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071605T4AUT**AUTOMOTIVE TECHNICIAN LEVEL 5****ENG/OS/AUT/CC/3/05/A**

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AUTOMOTIVE ENGINEERING SCIENCE PRINCIPLES**July /Aug. 2025**

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

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WRITTEN ASSESMENT**TIME: 3 HOURS**

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INSTRUCTIONS TO CANDIDATE

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1. The paper consists of **TWO** sections: **A** and **B**.

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2. Attempt **ALL** the questions in Section A and any **THREE** from Section B.

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3. You are provided with a separate answer booklet

4. **DO NOT** write on this question paper.

5. Do not write on the question paper.

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This paper consists of FOUR (4) printed pages

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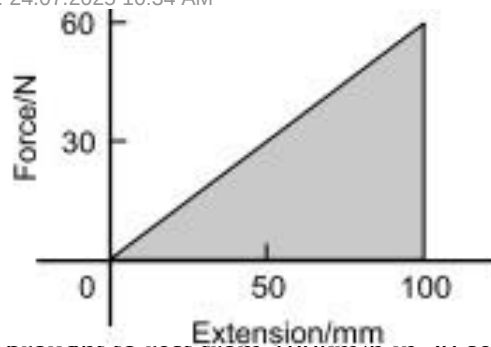
Candidate check to ascertain that all pages are printed as indicated and that no**page are missing.**

Turn Over

SECTION A (40 MARKS)

Answer ALL the questions in this section.

1. State Newton's first law. (2 Marks)
2. a) Define the term simple machine. (2 Marks)
b) List **four** examples of simple machines. (4 Marks)
3. The figure below shows a spring, initially in a relaxed state then extended by 100 mm. Determine the work done if the spring requires a force of 0.6 N per mm of stretch. (4 Marks)



4. A car is brought to rest from 180 km/h in 20 seconds. What is its retardation? (4 Marks)
5. For from the object's interaction with another object. State **three** types of forces. (3 Marks)
6. Determine the moment of a force of 25 N applied to a spanner at an effective length of 180 mm from the center of a nut. (4 Marks)
7. A gas in a fixed volume container has a pressure of 1.6×10^5 Pa at a temperature of 27 °C. What will be the pressure of the gas if the container is heated to a temperature of 277 °C? (3 Marks)
8. State **four** laws of friction. (4 Marks)
9. Highlight **four** advantages of friction. (4 Marks)
10. A body moving with uniform acceleration of 10 m/s^2 covers a distance of 320 m. if its initial velocity was 60 m/s. calculate its final velocity. (3 Marks)
11. An automotive technician can measure across the following terms in his research project. Define the terms. (3 Marks)

i. Work

iii. Power

SECTION B (60 MARKS)

Answer any **THREE** questions in this section

12.

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- a) A manufacturing company want to produce vehicle components using different materials. Briefly explain **five** factors the company should consider when selecting appropriate materials. (10 Marks)

- b) A car travelling at a speed of 72 km/h is uniformly retarded by an application of brakes and comes to rest after 8 seconds. If the car with its occupants has a mass of 1,250 kg. Calculate;

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- i) The breaking force. (5 Marks)
- ii) The work done in bringing it to rest. (5 Marks)

13.

- (a) Engineering materials have different properties, explain **five** properties of metals. (10 Marks)

- (b) (i) A gas occupies a volume of 2.0 m³ when 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)

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- (ii) Some air at a temperature of 40°C and pressure 4 bar occupies a volume of 0.05 m³.

Determine the mass of the air assuming the characteristic constant for air to be 287 J/

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- (kg K). (5 Marks)

14.

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- a) Heat is a form of energy and is measured in joules. Explain **three** modes of heat transfer. (6 Marks)

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- b) Determine the amount of heat energy needed to change 400 g of ice, initially at -20°C, into steam at 120°C. Assume the following: latent heat of fusion of ice is 335 kJ/kg, latent heat of vaporization of water is 2260 kJ/kg, specific heat capacity of ice is 2.1 kJ/(kg °C), specific heat capacity of water is 4.2 kJ/(kg °C) and specific heat capacity of steam is 2.01 kJ/(kg °C). (14 Marks)

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15.

a) State Archimedes' principle (2 Marks)

b) Explain how Archimedes' principle is applied in the following vessels. (8 Marks)

i. Ships

ii. Submarines

iii. Balloons

iv. Hydrometers

c) A body weighs 270 N in air and 195 N when immersed in water of

density 1000 kg/m^3 . Calculate:

i. The volume of the body (4 Marks)

ii. The density of the body (4 Marks)

iii. The relative density of the body. Take the gravitational acceleration as 9.81 m/s^2 . (2 Marks)