

**CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY
MARINE ENGINEER OFFICER**

STCW 78 as amended SMALL VESSEL CHIEF ENGINEER <3000 GT, <9000 KW UNLIMITED

058-11 - GENERAL ENGINEERING SCIENCE I

FRIDAY, 27 JUNE 2025

1400 - 1600 hrs

Materials to be supplied by examination centres

Candidate's examination workbook
Graph paper

Examination Paper Inserts

Notes for the guidance of candidates:

1. Examinations administered by SQA on behalf of the Maritime & Coastguard Agency.
2. Candidates are required to obtain 50% of the total marks allocated to this paper to gain a pass **AND** also obtain a minimum 40% in Sections A and B of the paper.
3. Non-programmable calculators may be used.
4. All formulae used must be stated and the method of working and **ALL** intermediate steps must be made clear in the answer.



GENERAL ENGINEERING SCIENCE I

Attempt ALL questions.

Marks for each question are shown in brackets.

Section A

1. (a) Simplify the following giving your answer in the simplest mixed number format.

$$x = \left(9\frac{5}{8} \div 1\frac{3}{4}\right) - 2\frac{2}{3} \quad (4)$$

- (b) Determine the value of 'n' using logarithms in the following expression when $P_2 = 2 \times P_1$ and $T_1 = 2.5 \times T_2$:

$$P_1 T_1^n = P_2 T_2^n \quad (4)$$

2. Simplify EACH of the following and rearrange to make x the subject of the expression:

(i) $y = \frac{x^3}{x^2} \times \frac{x^4}{4y}$ (4)

(ii) $y = \frac{x^2 \times z^3}{z^2} \div \frac{x^3 \times yz}{x^2}$ (4)

3. A function is given by the equation $y = 2.5x^2 + 1$.

- (a) Determine a table of data for the range $x = -2$ to $x = 2$ showing the method used. (4)

- (b) Sketch a graph of the data determined in Q3(a). (4)

- (c) From the graph estimate the value for x when $y = 5$. (2)

4. A, B, C and D are shown in Fig Q4. Determine the shortest distance between A and D. (8)

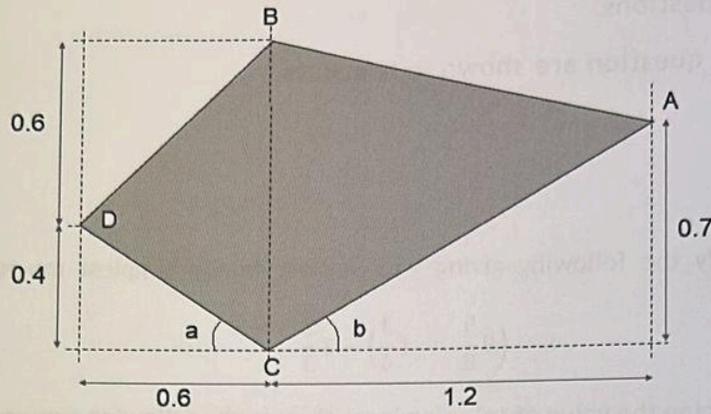


Fig Q4 (not to scale)

5. (a) Define the term scalene triangle. (2)
 (b) For the shape shown in Fig Q5 determine the angle MBD describing your reasoning. (6)

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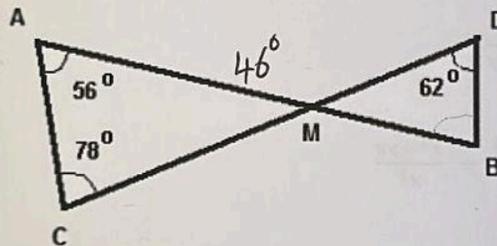


Fig Q5

6. A cone is to be cast from aluminium with base diameter of 80 mm and a height of 7 cm. Cubes of aluminium, 1 cm^3 are available to make the casting.

Aluminium has a density of 2.6 tonnes/m^3 .

- (a) Determine the minimum number of cubes that will be needed to make the cone. (5)
 (b) Determine the mass of the cone. (3)

Section B

7. A vehicle starts from rest and accelerates with constant acceleration of 1.5 m/s^2 to a speed of 7.0 m/s . It then travels at 7 m/s for 25 seconds after which it is retarded to a speed of 1 m/s . if the complete motion takes 44.5 seconds:
- (a) Sketch the velocity/time diagram. (2)
 - (b) Determine EACH of the following:
 - (i) the time taken to reach 7 m/s ; (3)
 - (ii) the retardation (Deceleration); (3)
 - (iii) the total distance travelled. (2)
8. The beam loaded as shown in FIG Q8 has a uniform cross section and a total mass of 200 kg . Determine the mass, M , required to balance the beam on the fulcrum, F . (8)

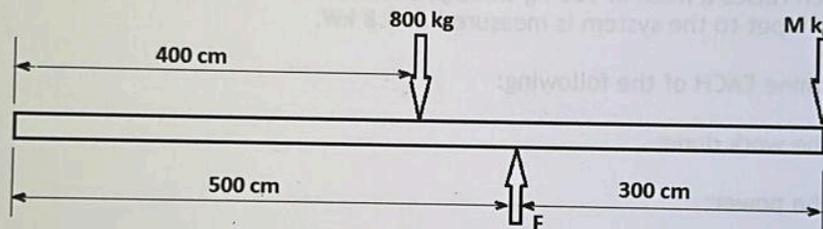


FIG Q8 (not to scale)

9. A worm and wheel gear has an overall efficiency of 82%. The worm has a single start thread and carries an effort pulley with a diameter, $d = 40 \text{ mm}$. The wheel has 160 teeth and a load pulley of diameter, $D = 150 \text{ mm}$.
- (a) Sketch the arrangement described. (2)
 - (b) Determine EACH of the following:
 - (i) the velocity ratio; (2)
 - (ii) the force ratio; (2)
 - (iii) the effort required to lift a load of 1000 kg . (2)

10. A stationary object with a mass of 25 kg has a force of 140 N applied to it which causes acceleration in a horizontal plane. The coefficient of friction between the body and the plane is 0.35.

Determine EACH of the following:

- (a) the acceleration of the body; (4)
(b) the distance the body will travel from rest in 6 seconds. (4)

11. A steel sheet 3 mm thick requires a round hole, 40 mm diameter, to be punched through it. If the metal has a shear strength of 180 MPa.

Determine EACH of the following:

- (a) the minimum force required to punch the hole; (4)
(b) the maximum compressive stress on the punch during this process. (4)

12. A winch raises a mass of 920 kg through a distance of 9.6 m in 45 seconds. The power input to the system is measured at 3.8 kW.

Determine EACH of the following:

- (a) the work done; (3)
(b) the power; (3)
(c) the system efficiency. (2)