Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESI 2019/2020

COURSE NAME	:	STATIC AND DYNAMIC
COURSE CODE	:	BFC10103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2020
DURATION	:	6 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) Briefly explain Newton's law of gravitational attraction.

(6 marks)

(b) Determine the following problems with an appropriate prefix in SI units.

(i) (5 N) x (20 GN)
(ii) (2 MN) x (100 m)

(4 marks)

(c) The lift sling is used to hoist a concrete beam having a mass of 500 kg as shown in **Figure Q1**. The center of gravity of the concrete beam is located at the middle span.

(i) Determine the force in each of the cables AB and AC as a function of θ.

(8 marks)

(ii) Determine the length of cables AB and AC that can be used for the lift if the maximum tension allowed in each cable is 5 kN.

(7 marks)

Q2 (a) A string is placed over a frictionless pulley as shown in **Figure Q2(a)**. A mass of m_1 is suspended at one end while a mass of m_2 is suspended from the other end.

(i) By using Newton's second law of F = ma, prove that the acceleration is equal to

$$a = \frac{(m_2 - m_1)g}{m_2 + m_1}$$

(5 marks)

(ii) How does a pulley system is important in construction industry. Briefly discuss with an example.

(4 marks)

(b) The motorcycle shown in **Figure Q2(b)** has a mass of 100 kg and a center of mass located at C1. The rider has a mass of 80 kg with a center of mass at C2. Neglect the mass of the wheels and assume that the front wheel is free to roll.

(i) The rider lifting the front wheel off the ground in order to do a 'wheely. Does the frictional forces acting on the front wheels influence the motorcycle's acceleration?. Explain your reason with aid of free body diagram.

(3 marks)

(ii) Analyse the minimum coefficient of static friction between the wheels and the pavement if the situation in Q2(i) is considered.

(13 marks)

Q3 (a) Briefly explain in what condition both of centre and centroid values will coincide. (4 marks)

(b) Locate the centroid of the shaded area shown in **Figure Q3**. (11 marks)

(c) Calculate the moment of inertia of the composite area. (10 marks)

Q4 (a) A beam is subjected to the forces as shown in **Figure Q4**. Determine the given system of forces to:

(i) An equivalent force-couple system at A (6 marks)

(ii) An equivalent force-couple system at B (6 marks)

(iii) A single force and point of application (6 marks)

(b) Briefly discuss four (4) types of friction laws for dry surface on an incline plane. (7 marks)

– END OF QUESTIONS –

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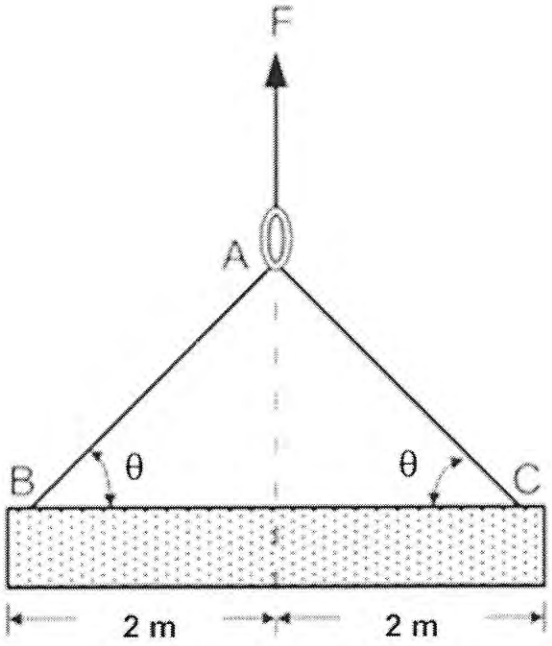

FIGURE Q1

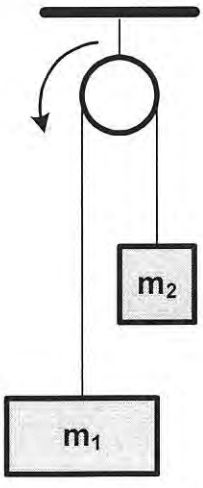

FIGURE Q2(a)

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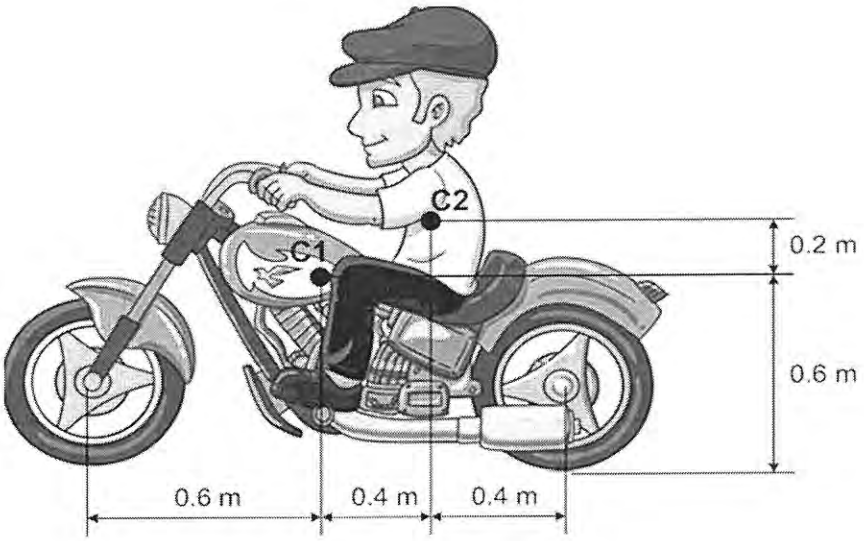

FIGURE Q2(b)

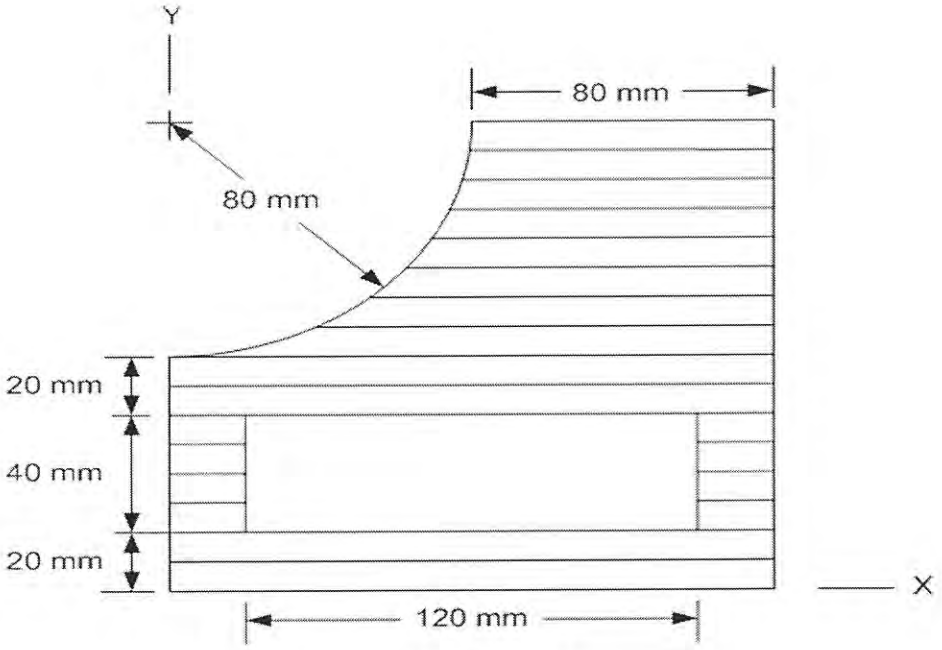

FIGURE Q3

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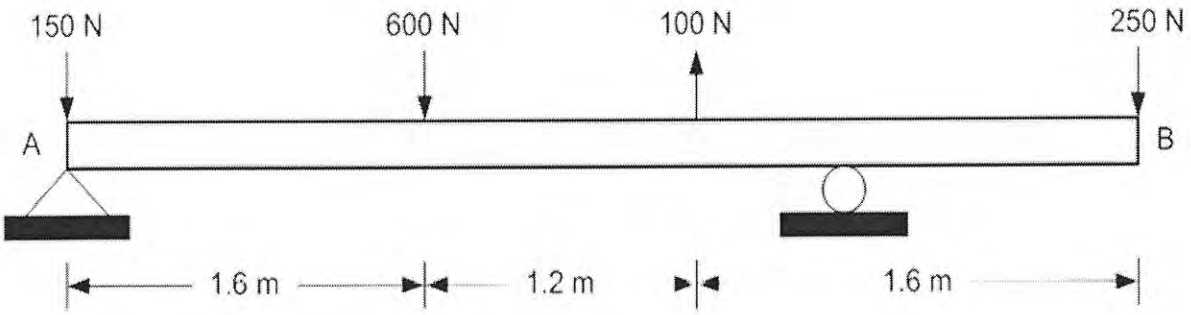

FIGURE Q4

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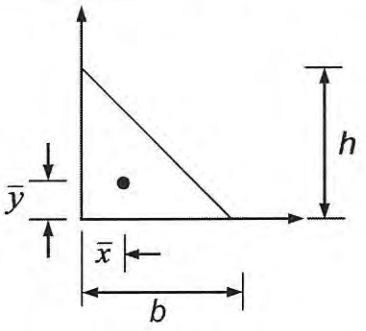
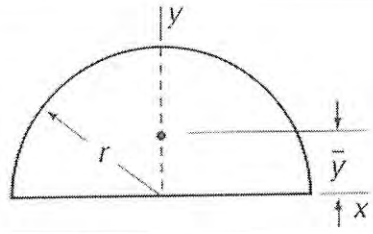
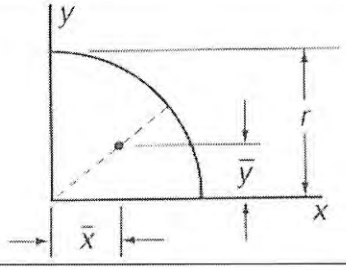
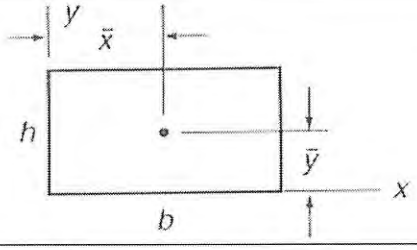
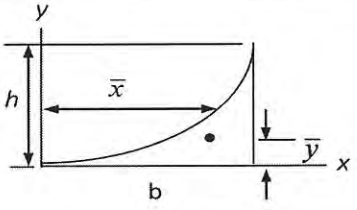
APPENDIX

1. Centroids of Areas

	Shape	$\bar{x}$	$\bar{y}$	A
Triangle		$\frac{b}{3}$	$\frac{h}{3}$	$\frac{1}{2}bh$
Semicircle		0	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{2}$
Quarter circle		$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{4}$
Rectangle		$\frac{b}{2}$	$\frac{h}{2}$	bh
Parabolic Spandrel		$\frac{3b}{4}$	$\frac{3h}{10}$	$\frac{bh}{3}$

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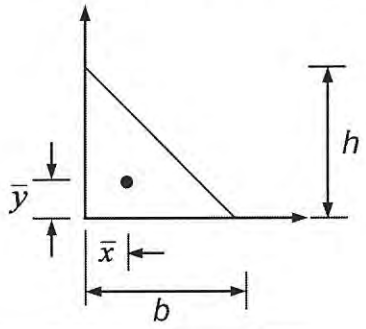
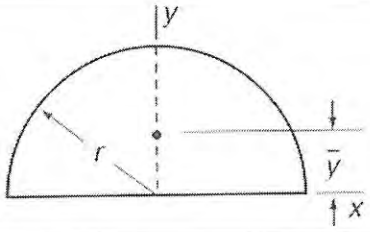
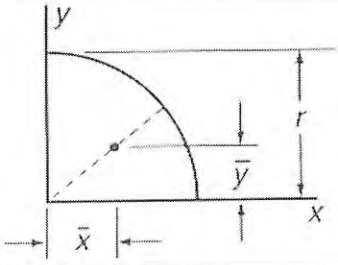
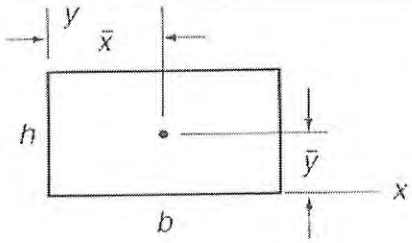
2. Equation of Moment of Inertia

	Shape	Equation
Triangle		$I_x = \frac{bh^3}{36}$, $I_y = \frac{b^3h}{36}$
Semicircle		$I_x = I_y = \frac{1}{8}\pi r^4$ $J = \frac{1}{4}\pi r^4$ 0
Quarter circle		$I_x = I_y = \frac{1}{16}\pi r^4$ $J = \frac{1}{8}\pi r^4$
Rectangle		$I_x = \frac{bh^3}{12}, I_y = \frac{b^3h}{12}$ $J = \frac{1}{12}bh(b^2 + h^2)$