

## APPLY MECHANICAL SCIENCE PRINCIPLES

**UNIT CODE:** 0714441 09A

**TVET CDACC UNIT CODE: ENG/OS/MDE/CC/04/5/MA**

### UNIT DESCRIPTION

This unit specifies the competencies required to apply mechanical science principles. Competencies includes: Applying forces in a system, Applying knowledge of moments, Applying friction principles, Applying motions laws, Describing work, energy and power, performing machine calculations, Demonstrating gas principles, Applying heat knowledge, Applying density knowledge, Applying pressure principles, Applying optical principles and Applying wave principles.

### ELEMENTS AND PERFORMANCE CRITERIA

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b>
These describe the key outcomes which make up workplace function.	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 forces in a system	1.1 Forces are applied as per physics concept 1.2 <b>Forces theorems</b> are applied as per the physics concept 1.3 Resultant of coplanar forces are calculated as per the mass x acceleration formula. 1.4 <b>Mechanical calculations</b> are performed as per the mass x acceleration formula.
2. Apply knowledge of moments	2.1 Moments are applied as per the physics concept 2.2 Moments are calculated as per the moment's formula 2.3 Principles of moments are applied as per the moments formula 2.4 Couples are identified and applied in engineering systems as per work requirement.
3. Apply friction principles	3.1 Laws of friction are applied as per the physics concept.

	<p>3.2 Limiting friction is calculated as per the coefficient of friction formula.</p> <p>3.3 Forces applied at an angle to a horizontal plane are calculated as per the coefficient of friction formula.</p> <p>3.4 Coefficient of friction is applied as per the work requirement.</p> <p>3.5 Advantages and disadvantages of friction are identified.</p>
4. Apply motions laws	<p>4.1 Motion concepts are applied as per the physics concept.</p> <p>4.2 Motion calculations are performed as per the equations of motion.</p> <p>4.3 Displacement/time graphs are applied as per the work requirement.</p>
5. Describe work, energy and power	<p>5.1 Work is calculated as per the force* distance formula</p> <p>5.2 Energy is calculated as per the force* distance formula</p> <p>5.3 Power calculations are performed as per the watt's formula</p> <p>5.4 <b>Problems on simple machines</b> and levers are solved as per the work requirement.</p>
6. Demonstrate gas principles	<p>6.1 <b>Gas laws</b> are applied as per the physics concept</p> <p>6.2 Gas laws are applied in solving engineering problems as per the work requirement.</p> <p>6.3 Uses of gases in engineering systems are identified as per the work requirement.</p>
7. Apply heat knowledge	<p>7.1 Heat physics concepts are applied as per the specific heat formula.</p> <p>7.2 Working principle of heat applied as per the specific heat formula.</p> <p>7.3 Heat capacity is calculated as per the specific heat formula.</p> <p>7.4 Heat problems are solved as per work requirements.</p>
8. Apply density knowledge	<p>8.1 Density physics concepts are applied as per the physics concept.</p> <p>8.2 Density measurements are carried out as per the density equation formula.</p> <p>8.3 Density problems are calculated as per the density equation formula.</p>
9. Apply pressure principles	<p>9.1 Pressure physics concepts are applied as per the pascal's theorem.</p> <p>9.2 Working principles of pressure is applied as per the pascal's theorem.</p> <p>9.3 Pressure problems are solved as per the pascal's formula.</p> <p>9.4 <b>Pressure applications</b> are applied as per the work requirement.</p>

10. Apply pneumatics and hydraulics principles	<p>10.1 Pneumatics and hydraulics physics concepts are applied as per the pound's formula.</p> <p>10.2 Pneumatics and hydraulics problems are solved as per the pound's formula.</p> <p>10.3 Working principle of pneumatics and hydraulics is applied as per the work requirement.</p>
11. Apply optical principles	<p>11.1 Nature of Light concepts are applied as per light propagation concepts</p> <p>11.2 <b><i>Geometrical Optics concepts</i></b> are applied as per the snells laws</p> <p>11.3 Fiber optics concepts are applied as per optical concepts</p>
12. Apply wave principles	<p>12.1 Wave phenomenon concepts are applied as per wave propagation concepts</p> <p>12.2 Electromagnetic waves concepts are applied as per radiation concept.</p> <p>12.3 Light waves concepts are applied as per radiation concepts</p> <p>12.4 Sound waves concepts are applied as per radiation concepts</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. Forces theorems include but not limited to:	<ul style="list-style-type: none"> <li>● Newton's First law</li> <li>● Newton's Second Law</li> <li>● Newton's Third Law</li> </ul>

2. Mechanical calculations	<ul style="list-style-type: none"> <li>● Mechanical advantage</li> <li>● Efficiency</li> <li>● Torque</li> <li>● Power/Energy</li> <li>● Work done</li> </ul>
3. Problems on simple machines include but not limited to:	<ul style="list-style-type: none"> <li>● Machine advantage</li> <li>● Velocity ratio</li> <li>● Efficiency</li> </ul>
4. laws include but not limited to:	<ul style="list-style-type: none"> <li>● Boyles law</li> <li>● Charles law</li> <li>● Gas equation</li> </ul>
5. Pressure applications include but not limited to:	<ul style="list-style-type: none"> <li>● Vacuum pump</li> <li>● Hydraulic pump</li> <li>● Hydrometers</li> </ul>
6. Geometrical Optics concepts	<ul style="list-style-type: none"> <li>● Light propagation,</li> <li>● Reflection</li> <li>● Refraction</li> <li>● Image formation</li> <li>● Mirrors</li> <li>● Lenses</li> </ul>

## 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:

- Use of tools and equipment
- Communication skills

- Troubleshooting skills
- Mechanical skills
- ICT skills
- Installation
- Calibration
- Problem solving
- Critical thinking
- Report writing
- Record keeping
- Interpersonal skills
- Numeracy skills
- Leadership skills

## **Required Knowledge**

The individual needs to demonstrate knowledge of:

- Safety precautions
- Fault diagnosis
- Electrical principles
- Electronics
- Hospital hygiene
- Standards of calibration

## **EVIDENCE GUIDE**

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

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Determined forces in a system as per the physics concept 1.2 Demonstrated knowledge of moments as per the formula
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	<p>1.3 Solved problems on friction principles as per the mass acceleration formula</p> <p>1.4 Solved problems on motions in engineering as per the equations of motion formula</p> <p>1.5 Described work, energy and power as per the physics concept</p> <p>1.6 Solved problems on gas principles as per the physics concept</p> <p>1.7 Applied heat knowledge as per the physics concept</p> <p>1.8 Applied density knowledge as per the physics concept</p> <p>1.9 Applied pressure principles as per the physics concept</p> <p>1.10 Applied pneumatics and hydraulics principles as per the physics concept</p> <p>1.11 Applied optical principles as per the physics concept.</p> <p>1.12 Applied wave principles as per the physics concept.</p>
2. Resource Implications	<p>The following resources should be provided:</p> <p>2.1 Access to relevant workplace where assessment can take place</p> <p>2.2 Access to mechanical tools and equipment which can be used for assessment</p> <p>2.3 Access to relevant tools which can be used for installation and maintenance</p>
3. Methods of Assessment	<p>Competency in this unit may be assessed through:</p> <p>3.1 Written test</p> <p>3.2 Practical Demonstration</p> <p>3.3 Interview</p>
4. Context of Assessment	<p>4.1 Competency may be assessed individually in the actual workplace or Simulated work place.</p>
5. Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>