



REPUBLIC OF KENYA

NATIONAL OCCUPATIONAL STANDARD

FOR

ANALYTICAL CHEMISTRY TECHNICIAN

KNQF LEVEL 6

OCCUPATION STANDARD ISCED CODE: 0531 554A

APPLY MATHEMATICS FOR SCIENCE

ISCED UNIT CODE: 0531 551 05A

TVET CDACC UNIT CODE: ASC/OS/ACHEM/CC/01/6/MA

UNIT DESCRIPTION

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

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT	PERFORMANCE CRITERIA
These describe the key outcomes which make up workplace functions	These are assessable statements which specify the required level of performance for each of the elements <i>(Bold and italicized terms are elaborated in the range)</i>
1. Apply basic arithmetic operation	1.1 Addition and subtraction are performed as per arithmetic operation rules. 1.2 Multiplication and division are applied as per arithmetic operation rules. 1.3 Rational and irrational numbers are evaluated as per algebraic rules. 1.4 Ratios, <i>proportions</i> and percentages is applied as per algebraic rules.
2. Apply algebraic equation and expression	2.1 Linear equations are solved as per prescribed methods 2.2 Simultaneous equations are solved as per the <i>simultaneous method</i> required. 2.3 Formulation of a formula is applied as per the algebraic rules.

	2.4 Quadratic equation is solved as per the quadratic methods required.
3. Apply linear and non-linear graphs	3.1 Linear and nonlinear graph is plotted as per the graphical rules. 3.2 Reduction of non-linear to linear graphs is performed as per the graphical rules. 3.3 Graph is interpreted as per the concept formulate Graphical Rules.
4. Apply indices and logarithms	4.1 Indices are operated as per the Indices Rules. 4.2 Logarithm is defined as per the Logarithms Rules. 4.3 Change of base of logarithms is performed as per Logarithms Rules. 4.4 Logarithmic and exponential graph is plotted as per Logarithms Rules.
5. Apply binomial expansions	5.1 Roots of numbers are determined using binomial theorem rules. 5.6 Errors of small changes are determined using binomial theorem rules. 5.7 Permutation and combination are applied using binomial theorem rules.
6. Apply matrices	6.1 Determinant and inverse of 2x2 matrix is determined as per matrix Rules. 6.2 Simultaneous equations are solved as per matrix Rules. 6.3 Eigenvalues and Eigenvectors are determined as per matrix Rules.
7. Apply vectors	7.1 Vectors and scalar quantities are obtained in two dimensions as per vector rules. 7.2 Operations on vectors are performed as per vector Rules.

	<p>7.3 Position of vectors are obtained as per vector rules.</p> <p>7.4 Vector is resolved as per vector rules.</p>
8. Apply trigonometry	<p>8.1 Trigonometric ratios are applied as per trigonometric rules.</p> <p>8.2 Angles of elevation and depression are determined as per trigonometric rules.</p> <p>8.3 Angles are determined as per compound angle formula</p> <p>8.4 Sine and cosine waves are interpreted as per trigonometric rules.</p>
9. Apply Calculus	<p>9.1 Rate of change is determined as per differentiation rule.</p> <p>9.2 Stationary points of functions are determined as per differentiation rules.</p> <p>9.3 Integrals of algebraic functions are determined as per integration rules.</p> <p>9.4 Integrals of logarithmic functions are determined as per integration rules.</p>
10. Apply sequences and series	<p>10.1 Arithmetic means and nth term of an arithmetic sequence is determined as per the sequence rules.</p> <p>10.2 Sum of terms of a given arithmetic series are determined as per the sequence rules.</p> <p>10.3 A geometric sequence is differentiated according to arithmetic sequence rules.</p> <p>10.4 A finite geometric sequence is differentiated according to finite geometric sequence rules.</p>

	<p>10.5 Geometric means and n^{th} terms of a geometric sequence is determined as per geometric sequence rules.</p> <p>10.6 Sum of finite and infinite geometric sequence is determined as per geometric sequence rules.</p>
11. Apply statistics methods	<p>11.1 Raw data is processed as per job requirement.</p> <p>11.2 Interpretation of data is performed as per job requirement.</p> <p>11.3 Data presentation is performed as per job requirement.</p>

RANGE

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

Variable	Range
1. Proportions may include but not limited to:	<ul style="list-style-type: none"> • Direct proportion • Inverse proportion
2. Simultaneous method may include but not limited to:	<ul style="list-style-type: none"> • Elimination method • Substitution • Graphical method
3. Quadratic methods May include but not limited to:	<ul style="list-style-type: none"> • Factorization • Completing Square Method • Quadratic formula

4. Logarithms may include but not limited to:	<ul style="list-style-type: none"> • Operation • Conversions • Graph plotting
5. Errors may include but not limited to:	<ul style="list-style-type: none"> • Absolute • Relative • Percentage
6. Trigonometric rules. May include but not limited to:	<ul style="list-style-type: none"> • Sine rule • Cosine rule • Double angle formula
7. Differentiation May include but not limited to:	<ul style="list-style-type: none"> • First principles. • High order functions • Differential equations • Inverse differentiation
8. Differentiation rules. May include but not limited to:	<ul style="list-style-type: none"> • Product rule • Chain rule • Quotient rule
9. Stationary points May include but not limited to:	<ul style="list-style-type: none"> • Maxima • Minima • Point of inflection
10. Integration May include but not limited to:	<ul style="list-style-type: none"> • Constant of integration • Integral notation • Indefinite and definite integrals

<p>11. Methods of integration May include but not limited to:</p>	<ul style="list-style-type: none"> • Standard form • Substitution • Integration by parts
<p>12. Currency table May include but not limited to:</p>	<ul style="list-style-type: none"> • Selling price • Buying price
<p>13. Series May include but not limited to:</p>	<ul style="list-style-type: none"> • Arithmetic Progression • Geometric Progression
<p>14. Raw data may include but not limited to:</p>	<ul style="list-style-type: none"> • Grouped data • Ungrouped data
<p>15. Data processing may include but not limited to:</p>	<ul style="list-style-type: none"> • Mean • Mode • Median • Range • Quartile • Standard deviation • Variance
<p>16. Data presentation May include but not limited to:</p>	<ul style="list-style-type: none"> • Pictograms • Histograms • Pie charts • Bar charts • Frequency polygon
<p>17. Order of matrix May include but not limited to:</p>	<ul style="list-style-type: none"> • Singular • Non-singular • Identity • Echelon

18. Matrix operation May include but not limited to:	<ul style="list-style-type: none">• Compatibility• Addition/subtraction• Multiplication• Multiplication by scalar
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REQUIRED SKILLS AND KNOWLEDGE

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

Required Skills

The individual needs to demonstrate the following skills:

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

Required knowledge

The individual needs to demonstrate knowledge of:

- Fundamental operations (addition, subtraction, division, multiplication)
- Types and purpose of measuring instruments
- Units of measurement and abbreviations

- Rounding techniques
- Types of fractions
- Types of tables and graphs
- Presentation of data in tables and graphs
- Vector operations
- Matrix operations
- Data presentation

EVIDENCE GUIDE

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

<p>1. Critical aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <p>1.1 Applied Ratios, proportions and percentages as per algebraic rules.</p> <p>1.2 Interpreted graph as per formulated graphical rules.</p> <p>1.3 Plotted logarithmic and exponential graph as per logarithmic rules.</p> <p>1.4 Solved Simultaneous equations as per matrix concept</p> <p>1.5 Performed operations on vectors as per vector rules.</p> <p>1.6 Determined angles of elevation and depression as per trigonometric rules.</p> <p>1.7 Determined rate of change as per differentiation concept</p> <p>1.8 Differentiated finite geometric sequence as per finite geometric sequence rules.</p>
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	<p>1.9 Determined sum of terms of geometric sequence as per the geometric sequence rules.</p> <p>1.10 Interpreted data as per work requirement.</p> <p>1.11 Presented data as per job requirement.</p>
2. Resource Implications	<p>The following resources should be provided:</p> <p>2.1 Appropriately simulated environment where assessment can take place</p> <p>2.2 Access to relevant work environment</p> <p>2.3 Resources relevant to the proposed activities or tasks</p>
3. Methods of Assessment	<p>Competency in this unit may be assessed through:</p> <p>3.1 Written assessment</p> <p>3.2 Oral assessment</p>
4. Context of Assessment	<p>4.1 Competency may be assessed individually in the actual workplace or simulated environment</p>
5. Guidance information for assessment	<p>5.1 Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>