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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER 2
SESSION 2012/2013

COURSE NAME	:	STATICS
COURSE CODE	:	BNJ 10203
PROGRAMME	:	1 BNL / 1 BNK / 1 BNH
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE** QUESTIONS ONLY FROM **SEVEN** QUESTIONS PROVIDED

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

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Q1 An insurance company is investigating an accident in which a speedboat driver ran over some debris, lost control, and crashed. The debris bent the driveshaft of one of the propellers and redirected the thrust (force) it exerts on the boat. The thrust F of each propeller is 2500 N and the thrust directions are $\alpha = 10°$, $\beta = 5°$, $\gamma = 20°$ respectively as shown on **Figure Q1**

(a) Draw a diagram of the speed boat, labeling all stated angles (α, β, γ).

(5 marks)

(b) Calculate the force in Cartesian vector form of the two propeller forces.

(5 marks)

(c) Determine the total thrust force (F_t) on the boat Cartesian vector form after the driveshaft was bent.

(10 marks)

Q2 Tall buildings such as Menara Felda will sway when the wind force acting on it, so engineers must consider the distribution of "Wind Loads" in order to ensure the building is safe and stable in strong winds. **Figure Q2,** shows the distribution of maximum wind load of 80 kN/m and 20 kN /m acting on the building

(a) Sketch the wind load force (F_R) acting on the building.

(7 marks)

(b) Determine the resultant force (F_R) of the wind loads and its location from the ground.

(13 marks)

Q3 A beam with the weight G = 50 kN is supported at A by a smooth pin and at B by the spring with the spring constant **c**. Under a distributed load with the constant height of w = 20 kN/m, the beam is deflected at an angle of $\theta = 15^{o}$. A load of weight W_L = 15 kN is used to reduce the deflection by pulling the beam at the angle α = 45^{o} with the cable 1 passing over the pulley. The system stays at equilibrium as illustrated in **Figure Q3**. The distributed loads are perpendicular to the beam and the weight of the cable is neglible. Given length a = b = 1 meter.

(a) Calculate the cable tension, T_1.

(3 marks)

(b) Calculate the replacement force of the distributed load and its location from point A.

(3 marks)

(c) Draw a free body diagram of the beam system.

(4 marks)

(d) Calculate the spring force, F_s

(5 marks)

(e) Calculate the reaction force, A and its direction, θ_A

(5 marks)

Q4 **Figure Q4** shows a member AB supported by cable BC and at A by a square rod which fits loosely through the square hold at the end joint of the member. These components are required to hold the cylinder of weight W = 600 kN by using the cable in equilibrium. Given length a = 2 meter, b = 8 meter and c = 3 meter.

(a) Draw a free body diagram of the system.

(3 marks)

(b) Calculate the unit vector $\mathbf{U_{BC}}$

(5 marks)

(c) Determine the reaction force, **A** and its direction.

(6 marks)

(d) Calculate the reaction moment, **M** at A

(6 marks)

Q5 **Figure Q5** shows a simple structure.

(a) (i) Draw a free body diagram (FBD) of the truss.
(ii) Calculate the magnitude of the reaction force at support E.

(4 marks)

(b) Using the method of section, determine the forces in members AC, CH, CD and GF of the truss.

(16 marks)

Q6 (a) Determine the centroid of the shaded area in **Figure Q6 (a)**

(8 marks)

(b) Refer to **Figure Q6(b)**, locate the center of mass of the bracket-and-shaft combination. The vertical face is made from sheet which has a mass of 25 kg/m^2. The material of the horizontal base has a mass of 40 kg/m^2, and the steel shaft has a density of 7.83 Mg/m^3.

(12 marks)

Q7 **Figure Q7** shows three block, A, B and C with weights W_B= 30 N and W_C= 90 N. Surface friction between A and B, μ_s = 0.2 and between B and C, μ_s = 0.18. Between C and the wall μ_s = 0.3.

(a) Draw a free body diagram of the wedges.

(4 marks)

(b) Calculate the normal force, F_N between AB and BC.

(10 marks)

(c) Calculate the magnitude of force, F needed to raise block C at a constant rate.

(6 marks)

"END OF QUESTION"

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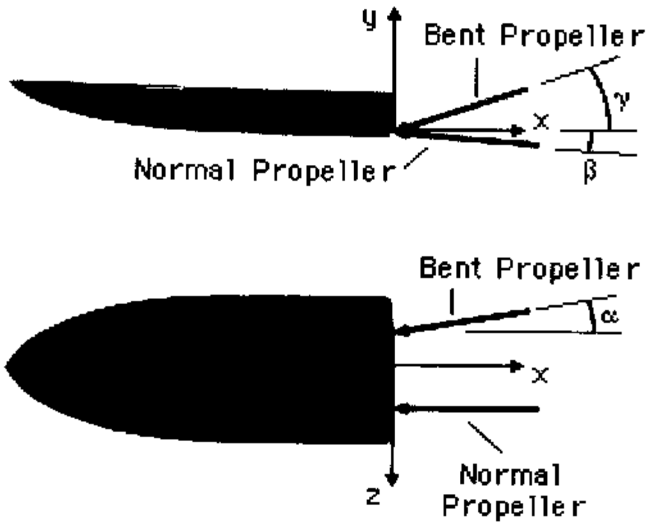

FIGURE Q1

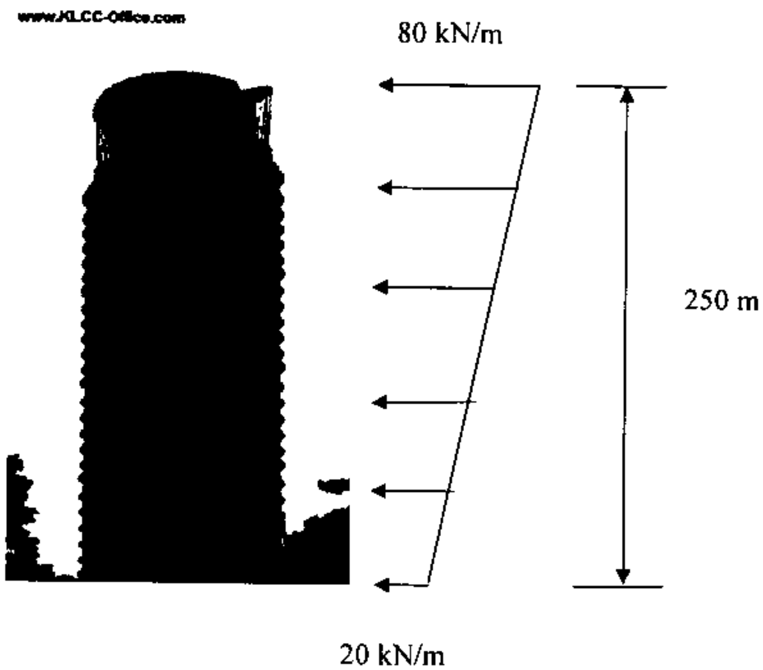

FIGURE Q2

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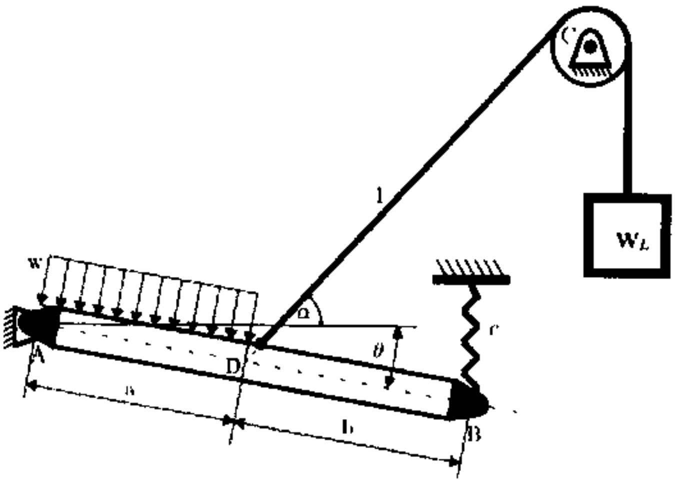


Data:

$a = b = 1$ **m**

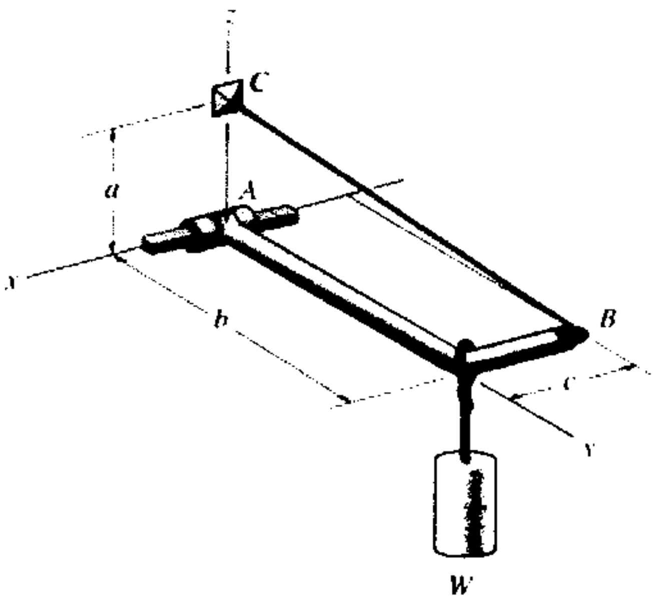
$\theta = 15^{\circ}, \alpha = 45$

$w = 20$ **kN/m**

$W_L = 15$ **kN**

$G = 50$ **kN**

FIGURE Q3



Data:

W:= 600 kN

a := 2 m

b := 8 m

c := 3 m

FIGURE Q4

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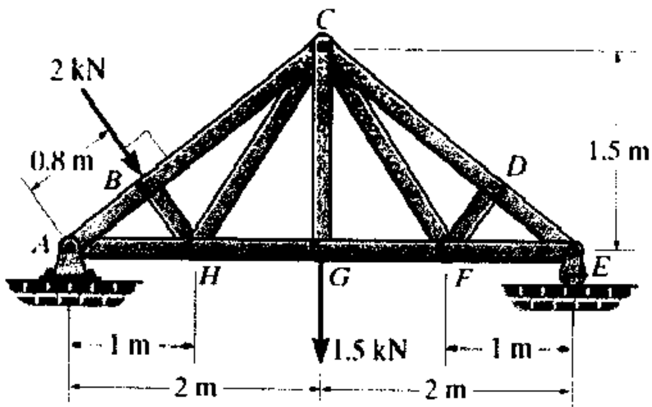

FIGURE Q5

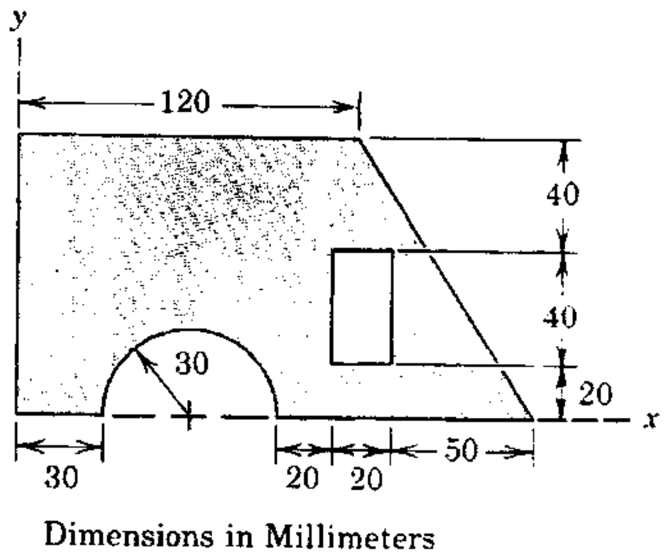

FIGURE Q6 (a)

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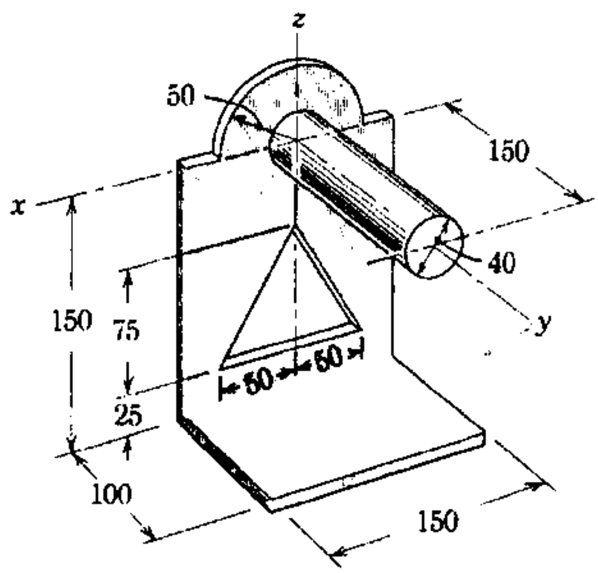

Dimensions in Millimeters

FIGURE Q6 (b)

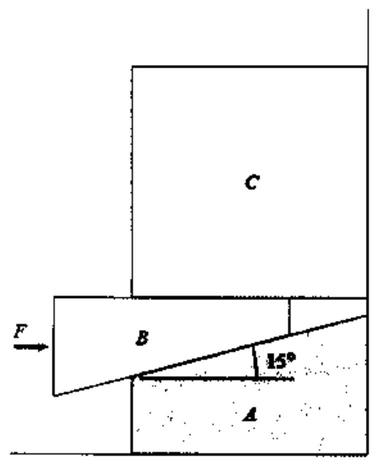

FIGURE Q7

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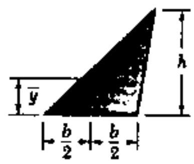
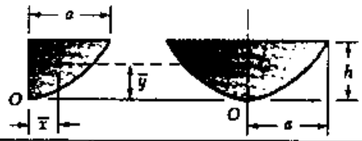
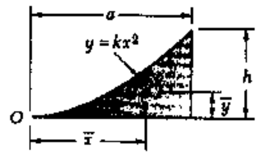
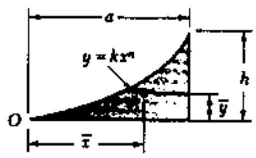
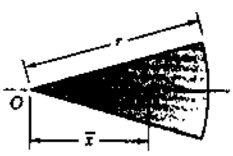
CENTROIDS OF COMMON SHAPES OF AREAS:

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