



ZIMBABWE

**MINISTRY OF HIGHER AND TERTIARY EDUCATION,
INNOVATION, SCIENCE AND TECHNOLOGY
DEVELOPMENT**

**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

NATIONAL CERTIFICATE

IN

**DIESEL PLANT FITTING, MOTOR VEHICLE MECHANICS, AUTO-ELECTRICS
AND ELECTRONICS PRECISION MACHINING, MVBR**

SUBJECT: Automotive Science Engineering PAPER NO: 346/18/S09

DURATION: 3 Hours

MARCH/APRIL 2024 EXAMINATION

REQUIREMENTS

Calculator, drawing Instruments

INSTRUCTIONS TO CANDIDATE

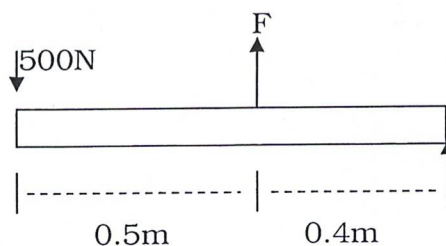
- 1) Section A: Answer all questions (40 marks)**
- 2) Section B: Answer any five (5) questions (60 marks).
Each question carries 12 marks.**

SECTION A

QUESTION 1

- 1.1 State the principle of moments. (2 marks)
- 1.2 Define acceleration. (2 marks)
- 1.3 An engine on test, running at 3000 rev/min has a torque reading of 175Nm. Calculate the power of the engine. (4 marks)
- 1.4 A car travelling at a speed of 54km/h is stopped in 16 seconds. Calculate the distance covered. (6 marks)
- 1.5 Define the following terms:
- Elasticity (2 marks)
 - Plasticity (2 marks)
 - Ductility (2 marks)
- 1.6 State three (3) factors that affect the amount of friction. (3 marks)
- 1.7 Distinguish between sensible heat and latent heat. (2 marks)
- 1.8 Determine the velocity ratio of a simple screw jack of a two start thread of pitch 5mm if the effort is applied at an effective radius of 350mm. (4 marks)
- 1.9 Calculate the radius of a wheel rotating at 132rad/s given that the linear velocity of a point on the edge of the wheel 66 m/s
- 1.10 Find the mass of water of specific heat capacity 4.2KJ/kj which gives 882kJ of heat when its temperature is raised by 30°C. (4 marks)

1.11



Calculate the effort F

SECTION B:

ANY FIVE (5) QUESTIONS

QUESTION 2

A vehicle of mass 2 tonne rests on an incline of 20° to the horizontal with the hand brake applied: Determine

- a) The force required to keep the vehicle stationery. (6 marks)
- b) The normal reaction between the wheels and the road surface. (6 marks)

QUESTION 3

A bus starts from rest at station A with uniform acceleration of 1m/s^2 which is maintained for 30seconds. The bus then travels with uniform speed then travels with uniform speed for 10 mins, and finally retarded at 1.5m/s^2 and comes to rest at station B.

Calculate the distance between station A and station B. (12 marks)

QUESTION 4

A six cylinder four stroke cycle engine is making 4800 rev/min. How many power strokes does it produce?

- a) Per revolution (4 marks)
- b) Per minute (4 marks)
- c) Second (4 marks)

QUESTION 5

A small winch of velocity ratio 50 is capable of raising loads of 10KN and 80KN with efforts of 450N and 1.05KN respectively. Find

- a) The relationship between the effort and load. (6 marks)
- b) The effort, force ratio and efficiency when the load lifted is 22500N. (6 marks)

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QUESTION 6

A copper sphere has diameter of 50mm at a temperature of 15°C. If the temperature of the sphere is then raised to 500°C. Determine the increase in:

- a) Diameter (4 marks)
- b) Surface area of the sphere (4 marks)
- c) The volume of the sphere. NB: take the coefficient of linear expansion of copper as $0.000017/^{\circ}\text{C}$. (4 marks)

QUESTION 7

- a) A horizontal force of 400N is required to slide a wooden case over a horizontal floor at a steady speed rate. If the coefficient of friction between the surfaces in contact is 0,5, find mass of the case. (6 marks)
- b) An engine running under full load conditions develops its maximum torque at 1200 rev/min when the engine power is 15000W. Calculate the torque transmitted. (6 marks)

QUESTION 8

A square hole having 12mm sides is to be punched out of a metal plate 1.6mm thick. If the shear stress required to cause fracture is 350N/mm^2 ;

- a) Determine the force which must be applied to the punching die. (6 marks)
- b) Determine also the compressive stress in the punch. (6 marks)

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