Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESI 2017/2018

COURSE NAME	:	STATIC AND DYNAMIC
COURSE CODE	:	BFC10103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE/JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ALL QUESTION IN PART A AND **THREE (3)** QUESTIONS FROM PART B

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

PART A

Q1 (a) A string is placed over a frictionless pulley as shown in **Figure Q1(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) If m_1 and m_2 are 10 kg and 5 kg respectively, calculate the acceleration, *a* and tension, *T* at string of the system.

(4 marks)

(b) The motorcycle shown in **Figure Q1(b)** has a mass of 120 kg and a center of mass located at C1. The rider has a mass of 70 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) Draw the free body diagram and calculate the motorcycle's acceleration if the rider lifting the front wheel off the ground in order to do a 'wheely'.

(13 marks)

(ii) Determine the minimum coefficient of static friction between the wheels and the pavement.

(3 marks)

PART B

Q2 (a) Fill in the blank with the correct answer.

(i)	50 kN/m^2	=	________________	N/mm^2
(ii)	20 ft/s^2	=	________________	m/s^2
(iii)	100 lb/in	=	________________	N/mm
(iv)	130 MPa	=	________________	kN/mm^2
(v)	20 g/cm^3	=	________________	kg/m^3

(10 marks)

(b) The flat slab shown in **Figure Q2** is supported by three cables, AB, AC and AD. If the force of the cables on the hook at A are F_{AB} = 150 N, F_{AC} = 100 N and F_{AD} = 120 N, determine the magnitude and direction of the resultant force, F_R by using the Cartesian vectors of i, j, k.

(15 marks)

Q3 A diagonal pole is fixed at point A and lifts 2.5 kg body of mass as shown in **Figure Q3**.

(a) Calculate the weight of body mass in Newton (N).

(3 marks)

(b) Sketch the free body diagram of the structure.

(3 marks)

(c) Calculate the reaction force on component x, y and z at point A

(4 marks)

(d) Calculate the moment reactions on component x, y and z at support A by using Cartesian vector method.

(9 marks)

(e) Determine the resultant force and moment at point A.

(6 marks)

Q4 (a) Briefly discuss why centre of gravity and centroid do not always coincide. Explain, in what condition both of these values will coincide.

(5 marks)

(b) Locate the coordinate of the centroid for the composite area in **Figure Q4**. A circle with centre at G with radius of 0.5 m has been cut out as shown. A triangle and quarter circle has been cut out in similar way. All units are in centimetre (cm).

(10 marks)

(c) Calculate the moment of inertia about the x and y axis for the area shown in **Figure Q4**.

(10 marks)

Q5 (a) The beams shown in **Figure Q5(a)** are subjected to the uniform and triangular distributed load. Determine the reactions at support A and B.

(10 marks)

(b) Three blocks with different mass of 75 kg, 50 kg and 25 kg located on an inclined plane is shown in **Figure Q5(b).** The coefficient of friction between block A and B is $\mu_s = 0.4$, $\mu_k = 0.2$ and between block B and C is $\mu_s = 0.3$, $\mu_k = 0.1$.

(i) Draw the free body diagram for every block.

(6 marks)

(ii) Determine the friction force for every block. Assume that there are no dry surface between the blocks

(9 marks)

– END OF QUESTIONS –

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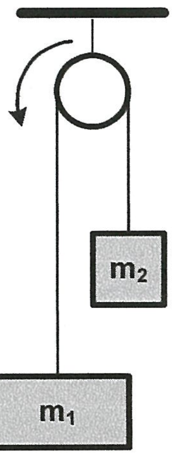

FIGURE Q1(a)

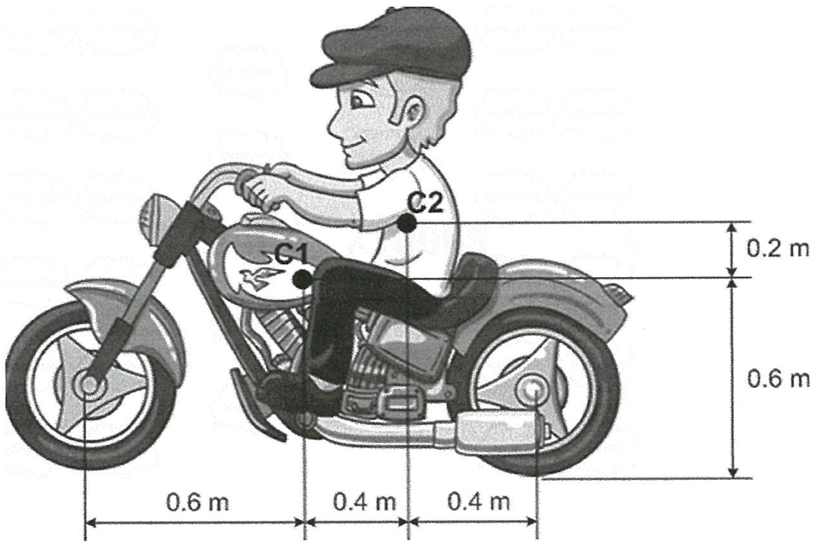

FIGURE Q1(b)

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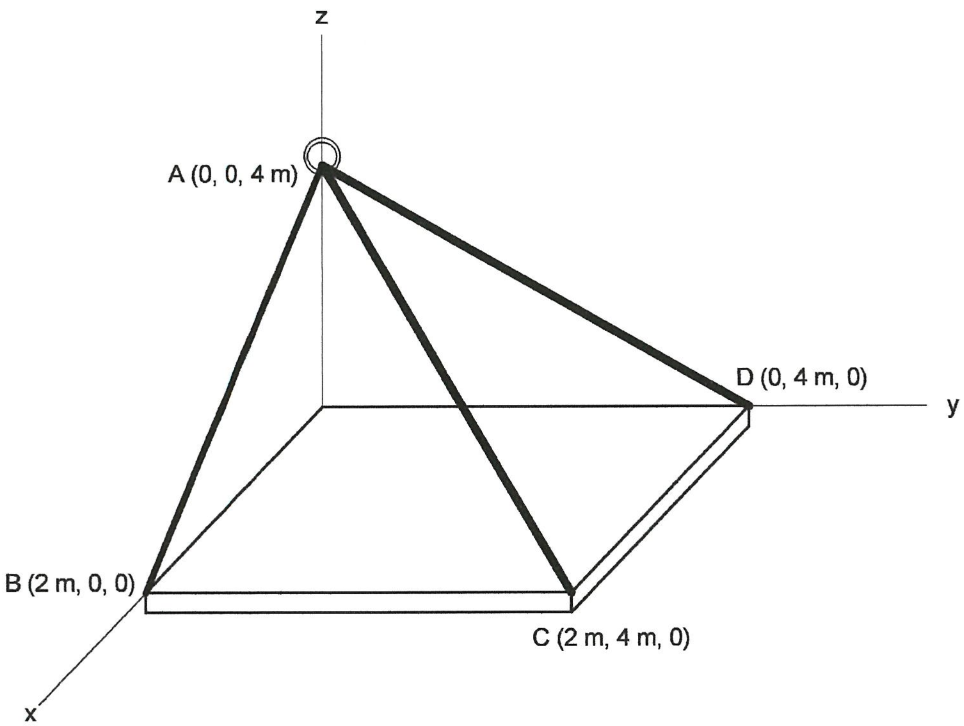

FIGURE Q2

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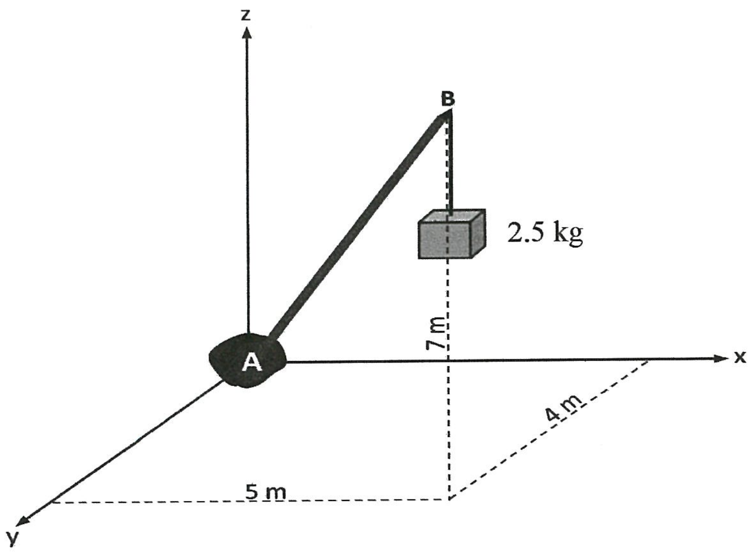

FIGURE Q3

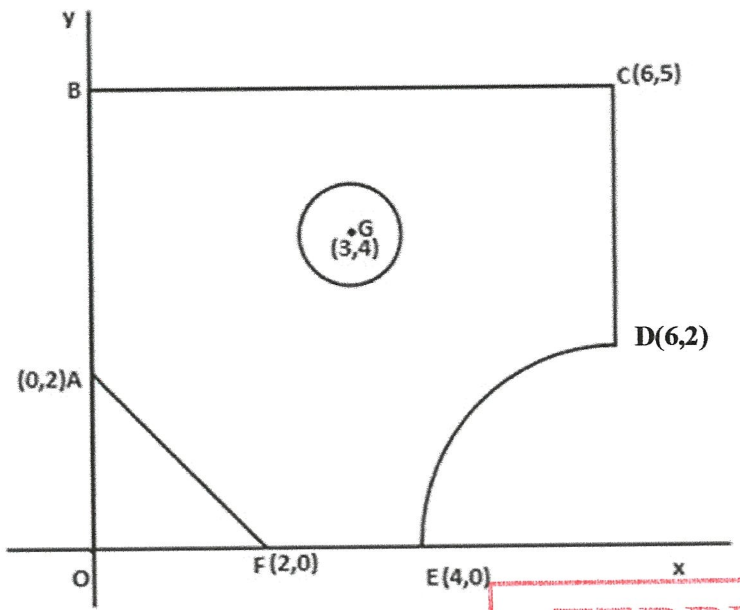

FIGURE Q4

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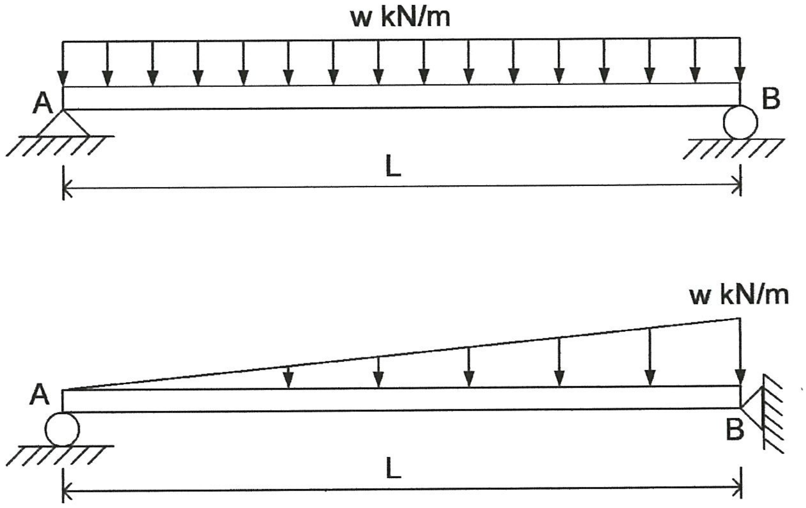

FIGURE Q5(a)

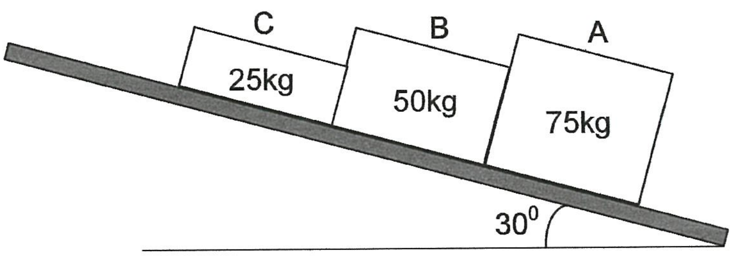

FIGURE Q5(b)

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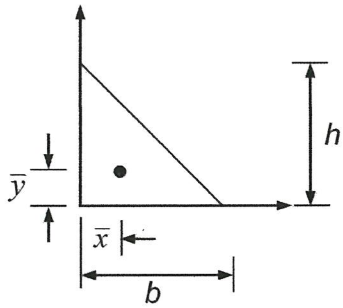
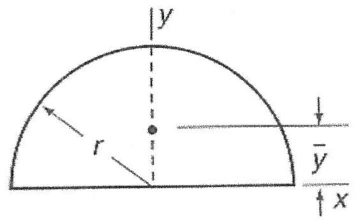
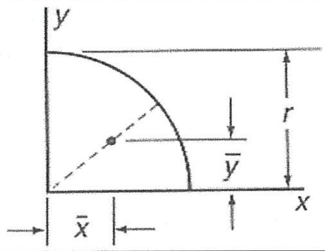
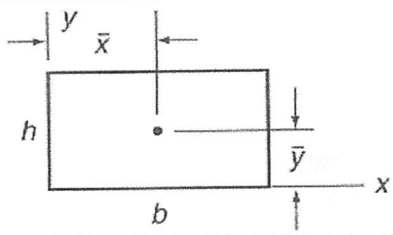
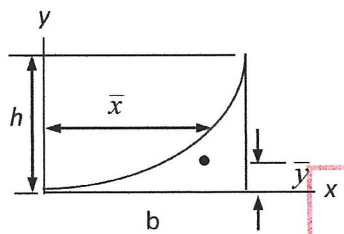
APPENDIX

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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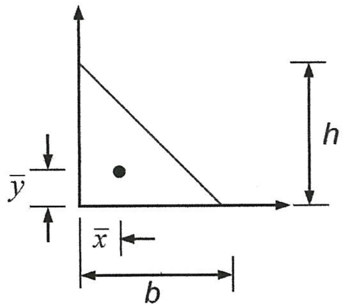
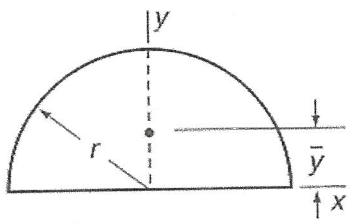
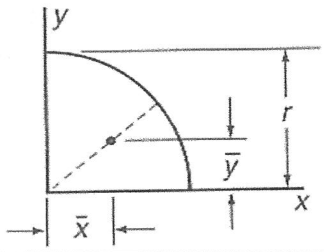
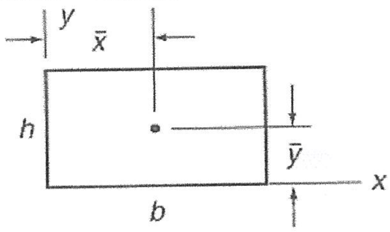
APPENDIX

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		$I_x = \frac{bh^3}{12}, I_y = \frac{b^3h}{12}$ $J = \frac{1}{12}bh(b^2 + h^2)$

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APPENDIX

3. Rectilinear Motion with Uniform Acceleration

$$s = v_0 t + \frac{1}{2} a t^2$$

$$v = v_0 + at$$

$$v^2 = {v_0}^2 + 2as$$

Where,

s	=	displacement
v_0	=	initial velocity
v	=	final velocity
a	=	constant acceleration
t	=	time