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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	STATIC AND DYNAMIC
COURSE CODE	:	BFC 1022/BFC10102/BFC 10103
PROGRAMME	:	1 BFF
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTION	:	A) ANSWER **THREE (3)** QUESTIONS ONLY B) ANSWER **All** QUESTIONS

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

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SECTION A

Q1 (a) Define the difference between *mass* and *weight*.

(5 marks)

(b) Figure **Q1** shows the truss structure. Replace the loading system acting on the structure by an equivalent force and couple moment at point C (ignore the reaction at A and B)

(10 marks)

(c) If the structure in Figure **Q1** is in equilibrium and support by roller at A and pinned at E, calculate the reaction force of the structure.

(10 marks)

Q2 (a) Draw free body diagram of three dimension rigid body for

i. Roller

(1 mark)

ii. Cable

(1 mark)

iii. Ball and socket

(3 marks)

(b) The building slab is subjected to three parallel column loadings.Determine the equivalent resultant force in Figure **Q2 (a)** and specify its location (x,y, z)

(9 marks)

(c) Determine the tension cables A and E and the x, y, z components of reaction at the ball and socket joint at C in Figure **Q2 (b)**.

(11 marks)

Q3 (a) Explain briefly the friction law and its basic mechanism.

(7 marks)

(b) The block of weight 100 kg is pulled by rope with a pulley and connected with a small block of *m* kg. A 200 N force also acts horizontally as shown in Figure **Q3 (a)**. If the coefficients of friction between the block and plane are $\mu_s = 0.3$ and $\mu_k = 0.25$:

i. Draw the free-body diagrams.

(2 marks)

ii. Calculate the friction force, if $m = 2$ kg and $m = 5$ kg. Determine whether the block is moving or in the verge of impending motion. (Assume no friction at the pulley)

(10 marks)

(c) Figure **Q3 (b)** shows the static equilibrium of pulley system that carries a block of weight 10 kN. Determine the tension force T in the cable of the pully system. Show appropriate free-body diagrams to support the calculation.

(6 marks)

Q4 (a) Explain the difference between centre of gravity and centroid of a body.

(4 marks)

(b) Determine the centroid of the composite area as shown in Figure **Q4** and with the aid of sketching, shows the location of centroid.

(8 marks)

(c) Determine the moment of inertia about the x-axis and y-axis of the shaded area as shown in Figure **Q4**.

(12 marks)

SECTION B

Q5 (a) Explain briefly the term:

(i) Displacement and distance

(2 marks)

(ii) Speed and velocity

(2 marks)

(iii) Acceleration

(2 marks)

(b) A car bumper is designed to bring a 1800 kg car to a stop from a speed of 2.23 m/s at displacement 150 mm. Assuming the constant deceleration, determine the average force on the bumper when it stop.

(9 marks)

(c) Three small sphere A, B and C with a mass of 3 kg, 4 kg and 7 kg respectively are arranged aline as shown in Figure **Q5**. Initially, the sphere B is placed in the static condition, while the sphere A is moving with a velocity 4*u* collides towards sphere B and collides. Then, sphere C move to the right direction with a velocity *u*. The elastic coefficient between sphere A and B is 3/4 and between B and C is 1/2. Determine:

(i) The velocity of sphere A and B after the first collision. Explain the condition of both sphere.

(4 marks)

(ii) The lost of energy from the first collision between sphere A and B.

(2 marks)

(iii) The velocity of sphere B and C after the second collision. Explain the condition of both spheres.

(4 marks)

- END OF QUESTION -

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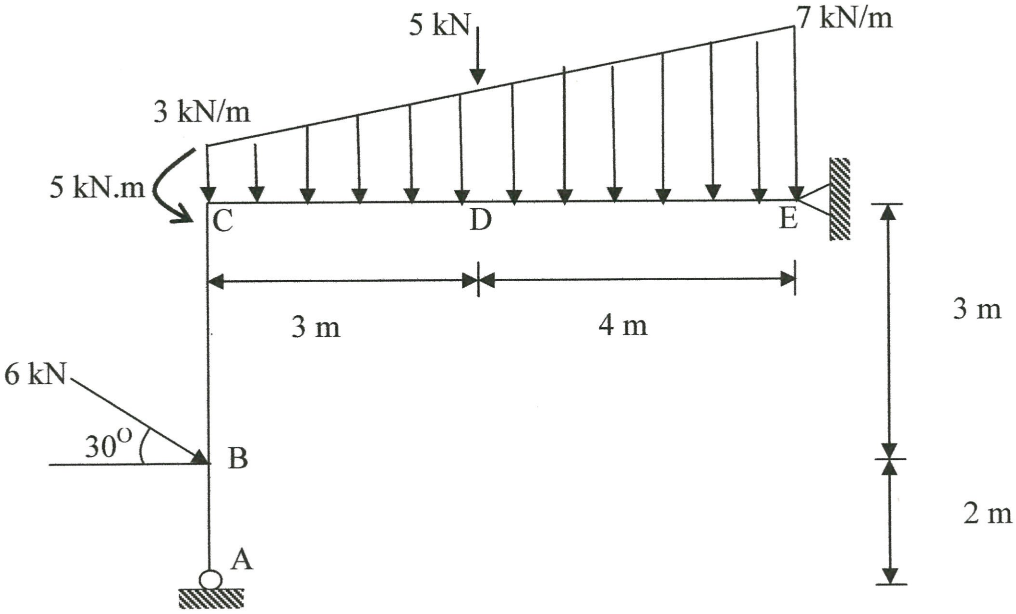

FIGURE Q1

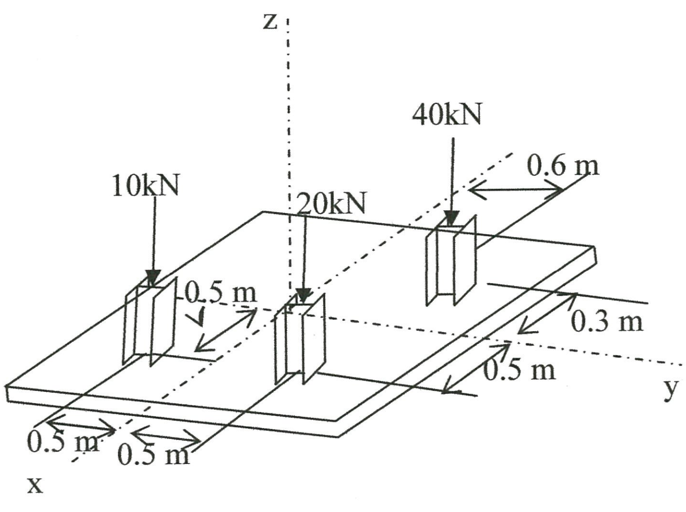

FIGURE Q2 (a)

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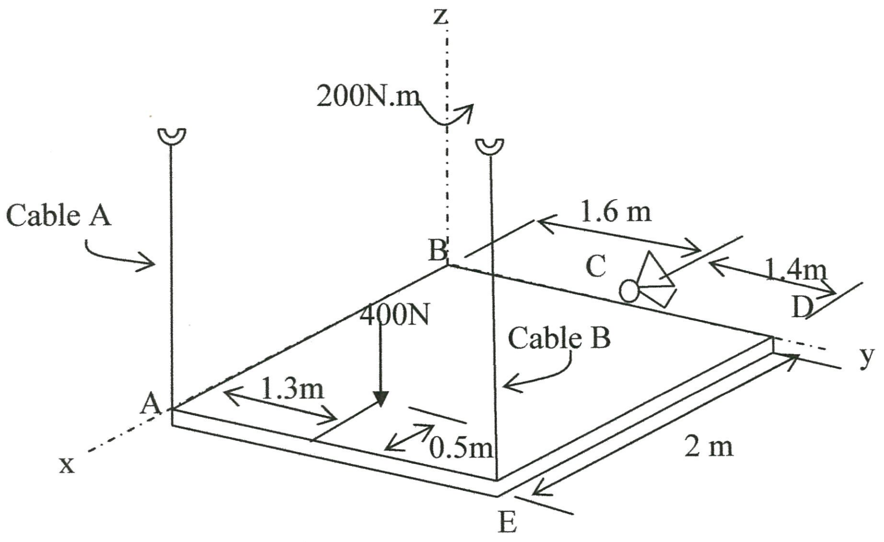

FIGURE Q2 (b)

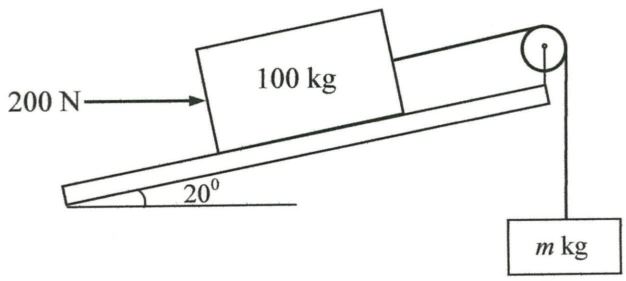

FIGURE Q3(a)

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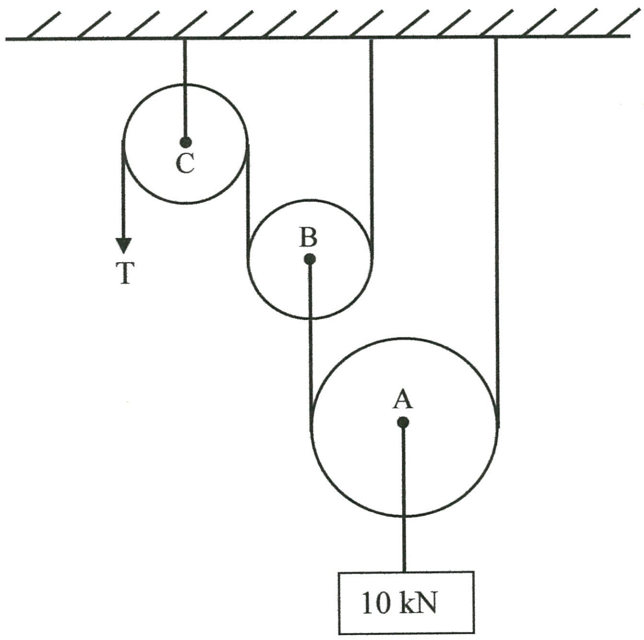

FIGURE Q3(b)

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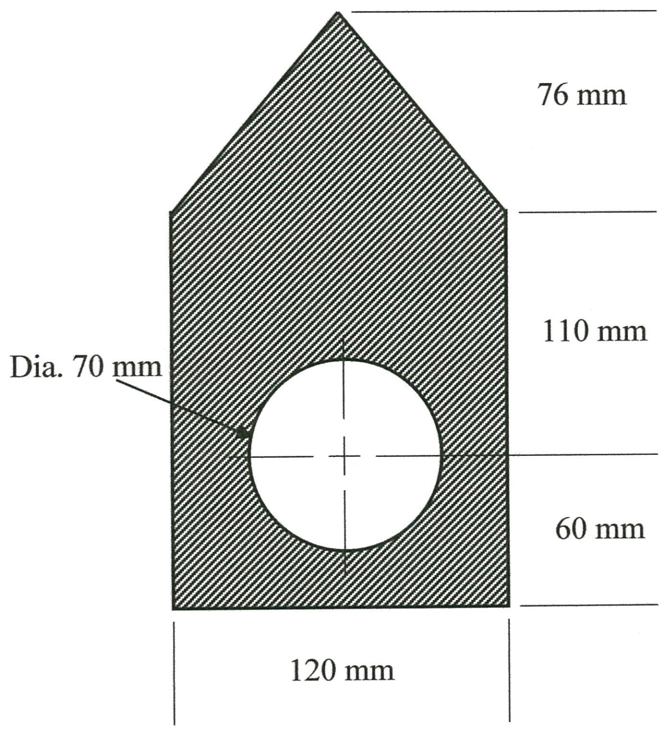

FIGURE Q4

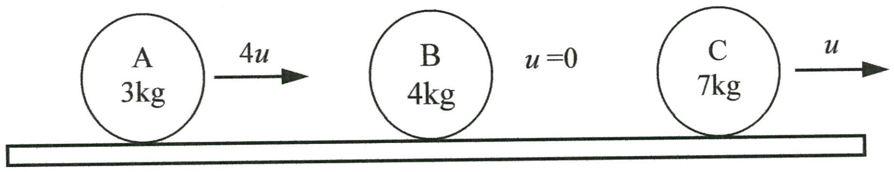

FIGURE Q5

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APPENDIX

TABLE 1 : CENTROID

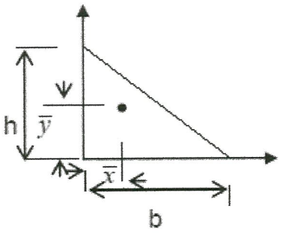
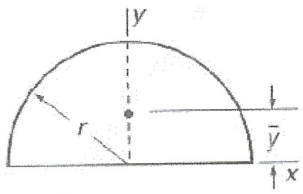
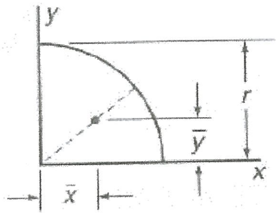
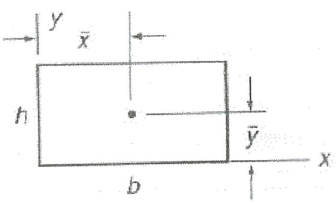
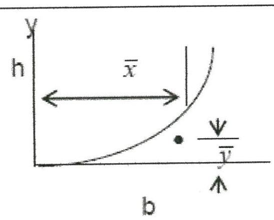
	SHAPE	$\bar{x}$	$\bar{y}$	A
Triangle		$\frac{b}{3}$	$\frac{h}{3}$	$\frac{1}{2}bh$
Semicircle		0	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{2}$
Quarter circle		$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{4}$
Rectangle		$\frac{b}{2}$	$\frac{h}{2}$	bh
Parabolic spanderl		$\frac{3b}{4}$	$\frac{3h}{10}$	$\frac{bh}{3}$

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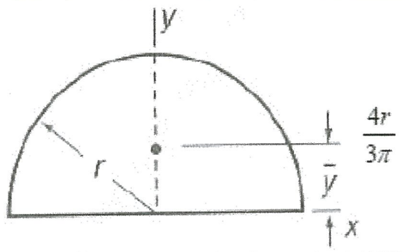
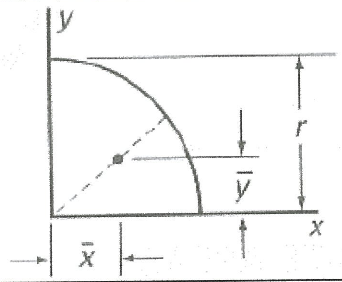
TABLE 2 : MOMENT OF INERTIA

Semicircle		$I_x = I_y = \frac{1}{8}\pi r^4$ $J = \frac{1}{4}\pi r^4$
Quarter circle		$I_x = I_y = \frac{1}{16}\pi r^4$ $J = \frac{1}{8}\pi r^4$

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LIST OF EQUATION

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

$$v = v_0 + at$$

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

Elastic Collision

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$m_1u_1 - m_2u_2 = m_1v_1 + m_2v_2$$

$$m_1u_1 + 0 = m_1v_1 + m_2v_2$$

Inelastic Collision

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v_1$$

Coefficient of Elasticity

$$\frac{v_2 - v_1}{u_1 - u_2} = e \quad \text{.................} 0 \le x \le 1$$

If e = 0, the material is not elastic
If e=1, the material is fully elastic.
If e = 0, inelastic collision, $v_1 = v_2 = v \rightarrow m_1u_1 + m_2u_2 = (m_1 + m_2)v$
If e = 1, elastic collision, $v_2 - v_1 = u_1 - u_2$

Hooke's Law

$$U = \tfrac{1}{2}Fx \quad @ \; \tfrac{1}{2}Fs$$

$$= \tfrac{1}{2}kx^2$$

$$= \tfrac{1}{2}k(\Delta x)^2$$

Energy, power , work

$$E = mgh$$

$$E = \tfrac{1}{2}mv^2$$

$$P = \frac{Work}{time} = \frac{W(J)}{T(s)}$$

$$Work = \frac{1}{2}F \cdot (\Delta x)^2$$