Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	STATIC AND DYNAMIC
COURSE CODE	:	DAC 10503
PROGRAMME	:	DAA
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	**PART A**: ANWER **ALL** QUESTIONS **PART B**: ANSWER **TWO (2)** QUESTIONS **ONLY**

THIS QUESTION PAPER CONTAINS **ELEVEN (11)** PAGES

PART A

Q1 (a) Define each of the following term:

(i) Particle
(ii) Rigid Body
(iii) Scalar
(iv) Vector

(8 marks)

(b) Evaluate each of the folowing to three significant figures and express each answer in SI unit using an appropriate prefix;

(i) $\frac{(354mg)}{(0.0356kN)}(45km)$

(ii) $(0.00453Mg)(201ms)$

(4 marks)

(c) **Figure Q1(c)** shows a box lifted up using three different forces. The resultant force is directed vertically upward and has a magnitude of 800 N. Determine the followings;

(i) Magnitude of F1.

(8 marks)

(ii) Direction θ.

(5 marks)

Q2 (a) Define Couple Moment.

(2 marks)

(b) The 2225 N block shown in **Figure Q2(b)** is in contact with 45° incline. The coefficient of static friction is 0.25. Based on this information find the followings, calculate the value of the horizontal force P necessary to:

(i) Start the block up the incline.

(6 marks)

(ii) Prevent motion down the incline.

(6 marks)

(c) **Figure Q2(c)** shows a beam that holds several types of force. Based on the figure find the followings:

(i) Calculate reaction force at each support.

(6 marks)

(ii) Calculate moment at point C.

(5 marks)

PART B

Q3 (a) **Figure Q3(a)** shows a cross sectional area of a steel plate beam with a cut out area on top. Calculate the moment of inertia (**Ix**), of the cross sectional area with respect to the x-axis as shown in the figure.

(7 marks)

(b) Calculate the **x** and **y** coordinates of the centroid in the **Figure Q3(b)**.

(10 marks)

(c) Based on **Figure Q3(c)**:

(i) Draw its free body diagram.

(3 marks)

(ii) If the $\alpha = 40°$, calculate the magnitude of resultant force and its angle θ from a' axis.

(5 marks)

Q4 (a) Give an explanation to differentiate the meaning between Centroid and Centre of Gravity. Construct appropriate diagram to support the answer.

(3 marks)

(b) Calculate and determine the centroid of the composite area as shown in **Figure Q4(b)**.

(10 marks)

(c) The link shown in **Figure Q4(c)** is pin-connected at A and rests against a smooth surface at B.

(i) Draw its free body diagram.

(3 marks)

(ii) Compute the horizontal and vertical components of reaction at pin A.

(9 marks)

Q5 (a) Explain a difference between dynamics and kinematics.

(4 marks)

(b) Isaac Newton established the physical laws which govern dynamics in physics. His three laws described force as the ability to cause a mass to accelerate. One of his laws particularly related to dynamics. Classify the name and explain this law.

(6 marks)

(c) A person is in an elevator that moving upward at a constant velocity. The weight of the person is 800 N. Immediately the elevator rope is broken, so the elevator falls. Determine the normal force (in Newton unit) acted by elevator's floor to the person just before and after the elevator's rope broke by using Newton's First law.
(6 marks)

(d) Evaluate the following questions using Newton's Second law;

(i) A 1 kg object accelerated at a constant 5 m/s^2. Estimate the net force needed to accelerate the object.
(4 marks)

(ii) From **Figure Q5(d)**, the object's mass = 2 kg, F1 = 5 N, F2 = 3 N. Determine the magnitude and direction of the acceleration.
(5 marks)

- END OF QUESTIONS -

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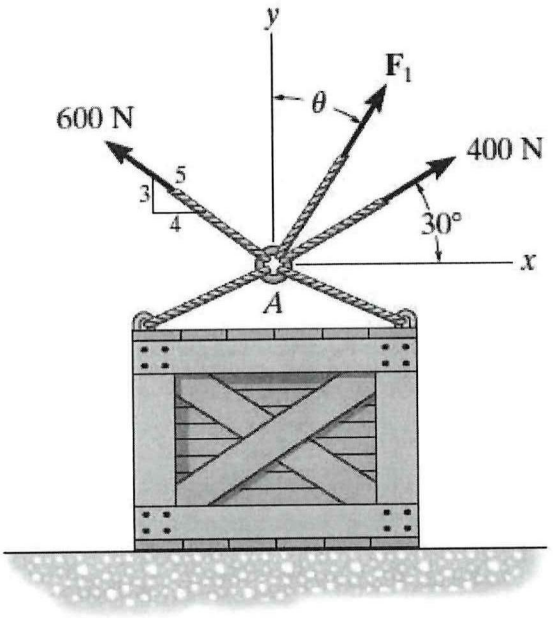

Figure Q1(c)

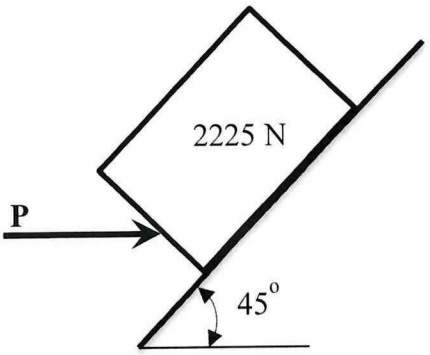

Figure Q2(b)

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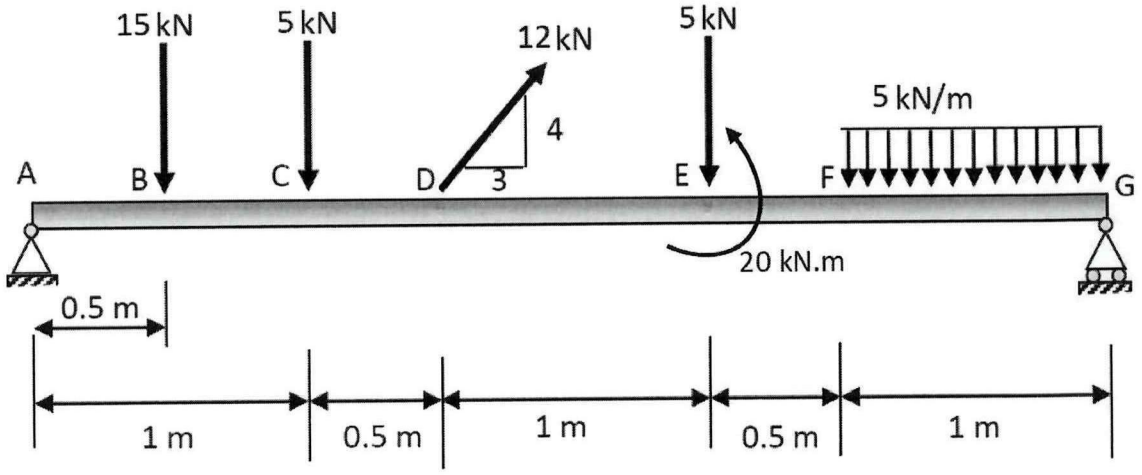

Figure Q2(c)

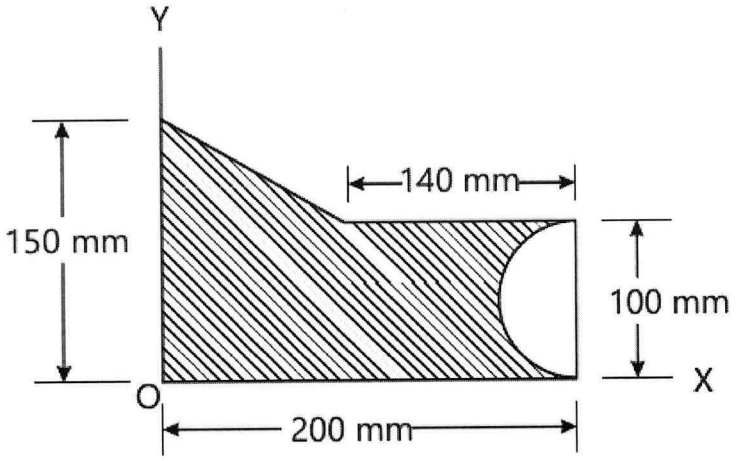

Figure Q3(a)

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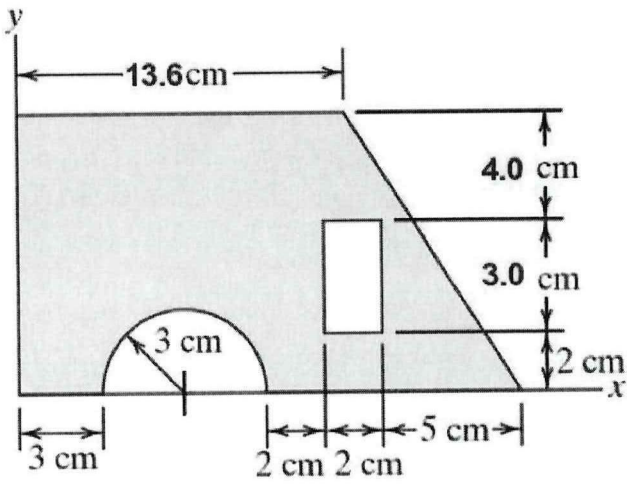

Figure Q3(b)

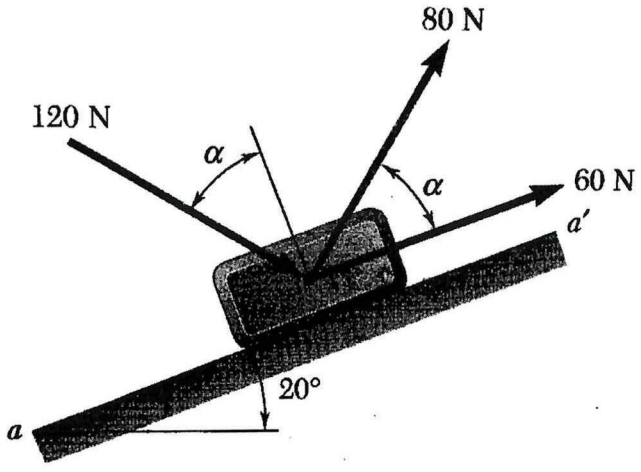

Figure Q3(c)

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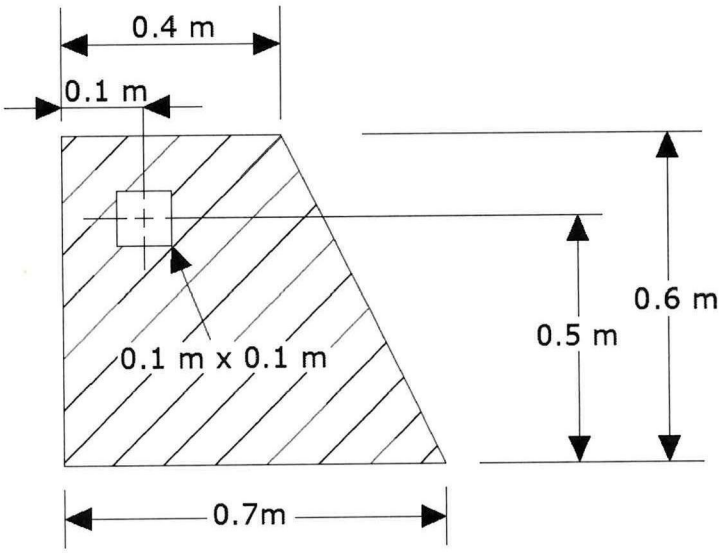

Figure Q4(b)

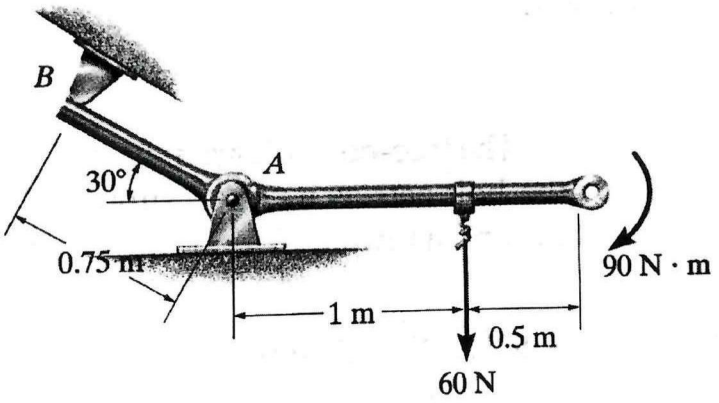

Figure Q4(c)

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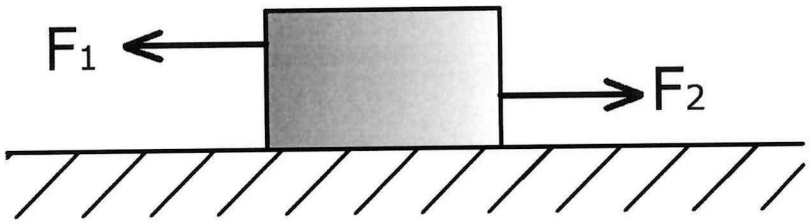

Figure Q5 (d)

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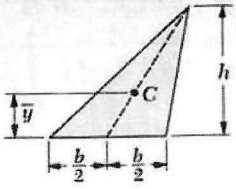
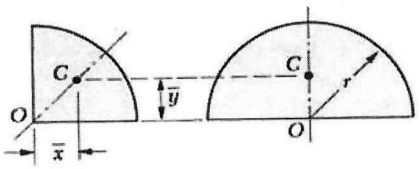
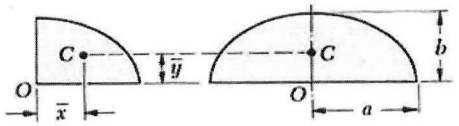
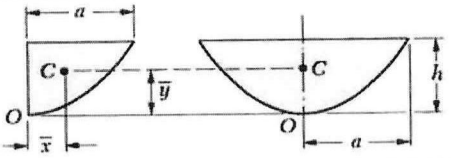
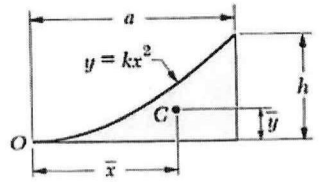
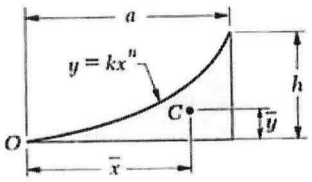
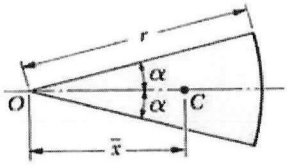
Appendix 1

Shape		$\bar{x}$	$\bar{y}$	Area
Triangular area			$\frac{h}{3}$	$\frac{bh}{2}$
Quarter-circular area		$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{4}$
Semicircular area		0	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{2}$
Quarter-elliptical area		$\frac{4a}{3\pi}$	$\frac{4b}{3\pi}$	$\frac{\pi ab}{4}$
Semielliptical area		0	$\frac{4b}{3\pi}$	$\frac{\pi ab}{2}$
Semiparabolic area		$\frac{3a}{8}$	$\frac{3h}{5}$	$\frac{2ah}{3}$
Parabolic area		0	$\frac{3h}{5}$	$\frac{4ah}{3}$
Parabolic spandrel		$\frac{3a}{4}$	$\frac{3h}{10}$	$\frac{ah}{3}$
General spandrel		$\frac{n+1}{n+2}a$	$\frac{n+1}{4n+2}h$	$\frac{ah}{n+1}$
Circular sector		$\frac{2r\sin\alpha}{3\alpha}$	0	αr^2

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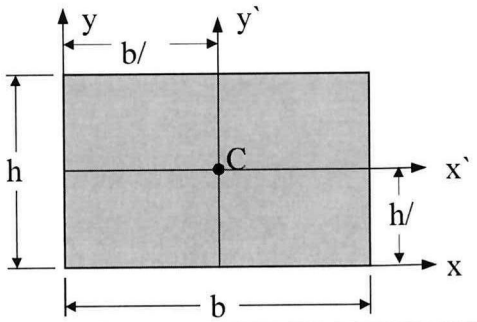
Appendix 2

Rectangle:

$$\bar{I}_{x'} = \frac{1}{12}bh^3 \qquad I_x = \frac{1}{3}bh^3$$

$$\bar{I}_{y'} = \frac{1}{12}b^3h \qquad I_y = \frac{1}{3}b^3h$$

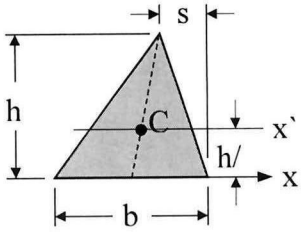
$$\bar{I}_{xy'} = 0 \qquad Area = bh$$



Triangle:

$$\bar{I}_{x'} = \frac{1}{36}bh^3 \qquad I_x = \frac{1}{12}bh^3$$

$$\bar{I}_{xy} = \frac{b(b-2s)h^2}{72} \qquad Area = \frac{1}{2}bh$$

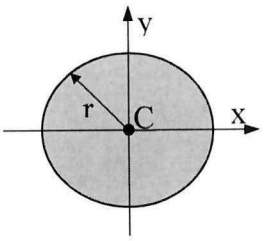


Circle:

$$\bar{I}_x = \bar{I}_y = \frac{1}{4}\pi r^4$$

$$\bar{I}_{xy'} = 0$$

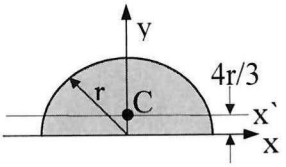
$$Area = \pi r^2$$



Semi-circle:

$$I_x = \bar{I}_y = \frac{1}{8}\pi r^4 \qquad \bar{I}_{x'} = \left(\frac{\pi}{8} - \frac{8}{9\pi}\right)r^4$$

$$\bar{I}_{xy'} = 0 \qquad Area = \frac{\pi r^2}{2}$$



Ellipse:

$$\bar{I}_x = \frac{1}{4}\pi ab^3 \qquad \bar{I}_y = \frac{1}{4}\pi a^3 b$$

$$\bar{I}_{xy'} = 0$$

$$Area = \pi ab$$