Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	STATIC AND DYNAMIC
COURSE CODE	:	BFC10103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN PART A AND **THREE (3)** QUESTIONS FROM PART B

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

PART A

Q1 (a) The position of a particle along a straight line is given by $s = (0.5t^3 - 3t^2 + 5t)$m, where t is in seconds. If the time interval of a particle is $0 \le t \le 5$, determine its maximum acceleration and maximum velocity during the time interval.

(6 marks)

(b) A concrete block has a mass of 70kg and is being towed by a chain which is always directed at 25° from the horizontal as shown in **Figure Q1 (b)**. If the magnitude of T is increased until the concrete block begin to slide, calculate the concrete block initial acceleration. Given the coefficient of static friction is $\mu_s = 0.25$ and the coefficient of kinetic friction is $\mu_k = 0.20$.

(10 marks)

(c) The **Figure Q1 (c)** shows an escalator with steps that move with a constant speed of 0.5m/s. If the steps are 125mm high and 250mm in length, determine the power of motor needed to lift an average mass of 140kg per step. There are 32 steps in total.

(9 marks)

PART B

Q2 (a) Briefly explain the Newton's three laws of motion.

(6 marks)

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

(i) (30 GN)(5 N)
(ii) (200 m)$(2\ \mathrm{MN})^2$

(4 marks)

(c) The lift sling is used to hoist a concrete beam having a mass of 400 kg as shown in **Figure Q2 (c)**. 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) If the maximum tension allowed in each cable is 3 kN, determine the lengths of cables AB and AC that can be used for the lift.

(7 marks)

Q3 (a) Fill in the blank with correct answer

(i) The resultant force for a given distributed load acts at the distributed load's __________.

(ii) In statics, a couple is defined as __________ separated by a perpendicular distance.

(iii) The moment of a couple is called a _________ vector.

(iv) If three couples act on a body, the overall result is that_______________.

(4 marks)

(b) Give **TWO (2)** applications of couple moment in our daily routine

(1 mark)

(c) Two couples act on the frame with the geometry shown in **Figure Q3 (b)**, find the resultant couple for this beam

(10 marks)

(d) By referring to **Figure Q3 (c)**, replace the particular distributed loads (rectangular and trapezoidal shapes) by an equivalent point load and located at a distance from point A. Then, determine:

(i) The resultant moment about point A

(ii) The equivalent point load and the distance from point A.

(10 marks)

Q4 (a) Provide the coordinate of the centroid for the composite area in **Figure Q4**.

(10 marks)

(b) Determine the second moment of inertia about the x and y axis for the composite area shown in **Figure Q4**.

(15 marks)

Q5 **Figure Q5** shows a singular frame of a timber structure.

(a) Identify **ONE (1)** type of support, and **ONE (1)** type of external force that can be found in **Figure Q5**. Name and indicate their positions.

(4 marks)

(b) Sketch the idealized model and free body diagram of Beam A, if both supports at points B and C are considered as pinned joint.

(6 marks)

(c) From **Q5 (b),** calculate reactions of Beam A at the supports.

(10 marks)

(d) If the selfweight of Beam A is given w kN/m, modify the free body diagram that was obtained from **Q5 (b).**

(2 marks)

(e) Explain whether the self-weight of the beam should be included or not in the reaction calculation. Support your answer with reasonable engineering knowledge.

(3 marks)

– END OF QUESTIONS –

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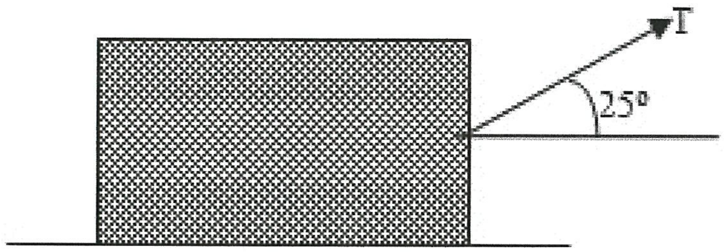

FIGURE Q1 (b)

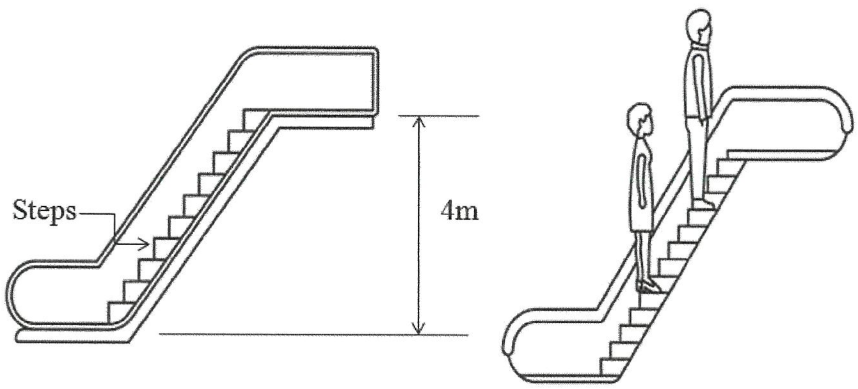

FIGURE Q1 (c)

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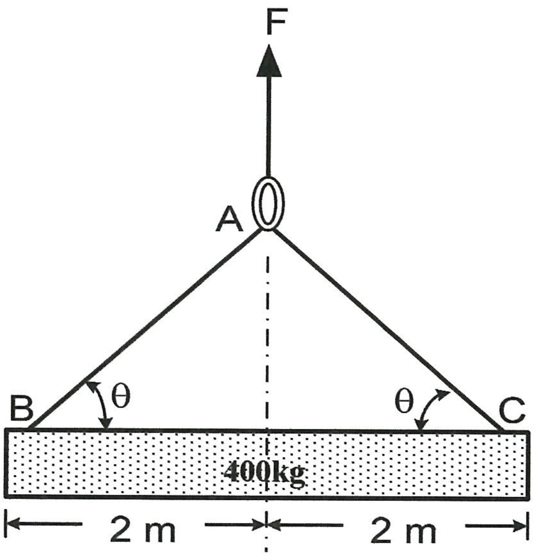

FIGURE Q2 (c)

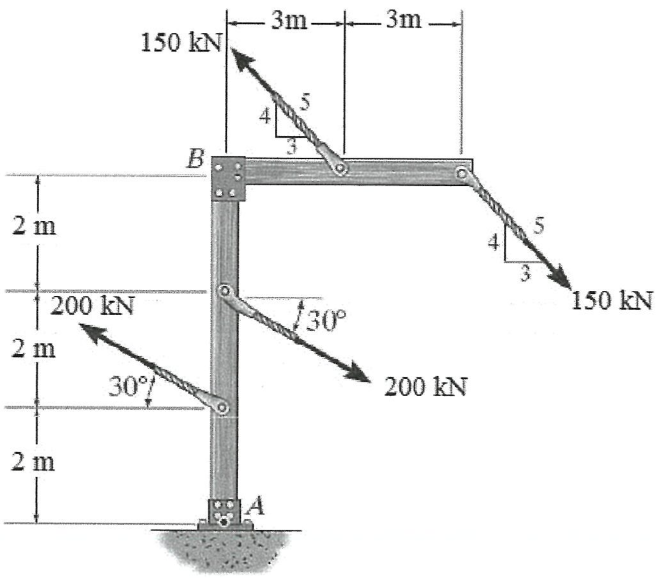

FIGURE Q3 (b)

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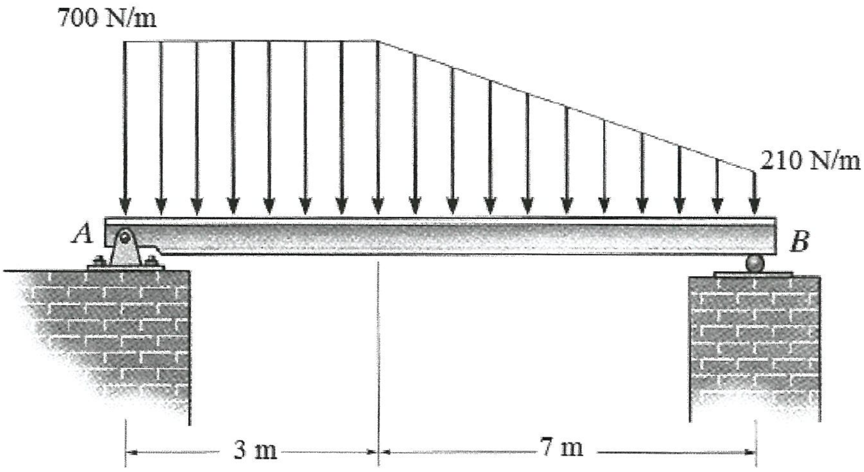

FIGURE Q3 (c)

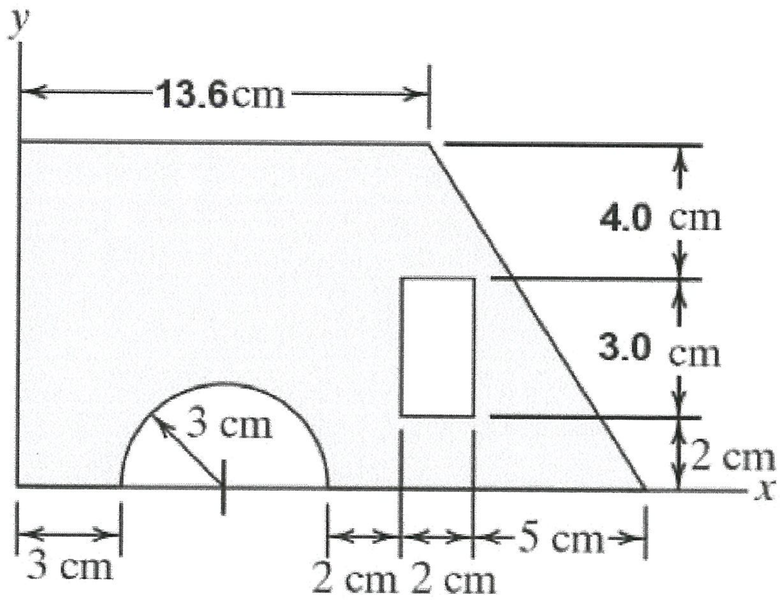

FIGURE Q4

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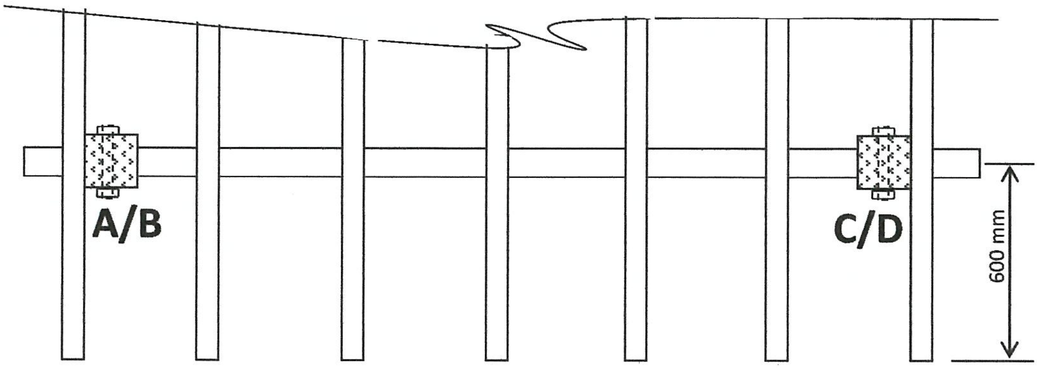
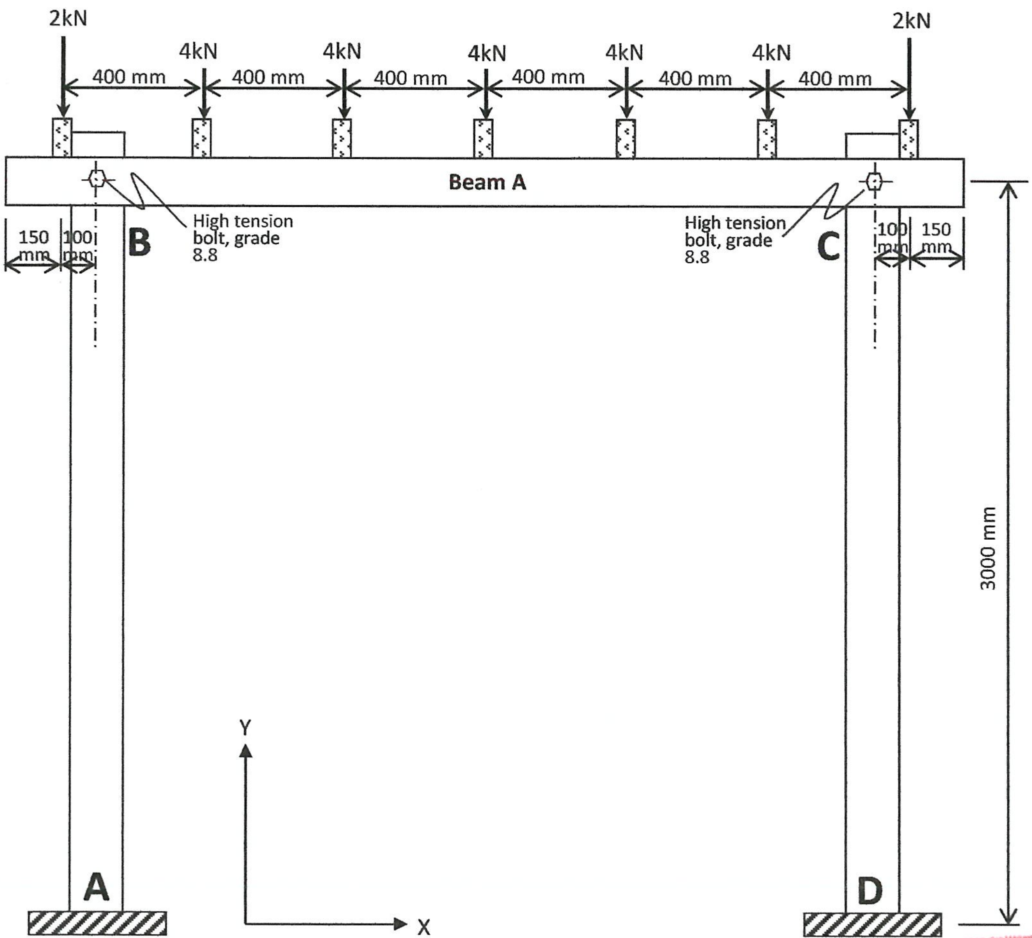


PLAN VIEW



FRONT VIEW

FIGURE Q5

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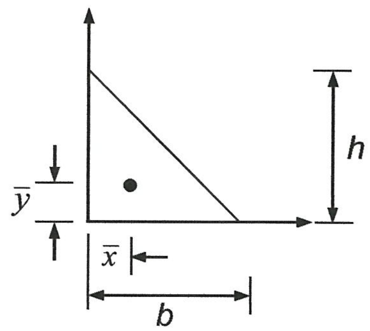
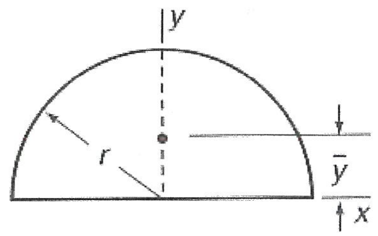
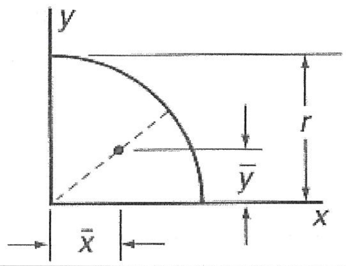
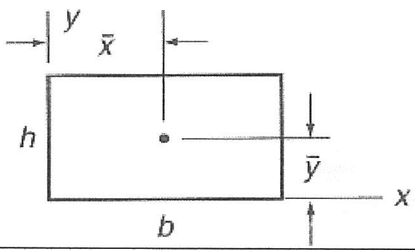
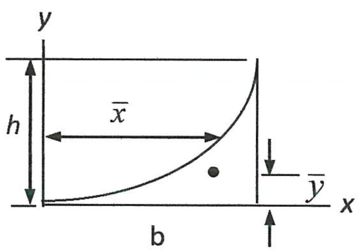
APPENDIX

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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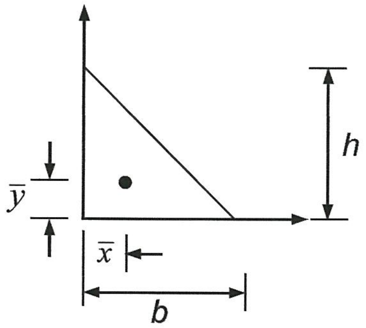
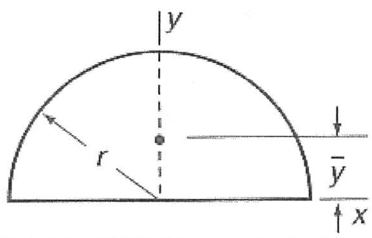
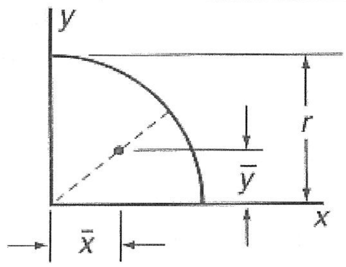
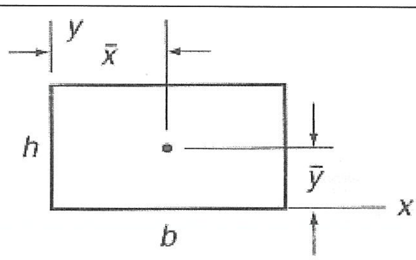
2. Equation of Moment of Inertia

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

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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