Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	STATIC AND DYNAMIC
COURSE CODE	:	DAC 10503
PROGRAMME CODE	:	DAA
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **TWO (2)** QUESTIONS FROM SECTION A & **TWO (2)** QUESTIONS FROM SECTION B

THIS QUESTION PAPER CONSISTS OF TWELVE **(12)** PAGES

Section A

Q1 (a) State the meaning of the following terms;
(i) Mechanics
(ii) Particle
(iii) Rigid body
(iv) Scalar
(v) Vector

(10 marks)

(b) Evaluate the following phrase and rewrite it in proper SI convention complete with prefix.
(i) 45320 kN

(ii) $568(10^5)$ mm

(iii) (28 ms)(0.0458 Mm) / (348 mg)

(iv) (684 μm) / (43 ms)

(4 marks)

(c) Based on **Figure Q1(c)**:
(i) Draw its free body diagram.

(3 marks)

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

(4 marks)

(iii) If the $\alpha=75°$, determine the magnitude of resultant force and its angle φ from a' axis.

(4 marks)

Q2 (a) Explain Force Couple with related figure.

(2 marks)

(b) Simply supported beam in **Figure Q2(b)** is subjected to distributed loads with moment and external loads. Determine the following;

(i) Draw the Free Body Diagram (FBD) for the analysis.

(3 marks)

(ii) Reaction forces at each support.

(10 marks)

(c) **Figure Q2(c)** shows two blocks are connected by a solid strut attached to each block with frictionless pins. If the coefficient of friction under each block is 0.25 and B weighs 2700 N, calculate the minimum weight of A to prevent motion.

(10 marks)

Q3 (a) **Figure Q3(a)** shows a piece of steel plate with composite shapes. Calculate the position of the area centroid with respect to the x axis and y axis for the shaded shape.

(15 marks)

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

(5 marks)

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

(5 marks)

Section B

Q4 (a) Based on the **Figure Q4(a-i, a-ii and a-iii)**, identify and explain the meaning for the number of unknowns for the following supports.

(9 marks)

(b) The link shown in **Figure Q4(b)** is pin-connected at A and rests against a smooth surface at B. Compute the horizontal and vertical components of reaction at pin A.

(6 marks)

(c) Based on the 8kg lamp is suspended in the position as shown in **Figure Q4(c)**;

(i) Draw its free body diagram.

(2 marks)

(ii) If the undeformed length of spring AB is 0.4m and its stiffness is 300 N/m, determine the required length of cord AC so that 8kg lamp is suspended in equilibrium position.

(8 marks)

Q5 (a) Give an explanation to differentiate the meaning between Centroid and Centre of Gravity. Construct appropriate diagram to support the answer.

(8 marks)

(b) Calculate and determine the centroid of the composite area as shown in **Figure Q5(b)**.

(10 marks)

(c) Find moment of inertia about the *x*-axis for the area as shown in **Figure Q5(c)**.

(7 marks)

Q6 (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 broke, 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 Q6(d),** the object's mass = 2 kg, F1 = 5 Newton, F2 = 3 Newton. Determine the magnitude and direction of the acceleration.

(5 marks)

-END OF QUESTIONS –

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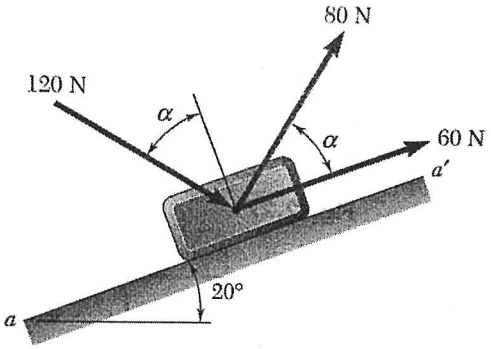

Figure Q1(c)

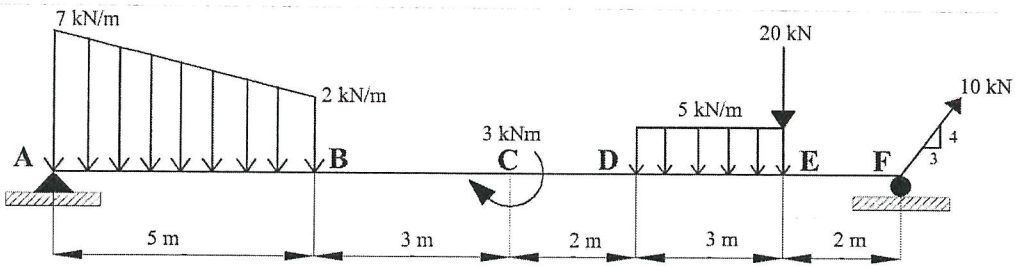

Figure Q2 (b)

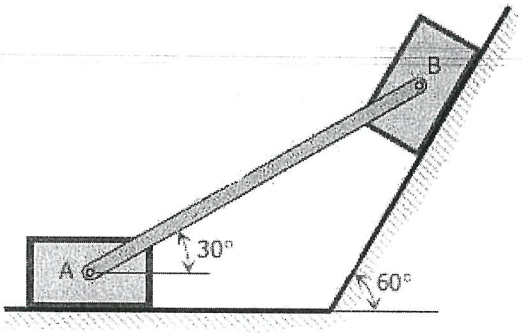

Figure Q2(c)

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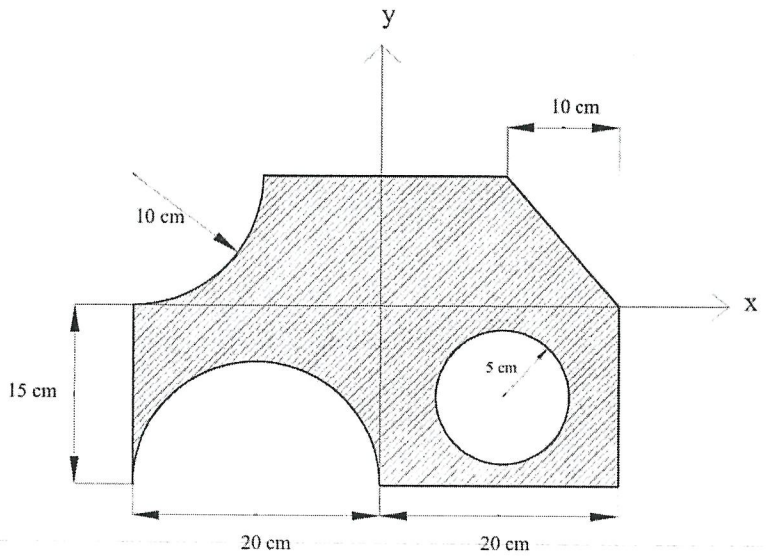

Figure Q3(a)

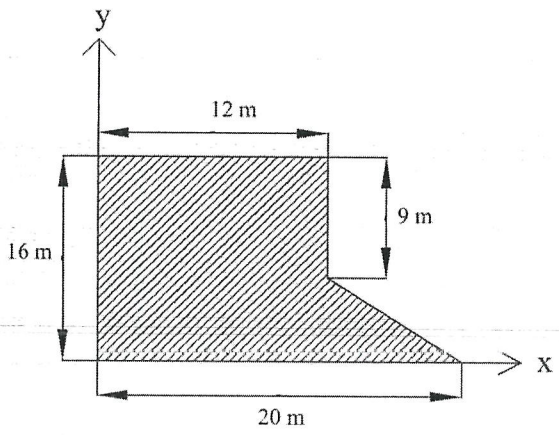

Figure Q3(b)

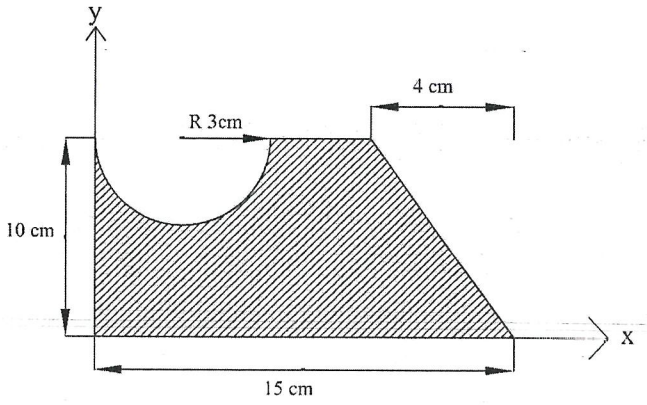

Figure Q3(c)

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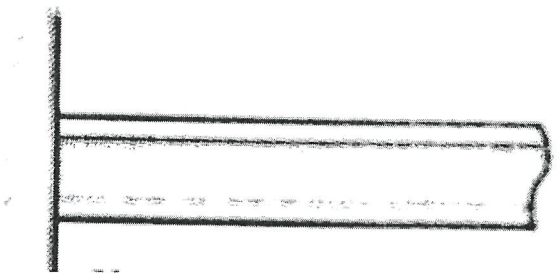
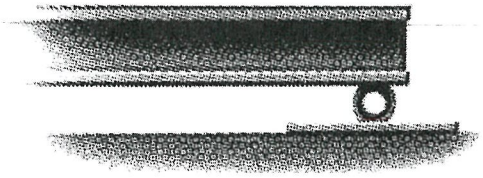
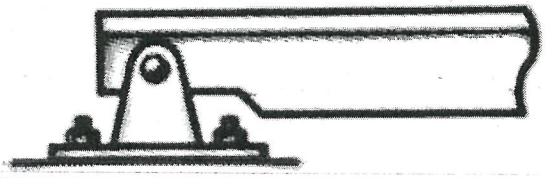


(i)



(ii)



(iii)

Figure Q4(a)

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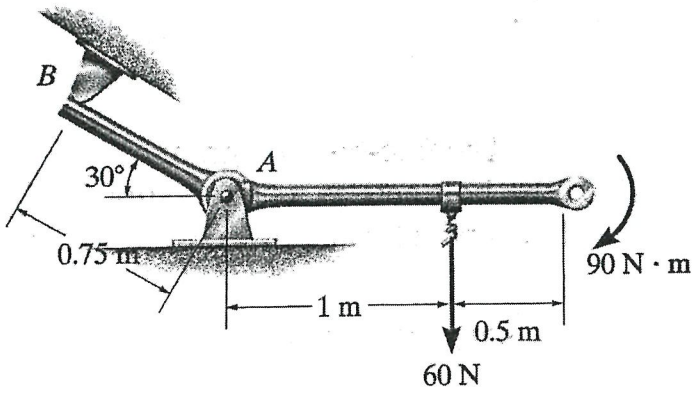

Figure Q4(b)

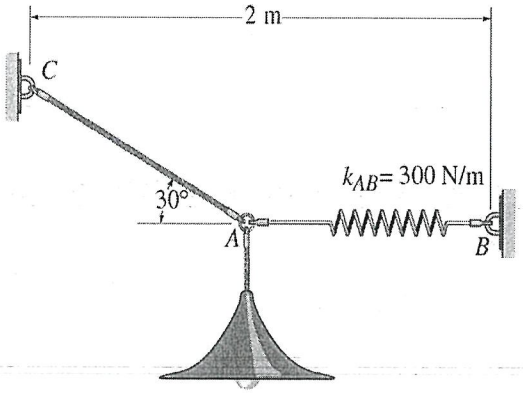

Figure Q4(c)

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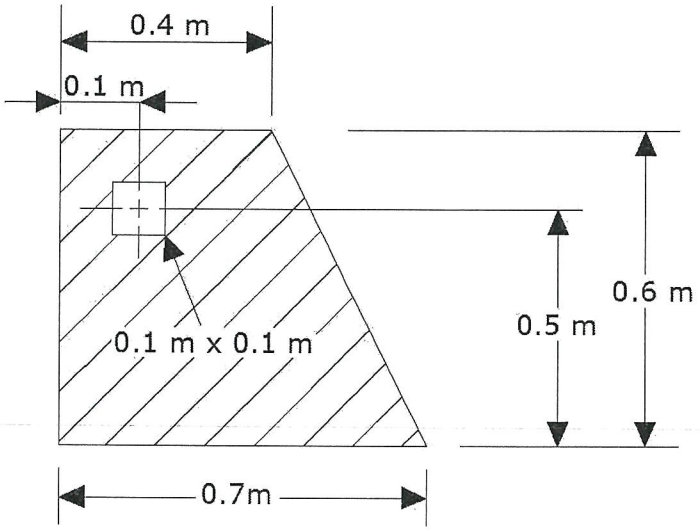
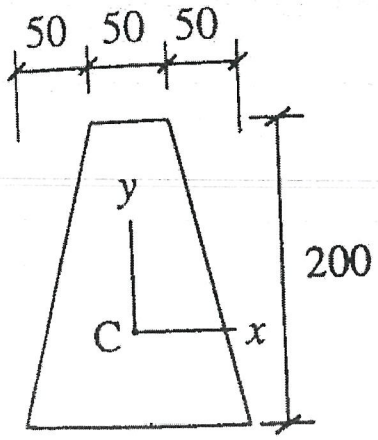


Figure Q5(b)



unit in mm

Figure Q5(c)

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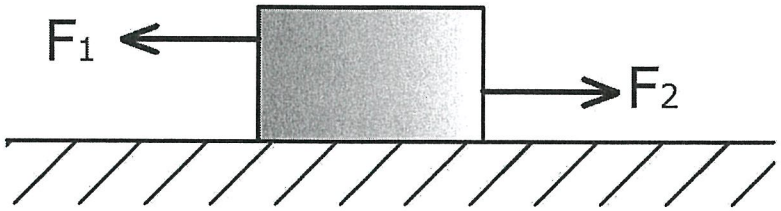

Figure Q6(d)

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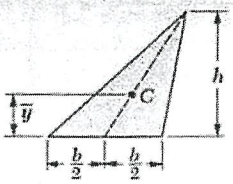
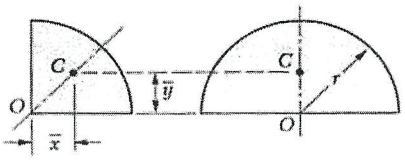
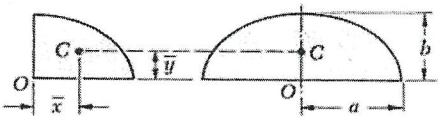
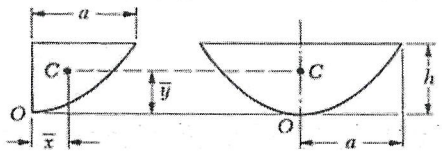
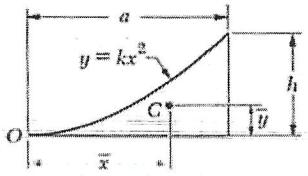
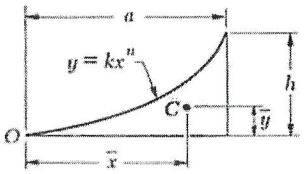
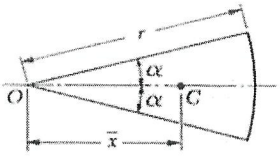
Appendix 1

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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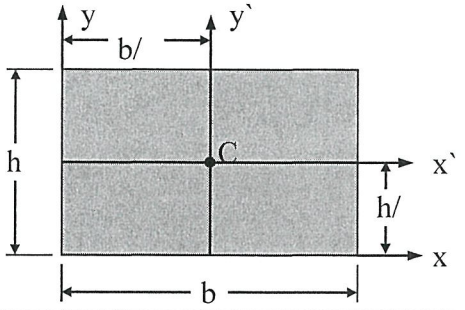
Appendix 2

Rectangle:

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

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

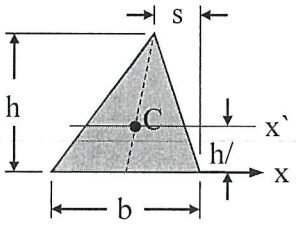
$\bar{I}_{xy'} = 0 \qquad Area = bh$



Triangle:

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

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

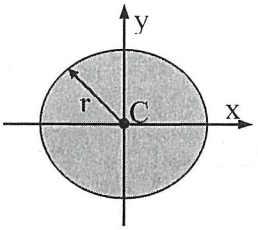


Circle:

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

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

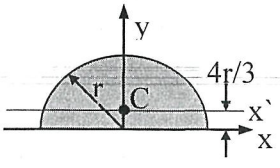
$Area = \pi r^2$



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:

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

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

$Area = \pi ab$