

**REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARD**

**FOR**

**ANALYTICAL CHEMISTRY TECHNICIAN**

**KNQF LEVEL 6**

**OCCUPATION STANDARD ISCED CODE: 0531 554A**

**First published 2024**

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# 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 also demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. This Occupational Standards will thus inform the development of Competency-Based Education and Training (CBET) curriculum for Industrial Chemistry level 6. This Occupational Standards will also be the basis for the assessment of an individual for competency certification.

It is my conviction that this Occupational Standard will play a great role in the development of a competent human resource for sustainable growth and development.

**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 were 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 this Occupational Standards.

I also thank all the individuals and organizations who participated in the validation of this Occupational Standard.

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# ABBREVIATION AND ACRONYMS

ISCED International Standard Classification of Education

QAI Qualification Awarding Institutions

TVET Technical and Vocational Education and Training

CBET Competency Based Education and Training

CBETA Competency Based Education and Training Authority

NSSC National Sector Skills Committee

SOPs Standard Operating Procedures

TLC Thin Layer Chromatography

HPLC High Performance Liquid Chromatography

AAS Atomic Absorption Spectroscopy

TVETA Technical and Vocational Education and Training Authority.

ANOVA Analysis of Variance

FAES Flame Atomic Emission Spectrometer

FT-IR Fourier Transform-Infrared

GC Gas Chromatography

HPLC High Performance Liquid Chromatography

CPU Central Processing Unit

RAM Random Access Memory

CDs Compact Discs

DVDs Digital Versatile Disc

HDMI High-Definition Multimedia Interface

DVI Digital Visual Interface

VGA Video Graphics Array

USB Universal Serial Bus

TVs Televisions

URIs Uniform Resource Identifier

CV Curriculum Vitae

LED Luminous Intensity Distribution

ICH Intangible Cultural Heritage

ICT Information and Communication Technology

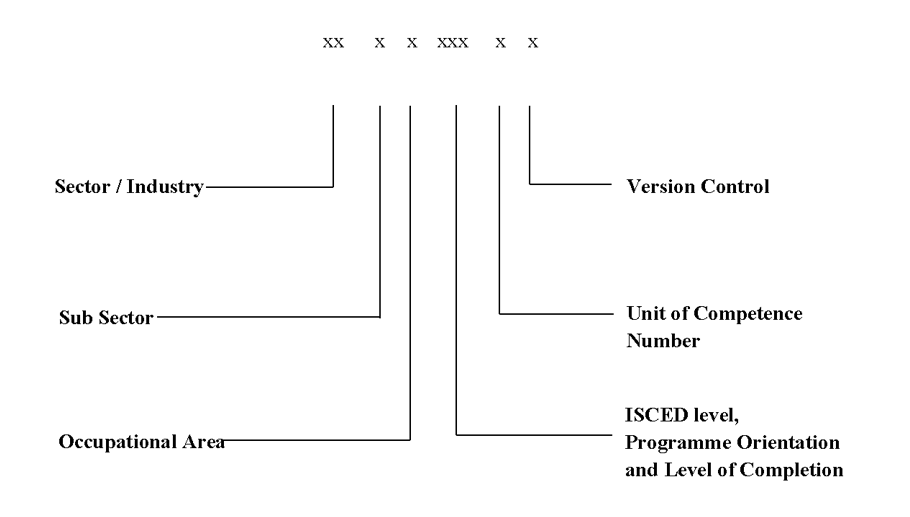
KCSE Kenya Certificate of Secondary Education

KNQA Kenya National Qualifications Authority

KNQF Kenya National Qualification Framework

UV-VIS Ultra-Violet Visible spectrophotometer

# KEY TO UNIT CODE



**OCCUPATIONAL STANDARD OVERVIEW**

The analytical chemistry technology level 6 occupational standard consists of competencies that an individual requires to enable him/her to effectively work as an analytical chemistry technician. This occupational standard consists of the following competencies; collection of chemical samples, performing classical, analysis techniques, performing biochemical analysis, instrumental analysis, performing chemical separation, quality assurance and control and performing industrial chemistry procedures to improve industrial process quality. Other competencies relevant to the performance of the duties of Analytical Chemist include: apply mathematics for science, apply physics principles. for science, apply physical chemistry principles, apply inorganic chemistry principles, apply organic chemistry principles, apply research methods. In addition, communication skills, digital literacy, entrepreneurial skills and work ethics and practices are applicable.

Thus, the units of competency in this occupational standard comprising Analytical Chemistry Level 6 qualification include the following basic, common and core competencies:

# SUMMARY OF UNITS OF COMPETENCY

|  |  |
| --- | --- |
| **BASIC UNITS OF COMPETENCY** | |
| **UNIT CODE** | **UNIT TITLE** |
| 0611 551 01A | APPLY DIGITAL LITERACY |
| 0031 541 02A | APPLY COMMUNICATION SKILL |
| 0417 541 01A | APPLY WORK ESSENTIAL SKILLS |
| 0413 541 04A | APPLY ENTREPRENEURIAL SKILLS |
| **COMMON UNITS OF COMPETENCY** | |
| 0531 551 05A | APPLY MATHEMATICS FOR SCIENCE |
| 0531 551 06A | APPLY PHYSICS PRINCIPLES. FOR SCIENCE |
| 0531 551 07A | APPLY PHYSICAL CHEMISTRY PRINCIPLES. |
| 0531 551 08 A | APPLY INORGANIC CHEMISTRY PRINCIPLES. |
| 0531 551 09A | APPLY ORGANIC CHEMISTRY PRINCIPLES. |
| 0542 551 10A | APPLY RESEARCH METHODS |
| **CORE UNITS OF COMPETENCY** | |
| 0531 551 011A | COLLECT CHEMICAL SAMPLES |
| 0531 551 012A | PERFORM CLASSICAL ANALYSIS TECHNIQUES |
| 0531 551 013A | PERFORM INSTRUMENTAL ANALYSIS |
| 0531 551 014A | PERFORM BIOCHEMICAL ANALYSIS |
| 0531 551 015A | PERFORM CHEMICAL SEPARATION |
| 0531 551 016A | PERFORM QUALITY ASSURANCE AND CONTROL |
| 0531 551 017A | PERFORM INDUSTRIAL CHEMISTRY PROCEDURES. |

**BASIC UNITS OF LEARNING**

**APPLY DIGITAL LITERACY**

**UNIT CODE:** 0611 551 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 * News Group * 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’s 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. Oral assessment   2. Portfolio of evidence   3. Third party report   4. Written assessment   5. Practical assessment   6. Project-Based Assessment |
| 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 541 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 | 1. Existing non-verbal communication techniques are identified and applied based on organization policy. 2. Non-verbal communication techniques are articulated and modeled to enhance inclusivity according to workplace requirements. |
| 1. Apply oral communication skills | 1. Types of oral communication are identified and established as per organization policy. 2. Pathways of oral communication are identified and established as per organization policy. 3. Pathways of oral communication are reviewed according to organization procedures. 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. 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. Oral assessment   2. Portfolio of evidence   3. Third party report   4. Written assessment   5. Practical assessment   6. Project-Based Assessment |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**APPLY WORK ETHICS AND PRACTICES**

**UNIT CODE:** 0417 541 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 | * 1. ***Teams*** are formed to enhance productivity based on organization’s objectives   2. Duties are assigned to teams under the organization policy.   3. Team activities are managed and coordinated as per set objectives.   4. Team performance is evaluated based on set targets as per workplace policy.   5. ***Conflicts*** are resolved between team members in line with organization policy.   6. Gender and diversity-related issues are identified and mainstreamed in accordance with workplace policy.   7. Healthy ***relationships*** are developed and maintained in line with the workplace.   8. Adaptability and flexibility are applied in dealing with team members as per workplace policies |
| 1. Maintain professional and personal development | 1. ***Personal growth and development*** needs are identified and assessed in line with the requirements of the job. 2. ***Training and career opportunities*** are identified and utilized based on job requirements. 3. ***Resources*** for training are mobilized and allocated based on organizations and individual skills needs. 4. Licenses and certifications relevant to the job and career are obtained and renewed as per policy. 5. Recognitions are sought as proof of career advancement in line with professional requirements. 6. Work priorities and personal commitments are balanced and managed based on the requirements of the job and personal objectives. 7. Dynamism and on-the-job learning are embraced in line with the organization’s goals and objectives. |
| 1. Apply Problem solving skills | 1. ***Creative, innovative*** and practical solutions are developed based on the problem    1. Independence and initiative in identifying and solving problems are demonstrated based on the requirements of the job.    2. Team problems are solved as per the workplace guidelines    3. Problem-solving strategies are applied as per the workplace guidelines    4. Problems are analyzed and assumptions tested as per the context of data and circumstances |
| 1. Promote Customer Care | 1. Customers' needs are identified based on their characteristics 2. Customer ***feedback*** is allowed and facilitated in line with organization policies. 3. Customer concerns and complaints are analyzed and resolved in line with the set organizational culture. 4. Proactive customer outreach programs are implemented as per organizational policies 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. Oral questioning 2. Written test 3. Project-Based Assessment 4. Portfolio of Evidence 5. Third party report |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | * 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**APPLY ENTREPRENEURIAL SKILLS**

**UNIT CODE:** 0413 541 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. Project Based Assessment 4. Third party report 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 | * 1. Holistic assessment with other units relevant to the   industry sector, workplace and job role are recommended. |

# COMMON UNITS OF LEARNING

## APPLY MATHEMATICS FOR SCIENCE

**UNIT CODE:** 0531 551 05A

**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. Addition and subtraction are performed as per arithmetic operation rules.   2. Multiplication and division are applied as per arithmetic operation rules.   3. Rational and irrational numbers are evaluated as per algebraic rules.   4. Ratios, ***proportions*** and percentages is applied as per algebraic rules. |
| 2. Apply algebraic equation and expression | * 1. Linear equations are solved as per prescribed methods   2. Simultaneous equations are solved as per the ***simultaneous method***required.   3. Formulation of a formula is applied as per the algebraic rules.   4. Quadratic equation is solved as per the ***quadratic methods***required. |
| 3. Apply linear and non-linear graphs | * 1. Linear and nonlinear graph is plotted as per the graphical rules.   2. Reduction of non-linear to linear graphs is performed as per the graphical rules.   3. Graph is interpreted as per the concept formulate Graphical Rules. |
| 4. Apply indices and logarithms | * 1. Indices are operated as per the Indices Rules.   2. ***Logarithm*** is defined as per the Logarithms Rules.   3. Change of base of logarithms is performed as per Logarithms Rules.   4. Logarithmic and exponential graph is plotted as per Logarithms Rules. |
| 5. Apply binomial expansions | 5.1Roots of numbers are determined using binomial theorem rules.   * 1. ***Errors*** of small changes are determined using binomial theorem rules.   2. Permutation and combination are applied using binomial theorem rules. |
| 6. Apply matrices | * 1. Determinant and inverse of 2x2 matrix is determined as per matrix Rules.   2. Simultaneous equations are solved as per matrix Rules.   3. Eigenvalues and Eigenvectors are determined as per matrix Rules. |
| 7. Apply vectors | * 1. Vectors and scalar quantities are obtained in two dimensions as per vector rules.   2. ***Operations*** on vectors are performed as per vector Rules.   3. Position of vectors are obtained as per vector rules.   4. Vector is resolved as per vector rules. |
| 8. Apply trigonometry | * 1. ***Trigonometric ratios*** are applied as per trigonometric rules.   2. Angles of elevation and depression are determined as per trigonometric rules.   3. Angles are determined as per compound angle formula   4. Sine and cosine waves are interpreted as per trigonometric rules. |
| 9. Apply Calculus | 9.1 Rate of change is determined as per ***differentiation rule.***  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 sequence rules.  10.2 Sum of terms of a given ***arithmetic series*** are determined as per the sequence rules.  10.3 A geometric sequence is differentiated according to arithmetic sequence rules.  10.4 A finite geometric sequence is differentiated according to finite geometric sequence rules.  10.5 Geometric means and nth terms of a geometric sequence is determined as per geometric sequence rules.  10.6 Sum of finite and infinite geometric sequence is determined as per geometric sequence rules. |
| 11. Apply statistics methods | 11.**1 *Raw data* is *processed*** as per job requirement.  11.2 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** |
| 1. Proportions may include but not limited to: | * Direct proportion * Inverse proportion |
| 1. Simultaneous method may include but not limited to: | * Elimination method * Substitution * Graphical method |
| 1. Quadratic methods May include but not limited to: | * Factorization * Completing Square Method * Quadratic formula |
| 1. Logarithms may include but not limited to: | * + Operation   + Conversions   + Graph plotting |
| 1. Errors may include but not limited to: | * + Absolute   + Relative   + Percentage |
| 1. Trigonometric rules. May include but not limited to: | * + Sine rule   + Cosine rule   + Double angle formula |
| 1. Differentiation May include but not limited to: | * + First principles.   + High order functions   + Differential equations   + Inverse differentiation |
| 1. Differentiation rules. May include but not limited to: | * + Product rule   + Chain rule   + Quotient rule |
| 1. Stationary points May include but not limited to: | * + Maxima   + Minima   + Point of inflection |
| 1. Integration May include but not limited to: | * + Constant of integration   + Integral notation   + Indefinite and definite integrals |
| 1. Methods of integration May include but not limited to: | * + Standard form   + Substitution   + Integration by parts |
| 1. Currency table May include but not limited to: | * + Selling price   + Buying price |
| 1. Series May include but not limited to: | * + Arithmetic Progression   + Geometric Progression |
| 1. Raw data may include but not limited to: | * + Grouped data   + Ungrouped data |
| 1. Data processing may include but not limited to: | * + Mean   + Mode   + Median   + Range   + Quartile   + Standard deviation   + Variance |
| 1. Data presentation May include but not limited to: | * + Pictograms   + Histograms   + Pie charts   + Bar charts   + Frequency polygon |
| 1. Order of matrix May include but not limited to: | * + Singular   + Non-singular   + Identity   + Echelon |
| 1. 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 rules.   3. Plotted logarithmic and exponential graph as per logarithmic rules.   4. Solved Simultaneous equations as per matrix concept   5. Performed operations on vectors as per vector rules.   6. Determined angles of elevation and depression as per trigonometric rules.   7. Determined rate of change as per differentiation concept   8. Differentiated finite geometric sequence as per finite geometric sequence rules.   9. Determined sum of terms of geometric sequence as per the geometric sequence rules.   10. Interpreted data as per work requirement.   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 in this unit may be assessed through:   * 1. Written assessment   2. Oral assessment |
| 1. Context of Assessment | 1. Competency may be assessed individually in the actual workplace or simulated environment |
| 1. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY PHYSICS PRINCIPLES.

**UNIT CODE:** 0531 551 06A

**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 forces are applied as per physics principles.   2. Linear motion is applied as per the ***laws of motion****.*   3. Circular motion 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* rules.**   3. Magnification power of optical device is determined as per optic principles. |
| 1. Apply friction principles. | * 1. Source of friction in an 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.   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** |
| 1. Laws of motion may include but not limited to: | * Law of inertia * Law of momentum * Law of interaction |
| 2. Heat energy includes but is not limited to: | * Heat capacity * Specific heat capacity * Latent heat * Latent heat of fusion * Latent heat of vaporization * Latent heat of sublimation |
| 3. Thermodynamic processes include but are not limited to: | * Adiabatic changes * Isothermal processes * Isobaric changes * Isochoric changes |
| 4. Thermodynamic quantities include but are not limited to: | * Pressure * Volume * Temperature |
| 5. Light properties include but are not limited to: | * Reflection * Total internal reflection * Refraction |
| 6. Mirror and lens formula include | 1/f= 1/u+ 1/vc   * f - Focal length * u - Object distance * v - Image distance   m = v/u=i/o   * i - Image height * 0– Object height |
| 7. Types of magnets include but are not limited to: | * Permanent * Temporary * Earth |
| 8. Magnetic properties include but are not limited to: | * Lines of force * Magnetic flux patterns * Flux density |
| 9. Electromagnetism may include but is not limited to: | * Quantities and units * Stationery Geld moving conductor * Fleming’s right led rule * Faraday’s and Lenz’s cork screw rule * Grip rule * Self-inductance * Mutual inductance * Induction due to current charge in another circuit |
| 10. Electrostatic devices may include but is not limited to: | * Capacitor * Van de Graff generator * Electroscope |
| 11. Electrical energy sources may include but is not limited to: | * Renewable sources * Non-renewable sources |
| 12. Induction may include but is not limited to: | * self-induction * mutual induction |
| 13.Semiconductor device may include but is not limited to: | * diode * transistor * LED |
| 14. Rectification may include but is not limited to: | * Half-wave * Full wave |
| 15. Radioactive element may include but is not limited to: | * Thorium * Uranium * Carbon 14 |
| 16. Radioactive radiations may include but is 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
* 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.

|  |  |
| --- | --- |
| * + - 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Applied circular motion as per laws of motion.   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. Applied semiconductor device as per electronic principles.   2. Utilized X-rays produced as per manufacturer’s manual.   3. Applied radioactive radiations based on nuclear principles. |
| * + - 1. Resource implications | The following resources should be provided:   1. Appropriately simulated environment where   assessment can take place   1. Access to relevant work environment 2. Resources relevant to the proposed activities or tasks |
| * + - 1. Methods of assessment | Competency in this unit may be assessed through:   1. Oral 2. Written 3. Third party report 4. Case study |
| * + - 1. Context of assessment | 1. Competency may be assessed individually in the actual workplace or simulated environment |
| * + - 1. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## APPLY PHYSICAL CHEMISTRY PRINCIPLES.

**UNIT CODE:** 0531 551 07A

**UNIT DESCRIPTION**

This unit covers the competencies required in applying physical chemistry principles. It involves ionic equilibrium, chemical equilibrium, kinetic theory of gases, electrochemistry principles, thermodynamics principles, and thermochemistry principles.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up laboratory 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 the Range)*** |
| 1. Apply ionic equilibrium | * 1. Hydrolysis constant is calculated as per standard laboratory procedures.   2. Precipitation of sparingly soluble salts is performed as per standard laboratory procedures.   3. Salt hydrolysis is calculated as per standard laboratory procedures.   4. Ionization constants are calculated as per standard laboratory procedures. |
| 1. Apply chemical equilibrium | * 1. Equilibrium constant is calculated as per standard laboratory procedures.   2. Le Chateliers principle is applied as per standard laboratory procedures.   3. Law of mass action is applied as per standard laboratory procedures. |
| 1. Apply reaction kinetics | * 1. ***Orders of reactions*** are calculated as per standard laboratory procedures.   2. Rates of reactions are calculated as per standard laboratory procedures.   3. Half-life of chemical reaction are calculated as per standard laboratory procedures.   4. Activation energy of chemical reactions is calculated as per standard laboratory procedures. |
| 1. Apply kinetic theory of gases | * 1. ***Kinetic energy equations*** are applied as per standard laboratory procedures.   2. Van der Waals equation is applied as per standard laboratory procedures.   3. ***Heat capacities*** are calculated as per standard laboratory procedures. |
| 1. Apply electrochemistry principles. | 5.1 Kohlrausch’s law is applied as per standard laboratory procedures.   * 1. Molar conductivity is calculated as per standard laboratory procedures.   2. Electromotive force is calculated as standard laboratory procedures.   3. ***Faradays*** are calculated as per standard laboratory procedures.   4. ***Polarograms***are interpreted as per standard laboratory procedures.   5. Nerst equation is applied as per standard laboratory procedures. |
| 1. Apply thermodynamics principles. | * 1. First law of thermodynamics is applied as per standard laboratory procedures.   2. Second law of thermodynamics is applied as per standard laboratory procedures.   3. Entropy change is calculated as per standard laboratory procedures.   4. Gibbs free energy is calculated as per standard laboratory procedures. |
| 1. Apply thermochemistry principles. | * 1. Hess’s law is applied as per standard laboratory procedures.   2. ***Enthalpy changes*** are calculated as per standard laboratory procedures.   3. Bond energies are calculated as per standard 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** |
| 1. Order of reactions | * Zero order * First order * Second order |
| 1. Kinetic energy equations | * Charles law * Boyles law * Grahams law * Avogadro’s law * Ideal gas law |
| 1. Heat capacities | * Molar heat capacity * Latent heat capacity |
| 1. Molar conductivity | * Strong electrolytes * Weak electrolytes * Infinite dilutions |
| 1. Faradays | * Faradays first law * Faradays second law |
| 1. Electromotive force | * Standard electrodes * Electrochemical cells * Salt bridge |
| 1. Polarograms | * Half wave potential * Decomposition voltage * Back emf * Dropping mercury electrode |
| 1. Enthalpy | * Enthalpy of combustion * Enthalpy of solutions * Enthalpy of neutralization |
| 1. Bond energies | * Bond dissociation * Bond formation |

**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 skills
* Taking measurements
* Computer skills

Required Knowledge

The individual needs to demonstrate knowledge of:

* Mathematics
* Basic physics

**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. Calculated hydrolysis constants as per standard laboratory procedures.   2. Performed precipitation of sparingly soluble salts as per standard laboratory procedures.   3. Calculated salt hydrolysis as per standard laboratory procedures.   4. Calculated ionization constants as per standard laboratory procedures.   5. Calculated equilibrium constant as per standard laboratory procedures.   6. Applied Le Chateliers principle as per chemical equation   7. Applied Law of mass action as per standard laboratory procedures.   8. Calculated orders of reactions as per standard laboratory procedures.   9. Calculated rates of reactions as per standard laboratory procedures.   10. Calculated Half-life of chemical reaction as per standard laboratory procedures.   11. Calculated activation energy of chemical reactions per standard laboratory procedures.   12. Applied kinetic energy equations as per standard laboratory procedures.   13. Applied Van der Waals equation as per standard laboratory procedures.   14. Calculated heat capacities as per standard laboratory procedures.   15. Applied Kolrouchs law as per standard laboratory procedures.   16. Calculated molar conductivity as per standard laboratory procedures.   17. Calculated electromotive force as per standard laboratory procedures.   18. Calculated Faradays as per standard laboratory procedures.   19. Interpreted polarograms as per standard laboratory procedures.   20. Applied Nerst equation as per standard laboratory procedures.   21. Applied First law of thermodynamics as per standard laboratory procedures.   22. Applied Second law of thermodynamics as per standard laboratory procedures.   23. Calculated entropy changes as per standard laboratory procedures.   24. Calculated Gibbs free energy as per standard laboratory procedures.   25. Applied Hess’s law as per standard laboratory procedures.   26. Calculated enthalpy changes as per standard laboratory procedures.   27. Calculated bond energies as per standard laboratory procedures. |
| 2. Resource Implications | The following resources should be provided:   1. Access to relevant workplace 2. Appropriately simulated environment where assessment can take place 3. Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Written tests   2. Oral questioning   3. Case studies |
| 4. Context of Assessment | Competency may be assessed:   1. Workplace 2. Simulated laboratory environment |
| 5. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, laboratory and job role is recommended. |

## APPLY INORGANIC CHEMISTRY PRINCIPLES.

**UNIT CODE:** 0531 551 08A

**UNIT DESCRIPTION**

This unit covers the competencies required in applying inorganic chemistry principles. It involves drawing chemical bonds, classifying S block. P block, D Block elements and applying nuclear chemistry principles.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up laboratory 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 the Range)*** |
| 1. Draw chemical bonds | * 1. ***Atomic structure*** is drawn as per IUPAC standards.   2. Electronic configuration is written based on IUPAC standards.   3. Types of ***chemical bonds*** are identified as per IUPAC standards.   4. Relative atomic mass is computed as per IUPAC standards.   5. ***Hybridization*** is computed based per IUPAC standards. |
| 2. Classify S block elements | * 1. ***History of the Periodic Table*** as per groups   2. Elements are grouped based on IUPAC standards.   3. Valence electrons are computed based on IUPAC standards.   4. Electronic configuration is written based on IUPAC standards.   5. Elements are classified based on IUPAC standards.   6. Elements are arranged on periodic table based on IUPAC standards.   7. Chemistry of ***group*** elements are applied based on the IUPAC standards.   8. ***Chemical* and *physical properties*** are analyzed based on IUPAC standards. |
| 3. Classify P block elements | * 1. Elements are grouped based on IUPAC standards.   2. Valence electrons are computed based on IUPAC standards.   3. Electronic configuration is written based on IUPAC standards.   4. Elements are classified based on IUPAC standards.   5. Elements are arranged on periodic table based on IUPAC standards.   6. Chemistry of ***group*** elements are applied based on the IUPA standards.   7. Chemical and physical properties are analyzed based on IUPAC standards. |
| 4. Classify D Block elements | * 1. Elements are grouped based on IUPAC standards.   2. Valence electrons are computed based on IUPAC standards.   3. Electronic configuration is written based on IUPAC standards.   4. Elements are classified based on IUPAC standards.   5. Elements are arranged on periodic table based on IUPAC standards.   6. Chemistry of group elements are applied based on the IUPAC standards.   7. Chemical and physical properties are analyzed based on IUPAC standards.   8. ***D block elements***are extracted as per EPA Act 1986 |
| 5. Apply nuclear chemistry principles. | *5.1* ***Nuclear reactions*** are illustrated as per IAEA standards.  5.2 Reactive materials, target and reaction conditions are selected as per NEA regulations.  *5.3* ***Nuclear radiations*** are selected as per IAEA standards.  5.4 Radioactive decay of radioisotopes is computed as per NEA regulations. |

**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. Chemical bonds | * Covalent * Ionic * Dative * Hydrogen * Intermolecular forces * Dipole-dipole attractions |
| 2. Atomic structure | * Discovery of Atoms experiments * Discovery of electron experiments * Discovery of Neutron experiments * SPDF notation of Atoms |
| 3. History of the Periodic table | * Dobereiners Triads * John Newlands Law of Octaves * Lother Meyers Concept * Mendeleevs Law of the Periodic table * Modern Law of the Periodic Table |
| 4. Hybridization | * Sp1 hybridization * sp2 hybridization * sp3 hybridization |
| 5. Group | * S block * P-block elements * D-block elements * F-block elements |
| 6. Physical and chemical properties | * Physical properties * Anomalous behavior * Melting and boiling points * Valence * Ionization energy * Atomic radius * Metal character * Chemical properties * Solubility * Flame test * Reaction with air * Oxidation- reduction |
| 7. D block elements | * Gold * Copper * Lead * Chromium * Iron |
| 8. Nuclear reactions | * Nuclear fission * Nuclear fusion * Radioactive decay * Neutron capture |
| 9. Nuclear radiations | * Alpha * Beta * Gamma |

**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 skills
* Computer skills
* Writing skill
* Time management skills
* Extraction skills
* Decision making
* First aid skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Periodic table
* Solid state chemistry
* Reaction mechanisms
* Coordination chemistry
* Transition metal chemistry
* History of the periodic table
* IUPAC Standards.
* Nuclear chemistry

**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. Drew atomic structure as per IUPAC standards.   2. Wrote electronic configuration based on IUPAC standards.   3. Extracted metals as per the EPA Act 1986   4. Placed elements in the correct groups of the periodic table as per the IUPAC standards.   5. Applied nuclear reactions in energy production and medical imaging as per NEA regulations. |
| 2. Resource Implications | The following resources should be provided:   1. Access to relevant workplace 2. Appropriately simulated environment where assessment can take place 3. Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   1. Written tests 2. Oral questioning |
| 4. Context of Assessment | Competency may be assessed:   1. Workplace 2. Simulated laboratory environment |
| 5. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, laboratory and job role is recommended. |

## APPLY ORGANIC CHEMISTRY PRINCIPLES.

**UNIT CODE:** 0531 551 09A

**UNIT DESCRIPTION**

This unit covers the competencies required in applying organic chemistry principles. It involves performing hydrocarbon tests, alkyl halide tests, alkanols tests, carboxylic acid tests, carbonyl compound tests, and amine tests preparing heterocyclic compounds and conducting aromatic compound tests.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up laboratory 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 the Range*** |
| 1. Perform hydrocarbon tests | * 1. ***Hydrocarbons***are classified based on IUPAC standards.   2. Hydrocarbons are prepared as per chemistry laboratory procedures manual.   3. ***Hydrocarbon tests*** are conducted as per chemistry laboratory procedures manual. |
| 2. Perform alkyl halide tests | 1. Types of ***alkyl halides*** are identified as per IUPAC standards. 2. Alkyl halides are prepared as per chemistry laboratory manual. 3. Chemical and physical properties are analyzed based on IUPAC standards. 4. Reactions and ***reaction mechanisms*** are carried out as per IUPAC standards. |
| 3. Perform alkanols Tests | * 1. ***Alkanols***are classified based on IUPAC standards.   2. Alcohol is prepared as per laboratory Procedures. Manual.   3. ***Alkanol tests*** is conducted as per laboratory procedures manual. |
| 4. Perform carboxylic acid tests | * 1. ***Carboxylic acids*** are classified based on IUPAC standards.   2. Carboxylic acid is prepared as per chemistry laboratory procedures manual.   3. ***Carboxylic acid tests*** are conducted as per chemistry laboratory procedures manual. |
| 5. Perform carbonyl compound tests | * 1. ***Carbonyl compounds*** are classified as per IUPAC standards.   2. Carbonyl compoundis prepared as per chemistry laboratory manual.   3. ***Carbonyl compound tests*** are conducted as per chemistry laboratory Manual.   4. Isomers of carbonyl compounds are drawn as per IUPAC standards. |
| 6. Perform amine tests | * 1. ***Amine groups*** are classified as per IUPAC standards.   2. Amine is prepared as per chemistry laboratory manual.   3. Chemical reactions of amine are carried out as per chemistry laboratory manual.   4. ***Amine derivatives*** are classified as per IUPAC standards. |
| 7. Prepare heterocyclic compounds | * 1. ***Heterocyclic compounds*** are classified based on IUPAC standards.   2. Structures of heterocyclic compounds are drawn as per IUPAC standards.   3. Heterocyclic compounds are prepared as per laboratory manual.   4. Substitution reaction for heterocyclic compounds is conducted as per laboratory manual. |
| 8.Conduct aromatic compound tests | * 1. Aromatic compounds are classified as per IUPAC standards.   2. Isomers of aromatic compounds are drawn as per IUPAC standards.   3. ***Aromatic compounds*** are prepared as per laboratory manual.   4. Aromatic compound tests are conducted as per laboratory annual |
| 9. Carry out Polymerization reactions | 9.1 ***Polymers*** are identified after IUPAC standards.  9.2 Monomers are converted to long chain polymers as  per prescribed methods   * 1. ***Condensation* and *addition*** polymerization done as per prescribed laboratory standards.   2. Monomers and Polymers are identified as per laboratory standards.   3. Substitution reaction for is done as per prescribed 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** |
| 1. Hydrocarbons | * Alkanes * Alkenes * Alkynes |
| 1. Hydrocarbon tests | * Baeyer`s test * Bromine test * Flame test |
| 1. Alkyl halides | * Primary alkyl halides * Secondary alkyl halides * Tertiary alkyl halides |
| 1. Reaction mechanisms | * Nucleophilic substitution reactions * Elimination reactions |
| 1. Alkanols | * Primary alkanols * Secondary alkanols * Tertiary alkanols |
| 1. Alkanol tests | * Luca’s test * Acidified KMnO4 test * Silver nitrate test * Chromic acid test |
| 1. Carboxylic acid | * Methanoic acid * Ethanoic acid * Propanoic acid * Butanoic acid * Pentanoic acid |
| 1. Carboxylic acid tests | * Hydrolysis of acid derivatives * Alcoholysis * Aminolysis * Hydroxamic acid test |
| 1. Carbonyl compounds | * Aldehydes * Ketones |
| 1. Carbonyl compound tests | * Tollen`s test * Fehling`s test * Benedict`s test |
| 1. Amine groups | * Primary amines * Secondary amines * Tertiary amines |
| 1. Amine derivatives | * Amides * Amino acids * Aniline * Trimethylamine |
| 1. Heterocyclic compounds | * Pyridine * Pyrroles * Indoles * Triazole * Furan * Thiophenes |
| 1. Aromatic compounds | * Benzene * Phenol * Toluene * Naphthalene |
| 1. Polymer | * Natural Polymers * Synthetic polymers * Co- Polymer |
| 1. Addition Polymerization | * Free radical Polymerization * Chain Initiation * Chain Propagation * Chain Termination * Cationic and Anionic polymerization |
| 1. Condensation Polymerization | * Dacron * Nylon 6’6 * Rubbers * Styrene |

**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 skills
* Computer skills
* Writing skill
* Time management skills
* Extraction skills
* Decision making
* First aid skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Organic synthesis
* Nomenclature
* Reaction mechanisms
* Knowledge of functional groups
* Understanding molecular structure

**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. Prepared hydrocarbons as per chemistry laboratory procedures manual. 2. Conducted hydrocarbon tests as per chemistry laboratory procedures manual. 3. Prepared alkyl halides as per chemistry laboratory manual. 4. Carried out reactions and reaction mechanisms as per IUPAC standards. 5. Prepared alcohol as per laboratory Procedures. Manual. 6. Conducted alkanol tests as per chemistry laboratory procedures manual. 7. Prepared carboxylic acid as per chemistry laboratory Procedures manual. 8. Conducted carboxylic acid tests as per chemistry laboratory procedures manual. 9. Prepared carbonyl compoundas per chemistry laboratory manual. 10. Conducted carbonyl compound tests as per chemistry laboratory Manual. 11. Prepared amine as per chemistry laboratory manual. 12. Carried out chemical reactions of amine as per chemistry laboratory manual. 13. Prepared heterocyclic compounds as per laboratory manual. 14. Conducted substitution reaction for heterocyclic compounds as per laboratory manual. 15. Prepared aromatic compounds as per laboratory manual. 16. Conducted aromatic compoundtests as per laboratory manual. |
| 2. Resource Implications | The following resources should be provided:   1. Access to relevant workplace 2. Appropriately simulated environment where assessment can take place 3. Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   1. Written tests 2. Practical |
| 4. Context of Assessment | Competency may be assessed:   1. Workplace. 2. Simulated laboratory environment |
| 5. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, laboratory and job role is recommended. |

## APPLY RESEARCH METHODS

**UNIT CODE:** 0531 541 10A

**UNIT DESCRIPTION**

This unit covers the competencies required in applying research methods. It involves developing research project proposal, carrying out sampling and data collection, applying methods of data analysis concepts, carrying out presentation and interpretation of data, and perform project report writing and presentation.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up laboratory 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 the Range)*** |
| 1. Develop research project proposal | 1. ***Research design*** is developed as per institutional guidelines. 2. Literature is gathered as per institutional guidelines. 3. Literature review is carried out as per institutional guidelines. 4. Research proposal is developed as per institutional guidelines. |
| 1. Carry out sampling and data collection | * 1. Sampling plan is developed as per institutional guidelines.   2. ***Sources of data*** are identified as per institutional guidelines.   3. Type ofdata is identified as per institutional guidelines. |
| 1. Apply methods of data analysis concepts | * 1. ***Measures of central tendency*** are calculated as per statistical rules.   2. Measures of dispersion are calculated as per statistical rules.   3. Probability is calculated as per statistical rules.   4. Correlation is calculated as per statistical rules. |
| 1. Carry out presentation and interpretation of data | 1. Tabulation of data is carried out as per statistical procedures. 2. Classification of data is performed as per statistical procedures. 3. ***Statistical data presentation*** is performed as per statistical procedures. 4. Interpretation ofdata is carried out as per statistical procedures. |
| 1. Perform project report writing and presentation | * 1. Findings are documented as per report writing format   2. Conclusions are drawn as per report writing format   3. Recommendations are made as per report writing format   4. Project report is presented as per institutional guidelines. |

**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. Research design | * Study survey * Experimental * Quantitative survey * Qualitative survey |
| 1. Source of data | * Primary sources * Second sources |
| 1. Measure of central tendency | * Mean * Mode * Median |
| 1. Statistical data presentation | * Tabulation * Graphical * Pie charts |

**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 skills
* Computer skills
* Problem solving
* Record keeping
* Team work

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Preparation of solution
* Preparation of samples
* Safety precaution
* Mathematics

**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. Developed research design as per institutional guidelines.   2. Carried out literature review as per institutional guidelines.   3. Developed research proposal as per institutional guidelines.   4. Developed sampling plan as per institutional guidelines.   5. Identified sources of data as per institutional guidelines.   6. Identified type of data as per institutional guidelines.   7. Calculated measures of central tendency as per statistical rules.   8. Calculated measures of dispersion as per statistical rules.   9. Calculated correlation as per statistical rules.   10. Classified data as per statistical procedures.   11. Presented statistical data as per statistical procedures.   12. Interpreted data as per statistical procedures.   13. Documented findings as per report writing format   14. Drew conclusions as per report writing format   15. Made recommendations as per report writing format   16. Presented project report as per institutional guidelines. |
| 2. Resource Implications | The following resources should be provided:   1. Access to relevant workplace 2. Appropriately simulated environment where assessment can take place 3. Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Practical test   2. Written test   3. Case studies   4. Project report |
| 4. Context of Assessment | Competency may be assessed:   * 1. Workplace   2. Simulated laboratory environment |
| 5. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, laboratory and job role is recommended. |

# CORE UNITS OF LEARNING

## PREPARE CHEMICAL SAMPLES

**UNIT CODE:** 0531 551 11A

**UNIT DESCRIPTION**

This unit covers the competencies required in preparing chemical samples. It involves designing sampling plan, collecting and storing chemical samples.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up laboratory 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 the Range)*** |
| 1. Design Sampling Plan | * 1. ***Sample type*** is identified as per chemistry laboratory procedures.   2. Sample frame is developed as per chemistry laboratory manual.   3. Sample size is identified as per chemistry laboratory manual.   4. Sampling tools and apparatus are selected as per chemistry laboratory manual.   5. Sampling procedures are developed as per chemistry laboratory manual. |
| 2. Collect Chemical Samples | * 1. Sample points are identified as per chemistry laboratory manual.   2. Sampling is performed as per chemistry laboratory manual.   3. Samples are ***pre-treated*** as per chemistry laboratory manual.   4. Samples are packaged as per standard laboratory procedures.   5. Samples are labelled as per chemistry laboratory manual.   6. Sample is transported as per chemistry laboratory manual. |
| 3. Store Chemical Samples | * 1. Sample processing is carried out as per chemistry laboratory manual.   2. ***Sample preservation techniques*** are identified as per chemistry laboratory manual.   3. Sample is labelled as per chemistry laboratory manual.   4. Sample is kept in their designated places as per chemistry laboratory 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** |
| 1. Sample type | * Solids, * liquids * gases |
| 2. Pre-treated | * Size reduction, * Extraction * Digestion |
| 3. Sample preservation techniques | * Refrigeration * Oven * Chemical storage |

**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 skills
* Taking measurements
* Computer skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Book keeping
* Sample constituents
* Safety precautions

**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:  1.1 Designed sampling plan as per chemistry laboratory manual.  1.2 Pretreated samples as per chemistry laboratory manual.  1.3 Preserved samples as per chemistry laboratory manual. |
| 2. Resource Implications | The following resources should be provided:   1. Access to relevant workplace 2. Appropriately simulated environment where assessment can take place 3. Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Written   2. Third party report |
| 4. Context of Assessment | Competency may be assessed:  4.1 Workplace   * 1. Simulated laboratory environment |
| 5. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, laboratory and job role is recommended. |

## PERFORM CLASSICAL ANALYSIS TECHNIQUES

**UNIT CODE:** 0531 551 12A

**UNIT DESCRIPTION**

This unit covers the competencies required in performing classical analysis techniques. It involves standardizing reagents, carrying-out volumetric analysis, gravimetric analysis and proximate analysis.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up laboratory 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 the Range)*** |
| 1. Standardize reagents | * 1. Apparatus for standardizing reagents is assembled as per laboratory manual.   2. Reagents are selected based on chemistry laboratory manual.   3. Reagent concentrations are calculated based on standard chemical formulae   4. Reagents are measured as per chemistry laboratory manual.   5. Reagent solutions are prepared as per chemistry laboratory manual.   6. Reagent solutions are transferred to a labeled reagent bottle as per chemistry laboratory manual. |
| 1. Carry-out Volumetric Analysis | * 1. Apparatus for volumetric analysis is assembled as per chemistry laboratory manual.   2. ***Standard solutions*** are prepared as per chemistry laboratory manual.   3. Titrations are performed as per chemistry laboratory manual.   4. Unknown concentrations are determined as per standard chemical formulae |
| 1. Carry out Gravimetric Analysis | * 1. Apparatus for gravimetric analysis is assembled as per laboratory manual.   2. Samples are weighed as per chemistry laboratory manual.   3. Samples are prepared as per chemistry laboratory manual.   4. Analytes are precipitated as per chemistry laboratory manual.   5. Precipitated analytes are filtered as per chemistry laboratory manual.   6. Precipitated analytes are washed as per chemistry laboratory manual.   7. Precipitated analytes are dried as per chemistry laboratory manual.   8. Precipitated analytes are ignited as per chemistry laboratory manual.   9. Precipitated analytes are weighed as per chemistry laboratory manual.   10. Concentrations are determined per chemistry standard chemical formulae |
| 1. Carry out Proximate Analysis | * 1. Apparatusandequipment required are assembled as per chemistry laboratory manual.   2. Reagents are selected based on biological components being analyzed   3. ***Biological samples*** are tested as per chemistry laboratory 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** |
| 1. Standard solutions | * + Buffer solutions   + Working standards.   + Stock solutions |
| 2. Biologicals components | * + Carbohydrates   + Lipids   + Proteins |

**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 skills
* Computer skills
* Problem solving
* Record keeping

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Preparation of solution
* Preparation of samples
* Separation of the analyte
* Computation of the analyte concentration

**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. Prepared reagents as per chemistry laboratory manual.   2. Prepared standard solutions as per chemistry laboratory manual.   3. Performed titrations as per chemistry laboratory manual.   4. Prepared samples as per chemistry laboratory manual.   5. Precipitated analytes as per chemistry laboratory manual.   6. Processed precipitate as per chemistry laboratory manual.   7. Tested biological samples as per chemistry laboratory manual. |
| 2. Resource Implications | The following resources should be provided:   1. Access to relevant workplace 2. Appropriately simulated environment where assessment can take place 3. Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:  3.1 Practical test  3.2 Written test  3.3Third party report   * 1. Case studies   2. Project report |
| 4. Context of Assessment | Competency may be assessed:  4.1 workplace   * 1. Simulated laboratory environment |
| 5. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, laboratory and job role is recommended. |

## PERFORM INSTRUMENTAL ANALYSIS

**UNIT CODE:** 0531 551 13A

**UNIT DESCRIPTION**

This unit covers the competencies required in performing instrumental analysis. It involves performing colorimetric analysis, UV-Vis analysis, FT-IR analysis, AES analysis, AAS analysis and conductometric analysis

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up laboratory 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 the Range)*** |
| 1. Perform Colorimetric analysis | * 1. Colorimetric equipment is set up as per chemistry laboratory manual.   2. ***Standard solutions*** are prepared as per chemistry laboratory manual.   3. Colorimeters are calibrated with standard solutions as per manufacturer instructions.   4. Sample solutions are prepared as per chemistry laboratory manual.   5. Sample solutions are run alongside standards.   6. Analytes concentrations are quantified as per colorimetric procedures. |
| 1. Perform UV-VIS Analysis | * 1. UV-VIS spectrophotometer equipment is set up as per chemistry laboratory manual.   2. Reference solutions are prepared as per chemistry laboratory manual.   3. Spectrophotometers are calibrated as per manufacturers manual.   4. Sample solutions are homogenized as per chemistry laboratory manual.   5. Sample solutions maximum absorption wavelength is obtained as per chemistry laboratory manual.   6. Analyte concentrations are quantified from the calibration curves as per spectrophotometric procedures. |
| 1. Perform FT-IR Analysis | * 1. FT-IR equipment is set up as per chemistry laboratory manual.   2. Reference solutions are prepared as per chemistry laboratory manual.   3. FT-IR Spectrophotometers are calibrated as per manufacturers manual.   4. Sample solutions are analyzed as per FT-IR spectroscopic procedures.   5. Unknown functional groups are identified from spectral peaks as per spectroscopic reference charts |
| 1. Conduct AES analysis | * 1. AES instrument is set up as per laboratory manual.   2. Instrument is calibrated using standard solutions as per laboratory manual.   3. Sample solutions are prepared as per chemistry laboratory procedures.   4. Samples are analyzed as per AES procedures.   5. Unknown concentrations are determined from the calibration curves as per spectrophotometric procedures. |
| 1. Perform AAS analysis . | 5.1 AAS spectrophotometer equipment is set up as per manufacturer’s manual.  5.2 Standard solutions are prepared as per chemistry laboratory manual.  5.3 AAS Spectrophotometer is calibrated as per chemistry laboratory manual.  5.4 Sample solutions are homogenized as per spectrophotometric procedures.   * 1. Sample solutions are analyzed as per spectrophotometric procedures.   2. Unknown concentrations are calculated from the calibration graph as per spectrophotometric procedures. |
| 1. Conduct Conductometric analysis | * 1. Apparatus and equipment are set up as per chemistry laboratory manual.   2. Conductometric equipment is calibrated as per manufacturers manual.   3. Sample solutions are prepared as per chemistry laboratory manual.   4. Buffer solutions are prepared as per chemistry laboratory manual.   5. Sample solutions are analyzed as per conductometric procedures.   6. Unknown concentrations are calculated from conductometric formulae as per conductometric 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** |
| 1. Standard solutions | * + Buffer solutions   + Working standards.   + Stock solutions |

**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 skills
* Taking measurements
* Computer skills
* Diagnosing animal diseases

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Preparation of solution
* Preparation of samples
* Relevant equipment operation

**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. Calibrated chemistry laboratory equipment as per the manufacture’s instruction. 2. Calculated analyte concentrations as per spectroscopic procedures. 3. Identified unknown functional groups as per FT-IR spectroscopic reference chart’ 4. Prepared buffer solution as per chemistry laboratory manual. |
| 2. Resource Implications | The following resources should be provided:   1. Access to relevant workplace 2. Appropriately simulated environment where assessment can take place 3. Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:  3.1 Practical test  3.2 Written test  3.3 Third party report |
| 4. Context of Assessment | Competency may be assessed:   * 1. Workplace   4.2 Simulated laboratory environment |
| 5. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, laboratory and job role is recommended. |

## PERFORM BIOCHEMICAL ANALYSIS

**UNIT CODE:** 0531 551 14A

**UNIT DESCRIPTION**

This unit covers the competencies required in performing biochemical analysis. It involves performing biochemical tests, separating biomolecules, preparing buffer solutions and performing biochemical analysis of biomolecules.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up laboratory 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 the Range*** |
| 1. Perform biochemical tests | * 1. ***Biomolecule samples*** are collected as per biochemistry laboratory manual.   2. ***Reagents*** are prepared as per biochemistry on laboratory manual.   3. Biomolecule samples are prepared as per biochemistry laboratory manual.   4. ***Presence-absence tests*** are performed as per the laboratory manual. |
| 2. Separate biomolecules | * 1. Biomolecule samples are collected as per biochemistry laboratory manual.   2. Reagents are prepared as per biochemistry laboratory manual.   3. Biomolecules are isolated as per biochemistry laboratory manual.   4. Biomolecules are purified as per biochemistry laboratory manual. |
| 3. Prepare buffer solutions | * 1. Buffer components are selected as per biochemistry laboratory manual.   2. Buffer components required are calculated as per biochemistry laboratory manual.   3. Buffer stock solutions are prepared per biochemistry laboratory manual.   4. Buffer solution pH is adjusted as per biochemistry laboratory manual.   5. Buffer solution is labelled as per biochemistry laboratory manual.   6. Buffer solutions are stored as per biochemistry laboratory manual. |
| 4. Perform biochemical analysis of biomolecules | * 1. Biomolecule samples are collected as per biochemistry laboratory manual.   2. Reagents are prepared as per biochemistry laboratory manual.   3. Biomolecule samples are prepared as per biochemistry laboratory manual.   4. Instrument is calibrated as per manufacturers manual.   5. Analysis is carried out as per biochemistry laboratory manual.   6. Results are documented as per organizational 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** |
| 1. Biomolecule samples | * + Lipids   + Proteins   + Carbohydrates   + Enzymes   + Vitamins |
| 1. Reagents | * + Buffer solutions   + Solvents |
| 1. Presence-absence tests | * + Benedicts solution test   + Burette test   + Millon test * Ninhydrin 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 skills:

* Communication skills
* Taking measurements
* Computer skills
* Observation skills
* Sample handling skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Biochemistry
* Biology
* Sample storage
* Sample preservation
* 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 | Assessment requires evidence that the candidate:   * 1. Prepared reagents as per biochemistry laboratory manual.   2. Prepared biomolecule samples as per biochemistry laboratory manual.   3. Performed qualitative tests as per biochemistry laboratory manual.   4. Prepared buffer solutions as per biochemistry laboratory manual.   5. Isolated biomolecules as per biochemistry laboratory manual.   6. Calibrated Instruments as per manufacturers instruction   7. Carried out analysis as per biochemistry laboratory manual.   8. Documented results as per organizational manual. |
| 2. Resource Implications | The following resources should be provided:   1. Access to relevant workplace 2. Appropriately simulated environment where assessment can take place 3. Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Written tests   2. Oral questioning   3. Practical and project   4. Third party report |
| 4. Context of Assessment | Competency may be assessed:   * 1. Workplace   2. Simulated laboratory environment |
| 5. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, laboratory and job role is recommended. |

## PERFORM CHEMICAL SEPARATION

**UNIT CODE:** 0531 551 15A

**UNIT DESCRIPTION**

This unit covers the competencies required in performing chemical separation. It involves carrying out extraction, filtration, distillation and chromatography.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up laboratory 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 the Range*** |
| 1.Carry out Extraction | * 1. ***Apparatus and equipment*** are set up as per laboratory manual.   2. ***Solvents*** are prepared as per laboratory manual.   3. Analytes are extracted as per laboratory manual.   4. Extracts are tested as per laboratory manual. |
| 2. Carry out Filtration | * 1. Apparatus and equipment are set up as per laboratory manual.   2. Samples are prepared as per laboratory manual.   3. Analytes are filtered as per laboratory manual.   4. Filtered analytes are tested as per laboratory manual. |
| 3. Carry out distillation | * 1. Apparatus and equipment are set up as per laboratory manual.   2. Samples are prepared as per laboratory manual.   3. Analytes are distilled as per laboratory manual.   4. Distillates are tested as per laboratory manual. |
| 4. Carry out Chromatography | * 1. Apparatus and equipment for ***chromatography*** are set up as per laboratory manual.   2. Samples are prepared as per laboratory manual.   3. Analytes are separated as per laboratory manual.   4. Analytes are tested as per laboratory 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** |
| 1. Apparatus and equipment | * Separating Funnel * Soxhlet apparatus * Distillation apparatus * Water bath * Heating mantle   + TLC plates |
| 2. Solvents | * + Ethanol   + Chloroform   + Acetone * Diethyl ether |
| 3. Chromatography | * Paper Chromatography * Thin layer Chromatography * High Performance Chromatography * Gas Chromatography |

**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 skills
* Taking measurements
* Computer skills
* Observation skills
* Sample handling skills
* Required Knowledge

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Basic extraction techniques
* Safety precautions
* Principles. of distillation

**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. Prepared solvents as per chemistry laboratory manual.   2. Prepared samples as per chemistry laboratory manual.   3. Separated analytes as per chemistry laboratory manual.   4. Tested analytes as per chemistry laboratory manual. |
| 2. Resource Implications | The following resources should be provided:   1. Access to relevant workplace 2. Appropriately simulated environment where assessment can take place 3. Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:  3.1 Written tests  3.2 Observation (practical and projects)  3.3 Third party reports |
| 4. Context of Assessment | Competency may be assessed:  4.1 Workplace   * 1. Simulated laboratory environment |
| 5. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, laboratory and job role is recommended. |

## PERFORM QUALITY ASSURANCE AND CONTROL

**UNIT CODE:** 0531 551 016A

**UNIT DESCRIPTION**

This unit covers the competencies required in performing quality assurance and control of analytical chemistry laboratory procedures. It involves conducting quality control, quality assurance, quality audits, and method validation.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up laboratory 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 the Range)*** |
| 1. Conduct quality control | 1. Samples are collected as per chemistry laboratory manual. 2. Blank samples are run as per chemistry laboratory manual. 3. Quality control samples are run as per chemistry laboratory manual. 4. Blind samples are run as per chemistry laboratory manual. 5. ***Chemical standards*** are run as per chemistry laboratory manual. 6. Repeat samples are run as per laboratory manual. 7. Results are***documented*** as per organizational procedures. |
| 2. Conduct quality assurance | * 1. Samples are collected as per chemistry laboratory manual.   2. Certified reference materials are run as per chemistry laboratory manual.   3. Chemical standards. are run as per chemistry laboratory manual.   4. ***Interlaboratory comparisons*** are run as per chemistry laboratory manual.   Uncertainty is evaluated as per chemistry laboratory manual. |
| 3.Conduct quality audits | * 1. ***Quality audits*** are selected as per institutional guidelines.   2. Audit plan is developed as per institutional guidelines.   3. Pre-audit reviews are conducted as per institutional guidelines.   4. Audit is conducted onsite as per institutional guidelines.   5. Audit findings are generated as per institutional guidelines.   3.4 Audit findings are reported as per institutional guidelines. |
| 4. Conduct method validation | * 1. Method selectivity is validated as per ICH 2003 guidelines.   2. Method precision is validated as per ICH 2003 guidelines.   3. Method accuracy is validated as per ICH 2003 guidelines.   4. Method bias is validated as per ICH2003 guidelines.   4.5 ***Measurement range*** is validated as per institution ICH 2003 guidelines. |

**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. Chemical standards. | * + Standard solution   + Analytical reagents * Reference standard |
| 2. Results are documented | * Reports * Graphs * Filling |
| 3. Interlaboratory comparisons | * + Independent certified laboratory   + Compliance laboratories |
| 4. Quality audits | * Safety   + Quality management systems   + Product quality   + Quality operations * Pollution |
| 5 Measurement range. | * + Accuracy   + Selectivity * Detection limits |

**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 skills
* Taking measurements
* Computer skills
* Problem solving skills
* Numeracy skills
* Teamwork

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* OSHA
* Environmental literacy
* Book keeping
* Calibration procedures.
* ISO 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:  1.1 Ran blank samples as per chemistry laboratory manual.  1.2 Ran quality control samples as per chemistry laboratory manual.  1.3 Ran blind samples as per chemistry laboratory manual.  1.4. Ran Chemical standards. as per laboratory manual.  1.5 Ran repeat samples as per chemistry laboratory manual. |
| 2. Resource Implications | The following resources should be provided:  2.1 Access to relevant workplace  2.2 Appropriately simulated environment where assessment can take place  2.3 Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Written   2. Third party report |
| 4. Context of Assessment | Competency may be assessed:   * 1. Workplace   2. Simulated laboratory environment |
| 5. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, laboratory and job role is recommended. |

## PERFORM INDUSTRIAL CHEMISTRY ANALYSIS

**UNIT CODE:** 0531 551 17A

**UNIT DESCRIPTION**

This unit covers the competencies required in performing industrial chemistry. It involves performing water and waste water analysis, carrying out soap and detergents analysis, performing agrochemical analysis, petroleum analysis, cement analysis, sugar and allied analysis and pulp analysis.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up laboratory 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 the Range*** |
| 1. Perform water and waste water analysis | * 1. Water samples are obtained as per chemistry laboratory manual.   2. ***Water biological parameters*** are measured as per chemistry laboratory manual.   3. ***Water physical parameters*** are measured as per chemistry laboratory manual.   4. ***Water chemical parameters*** are measured as per chemistry laboratory manual. |
| 1. Carry out soap and detergents analysis | * 1. Free Fatty acid is tested as per laboratory manual.   2. Acid value test is carried out as per laboratory manual.   3. Moisture content is tested as per laboratory manual.   4. Foam stability is tested as per laboratory manual.   5. Hardness is tested as per laboratory manual.   6. Saponification values are calculated as per laboratory manual. |
| 1. Perform agrochemical analysis | * 1. Solubility tests is carried out as per laboratory manual.   2. Vapor pressure test is carried out as per laboratory manual.   3. Photo stability test is performed as per laboratory manual.   4. Shelf- life Stability test is carried out as per laboratory manual. |
| 1. Perform petroleum analysis | * 1. Octane number is calculated as per laboratory manual.   2. Cetane number is calculated as per laboratory manual.   3. Flash point is determined as per laboratory manual.   4. Specific gravity is measured as per laboratory manual. |
| 1. Perform cement analysis | * 1. Finess test is carried out as per laboratory manual.   2. Setting time is determined as per laboratory manual.   3. Unsoundness is tested as per laboratory manual. |
| 1. Perform sugar and allied analysis | * 1. Brix test is measured as per laboratory manual.   2. Crystal size is determined as per laboratory manual.   3. Moisture content is tested as per laboratory manual.   4. Color is tested as per laboratory manual. |
| 1. Perform paper and allied analysis | * 1. Estimation of copper number is calculated as per laboratory manual.   2. Estimation of kappa number is calculated as per laboratory manual.   3. Viscosity is tested as per laboratory manual.   4. Starch is tested as per laboratory 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** |
| 1. Water biological parameters | * Nutrients * Bacteria * Algae * Protozoa * Virus |
| 2. Water physical parameters | * Turbidity * Odor * Density * Taste * Temperature * Color * Electric conductivity |
| 3. Water chemical parameters | * pH * Dissolved oxygen * Hardness * Biological oxygen demand * Total soluble solids * Total dissolved solids * Chemical oxygen demand |

**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:

* Data interpretation skills
* Problem solving skills
* Proficiency in relevant software
* Safety precautions skills
* Laboratory skills
* Time management
* Report writing skills
* First aid
* Report writing

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Decision making
* Report writing
* Data interpretation
* Proficient in ICT
* Time management
* Problem solving
* Negotiation

**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. Obtained samples as per chemistry laboratory manual.   2. Measured water biological parameters as per chemistry laboratory manual.   3. Measured water physiochemical parameters as per chemistry laboratory manual.   4. Tested free fatty acid as per laboratory manual.   5. Carried out acid value test as per laboratory manual.   6. Tested moisture content as per laboratory manual.   7. Tested foam stability as per laboratory manual.   8. Tested hardness as per laboratory manual.   9. Calculated saponification values as per laboratory manual.   10. Carried out solubility tests as per laboratory manual.   11. Carried out vapor pressure test as per laboratory manual.   12. Performed photostability test as per laboratory manual.   13. Calculated octane number as per laboratory manual.   14. Determined flash point as per laboratory manual.   15. Carried out finesse test as per laboratory manual.   16. Determined setting time as per laboratory manual.   17. Measured brix test as per laboratory manual.   18. Calculated copper number estimate as per laboratory manual.   19. Calculated kappa number estimate as per laboratory manual.   20. Tested starch as per laboratory manual. |
| 2. Resource Implications | The following resources should be provided:   1. Access to relevant workplace 2. Appropriately simulated environment where assessment can take place 3. Materials relevant to the proposed activity or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Written   2. Practical   3. Third party report   4. Case study |
| 4. Context of Assessment | Competency may be assessed:   1. Workplace or simulated laboratory environment |
| 5. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, laboratory and job role is recommended. |