Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	STATICS AND DYNAMICS
COURSE CODE	:	BFC 10102/ BFC 10103
PROGRAMME	:	1 BFF
EXAMINATION DATE	:	DECEMBER 2014/JANUARY 2015
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTION	:	ANSWER **THREE (3)** QUESTIONS IN **SECTION A** AND **All** QUESTIONS IN **SECTION B.**

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

SECTION A

Q1 (a) Define the differences between mass and weight.

(5 marks)

(b) Figure **Q1** shows the truss of the 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 an equilibrium and support by roller at A and pinned at E, calculate the force reaction 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

(1 mark)

(b) A steel plate is supported by a bracket at A and B as shown in Figure **Q2(a)**. A100 N force P acts at C which creates the moment along the plate.

(i) Determine, the moment of the force about A, B and C.

(5 marks)

(ii) Sketch the direction of the moment at each bracket.

(2 marks)

(iii) Calculate the smallest force applied at C which creates the same moment about B.

(5 marks)

(c) State a definition of the moment of a couple.

(2 marks)

(d) A plate girder is held in a horizontal position by two cables as shown in Figure **Q2(b)**. Knowing that the weight of the box at O is 500 kg, determine anequivalent resultant force and moment about point B when $\alpha = 40^{\circ}$.

(8 marks)

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

(7 marks)

(b) The block of weight 100 kg is pulled by the ropes 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 there is 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 T in the cable of the pully system. Draw appropriate free-body diagrams to support the calculation.

(6 marks)

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

(4 marks)

(b) Determine the centroid of the composite area as shown in Figure **Q4** and draw the centroid location using sketch diagram.

(9 marks)

(c) Compute 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
(ii) Speed and velocity
(iii) Acceleration

(6 marks)

(b) A car bumper is designed to bring a 1800 kg car to a stop from a speed of 2.23 m/s while deforming 150 mm. Assume constant deceleration. Determine the average force on the bumper during this 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 in the same line as shown in Figure **Q5**. Initially, the sphere B is placed in the static condition, while the sphere A is moving with a velocity $4u$ collides to the sphere B. Then, sphere C moving 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 for 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 sphere.

(4 marks)

- END OF QUESTION -

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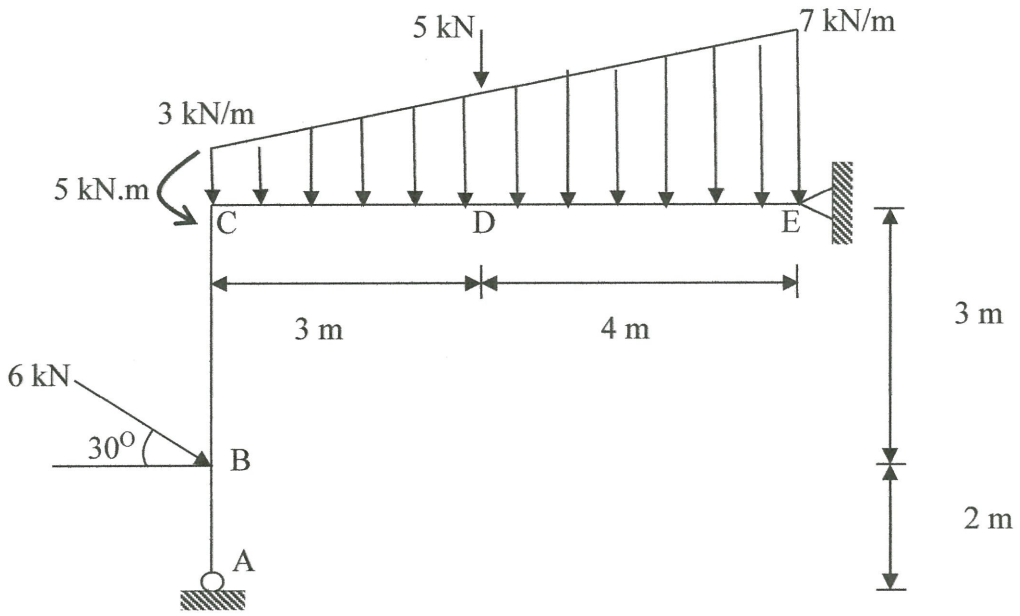

FIGURE Q1

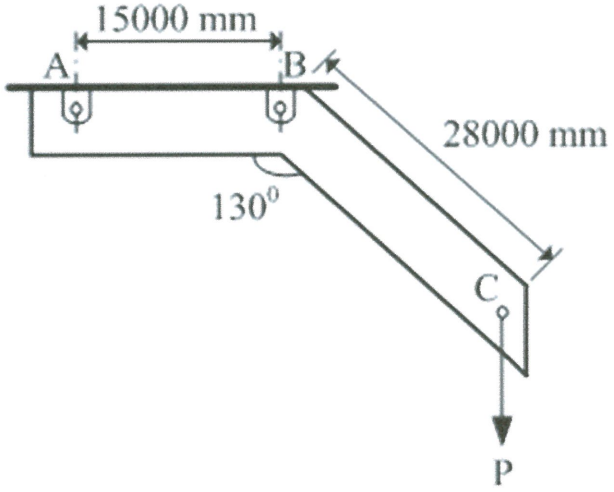

FIGURE Q2 (a)

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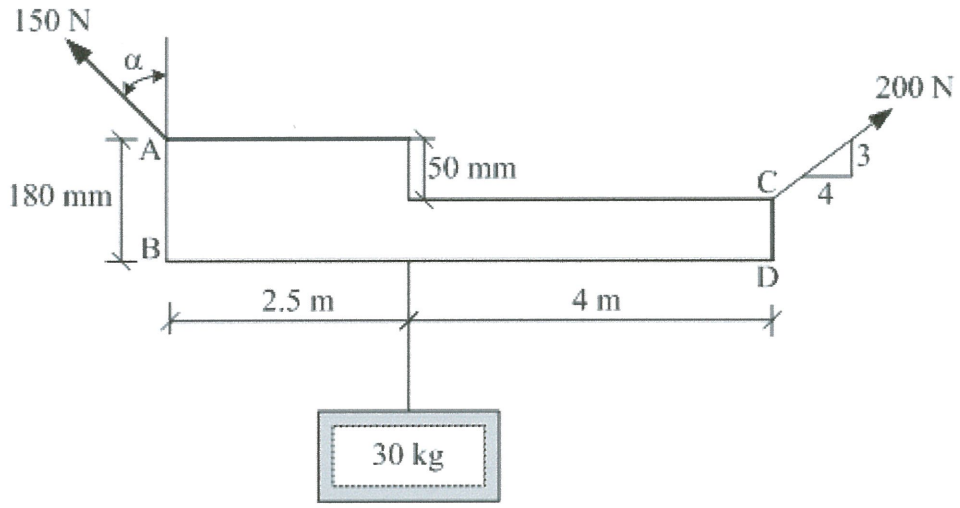

FIGURE Q2 (b)

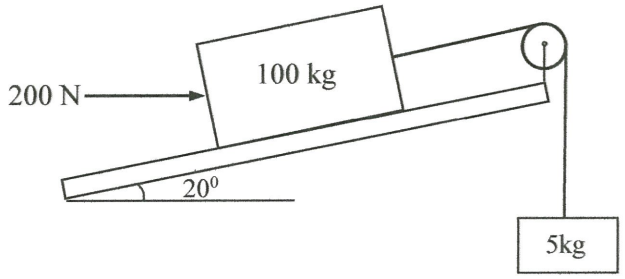

FIGURE Q3(a)

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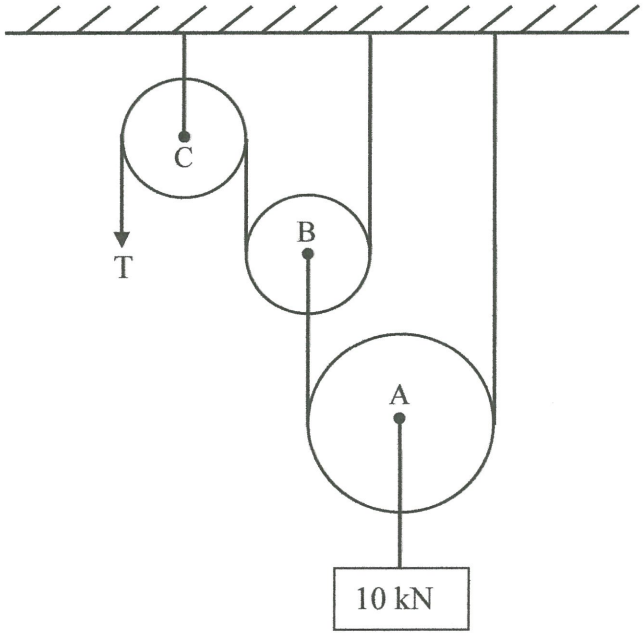

FIGURE Q3(b)

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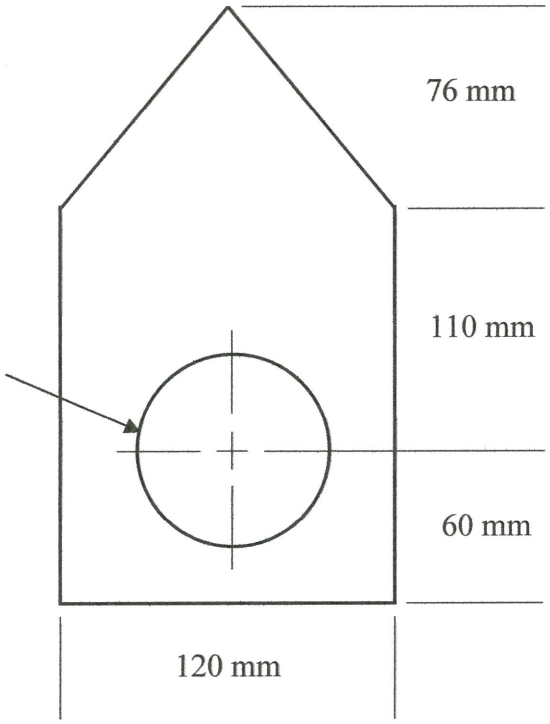

FIGURE Q4

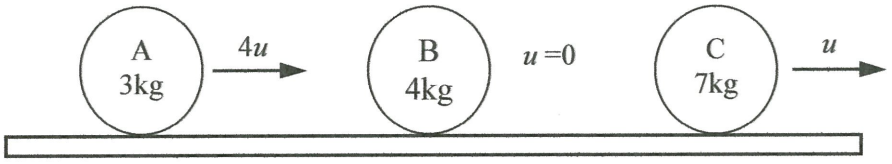

FIGURE Q5

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APPENDIX

TABLE 1 : Centroid

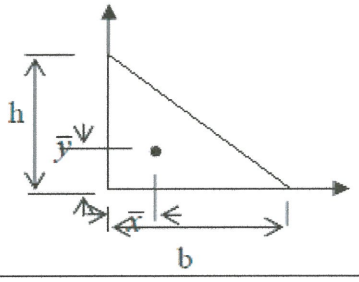
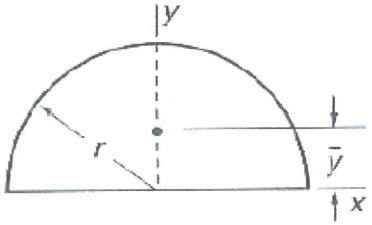
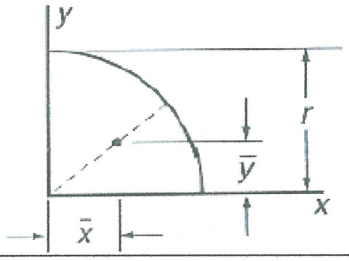
	SHAPE	$\bar{x}$	$\bar{y}$	A
Triangle		$\frac{b}{3}$	$\frac{h}{3}$	$\frac{1}{2}bh$
Semicircle		0	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{2}$
Quarter circle		$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{4}$

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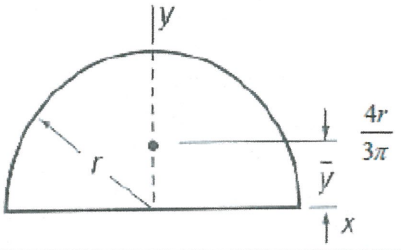
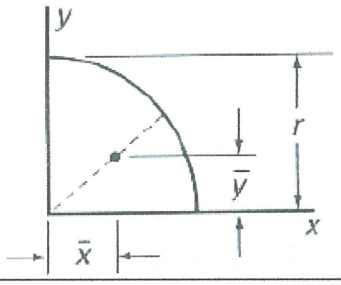
TABLE 2 : Moment of Inertia

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

$$E = mgh$$

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

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

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