



**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

NATIONAL CERTIFICATE

IN

**MOTOR CYCLE MECHANICS, MOTOR MECHANICS, DIESEL
PLANT FITTING, AUTO ELECTRICS, AUTO PRECISION , MVBR**

MODULE: Engineering Maths and Science PAPER NO: 346/22/M07

DURATION: 3 Hours

NOVEMBER/DECEMBER 2025 EXAMINATION

REQUIREMENTS

Scientific calculator, answer booklet, blue pen, graph paper.

INSTRUCTIONS TO CANDIDATE

1. **Section A: Answer all questions.** (50 marks)
2. **Section B: Answer all questions.** (50 marks)

This paper consists of 3 printed pages.

SECTION A

Answer all questions

QUESTION 1

- 1.1 State whether the following number is rational or irrational: 0,145145
-----, (1 mark)
- 1.2 Give the equivalence or identity of this equation $\log_2 6 = x$. (2 marks)
- 1.3 Find the inverse of the following matrix
$$\begin{pmatrix} 1 & 4 \\ 3 & 0 \end{pmatrix}$$
 (4 marks)
- 1.4 Differentiate from first principle $3x^2 - 2x + 3$. (8 marks)
- 1.5 Find the surface area of a hollow cylinder of radius 3m and height of 4m. (5 marks)
- 1.6 Resolve into linear factors $x^3 - 4x - 12$ (6 marks)
- 1.7 Calculate the area under the curve $\int_0^4 (x^2 - 2) dx$. (4 marks)
- 1.8 Find the coordinates and nature of the turning points on the curve $y = x^3 - 3x^2 - 9x + 6$. (10 marks)
- 1.9 If the angle of elevation of the top of a vertical 30m high aerial is 32° , how far is it to the aerial? (3 marks)
- 1.10 If $A = 2i - 2j + k$, find
- (i) $3A$ (3 marks)
- (ii) $|A|$ (4 marks)

SECTION B

Answer all questions

QUESTION 2

- 2.1 (a) State Newton's first law of motion. (1 mark)
- (b) A vehicle is towed along a straight level road by a force of 120N. Calculate the work done in towing the vehicle through a distance of 70m. (3 marks)
- 2.2 A single plate clutch of 0.15m effective diameter is lined with material of coefficient of friction 0,35. If the total spring force is 2.5kN, calculate:
- (a) maximum torque transmitted $F \times R$ (4 marks)
- (b) power transmitted at 3000rev/min. (4 marks)
- 2.3 (a) State the principle of conservation of energy. (2 marks)
- (b) A vehicle has wheelbase of 2.5m, when the vehicle is at rest the load on the front axle is 3980N load at the rear axle 5970N. Determine the distance of the centre of gravity behind the front axle. (6 marks)
- 2.4 (a) A simple screw jack has a thread 5mm lead. If the effort is applied at an effective radius of 210mm, determine the velocity ratio. (3 marks)
- (b) It is found that the jack can lift a load W of 500N when the effort P applied is 20N, and that W is 1000N when P is 30N. Given that P and Q are linearly related.
- (i) State the law of this machine. (6 marks)
- (ii) Determine when load is 1500N, the effort (3 marks)
- 2.5 (a) State the two types of latent heat. (2 marks)
- (b) The cooling system of an engine contains 9 litres of water at a temperature of 15°C. After a run the temperature of the water is found to be 85°C. Calculate the volume of water lost by expansion through the overflow pipe. Volumetric expansion of water is 0,000045/K. (6 marks)
- 2.6 A vehicle travelling at a steady velocity of 8m/s is accelerated at 3.2m/s². Determine the velocity after 4 seconds. (4 marks)
- 2.7 A steel bar 5m long and 60 x 50mm cross section withstands a pull of 120kN. Determine the tensile stress on the section in MN/m² and the increase in length of the bar under this pull in mm. Given $E = 210 \text{ GPa}$. (6 marks)

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