# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2022/2023

COURSE NAME          :     STATICS

COURSE CODE          :     BDA 10203

PROGRAMME CODE   :     BDD

EXAMINATION DATE   :     JULY / AUGUST 2023

DURATION                 :     3 HOURS

INSTRUCTIONS          1.   ANSWER **THREE (3)** QUESTIONS IN **PART A** AND **ALL** QUESTIONS IN **PART B**
                                 2.   THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**
                                 3.   STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

**PART A : ANSWER THREE (3) QUESTIONS.**

**Q1**    (a)    State Newton's three laws of motion.

(3 marks)

        (b)    What is different between scalar quantity and vector quantity. Give example for each quantity.

(4 marks)

        (c)    Two forces as shown in **Figure Q1 (c)** 500 N and 780N and tension in BC = 725 N. Determine the resultant of the three (3) forces at B.

(13 marks)

**Q2**    A force F with a magnitude of 100 N is applied at the origin O of the axes x-y-z as shown in **Figure Q2**. The line of action of F passes through a point A whose coordinates are 3 m, 4 m, and 5 m. Determine

        (a)    the x, y, and z scalar components of F,

(7 marks)

        (b)    the projection $F_{xy}$ of F on the x-y plane,

(7 marks)

        (c)    the projection $F_{OB}$ of F along the line OB.

(6 marks)

**Q3**    (a)    Calculate the moment of 1500 N force as shown in **Figure Q3 (a)** about points A and B.

(12 marks)

        (b)    The magnitude of the couple force applied to each wrench are F = {15 k}N and −F = {− 15 k}N as shown in **Figure Q3 (b).** Determine the magnitude of the couple moment acting on the pipe assembly using Cartesian vector notation.

(8 marks)

**Q4**    (a)    Sketch **two (2)** type of truss which a framework composed of members joined at their ends to form a rigid structure.

(4 marks)

        (b)    Determine the force in members GE, GC, and BC of the truss shown in **Figure Q4 (b)**. Indicate whether the members are in tension or compression.

(16 marks)

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**PART B :** ANSWER ALL QUESTIONS.

Q5   Sheet metal as shown in **Figure Q5** is uniform thickness.

(a)   Locate the x coordinate of the center of gravity.

(8 marks)

(b)   Locate the y coordinate of the center of gravity.

(6 marks)

(c)   Locate the z coordinate of the center of gravity.

(6 marks)

Q6   The uniform 10 kg ladder as shown in **Figure Q6** rests against the smooth wall at B, and the end A rests on the rough horizontal plane for which the coefficient of static friction is $\mu s = 0.3$. Determine

(a)   the angle of inclination $\theta$ of the ladder.

(10 marks)

(b)   the normal reaction at B if the ladder is on the verge of slipping.

(10 marks)

- END OF QUESTIONS -

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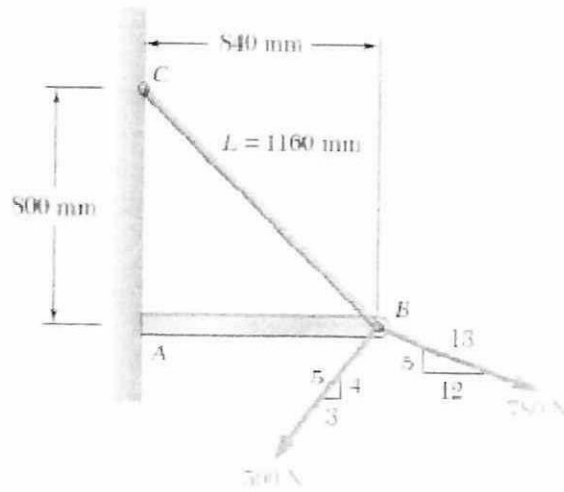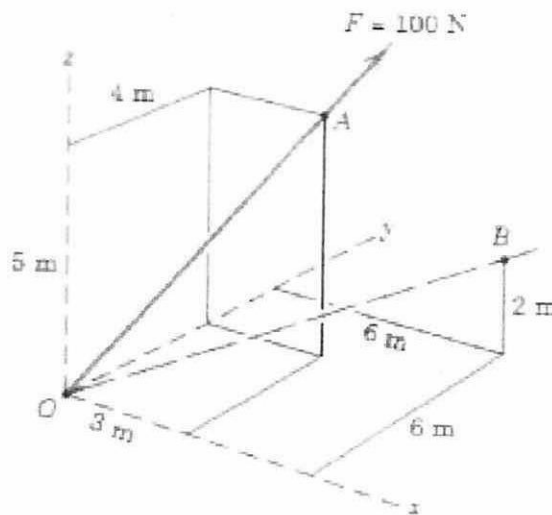
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**Figure Q1 (c)**
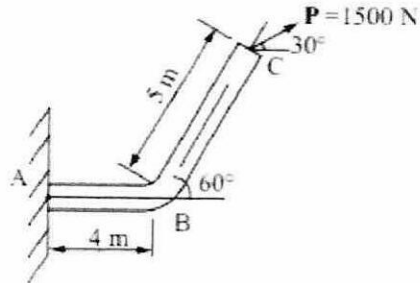


**Figure Q2**

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**Figure Q3 (a)**



**Figure Q3 (b)**
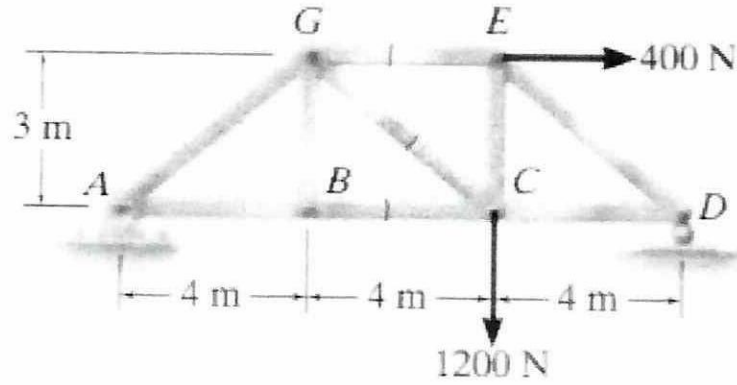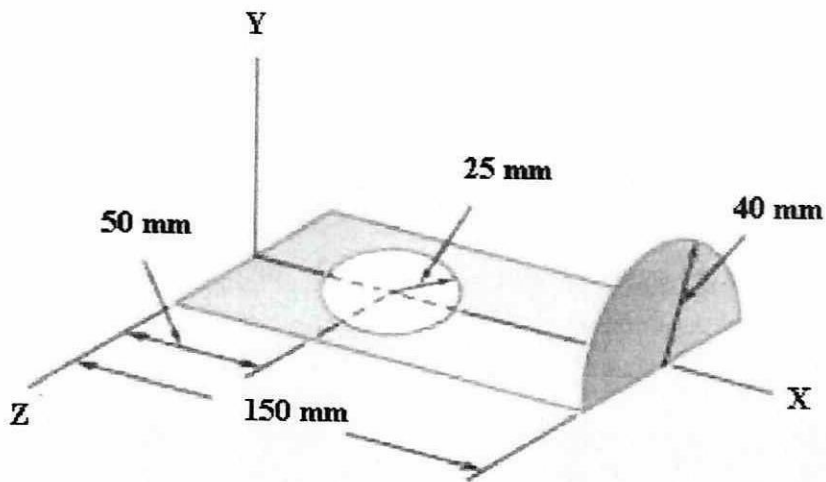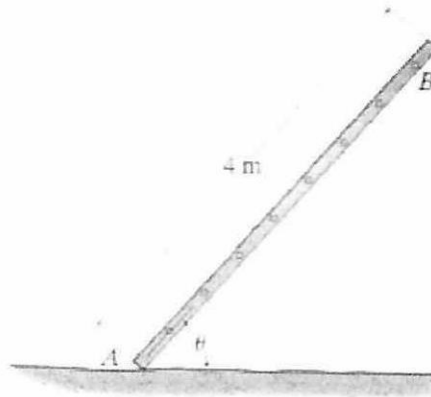
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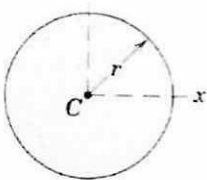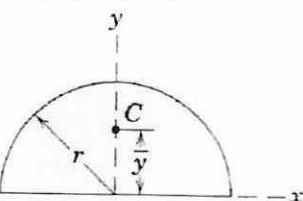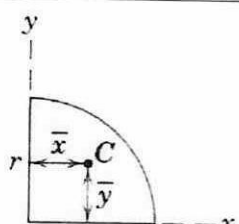| SEMESTER/SESSION | : SEM II/ 2022/2023 | PROGRAMME CODE | : BDD |
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**Figure Q4 (b)**



**Figure Q5**

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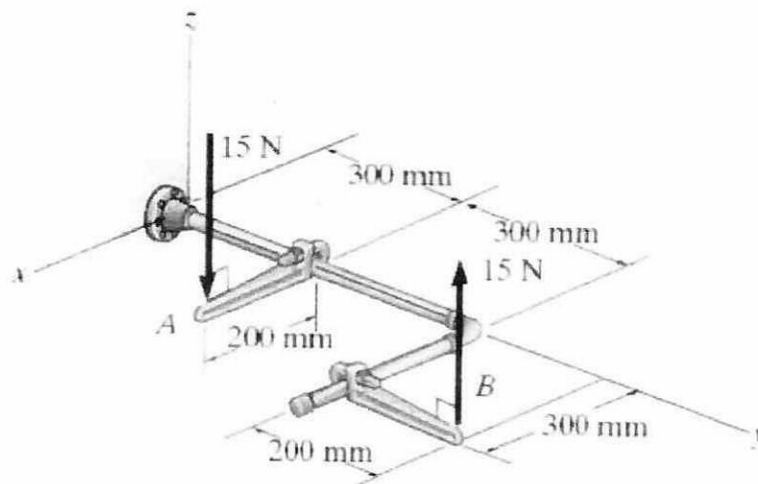
**Figure Q6**

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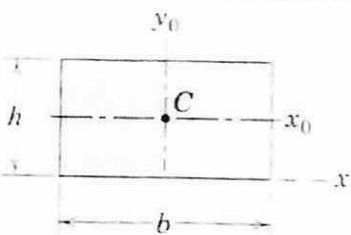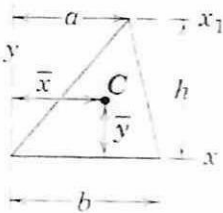
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## CENTROIDS OF COMMON SHAPES OF AREAS :

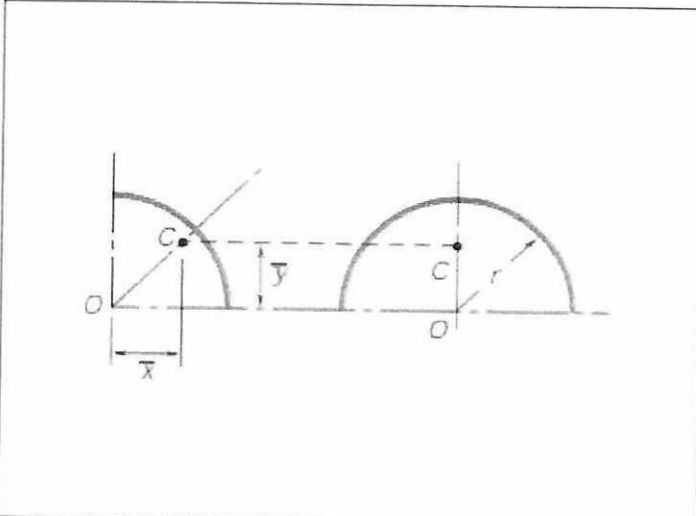| Figure | Centroid | Area Moments of Inertia |
|---|---|---|
| Circular Area | — | $I_x = I_y = \dfrac{\pi r^4}{4}$<br><br>$I_z = \dfrac{\pi r^4}{2}$ |
| Semicircular Area | $\bar{y} = \dfrac{4r}{3\pi}$ | $I_x = I_y = \dfrac{\pi r^4}{8}$<br><br>$\bar{I}_x = \left(\dfrac{\pi}{8} - \dfrac{8}{9\pi}\right)r^4$<br><br>$I_z = \dfrac{\pi r^4}{4}$ |
| Quarter-Circular Area | $\bar{x} = \bar{y} = \dfrac{4r}{3\pi}$ | $I_x = I_y = \dfrac{\pi r^4}{16}$<br><br>$\bar{I}_x = \bar{I}_y = \left(\dfrac{\pi}{16} - \dfrac{4}{9\pi}\right)r^4$<br><br>$I_z = \dfrac{\pi r^4}{8}$ |
| Rectangular Area | — | $I_x = \dfrac{bh^3}{3}$<br><br>$\bar{I}_x = \dfrac{bh^3}{12}$<br><br>$\bar{I}_z = \dfrac{bh}{12}\left(b^2 + h^2\right)$ |
| Triangular Area | $\bar{x} = \dfrac{a+b}{3}$<br><br>$\bar{y} = \dfrac{h}{3}$ | $I_x = \dfrac{bh^3}{12}$<br><br>$\bar{I}_x = \dfrac{bh^3}{36}$<br><br>$I_{x1} = \dfrac{bh^3}{4}$ |

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## CENTROIDS OF COMMON SHAPES OF LINES:
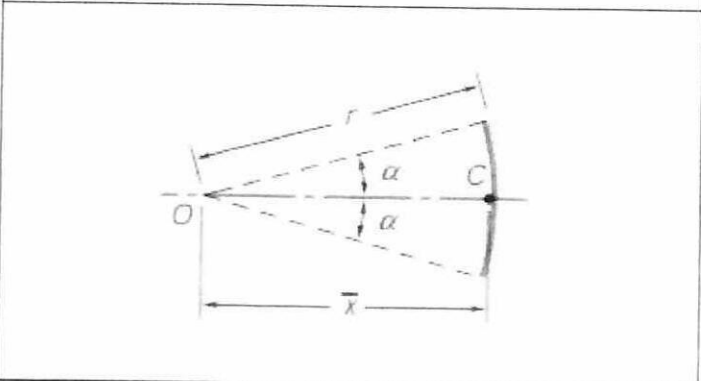


Quarter-circular arc:

$$\bar{x} = \bar{y} = \frac{2r}{\pi}$$

$$Length = \frac{\pi r}{2}$$

Semicircular arc:

$$\bar{x} = 0 , \bar{y} = \frac{2r}{\pi}$$

$$Length = \pi r$$



Arc of circle:

$$\bar{x} = \frac{r\sin\alpha}{\alpha}$$

$$\bar{y} = 0$$

$$Length = 2\alpha r$$