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AGRICULTURAL ENGINEERING LEVEL 6

ENG/OS/AGR/CC/03/6

Apply Principles of Mechanical Science N

November/December 2025



**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL
(TVET CDACC)**

WRITTEN ASSESSMENT

TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATE

1. This paper consists of **TWO** sections: **A** and **B**.
2. Answer **ALL** questions in section A and **ANY THREE** (3) questions in section B.
3. Marks for each question are indicated in the brackets. 4. Candidates are provided with a separate answer booklet
5. Do not write on the question paper.

This paper consists of FIVE (5) printed pages

Candidate should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

SECTION A (40 MARKS)*Attempt ALL questions in this section*

1. Science is the systematic study of nature through observation, experimentation, and analysis to understand how things work. Define the following terms as used in science. (4 Marks)
 - a. Compression ratio.
 - b. Moment of a force.
 - c. Uniform beam.
 - d. Specific Heat capacity.
2. A storage tank contains petrol to a height of 5.0m and the pressure at the base of the tank is given as 32.3 kPa, determine the density of the petrol. (Take g to be 9.8 m/s^2). (4 Marks)
3. A hydraulic lift uses fluid pressure to amplify a small force, enabling it to raise heavy objects. State FOUR factors that govern pressure in liquids. (4 Marks)
4. Everyday actions like walking, driving, stopping, and holding objects rely on forces that prevent slipping and sliding. Outline FOUR advantages of frictional forces. (4 Marks)
5. A car of mass 800 kg is climbing an inclined plane at 10° to the horizontal. Determine the increase in potential energy of the car as it moves a distance of 50m up the inclination. (4 Marks)
6. Various activities and technologies rely on heat transfer for drying crops, heating spaces, and even cooking. State FOUR application of radiation on heat transfer. (4 Marks)
7. Frictional forces play a crucial role in day-to-day activities. Outline **FOUR** instances where frictional forces are an advantage in our daily activities. (4 Marks)
8. The hammer of a pile-driver of mass 1 tonne falls a distance of 1.5m on to a pile. The blow takes place in 25 micro seconds and the hammer does not rebound. Determine the average applied force exerted on the pile by the hammer. (4 Marks)
9. A substance absorbs heat during melting and boiling, but its temperature stays constant during each change. Differentiate between specific latent heat of fusion and latent heat of vaporization. (4 Marks)
10. A beam P Q is 5.0 m long and is supported at its ends in a horizontal position as shown in Figure 1 below. Its mass is equivalent to a force of 400 N acting at its centre as shown. Point loads of 12 kN and 20 kN act on the beam in the positions shown. When the beam is in equilibrium, determine the reactions of the supports, R_P and R_Q . (4 Marks)

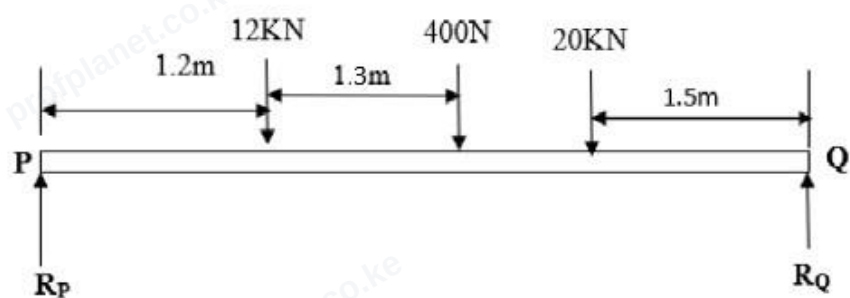


Figure 1.

SECTION B (60 MARKS)

Attempt **ANY THREE** questions in this section.

11. Fundi is fixing a metal frame that supports a water tank, where various mechanical forces with direction and magnitude being applied to different sections of the structure.

- Outline FOUR main types of mechanical forces that can act on the structure. (4 Marks)
- Differentiate between a scalar and a vector quantity citing examples (4 Marks)
- Use the parallelogram of forces methods to find the magnitude and direction of the resultant of forces of 300N acting at an angle of 135° and a force of 400 N acting at an angle of 120° . Use scale of 1cm:40N. (12 Marks).

12. Itec construction workers are building a small grain storage shed in Ngati area. To complete the project efficiently, they make use of various simple machines to reduce the amount of effort needed for different tasks.

- Identify FOUR simple machines used to make work easier. (4 Marks)
- A screw-jack is being used to support the axle of a car, the load on it being 2.4 kN. The screw jack has an effort of effective radius 200 mm and a single-start square thread, having a lead of 5 mm. determine the efficiency of the jack if an effort of 60 N is required to raise the car axle. (6 Marks)
- Determine the amount of heat energy needed to change 400g of ice, initially at -20°C , into steam at 120°C . Assume the following: latent heat of fusion of ice = 335kJ/kg , latent heat of vaporization of water = 2260kJ/kg , specific heat capacity of ice = $2.14\text{kJ/kg } ^\circ\text{C}$, specific heat capacity of water = $4.2\text{ kJ/kg } ^\circ\text{C}$ and specific heat capacity of steam = $2.01\text{ kJ/kg } ^\circ\text{C}$ (10 Marks)

13. Energy changes form during motion, but the total amount remains constant in a closed system.

- State the Principles of conservation of energy. (1 mark)
- Fill gaps in the table below. (4 Marks)

S. No	Initial form of energy	Final form of energy	Transducer
i.	Mechanical Energy		Friction
ii.	Sound		Microphone
iii.	Electrical Energy	Light	
iv.		Electrical energy	Generator

- c. A hoist exerts a force of 500 N in raising a load through a height of 20 m. The efficiency of the hoist gears is 75% and the efficiency of the motor is 80%. Calculate the input energy to the hoist. (8 Marks)
- d. A canister containing a meteorology balloon of mass 4 kg is fired vertically upwards from a gun with an initial velocity of 400 m/s. neglecting the air resistance, Calculate:
- i Initial kinetic energy. (2 Marks)
 - ii Velocity at a height of 1 km. (3 Marks)
 - iii The maximum height reached. (2 Marks)
14. A fisherman in a rural village loads his wooden canoe with fishing nets and gear, then gently pushes it into the river. As the canoe enters the water, it sinks slightly and floats steadily, even with the fisherman climbing in.
- a. State the Archimedes' principle. (1 mark)
 - b. Name FOUR devices used to measure pressure. (4 Marks)
 - c. A circular piston exerts a pressure of 80 kPa on a fluid, when the force applied to the piston is 0.2 kN. Find the diameter of the piston. (5 Marks)
 - d. A body weighs 2.760 N in air and 1.925 N when completely immersed in water of density 1000 kg/m³. Take the gravitational acceleration as 9.81 m/s². Calculate:
 - i Volume of the body. (3 Marks)
 - ii Density of the body. (5 Marks)
 - iii Relative density of the body. (2 Marks)