Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION

(ONLINE)

SEMESTER II

SESSION 2019 / 2020

COURSE NAME	:	STATICS
COURCE CODE	:	BDA 10203
PROGRAMME	:	BDD
EXAMINATION DATE	:	JULY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	PART A: ANSWER **THREE (3)** QUESTIONS **ONLY** PART B: ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

PART A (OPTIONAL): Answer **THREE (3)** questions **ONLY**.

Q1. (a) Define Newton's First and Third law.

(4 marks)

(b) Represent each of the following to three significant figures and express each answer in SI units using an appropriate prefix. Given that $MN = 10^6$ N, $\mu g = 10^{-6}$ g, $kN = 10^3$ N.

(i) X = 45320 kN

(ii) Y = 568 x 105 mm

(iii) Z = 0.00563 mg

(3 marks)

(c) The two forces F_1 and F_2 act on a bracket as shown in **Figure Q1(c)**. Determine the magnitude of the resultant force $F_R = F_1 + F_2$ and its direction, measured counter clockwise from the positive u axis by using trigonometry approach.

(7 marks)

(d) A force is specified by the vector **F** =120**i** + 160**j** - 80**k** N. Calculate the angles made by F with the positive x, y, and z-axes.

(6 marks)

Q2. (a) Given that the ratio of lift force (L) to the drag force (D) for a simple airfoil is L/D=10. If the lift force on the short length section is 500 N, compute:

(i) the magnitude of resultant force **R** and

(ii) the angle **θ** which it makes with the horizontal line.

(4 marks)

(b) Cable AB passes over the small ideal pulley C without a change in its tension.

(i) What length of cable CD is required for static equilibrium in the position shown?

(12 marks)

(ii) What is the tension T in cable CD?

(2 marks)

(iii) If pulley at C is replaced with O ring, is the tension CA and CB will be the same?

(2 marks)

Q3. The slab is to be hoisted using the three slings as shown in **Figure Q3**. The force F_1 is vertical.

(a) Express all forces in Cartesian vector notation.

(5 marks)

(b) Determine the magnitude of the resultant force, F_R.

(4 marks)

(c) Determine the coordinate direction angle of the resultant force, F_R found in (b)

(6 marks)

(d) Determine the resultant moment, M_R about point O.

(5 marks)

Q4. (a) Briefly differentiate between trusses, frames and machines.

(3 marks)

(b) The truss supports a 100-kN load at J as shown in **Figure Q4 (b)**. The horizontal members are each 1 m in length. Determine the axial forces of member CD, DG and GH. State whether the members in tension or compression.

(9 marks)

(c) The frame shown in **Figure Q4 (c)** supports a 6-kN load at C. Determine the reactions on the frame at A and D and the axial force of member BE and CF.

(8 marks)

PART B (COMPULSORY): Answer **ALL** questions.

Q5. (a) Determine by direct integration the location (x_c,y_c) of the centroid of the triangular area shown in **Figure Q5 (a).**

(7 marks)

(b) **Figure Q5 (b)** shows a homogeneous thin plate. By using the Method of Composites, determine the location of the centroid of the plate.

(13 marks)

Q6. (a) Determine the range of values which the mass m_o may have so that the 100 kg block shown in the figure will neither start moving up the plane nor slip down the plane The coefficient of static friction for the contact surfaces is 0.30.

(10 marks)

(b) The horizontal position of the 500-kg rectangular block of concrete is adjusted by the 5 edge under the action of the force P. If the coefficient of static friction for both wedge surfaces is 0.30 and if the coefficient of static friction between the block and the horizontal surface is 0.60, determine the least force P required to move the block.

(10 marks)

-END OF QUESTION –

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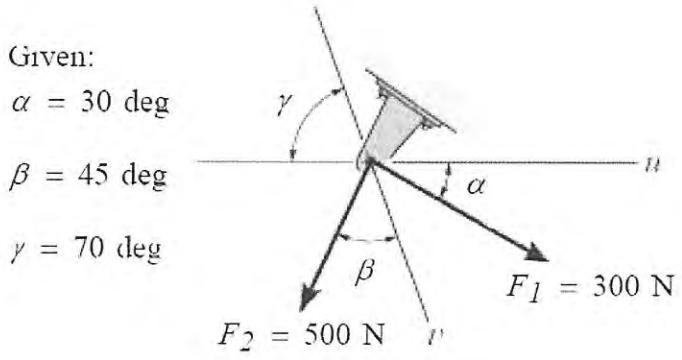

Figure Q1 (c)

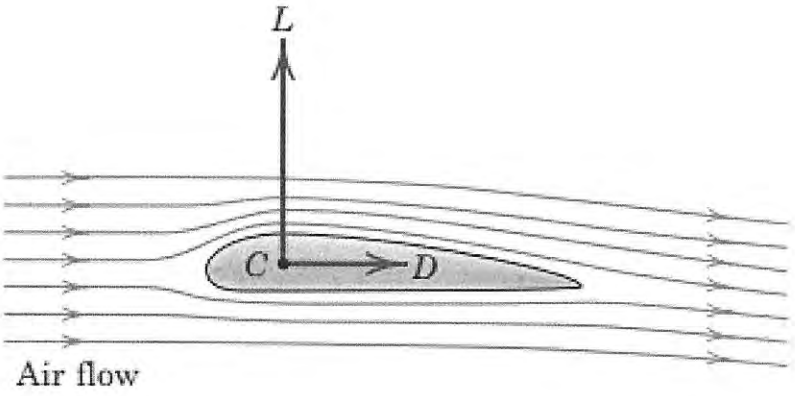

Figure Q2 (a)

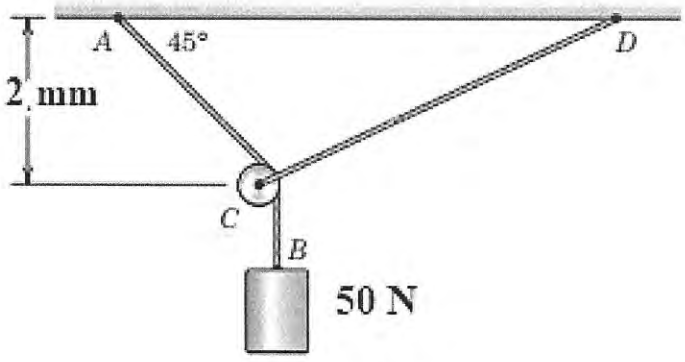

Figure Q2 (b)

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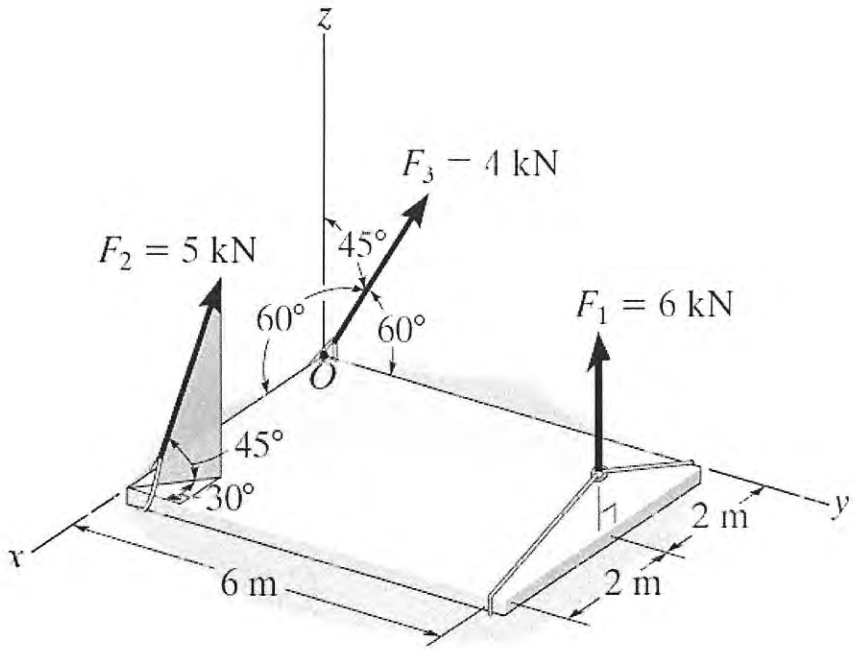

Figure Q3

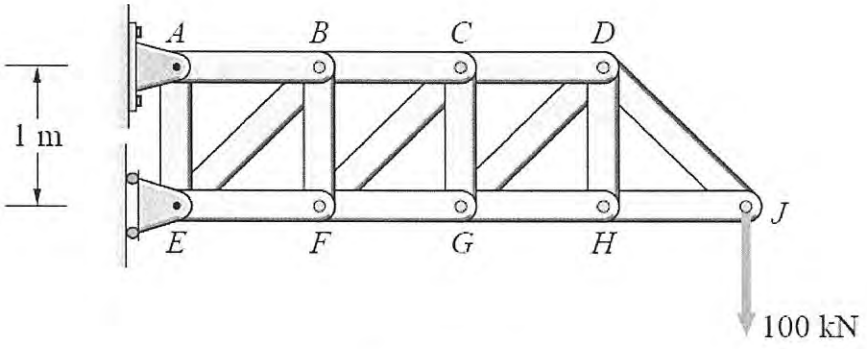

Figure Q4 (b)

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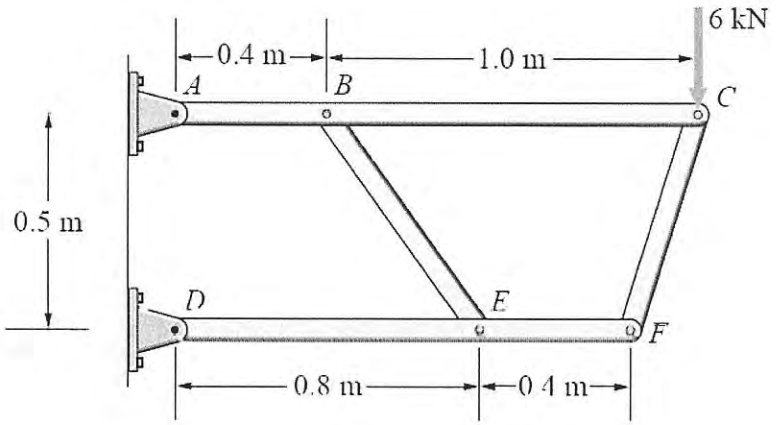

Figure Q4 (c)

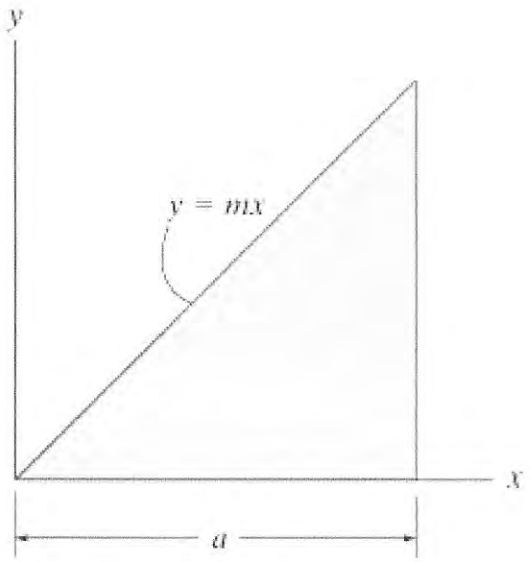

Figure Q5 (a)

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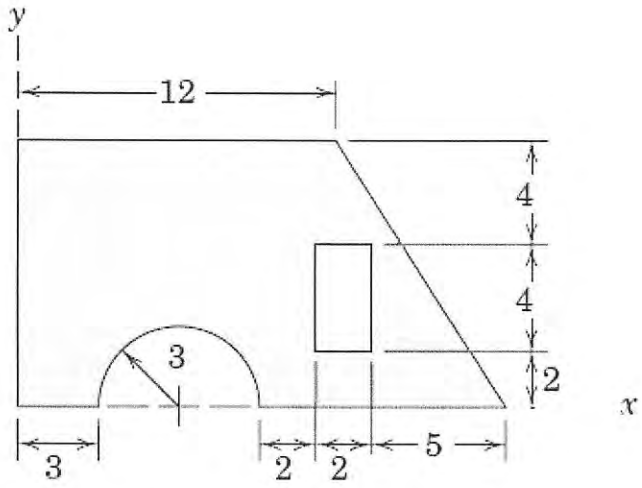

*the dimension unit is in meter

Figure Q5 (b)

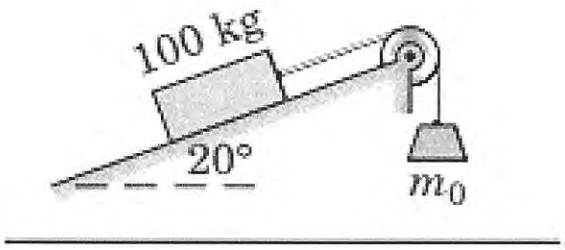

Figure Q6 (a)

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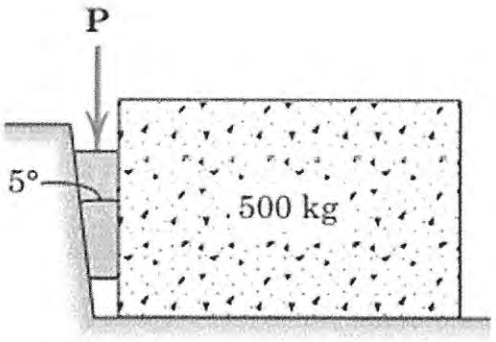

Figure Q6 (b)

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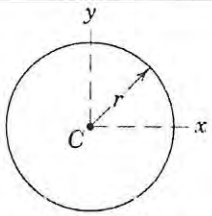
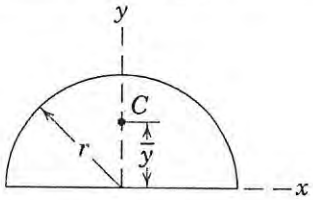
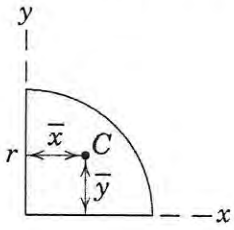
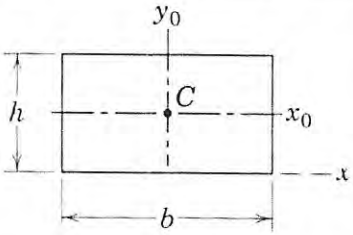
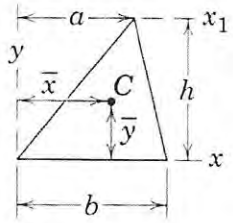
CENTROIDS OF COMMON SHAPES OF AREAS :

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

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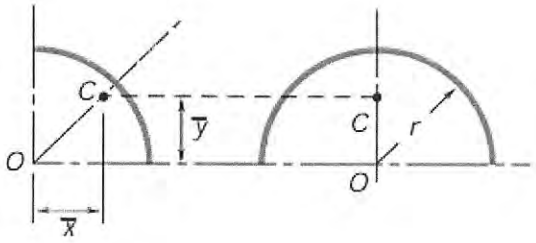
CENTROIDS OF COMMON SHAPES OF LINES:



Quarter-circular arc:

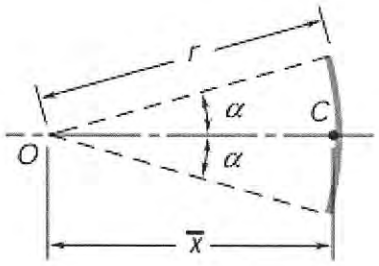
$$\bar{x} = \bar{y} = \frac{2r}{\pi}$$

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

Semicircular arc:

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

$$Length = \pi r$$

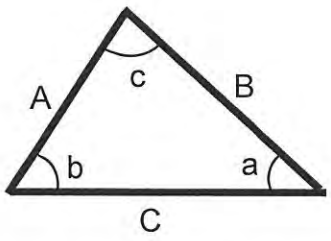


Arc of circle:

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

$$\bar{y} = 0$$

$$Length = 2\alpha r$$



$$\frac{A}{\sin a} = \frac{B}{\sin b} = \frac{C}{\sin c}$$

$$C = \sqrt{A^2 + B^2 - 2AB\cos c}$$