



UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
JULY 2025 SEMESTER SESSION

SUBJECT CODE : LMB11902

SUBJECT TITLE : STATICS

PROGRAMME NAME : BACHELOR OF MARINE ENGINEERING
(FOR MPU: PROGRAMME LEVEL) TECHNOLOGY WITH HONOURS

TIME / DURATION : 9.00 AM - 12.00 PM
(3 HOURS)

DATE : 22 DECEMBER 2025

INSTRUCTIONS TO CANDIDATES

1. Please read **CAREFULLY** the instructions given in the question paper.
 2. This question paper has information printed on both sides of the paper.
 3. This question paper consists of **TWO (2)** sections; Section A and Section B.
 4. Answer **ALL** question in Section A, and **THREE (3)** questions **ONLY** in Section B.
 5. Please write your answers on this answer booklet provided.
 6. Answer **ALL** questions in English language **ONLY**.
 7. Formula has been appended for your reference.
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THERE ARE 12 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

With reference to the equilibrium of particles:

(a) The crate has a weight of 550 N.

- i. Draw Free body diagram and

(3 marks)

- ii. Determines the force in each supporting cable (AB and AC) as shown in Figure 1(a).

(7 marks)

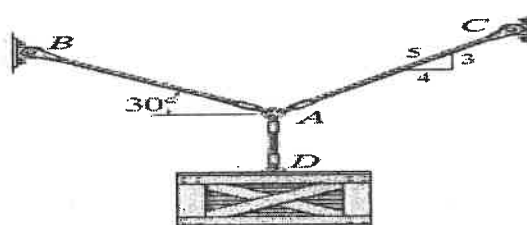


Figure 1(a)

(b) The beam as shown in Figure 1(b) has a weight of 700 lb.

- i. Draw Free body diagram and

(3 marks)

- ii. determines the shortest cable ABC that can be used to lift it if the maximum force the cable can sustain is 1500 N.

(7 marks)

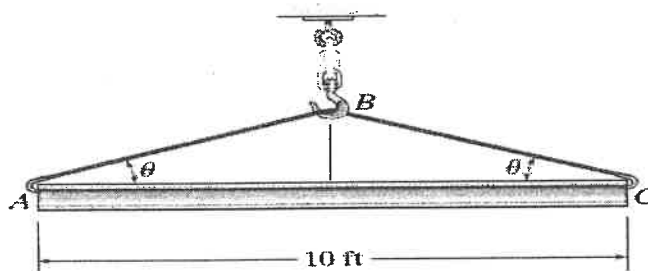


Figure 1(b)

Question 2

With reference to the equilibrium of a rigid body:

(a) As shown in Figure 2(a), a horizontal beam is supported by a pin at A (left end) and a roller at B (located 10 ft from A). A 500 lb force acts at a point 5 ft from A, inclined according to the 3-4-5 triangle (i.e., with horizontal and vertical components). At the right end of the beam (15 ft from A), a clockwise couple moment of 600 lb·ft is applied. Neglect the thickness of the beam.

- i. Draw a clear free-body diagram (FBD) of the beam, showing: Support reactions (A_x , A_y at A and B_y at B), The resolved components of the 500 lb force (use the 3-4-5 ratio), The applied 600 lb·ft clockwise moment and all distances.

(4 marks)

- ii. Determine the horizontal and vertical reaction components at the supports (A_x , A_y , B_y) by using the equations of equilibrium.

(6 marks)

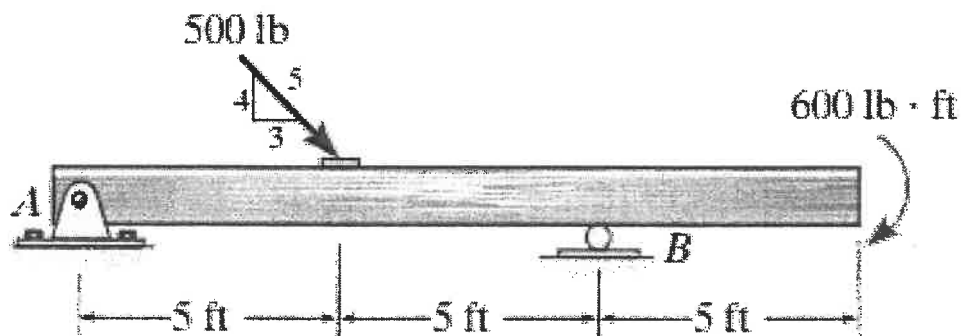


Figure 2(a)

(b) A horizontal beam AB is pinned at A and connected at C to a slender link CD. Point C is at midspan, $AC = 1.5\text{ m}$ and $CB = 1.5\text{ m}$. A 4 kN vertical downward load acts at B.

- i. Draw clear Free-Body Diagrams (FBDs) for: the beam AB (show A_x , A_y at A the interaction force at C and the 4 kN at B) and the link CD (treat it as a two-force member and show the force direction along the link).

(4 marks)

- ii. Determines the horizontal and vertical reaction components at A (A_x , A_y) and the reaction on the beam at C (F_{CD}), (give its components and magnitude) by using the equations of equilibrium.

(6 marks)

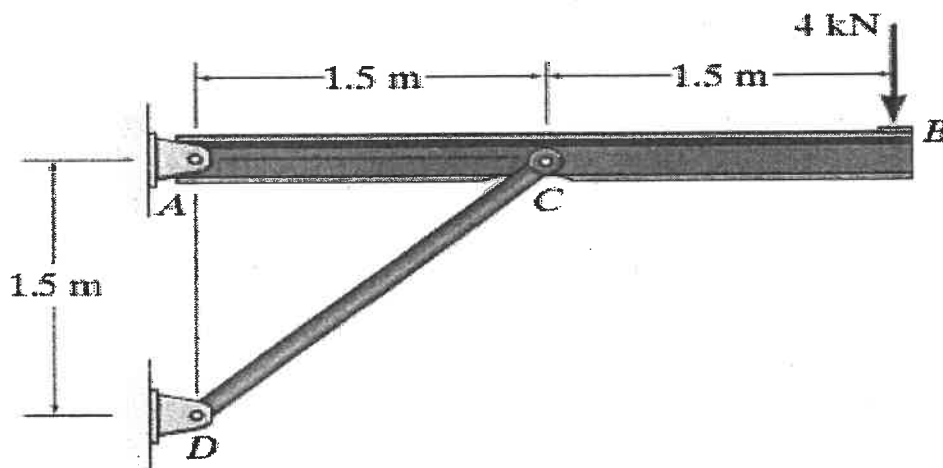


Figure 2(b)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer only THREE (3) questions.

Please use the answer booklet provided.

Question 3

With reference to structural analysis:

The Figure 3 below shows a simple triangular truss subjected to a horizontal load at the top joint.

- (a) Draw the free-body diagram (FBD) of the whole truss and determine the support reactions at A and C.

(4 marks)

- (b) Determine the forces in members AD and DC by using the method of joints, starting at joint D.

(12 marks)

- (c) State whether each member is in tension or compression.

(4 marks)

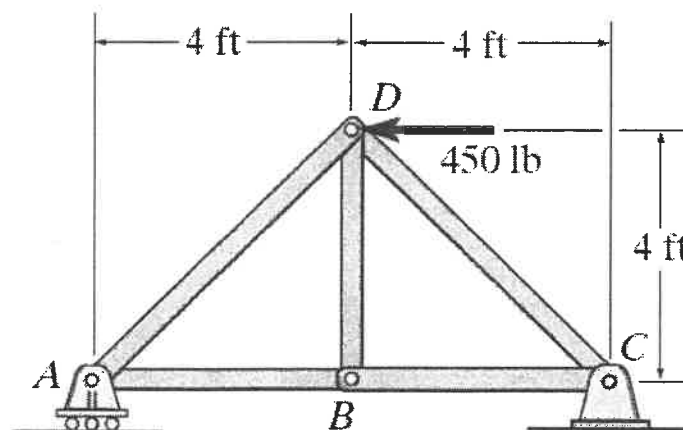


Figure 3

Question 4

With reference to the center of gravity and centroid:

A wire is bent into the shape shown in Figure 4, consisting of three straight segments lying in three perpendicular planes. The wire has uniform cross-section and density.

- (a) Sketch a clear 3D diagram showing all three wire segments and label their coordinates with respect to the origin. (4 marks)

- (b) Determine the length and centroid coordinates of each segment with respect to the reference axes. (6 marks)

- (c) Determine the centroid $(\bar{x}, \bar{y}, \bar{z})$ of the wire by using the centroid formula. (10 marks)

$$\bar{x} = \frac{\sum x_i L_i}{\sum L_i}, \quad \bar{y} = \frac{\sum y_i L_i}{\sum L_i}, \quad \bar{z} = \frac{\sum z_i L_i}{\sum L_i}$$

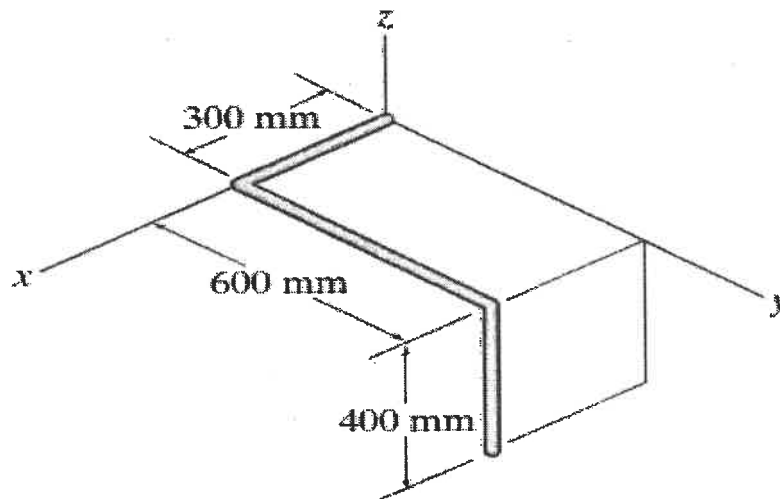


Figure 4

Question 5

With reference to internal forces:

A simply supported beam AB as shown in Figure 5 has a total span of 6.0 m. A 10 kN vertical downward load acts 1.5 m from the left support (A), and a 15 kN vertical downward load acts 1.5 m from the right support (B). Point C is located at the midpoint of the beam (3.0 m from A).

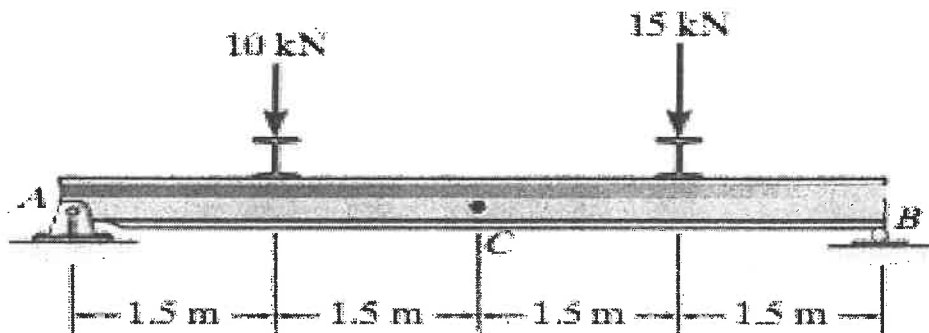


Figure 5

- (a) Draw the Free-Body Diagram (FBD) of the beam showing all applied loads, dimensions and the unknown reaction forces at the supports A and B. (4 Marks)
- (b) Determine the reactions at A_y and B_y by using equilibrium equations. (6 marks)
- (c) Determine the normal force, shear force and moment force at point C of the beam structure in Figure 5. (10 marks)

Question 6

With reference to internal force:

A solid shaft ABC is supported by a thrust bearing at A and a journal bearing at C. The shaft is loaded with a vertically concentrated load of 5 kN acting downward at point B, as shown in Figure 6. The distance between the supports is 4 m, with B located at the midpoint (2 m from A and 2 m from C).

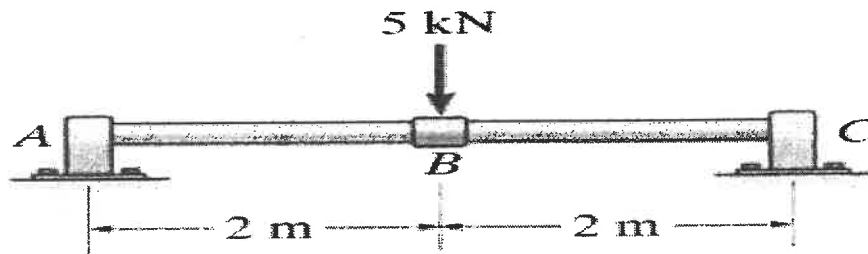


Figure 6

- Draw a Free-Body Diagram (FBD) of the shaft showing all reaction forces at A and C and the applied 5 kN load at B.
(4 marks)
- Determine the reaction forces at supports A and C by using equilibrium equations.
(4 marks)
- Using your results at (b), construct the Shear Force Diagram (SFD) for the shaft. Clearly indicate the magnitudes and directions of shear forces at key points (A, B, and C).
(6 marks)
- Construct the Bending Moment Diagram (BMD) for the shaft, showing the maximum bending moment value and its location.
(6 marks)

END OF QUESTION PAPER

Appendix: List of formulae

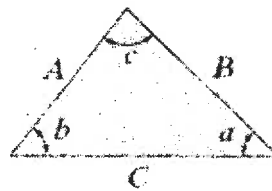
$$\bar{x} = \frac{\sum \tilde{x}A}{\sum A}$$

$$\bar{y} = \frac{\sum \tilde{y}A}{\sum A}$$

$$I = \sum (I + Ad^2)$$

$$k_{x'} = \sqrt{\frac{I_{x'}}{A}}$$

<p>Cosine law: $C^2 = A^2 + B^2 - 2AB \cos c$</p> <p>Sine law: $\frac{A}{\sin a} = \frac{B}{\sin b} = \frac{C}{\sin c}$</p>

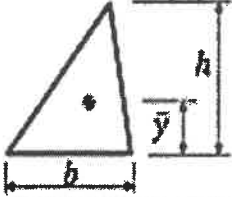
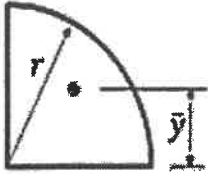
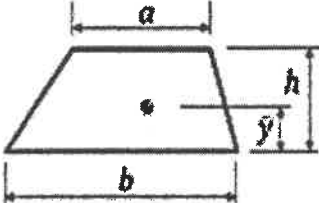


$$F_{Rx} = \sum F_x$$

$$F_{Ry} = \sum F_y$$

$$F_R = \sqrt{F_{Rx}^2 + F_{Ry}^2} \quad \text{and} \quad \theta = \tan^{-1} \left| \frac{F_{Ry}}{F_{Rx}} \right|$$

Semicircle		$I_x = I_y = \frac{1}{8} \pi r^4$ $J_O = \frac{1}{4} \pi r^4$
Quarter circle		$I_x = I_y = \frac{1}{16} \pi r^4$ $J_O = \frac{1}{8} \pi r^4$
Ellipse		$\bar{I}_x = \frac{1}{4} \pi a b^3$ $\bar{I}_y = \frac{1}{4} \pi a^3 b$ $J_O = \frac{1}{4} \pi a b (a^2 + b^2)$
Rectangle		$\bar{I}_{x'} = \frac{1}{12} b h^3$ $\bar{I}_{y'} = \frac{1}{12} b^3 h$ $I_x = \frac{1}{3} b h^3$ $I_y = \frac{1}{3} b^3 h$ $J_C = \frac{1}{12} b h (b^2 + h^2)$
Triangle		$\bar{I}_{x'} = \frac{1}{36} b h^3$ $I_x = \frac{1}{12} b h^3$
Circle		$\bar{I}_x = \bar{I}_y = \frac{1}{4} \pi r^4$ $J_O = \frac{1}{2} \pi r^4$

Shape	Area	Center of mass
	$\frac{bh}{2}$	$\bar{y} = \frac{h}{3}$
	$\frac{\pi r^2}{4}$	$\bar{y} = \frac{4r}{3\pi}$
	$\frac{1}{2}(a + b)h$	$\bar{y} = \frac{h}{3} \left(\frac{b + 2a}{b + a} \right)$

Shape	Drawing	\bar{x}	\bar{y}	Area
Rectangle		$b/2$	$h/2$	bh
Triangle		$b/3$	$h/3$	$bh/2$
Semicircle		0	$4r/3\pi$	$\pi r^2 / 2$
Quarter Circle		$4r/3\pi$	$4r/3\pi$	$\pi r^2 / 4$
Parabolic Segment		$5b/8$	$2h/5$	$2bh/3$
Complement of a Parabolic Segment		$3b/4$	$3h/10$	$bh/3$

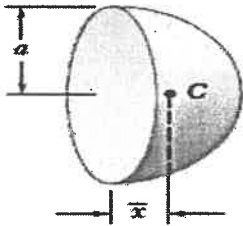
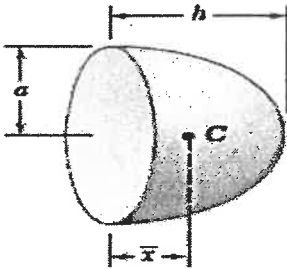
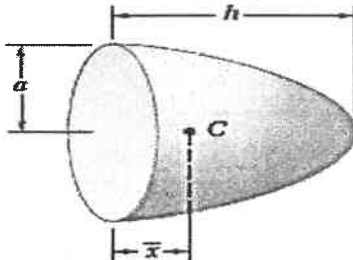
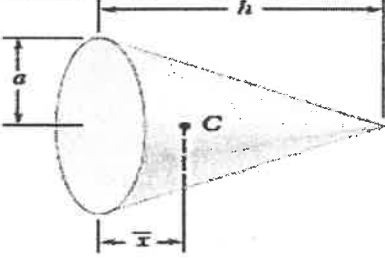
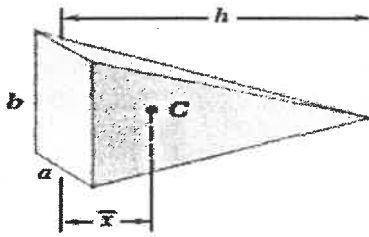
Shape		\bar{x}	Volume
Hemisphere		$\frac{3a}{8}$	$\frac{2}{3}\pi a^3$
Semiellipsoid of revolution		$\frac{3h}{8}$	$\frac{2}{3}\pi a^2 h$
Paraboloid of revolution		$\frac{h}{3}$	$\frac{1}{2}\pi a^2 h$
Cone		$\frac{h}{4}$	$\frac{1}{3}\pi a^2 h$
Pyramid		$\frac{h}{4}$	$\frac{1}{3}abh$

Fig. 5.21 Centroids of common shapes and volumes.