071906T4AEN
Agricultural Engineering Level 6
ENG/OS/AGR/CC/03/6/A
Apply Principles of Mechanical Science
July /Aug 2023

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

WRITTEN ASSESSMENT

Time : 3 hours

INSTRUCTIONS TO CANDIDATES

1. This paper has **two** sections **A** and **B.**
2. You are provided with a separate answer booklet.
3. Marks for each question are as indicated.
4. Do not write on the question paper.

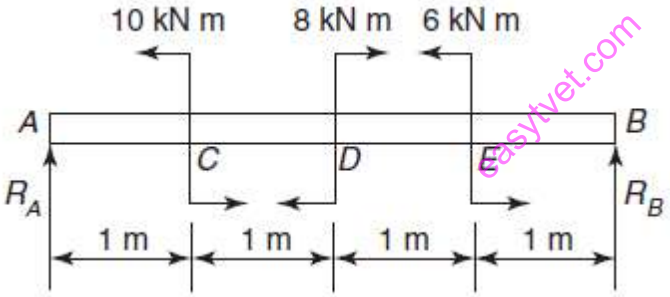
This paper consists of 4 printed pages

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

SECTION A: (40 Marks)

Answer all questions in this section.

1. Define the following terms; (4 marks)
   (a) Force
   (b) Work done
   (c) Energy
   (d) Specific Heat capacity
2. A storage tank contains petrol to a height of 5.0m. If the pressure at the base of the tank is 32.3 kPa, determine the density of the petrol. Take the gravitational force as 9.8 m/s^2 (4 marks)
3. Determine the values of reactions R_A and R_B for the force system shown below (4 marks)



4. (a) Highlight TWO advantages of frictional forces. (2 marks)
   (b) Determine the value of the force P, which will just move the body of mass of 25 Kg down the plane. It may be assumed that the coefficient of limiting friction, $\mu = 0.3, \theta = 15°$ and $g = 9.81\ m/s^2$ (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 50 m up the inclination. (4 marks)
6. State FOUR application of radiation on heat transfer (4 marks)
7. Explain FOUR factors that govern pressure in fluids (4 marks)
8. A gas occupies a volume of $2.0m^3$ at a pressure of 100 kPa and a temperature of 120 °C. Determine the volume of the gas at 15 °C if the pressure is increased to 250 KPa. (5 marks)

9. State Newton's first law of motion. (1 mark)
10. 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)

SECTION B (60 Marks)

Answer three questions in this section

11. (a) List THREE main types of mechanical forces that can act on a body (3 marks)

(b) Differentiate between a scalar and a vector quantity citing examples (4 marks)

(c) 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^{o} and a force of 400 N acting at an angle of -120^{o}. Use scale of 1cm: 40N (13 marks)

12. (a) Identify FOUR simple machine used to make work easier (4 marks)

(b) 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)

(c) In a test on a simple machine, the effort/load graph was a straight line of the form $Fe = aFl + b$. Two values lying on the graph were at Fe = 10 N, Fl = 30 N, and at Fe = 74 N, Fl = 350 N. The movement ratio of the machine was 17. Determine the limiting force ratio and the limiting efficiency of the machine. (10 marks)

13. (a) State the Principles of conservation of energy (1 mark)

(b) Fill gaps in the table below. (4 marks)

No	Initial form of energy	Final form of energy	Transducer
I.		Electrical energy	Generator
II.	Sound		Microphone
III.	Electrical Energy	Light	
IV.	Mechanical Energy		Friction

(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) 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/m^3. Take the gravitational acceleration as 9.81 m/s^2.

Calculate:

(i) volume of the body; (3 marks)

(ii) density of the body; (5 marks)

(iii) Relative density of the body. (2 marks)

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