

**REPUBLIC OF KENYA**

**MINISTRY OF LABOUR AND SOCIAL PROTECTION**

**STATE DEPARTMENT FOR LABOUR AND SKILS DEVELOPMENT**

**NATIONAL OCCUPATIONAL STANDARD FOR SCIENCE LABORATORY**

**TECHNICIAN LEVEL 6**

**OCCUPATIONAL STANDARDS ISCED CODE: 0711 554A**

First published 2024

All rights reserved. No part of this occupational standard may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods without the prior written permission of the authorizing agent, except in the case of brief quotations embodied in critical reviews and certain other non-commercial uses permitted by copyright law.

# FOREWORD

The provision of quality education and training is fundamental to the Government’s overall strategy for social-economic development. Quality education and training will contribute to the achievement of Kenya’s development blueprint, Vision 2030 and sustainable development goals.

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. These reforms resulted to the formulation of the Policy Framework for Reforming Education and Training (Sessional Paper No.14 of 2012). A key feature of this policy is the radical change in the design and delivery of the TVET training. This policy document requires that training in TVET be competency based, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

The reforms require that industry develops occupational standards to inform the development of Competency-Based Education and Training (CBET) curriculum. This occupational standard will thus inform development of the Science Laboratory Technology Level 5 curriculum.

# PREFACE

Kenya Vision 2030 aims to transform the country into a newly industrializing, middle-income country providing a high-quality life to all its citizens by the year 2030. Kenya intends to create a globally competitive and adaptive human resource base to meet the requirements of a rapidly industrializing economy through life-long education and training. TVET has a responsibility of facilitating the process of inculcating knowledge, skills, and attitudes necessary for catapulting the nation to a globally competitive country, hence the paradigm shift to embrace Competency-Based Education and Training (CBET).

The TVET Act CAP 210A and sessional paper No.14 of 2012 on Reforming Education and Training in Kenya, emphasized the need to reform curriculum development, assessment and certification. This called for a shift to CBET to address the mismatch between skills acquired through training and skills needed by the industry as well as increase the global competitiveness of the Kenyan labour force.

# ACKNOWLEDGMENT

This occupational standard was developed through the combined effort of various stakeholders from private and public organizations. I am thankful to the management of these organizations for allowing their staff to participate in this course. I wish to acknowledge the invaluable contribution of industry players who provided input towards the development of these occupational standard.

I also thank all the individuals and organizations who participated in the validation of these occupational standard.

**TABLE OF CONTENTS**

[FOREWORD ii](#_Toc197075602)

[PREFACE ii](#_Toc197075603)

[ACKNOWLEDGMENT iii](#_Toc197075604)

[ACRONYMS vi](#_Toc197075605)

[OCCUPATIONAL STANDARD OVERVIEW viii](#_Toc197075606)

[BASIC UNITS OF COMPETENCY x](#_Toc197075607)

[APPLY DIGITAL LITERACY xi](#_Toc197075608)

[**APPLY COMMUNICATION SKILLS** xxiii](#_Toc197075609)

[APPLY WORK ETHICS AND PRACTICES xxviii](#_Toc197075610)

[APPLY ENTREPRENEURIAL SKILLS xxxix](#_Toc197075611)

[COMMON UNITS OF COMPETENCY xlvi](#_Toc197075612)

[APPLY GENERAL SCIENCE PRINCIPLES xlvii](#_Toc197075613)

[CONDUCT SCIENCE LABORATORY RESEARCH liv](#_Toc197075614)

[APPLY MATHEMATICS FOR SCIENCE lx](#_Toc197075615)

[APPLY LABORATORY AND MANAGEMENT PRACTICES lxviii](#_Toc197075616)

[APPLY PHYSICS PRINCIPLES lxxv](#_Toc197075617)

[APPLY CHEMISTRY PRINCIPLES lxxxii](#_Toc197075618)

[APPLY BIOLOGY PRINCIPLES lxxxvii](#_Toc197075619)

[CORE UNITS OF COMPETENCY xciii](#_Toc197075620)

[PERFORM STANDARD LABORATORY PRACTICES xciv](#_Toc197075621)

[PERFORM BIOLOGY TECHNIQUES c](#_Toc197075622)

[PERFORM CHEMISTRY TECHNIQUES cx](#_Toc197075623)

[PERFORM PHYSICS TECHNIQUES cxvii](#_Toc197075624)

[MEASURE PHYSICAL QUANTITIES cxxvi](#_Toc197075625)

[TEST MATERIAL PROPERTIES cxxxiv](#_Toc197075626)

[MAINTAIN LABORATORY EQUIPMENT cxxxix](#_Toc197075627)

[PERFORM CHEMICAL ANALYSES cxliii](#_Toc197075628)

[PERFORM CHEMISTRY INSTRUMENTATION TECHNOIQUES cxlviii](#_Toc197075629)

[CARRY OUT CYTO-HISTOLOGICAL AND IMMUNOLOGICAL TECHNIQUES cliv](#_Toc197075630)

[CONDUCT MICROBIOLOGICAL TESTS clix](#_Toc197075631)

[PERFORM AQUARIUM, VIVARIUM AND HERBARIUM TECHNIQUES clxiv](#_Toc197075632)

# ACRONYMS

OSHA Occupation Safety and Health Act

PPE Personal Protective Equipment

TVET Technical and Vocational Education and Training



# OCCUPATIONAL STANDARD OVERVIEW

This occupational standard consists of competencies that a person requires achieve to enable him/her to work as a science laboratory technician of level 6. The core competencies include performing standard laboratory practices, performing biology techniques, performing chemistry techniques, performing physics techniques, measure physical quantities test material properties maintain laboratory equipment perform chemical analyses perform chemical instrumentation techniques carry out cyto-histological and immunological techniques, conduct microbiological tests and perform aquarium, vivarium and herbarium techniques. The individual should also be able to apply general science skills, conduct science laboratory research and apply basic mathematics for science. Other competencies required include applying digital literacy, applying communication skills, applying work ethics and practices and applying entrepreneurial skills.

The units of competency in this occupational standard include the following four basic units, seven common units and twelve core units of competency:

**SUMMARY OF UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **BASIC UNITS OF COMPETENCY** | |
| **UNIT CODE** | **UNIT TITLE** |
| 0611 451 01A | APPLY DIGITAL LITERACY |
| 0031 441 02A | APPLY COMMUNICATION SKILLS |
| 0417 441 03A | APPLY WORK ETHICS AND PRACTICES |
| 0413 441 04A | APPLY ENTREPRENEURIAL SKILLS |
| **COMMON UNITS OF COMPETENCY** | |
| 0531 441 05A | APPLY GENERAL SCIENCE SKILLS |
| 0588 441 06A | CONDUCT SCIENCE LABORATORY RESEARCH |
| 0541 441 07A | APPLY MATHEMATICS FOR SCIENCE |
| 1022 541 08A | APPLY LABORATORY AND MANAGEMENT PRACTICES |
| 0533 541 09A | APPLY PHYSICS PRINCIPLES |
| 0531 541 10A | APPLY CHEMISTRY PRINCIPLES |
| 0533 541 11A | APPLY BIOLOGY PRINCIPLES |
| **CORE UNITS OF COMPETENCY** | |
| 1022 441 12A | PERFORM STANDARD LABORATORY PRACTICES |
| 0511 441 13A | PERFORM BIOLOGY TECHNIQUES |
| 0531 441 14A | PERFORM CHEMISTRY TECHNIQUES |
| 0533 441 15A | PERFORM PHYSICS TECHNIQUES |
| 0533 541 16A | MEASURE PHYSICAL QUANTITIES |
| 0533 541 17A | TEST MATERIAL PROPERTIES |
| 1022 541 18A | MAINTAIN LABORATORY EQUIPMENT |
| 0531 541 19A | PERFORM CHEMICAL ANALYSES |
| 0531 541 20A | PERFORM CHEMICAL INSTRUMENTATION TECHNIQUES |
| 0511 541 21A | CARRY OUT CYTO-HISTOLOGICAL AND IMMUNOLOGICAL TECHNIQUES |
| 0511 541 22A | CONDUCT MICROBIOLOGICAL TESTS |
| 0511 5411 23A | PERFORM AQUARIUM, VIVARIUM AND HERBARIUM TECHNIQUES |

# BASIC UNITS OF COMPETENCY

# APPLY DIGITAL LITERACY

**UNIT CODE:** 0611 451 01A

**UNIT DESCRIPTION:**

This unit covers the competencies required to demonstrate digital literacy. It involves operating computer devices, solving tasks using the Office suite, accessing online/offline data and information, performing online communication and collaboration, applying cybersecurity skills and performing jobs online. It also involves applying job entry techniques.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| --- | --- |
| 1. Operate computer devices | * 1. C***omputer device*** usage is determined as per workplace requirements.   2. ***Computer hardware*** is identified according to job requirements.   3. ***Computer software*** is identified according to workplace requirements.   4. Computer devices are turned on or off as per the correct workplace procedure.   5. ***Mouse techniques*** are applied in solving tasks as per workplace requirements.   6. Keyboardtechniques are applied in solving tasks as per workplace requirements.   7. Computer files and folders are created and managed as per workplace requirements.   8. ***Internet connection option***s are identified and applied in connecting computer devices to the Internet.   9. ***External devices*** are identified and connected to the computer devices as per the job requirement. |
| 1. Solve tasks using Office suite | 1. ***Word processing concepts***are applied in solving workplace tasks as per job requirements. 2. Worksheet data is entered and prepared in accordance with work procedures. 3. Worksheet data is built and edited in accordance with workplace procedures. 4. ***Data manipulation*** on a worksheet is undertaken in accordance with work requirements. 5. Worksheets are saved and printed in accordance with job requirements. 6. ***Electronic presentation concepts***are applied in solving workplace tasks as per job requirements. |
| 1. Manage data and information | * 1. Office ***internet services*** are identified and applied in accordance with office procedures.   2. ***Internet access applications*** are determined in accordance with office operation procedures.   3. Internet search is performed as per job requirements.   4. Online digital content is downloaded in accordance with workplace requirements.   5. Digital content is identified and backed up in accordance with workplace procedures. |
| 1. Perform online communication and collaboration | * 1. Netiquette principles are observed as per work requirements.   2. Electronic mail communication is executed in accordance with workplace policy.   3. Digital content copyright and licenses are identified and applied according to workplace policies and regulatory requirements.   4. ***Online*** ***collaboration tools*** are applied in accordance with workplace policies and regulatory requirements. |
| 1. Apply cybersecurity skills | * 1. ***Data protection*** and ***privacy*** is classified in accordance with workplace policies and regulatory requirements.   2. ***Internet security threats*** are identified as per workplace policies and regulatory requirements.   3. Computer threats and crimes are detected in accordance to Information Management security guidelines   4. ***Cybersecurity control measures*** are applied in accordance with workplace policies and regulatory requirements. |
| 1. Perform online jobs | * 1. ***Online job platforms*** are identified as per the job requirements.   2. Online accounts and profiles are created in accordance with the work requirements.   3. Online jobs are identified according to the bidder’s skillset.   4. Online digital identity is managed according to industry best practices.   5. Online job bidding is done as per the specific job requirements.   6. Online tasks are executed according to the job requirements.   7. Personal online payment account is managed in accordance with financial regulations. |
| 1. Apply job entry techniques | * 1. ***Job opportunities*** are sought based on competencies.   2. A winning resume/CV is developed as per job advertisement.   3. An application/cover letter is developed based on the job advertisement.   4. ***certificates and testimonials*** are organized as per resume.   5. ***Interview skills*** are demonstrated as per job advertisement. |

**RANGE**

This section provides a work environment and conditions to which the performance criteria apply. It allows for a different work environment and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Computer devices may include but are not limited to: | * Desktops * Laptops * Smartphones * Tablets * Smartwatches |
| 1. Computer hardware may include but are not limited to: | * The System Unit E.g., Motherboard, CPU, casing, * Input Devices e.g., Pointing, keying, scanning, voice/speech recognition, direct data capture devices. * Output Devices e.g., hardcopy output and softcopy output * Storage Devices e.g., main memory e.g., RAM, secondary storage (Solid state devices, Hard Drives, CDs & DVDs, Memory cards, Flash drives * Computer Ports e.g., HDMI, DVI, VGA, USB type C etc. |
| 1. Computer software may include but are not limited to: | * System software e.g., Operating System (Windows, Macintosh, Linux, Android, iOS) * Application Software e.g., Word Processors, Spreadsheets, Presentations etc. * Utility Software e.g., Antivirus programs |
| 1. External devices may include but are not limited to: | * Printers * Projectors * Smart Boards * Speakers * External storage drives * Digital/Smart TVs |
| 1. Word processing concepts may include but are not limited to: | * Creating word documents * Editing word documents * Formatting word documents * Saving word documents * Printing word documents |
| 1. Mouse techniques may include but are not limited to: | * Clicking * Double-clicking * Right-clicking * Drag and drop |
| 1. Internet connection options may include but are not limited to: | * Mobile Networks/Data Plans * Wireless Hotspots * Cabled (Ethernet/Fiber) * Dial-Up * Satellite * ISDN (Integrated Services Digital Network) |
| 1. Data manipulation may include but are not limited to: | * Use of formulae * Use of functions * Sorting * Filtering * Visual representation using charts |
| 1. Electronic presentation concepts may include but are not limited to: | * Creating slides * Editing slides * Formatting slides * Applying slide effects and transitions * Creating and playing slideshows * Saving presentations * Printing slides and handouts |
| 1. Internet services may include but are not limited to: | * Communication Services * Information Retrieval Services * File Transfer * World Wide Web Services * Web Services * Directory Services * Automatic Network Address Configuration * Newsgroup * Ecommerce |
| 1. Internet access applications/software may include but are not limited to: | * Browsers * Email Apps * eCommerce Apps |
| 1. Online collaboration tools may include but are not limited to: | * Online Storage * Online productivity applications * Online meetings, * Online learning environments, * Online calendars * Social networks |
| 1. Data protection and privacy may include but not limited to: | * Confidentiality of data/information * Integrity of data/information * Availability of data/information |
| 1. Internet security threats may include but not limited to: | * Malware attacks * Social engineering attacks * Software supply chain attacks * Advanced persistent threats (APT) * Distributed denial of service (DDoS) * Man-in-the-middle attack (MitM) * Password attacks * IoT Attacks * [Phishing Attacks](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#phishing-attacks) * [Ransomware](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#ransomware) |
| 1. Security threats control measures may include but not limited to: | * Counter measures against cyber terrorism * Physical Controls * Technical/Logical Controls * Operational Controls |
| 1. Online job platforms may include but are not limited to: | * Remo task * Data annotation.tech * Cloud worker * Upwork * Oneforma * Appen |
| 1. Job opportunities may include but not limited to: | * Self-employment * Service provision * product development * salaried employment |
| 1. Certificates and testimonialsmay include but not limited to: | * Academic credentials * Letters of previous employments/ services rendered * Letters of commendation * Certifications of participation * Awards |
| 1. Interview skills may include but not limited to: | * Listening skills * Grooming * Language command * Articulation of issues * Body language * Time management * Honesty * Generally knowledgeable in current affairs and technical area |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Computer Hardware and Software Concepts
* Computer Security Concepts (Data security and privacy)
* Cyber security threats and control measures
* Understanding Computer Crimes
* Detection and protection against computer crimes
* Laws governing protection of ICT in Kenya
* Digital Identity Management
* Netiquette Principles
* Fundamentals of Copyright and Licenses
* Word processing;

Functions and concepts of word processing;

Documents and tables creation and manipulations;

Document editing;

Document formatting;

Word processing utilities

* Spreadsheets;

Meaning, types and importance of spreadsheets;

Components of spreadsheets;

Functions, formulae, and charts, uses and layout;

Data formulation, manipulation and application to cells;

Editing & formatting spreadsheets;

* Presentation Packages;

Types of presentation Packages.

Creating, formulating, running, editing, printing and presenting slides and handouts

* Networking and Internet;

Internet connectivity.

Browser and digital content management;

Managing data, information, and digital content

Electronic mail and World Wide Web

* Fundamentals of Online Working;

Online Profile Management;

e-Portfolio Management;

Online Jobs Bidding;

Online Payment Systems;

* Job entry techniques

Job searching sites

Interview preparation skills

Interview handling

**Required skills**

The individual needs to demonstrate the following skills:

* Active listening
* Keyboard Skills
* Mouse Skills
* Analytical skills
* Creativity
* Interpretation Skills
* Communication
* Spreadsheet operations (applying fundamental operations such as addition, subtraction, division and multiplication)
* Computer Use Safety Skills
* Document Editing Skills
* Document Formatting Skills
* Document Printing Skills
* Netiquette Skills
* Internet Browsing Skills
* Problem Solving Skills
* Online Collaboration Skills
* Cybersecurity Skills
* CV writing
* grooming

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge, and skills range.

|  |  |
| --- | --- |
| 1. Critical aspects of competency | ***Assessment requires evidence that the candidate:***   * 1. Operated computer devices as per workplace policies and regulations.   2. Solved tasks using the office suite as per workplace policies and regulations.   3. Manage data and information as per workplace policies and regulations.   4. Performed online communication and collaboration as per workplace policies and regulations.   5. Applied cybersecurity skills in accordance with workplace policies and regulations.   6. Executed online tasks according to the job requirements.   7. Searched for job opportunity based on competencies.   8. Prepared job requirement documentations based on job opportunity.   9. Demonstrated interview skills based on the job opportunity. |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environments where assessment can take place.   3. Resources relevant to the proposed activities or task. |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Observation   2. Oral assessment   3. Portfolio of evidence   4. Interviews   5. Third party report   6. Written assessment   7. Practical assessment   8. Projects |
| 1. Context of assessment | Competency may be assessed:   * 1. Workplace or simulated workplace. |
| 1. Guidance information for assessment | * 1. Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

**APPLY COMMUNICATION SKILLS**

**UNIT CODE:** 0031 441 02A

**UNIT DESCRIPTION**

This unit covers the competencies required to demonstrate communication skills. It involves applying communication channels, written, non-verbal, oral, and group communication skills.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements that specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| --- | --- |
| 1. Apply communication channels | 1. Specific communication channels are identified and applied based on workplace requirements. 2. Challenges are identified and addressed as per the operational standards of the organization. 3. Communication channels are evaluated to meet workplace needs. |
| 1. Apply written communication skills | * 1. Types of written communication are identified and applied according to the workplace requirements.   2. Written communication needs are identified and implemented according to workplace procedures.   3. Written communication guidelines are analyzed, evaluated, and revised based on workplace needs. |
| 1. Apply non-verbal communication skills | 3.1 Existing non-verbal communication techniques are identified and applied based on organization policy.  3.2 Non-verbal communication techniques are articulated and modeled to enhance inclusivity according to workplace requirements. |
| 1. Apply oral communication skills | 4.1 Types of oral communication are identified and established as per organization policy.  4.2 Pathways of oral communication are identified and established as per organization policy.  4.3 Pathways of oral communication are reviewed according to organization procedures.  4.4 Pathways of oral communication are maintained according to the organization standards. |
| 1. Apply group communication skills | 1. Group communication strategies are appliedbased on the workplace needs. 2. Groups are organized in accordance with workplace procedures. 3. Effective questioning, listening and non-verbal communication techniques are used as per needs.   5.4 Group communication challenges are identified and addressed according to the workplace needs. |

**RANGE**

This section provides the work environment and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Communication strategies may include but are not limited to: | * Language switch * Comprehension check * Repetition * Asking confirmation * Paraphrasing * Clarification request * Translation * Restructuring * Generalization |
| 1. Effective group interaction may include but not limited to: | * Identifying and evaluating what is occurring within an interaction in a non-judgmental way. * Using active listening. * Making decision about appropriate words, behavior. * Putting together response which is culturally appropriate. * Expressing an individual perspective. * Expressing own philosophy, ideology and background and exploring impact with relevance to communication |
| 1. Situations may include but are not limited to: | * Establishing rapport * Eliciting facts and information * Facilitating resolution of issues * Developing action plans |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Active listening
* Interpretation
* Negotiation
* Writing
* Oral skills
* Creative thinking
* Critical thinking
* Decision making
* Analytical
* Innovation
* Conflict skills
* Leadership
* Problem solving skills
* Management
* Organizational
* Teamwork

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Communication process
* Dynamics of groups
* Styles of group leadership
* Key elements of communications strategy
* Principles of effective communication
* Turn-taking techniques
* Conflict resolution techniques
* Work planning
* Work organization
* Company policies
* Company operations and procedure standards
* Fundamental rights at the workplace
* Personal hygiene
* Accountability
* Workplace problems and how to deal with them

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills, knowledge, and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency. | Assessment requires evidence that the candidate:   * 1. Identified and applied specific communication channels based on workplace requirements.   2. Identified and applied specific written communication correspondence according to the workplace requirements.   3. Applied and developed non-verbal strategies to communicate in all areas of the workplace requirements.   4. Established pathways of oral communication as per workplace policy.   5. Applied group communication strategies based on workplace needs. |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place. 2. Appropriately simulated environment where assessment can take place. 3. Resources relevant to the proposed activity or tasks. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Observation   2. Oral assessment   3. Portfolio of evidence   4. Interviews   5. Third party report   6. Written assessment   7. Practical assessment   8. Projects |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# APPLY WORK ETHICS AND PRACTICES

**UNIT CODE:** 0417 441 03A

**UNIT DESCRIPTION**

This unit covers competencies required to effectively apply work ethics and practices. It involves the ability to: conduct self-management, promote ethical work practices and values, promote teamwork, manage workplace conflicts, maintain professional and personal development, apply problem-solving and promote customer care.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  **These describe the key outcomes which make up workplace function.** | **PERFORMANCE CRITERIA**  **These are assessable statements which specify the required level of performance for each of the elements.**  ***Bold and italicized terms are elaborated in Range*** |
| --- | --- |
| 1. Apply self-management skills | 1. Personal vision, mission and goals are formulated based on potential and concerning organization objectives and strategic plan 2. Self-esteem and a positive self-image are developed and maintained based on value 3. Emotional intelligence and stress management are demonstrated as per workplace requirements. 4. Assertiveness is developed and maintained based on the requirements of the job. 5. Accountability and responsibility for one's actions are demonstrated based on workplace instructions. 6. Time management, attendance and punctuality are observed as per the organization’s policy. 7. Personal goals are managed as per the organization’s objective 8. Self-strengths and weaknesses are identified based on personal objectives 9. Motivation, initiative and proactivity are utilized as per the organization policy 10. Individual performance is evaluated and monitored according to the agreed targets. |
| 1. Promote ethical work practices and values | 1. Integrity is demonstrated as per acceptable norms 2. Codes of conduct is applied as per the workplace requirements 3. Policies and guidelines are observed as per the workplace requirements 4. Professionalism is exercised in line with organizational policies |
| 1. Promote Team work | 3.1 ***Teams*** are formed to enhance productivity based on organization’s objectives  3.2 Duties are assigned to teams under the organization policy.  3.3 Team activities are managed and coordinated as per set objectives.  3.4 Team performance is evaluated based on set targets as per workplace policy.  3.5 ***Conflicts*** are resolved between team members in line with organization policy.  3.6 Gender and diversity-related issues are identified and mainstreamed in accordance with workplace policy.  3.7 Healthy ***relationships*** are developed and maintained in line with the workplace.  3.8 Adaptability and flexibility are applied in dealing with team members as per workplace policies |
| 1. Maintain professional and personal development | 4.1 ***Personal growth and development*** needs are identified and assessed in line with the requirements of the job.  *4.2* ***Training and career opportunities*** are identified and utilized based on job requirements.  4.3 ***Resources*** for training are mobilized and allocated based on organizations and individual skills needs.  4.4 Licenses and certifications relevant to the job and career are obtained and renewed as per policy.  4.5 Recognitions are sought as proof of career advancement in line with professional requirements.  4.6 Work priorities and personal commitments are balanced and managed based on the requirements of the job and personal objectives.  4.7 Dynamism and on-the-job learning are embraced in line with the organization’s goals and objectives. |
| 1. Apply Problem solving skills | 5.1 ***Creative, innovative*** and practical solutions are developed based on the problem  5.2 Independence and initiative in identifying and solving problems are demonstrated based on the requirements of the job.  5.3 Team problems are solved as per the workplace guidelines  5.4 Problem-solving strategies are applied as per the workplace guidelines  5.5 Problems are analyzed and assumptions tested as per the context of data and circumstances |
| 1. Promote Customer Care | 6.1 Customers' needs are identified based on their characteristics  6.2 Customer ***feedback*** is allowed and facilitated in line with organization policies.  6.3 Customer concerns and complaints are analyzed and resolved in line with the set organizational culture.  6.4 Proactive customer outreach programs are implemented as per organizational policies  6.5 Customer retention strategies are developed and implemented in line with the organizational policy |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Feedback may include but not limited to: | * Verbal * Written * Informal * Formal |
| 1. Conflicts include but are not limited to: | * Interpersonal Conflict. * Intrapersonal Conflict. * Intergroup Conflict. * Intragroup Conflict. |
| 1. Relationships may include but not limited to: | * Man/Woman * Trainer/trainee * Employee/employer * Client/service provider * Husband/wife * Boy/girl * Parent/child * Sibling relationships |
| 1. Team may include but not limited to: | * Small work group * Staff in a section/department * Inter-agency group * Virtual teams |
| 1. Personal growth may include but not limited to: | * Growth in the job * Career mobility * Gains and exposure the job gives * Net workings * Benefits that accrue to the individual as a result of noteworthy performance |
| 1. Personal objectives may include but not limited to: | * Long term * Short term * Broad * Specific |
| 1. Trainings and career opportunities may include but not limited to | * Participation in training programs * Serving as Resource Persons in conferences and workshops * Capacity building |
| 1. Resource may include may but not limited to: | * Human * Financial * Technology |
| 1. Creative and innovative may include but not limited to: | * New ideas * Original ideas * Different ideas * Methods/procedures * Processes * New tools |
| 1. Emerging issues may include but not limited to: | * Artificial Intelligence * Data confidentiality * National cohesion * Open offices |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

Required Skills

The individual needs to demonstrate the following skills:

* Active listening
* Critical thinking
* Organizational
* Negotiation
* Monitoring
* Evaluation
* Problem solving
* Decision Making
* Leadership
* Creative/innovative thinking
* Adaptability
* Conflict management
* Emotional intelligence
* Teamwork

Required Knowledge

The individual needs to demonstrate knowledge of:

* Work values and ethics
* Company policies and procedures
* Company operations, procedures and standards
* Flexibility and adaptability
* Concept of time and leisure time
* Decision making
* Work planning
* Organizing work
* Monitoring and evaluation
* Record keeping
* Gender and diversity mainstreaming
* Drug and substance abuse
* Professional growth and development
* creativity
* Innovation
* problem solving
* customer care
* mentoring and coaching.
* Emerging issues

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment require evidence that the candidate:   * 1. Applied self-management skills as per organizational procedures.   2. Promoted ethical practices and values as per organizational procedures.   3. Promoted Teamwork as per workplace assignments.   4. Maintained professional and personal development as per organizational procedures.   5. Applied Problem-solving skills based on work requirements.   6. Identified customer needs based on their characteristics.   7. Gave back Customer feedback in line with organization policies. |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place. 3. Resources relevant to the proposed activity or tasks. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Practical 2. Project 3. Third party reports 4. Portfolio of evidence 5. Written test 6. Oral questioning |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# APPLY ENTREPRENEURIAL SKILLS

**UNIT CODE :** 0417 441 04A

**UNIT DESCRIPTION**

This unit covers the competencies required to demonstrate an understanding of entrepreneurship. It involves demonstrating an understanding of financial literacy, applying entrepreneurial concepts identifying entrepreneurship opportunities, applying business legal aspects, developing business innovative strategies, and developing business plans.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements that specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in Range*** |
| --- | --- |
| 1. Apply Financial Literacy Skills | 1. **Sources of personal and business** ***funds*** are identified as per financial procedures and standards 2. Personal finances are managed as per financial procedures and standards 3. Savings are managed as per financial procedures and standards 4. Debts are managed as per financial procedures and standards 5. Investments are undertaken as per financial procedures and standards 6. Insurance services are procured as per financial procedures and standards |
| 1. Apply entrepreneurial concept | 1. Entrepreneurs and Business persons are distinguished as per principles of entrepreneurship 2. ***Types of entrepreneurs*** are identified as per principles of entrepreneurship 3. Ways of becoming an entrepreneur are identified as per principles of Entrepreneurship 4. ***Characteristics of Entrepreneurs*** are identified as per principles of Entrepreneurship 5. Salaried employment and self-employment are distinguished as per principles of entrepreneurship 6. ***Requirements for entry into self-employment*** are identified according to business procedures and standards 7. Roles of an Entrepreneur in an enterprise are determined according to business procedures and standards 8. **Contributions of entrepreneurship** to National development are identified as per business procedures and standards |
| 1. Identify entrepreneurial opportunities | 1. Business ideas are identified as per business procedures and standards 2. Factors to consider when evaluating business opportunity viability are explored based on business procedure and standards 3. Entrepreneurial opportunities are evaluated as per business procedures and standards 4. Business ideas and opportunities are generated as per business procedures and standards 5. Business life cycle is analysed as per business procedures and standards |
| 1. Apply business legal aspects | 1. ***Forms of business ownership*** are identified as per legal procedures and practices 2. Business Registration and Licensing processes are identified as per legal procedures and practices 3. Types of Contracts and Agreements are analysed as per legal procedures and practices 4. Employment Laws are identified as per legal procedures and practices 5. Taxation laws are identified as per legal procedures and practices |
| 1. Innovate Business strategies | 1. Business innovation strategies are determined by the organization standards 2. Creativity in business development is demonstrated in accordance with business standards 3. ***Innovative business standards***  are developed as per business principles 4. Linkages with other entrepreneurs are created as per best practice 5. ICT is incorporated in business growth and development as per best practice |
| 1. Develop Business Plan | 1. Business idea is described as per business procedures and standards 2. Business description is developed as per business plan format 3. Marketing plan is developed as per business plan format 4. Organizational/Management plan is prepared in accordance with business plan format 5. Production/operation plan is prepared in accordance with business plan format 6. Financial plan is prepared in accordance with the business plan format 7. Executive summary is prepared in accordance with business plan format 8. Business plan is presented as per best practice 9. Business ideas are incubated as per institutional policy. |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Sources of personal funds mayinclude but not limited to: | * Salary/Wages * Investments * Savings * Inheritance * Government Benefits |
| 1. Sources of business finance mayinclude but not limited to: | * Equity Financing * Debt Financing, * Personal Savings/Investment * Retained Earnings * Grants and Subsidies * Crowdfunding * supplier Credit: * Leasing and Asset Financing: |
| 1. Types of entrepreneurs may include but not limited to: | * Innovators * Imitators * Craft * Opportunistic * Speculators |
| 1. Characteristics of Entrepreneurs may include but not limited to: | * Creative * Innovative * Planner * Risk taker * Networker * Confident * Flexible * Persistent * Patient * Independent * Future oriented * Goal oriented |
| 1. Requirements for entry into self-employment may include but not limited to | * Technical skills * Management skills * Entrepreneurial skills * Resources * Infrastructure |
| 1. Forms of businesses ownership may include but not limited to: | * Sole proprietorship * Partnership * Limited companies * Cooperatives |
| 1. Innovative business standards may include but not limited to: | * New products * New methods of production * New markets * New sources of supplies * Change in industrialization |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Analytical
* Management
* Problem-solving
* Root-cause analysis
* Communication

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Decision making
* Business communication
* Change management
* Competition
* Risk
* Net working
* Time management
* Leadership
* Factors affecting entrepreneurship development
* Principles of Entrepreneurship
* Features and benefits of common operational practices, e. g., continuous improvement (kaizen), waste elimination,
* Conflict resolution
* Health, safety and environment (HSE) principles and requirements
* Customer care standards
* Basic financial management
* Business strategic planning
* Impact of change on individuals, groups and industries
* Government and regulatory processes
* Local and international market trends
* Product promotion standards
* Market and feasibility studies
* Government and regulatory processes
* Local and international business environment
* Relevant developments in other industries
* Regional/ County business expansion standards

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   1. Identified Sources of personal and business finance as per financial procedures and standards 2. Managed Personal finances as per financial procedures and standards 3. Made Investment decisions as per financial procedures and standards 4. GeneratedBusiness ideas and opportunities based on business procedure and standards 5. Analysed business life cycle based on business procedure and standards 6. Determined business innovative standards as per business principles 7. Developed and presented a business plan as per regulatory framework. |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written tests 2. Oral questions 3. Third party report 4. Interviews 5. Portfolio |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# COMMON UNITS OF COMPETENCY

## APPLY GENERAL SCIENCE PRINCIPLES

**UNIT CODE:** 0531 441 05A

**UNIT DESCRIPTION:**

This unit covers the competencies required to apply general science principles. It involves applying animal anatomy and physiology concepts, plant anatomy and physiology concepts, inorganic chemistry concepts, organic chemistry concepts, physical chemistry concepts, mechanics concepts and thermodynamics concepts.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENTS**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  **Bold and italicized terms are elaborated in the range** |
| 1. Apply animal anatomy and physiology concepts | 1. ***Animal nutrition*** concept is applied as per work requirement 2. Animal transport system is analyzed as per biology laboratory manual 3. Animal reproductive system is analyzed as per work requirement 4. Animal excretory systemis analyzed as per biology laboratory manual 5. Animal gaseous exchange systemis analyzed as per biology laboratory manual |
| 1. Apply plant anatomy and physiology concepts | 1. Plant nutrition concept is applied as per work requirement 2. Plant transport concept is applied as per work requirement 3. ***Plant reproduction*** concept is applied as per work requirement 4. Plant excretion concept is applied as per work requirement 5. Plant gaseous exchange structure is analysed as per biology laboratory manual |
| 1. Apply inorganic chemistry concepts | 1. ***Elements classification*** knowledge is applied as per the periodic table 2. ***Chemical bonds*** are modeled according to Valence Shell Electron Pair Repulsion (VSEPR) theory 3. Inorganic salt is prepared as per chemical solubility rules |
| 1. Apply organic chemistry concepts | 1. ***Organic compound classification*** knowledge is applied as per International Union of Pure and Applied Chemistry (IUPAC) rules 2. Organic compound is modeled as per chemistry laboratory manual 3. ***Organic reaction*** concept is applied as per work requirement |
| 1. Apply physical chemistry concepts | 1. ***Acids*** and ***bases*** are identified as per work requirement 2. ***Gas law concept*** is applied as per work requirement 3. ***Electrochemistry concept*** is applied as per work requirement |
| 1. Apply mechanics concept | 1. ***Mechanics force*** concept is applied as per work requirement 2. Circular motion concept is applied as per work requirement 3. ***Newton’s Law of Motion*** is applied as per work requirement |
| 1. Apply thermodynamics concepts. | 1. ***Heat transfer*** knowledge is applied as per work requirement 2. ***Thermodynamics law*** concept is applied as per work requirement 3. Work, energy and power concepts are applied as per work requirement |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Animal nutrition may include but not limited to; | * + Parasitism   + Symbiotism   + Saprophitism   + Holozoic nutrition |
| 1. Plant reproduction may include but not limited to; | * + Sexual   + Asexual |
| 1. Elements classification may include but not limited to; | * + S- block elements   + P-block elements   + D- block elements |
| 1. Chemical bonds may include but not limited to; | * + Ionic bond   + Covalent bond   + Metallic bond   + Dative bond   + Hydrogen bonding |
| 1. Organic compound classification may include but not limited to; | * + Alkanes   + Alkenes   + Alkynes   + Alkanols   + Alkanoic acids |
| 1. Organic reactions may include but not limited to; | * + Addition   + Reduction   + Substitution |
| 1. Acids may include but not limited to; | * + Hydrochloric acid   + Sulphuric acid   + Nitric acid |
| 1. Bases may include but not limited to; | * + Sodium hydroxide   + Ammonia solution   + Calcium hydroxide |
| 1. Gas law concept may include but not limited to; | * + Boyle’s Law   + Charle’s Law   + Daltons Law of partial pressures   + Grahams Law of diffusion |
| 1. Electrochemistry concept may include but not limited to; | * + Reduction   + Oxidation   + Electrolysis   + Faraday’s Laws 1$2   + electrolytes |
| 1. Mechanics force may include but not limited to; | * + Friction   + Tension   + Shear |
| 1. Newton’s Law of Motion may include but not limited to; | * + First law of Newton   + Second law of Newton   + Third law of Newton |
| 1. Heat transfer may include but not limited to; | * + Conduction   + Convection   + Radiation |
| 1. Thermodynamics laws may include but not limited to; | * + First law of thermodynamics   + Second law of thermodynamics |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required skills**

The individual needs to demonstrate the following skills:

* Basic computer
* Critical thinking
* Problem solving
* Communication
* Creativity
* Interpretation

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Laboratory apparatus and equipment
* Occupation Safety and Health practices
* Characteristics of living organisms
* Elements and compounds
* Mixtures and compounds
* Chemical reactions
* Conductors and insulators
* Classification of organisms
* Cells
* Measurements
* SI units and conversions
* Computer literacy

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge range.

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   1. Applied animal nutrition concepts as per work requirement 2. Analyzed animal transport system as per work requirement 3. Analyzed animal reproduction system as per work requirement 4. Analyzed animal excretory system as per biology laboratory manual 5. Analyzed Animal gaseous exchange system as per biology laboratory manual 6. Applied plant nutrition concept as per biology laboratory manual 7. Applied plant transport concepts as per biology laboratory manual 8. Applied plant reproduction concepts as per biology laboratory manual 9. Applied plant excretion concepts as per work requirement 10. Analyzed plant gaseous exchange structure as per work requirement 11. Applied elements classification knowledge as per the periodic table 12. Applied chemical bonds modeled as per VSEPR theory 13. Applied organic reactions knowledge as per work requirement 14. Applied gas law concept as per work requirement 15. Applied electrochemistry concept as per work requirement 16. Applied circular motion concept as per work requirement 17. Applied Newton’s law of motion as per work requirement 18. Applied thermodynamics law concepts as per work requirement 19. Applied work, energy and power concepts as per work requirement |
| 2. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 3.Methods of assessment | Competency in this unit may be assessed through:   1. Practical 2. Project 3. Third party report 4. Portfolio of evidence 5. Written test 6. Oral test |
| 1. Context of assessment | Competency may be assessed in a workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace job role is recommended. |

## CONDUCT SCIENCE LABORATORY RESEARCH

**UNIT CODE:** 0588 441 06A

**UNIT DESCRIPTION**

This unit specifies the competencies required to conduct science laboratory research. It involves

preparing science laboratory research data collection tools, carrying out science laboratory research data collection and science laboratory research data analysis

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the **key outcomes** which make up workplace function (to be stated in active) | **PERFORMANCE CRITERIA**  These are **assessable statements** which specify the required level of performance for each of the elements (to be stated in passive voice)  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Prepare science laboratory research data collection tools | 1. ***Data collection method*** is identified as per work requirement 2. ***Data collections tools*** are identified as per work requirement 3. Data collection tools are designed as per research design 4. Data collection tools are pretested as per work requirement |
| 1. Carry out science laboratory research data collection | 1. Research study location is identified as per work requirement. 2. Research Sample size is identified as per work requirement. 3. Data collection procedure is carried out as per study design |
| 1. Carry out science laboratory research data analysis | 1. ***Data organization*** is carried out as per work requirement 2. Data analysis tools are identified as per study design. 3. Data analysis procedure is carried out as per work requirement 4. Research data results are reported as per scientific research methodology |
| 1. Prepare scientific research proposal | * 1. Scientific research problem is identified based on existing research gap   2. Research objectives are developed according to research problem   3. Research questions are designed based on research objectives   4. Scientific research proposal is developed as per standard research procedures |
| 1. Apply scientific research methods | * 1. ***Scientific study design*** is determined in accordance with research problem and research data   2. Sample size is determined based on the research methodology   3. ***Sampling techniques*** are determined in accordance with scope and research methodology   4. Ethical considerations are determined based on research methods utilized   5. Research materials are identified based on scope and research methodology   6. Data is collected in accordance with research methodology |
| 1. Analyze scientific research findings | * 1. ***Data analysis methods*** are identified as per job requirement.   2. Data analysis is performed as per work procedure   3. Research report is prepared as per work procedure. |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| 1. Data collection method includes but not limited to: | * Interviews * Surveys * Observations * Experiments * Secondary data sources * Direct measurements |
| 1. Data collections tools include but not limited to: | * Questionnaires * Photography and videos * Google forms |
| 1. Data organization include but not limited to: | * Data formatting * Data cleaning * Data coding |
| 1. Conceptual framework includes but not limited to: | * + Analytical tool   + A diagram that shows causes and effects of a problem   + Diagram that shows relationship between independent and dependent variables |
| 5. Theoretical framework includes but not limited to: | * + Structure that can hold or support a theory of a research study.   + Introduces and describes the theory   + Identification of theories that relate to a research problem   + Context for explaining a problem |
| 6. Scientific study design includes but not limited  to: | * + Qualitative designs   + Quantitative designs |
| 7. Sampling techniques include but not limited to: | * Probability   + Non-probability |
| 8. Data analytical methods include but not limited to: | * + ANOVA   + Measures of central tendency   + Measures of dispersal |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Computer application
* Scientific research reporting
* First aid
* Communication
* Observation
* Critical thinking
* Problem solving
* Environmental conservation

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Laboratory ware and equipment
* Science laboratory safety
* Quantitative and qualitative analysis
* Laboratory safety designs
* Laboratory waste disposal
* Laboratory ethical standards
* Record maintenance
* Computer application
* Laboratory hygiene
* Basic mathematics
* Entrepreneurship

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Identified data collection method as per work requirement   2. Designed data collection tools as per research design   3. Identified research sample size as per work requirement.   4. Carried out data collection procedure as per study design   5. Carried out data analysis procedure as per work requirement   6. Identified scientific research problem based on existing research gap   7. Developed scientific research proposal as per work requirement.   8. DeterminedScientific study design in accordance with research problem and research data   9. Collected data in accordance with research methodology   10. Applied data analysis techniques as per work requirement Compiled Research report as per work requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Project   3. Third party report   4. Portfolio of evidence   5. Written test   6. Oral test |
| 1. Context of Assessment | Competency may be assessed in a work place or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

# APPLY MATHEMATICS FOR SCIENCE

**UNIT CODE:** 0541 441 07A

**UNIT DESCRIPTION**

This unit describes the competencies required by a science laboratory technologist in order to apply mathematics for science. It involves applying: basic arithmetic operation; algebraic equation and expression; linear and non-linear graphs; indices and logarithm; binomial expansion; matrices; vectors; trigonometry; calculus; sequence and series and statistics.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Apply basic arithmetic operation | 1.1 Addition and subtraction is performed as per arithmetic operation rules  1.2 Multiplication and division is applied as per arithmetic operation rules  1.3 Rational and irrational numbers are evaluated as per algebraic rules  1.4 Ratios, ***proportions*** and percentages is applied as per algebraic rules |
| 2. Apply algebraic equation and expression | 2.1 Linear equations are solved as per the concept  2.2 Simultaneous equations are solved as per the ***simultaneous method***  2.3 Formulation of a formula is applied as per the concept  2.4 quadratic equation is solved as per the ***quadratic methods*** |
| 3. Apply linear and non-linear graphs | 3.1 Linear and nonlinear graph is plotted as per the graphical methods  3.2 Reduction of non-linear to linear graphs is performed as per the concept  3.3 Graph is interpreted as per the concept formulate Graphical solution |
| 4. Apply indices and logarithms | 4.1 Indices are operated as per the concept  4.2 ***Logarithm*** is defined as per the concept  4.3 Change of base of logarithms is performed as per  logarithmic concept  4.4 Logarithmic and exponential graph is plotted as per logarithmic concept |
| 5. Apply binomial expansions | 5.1. Roots of numbers are determined using binomial theorem  5.2. ***Errors*** of small changes are determined using binomial theorem  5.3. Permutation and combination are applied using binomial theorem |
| 6.Apply matrices | 6.1 Determinant and inverse of 2x2 matrix is determined as per the concept.  6.2 Simultaneous equations are solved as per matrix concept  6.3 Eigenvalues and Eigenvectors are determined as per matrix concepts |
| 7. Apply vectors | 7.1 Vectors and scalar quantities are obtained in two dimensions  7.2 ***Operations*** on vectors are performed as per vector concept  7.3 Position of vectors are obtained as per vector concept  7.4 Vector is resolved as per vector concept |
| 8. Apply trigonometry | 8.1 ***Trigonometric ratios*** are applied as per trigonometric rules.  8.2 Angles of elevation and depression are determined as per trigonometric rules.  8.3 Angles are determined as per compound angle formula  8.4 Sine and cosine waves are interpreted as per trigonometric rules. |
| 9.Apply Calculus | 9.1 Rate of change is determined as per ***differentiation rules.***  9.2 ***Stationary points*** of functions are determined as per differentiation rules.  9.3 Integrals of algebraic functions are determined as per ***integration rules***  9.4 Integrals of logarithmic functions are determined as per integration rules |
| 10. Apply sequences and series | 10.1 Arithmetic means and nth term of an arithmetic sequence is determined as per the concept  10.2 Sum of terms of a given ***arithmetic series*** are determined as per the concept  10.3 A geometric sequence is differentiated according to arithmetic sequence  10.4 A finite geometric sequence is differentiated according to finite geometric sequence  10.5 Geometric means and nth terms of a geometric sequence is determined as per geometric sequence concept  10.6 Sum of finite and infinite geometric sequence is determined as per geometric sequence concept |
| 11.Apply statistics methods | 11.1 ***Raw data*** is collected as per job requirement  11.2 ***processing of raw data*** is carried out as per job requirement  Interpretation of data is performed as per job requirement  11.3 ***Data presentation*** is performed as per job requirement |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range**  May include but not limited to: |
| 1. Proportions may include but not limited to: | * Direct proportion * Inverse proportion |
| 2. Simultaneous method may include but not limited to: | * Elimination method * Substitution * Graphical method |
| 3. Quadratic methods May include but not limited to: | * Factorization * Completing Square Method * Quadratic formula |
| 4. Logarithms may include but not limited to: | * Operation * Conversions * Graph plotting |
| 5. Errors may include but not limited to: | * Absolute * Relative * Percentage |
| 6. Trigonometric rules May include but not limited to: | * Sine rule * Cosine rule * Double angle formula |
| 7. Binomial theorem May include but not limited to: | * Pascal triangle |
| 8. Differentiation May include but not limited to: | * First principles * High order functions * Differential equations * Inverse differentiation |
| 9. Differentiation rules May include but not limited to: | * Product rule * Chain rule * Quotient rule |
| 10. Stationary points May include but not limited to: | * Maxima * Minima * Point of inflection |
| 11. Integration May include but not limited to: | * Constant of integration * Integral notation * Indefinite and definite integrals |
| 12. Methods of integration May include but not limited to: | * Standard form * Substitution * Integration by parts |
| 13. Currency table May include but not limited to: | * Selling price * Buying price |
| 14. Series May include but not limited to: | * Arithmetic Progression * Geometric Progression |
| 13. Raw data may include but not limited to: | * Grouped data * Ungrouped data |
| 14. Processing of raw data may include but not limited to: | * Mean * Mode * Median * Range * Quartile * Standard deviation * Variance |
| 15. Data presentation May include but not limited to: | * Pictograms * Histograms * Pie charts * Bar charts * Frequency polygon |
| 16. Order of matrix May include but not limited to: | * Singular * Non-singular * Identity * Echelon |
| 17. Matrix operation May include but not limited to: | * Compatibility * Addition/subtraction * Multiplication * Multiplication by scalar |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Applying fundamental operations (addition, subtraction, division, multiplication)
* Using and applying mathematical formulas
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Fundamental operations (addition, subtraction, division, multiplication)
* Types and purpose of measuring instruments
* Units of measurement and abbreviations
* Rounding techniques
* Types of fractions
* Types of tables and graphs
* Presentation of data in tables and graphs
* Vector operations
* Matrix operations
* Data presentation

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills, knowledge and range

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   * 1. Applied Ratios, proportions and percentages as per algebraic rules   2. Interpreted graph as per formulated graphical solution   3. Plotted logarithmic and exponential graph as per logarithmic concept   4. Solved Simultaneous equations as per matrix concept   5. Performed operations on vectors as per vector concept   6. Determined angles of elevation and depression as per trigonometric concept   7. Determined rate of change as per differentiation concept   8. Differentiated finite geometric sequence as per finite geometric sequence   9. Determined sum of terms of geometric sequence as per the geometric sequence concept   1.10 Interpreted data as per work requirement  1.11 Presented data as per job requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Written Assessment |
| 1. Context of Assessment | Competency may be assessed in a  4.1. workplace  4.2. simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# APPLY LABORATORY AND MANAGEMENT PRACTICES

**UNIT CODE:**

**UNIT DESCRIPTION**

This unit of competency provides knowledge required by a science laboratory technologist to apply laboratory and management practices. The practices include maintaining laboratory safety, manage laboratory animals, managing laboratory personnel and material resources, preparing laboratory water and managing laboratory waste.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| * + - 1. Maintain laboratory safety | * 1. Laboratory safety rules are applied as per good laboratory practices   2. ***Laboratory*** ***hazards*** are handled in line with laboratory safety procedures   3. Types of ***injuries*** are handled according to laboratory first aid procedures   4. First aid procedures are reviewed as per laboratory safety guidelines |
| 2.Manage Laboratory animals | 2.1 ***Laboratory animals*** are handled as per science laboratory requirement  2.2 Sexing of laboratory animals is carried out according to science laboratory procedures  2.3 ***Humane killing*** is carried out as per type of animal  2.4 Dissection of laboratory animal is carried out as per science laboratory procedures  2.5 Animal carcasses are disposed based on science laboratory safety procedures |
| 1. Prepare laboratory water | 3.1 Water sources are identified as per laboratory requirement   * 1. ***Water treatment*** is carried out in line with organisational laboratory manual   2. Laboratory water is stored according to organisational laboratory manual |
| 1. Manage laboratory personnel and material resources | 4.1 ***Principles of laboratory management*** are applied as per science laboratory standards   * 1. Laboratory manager qualities are applied based on good laboratory practices   2. ***Laboratory inventories*** are maintained as per science laboratory guidelines |
| 1. Manage laboratory waste | 5.1 ***Laboratory wastes*** are segregated according to laboratory procedures   * 1. Laboratory working areas are cleaned and ***decontaminated*** as per laboratory procedures   2. Laboratory waste is disposed as per laboratory procedures |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Laboratory hazards may include but are not limited to: | * + Chemical   + Biological   + Physical   + Electrical   + Fire |
| Injuries may include but are not limited to: | * Cuts * Bleeding * Bites * Burns * Bruises * Fractures |
| Laboratory animalsmay include but are not limited to: | * Guinea pig * Albino rats * Rabbits * Frogs * Insects * Hamsters * Mice |
| * + 1. Humane killing may include but are not limited to: | * Pithing * Decapitation * Chemical suffocation * Neck twisting * Breaking of the spinal cord * Cervical dislocation |
| Water treatment may include but are not limited to: | * Distillation * Deionization * Filtration * Sedimentation * Reverse osmosis * Adsorption |
| Principles of laboratory management may include but are not limited to: | * Delegation * Coordination * Organizational structure * Leadership * Unity of purpose |
| Laboratory inventoriesmay include but are not limited to: | * Inventory * Invoice * Quotations * Catalogues * Local purchase order * Bin cards |
| Laboratory wastesmay include but not limited to: | * Organic * Halogenated * Aqueous * Solid * Glass ware |
| Laboratory disposal routesmay include but not limited to: | * Sewer line * Incineration * Burying * Burning * Soak pit * Evaporation |
| Decontaminated may include but not limited to: | * Disinfectant * Antiseptic * Alcohols * Aldehydes |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Communication
* laboratory safety
* Chemistry and instrumentation knowledge
* Information Technology
* Sample collection and storage

**Required skills**

The individual needs to demonstrate the following skills:

● Problem-solving skills

● Analytical skills

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and skills range.

|  |  |
| --- | --- |
| 1. **Critical aspects of performance** | * handled laboratory hazards in line with laboratory safety procedures * handled injuries according to laboratory first aid procedures * handled laboratory animals as per science laboratory requirement * carried out humane killing as per type of animal * disposed of animal carcasses based on science laboratory safety procedures * carried out water treatment in line with good organizational laboratory manual * applied principles of laboratory management as per science laboratory standards * maintained laboratory inventories as per science laboratory guidelines |
| * **Resource implications** | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 1. **Methods of Assessment** | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Third Party Reports   5. Written Assessment |
| 1. **Context of assessment** | Competency may be assessed in a workplace or simulated workplace |
| 1. **Guidance information for assessment** | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

# APPLY PHYSICS PRINCIPLES

**UNIT CODE:** 0533 541 09A

**UNIT DESCRIPTION**

This unit specifies the competencies required to apply physics principles. It involves applying: dynamics principles; principles of thermodynamics; principles of optics; friction principles; work, energy and power principles; pressure principles; principles of electromagnetism; electrostatic and electrical principles; semiconductor device principles and principles of nuclear physics.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Apply dynamics principles | * 1. Static force principle is applied as per physics principles   2. Linear motion principle is applied as per the ***laws of motion***   3. Circular motion principle is applied as per laws of motion. |
| 1. Apply principles of thermodynamics | * 1. ***Heat energy*** is measured as per physics laboratory manual   2. Heat energy is calculated as per ***thermodynamic principles***   3. ***Thermodynamic processes*** are determined as per physics laboratory manual   4. ***Thermodynamic quantities*** are calculated as per physics laboratory manual |
| 1. Apply principles of optics | * 1. ***Light properties*** are applied as per optic principles   2. Distances and sizes of object and images are determined as per the geometrical optics and ***mirror and lens formula***   3. Magnification power of optical device is determined as per optic principles. |
| 1. Apply friction principles | * 1. Source of friction in equipment is identified as per manufacturer’s manual.   2. ***Resultant forces*** are applied as per friction principles   3. Coefficient of friction is calculated as per friction principles |
| 1. Apply pressure principles | * 1. Pressure concepts are applied as per ***pressure laws***   2. Pressure problems are solved according to pressure laws   3. ***Pressure applications*** are identified as per job specification |
| 1. Apply principles of electromagnetism | * 1. Magnets are identified as per the physics laboratory manual   2. ***Magnetic properties*** are determined based on the magnetic principles   3. ***Electromagnetism*** is applied based on the principle of electromagnetism |
| 1. Apply electrostatic and electrical principles | * 1. ***Electrostatic devices*** are identified as per job specification   2. Circuits are connected as per electrical principles   3. Ohm’s law is applied as per electrical principles   4. ***Electrical energy sources*** are identified as per electrical principles   5. Principle of operation of ***induction*** is applied as per job specification. |
| 1. Apply semiconductor device principles | * 1. ***Semiconductor device*** is identified as per job specification.   2. ***Rectification*** is carried out as per the electronic principles   3. Characteristic of semi-conductor diodes are verified as per the manufacturer’s manual |
| 1. Apply principles of nuclear physics | * 1. X-rays are produced and utilized as per the manufacturer’s manual   2. ***Radioactive element*** is detected based on the detection systems   3. Safety precautions on radioactive elements are observed based on safety regulations   9.4 Radioactive ***radiations*** are applied based on nuclear principles |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Laws of motion may include but not limited to: | * Law of inertia * Law of momentum * Law of interaction |
| Heat energy includes but  not limited to: | * Heat capacity * Specific heat capacity * Latent heat * Latent heat of fusion * Latent heat of vaporization * Latent heat of sublimation |
| Thermodynamic processes include but not limited to: | * Adiabatic changes * Isothermal processes * Isobaric changes * Isochoric changes |
| Thermodynamic quantities include but not limited to: | * Pressure * Volume * Temperature |
| Light properties include but not limited to: | * Reflection * Total internal reflection * Refraction |
| Mirror and lens formula include | 1/f= 1/u+ 1/v   * f - Focal length * u - Object distance * v - Image distance   m = v/u=i/o   * i - Image height * 0– Object height |
| Types of magnets include but not limited to: | * Permanent * Temporary * Earth |
| Magnetic properties include but not limited to: | * Lines of force * Magnetic flux patterns * Flux density |
| Electromagnetism may include but not limited to: | * Quantities and units * Stationery Geld moving conductor * Fleming’s right led rule * Faradays and Lenz’s cork screw rule * Grip rule * Self-inductance * Mutual inductance * Induction due to current charge in another circuit |
| Electrostatic devices may include but not limited to: | * Capacitor * Van de Graff generator * Electroscope |
| Electrical energy sources may include but not limited to: | * Renewable sources * Non-renewable sources |
| Induction may include but not limited to: | * self-induction * mutual induction |
| Semiconductor device may include but not limited to: | * diode * transistor * LED |
| Rectification may include but not limited to: | * Half-wave * Full wave |
| Radioactive element may include but not limited to: | * Thorium * Uranium * Carbon 14 |
| Radioactive radiations may include but not limited to: | * Alpha particles * Beta particles * Gamma radiation * Background radiations |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Technical
* Observation
* Problem solving
* Critical thinking
* Reporting
* Interpretation

**Required skills**

The individual needs to demonstrate the following skills:

* Physics equipment and apparatus
* Physics formulas
* Physical quantities
* Thermodynamic processes
* Characteristics and behavior of waves
* Light properties and behavior

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and skills range.

|  |  |
| --- | --- |
| Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Applied circular motion principle as per laws of motion.   1.2 Determined thermodynamic processes as per physics laboratory manual  1.3 Calculated thermodynamic quantities as per physics laboratory manual   * 1. Applied light properties as per physics laboratory manual.   2. Determined distances and sizes of object and images as per geometrical optics and mirror and lens formula   3. Determined magnification power of an optical device as per physics laboratory manual   4. Applied resultant forces as per physics laboratory manual   5. Applied pressure concepts as per pressure laws   6. Applied electromagnetism based on Principle of electromagnetism   7. Applied electrostatic devices as per electrostatic principles   1.11Applied principle of induction as per job specification.  1.12 Applied semiconductor device as per electronic principles   * 1. Utilized X-rays produced as per manufacturer’s manual   1***.***14 Applied radioactive radiations based on nuclear principles |
| 2. Resource implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place  2.2 Access to relevant work environment  2.3 Resources relevant to the proposed activities or tasks  2.4 Functional physics laboratory facility  2.5 Functional laboratory apparatus, equipment and  materials  2.6 Science laboratory manuals |
| 3. Methods of assessment | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Third Party Reports   5. Written Assessment |
| 4. Context of assessment | Competency may be assessed in a workplace or simulated workplace |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

# APPLY CHEMISTRY PRINCIPLES

**UNIT CODE:**

**UNIT DESCRIPTION**

This unit of competency provides knowledge required by a science laboratory technologist to apply chemistry principles. The principles include applying physical chemistry, organic chemistry, inorganic chemistry and biochemistry concepts.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| * + 1. Apply physical chemistry concepts | 1.1 ***Gas law*s** are determined according to kinetic molecular theory of gases.   * 1. Acids and bases are identified according to universal pH chart.   2. Ionic equilibrium is determined as per Ostwald’s Dilution Law   3. Electrochemistry principles are applied according to reduction potential principles.   4. Chemical kinetics are determined according to reaction rates theory.   5. Chemical thermodynamics are determined as per chemical thermodynamic principles. |
| 1. Apply organic chemistry concepts | * 1. ***Organic compounds classes*** are identified according to International Union of Pure and Applied Chemistry (IUPAC) rules.   2. ***Organic reactions*** are determined as per organic chemistry reaction type.   3. Organic compounds are synthesized according to principles of organic synthesis   4. Synthesized compounds are purified as per organic laboratory manual   5. Purified compounds are characterized as per organic laboratory manual |
| 1. Apply inorganic chemistry concepts | * 1. Elements are identified and classified as per the periodic table.   2. ***Chemical bonds*** are determined according to Valence Shell Electron Pair Repulsion (VSEPR) theory.   3. Inorganic salts are tested as per solubility rules |
| 1. Apply biochemistry concepts | * 1. ***Biochemical molecules*** are identified and classified according to International Union for Biochemistry and Molecular Biology standards (IUBMB).   2. ***Biochemical reactions*** are carried out in line with laboratory procedures.   3. ***Biochemical processes*** are determined as per laboratory procedures |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Gas laws may include but are not limited to: | * Boyle’s * Charles’ * Graham’s * Gay Lussac’s |
| Organic compounds classes may include but are not limited to: | * Alkanes * Alkanols * Alkenes * Carboxylic acids * Aldehydes |
| Organic reactions may include but are not limited to: | * Addition * Elimination * Substitution * Reduction |
| Chemical bonds may include but are not limited to: | * Covalent * Electrovalent * Coordinate * Hydrogen |
| Biochemical molecules may include but are not limited to: | * Carbohydrates * Lipids * Proteins * Nucleic acids |
| Biochemical reactions may include but are not limited to: | * Reduction- Oxidation * Hydrolysis * Condensation * Neutralization |
| Biochemical processes may include but are not limited to: | * Photosynthesis * Fermentation * Glycolysis * Respiration |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Communication
* laboratory safety
* Chemistry and instrumentation knowledge
* Information Technology
* Sample collection and storage

**Required skills**

The individual needs to demonstrate the following skills:

● Problem-solving skills

● Analytical skills

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and skills range.

|  |  |
| --- | --- |
| * + - 1. Critical aspects of performance | * 1. Determined gas laws according to kinetic molecular theory of gasses.   2. Performed Ionic equilibria calculations as per Ostwald’s Dilution Law.   3. Determined Chemical kinetics according to reaction rates theory.   4. Determined Organic reactions as per organic chemistry name reactions.   5. Synthesized Organic compounds according to principles of organic synthesis.   6. Carried out biochemical reactions in line with IUBMB standards.   7. Determined biochemical processes as per IUBMB standards |
| * + - 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| * + - 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Third Party Reports   5. Written Assessment |
| * + - 1. Context of assessment | Competency may be assessed in a workplace or simulated workplace |
| * + - 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

# APPLY BIOLOGY PRINCIPLES

**UNIT CODE:**

**UNIT DESCRIPTION**

This unit of competence specifies the knowledge and competences required to apply biological principles. It involves analyzing: communication, nutrition, transport, reproduction, excretion in plants and animals, applying support and locomotion in animals and plants and analyzing genes and Chromosomes structures

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the **key outcomes** which make up workplace function (to be stated in active) | **PERFORMANCE CRITERIA**  These are **assessable statements** which specify the required level of performance for each of the elements (to be stated in passive voice)  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Analyze communication in plants and animals | * 1. Experiments on Structure and function of the ***nervous* system** is performed as per anatomical procedures   2. Experiment to determine Structure and function of the ***sensory organs*** as per anatomical procedures   3. Experiment on role of ***endocrine glands*** in communication is performed as per laboratory procedures   4. Experiment to measure plant growth is performed as per laboratory procedures |
| 1. Apply nutrition in plants and animals | * 1. ***Experiment on nutrition*** of the organism is performed as per physiological processes   2. Experiment involving digestive enzymes are analyzed as per physiological process   3. Dissection of a laboratory animal is carried out as per laboratory procedures |
| 1. Apply transport in plants and animals | * 1. Internal structures of the root and shoot are identified as per laboratory procedures   2. Experiment on uptake of water and mineral salts in plants is performed as per laboratory procedures   3. Translocation experiments are carried out as per laboratory procedures   4. ***Experiment*** on mammalian circulatory system is performed as per laboratory procedures   5. ***experiment of gaseous exchange in plants and animals*** are performed as per laboratory procedures |
| 1. Analyze support and locomotion in animals | * 1. ***Experiment*** to identify ***types of muscles*** is performed as per laboratory procedures   2. ***Types of skeletons*** are identified as per anatomical procedures   3. Structure of skeletons are identified as per anatomical procedures |
| 1. Analyze reproduction in plants and animals | * 1. Experiment on meiosis in plants is carried out as per laboratory procedures   2. Dissection of a flower is carried out to identify floral parts as per laboratory procedures.   3. Seeds and fruits are identified as per laboratory procedures.   4. Adaptations of seeds and fruits to dispersal is demonstrated as per anatomical and physiological procedures   5. Experiment on reproductive system in animals is performed as per laboratory procedures.   6. Breeding of plant and animal is carried out as per Mendelian theory   7. Industrial genetics is applied as per ***molecular biology techniques.*** |
| 1. Apply excretion in plants and animals | * 1. ***Products of excretion in plants*** are collected and identified as per laboratory procedures   2. Mammalian excretory organs are identified as per laboratory procedures   3. Excretion products are analyzed as per laboratory procedures |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| Nervous system includes but not limited to: | * Neuron * Central Nervous System (CNS) * Peripheral Nervous System (PNS) |
| Sensory organs include but not limited to: | * + Eye   + Ear   + Nose   + Tongue   + Skin |
| Endocrine glands include but not limited to: | * Pituitary gland * Hypothalamus * Pineal gland * Thyroid gland * Parathyroid gland * Pancreas * Adrenal gland * Testes * Ovaries * Thymus |
| Types of nutrition include but not limited to: | * Heterotrophic nutrition * Holozoic * Symbiosis |
| Nutrition Experiment include but not limited to: | * + Food test   + Test for photosynthesis |
| Experiment to identify types of muscles include but not limited to: | * + Histological experiments   + Cytological experiments |
| Types of musclesinclude but not limited to: | * Skeletal muscles * Smooth * Cardiac * Striated |
| Molecular biology techniques include but not limited to: | * DNA extraction * Gel electrophoresis * Polymerase chain reaction * Blotting techniques * ELISA |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skill

* Observation
* Communication
* Interpersonal
* Analytical
* Critical thinking
* Problem solving
* Dissection
* Innovation
* Creativity
* Drawing
* Interpretation
* Reporting

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Microscopy
* Anatomy
* Physiology
* Genetics
* Cytological techniques
* Cell growth and division
* Histological techniques
* Specimen collection methods
* Storage of specimens
* Tissue processing

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Performed Experiments to determine structure and function of sensory organs as per laboratory procedures   2. Performed experiment involving digestive enzymes as per laboratory procedures   3. Performed experiment of gaseous exchange as per laboratory procedures   4. Identified types of skeletons as per laboratory procedures   5. Carried out breeding of plant and animals as per Mendelian theory   6. Analyzed excretion products as per laboratory procedures |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Third Party Reports   5. Written Assessment |
| 1. Context of Assessment | Competency may be assessed in a workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# CORE UNITS OF COMPETENCY

## PERFORM STANDARD LABORATORY PRACTICES

**UNIT CODE:** 1022 441 08A

**UNIT DESCRIPTION**

This unit specifies the competencies required to perform standard laboratory practices. It involves performing laboratory safety procedures, maintaining laboratory resources and preparing laboratory reagents and chemicals.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the **key outcomes** which make up workplace function (to be stated in active) | **PERFORMANCE CRITERIA**  These are **assessable statements** which specify the required level of performance for each of the elements (to be stated in passive voice)  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Perform laboratory safety procedure | * 1. ***Personal Protective Equipment*** (PPE) is donned as per work requirement   2. ***laboratory hazard and risk*** are handled based on laboratory safety procedures   3. Laboratory chemical and reagent are stored based on manufacturers specifications   4. ***Laboratory waste*** is disposed as per work requirement   5. Laboratory safety rules are applied as per good laboratory practices   6. Risks assessment is conducted according to the likelihood and severity.   7. Types of ***injuries*** are handled according to laboratory first aid procedures   8. First aid procedures are reviewed as per laboratory safety guidelines   9. Develop emergency response procedures and preparedness as per OSHA.   10. Maintain records of hazards, risks assessment and control measures as per legal requirement |
| 1. Maintain laboratory resource | 1. Laboratory inventory is maintained as per Good Laboratory Practice work requirement 2. ***Laboratory equipment*** and ***apparatus*** is maintained as per the manufacturer’s specifications. 3. ***Laboratory resource*** is stored as per the manufacturer’s guidelines 4. Obsolete resource is disposed as per Occupational Safety and Health (OSH) guidelines |
| 1. Prepare laboratory reagents and chemicals | 1. Personal protective equipment is donned as per work requirement 2. ***Laboratory reagents*** and apparatus are assembled as per work requirement 3. Laboratory reagents and chemicals standardization is carried out as per work requirement   3.4 Laboratory reagent and chemical is stored according to work requirement laboratory manual procedures |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| 1. Personal Protective Equipment include but not limited to: | * Lab coats * Gloves * Overalls * Goggles * Muffs * Face shields * Helmets * Hair nets * Respirators * Masks |
| 2. Laboratory hazards and risks include but not limited to: | * Chemical * Biological * Electrical * Radioactive * Musculoskeletal stresses * Electrical * Physical |
| 3. Laboratory waste include but not limited to: | * Sharp objects * Glassware * Biological samples * General lab waste * Wipes * Gloves * Tissues * Chemicals * Radioactive materials * Electrical materials |
| 4. Laboratory equipment include but not limited to: | * Bunsen burner * Microscopes * Hot plates * Magnetic stirrer * Water baths * Oven * Freezers * Furnace |
| Laboratory apparatus include but not limited to: | * Balances * Wash bottles * Glass ware * Crucibles * Brushes * Filter papers * Pestle and mortar |
| Laboratory resource includes but not limited to: | * Equipment * Apparatus * Inventories |
| Laboratory reagent includes but not limited to: | * Acids * Bases * Salts * Indicators * Distilled water |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Computer application
* Scientific research reporting
* First aid
* Communication
* Observation
* Critical thinking
* Problem solving
* Environmental conservation

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Laboratory ware and equipment
* Science laboratory safety
* Quantitative and qualitative analysis
* Laboratory safety designs
* Laboratory waste disposal
* Laboratory ethical standards
* Record maintenance
* Computer application
* Laboratory hygiene
* Basic mathematics
* Entrepreneurship

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1.Critical Aspects of Competency | 1. Assessment requires evidence that the candidate: 2. Donned Personal Protective Equipment (PPE) as per work requirement 3. Handled laboratory hazard and risk based on laboratory safety procedures 4. Stored laboratory chemical and reagent based on manufacturers specifications 5. Disposed laboratory waste as per work requirement 6. Maintained laboratory inventory as per work requirement 7. Maintained laboratory equipment and apparatus as per manufacturer’s specifications. 8. Carried out laboratory reagents and chemicals standardization as per work requirement |
| 2.Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 3.Methods of Assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Project   3. Third party report   4. Portfolio of evidence   5. Written test   6. Oral test |
| 4.Context of Assessment | Competency may be assessed in a workplace or simulated workplace |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

# PERFORM BIOLOGY TECHNIQUES

**UNIT CODE:** 0511 441 09A

**UNIT DESCRIPTION**

This unit specifies the competencies required to Perform Biology Technique. It involves performing cytological test, performing food test, Care for laboratory animal and carrying out microbiological techniques. It also entails carrying out herbarium techniques, carrying out museum techniques and conducting ecological experiments

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the **key outcomes** which make up workplace function (to be stated in active) | **PERFORMANCE CRITERIA**  These are **assessable statements** which specify the required level of performance for each of the elements (to be stated in passive voice)  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Perform cytological test | 1. ***Cytological specimen*** is extracted as per work requirement 2. Specimen is prepared as per laboratory manual 3. Specimen is observed under ***a microscope*** as per work requirement. 4. Cytological test report is prepared as per science laboratory procedures |
| 1. Perform food test | 1. ***Food test apparatus*** and ***equipment*** are assembled as per work requirement 2. ***Food test reagents*** are prepared as per standard laboratory procedures 3. Food sample is tested as per laboratory manual procedures. 4. ***Food test*** report is prepared as per work requirement |
| 1. Carry out microbiological technique | 1. ***Microbiology apparatus*** and ***Equipment*** is sterilized as per laboratory manual procedure 2. Culture media is prepared as per manufacturer’s specification. 3. ***Microbial Specimen*** is cultured as per work requirement. 4. Microbial culture report is prepared as per work requirement Culture media is disposed as per work requirement |
| 1. Care for laboratory animals | 1. ***Laboratory animals*** are handled as per science laboratory requirements 2. Sexing of laboratory animals is carried out as per anatomical procedures 3. ***Humane killing*** is carried out as per laboratory procedures 4. Laboratory animals is dissected as per anatomy and physiology laboratory manual 5. Animal carcasses are disposed as per work requirement |
| 1. Carry out herbarium technique | 1. ***Herbarium tools*** are assembled as per work requirement 2. ***Botanical garden maintenance*** is carried out as per Botanical accreditation standards 3. Plant specimens are collected as per botanical guidelines 4. Plant specimen processing is carried out according to herbarium laboratory manual 5. ***Herbarium specimen*** is labeled according to herbarium handbook 6. Herbarium specimen is displayed according to herbarium handbook 7. Herbarium specimens are stored according to work requirement |
| 1. Carry out museum technique | 1. ***Museum apparatus*** and ***equipment*** are assembled as per work requirement 2. ***Museum specimens*** are collected as per work requirement 3. Museum specimens are preserved according to work requirement 4. Museum specimens are labeled as per museum handbook 5. Museum specimens are displayed as per museum handbook 6. Museum specimens are stored as per museum handbook |
| 1. Conduct ecological experiments | 1. Terminologies used in ecology 2. ***Ecological equipment*** is maintained as per science laboratory procedures 3. ***Abiotic factors*** are measured as per weather station manual 4. ***Biotic factors*** are measured as per work requirement 5. Ecological factors report is prepared as per work requirement |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| 1. Cytological specimen includes but not limited to: | * Plant cells * Animal cells * Microbial cells * Tissue samples |
| 1. Microscopes include but not limited to: | * Florescent microscope * Bright field microscope * Dark ground microscope * Electron microscope * Phase contrast microscope * Dissecting microscope |
| 1. Food test apparatus and equipment includes but is not limited to: | * Water bath * Test tube * Scapula * White tile * Reagent bottle * mortar and Pestle * Glassware |
| 1. Food test reagents include but is not limited to: | Reagents for testing;   * reducing sugars * non reducing sugars * lipids * proteins * starch * vitamins |
| 1. Food test include but not limited to: | Test for   * Protein * Vitamins * reducing sugars * non-reducing sugars * starch * lipids |
| 1. Microbiology apparatus and equipment includes but not limited to: | * Autoclaves * Ovens * Incubator * Incinerator * Wire loops * Bunsen burners * Culture plates * Microbiological glassware * Biosafety hoods * Refrigerator |
| 1. Microbial Specimenincludes but not limited to: | * Bacteria * Fungi * Protozoa |
| 1. Laboratory animals include but not limited to: | * Rats * Guinea pigs * Rabbits * Mongolian gerbil * Hamsters * Insects * Birds |
| 1. Humane killing includes but not limited to: | * Physical methods * Chemical methods * Electrical methods |
| 1. Herbarium toolsinclude but not limited to: | * Cutting tools * Digging tools * Collection bags * Field stationery * Plant press * Blotting papers * Source of heat |
| 1. Botanical garden maintenance include but not limited to: | * Weeding * Pruning * Irrigation * Pest control * Planting |
| 1. Herbarium specimens includes but not limited to: | * Leaves * Roots * Flowers * Fruits * Whole plants * Seeds * Stems |
| 1. Museum apparatus and equipment includes but not limited to: | * Museum jars * Killing jars * Pouter * Nets * Traps * Field stationeries * Collection bags * Pair of tongs and forceps |
| 1. Museum specimens include but not limited to: | * Arthropods * Mammals * Reptiles * Birds * Plants * Fish * Annelids |
| 1. Ecological equipment includes but not limited to: | * Quadrats * Nets * Tape measure * Ropes and strings * Marker pens * Instruments of measuring elements of weather |
| 1. Abiotic factors include but not limited to: | * Rainfall * Humidity * Salinity * Ph * Soil * Temperature * Atmospheric pressure * Oxygen * Air |
| 1. Biotic factors include but not limited to: | * Symbiosis * Competition * Parasitism * Commensalism * Predation |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Maintenance
* Communication
* Interpersonal
* Analytical
* Critical thinking
* Problem solving
* First aid
* Innovation
* Creativity
* Drawing
* Organisation
* Management
* Planning
* Decision making

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Microscopy
* Photography
* Scientific report writing
* Occupational safety and health
* Basic mathematics
* Computer application
* Environmental conservation
* Entrepreneurship

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | 1. Assessment requires evidence that the candidate: 2. Observed specimen under a microscope as per work requirement. 3. Preparedfood test reagents as per standard laboratory procedures 4. Tested food sample as per laboratory manual procedures 5. Prepared culture media as per manufacturer’s specification. 6. CulturedMicrobial Specimenas per work requirement. 7. Handledlaboratory animal as per science laboratory requirements 8. Carried out humane killing as per laboratory procedures 9. Dissected laboratory animals as per anatomy and physiology laboratory manual 10. Collected plant specimens as per work requirement 11. Carried out plant specimen processing according to herbarium laboratory manual 12. Stored herbarium specimens according to work requirement 13. Collectedmuseum specimensas per work requirement 14. Preserved museum specimens according to work requirement 15. Measuredabiotic factors as per weather station manual 16. Measuredbiotic factorsas per work requirement |
| 2. Resource implications | The following resources should be provided:   1. Appropriately simulated environment where assessment can take place. 2. Access to relevant work environment. 3. Resources relevant to the proposed activities or tasks. |
| 3. Methods of assessment | Competency in this unit may be assessed through:   1. Practical 2. Project 3. Third party report 4. Portfolio of evidence 5. Written test 6. Oral test |
| 4. Context of assessment | Competency may be assessed in a work place or simulated workplace |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

# PERFORM CHEMISTRY TECHNIQUES

**UNIT CODE:** 0531 441 10A

**UNIT DESCRIPTION**

This unit specifies the competencies required to perform chemistry techniques. It involves carrying out pH measurements, analyzing chemical samples and carrying out separation techniques.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the **key outcomes** which make up workplace function (to be stated in active) | **PERFORMANCE CRITERIA**  These are **assessable statements** which specify the required level of performance for each of the elements (to be stated in passive voice)  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Carry out pH measurement | 1. ***pH apparatus*** and ***equipment*** are assembled as per work requirement 2. ***Sample pH measurement*** is performed as per chemistry laboratory manual 3. Sample pH result is reported as per chemistry laboratory manual |
| 1. Analyze chemical sample | 1. ***Chemical analysis apparatus*** and ***equipment*** are assembled as per work requirement 2. ***Chemical samples*** and ***reagents*** are prepared as per chemistry laboratory manual 3. ***Chemical analysis*** is performed as per chemistry laboratory manual 4. Chemical analysis results are reported as per chemistry laboratory manual |
| 1. Carry out separation technique | 1. ***Separation technique apparatus*** and ***equipment*** are assembled as per work requirement 2. Chemical sample and ***separation reagent*** is prepared as per work requirement 3. ***Sample separation*** is performed as per chemistry laboratory manual 4. Separation result is reported as per chemistry laboratory manual |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| 1. pH apparatus includes but not limited to: | * + Indicator papers   + Glassware |
| 1. pH reagents include but not limited to: | * Distilled water * pH indicator solutions * Organic solvents * Inorganic solvents |
| 1. Sample pH measurement includes but not limited to: | * pH indicator solution * pH indicator paper * pH meter |
| 1. Chemical analysis apparatus includes but not limited to: | * Glassware * Hot plates * Burettes * Pipettes * Magnetic stirrer plates * Bunsen burners * Spatulas * Crucibles * Tripod stand * Clamp and stand * Test tube racks * Tongs |
| 1. Chemical analysis equipment includes but not limited to: | * Analytical balances * Ovens * Karl Fischer titrators |
| 1. Chemical samples include but not limited to: | * Alcoholic beverages * Food substances * Petroleum products * Soil * Gases * Metal ores * Mineral salts |
| 1. Chemical reagents include but not limited to: | * Organic acids * Inorganic acids * Organic bases * Inorganic bases * Polar solvents * Non-polar solvents |
| 1. Chemical analysis includes but not limited to: | * Volumetric * Gravimetric * Flame photometry * Colorimetry |
| 1. Separation technique apparatus include but not limited to: | * Glassware * Pestle and mortar * Water bath * Separating funnel * Hot plates * Magnetic stirrer plates * Bunsen burners * Spatula * Crucibles * Tripod stand * Filter paper * Clamp and stand * Chromatography paper * Thin layer chromatography development chamber * Tongs |
| 1. Separation technique equipment include but not limited to: | * Distillation apparatus * Soxhlet apparatus * Analytical balance * Oven * Furnace * Fridge |
| 1. Separation reagent includes but not limited to: | * Organic solvents * Distilled water * Inorganic solvents |
| 1. Sample separation include but not limited to: | * Distillation * Evaporation * Paper chromatography * Decantation * Extraction * Filtration * Crystallization |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Analytical
* Computer
* Maintenance
* Problem solving
* Technical
* Calibration
* Critical thinking
* Observation
* Interpretation
* Sample handling

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Qualitative and quantitative analysis
* Sample preparation and storage
* Operation of laboratory equipment
* Laboratory ware and equipment
* Laboratory safety

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | 1. Assessment requires evidence that the candidate: 2. Performed sample pH measurement as per chemistry laboratory manual 3. Reported sample pH result as per chemistry laboratory manual 4. Prepared chemical samples and reagents as per chemistry laboratory manual 5. Performed chemical analysis as per chemistry laboratory manual 6. Chemical analysis results are reported as per chemistry laboratory manual 7. Prepared chemical sample and separation reagent as per work requirement 8. Performed sample separation as per chemistry laboratory manual 9. Separation result is reported as per chemistry laboratory manual |
| 1. Resource Implications | 1. The following resources should be provided: 2. Appropriately simulated environment where assessment can take place. 3. Access to relevant work environment. 4. Resources relevant to the proposed activities or tasks. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Practical 2. Project 3. Third party report 4. Portfolio of evidence 5. Written test 6. Oral test |
| 1. Context of Assessment | Competency may be assessed in a work place or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM PHYSICS TECHNIQUES

**UNIT CODE:** 0533 441 11A

**UNIT DESCRIPTION**

This unit specifies the competencies required to perform physics techniques. It involves measuring physical quantities, performing pressure experiment, measuring heat capacity, conducting wave experiment, performing optical experiment, conducting electrical experiment, carrying out electromagnetism experiment and performing particulate nature of matter experiment.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the **key outcomes** which make up workplace function (to be stated in active) | **PERFORMANCE CRITERIA**  These are **assessable statements** which specify the required level of performance for each of the elements (to be stated in passive voice)  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Measure physical quantities | 1. ***Measurement tools, equipment and apparatus*** are assembled according to work requirement 2. Body ***physical quantity*** is measured according to physics laboratory manual 3. Body physical quantity measurements are reported as per international system of units |
| 1. Perform pressure experiment | 1. ***Pressure tools*** ***and*** ***equipment*** are assembled according to physics manual 2. Pressure tools and equipment are set as per work requirement 3. ***Pressure*** ***variables*** determination is carried out as per physics laboratory manual 4. Pressure is calculatedas per ***pressure formulae*** |
| 1. Measure heat capacity | 1. ***Heat capacity tools, equipment*** and ***apparatus*** are assembled according to work requirement 2. Body ***heat capacity*** is measured according to physics laboratory manual 3. Heat capacity measurement is reported as per physics laboratory manual |
| 1. Conduct wave experiment | 1. ***Wave experiment tools*** and ***equipment*** are assembled according to physics manual 2. ***Wave characteristic*** experiment is carried out as per physics laboratory manual 3. ***Wave behavior*** is reported as per the physics laboratory manual |
| 1. Perform optical experiment | 1. ***Optical instruments*** are assembled as per the work requirement 2. Optical experiment is carried out as per physics laboratory manual 3. Image characteristics are recorded as per the ***mirror and lens formulae*** 4. ***Light behavior*** is reported as per the physics laboratory manual |
| 1. Conduct electrical experiment | 1. ***Electrical devices*** and ***apparatus*** are assembled as work requirement 2. ***Electrical circuit*** is set based on the physics laboratory manual 3. ***Electrical quantities*** are read and reported as per physics laboratory manual |
| 1. Carry out electromagnetism experiment | * 1. ***Magnets*** are assembled as per work requirement   2. ***Magnetic properties*** are determined based on magnetic principles   3. ***Magnetization and demagnetization*** experiments are performed as per physics laboratory manual. |
| 1. Perform particulate nature of matter experiment | 1. ***Particulate nature of matter experiment apparatus*** is assembled as per the physics laboratory manual 2. Particulate nature of matter experiment is carried out as per physics laboratory manual 3. Particulate nature of matter experiment results is reported as per physics laboratory manual. |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| 1. Measurement tools, equipment and apparatus includes but not limited to: | * Tape measure * Ruler * Vernier calipers * Micrometer screw gauge * Weighing balance * Pressure gauge * Stop watch |
| 1. Physical Quantity includes but not limited to: | * Mass * Length * Time * Temperature * Density |
| 1. Pressure tools and equipment includes but not limited to: | * Pressure gauge * Barometer |
| 1. Pressure variables include but not limited to: | * Force * Density * Area |
| 1. Pressure formulae include but not limited to: |  |
| 1. Heat capacity tools, equipment and apparatusincludes but not limited to: | * Calorimeter * Thermometer * Heat source |
| 1. Heat capacity includes but not limited to: | * Heat transfer * Specific heat capacity * Latent heat   + Latent heat of fusion   + Latent heat of vaporization   + Latent heat of sublimation |
| Wave experiment tools and equipment includes but not limited to: | * Ripple tank * Slinky spring * Resonance tube * Tuning fork * Sonometer |
| 1. Wave characteristic includes but not limited to: | * Amplitude * Wavelength * Frequency |
| 1. Wave behavior includes but not limited to: | * Refraction * Reflection * Diffraction * interference |
| 1. Optical instruments include but not limited to: | * Mirror * Lenses * Glass block * Optical pins |
| 1. Mirror and lens formulae includes but not limited to: | * = +   + f - Focal length   + u - Object distance   + v - Image distance * m = =   + - Image height * – Object height |
| 1. Light behavior includes but not limited to: | * Polarization * Reflection * transmission |
| 1. Electrical devices and apparatus include but not limited to: | * Ammeter * Voltameter * Resistors * Capacitors * Connecting wires * Dry cells * LED * Diode * Galvanometer |
| 1. Electrical quantitiesinclude but not limited to: | * Resistance * Voltage * current * Capacitance * Inductance * Power |
| 1. Magnets includes but not limited to: | * Permanent * Temporary * Earth |
| 1. Magnetic properties include but not limited to: | * Diamagnetic * Paramagnetic * Ferromagnetic * Lines of force * Magnetic flux patterns * Flux density |
| 1. Magnetization and demagnetization include but not limited to: | * Electrical * Hammering * Induction * Stroking * Contact |
| 1. Particulate nature of matter experiment apparatusincludes but not limited to: | * Smoke cell * Lens * Beakers * Potassium permanganate crystals |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Technical
* Observation
* Problem solving
* Critical thinking
* Reporting
* Interpretation

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Physics equipment and apparatus
* Physics formulas
* Physical quantities
* Characteristics and behaviour of waves
* Light properties and behaviour
* Electromagnetic principles
* Electrical components
* Connection of circuits
* Electrical quantities

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1.Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Measured body physical quantity according to physics laboratory manual   2. Reported body physical quantity measurements as per international system of units   3. Set pressure tools and equipment as per work requirement   4. Calculated pressure as per pressure formulae   5. Measured body heat capacity according to physics laboratory manual   6. Reported heat capacity measurement as per physics laboratory manual   7. Carried out wave characteristic experiment as per physics laboratory manual   8. Reported wave behavior as per the physics laboratory manual   9. Carried out optical experiment as per physics laboratory manual   10. Recorded image characteristics as per the mirror and lens formulae   11. Set electrical circuit based on the physics laboratory manual   12. Read and reported electrical quantities as per physics laboratory manual   13. Determined magnetic properties based on magnetic principles   14. Performed magnetization and demagnetization experiments as per physics laboratory manual   15. Carried out particulate nature of matter experiment as per physics laboratory manual |
| 2. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Project   3. Third party report   4. Portfolio of evidence   5. Written test   6. Oral test |
| 4. Context of Assessment | Competency may be assessed in a work place or simulated workplace |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# **MEASURE PHYSICAL QUANTITIES**

**UNIT CODE:**

**UNIT DESCRIPTION**

This unit of competency covers the ability of a laboratory technologist to measure various physical quantities accurately using various measuring instruments. It involves measuring fundamental quantities, measuring electrical quantities, measuring material flow, thermometric quantities, measuring optical properties, measuring sound and acoustic.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| --- | --- |
| 1.Measure fundamental quantity | 1.1 Measuring ***instruments*** are identified as per the job specification.  1.2 ***Fundamental quantities*** of the ***samples*** are measured as per the standard laboratory procedures  1.3 Fundamental quantities are recorded as per the job specification |
| 2.Measure electrical quantity | 2.1 ***Components*** for electrical measurement are prepared as per laboratory procedures.   |  | | --- | | 2.2 Electrical ***measuring instruments*** are selected as per job specification  2.3 Electrical ***quantities*** are measured as per standard laboratory procedures  2.4 Electrical measurement results are recorded as per laboratory procedures | |
| 3.Measure material flow | * 1. ***Sample material*** for flow measurement is prepared as per laboratory procedures.   2. ***Flow measuring instrument*** is selected as per job specification   3. ***Flow rate*** is measured as per standard laboratory procedures   3.4 Flow quantity measurement results are recorded as per laboratory guidelines |
| 4.Measure and control thermometric quantity | * 1. Sample objects for temperature measurement are identified as per laboratory procedures.   2. ***Temperature measuring instrument*** is selected as per laboratory manuals   3. ***Thermometric quantity*** is measured as per standard laboratory p1rocedures   4. Control thermometric quantity as per industry practice***.***   4.5 Thermometric measurement results are recorded as per laboratory procedures. |
| 5.Measure optical property | 5.1 ***Optical objects*** for measurement are prepared as per laboratory procedures  5.2 ***Optical measuring instrument*** is selected as per laboratory manuals  5.3 ***Optical quantities*** are measured as per standard laboratory procedures  5.4 Optical measurement results are recorded as per laboratory guidelines |
| 6. Measure sound and acoustic. | 6.1 Sample objects for sound measurement are identified as per laboratory procedures.  6.2 ***Sound measuring instrument*** is selected as per laboratory manuals  6.3 ***Sound level*** is measured as per standard laboratory procedures  6.4Sound measurement results are recorded as per laboratory procedures |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Measuring instruments include but not limited to: | * meter rule * Vernier caliper * micrometer screw gauge * stopwatch * beam balance |
| * 1. Fundamental quantities include but not limited to: | * mass * length * time |
| Samples may include but not limited to: | * solids * fluids |
| Electrical Components may include but not limited to: | * switches * cells * resistors * capacitors * inductors |
| Electrical measuring instruments include but not limited to: | * voltmeter * ammeter * ohmmeter * multimeter |
| Electrical quantities include but not limited to: | * current * voltage * resistance * capacitance * inductance |
| Sample material include but not limited to: | * liquid * gases |
| Flow measuring instrument include but limited to: | * variable flow meter * mechanical flow meter * flow meter * venturi meter |
| Flow rate include but not limited to: | * laminar * turbulent * rotational * compressible |
| Temperature measuring instrument include but not limited to: | * thermocouple * clinical thermometer * bimetallic thermometer * digital thermometer * infrared thermometer |
| Thermometric quantity includes but not limited to: | * volume * pressure * resistance * electromotive force |
| Optical objects include but not limited to: | * mirrors * lenses * fibre optics * glass prisms |
| Optical quantities include but not limited to: | * luminous flux * luminous intensity * illuminous |
| Sound measuring include but not limited to: | * sound level meters * dosimeter * vibration meters * octave band analyzer |
| Sound level include but not limited to: | * sound exposure level * sound power level * sound pressure level * sound intensity level * sound veracity level |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

**●** Physics equipment and apparatus

● Physics formulas

● Physical quantities

● Thermodynamic processes

● Characteristics and behavior of waves

● Light properties and behavior

● Electromagnetic principles

● Electrical components

● Connection of circuits

● Electrical quantities

**Required skills**

The individual needs to demonstrate the following skills:

● Active listening

● Reflecting

● Technical

● Observation

● Problem solving

● Critical thinking

● Reporting

● Interpretation

● Maintenance

● Communication

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and skills range.

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:  1.1 Measuring instruments are identified as per the job specification.  1.2 Fundamental quantities of the samples are measured as per the standard laboratory procedures  1.3. Components for electrical measurement are prepared as per laboratory procedures.  1.4 Electrical quantities are measured as per standard laboratory procedures  1.5 Flow rate is measured as per standard laboratory procedures  1.6 Thermometric quantity is measured as per standard laboratory procedures  *1.7*Optical quantities are measured as per standard laboratory procedures  1.8 Sound level is measured as per standard laboratory procedures |
| 2. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 3. Methods of assessment | Competency may be assessed through:   * Practical Assessment * Project-Based Assessment * Portfolio of Evidence * Third Party Reports * Written Assessment |
| 4. Context of assessment | Competency may be assessed in a workplace or simulated workplace |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

# **TEST MATERIAL PROPERTIES**

**UNIT CODE: 0533 541 17A**

**UNIT DESCRIPTION**

This unit of competency covers the ability of a laboratory technologist to test the characteristics and behavior of substances such as metals, ceramics, or plastics under various conditions. It involves testing material mechanical properties, test material electrical properties, test material conductivity, test material magnetic properties and test material optical properties of materials

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Test material mechanical property | 1.1 Mechanical test sample is identified and classified based on ***material type***  1.2 Mechanical Testing procedures are developed based on ***testing methods***  1.3 Testing instrument is set and optimized as per manufacturer’s operating manual  1.4Mechanical testing is conducted as per laboratory procedures  1.5 Mechanical properties test results are documented as per laboratory procedures |
| 2. Test material conductivity | 2.1 Conductivity test sample is identified and classified as per the material type  2.2 Test Procedures are developed based on the testing method  2.3 conductivity Test instruments is set and optimized as per manufacturer's operating manual  2.4 ***Conductivity testing*** is conducted as per laboratory procedures  2.5 Conductivity measurement results are documented as per laboratory procedures |
| 3.Test material magnetic property | |  | | --- | | 3.1 Magnetic test samples are received as per lab procedures  3.2 Testing procedures are developed based on testing methods  3.3 Testing instrument is set and optimized as per manufacturer’s operating manual  3.4 Magnetic testing is conducted as per laboratory procedures |   3.5 magnetic measurement results are documented as per laboratory procedures |
| 4. Test material optical property | 4.1 Optical test sample is identified and classified based on material type  4.2 Testing procedures are developed based on testing methods   | 4.3 Testing instrument is set and optimized as per manufacturer’s operating manual  4.4 Optic property testing is conducted as per laboratory procedures | | --- |   4.5 Optical material properties results are documented as per laboratory procedures |

**RANGE**

This section provides a work environment and conditions to which the performance criteria apply. It allows for a different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Material type include but not limited to | * metals * ceramics * plastics * glass |
| Testing methods include but not limited to: | * tensile testing * compression testing * shear testing * peel testing * tear testing |
| Conductivity testing include but not limited to | * thermal conductivity * electrical conductivity * ionic conductivity |
| Magnetic testing includes but not limited to: | * wet particle magnetic testing * dry particle magnetic testing |
| Optical measurement includes but not limited to: | * refractive index * luminous intensity * reflection * diffraction |
| Optical measuring instruments include but not limited to: | * diffraction grating * refractometer * optical power meter * polarizer |
| Optical quantities may include but not limited to: | * wavelength * frequency * amplitude |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

**●** Physics equipment and apparatus

● Physics formulas

● Physical quantities

● Characteristics and behavior of waves

● Light properties and behavior

● Electromagnetic principles

● Electrical components

● Connection of circuits

● Electrical quantities

**Required skills**

The individual needs to demonstrate the following skills:

● Active listening

● Reflecting

● Technical

● Observation

● Problem solving

● Critical thinking

● Reporting

● Interpretation

● Maintenance

● Communication

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and skills range.

|  |  |
| --- | --- |
| 1 Critical aspects of competency | Assessment requires evidence that the candidate:  1.1 Set and optimized testing instrument as per manufacturer’s operating manual  1.2 Conducted mechanical testing as per laboratory procedures  1.3 Conducted conductivity testing as per laboratory procedures  1.4 Conducted magnetic testing as per laboratory procedures |
| 2. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 3. Methods of assessment | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Third Party Reports   5. Written Assessment |
| 4. Context of assessment | Competency may be assessed in a workplace or simulated workplace |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

# **MAINTAIN LABORATORY EQUIPMENT**

**UNIT CODE:**

**UNIT DESCRIPTION**

This unit of competency covers the ability of a laboratory technologist to perform pre-use checks on laboratory equipment, perform calibration checks on laboratory equipment and perform equipment cleaning.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Perform pre-use checks on laboratory equipment | 1.1 Laboratory equipment check-ups are carried out in accordance with workplace procedure   * 1. ***safety check-ups*** are carried out as per manufacturer’s manual   2. Faulty or unsafe components are identified in line with manufacturer’s manual   3. Faulty or unsafe components are reported as per laboratory procedures |
| 2. Perform calibration checks on laboratory equipment | 2.1 Laboratory equipment is started according to operating procedure   * 1. Laboratory equipment is calibrated as per manufacturer’s manual   2. ***Calibration data*** is recorded as per job requirement   2.4 Out-of-calibration equipment is quarantined as per job specification |
| 1. Perform equipment cleaning | * 1. Laboratory Equipment for cleaning are identified in accordance with manufacturer's manual   2. laboratory equipment cleaning is carried out in accordance with manufacturer's manual   3. Cleaned laboratory equipment is stored according to manufacturer manual |

**RANGE**

This section provides a work environment and conditions to which the performance criteria apply. It allows for a different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Safety check-upsinclude but not limited to | * power inputs * mechanical check |
| Calibration data include but not limited to | * zero error * electrical * temperature * humidity |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Physics equipment and apparatus
* Physics formulas
* Mathematics
* Physical quantities
* Thermodynamics
* Characteristics and behavior of waves
* Light properties and behavior
* Electromagnetic principles
* Electrical components
* Radioactivity
* Connection of circuits
* Electrical quantities

**Required skills**

The individual needs to demonstrate the following skills:

Examples:

● Active listening

● Reflecting

● Technical

● Observation

● Problem solving

● Critical thinking

● Reporting

● Interpretation

● Maintenance

● Communication

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and skills range.

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:  1.1 Carried out safety check-ups as per manufacturer’s manual  1.2 Recorded calibration data is as per job requirement 1.3 Carried out laboratory equipment cleaning in accordance with manufacturer's manual  1.4 stored cleaned laboratory equipment according to manufacturer’s manual |
| 2. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 3. Methods of assessment | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Third Party Reports   5. Written Assessment |
| 4. Context of assessment | Competency may be assessed in a workplace or simulated workplace |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

# **PERFORM CHEMICAL ANALYSES**

**UNIT CODE: 0531 541 19A**

**UNIT DESCRIPTION**

This unit of competency covers the ability of a laboratory technologist to perform chemical analyses that includes conducting chemical sampling, preparing chemical reagents, conducting volumetric analysis and gravimetric analysis.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1.Conduct chemical sampling | * 1. Type of chemical analysis is identified based on the clients need   2. Tools and equipment for sampling are assembled as per test requirement   3. ***Chemical samples*** are collected as per organizational sampling procedure. |
| 1. Prepare chemical reagents | * 1. Chemical reagents to be prepared are determined according to the test requirement.   2. Concentrations of the reagents are calculated based on mole concept.   3. ***Apparatus and equipment*** are assembled as per the organizational laboratory manual.   4. ***Chemical reagents*** are prepared and stored according to the laboratory manual. |
| 1. Conduct Volumetric analysis | * 1. ***Apparatus and equipment*** are assembled as per work requirement.   2. Chemical reagents are assembled according to the work requirement.   3. Titration is carried out as per the organizational laboratory manual.   4. Volumetric analysis results are ***processed*** according to technical writing standards |
| 4.Conduct gravimetric analysis | 4.1. Apparatus and equipment are assembled as per work requirement.  4.2. Chemical reagents are assembled according to specific ***gravimetry***.  4.3. Gravimetry is carried out as per the organizational laboratory manual.  4.4. Gravimetric results are processed as per laboratory manual  4.5. Gravimetric results are documented according to Laboratory manual |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Chemical samples may include but are not limited to: | * Water * Food stuff * Soil * Blood * Air * Paints * Petroleum products * Fertilizers * Agrochemicals |
| Apparatus and equipment may include but are not limited to: | * Graduated cylinders * Laboratory flasks * Droppers * Funnels * Bunsen burner * Analytical balances * Oven * Muffle furnace * Tripod stand |
| Chemical reagents may include but are not limited to: | * Acids * Bases * Salts * Indicators * Distilled water |
| Processing of results may include but are not limited to: | * Tabulation * Calculation * Discussion * Presentation |
| Titrimetric may include but are not limited to: | * Acid-base * Back * REDOX * Complexometric |
| Gravimetry may include but are not limited to: | * Precipitation * Electrogravimetry * Volatility * Particulate |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

* Communication
* laboratory safety
* Chemistry and instrumentation knowledge
* Information Technology
* Sample collection and storage

**Required skills**

* Problem-solving skills
* Critical thinking
* Analytical skills
* Digital literacy

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and skills range.

|  |  |
| --- | --- |
| * + - 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Collected Chemical samples are as per organizational sampling procedure.   2. Calculated Concentration of the reagents based on mole concept.   3. Prepared and stored Chemical reagents according to the laboratory manual.   4. Carried out titration as per the organizational laboratory manual.   5. Processed volumetric analysis results according to technical writing standards.   6. Carried out gravimetry as per the organizational laboratory manual.   7. Processed gravimetric results as per laboratory manual. |
| * + - 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| * + - 1. Methods of assessment | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Third Party Reports   5. Written Assessment |
| * + - 1. Context of assessment | Competency may be assessed in a workplace or simulated workplace |
| * + - 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

# **PERFORM CHEMISTRY INSTRUMENTATION TECHNOIQUES**

**UNIT CODE: 0531 541 20A**

**UNIT DESCRIPTION**

This unit of competency covers the ability of a laboratory technologist to use chemical analytical instruments to analyze samples and it will include to carry out chromatographic technique, carry out spectroscopic technique, carry out electroanalytical technique and carry out colorimetric techniques.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Carry out chromatographic technique | * 1. Chromatographic test to be carried out is identified in line with work requirement.   2. ***Apparatus*** andchromatographic equipment are identified as per work requirement.   3. ***Chromatographic equipment*** is ***optimized*** according to the manufacturer's manual.   4. Standards and samples are prepared according to the organizational laboratory manual.   5. Analysis is carried out in line with the organizational laboratory manual.   6. Results are ***processed*** and documented according to organizational laboratory manual. |
| 2. Carry out spectroscopic technique | * 1. Test to be performed is identified in line with work requirements.   2. ***Apparatus*** and Spectroscopic equipmentare identified as per work to be done.   3. ***Spectroscopic equipment*** is ***optimized*** according to the manufacturer's manual.   4. Standards and samples are prepared according to the organizational laboratory manual.   5. Analysis is carried out in line with the organizational laboratory manual.   6. Results are ***processed*** and documented according to organizational laboratory manual. |
| 3. Carry out electroanalytical technique | * 1. Test to be performed is identified in line with work requirements.   2. ***Apparatus*** and Electroanalytical equipment are identified as per work to be done.   3. ***Electroanalytical equipment*** is ***optimized*** according to manufacturer's manual.   4. Standards and samples are prepared according to organizational laboratory manual.   5. Analysis is carried out as per the organizational laboratory manual.   6. Results are ***processed*** and documented according to organizational laboratory manual. |
| 4. Carry out colorimetric technique | * 1. Colorimetric test to be performed is identified in line with work requirements.   2. ***Apparatus*** and colorimetric equipment are identified as per work to be done.   3. ***colorimetric equipment*** is ***optimized*** according to the manufacturer's manual.   4. Standards and samples are prepared according to the organizational laboratory manual.   5. Analysis is carried out in line with the organizational laboratory manual.   6. Results are ***processed*** and documented according to organizational laboratory manual. |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Apparatus may include but not limited to: | * Syringe * Volumetric flasks * Analytical balances * Crucibles * Graduated glassware * Cuvettes |
| * Chromatographic equipment includes but not limited to: | * High Performance Liquid Chromatography (HPLC) * Gas Chromatography (GC) * Ion Exchange Chromatography (IEC) * Thin Layer Chromatography (TLC) * Gel Electrophoresis (GE) |
| Optimizing laboratory instrument include but not limited to: | * Calibration * Troubleshooting * Physical checks |
| Processing of results include but not limited to: | * Tabulation * Calculation * Interpretation * Discussion |
| Spectroscopic equipment includes but not limited to: | * Flame Atomic Emission Spectrometer   (FAES)   * Atomic Absorption Spectrophotometer (AAS) * Mass Spectrometer (MS) * Inductively Coupled Plasma-Atomic Emission Spectrometer (ICP-AES) |
| Electroanalytical equipment includes but not limited to: | * Potentiometer * Amperemeter * Conductometer * Electrogravimeter * Voltameter |
| Colorimetric equipmentincludes but not limited to: | * Lovibond color comparator * colorimeter * UV-Vis spectrophotometer |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Communication
* laboratory safety
* Chemistry and instrumentation knowledge
* Information Technology
* Sample collection and storage

**Required skills**

The individual needs to demonstrate the following skills:

● Problem-solving skills

● Analytical skills

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and skills range.

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Optimized chromatographic equipment according to the manufacturer's manual.   2. Prepared standards and samples according to the organizational laboratory manual.   3. Carried out analysis in line with the organizational laboratory manual   4. Optimized spectroscopic equipment according to the manufacturer's manual.   5. Prepared standards and samples according to the organizational laboratory manual.   6. Optimized electroanalytical equipment according to manufacturer's manual.   7. Standards and samples are prepared according to organizational laboratory manual.   8. Carried out analysis as per the organizational laboratory manual.   9. Optimized colorimetric equipment according to the manufacturer's manual.   10. Prepared standards and samples according to the organizational laboratory manual.   11. Carried out analysis in line with the organizational laboratory manual. |
| 2. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 3. Methods of assessment | Competency may be assessed through:  3.1 Practical Assessment  3.2 Project-Based Assessment  3.3 Portfolio of Evidence  3.4 Third Party Reports  3.5 Written Assessment |
| 4. Context of assessment | Competency may be assessed in a workplace or simulated workplace |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

# **CARRY OUT CYTO-HISTOLOGICAL AND IMMUNOLOGICAL TECHNIQUES**

**UNIT CODE:** 0511 541 21A

**UNIT DESCRIPTION**

This unit specifies the competencies required to carry out cyto-histological and immunological techniques. It involves Carrying out care and maintenance of microscopes, performing cytological technique, performing histological technique and performing immunological technique.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| 1. Carry out care and maintenance of microscopes | * 1. Ocular parts and surfaces are cleaned as per manufacturer's specifications   2. Movable parts are lubricated as per manufacturer's specification   3. Measurement parts are calibrated as per manufacturer’s standards   4. Microscope is positioned and stored as per manufacturer’s specifications |
| 2. Perform cytological technique | 2.1 Cytological specimens are collected as per cytological laboratory procedures.  2.2 ***Cytological specimen is processed*** as per cytological laboratory manual procedures  2.3 Cytological specimens are examined as per cytological laboratory practical manual.  2.4 Results are reported as per work requirement |
| 3. Perform Histological technique | 3.1 Histological specimens are collected as per histological laboratory procedures.  3.2 ***Histological specimen is processed*** as per histological laboratory manual procedures  3.3 Histological specimens are examined and reported as per histological laboratory practical manual.  3.4 Results are reported as per work requirement |
| 4. Perform immunological Test | 4.1 ***Immunological specimens*** are collected as per immunological laboratory procedures.  4.2 Immunological specimen is processed as per immunological laboratory manual  4.3 ***Immunological tests*** are performed as per immunological laboratory manual  4.4 Results are reported as per work requirement |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| Cytological specimens include but not limited to: | * Plant cells * Blood * Urine * Saliva * Faecal sample |
| Histological specimens include but not limited to: | * Plant tissues * Animal tissues |
| Immunological specimens include but not limited to: | * Blood * Serum * Urine * Saliva * Feacal |
| Immunological tests include but not limited to: | * Rapid diagnostic test * Agglutination test * ELISA Test |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skill

* Maintenance
* Communication
* Interpersonal
* Analytical
* Critical thinking
* Problem solving
* First aid
* Innovation
* Creativity
* House keeping

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Microscopy
* Blood grouping
* Types of cells
* Cell growth and division
* Types of tissues
* Specimen collection methods
* Storage of specimens
* Tissue processing methods
* Disposal of specimen

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Cleaned ocular parts as per manufacturer's specifications   2. Examined cytological specimens and reported as per laboratory practical manual.   3. Processed histological specimen as per laboratory manual procedures   4. Processed immunological specimen as per laboratory manual procedures   5. Carried out immunological test as per laboratory manual |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Third Party Reports   5. Written Assessment |
| 1. Context of Assessment | Competency may be assessed in a workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# **CONDUCT MICROBIOLOGICAL TESTS**

**UNIT CODE:** 0511 541 22A

**UNIT DESCRIPTION**

This unit specifies the competencies required to carry out microbiological techniques. It involves Culturing microbial specimen, carrying out antibiotic sensitivity test, and applying industrial microbiological techniques.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| 1.Culture microbial specimen | 1.1 ***Culture equipment*** are assembled and sterilized as per microbiology manual procedures  1.2 ***Culture*** ***reagents*** and media are prepared as per manufacturer specifications.  1.3 Culture media is ***inoculated*** and incubated as per manufacturer specifications.  1.4 ***Microbial cultures*** are examined and identifiedas per Standard Microbiological Procedures (SMP)  1.5 Micro-organisms identified are reported as per Good Laboratory Practices (GLP) |
| 2.Carry out antibiotic sensitivity test | 2.1 Microbial cultures are prepared as per SMP  2.2 ***Antibiotic samples*** are introduced into the microbial culture and incubated as per standard drug sensitivity protocols  2.3 Sensitivity tests results are recorded as per GLP standards |
| 3.Apply industrial microbiological techniques | 3.1 Industrial microorganisms are assorted as per good laboratory practices  3.2 Microorganisms are sub-cultured and maintained as per Standard operating procedures  3.3 Microorganisms are introduced into ***industrial processes*** and monitored as per the industrial SOP |
| 4.Carry out parasitic test | 4.1 Sample for parasitic analysis is collected as per laboratory manual procedures  4.2 Samples for ***parasitic tests*** is prepared as per test requirements  4.3 Parasitic test is carried out as per laboratory manual procedures  4.4 Test results reported as per GLP |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| Culture equipment include but not limited to: | * + Autoclave   + Wire loop   + Source of heat   + Oven   + Aluminum foil   + Sterility indicator   + Petri plate   + Incubator |
| Culture reagents include but not limited to: | * + Agar   + Distilled water   + 70% Alcohol |
| Methods of inoculations include but not limited to: | * + Streaking   + Pour plate   + Stabbing   + Spread plating |
| Microbial cultures include but not limited to: | * + Bacterial culture   + Fungal Culture |
| Antibiotic samples include but not limited to: | * + Antibiotic sensitivity discs for commercial antibiotics   + Crude extracts |
| Industrial processes include but not limited to: | * Fermentation e.g., production of alcohol, vitamin, amino acids, bread making. * Yoghurt making   + Biogas production   + Bioremediation |
| Parasitic tests include but not limited to: | * Protozoans * Metazoans * Helminths |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Maintenance
* Communication
* Interpersonal
* Analytical
* Critical thinking
* Problem solving
* First aid
* Innovation
* Creativity

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Sterilization
* Safety
* Culture media
* Viruses
* Fungi
* Bacteria
* Water treatment
* Sewage treatment
* Fermentation
* Nucleic acids
* Antibiotics

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | 1.1 PreparedCulture reagents and media as per manufacturer specifications.  1.2 Inoculated and incubated Culture media is as per manufacturer specifications.  1.3 Introducedantibiotic samples into the microbial culture and incubated as per standard drug sensitivity protocols  1.4 Recorded sensitivity tests result as per GLP standards  1.5 Introduced and monitored microorganisms in ***industrial processes*** as per the industrial SOP  1.6 Carried out parasitic test as per laboratory manual procedures  1.6 Reported Test results as per GLP |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment.   3. Resources relevant to the proposed activities or tasks. |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Third Party Reports   5. Written Assessment |
| 1. Context of Assessment | Competency may be assessed in a workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# **PERFORM AQUARIUM, VIVARIUM AND HERBARIUM TECHNIQUES**

**UNIT CODE: 0511 5411 23A**

**UNIT DESCRIPTION**

This unit specifies the competencies required to perform herbarium techniques, museum techniques and Aquarium techniques.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| 1. Perform herbarium technique | * 1. Herbarium specimen is collected as per herbarium procedures   2. Herbarium specimen is processed as per herbarium laboratory manuals   3. Herbarium specimen is preserved as per herbarium standards   4. Preserved specimen is labeled and stored as per taxonomic requirements |
| 2. Perform Museum technique | * 1. ***Museum specimen*** is collected as per Museum procedures   2. Museum specimen is processed as per museum laboratory manuals   3. Museum specimen is preserved as per Museum standards   4. Preserved specimen is labelled and stored as per taxonomic requirements |
| 3. Perform Aquarium and vivarium techniques | 3.1 ***Aquarium*** and ***vivarium specimen*** is collected as per aquarium procedures   * 1. Aquarium and vivarium specimen is processed as per work requirement   2. Aquarium and vivarium specimen is preserved as per work requirement   3. Preserved aquarium and vivarium specimen is labelled and stored as per taxonomic requirements |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| Museum specimen includes but not limited to: | * + Arthropods   + Bones   + Plants   + Mammals   + Birds   + Reptiles   + Fish |
| Aquarium specimen includes but not limited to: | * Water plants   + Fish |
| Vivarium specimen includes but not limited to: | * Amphibians * Molluscs * Reptiles * Plants |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Maintenance
* Communication
* Interpersonal
* Critical thinking
* Problem solving
* First aid
* Innovation
* Creativity
* Specimen collection

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Sterilization
* Safety
* Classification
* Ecology
* Preservatives
* Fixation
* Preservation
* Mounting
* Anatomy and physiology

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1.Critical Aspects of Competency | * 1. Processed herbarium specimen as per laboratory manuals   1.2 Preserved herbarium specimen as per herbarium standards  1.3 Processed Museum specimen as laboratory manuals  1.4 Preserved Museum specimen as per museum standards  1.5 Processed aquarium specimen as per laboratory manuals   * 1. Preserved aquarium specimen as per museum standards |
| 2.Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 3.Methods of Assessment | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Third Party Reports   5. Written Assessment |
| 4.Context of Assessment | Competency may be assessed in a workplace or simulated workplace |
| 5.Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |