Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESI 2019/2020

COURSE NAME	:	STATIC AND DYNAMIC
COURSE CODE	:	BFC10103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2019/JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

Q1 (a) Briefly explain with suitable sketch.

(i) Moment

(4 marks)

(ii) Couple

(4 marks)

(b) Two concentrated forces and one moment act on the simply supported beam as shown in **Figure Q1(i)**.

(i) Calculate the resultant force of the beam

(10 marks)

(ii) Determine the distance of resultant force from point A.

(7 marks)

Q2 (a) Sketch and label the free body diagram of the structural element for the support condition and its loading as highlighted in **Figure Q2(i), (ii) and (iii)**.

(3 marks)

(b) The cantilever beam shown in **Figure Q2(iv)** is loaded with inclined load of 30 kN at B, vertical load of 40 kN at C and moment of 100 kNm at D, respectively. The total length of the cantilever beam is 6 m and part of the beam and the beam is embeded in the wall at point A.

(i) Sketch the free body diagram of the cantilever beam.

(4 marks)

(ii) Calculate the reaction forces at point A.

(6 marks)

(c) Three blocks are in contact with each other that is sliding down on inclined plane as shown in **Figure Q2(v)**. The plane is inclined at an angle of 20 degrees. The friction coefficients of block A and B are $\mu_s = 0.3$ and $\mu_k = 0.2$ respectively. While, the friction coefficients for block C are $\mu_s = 0.4$ and $\mu_k = 0.3$. Assume no friction between these three blocks. Convert the force unit in Newton.

(i) Calculate the resultant normal force, N and the value of static friction force, F_s of each block.

(6 marks)

(ii) Determine whether each block is in equilibrium and then calculate the value of kinetic friction force, F_k.

(6 marks)

Q3 (a) Briefly explain in what condition of centre of gravity and centroid in situation of:

(i) coincide

(2 marks)

(ii) do not coincide

(2 marks)

(b) Determine the centroid of composite area in **Figure Q3(b)**.

(11 marks)

(c) Calculate the moment of inertia about the x and y axis for the area shown in **Figure Q3(b)**.

(10 marks)

Q4 (a) Give definition and explanation on the relationship of gravitational potential energy (GPE) and kinetic energy (KE).

(6 marks)

(b) Muhammad travels using a 1060 kg sport car from Johor Baharu to Kuala Lumpur at 3 m/s, it begin to accelerate at a m/s^2, where v = $\sqrt[4]{(80/a)}$ m/s. At 5 second after the acceleration;

(i) Calculate the acceleration, a and position of the sport car after 5 second.

(13 marks)

(ii) If the drag resistance on the car due to the wind is FD = (10v) N, where v is the velocity, determine the power supply to the engine at this instant. The engine has a running efficiency of $\varepsilon = 0.68$.

(6 marks)

– END OF QUESTIONS –

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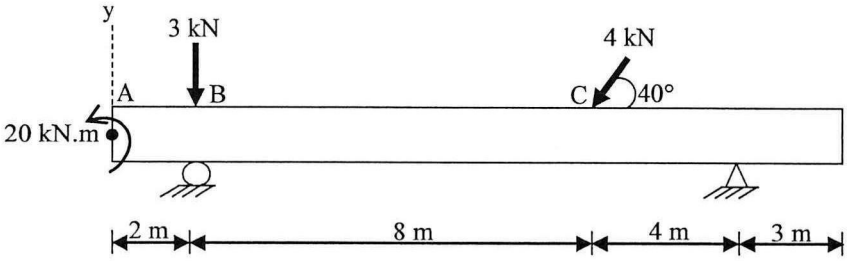

FIGURE Q1(i)

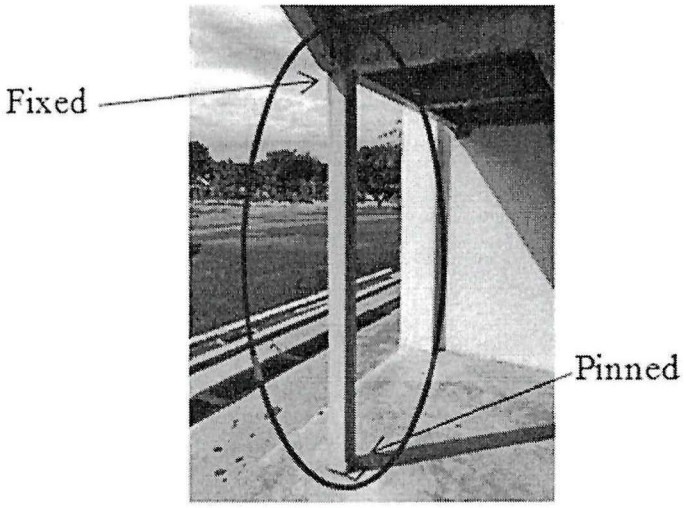

FIGURE Q2(i)

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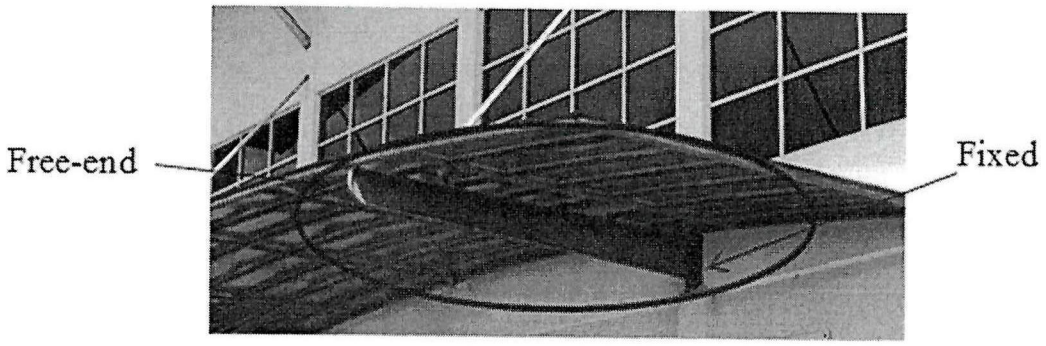

FIGURE Q2(ii)

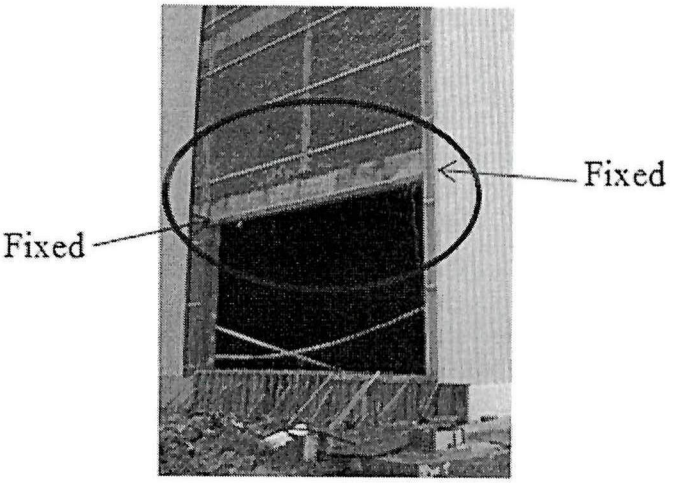

FIGURE Q2(iii)

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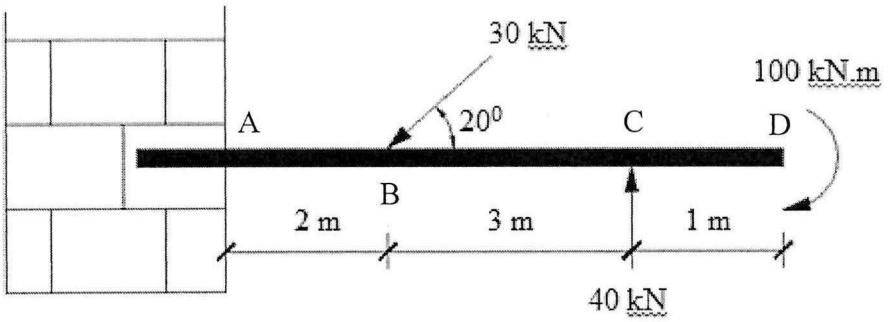

FIGURE Q2(iv)

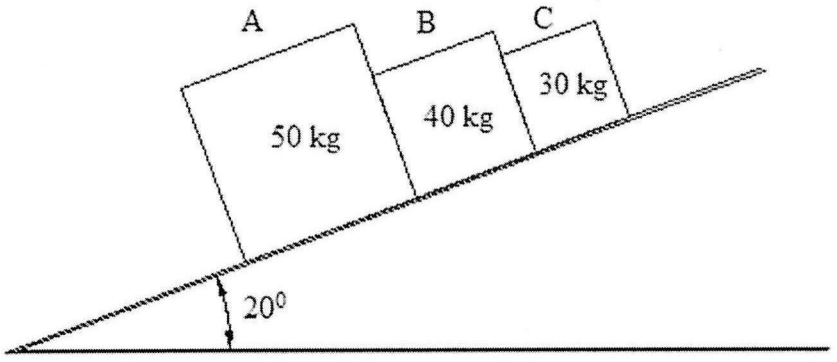

FIGURE Q2(v)

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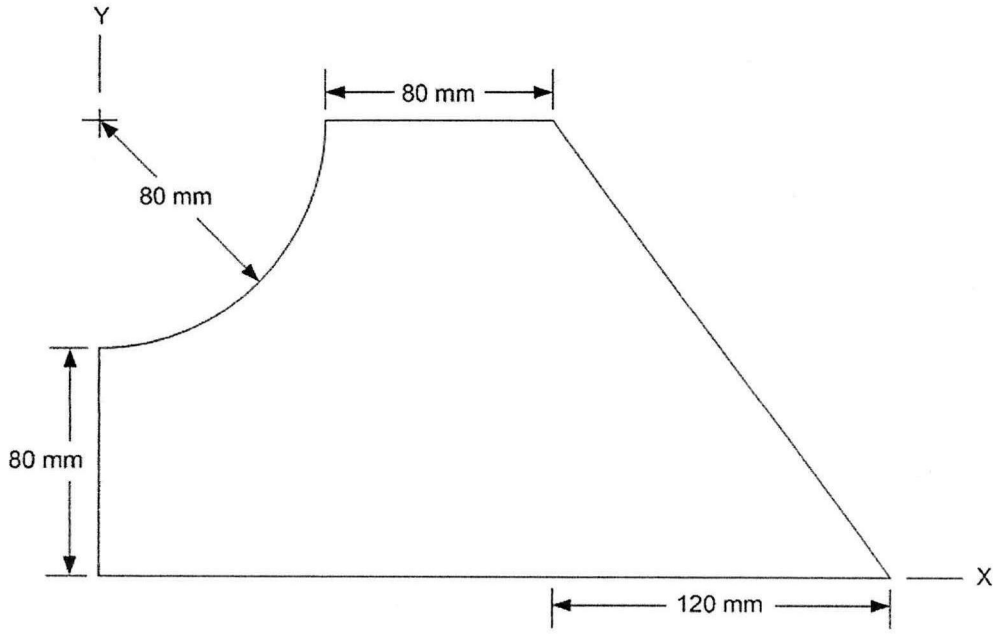

FIGURE Q3(b)

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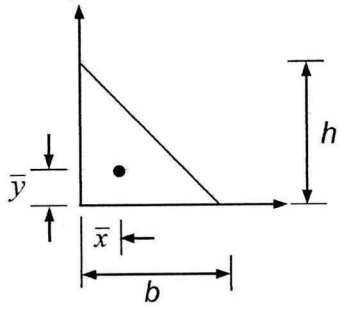
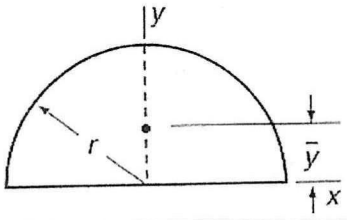
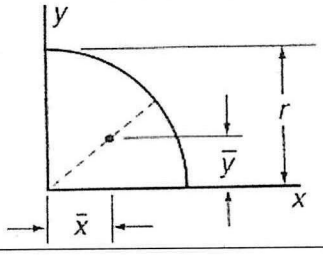
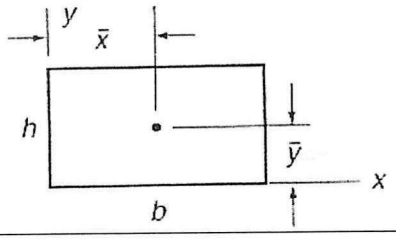
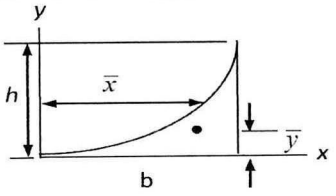
APPENDIX

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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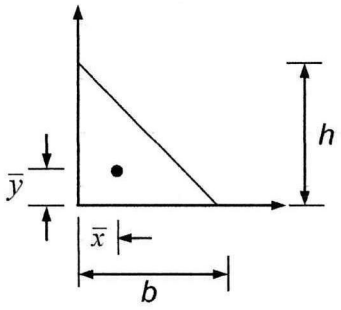
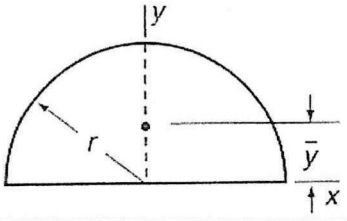
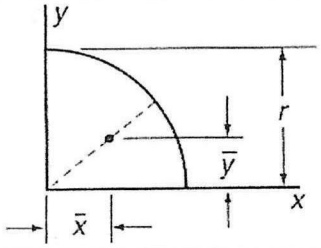
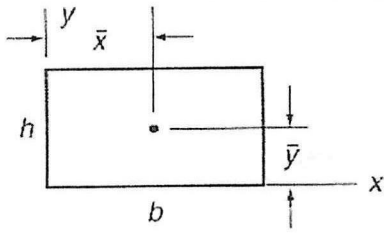
APPENDIX

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

$$a = \frac{dv}{dt}, \quad a = v\frac{dv}{ds}$$

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

$$v = v_0 + at$$

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

where,

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

4. Newton Law

$F = ma$

where,

F	=	force
m	=	mass
a	=	acceleration

5. Engine Power

$P = Fv$

where,

P	=	power
F	=	force
v	=	velocity