

**REPUBLIC OF KENYA**

**MINISTRY OF LABOUR AND SOCIAL PROTECTION**

**STATE DEPARTMENT FOR LABOUR AND SKILS DEVELOPMENT**

**NATIONAL OCCUPATIONAL STANDARD**

**FOR**

**SCIENCE LABORATORY TECHNICIAN**

**KNQF LEVEL5**

**OCCUPATION STANDARD ISCED CODE: 0711 454A**

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

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

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

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# ACRONYMS

OSHA Occupation Safety and Health Act

PPE Personal Protective Equipment

TVET Technical and Vocational Education and Training



# OCCUPATIONAL STANDARD OVERVIEW

This occupational standard consists of competencies that a person requires achieve to enable him/her to work as a science laboratory technician of level 6. The core competencies include performing standard laboratory practices, maintain laboratory equipment, performing biology techniques, performing chemistry techniques and performing physics techniques. The individual should also be able to apply general science skills, conduct science laboratory research and apply basic mathematics for science. Other competencies required include applying digital literacy, applying communication skills, applying work ethics and practices and applying entrepreneurial skills.

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

**SUMMARY OF UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **BASIC UNITS OF COMPETENCY** | |
| **UNIT CODE** | **UNIT TITLE** |
| 0611 451 01A | APPLY DIGITAL LITERACY |
| 0031 441 02A | APPLY COMMUNICATION SKILLS |
| 0417 441 03A | APPLY WORK ETHICS AND PRACTICES |
| 0413 441 04A | APPLY ENTREPRENEURIAL SKILLS |
| **COMMON UNITS OF COMPETENCY** | |
| 0531 441 05A | APPLY GENERAL SCIENCE SKILLS |
| 0588 441 06A | CONDUCT SCIENCE LABORATORY RESEARCH |
| 0541 441 07A | APPLY MATHEMATICS FOR SCIENCE |
| **CORE UNITS OF COMPETENCY** | |
| 1022 441 08A | PERFORM STANDARD LABORATORY PRACTICES |
| 1022 541 09A | MAINTAIN LABORATORY EQUIPMENT |
| 0511 441 10A | PERFORM BIOLOGY TECHNIQUES |
| 0531 441 11A | PERFORM CHEMISTRY TECHNIQUES |
| 0533 441 12A | PERFORM PHYSICS TECHNIQUES |

# BASIC UNITS OF COMPETENCY

# APPLY DIGITAL LITERACY

**UNIT CODE:** 0611 451 01A

**UNIT DESCRIPTION:**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

Functions and concepts of word processing;

Documents and tables creation and manipulations;

Document editing;

Document formatting;

Word processing utilities

* Spreadsheets;

Meaning, types and importance of spreadsheets;

Components of spreadsheets;

Functions, formulae, and charts, uses and layout;

Data formulation, manipulation and application to cells;

Editing & formatting spreadsheets;

* Presentation Packages;

Types of presentation Packages.

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

* Networking and Internet;

Internet connectivity.

Browser and digital content management;

Managing data, information, and digital content

Electronic mail and World Wide Web

* Fundamentals of Online Working;

Online Profile Management;

e-Portfolio Management;

Online Jobs Bidding;

Online Payment Systems;

* Job entry techniques

Job searching sites

Interview preparation skills

Interview handling

**Required skills**

The individual needs to demonstrate the following skills:

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

**EVIDENCE GUIDE**

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

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

# APPLY COMMUNICATION SKILLS

**UNIT CODE:** 0031 441 02A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

# APPLY WORK ETHICS AND PRACTICES

**UNIT CODE:** 0417 441 03A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

Required Skills

The individual needs to demonstrate the following skills:

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

Required Knowledge

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

# APPLY ENTREPRENEURIAL SKILLS

**UNIT CODE :** 0417 441 04A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

# COMMON UNITS OF COMPETENCY

## APPLY GENERAL SCIENCE PRINCIPLES

**UNIT CODE:** 0531 441 05A

**UNIT DESCRIPTION:**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## CONDUCT SCIENCE LABORATORY RESEARCH

**UNIT CODE:** 0588 441 06A

**UNIT DESCRIPTION**

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

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## APPLY BASIC MATHEMATICS FOR SCIENCE

**UNIT CODE:** 0541 441 07A

**UNIT DESCRIPTION**

This unit describes the competencies required to apply basic mathematics for science. It involves applying: basic arithmetic operations, algebraic equation and expression, binomial expansion, matrices, vector operations, trigonometry and statistical methods.

**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 operations | 1.1 Addition and subtraction is performed as per arithmetic operation rules  1.2 Multiplication and division is applied as per arithmetic operation rules  1.3 Ratios, ***mathematical*** ***proportions*** and percentages is applied as per algebraic rules  1.4 Indices are operated as per laws of indices |
| 2. Apply algebraic equation and expression | 2.1 Linear equations are solved as per linear concept  2.2 Simultaneous equation is solved as per ***simultaneous method***  2.3Linear graph is interpreted as per linear graph concept  2.4 Quadratic equation is solved as per ***quadratic methods*** |
| 3. Apply binomial expansions | 3.1 Evaluate binomial expression as per mathematical concepts  3.2 Formulate binomial theorem as per mathematical concepts  3.3 Pascal’s triangle is applied as per mathematical concepts |
| 4. Apply matrices | 4.1 2x2 matrix operation is carried out as per mathematics concept.  4.2 Determinant of 2x2 matrix is determined as per mathematics concept.  4.3 Inverse of 2x2 matrix is determined as per mathematics concept  4.2 Simultaneous equations are solved as per matrix concept |
| 5. Apply vector operations | 5.1 Vector addition is carried out as per vector concepts  5.2 Vector subtraction is carried out as per vector concepts  5.3 Vector multiplication is carried out as per vector concepts  5.4 Position of vectors are obtained as per vector concept |
| 6. Apply trigonometry | 6.1 ***Trigonometric ratios*** are applied as per trigonometric rules.  6.2 Trigonometric operations are performed as per ***trigonometric rules***  6.3 Angles of elevation and depression are determined as per trigonometric rules. |
| 7. Apply statistical methods | 7.1 ***Statistical raw data*** is organizedas per job requirement  7.2 ***Statistical data*** ***processing*** is carried outas per job requirement  7.3 Statistical Data results are reported as per job requirement |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range**  May include but not limited to: |
| * + - 1. Mathematical proportions include but not limited to: | * Direct proportion * Inverse proportion |
| 1. Simultaneous methods include but not limited to: | * Elimination method * Substitution * Graphical method |
| 1. Quadratic methods include but not limited to: | * Factorization * Completing squares method * Quadratic formula |
| 1. Trigonometric ratios May include but not limited to: | * Sine * Cosine * Tangent |
| 1. Trigonometric rules include but not limited to: | * Sine rule * Cosine rule * Tangent rule |
| 1. Binomial theorem includes but not limited to: | * Pascal triangle |
| 1. Statistical raw data include but not limited to: | * Grouped data * Ungrouped data |
| 1. Statistical data processing includes but not limited to: | * Mean * Mode * Median * Standard deviation |

**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
* Observation
* Interpersonal
* Applying fundamental operations (addition, subtraction, division, multiplication)
* Using and applying mathematical formulas
* Problem solving
* Applying statistics
* Drawing graphs

**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:  1.1 Performed addition and subtraction is as per arithmetic operation rules  1.2 Applied multiplication and division as per arithmetic operation rules  1.3 Applied ratios, mathematical proportions and percentages as per algebraic rules  1.4 Operated indices as per laws of indices  2.1 Solved linear equations as per linear concept  2.4 Solved quadratic equation as per quadratic methods  3.1 Evaluated binomial expression as per mathematical concepts  4.1 Carried out 2x2 matrix operation as per mathematics concept.  5.4 Obtained position of vectors as per vector concept  9.2 Performed trigonometric operations as per trigonometric rules  9.2 Angles of elevation and depression are determined as per trigonometric rules.  10.1 statistical raw data is organized as per job requirement  10.2 Statistical data processing is carried out as per job requirement  10.3 Statistical Data results are reported as per job requirement |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2. Access to relevant work environment.   * 1. Resources relevant to the proposed activities or tasks. |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical Assessment   2. Project-Based Assessment   3. Portfolio of Evidence   4. Written Assessment |
| 1. Context of Assessment | Competency may be assessed in a workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# CORE UNITS OF COMPETENCY

## PERFORM STANDARD LABORATORY PRACTICES

**UNIT CODE:** 1022 441 08A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

# **MAINTAIN LABORATORY EQUIPMENT**

**UNIT CODE: 1022 541 18A**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

**Required skills**

The individual needs to demonstrate the following skills:

Examples:

● Active listening

● Reflecting

● Technical

● Observation

● Problem solving

● Critical thinking

● Reporting

● Interpretation

● Maintenance

● Communication

**EVIDENCE GUIDE**

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

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

# PERFORM BIOLOGY TECHNIQUES

**UNIT CODE:** 0511 441 09A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

# PERFORM CHEMISTRY TECHNIQUES

**UNIT CODE:** 0531 441 10A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## PERFORM PHYSICS TECHNIQUES

**UNIT CODE: 0533 441 11A**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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