• heart • lungs • stomach • liver • brain
Body system for examination must include:	• examination of at least 2 systems
Disorders include:	• at least one disorder per body system • illnesses, diseases, conditions that affect the system's ability to function normally

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: • access and interpret information about major body systems and the major organs which belong to them • select at least 2 body systems and examine their components and normal function within the whole system

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.

Assessment must ensure access to:

- information about body systems and their parts
- models and charts of body systems

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- verbal or written questioning to assess knowledge of major body systems
- written or verbal reports on a body system and its function

Unit Code
VU22072

Unit Title
Apply essential further study skills for science

Unit Descriptor
This unit describes 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.

Application of the Unit
This unit applies to learners who wish to engage with studies in the science field and who need to develop study skills essential to the study of science or science related disciplines.

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 Use a range of learning strategies to the study of science	1.1 Identify a range of ***learning strategies*** that can be applied to the study of science
	1.2 Investigate the main ***learning contexts*** that may be experienced in the study of science in a tertiary learning environment
	1.3 Use learning strategies appropriate for a range of learning contexts in the science field
	1.4 Assess individual strengths, weaknesses and preferences in the use of different learning strategies to support the study of science
2 Use a range of library and online sources to access information related to the science field	2.1 Describe the main ***services*** of a library
	2.2 Identify the range of sources for obtaining information about science in a library
	2.3 Assess ***appropriateness*** of scientific information.
	2.4 Record and store information appropriately
3 Use effective reading strategies to interpret complex scientific texts	3.1 Describe and apply a range of ***academic reading strategies***
	3.2 Identify and discuss the significance of ***context*** for the

		meaning of a text
	3.3	Apply techniques for note-taking, summarising and synthesising information
	3.4	Use ***text structure***, technical vocabulary, wording and syntax to assist with interpretation of meaning
	3.5	Use dictionaries and other reference materials to assist with interpretation of scientific texts
4 Use academic writing skills to produce complex scientific texts	4.1	Identify the ***main features*** of different ***academic texts*** in the science field
	4.2	Identify the main phases of the academic ***writing process***
	4.3	Identify the significance of audience and context in the conventions of academic writing
	4.4	Use appropriate citation for references and quoted work
	4.5	Observe academic standards on plagiarism and collusion
	4.6	Produce a scientific text
5 Participate effectively in collaborative learning	5.1	Identify the key features of ***collaborative learning***
	5.2	Describe the characteristics of effective collaborative learning
	5.3	Apply verbal, interpersonal and participatory skills necessary for effective learning collaboration
	5.4	Negotiate appropriate planning processes with fellow students to achieve agreed outcomes

Required Knowledge and Skills

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

Required Knowledge:

- range of learning strategies
- library and online services to access information
- reading strategies to interpret scientific texts
- key stages in the writing process
- text structures and features in scientific texts
- conventions of academic referencing

- what constitutes plagiarism and the consequences of submitting plagiarised work

Required Skills:

- verbal communication such as negotiation and discussion to participate in collaborative learning
- writing skills appropriate for the completion of complex texts including correct use of citations
- literacy skills such as skimming, scanning, reading for meaning to interpret scientific texts
- literacy skills to take notes including summarising and synthesising key information
- planning and organising to record sources of information
- technology skills to access electronic library resources including internet and online searches
- problem solving skills to assess appropriateness of information for specific purposes

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.

Learning strategies may include :

- self-assessment
- note-taking
- revision
- partnerships with other students
- questioning
- tracking
- grouping/classifying information
- representing information visually
- using inferences and prior knowledge
- hypothesising
- research

Learning contexts may include:

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

- independent projects
- examinations

Services of a library may include:

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

Appropriateness of information may include:

- relevance to topic
- level of detail
- nature of media
- currency
- authenticity
- complexity or difficulty of material
- evidence base

Academic reading strategies may include:

- skimming and scanning information
- selecting main points
- critical reading

Context includes:

- implied readers of the text
- other texts cited or debated
- intention of the writer

Text structure may include:

- chapter headings
- paragraph headings and sub-headings
- diagrams and illustrations
- tables and charts
- bibliographies and references

Main features may include:	• research findings • sampling • statistical analysis
Academic texts may include :	• journal articles • reports • theses • monographs • archival documents • encyclopaedias • indexes
The ***writing process*** includes but is not limited to :	• planning • researching • referencing • drafting • revising • editing • proof reading
Collaborative learning may include :	• study groups • learning partnerships • group presentations • tutorials • workshops • on-line discussion groups

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:

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

Context of and specific resources for assessment	Assessment must ensure access to: • library resources • appropriate scientific texts • internet access and printing facilities • computers and word processing software
Method(s) of assessment	The following suggested assessment methods are suitable for this unit: • portfolio of evidence that may include draft planning materials, research notes, written pieces, reference lists, graphs, maps and diagrams • oral or written questioning to assess knowledge of features of scientific texts • verbal or written reports

Unit Code VU22073

Unit Title Research scientific fields of study

Unit Descriptor This unit describes the knowledge and skills to research a scientific field of study in a tertiary learning environment

Employability Skills This unit contains employability skills.

Application of the Unit This unit applies to learners who are preparing for study in the science or science related disciplines at a tertiary level.

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 scientific field of study	1.1 Identify **scientific *fields of study*** available in tertiary environments
	1.2 Select a field of study for investigation
	1.3 Describe the field of study and areas of ***specialisation***
	1.4 Examine the core subject matter and areas of specialisation
	1.5 Describe ***forms of enquiry*** and research methods used in the field of study
2 Use on-line technologies for researching a field of study	2.1 Source information using academic databases and search engines
	2.2 Cross –check Information using alternative sources and accepted authorities
	2.3 Examine online texts for reliability and quality of evidence and argument
	2.4 Examine online resources for consistency with academic discourse and conventions.
3 Use online technology to examine a journal article	3.1 Access journal article abstracts using academic databases
	3.2 Select and access a peer reviewed journal article

	3.3	Describe the peer review process
	3.4	Examine the research methods and the subject matter presented in the journal article
4 Deliver a presentation on field of study examined	4.1	Identify audience and purpose of the presentation
	4.2	Structure and organise presentation to fit time available
	4.3	Source images appropriate to purpose and sequence logically
	4.4	Source supporting material as required
	4.5	Use delivery register appropriate to audience and communicate clearly and succinctly
	4.6	Respond to questions and discussion

Required Knowledge and Skills

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

Required Knowledge:

- fields of study available at Australian universities
- online technologies and their applications
- the purpose of peer review of journals
- research methods specific to fields of study
- presentation techniques and protocols

Required Skills:

- oral skills to communicate verbally for presentations
- research skills to source, examine and compare information
- literacy skills to summarise and paraphrase academic texts
- digital literacy skills to access information using online technologies
- problem solving skills to critically assess reliability and quality of online evidence

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.

Scientific fields of study may include:	• biological sciences • physical sciences • chemical sciences

- earth sciences

Specialisations may include:

- aeronautics
- anatomy
- astronomy
- 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 may include:

- 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 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:

- obtain information about scientific fields of study from a variety of sources
- use online technologies, specifically search engines and online authoring tools to research a scientific field of study
- make a presentation on a scientific field of study

Context of and specific resources for assessment

Assessment must ensure access to:

- library resources to access information about fields of study
- course directories
- field of study guides
- internet access and printing facilities
- computers and word processing software

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- portfolio of research information for selected scientific field of study
- written or oral questioning to establish knowledge of field of study
- presentation on selected field of study

Unit Code	**VU22074**
Unit Title	**Use a range of techniques to solve mathematical problems**
Unit Descriptor	This unit describes the skills and knowledge to use a range of specialist techniques and concepts to solve mathematical problems.
Employability Skills	This unit contains employability skills.
Application of the Unit	This unit applies to a number of science streams

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 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 triangles
3 Use indices to solve problems	3.1 Evaluate index form expressions
	3.2 Simplify 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	4.1 Determine lengths and perimeters of rectangles, triangles, circles and simple combined shapes using

	problems in two and three dimensions	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 equations and formulae	5.1 Substitute given values into equations and formulae
		5.2 Write equations to solve problems
		5.3 Transpose ***formulae***
		5.4 Solve linear equations
6	Solve problems by plotting points	6.1 Plot given points and points determined from the general formula y = mx+c 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+c, 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 and analyse ***statistical information***
8	Identify connections between formulae and graphical representations	8.1 Use graphical techniques to draw linear and ***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 Knowledge and Skills

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

Required Knowledge:

- use of Pythagoras Theorem in trigonometry
- principles of algebra
- techniques to solve algebraic problems
- major characteristics of linear and simple non-linear graphs
- graphical techniques to draw graphs

Required Skills:

- numeracy skills to perform a range of calculations including:
  - fractions and mixed numbers
  - decimals and directed numbers
- problem solving skills to :
  - round a decimal to a given number of decimal places
  - use geometry to determine angles in triangles (including non-right angled)
  - convert unit quantities to units with a different prefix
  - write a number correct to a given number of significant figures
  - calculate systematic, random and percentage errors
  - describe the general shape of a given or plotted scatter diagram
  - identify and determine dimensions of general shapes
  - estimate to check calculations and reasonableness of outcomes
  - use a range of mathematical symbolism, charts, diagrams and graphs to represent mathematical thinking and processing
- literacy skills to:
  - read and interpret values in a table, chart or graph
  - locate embedded information necessary to solve a problem or analyse quantitative information
- technology skills to use scientific calculator functions including statistical functions
- planning and organising skills to collect and organise mathematical data

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.

Formulae may include:	• simple formulae with powers
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
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 may include:	• linear (involving multiple operations) • simultaneous linear • quadratic

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:

- apply a wide range of mathematical concepts 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
  - presenting and evaluating statistical information
  - identifying connections between formulae and graphical representations
  - using algebraic techniques to analyse and solve problems

- apply estimation to check calculations and reasonableness of problem solving outcomes
- use mathematical symbolism, charts, diagrams and graphs to convey mathematical thinking and processing.

Context of and specific resources for assessment

- Calculations should be performed using a combination of pen and paper and calculator as appropriate to the calculation

Assessment must ensure access to:

- calculators to perform calculations
- computers and internet to access relevant mathematical data such as spreadsheets and data bases
- materials and texts to support completion of tasks

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- oral or written questioning to assess knowledge of mathematical techniques
- pictures, diagrams, models to demonstrate a mathematical concept
- records of teacher observations of learner's activities, discussions and practical tasks
- written or verbal reports of investigations or problem-solving activities

Unit Code
VU22075

Unit Title
Apply mathematical techniques to scientific contexts

Unit Descriptor

This unit describes the skills and knowledge related to basic statistics, functions and their graphs, circular functions, exponents and logarithms for study in science related disciplines..

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit applies to learners who are seeking to re-engage with learning in the science field.

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 Use trigonometry and circular function to solve mathematical problems	1.1 Define Sin θ, cos θ and tan θ in terms of the unit circle and use symmetry properties to convert the function of a negative angle or an angle greater than 90° to the function of an acute angle
	1.2 Convert angles between degrees and radian measure
	1.3 Determine the value of the three basic trigonometric ratios of any angle given in degrees or radians
	1.4 ***Sketch*** the graphs of y = sin x, y = cos x and y = tan x, where x is measured in degrees or radians
	1.5 Sketch the graphs of y = a sin bx and y = a cos bx, giving amplitude and wavelength
	1.6 Solve problems involving simple applications of circular functions
2 Use simple algebraic functions and their graphs to solve mathematical problems	2.1 Solve simple problems involving direct and inverse proportion
	2.2 Describe general shape, rates of change, intercepts and asymptotes of a graph and give domain and range using set notation
	2.3 Sketch the graph of a quadratic function

	2.4 Determine whether a relation of a given graph is a function from a graph, a set of co-ordinates or an equation
	2.5 Solve quadratic equations algebraically and graphically
	2.6 Determine equations from graphs with known quadratic rules
	2.7 Solve ***simultaneous equations*** algebraically and graphically
3 Determine non-linear laws by transforming them into a linear form	3.1 Transform a set of non-linear data to a linear form and draw the line of best fit
	3.2 Determine the corresponding non-linear formula
4 Solve problems involving exponential and logarithmic functions	4.1 Simplify exponential expressions using the laws of indices
	4.2 Solve exponential equations without using logarithms
	4.3 Convert expressions between exponential and logarithmic forms
	4.4 Evaluate logarithms
	4.5 Solve applied problems using logarithms and simple exponential equations
	4.6 Draw graphs of exponential functions
5 Collect and process numerical data to illustrate its statistical properties	5.1 Present statistical data using tables and ***graphs***
	5.2 Use frequency distribution curves to determine numbers and/or percentage values which have a particular characteristic
	5.3 Use cumulative frequency curves to determine percentiles for data
	5.4 Determine ***measures of central tendency*** for a given set of data and identify limitation of their use in isolation
	5.5 Determine measures of ***spread*** and identify limitation of their use in isolation
	5.6 Determine properties of statistical data

Required Knowledge and Skills

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

Required Knowledge:

- 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 =a, x=b and $y = ax^2+bx+c$, 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 x^2 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.

Required Skills:

- technology skills to use appropriate keys on a scientific calculator
- literacy skills to interpret and use statistical data
- communication skills to present statistical data
- problem solving skills to apply a range of mathematical functions including:
  - trigonometric functions and radian measure
  - algebraic functions
  - exponential and logarithmic functions

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.

Sketch means:	• using main features not by plotting points
Simultaneous equations are:	• quadratic plus linear
Graphs should include:	• histograms • cumulative frequency ogives • box and whiskers plots

Measures of central tendency include:	• mean • median • mode
Spread includes:	• range • variance • standard deviation

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:

- 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

Context of and specific resources for assessment

Assessment must ensure access to:

- scientific calculator
- materials and texts to support completion of tasks

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- oral or written questioning to assess knowledge of mathematical concepts and techniques
- pictures, diagrams, models that demonstrate a problem solving process
- practical demonstration to illustrate a mathematical

technique

- teacher observations of learner's activities, discussions and practical tasks
- written or verbal reports of investigations or problem-solving activities

Unit Code
VU22076

Unit Title
Investigate atomic structure and bonding

Unit Descriptor
This unit describes the skills and knowledge to investigate the application of atomic structure, bonding and the periodic table.

Employability Skills
This unit contains employability skills.

Application of the Unit
This unit applies to learners who wish to develop their knowledge and skills in the area of chemistry and related science disciplines

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 Apply the particle theory of matter	1.1 Use ***appropriate terminology*** to discuss classification and properties of matter
	1.2 Use the particle theory of matter to explain the states of matter and their ***common properties***
	1.3 Identify distinctions between physical and chemical changes
	1.4 Describe the relationship between properties of materials and their uses
	1.5 Classify pure substances into ***elements*** and compounds on the basis of their properties and the particle theory of matter
2 Use the Bohr-Rutherford model to explain the structure of an atom	2.1 Identify the ***principal sub-atomic particles*** together with their mass, relative mass and charge
	2.2 Explain the way shell/energy level structure of an atom relates to its electron configuration in the ground state
	2.3 Explain the ***structure*** of the modern periodic table
	2.4 Explain the relationship between the electronic configuration of an atom and its position in the periodic table
	2.5 Explain ***atomic property trends*** in the periodic table

3 Use knowledge of periodicity and bonding to explain the chemical and physical properties of common elements and compounds	3.1 Identify stable electron configurations with reference to atoms of the noble gases and use to predict likely gain or loss of electrons for main group metallic and non-metallic atoms
	3.2 Explain ionic, covalent and metallic bonding using common examples and predict the likely nature of bonding in elements and binary compounds
	3.3 Use the concept of electronegativity to identify polar covalent bond
	3.4 Describe the role polarity plays in intermolecular forces
	3.5 Use electron dot diagrams to represent the transfer of electrons in ionic bonding
	3.6 Use electron dot and dash diagrams to represent the bonding in and structure of simple molecules
	3.7 Use the nature of bonding in an element or compound to predict some of their ***physical properties***
4 Derive systematic names and formulae for simple inorganic compounds	4.1 Determine the correct chemical formulae for binary compounds using basic valency concept
	4.2 Identify binary, ionic and molecular compounds
	4.3 Determine the correct ***chemical formulae and names for acids, bases and salts***

Required Knowledge and Skills

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

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
- structure of the periodic table and its relationship to atomic structure
- periodicity and bonding
- systematic names and formulae for simple inorganic compounds
- safety procedures to work safely with common chemicals

Required Skills:

- problem solving skills to:
  - apply particle theory and identify chemical relationships
  - classify elements and compounds

  - draw and interpret electronic dot/dash diagrams
  - predict electron configurations of atoms
- literacy skills to:
  - write chemical formulae
  - read and interpret the periodic table

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.

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

Common properties may include:	• conservation of mass • conservation of shape versus flow • conservation of volume versus expansion • compressibility
Elements include:	• metals • non-metals • noble gases
Principal sub-atomic particles include:	• electrons • protons • neutrons
Explanation of the structure should include but is not limited to:	• at least the first 20 elements • some transition elements • drawing and interpreting diagrams which represent Bohr-Rutherford models of atoms and atomic ions
Atomic property trends may	• atomic size

include:	• 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 may include:	• compounds 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 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:

- apply theories in atomic structure and bonding to:
  - classify properties of matter
  - explain the structure of an atom
  - explain the chemical and physical properties of common elements and compounds
  - determine names and formulae for simple inorganic compounds
  - represent information related to structure and bonding

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.

Assessment must ensure access to:

- periodic table
- drawing materials
- equipment and resources to complete tasks

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- oral or written questioning to assess knowledge of concepts such as atomic structure and bonding
- oral presentation based on a problem solving activity
- practical demonstration related to application of concepts such as atomic structure and bonding

- research assignment
- written report based on a problem solving activity

Unit Code	**VU22077**
Unit Title	**Investigate stoichiometry and solution chemistry**
Unit Descriptor	This unit describes the skills and knowledge to apply stoichiometry and solution chemistry to solve problems.
Employability Skills	This unit contains employability skills.
Application of the Unit	This unit applies to learners who wish to develop their knowledge and skills in the area of chemistry and related science disciplines
Prerequisite	VU22076 Investigate atomic structure and bonding

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 Use the mole definition and formulae to solve problems	1.1 Define and calculate the relative atomic mass of an element using mass spectrometric data
	1.2 Calculate the relative molecular and formula mass of molecular and ionic compounds
	1.3 Use the mole to solve ***problems***
	1.4 Use experimental data to calculate the empirical formulae of compounds
	1.5 Use empirical formulae and relative molecular masses to determine molecular formulae.
2 Derive balanced chemical equations for simple reactions and apply stoichiometry to these equations	2.1 Write balanced chemical equations to represent chemical reactions
	2.2 Distinguish the differences between ***types of chemical reactions***
	2.3 Use stoichiometric equations to calculate mass-mass relationships between reactants and products.
3 Explain solution formation and solubility	3.1 Explain the characteristics of solutions, suspensions and other mixtures

	3.2 Use ***terminology*** relevant to solution formation
	3.3 Explain factors which affect solubility
	3.4 Explain factors which affect the rate at which a solute dissolves
	3.5 Explain the ***types of solution***
	3.6 Construct and interpret solubility curves from experimental data.
4 Solve concentration problems	4.1 Perform ***dilution calculations***
	4.2 Calculate the ***molarity*** of solutions
	4.3 Calculate concentration in ***other units***.

Required Knowledge and Skills

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

Required Knowledge:

- definition of mole to solve problems
- solution formation and solubility
- different types of chemical reactions
- terminology related to solution formation and solubility
- types of solution

Required Skills:

- problem solving skills to:
  - use formulae to solve problems
  - write balanced chemical equations
  - construct solubility curves
  - use experimental data to make calculations
- numeracy skills to perform calculations related to solution formation and solubility

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.

Problems may include:

- mass of substance
- number of particles and relative atomic mass or molecular mass

Types of 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 • supersaturated
Dilution calculations refers to:	• using the formula $C_1V_1=C_2V_2$
Calculate ***molarity*** by:	• using the formula $c = \frac{n}{V}$
Other units include:	• percentages • weight/volume • volume(v/v) • parts per million(ppm)

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: • apply concepts in stoichiometry and solution chemistry to solve problems and perform a range of calculations including: − using mole definition and formulae to solve problems − representing chemical reactions for simple chemical reactions with chemical equations − calculating solution formation and solubility rates − solving concentration problems • interpreting experimental data
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.

Assessment must ensure access to:

- calculator
- resources and equipment to complete tasks

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- oral or written questioning to assess knowledge of concepts such as solution formation
- oral presentation based on a problem solving activity
- practical demonstration to demonstrate the application of concepts to solve problems
- research assignment based on a problem solving task
- written or verbal report based on the outcomes of calculations such as those related to solutions

Unit Code	**VU22078**
Unit Title	**Investigate organic chemistry and properties of materials**
Unit Descriptor	This unit describes the skills and knowledge to investigate and apply the concepts of organic chemistry and properties of materials to solve problems
Employability Skills	This unit contains employability skills.
Application of the Unit	This unit applies to learners who wish to develop their knowledge and skills in the area of chemistry and related science disciplines

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 Use simple hydrocarbons to explain structure and isomerism of organic molecules	1.1 Draw the structural formulae of ***simple hydrocarbons*** up to C6
	1.2 Explain the concept of isomerism
	1.3 Identify common functional groups in organic molecules
2 Name and draw structures of simple organic molecules using IUPAC rules	2.1 Use International Union of Pure and Applied Chemistry(IUPAC) conventions to name ***simple organic compounds*** on the basis of their molecular structures
	2.2 Draw the structures of simple organic molecules based on their IUPAC names
3 Explain the relationship between structure and properties of organic compounds	3.1 Identify the ***intermolecular bonding*** present in simple organic compounds
	3.2 Identify the relationship between the structures of organic compounds and their ***physical properties***
	3.3 Describe the formation of polymers from simple monomers
4 Write balanced chemical equations to represent	4.1 Write balanced equations for organic reactions where the reactants and products are specified

simple organic reactions	4.2	Write balanced equations for the complete and/or partial combustion of hydrocarbons in the context of their use as fuels
	4.3	Write balanced equations to demonstrate the acidic nature of carboxylic acids and the alkaline nature of organic amines.

Required Knowledge and Skills

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

Required Knowledge:

- structural formulae of simple hydrocarbons
- the concept of isomerism
- functional groups in organic molecules
- IUPAC naming and conventions
- physical properties of organic compounds
- names of simple organic compounds
- correct terminology to describe concepts of organic chemistry and the properties of materials

Required Skills:

- Problem solving skills to:
  - represent simple chemical reactions of organic compounds
  - identify relationships between organic compounds and physical properties
  - draw molecules using the appropriate techniques
- literacy skills to write chemical equations in the correct format

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.

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 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:

- apply concepts in organic chemistry and properties of material to solve problems and represent information including:
  - demonstrating knowledge of the structure and isomerism of organic molecules
  - representing simple organic molecules using IUPAC rules
  - explaining relationships between structure and properties of organic compounds
  - writing balanced chemical equations to represent simple organic reactions

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.

Assessment must ensure access to:

- drawing materials
- resources and equipment to complete tasks
- IUPAC conventions

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- verbal or written questioning to assess knowledge of concepts such as isomerism
- oral presentation on the outcomes of a problem solving activity
- practical demonstration such as drawing the structure

of organic molecules

- research assignment based on a problem solving task
- written report based on the outcomes of a problem solving activity

Unit Code	**VU22079**
Unit Title	**Investigate chemical reactions**
Unit Descriptor	This unit describes the skills and knowledge to apply basic concepts related to chemical reactions including acid-base and redox theory.
Prerequisites	VU22076 Investigate atomic structure and bonding VU22077 Investigate stoichiometry and solution chemistry VU22078 Investigate organic chemistry and properties of materials
Employability Skills	This unit contains employability skills.
Application of the Unit	This unit applies to learners who wish to develop their knowledge and skills in the area of chemistry and related science disciplines

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 Use ionic equations to represent reactions involving ions in solution	1.1 Distinguish ionic liquids from aqueous solutions containing ions 1.2 Distinguish ionisation reactions from dissociation reactions 1.3 Classify electrolytes into strong or weak depending on the degree of their ionisation or dissociation 1.4 Write ***ionic equations***
2 Use current theories to explain acid-base behaviour	2.1 Identify the general properties of acids and bases 2.2 Classify common substances as acids or bases using the ***Arrhenius*** and ***Bronstead- Lowry*** theories 2.3 Use ***terminology*** relevant to explaining acid-base behaviour 2.4 Explain the differences between strong and weak acids and bases 2.5 Write stoichiometric and ionic equations for

		neutralisation reactions
	2.6	Write ionic equations for the ionisation reactions of common polyprotic acids
3 Use the pH scale	3.1	Use the ionic product of water and the pH formula to solve simple pH calculations
	3.2	Use the pH scale to classify aqueous solutions as acidic, alkaline or neutral
	3.3	Explain why aqueous solutions of some neutralisation salts are not pH neutral
4 Use titration results to complete concentration problems	4.1	Prepare ***equipment*** to perform titrations
	4.2	Perform titrations
	4.3	Calculate the concentration of an acid or base from titration results
	4.4	Draw and interpret a pH titration curve (of a strong acid and base) from experimental data
5 Write ionic equations to represent redox reactions	5.1	Use ***terminology*** relevant to redox reactions
	5.2	Use the activity series of metals to predict reactions between metals and water
	5.3	Write ionic equations (half and total) for ***simple redox reactions***
	5.4	Determine and use oxidation numbers to identify redox reactions.
6 Explain the operation and uses of galvanic and electrolytic cells	6.1	Identify the parts of an electrochemical (galvanic) cell
	6.2	Make ***predictions*** as to the behaviour of electrochemical cells
	6.3	Identify the parts of an electrolytic cell and explain the differences between an electrochemical and electrolytic cell
	6.4	Write ionic equations (half and total) for simple electrolytic processes.
7 Explain the corrosion of steel and its prevention in terms of redox theory	7.1	Identify the conditions needed for corrosion

7.2 Use redox theory and ionic equations to explain the corrosion of steel and its prevention

Required Knowledge and Skills

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

Required Knowledge:

- definition of electrolyte
- acid-base theories including Arrhenius and Bronstead-Lowry theories
- strengths of acids and bases
- titration techniques and calculations
- structure of the pH scale
- redox theory
- terminology related to:
  - titration techniques
  - acid-base behaviour
  - redox reactions
- classification of:
  - electrolytes
  - acids and bases
  - aqueous solutions
- procedures for the safe use of chemical equipment and resources

Required Skills:

- problem solving skills to:
  - apply chemical concepts and processes to predict and explain chemical reactions
  - write and solve equations
  - calculate pH
  - calculate acid/base concentration
  - classify aqueous solutions
  - interpret and calculate results from experimental data

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.

Electrolyte may include:

- liquid such as ionic liquids, aqueous solutions containing ions
- solid such as ceramic fuel cell

Ionic equations may be for:	• ionisation and dissociation • precipitation (association) reactions
Arrhenius theory refers to:	• production of $H_3O^+(aq)$ or $OH^-(aq)$ in water
Bronstead- Lowry theory refers to:	• proton transfer
Terminology relevant to explaining acid-base behaviour may include:	• hydrolysis • amphoteric (amphiprotic) substance • conjugate acid and base
Equipment may include:	• pipette, • burette, • volumetric flasks
Terminology relevant to redox reactions may include:	• oxidation • reduction • redox • reductant (reducer) • 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 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:

- apply theories related to chemical reactions to solve problems, perform calculations and interpret and represent data including:
  - representing reactions involving ions in solution
  - explaining chemical behaviour
  - using the pH scale to solve problems and perform calculations
  - performing titrations and using results to solve problems and make calculations
  - writing ionic equations to represent redox reactions
  - explaining the operation and uses of galvanic and electrolytic cells

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.

Assessment must ensure access to:

- drawing materials
- equipment to complete tasks such as:
  - burettes
  - laboratory glassware
  - chemical solutions & indicators

Method(s) of assessment

- verbal or written questioning to assess knowledge of theories and concepts such as theories to explain acid-base behaviour
- verbal presentation based on the outcomes of a problem solving task
- practical demonstration such as undertaking calculations of the concentration of an acid
- research assignment based on the application of a theory or concept
- written report based on the outcomes of a problem solving activity

Unit Code VU22080

Unit Title Investigate waves and optics

Unit Descriptor This unit describes the skills and knowledge to apply wave theory and the laws of optics.

Employability Skills This unit contains employability skills.

Application of the Unit This unit applies to learners who wish to develop their knowledge and skills in the area of physics and related science disciplines

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 Distinguish between transverse and longitudinal wave type	1.1 Use wave theory ***terminology*** appropriately
	1.2 Explain the difference between a transverse wave and a longitudinal wave
	1.3 Describe the motion of individual particles in a transverse and longitudinal wave
	1.4 Explain how to determine when two particles in a wave are in phase
2 Explain the nature of sound waves	2.1 Explain the ***properties of sound waves***
	2.2 Identify the purpose and features of the decibel scale
	2.3 Describe the ***behaviour of sound waves***
	2.4 Describe the properties of resonance and standing waves
3 Explain the applications of the major bands of the electromagnetic spectrum	3.1 Contrast the ***properties*** of the major components of the electromagnetic spectrum
	3.2 Provide an example of an application for each section of the electromagnetic spectrum
	3.3 Describe factors affecting the intensity of a source of electromagnetic radiation

	3.4 Calculate the wavelength or frequency of an electromagnetic wave
	3.5 Describe the features of laser radiation
4 Determine the path of a light ray	4.1 Describe the ***behaviour of light*** when it undergoes reflection and refraction
	4.2 Determine the path of a light ray quantitatively
5 Describe the formation of images by mirrors and lenses	5.1 Use ray tracing techniques to describe images formed by ***mirrors*** and lenses
	5.2 Identify the three principal rays for concave mirrors and concave lenses
	5.3 Explain the optics of ***simple optical instruments***

Required Knowledge and Skills

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

Required Knowledge:

- main types of waves including transverse and longitudinal
- scientific laws and theories to explain the behaviour of light
- relationship between velocity, frequency and wavelength
- the properties and behaviour of sound waves
- amplitude, period and phase
- factors affecting light intensity
- components of the electromagnetic spectrum and their relationship
- critical angle and total internal reflection
- optical fibres
- terminology to describe wave theory and its application
- purpose and safe use of scientific equipment in a physics laboratory

Required Skills:

- Problem solving skills to:
  - use ray tracing techniques
  - calculate paths of light rays
  - use a scientific calculator
  - determine relationships between the components of wave theory and their applications
  - distinguish differences between waves

- use information about sound waves to undertake calculations

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.

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
Properties of sound waves may include	• velocity • pitch and Frequency • interference • diffraction • intensity and loudness
Behaviour of sound waves may include	• interference and beats • shock waves • boundary behaviour • reflection • refraction
Properties include:	• source • frequency • wavelength • energy • detection
Describing 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.
Mirrors may include:	• 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 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:

- apply relevant scientific theories and laws to solve a range of problems and undertake a range of calculations including:
  - comparing the differences between transverse and longitudinal wave types and their motion
  - explaining the behaviour of sound waves
  - explaining and using the applications of the major bands of the electromagnetic spectrum
  - determining the path of a light ray
  - describing the formation of images by mirrors and lenses.

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.

Assessment must ensure access to:

- scientific calculator
- equipment to complete tasks such as wave generator, slinky springs, ripple tanks, microwave generator, laser and accessories, Hodson's light box kits and optical bench
- optical instruments
- blackout facilities

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- verbal or written questioning to assess knowledge of theories and concepts such as the properties and behaviour of light and sound waves
- verbal presentation based on the outcomes of a problem solving task
- practical demonstration such as calculating the path of

a light ray

- research assignment based on the application of a theory or concept
- written report based on the outcome of a calculation or problem solving activity

Unit Code VU22081

Unit Title Apply principles of kinematics

Unit Descriptor This unit describes the skills and knowledge to describe and use the principles of kinematics to represent and calculate the motion of an object.

Employability Skills This unit contains employability skills.

Application of the Unit This unit applies to learners who wish to develop their knowledge and skills in the area of physics and related science disciplines.

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 Explain the linear motion of an object	1.1 Describe the motion of an object using appropriate ***terminology***
	1.2 Distinguish the position, displacement and distance travelled by an object moving with linear motion.
	1.3 Calculate the velocity and speed of an object given the displacement, distance and time
	1.4 Calculate the acceleration of an object given the initial velocity, final velocity and time
	1.5 Solve ***problems*** related to moving objects
	1.6 Present ***data*** based on calculations
2 Draw and interpret kinematic graphs	2.1 Draw position-time and velocity-time graphs from experimental data
	2.2 Calculate displacement and acceleration from a velocity-time graph
	2.3 Draw position-time, velocity-time and acceleration-time graphs for objects moving with constant velocity and acceleration
	2.4 Describe the motion of an object in a velocity-time graph using appropriate kinematic terminology

	2.5 Present data
3 Define vector and scalar quantities	3.1 Explain the difference between vector and scalar quantities
	3.2 Demonstrate vector quantities graphically
	3.3 Resolve a vector into two right-angled components
	3.4 Present data
4 Calculate the displacement and velocity of an object in two dimensions	4.1 Calculate the vector sum or subtraction of two displacement or velocity vectors that have directions parallel or perpendicular to each other
	4.2 Solve ***vector addition problems***
	4.3 Present data

Required Knowledge and Skills

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

Required Knowledge:

- concepts of position, displacement and distance to perform calculations
- concepts of velocity, speed and acceleration to calculate linear motion
- position, velocity and acceleration versus time graphs
- differences between vector and scalar quantities
- vector components
- relative velocities
- kinematic terminology to describe and calculate motion

Required Skills:

- Problem solving skills to:
  - represent and interpret data in graphic form
  - calculate velocity, speed and acceleration of moving objects
- communication skills to present scientific data
- numeracy skills to:
  - perform addition and subtraction of vectors
  - interpret experimental data
- technology skills 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. Bold / italicised wording in the Performance Criteria is detailed below.

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
Data may be presented by using:	• appropriate S.I. units and converting where necessary • appropriate number of significant figures
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 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:
	• apply the principles of kinematics to represent and calculate the motion of objects
	• explain and perform calculations of:
	  − the linear motion of an object
	  − the displacement and velocity of an object in two dimensions
	• draw and interpret kinematic graphs
	• present data based on calculations
	• apply vector and scalar quantities to calculations

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. Assessment must ensure access to: • drawing materials

- scientific calculator
- equipment to complete tasks such as ticker timers, linear air tracks and computer interfacing equipment with light gates and/or sonic ranger

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- verbal or written questioning to assess knowledge of theories and concepts such as linear motion
- verbal presentation based on the outcomes of a problem solving task such as presenting data
- practical demonstration such as calculating the motion of an object
- research assignment based on the application of a theory or concept
- written report based on the outcome of a calculation or problem solving activity

Unit Code VU22082

Unit Title Apply principles of electricity

Unit Descriptor

This unit describes the skills and knowledge to apply the principles of electricity to analyse and explain the operation of simple electrical circuits, motors, generators and domestic electricity supply.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit applies to learners who wish to develop their knowledge and skills in the area of physics and related science disciplines.

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 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 International System of Units (SI units), converting where necessary, to present 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 Identify and follow WHS requirements for assembling and measuring circuits
	2.5 Follow a circuit diagram to assemble a simple electrical extra low voltage circuit
	2.6 Measure voltage and resistance for components of an extra low voltage circuit

	2.7 Use appropriate S.I. units, converting where necessary, to present data with the appropriate number of significant figures
3 Apply the concepts of electromagnetism	3.1 Demonstrate a ***range of magnetic fields***
	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, converting where necessary, to present data with the appropriate number of significant figures
4 Explain the main features and safety components of domestic supply and household circuits	4.1 Determine the main components and stages of the transmission of electric power to the household
	4.2 Explain 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, converting where necessary, to present data with the appropriate number of significant figures

Required Knowledge and Skills

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

Required Knowledge:

- elementary unit of charge
- Coulomb's law and Ohm's law as they apply to charge and electric current
- concepts of electrical current to solve a range of problems related to current and charge and the operation of simple devices
- conventional current flow
- the S.I. units to represent data related to electric current
- difference between potential difference and electromotive force
- definition of electrical power
- the difference between AC and DC charges

- how electric power is transmitted at high voltages
- main components of household electric circuits and their function
- WHS requirements to work with circuits and use equipment safely

Required Skills:

- problem solving skills to:
  - record and present data accurately and clearly
  - evaluate the quality of experimental data, both during the experiment and following simple error analysis
  - analyse experimental data and draw valid conclusions
  - list and classify the possible sources of errors encountered when making a measurement
  - apply concepts of electrical current to assemble electric circuits
- numeracy skills to:
  - use a scientific calculator
  - compute 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
  - measure voltage and current
  - interpret a circuit diagram to assemble a circuit

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.

Calculate refers to:	• using Coulomb's law and Ohm's law
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 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:

- safely apply the principles and concepts of electricity to solve problems and perform calculations related to charge and electric current including:
  - calculating the electrical force between point charges
  - solving problems involving charge, current and time
  - presenting data with the appropriate number of significant figures
  - assembling a simple electrical circuit
  - investigating a range of magnetic fields and their relationship to the production of electric current
  - explaining the main features of domestic supply and household circuits and safety components

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.

Assessment must ensure access to:

- a scientific calculator
- equipment and resources such as
  - extra low voltage electrical power supplies
  - multimeters
  - various electrical components for circuit connection
  - electromagnetic practical kits
- safety information for use of equipment

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- verbal or written questioning to assess knowledge of theories and concepts such as the concepts of electromagnetism
- verbal presentation based on the outcomes of a problem solving task such as presenting data related to a task
- practical demonstration such as assembling electric circuits
- written or verbal report on the outcome of a calculation or problem solving activity

Unit Code	**VU22083**
Unit Title	**Apply dynamics and conservation principles**
Unit Descriptor	This unit describes the skills and knowledge to apply dynamics and conservation principles to an object and/or system. It includes 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.
Employability Skills	This unit contains employability skills.
Pre-requisite Unit	VU22081 Apply principles of kinematics
Application of the Unit	This unit applies to learners who wish to develop their knowledge and skills in the area of physics and related science disciplines.

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 Apply Newton's laws of motion	1.1 Demonstrate one proportionality from Newton's second law of motion
	1.2 Use vectors to calculate 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, converting where necessary, to present 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, converting where necessary, to present 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 ***conservation of energy principles*** to determine relevant quantities
	3.5 Use appropriate S.I. units, converting where necessary, to present 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, converting where necessary, to present 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, converting where necessary, to present 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, converting where necessary, to present 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, converting where necessary, to present data with the appropriate number of significant figures

Required Knowledge and Skills

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

Required Knowledge:

- Newton's three laws of motion and their application
- work and energy principle and its application
- definition of potential energy and forms of energy resources
- impulse and momentum equation and its application
- law of conservation of momentum and its application
- definition of the moment of force
- the principle of moments and its application
- methods of energy conservation
- International System(SI) of Units

Required Skills:

- problem solving skills to:
  - analyse experimental data, and draw valid conclusions
  - list and classify the possible sources of errors encountered when making a measurement
  - compute 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
  - use a scientific calculator to perform calculations
  - distinguish between the weight and mass of an object
- numeracy skills to present data according to S.I requirements

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.

Conservation of energy 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 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:

- apply dynamics and conservation principles and theories to perform a range of calculations related to energy and motion
- present data using appropriate S.I. units

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.

Assessment must ensure access to :

- scientific calculator
- equipment and resources to complete tasks such as
  - ticker timers,
  - linear air tracks
  - computer interfacing equipment with light gates and /or sonic ranger

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- verbal or written questioning to assess knowledge of theories and concepts such as the work-energy principle
- verbal presentation on the outcomes of a problem solving task such as calculating the momentum of an object
- practical demonstration of theories or principles such as application of the conservation of momentum principle
- written reports such as data records and results

prepared by the candidate

- research assignment based on the outcomes of an investigation

Unit Code	**VU22084**
Unit Title	**Operate simple analogue and digital electronic circuits**
Unit Descriptor	This unit describes the knowledge and skills to assemble, analyse and explain the operation of simple analogue and digital electronic circuits.
Employability Skills	This unit contains employability skills.
Pre-requisite Unit	VU22082 Apply principles of electricity
Application of the Unit	This unit applies to learners who wish to develop their knowledge and skills in the area of physics and related science disciplines.

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 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 power supply	4.1 Describe the operation of diodes in the half wave rectifier and the 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

Required Knowledge and Skills

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

Required Knowledge:

- main components and operation 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
- terminology related to electric circuits and their operation
- safety requirements to use equipment safely in a physics laboratory
- circuit symbols

Required Skills:

- problem solving skills to:
  - assemble electrical components correctly in electrical circuits
  - represent voltage signals graphically
  - conduct a range of calculations related to the operation of electronic circuits
  - use a scientific calculator
  - interpret timing diagrams
- technology skills to 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. Bold / italicised wording in the Performance Criteria is detailed below.

Logic output of the logic gates may include:	• 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 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:

- 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
- conduct a range of calculations and measurements related to the operation of simple electronic circuits

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.

Assessment must ensure access to:

- scientific calculators
- formula sheets
- equipment and resources to complete tasks such as
  - 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 such as Crocodile Clips

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- verbal or written questioning to assess knowledge of theories and concepts such as the components of a DC power supply
- verbal presentation on the outcomes of a problem solving task such as analysis of the operation of a DC power supply
- practical demonstration such as assembling a simple electronic circuit and demonstrating the operation of the circuit
- written report such as data records and results for calculations of signal frequency

Unit Code VU22085

Unit T7itle Investigate cell biology

Unit Descriptor

This unit describes the skills and knowledge to apply cell theory to identify cell organelles and structures, state their functions and outline various cellular life-supporting processes.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit applies to learners who wish to develop their knowledge and skills in the area of biology and related science disciplines.

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 Investigate cell theory	1.1 Identify the ***characteristics of living things***
	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 and functions	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
4 Describe cellular	4.1 Outline the cell cycle and apoptosis

reproduction	4.2	Describe the ***stages*** of mitosis
	4.3	Discuss the biological significance of mitosis
5 Prepare and stain tissue specimens for microscopic examination	5.1	Prepare slides of biological materials following agreed ***procedures***.
	5.2	Check specimen slides for clarity and accuracy against requirements
	5.3	Use personal protective equipment and observe established safety procedures
	5.4	Operate and maintain ***microscopes*** to obtain focussed images and to optimise performance

Required Knowledge and Skills

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

Required Knowledge:

- name, structure and function of cellular characteristics common to both plants and animals
- biological terms used to describe cell theory, cellular processes and reproduction
- cellular processes
- three tenets of cell theory
- function of major microscope components
- safety requirements and personal protective equipment
- procedures to prepare specimen slides

Required Skills:

- literacy skills to locate and interpret information about cell biology
- problem solving skills to:
  - apply cell theory to cellular processes and functions
  - produce slide specimens
  - check specimen slides against requirements
- use a microscope to perform microscopic examination of 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. Bold / italicised wording in the Performance Criteria is detailed below.

Characteristics of living things may include:	• organisation • movement

- feeding
- respiration
- excretion
- reproduction
- growth
- 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 cellular respiration and photosynthesis
- diffusion and osmosis
- active transport
- endocytosis
- exocytosis

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

Procedures may include:
- preparation of whole live specimens
- cutting sections
- staining

Microscopes include:
- compound
- stereo

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:

- use cell theory to explain cellar structures, processes and functions including cellular reproduction and cellular respiration and photosynthesis
- follow procedures to prepare clear slide specimens according to requirements
- use a microscope to perform microscopic examination of specimens

Context of and specific resources for assessment

Theoretical concepts should be supported by demonstrations and/or laboratory experiments to reinforce the links between theoretical knowledge and its practical applications.

Assessment must ensure access to:

- scientific texts
- audio visual resources
- the internet to access information
- microscopes
- specimen slides

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- verbal or written questioning to assess knowledge of theories and concepts such as cell theory
- practical work and/or demonstrations such as conducting microscopic examinations
- laboratory reports documenting data and results
- written reports based on an investigation such as the structure and function of cells
- verbal presentations on the outcomes of an investigative task such as cellular processes and functions

Unit Code
VU22086

Unit Title
Investigate anatomy and physiology

Unit Descriptor

This unit describes the skills and knowledge to explain the anatomy and physiology of living organisms and apply this knowledge to perform a simple dissection. Although the focus of this unit is on mammals, it is not a requirement that this includes humans.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit applies to learners who wish to develop their knowledge and skills in the area of biology and related science disciplines.

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 Explain the key components and functions of major mammalian anatomical and physiological systems	1.1 Locate anatomical components within an organism with reference to anatomical ***planes*** and body ***cavities***.
	1.2 Explain the contribution of major ***organ systems*** to the working of the organism
	1.3 Explain the basic mechanical, physical and biochemical functions of organ systems
	1.4 Identify common illnesses or injuries of the major organ systems
	1.5 Use ***anatomic terminology***
2 Perform a simple dissection	2.1 Prepare dissection specimens and ***equipment*** according to required procedures
	2.2 Locate and identify major anatomical organs and organ systems.
	2.3 Perform the dissection according to work/occupational health and safety requirements including the use of personal protective equipment
	2.4 Use scientific terminology related to anatomy and physiology

2.5 Follow clean up procedures after the dissection

Required Knowledge and Skills

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

Required Knowledge:

- major anatomical features of mammalian body systems
- gross physiological functions of major anatomical structures
- function of various organ systems
- common illnesses and injuries affecting major organs
- occupational health and safety requirements to perform dissections
- terminology related to the structure of major anatomical and physiological systems
- equipment required to perform dissections
- personal protective equipment to perform dissections
- clean up procedures for dissections

Required Skills:

- problem solving skills to:
  - locate anatomical components in anatomical and physiological systems
  - identify relationships between major mammalian anatomical and physiological systems
  - use dissection instruments
- literacy skills to:
  - access and use information about mammalian anatomical and physiological systems
  - apply WHS requirements when performing dissections
- planning and organisation skills to:
  - prepare dissection specimens and equipment

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.

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 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:

- explain the physiological functions and relationships of major anatomical features of at least three body systems
- apply knowledge of anatomical and physiological systems to prepare for and perform a simple dissection safely

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.

Assessment must ensure access to:

- personal protective equipment
- anatomical information such as charts and models
- dissecting equipment
- cleaning and safety materials

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- verbal or written questioning to assess knowledge of theories and concepts such as the features and components of anatomical and physiological systems
- verbal presentation on an aspect of anatomy and physiology
- practical demonstration such as undertaking a simple dissection
- written reports based on an investigation such as the results of a dissection

Unit Code
VU22087

Unit Title
Investigate introductory genetics

Unit Descriptor

This unit describes the skills and knowledge to use introductory genetics concepts to investigate the key elements of genetically-related phenomena including DNA structure, function and replication; chromosomes; and genes.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit applies to learners who wish to develop their knowledge and skills in the area of biology and related science disciplines.

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 Explain the relationship between genes, chromosomes, DNA and RNA	1.1 Define the terms DNA, chromosome and gene 1.2 Describe the ***functions and structure*** of DNA and RNA 1.3 Describe the process of protein synthesis and DNA replication
2 Explain gamete formation and sex determination	2.1 Outline the ***process*** & outcomes of meiosis 2.2 Outline the steps involved in genetic sex determination 2.3 Outline the factors involved in environmental sex determination
3 Explain types and causes of genetic mutation and chromosomal disorders	3.1 Define the terms genetic mutation and chromosomal disorder 3.2 Identify and describe ***mutation types*** 3.3 Explain the ***causes*** of mutation and rates of variation
4 Explain and apply Mendel's laws of inheritance	4.1 Use ***genetic terms*** relevant to Mendelian inheritance 4.2 Outline ***Mendelian laws*** 4.3 Illustrate the laws of inheritance using appropriate terminology

5 Discuss procedures and issues in current genetic engineering techniques	5.1 Define ***key terms*** related to genetic engineering
	5.2 Explain ***procedures*** used in genetic engineering
	5.3 Discuss ***issues*** surrounding emerging genetic technologies

Required Knowledge and Skills

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

Required Knowledge:

- relevant scientific terminology and definitions related to genetics
- genetic processes such as DNA replication and sex determination
- sequence and outcomes of meiosis
- Mendel's laws of inheritance
- types of mutations
- functions and structure of DNA and RNA
- genetic technology related to genetic engineering

Required Skills:

- Literacy skills to:
  - construct and interpret information related to genetic processes
  - analyse and discuss issues related to genetic disorders and genetic engineering
  - research issues in genetics
  - use genetic terminology
- Problem solving skills to:
  - identify relationships between different genetic components
  - link the steps in genetic processes

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.

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

Process of meiosis includes:

- sequence and stages of the first and second divisions of meiosis
- interphase I, prophase I, metaphase I, anaphase I and telophase I
- metaphase II, anaphase II and telophase II

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

Causes may include:

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

Genetic terms may include:

- allele
- phenotype, genotype
- dominant, recessive, gene pairs
- linkage, autosome or sex chromosome
- homozygous, heterozygous, mono and dihybrid crosses

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 such as sickle-cell anaemia, Tay-Sachs disease, cystic fibrosis and xeroderma pigmentosa.
- the laws of segregation and independent assortment

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 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: • apply knowledge of the theories of genetics, to describe and present information on genetic processes, laws of inheritance and mutations • present and discuss issues related to genetic engineering
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. Assessment must ensure access to: • scientific texts related to genetics • resources such as charts and sample/models • the internet to access information
Method(s) of assessment	The following suggested assessment methods are suitable for this unit: • verbal or written questioning to assess knowledge of theories and concepts such as Mendel's laws of inheritance • logbook of practical work/investigation/research activities • laboratory reports or written reports of results of investigations • verbal presentations based on investigations such as issues in current genetic engineering techniques

Unit Code VU22088

Unit Title Investigate ecology

Unit Descriptor This unit describes the skills and knowledge to apply key ecological principles underpinning issues of concern about any specific type of environment.

Employability Skills This unit contains employability skills.

Application of the Unit This unit applies to learners who wish to develop their knowledge and skills in the area of biology and related science disciplines.

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 Explain the levels of classification used in plant and animal taxonomy	1.1 Name the ***major levels of classification*** used in plant and animal classification
	1.2 Summarise the scientific requirements needed for two organisms to be placed into the same species
	1.3 Apply correct use of classification keys for both plants and animals
2 Outline the general characteristics of ecosystems	2.1 Identify the ***major components and terminologies*** associated with any ***type of ecosystem***
	2.2 Identify the biotic and abiotic features and other major components in specific ecosystem contexts
3 Describe energy flow, nutrient recycling and relationships in living systems	3.1 Categorise specific features and major components of ***food chains and webs***
	3.2 Describe energy flow through an ecosystem
	3.3 List the different types of ***symbiotic relationships*** that can occur within an ecosystem
	3.4 Describe ***nutrient*** recycling through living systems
4 Analyse key issues involved in major	4.1 Discuss and analyse the key issues surrounding an *ecological problem* caused by human activity

ecological problems caused by humans	4.2 Provide a detailed analysis of a ***major ecological problem*** and its ***environmental impact*** using appropriate scientific terminology

Required Knowledge and Skills

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

Required Knowledge:

- levels of classification used in plant and animal taxonomy
- classification keys for plants and animals
- general characteristics of ecosystems and their relationships
- features and components of food chains and webs
- terminology related to ecosystems

Required Skills:

- literacy skills to:
  - access and interpret information about eco systems
  - categorise information about food chains and webs
  - discuss and analyse current ecological issues
- problem solving skills to apply 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. Bold / italicised wording in the Performance Criteria is detailed below.

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
Type of ecosystem may include:	• aquatic • marine

- terrestrial
  - forests
  - grasslands
  - deserts
  - tundra

Food chains and webs may include	• aquatic, • marine • terrestrial
Symbiotic relationships may include	• parasitism • mutualism • commensalism
Nutrients may include	• water • carbon • nitrogen • phosphorus
Major 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 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: • apply key ecological principles to: − apply knowledge of the classifications used in plant and animal taxonomy

- identify the general characteristics of ecosystems including food chains and webs and their relationships
- analyse issues involved in current ecological problems and their impacts

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

Assessment must ensure access to:

- scientific texts
- resources such as charts and sample/models
- the internet to access information

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

verbal or written questioning to assess knowledge of theories and concepts such as the features of ecosystems

logbook documenting practical work/investigation/research activities/fieldwork

laboratory reports or written reports based on results of investigations

verbal presentations based on investigations such as current ecological problems caused by humans

Unit Code
VU22089

Unit Title
Work mathematically with statistics and calculus

Unit Descriptor

This unit describes the skills and knowledge to determine and use statistical relationships between bivariate data, the normal distribution, sets applied to problems, probability and differential calculus.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit applies to learners who wish to develop their knowledge and skills in the area of statistics and calculus as they apply to different fields of maths and science.

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 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 and describe mutually exclusive and independent events
	3.4 Determine the probability of compound events using the addition and multiplication principles
	3.5 Define 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'
	5.3 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 Knowledge and Skills

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

Required Knowledge:

- 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.

Required Skills:

- Literacy and numeracy skills 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)
  - use tables and/or calculator to determine probabilities and applications
  - use appropriate keys on a scientific calculator
  - produce scientific information in charts, diagrams and graphs
- problem solving skills to 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

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.

Bivariate data includes:	• data relating to the simultaneous measurement of two variables; for example, age and income
Calculations may be performed using:	• a calculator • a 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 for example, disease in different age groups over time

Theoretical probabilities include:	• conditional probability

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:

- apply a range of theories and techniques to solve applied mathematical problems and make predictions
- 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

Assessment must ensure access to:

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

Method(s) of assessment

The following suggested assessment methods are suitable for this unit:

- oral or written questioning to assess knowledge of mathematical concepts and techniques such as probability theory
- pictures, diagrams, models that demonstrate a problem solving process
- practical demonstration of a mathematical concept to solve a problem
- observations of learner's activities, discussions and practical tasks
- written or verbal reports of investigation or problem-solving outcomes