Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	STATICS
COURSE CODE	:	BNJ 10203
PROGRAMME	:	1 BNG/BNM/BNL
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 The plate in **Figure Q1** is subjected to three forces F_1, F_2, and F_3.

(a) If $\theta = 30^o$ and $F_2 = 4kN$, calculate the magnitude of the resultant force acting on the plate and its direction using Triangular rule.

(9 marks)

(b) Calculate the magnitude of the resultant force acting on the plate and its direction using scalar analysis.

(9 marks)

(c) Draw the resulant force and its direction measured clockwise from the positive x-axis.

(2 marks)

Q2 **Figure Q2** shows two cables are used to secure the overhang boom in position and support the 1000N load.

(a) Find the position vector and unit vector for cable AB and AC.

(6 marks)

(b) If the resultant force is directed along the boom from point A towards O, determine the values of x and z for the coordinates of point C and the magnitude of the resultant force. Given $F_B = 1400N$ and $F_C = 2000N$.

(14 marks)

Q3 (a) Define the meaning of moment of couple and give one example.

(4 marks)

(b) The winch cable on a tow truck is subjected to a force of $T = 5kN$ when the cable is directed at $\theta = 60^o$ as shown in **Figure Q3**. The truck has a total mass 4Mg and mass center at G.

i. Draw the free body diagram (FBD) of the tow truck.

(4 marks)

ii. Determine the magnitudes of the total brake frictional force, F for the rear set of wheels B for equilibrium.

(4 marks)

iii. Find the magnitude of total normal force at both wheels A and both rear wheels B for equilibrium.

(8 marks)

Q4 **Figure Q4** shows a simple structure. Given $P_1 = 20kN$, $P_2 = 10kN$, a = 1.5m and e = 2m.

(a) Explain briefly the concept of truss, frame and machine in engineering mechanics.

(3 marks)

(b) Draw a free body diagram (FBD) of the truss and calculate the magnitude of the reaction force at support E.

(5 marks)

(c) Using the method of section, determine the forces in members DC, CF, and GF of the truss and state if the members are in tension or compression.

(12 marks)

Q5 (a) For the composite area shown in **Figure Q5 (a)**, determine the location of its centroid, (X, Y).

(10 marks)

(c) Referring to **Figure Q5 (b)**, by using the second theorem of Pappus and Guldinus, determine the volume of the solid generated by revolving the shaded area about the *x*-axis.

(10 marks)

Q6 (a) Define what Coulomb friction is and describe **THREE (3)** various kind of friction?

(3 marks)

(b) **Figure Q6** shows three blocks A, B, and C with weights $W_B = 30N$ and $W_C = 90N$. Surface friction between A and B, $\mu_s = 0.18$. Between C and the wall surface friction is $\mu_s = 0.3$.

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

(3 marks)

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

(7 marks)

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

(7 marks)

- END OF QUESTION –

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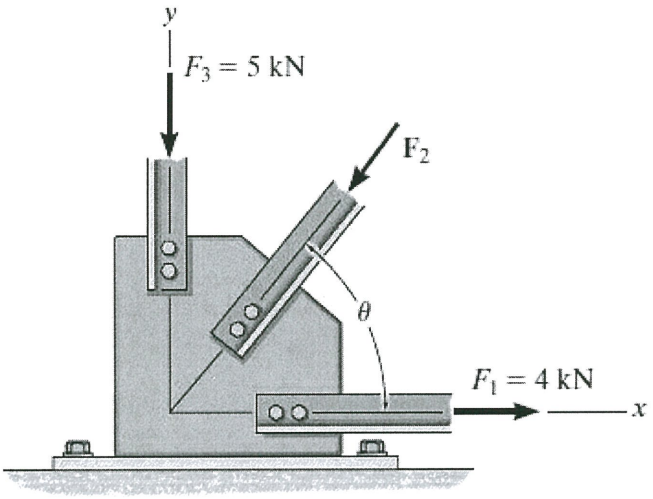

FIGURE Q1

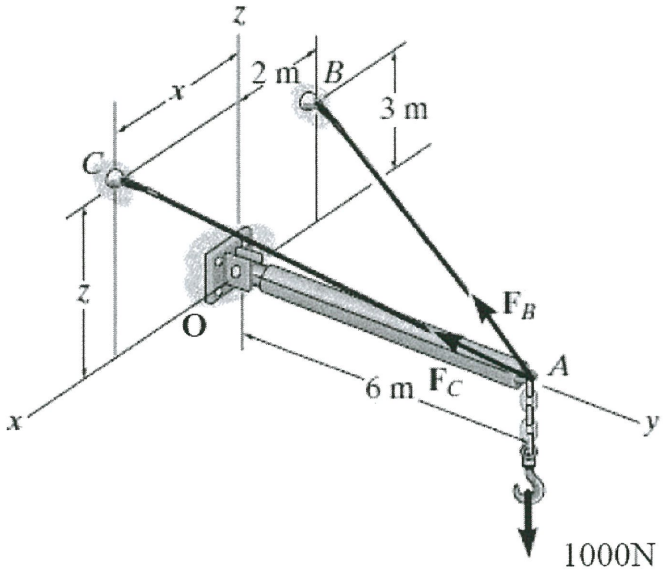

FIGURE Q2

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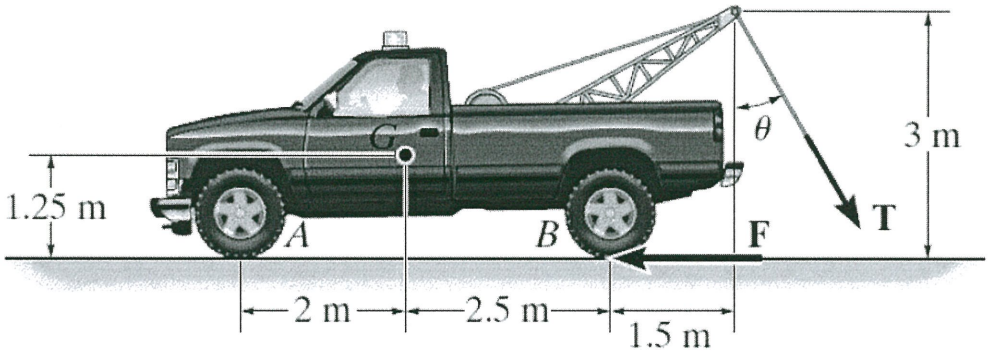

FIGURE Q3

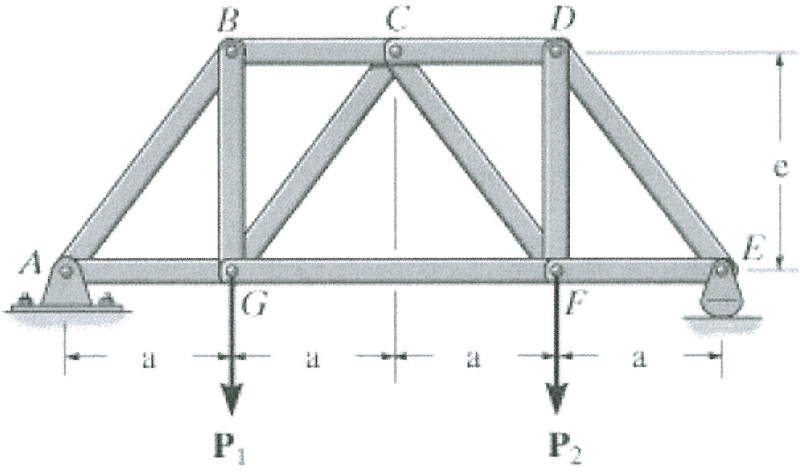

FIGURE Q4

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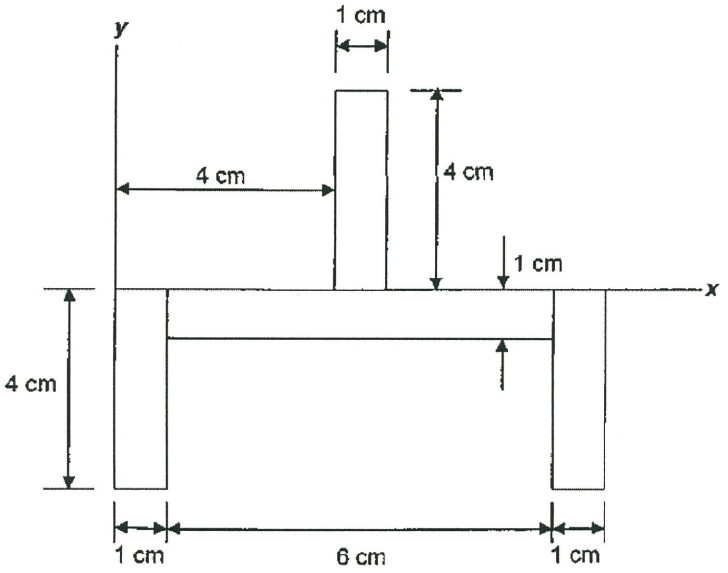

FIGURE Q5 (a)

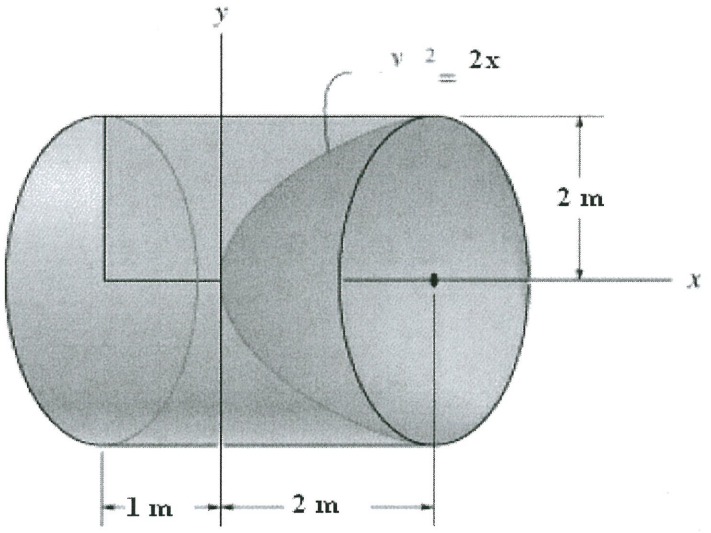

FIGURE Q5 (b)

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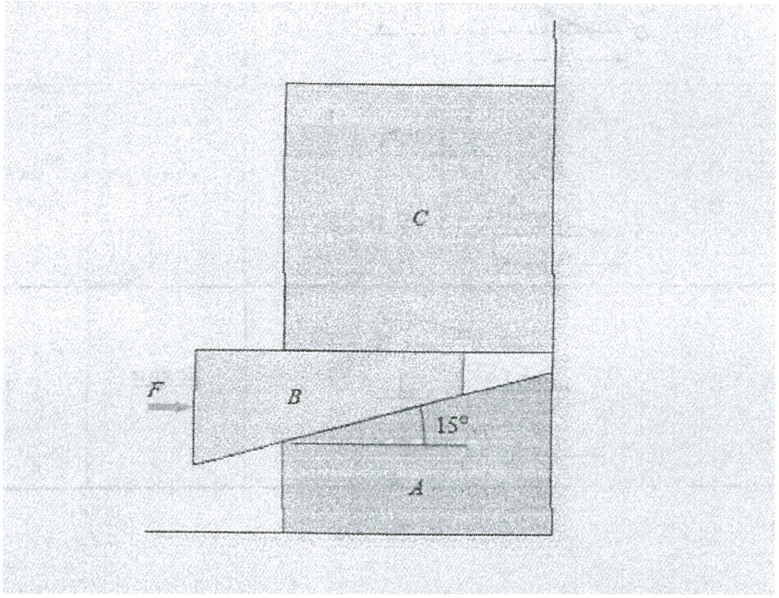

FIGURE Q6

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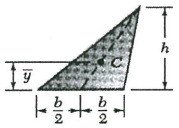
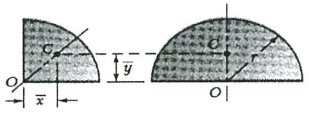
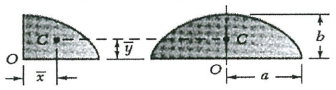
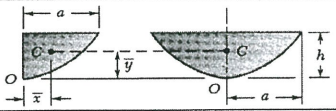
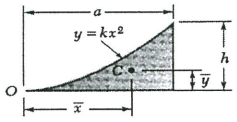
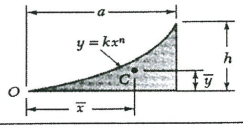
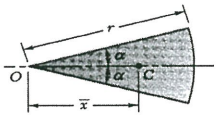
CENTROIDS OF COMMAN SHAPES OF AREAS:

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