Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION

SEMESTER I

SESSION 2019 / 2020

COURSE NAME	:	STATICS
COURCE CODE	:	BDA 10203
PROGRAMME	:	BDD
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION :	:	PART A: ANSWER **THREE (3)** QUESTIONS **ONLY**
		PART B: ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

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

Q1. (a) The old woman walk at speed of 2 kilometre per hour. What is her speed in term of meter per second? Convert her speed in feet per second if one feet is equal to 30.48 centimetre.

(6 marks)

(b) The pipe of mass 30 kg is supported at A by a system of five cords as shown in **Figure Q1 (b)**. Determine the force in each cord for equilibrium.

(14 marks)

Q2. (a) The force system acting on a structural member as shown in **Figure Q2 (a)** with forces F_1, F_2 and F_3. Determine the equivalent resultant force system with the force acting at point G. Use $F_1 = 100$ N, $F_2 = 90$ N and $F_3 = 120$ N.

(4 marks)

(b) 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 (b)**. The line of action of F passes through at point A whose coordinate are 3 m, 4 m and 5 m. Determine;

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

(4 marks)

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

(5 marks)

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

(7 marks)

Q3. The light right angle boom which supports the 400 kg cylinder as shown in **Figure Q3** is supported by three cables and a ball-and-socket joint at point *O* attached to the vertical *x-y* surface.

(a) Draw a free body diagram of all the forces acting on the right angle boom at point *A*, *B*, and *O*.

(1 mark)

(b) Determine the position vector of point *A*, *B*, *C*, *D* and *E*.

(5 marks)

(c) Find the force vector notation of all cables and reaction at point *O* in terms of T_{ac}, T_{bd}, T_{be}, F_{ox}, F_{oy} and F_{oz}.

(7 marks)

(d) Determine the reaction forces at point *O* and the cable tensions.

(7 marks)

Q4. (a) What are the differences between truss and frame?

(4 marks)

(b) Determine the force members *BC*, *FC*, and *FE* for the structure shown in **Figure Q4 (b)**, and state if the members are in tension or compression.

(8 marks)

(c) The hoist supports the engine of mass m =125 kg as shown in **Figure Q4 (c)**. Determine the force in member *DB* and in the hydraulic cylinder *H* of member *FB*.

(8 marks)

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

Q5. (a) Referring to Figure **Q5 (a)**,

(i) plan how you can obtain the centroid of the shape using composite methods,

(4 marks)

(ii) locate the centroid $(\bar{x}, \bar{y})$ of the composite area.

Given a = 1.5 cm, b = 8 cm, c = d = 4 cm.

(6 marks)

(b) **Figure Q5 (b)** demonstrates a common streetlight. By neglecting the thickness of each segment, determine the center of gravity G (x_c, y_c) of the streetlight. The mass per unit length of each segment is as follows:

$\rho_{AB} = 12\,\text{kg/m}, \rho_{BC} = 8\,\text{kg/m}$, $\rho_{CD} = 5\,\text{kg/m}$ and $\rho_{DE} = 2\,\text{kg/m}$

(10 marks)

Q6. (a) The horizontal force, P = 400 N acts on a crate as shown in **Figure Q6 (a)**. The friction coefficients are μs = 0.3 and μ_k = 0.2. Given θ = 20°. Determine the normal and frictional forces acting on the crate of weight W = 1500 N.

(6 marks)

(b) Column D is subjected to a vertical load W = 40 N as shown in **Figure Q6 (b)**. It is supported on two identical wedges A and B for which the coefficient of static friction at the contacting surfaces between A and B and between B and C is μ_s. The contacting surface between A and D is smooth. μ_s = 0.4. Determine;

(i) the force P needed to raise the column, and

(11 marks)

(ii) the equilibrium force P' needed to hold wedge A stationary

(3 marks)

- END OF QUESTION –

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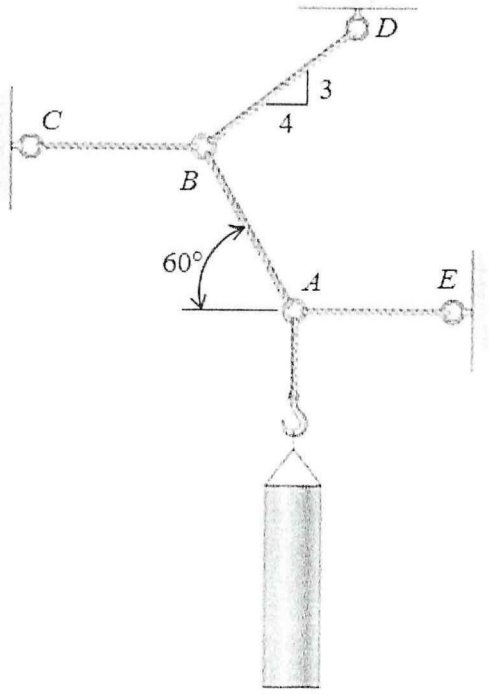

Figure Q1 (b)

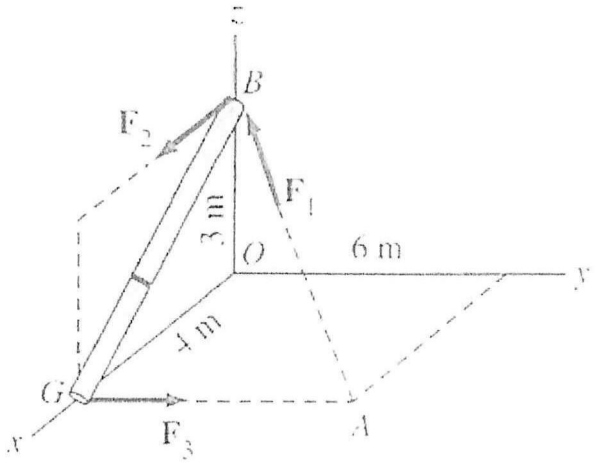

Figure Q2 (a)

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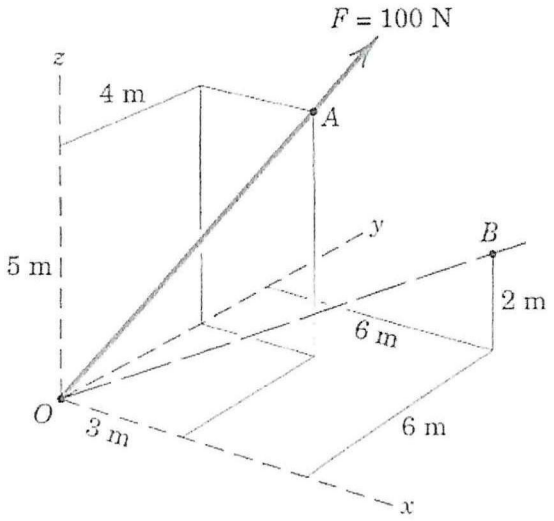
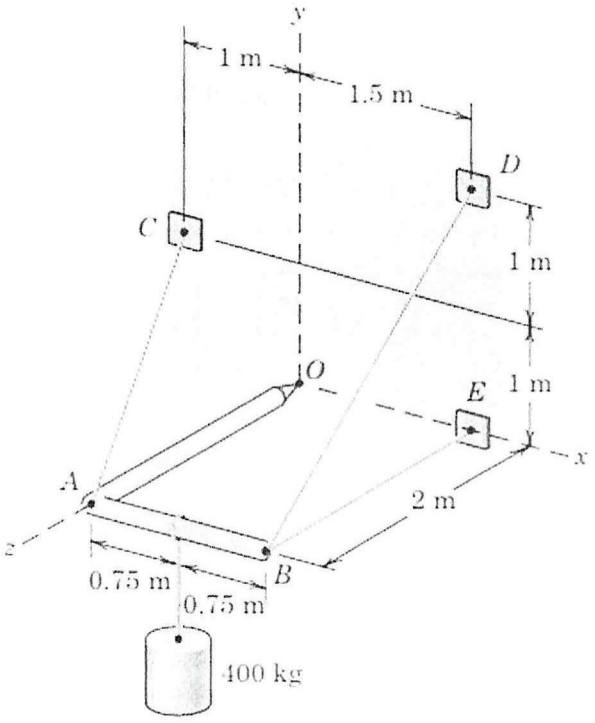


Figure Q2 (b)



*AB parallel to x-axis

Figure Q3

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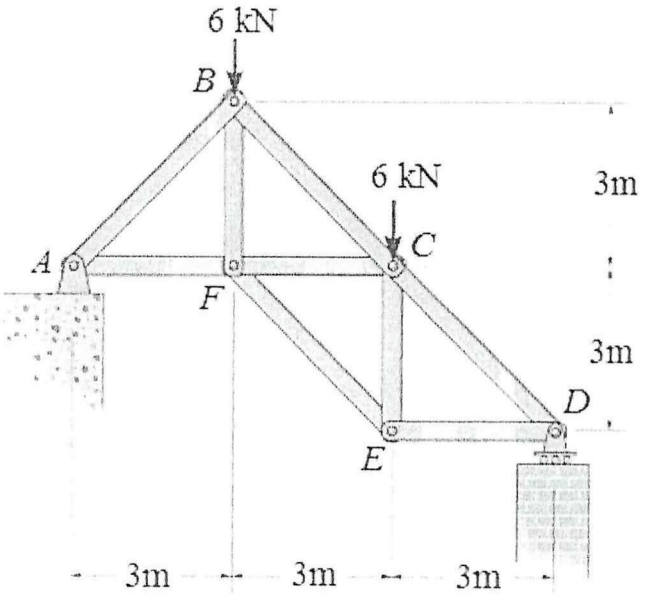

Figure Q4 (b)

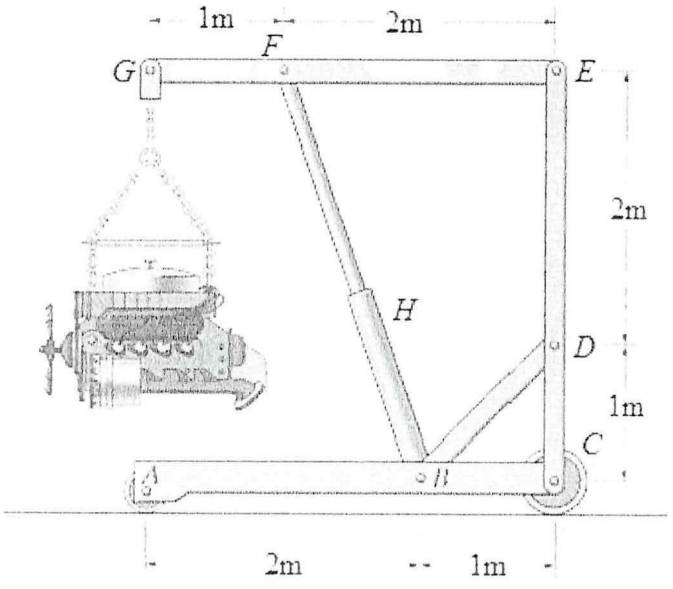

Figure Q4 (c)

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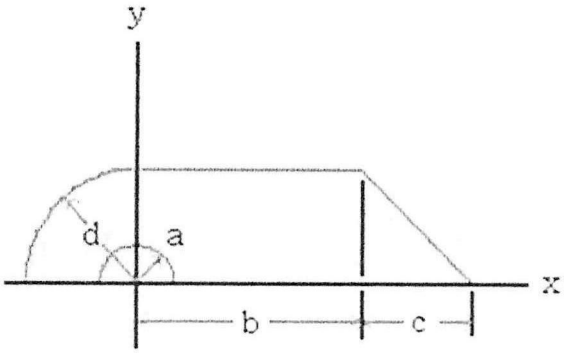

Figure Q5 (a)

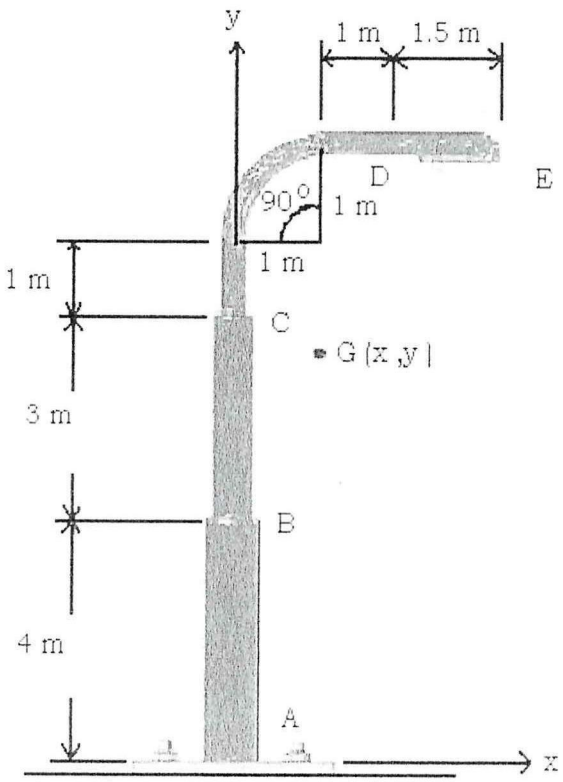

Figure Q5 (b)

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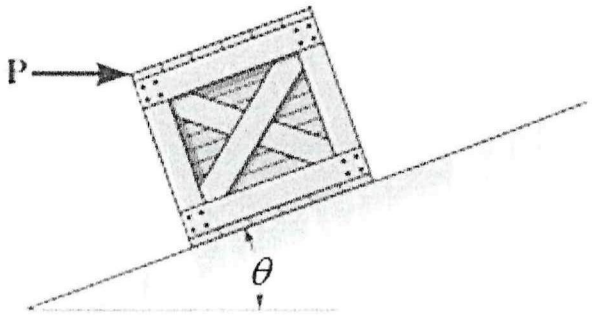

Figure Q6 (a)

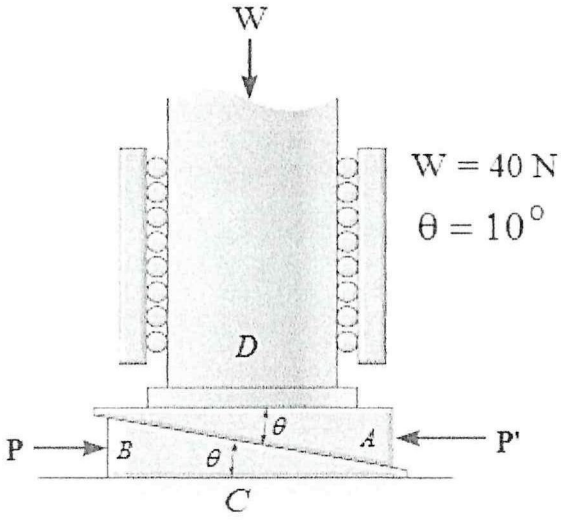

Figure Q6 (b)

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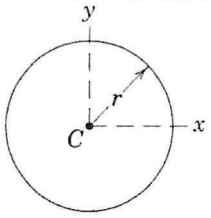
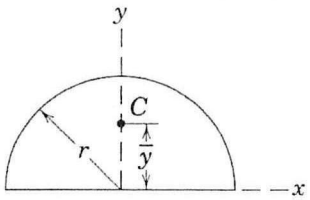
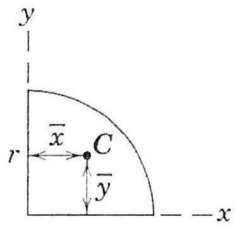
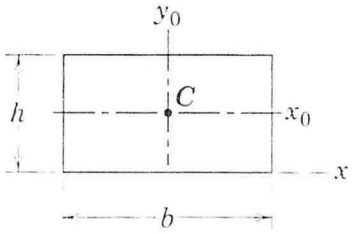
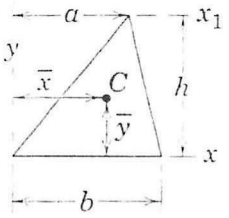
CENTROIDS OF COMMON SHAPES OF AREAS :

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	$\bar{x} = \frac{a+b}{3}$ $\bar{y} = \frac{h}{3}$	$I_x = \frac{bh^3}{12}$ $\bar{I}_x = \frac{bh^3}{36}$ $I_{x1} = \frac{bh^3}{4}$