Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	DYNAMICS
COURSE CODE	:	BNJ 20103 & BNT 20103
PROGRAMME CODE	:	BNG / BNL / BNM / BNT
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION	1.	ANSWER ALL QUESTIONS
	2.	THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK**

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) **Figure Q1 (a)** shows a basketball game. Player A is trying to shoot the ball from point A, at 60° angle with distance 5.6 m from the hoop. The hoop is 3 m off the ground. Neglect the size of the ball. Use $g = 9.81 m/s^2$.

(i) Determine the velocity, V_A, required for the ball to enter the hoop if the ball is shoot at 2.X metres off the ground, where X is the last non-zero digit of your matric number. For example: if your matric number is AN201050, point A = 2.5 metres off the ground.

(6 marks)

(ii) The player playing defence, intends to block the ball at point B. He makes a jump at 60° angle from the floor at the exact same time the ball is shot at A. Calculate the height of point B from the ground, *h*, if the horizontal distance from the hoop is 0.X m, where X is the last non-zero digit of your matric number. For example: if your matric number is AN201050, point B = 0.5 metres from the hoop.

(4 marks)

(iii) Calculate the magnitude and direction of velocity of the ball when it contacts player B's hands.

(6 marks)

(b) A particle moves with a velocity, $v = 2t - 5$. Given initial velocity and position, $a_0 = 0$ m/s^2 and $S_0 = 4$ m for the time 0 to t seconds and $t = 4 + X$, where X is the last non-zero digit of your matric number. For example: if your matric number is AN201050, $t = 4 + 5 = 9$ seconds.

(i) Fully sketch the $v - t$ graph for the time 0 to t seconds.

(2 marks)

(ii) Fully sketch the $s - t$ graph for the time 0 to t seconds.

(3 marks)

(iii) Calculate displacement, s at t seconds.

(1 marks)

(iv) Fully sketch the $a - t$ graph for the time 0 to t seconds.

(3 marks)

Q2 (a) Explain **ONE (1)** example of Newton's second law, that you can find in your house that can be treated as a particle and then sketch the free body diagram and kinetic diagram of your example.

(4 marks)

(b) **Figure Q2 (b)** shows a box fitted with a pulley. The wall has one pulley fixed. A cord is pulled with a tension, T, is attached to the centre of the pulley of the box and wrapped around the pulleys. Given $T = 3X$ N and the mass of the block, $m = 1X$ kg where X is the last non-zero digit of your Matric number. For example: if your matric number is AN201050, then $T = 35$ N and $m = 15$ kg.

(i) Draw the free body diagram and kinetic diagram.

(2 marks)

(ii) Determine the maximum frictional force.

(3 marks)

(iii) Determine the total force in the x-direction, Fx, due to the tension on the cord and due to the pulleys.

(3 marks)

(iv) Explain if the box will move or not.

(2 marks)

(v) Determine the acceleration of the box.

(3 marks)

(c) **Figure Q2 (c)** shows an impact event. A big disc, $m_1 = 8$ kg impacts a smaller disc, $m_2 = X$ kg where X is the last non-zero digit of your Matric number. For example: if your matric number is AN201050, $m_2 = 5$ kg. The initial velocities of the discs are given in **Figure Q2 (c)** and the coefficient of restitution $e = 0.80$. Calculate the magnitude and directions of the final velocities of m_1 and m_2.

(8 marks)

Q3 (a) Sketch with direction of motion examples of **FOUR (4)** types of planar rigid body motion available in your house.

(4 marks)

(b) **Figure Q3 (b)** shows constant angular velocity $\omega_1 = 20$ rad/s anticlockwise applied to the system of links *AB*, *BD* and *DE*. At the current position, determine angular velocity of rod *BD* and *DE* using these methods;

(i) Relative motion analysis for velocity.

(9 marks)

(ii) Instantaneous centre of zero velocity.

(12 marks)

Q4 (a) **Figure 4 (a)** shows a thin circular disc with a mass of 2 kg welded to the surface of a thin square plate with mass of 1 kg and length of the edge, $l = 0.X$ m, where X is the last non-zero digit of your Matric number. For example: if your matric number is AN201050, then $l = 0.5$ m. The disc is pin join to the yellow bracket at the centre of the disc and is free to rotate. Both disc and plate are homogenous solids.

(i) Give the equations for mass moment of inertia for thin circular disc and thin plate. Then, give the parallel axis theorem.

(5 marks)

(ii) Determine the angular acceleration at this instant if a Force, $F = 0.X$ N, where X is the last non-zero digit of your Matric number. For example: if your matric number is AN201050, then $F = 0.5$ N. F is directed towards the centre of the square plate. The system is initially at rest.

(16 marks)

(b) Explain and then sketch the free body diagram and kinetic diagram of **ONE (1)** example that must be treated as a rigid body that you can find in your house.

(4 marks)

- END OF QUESTIONS -

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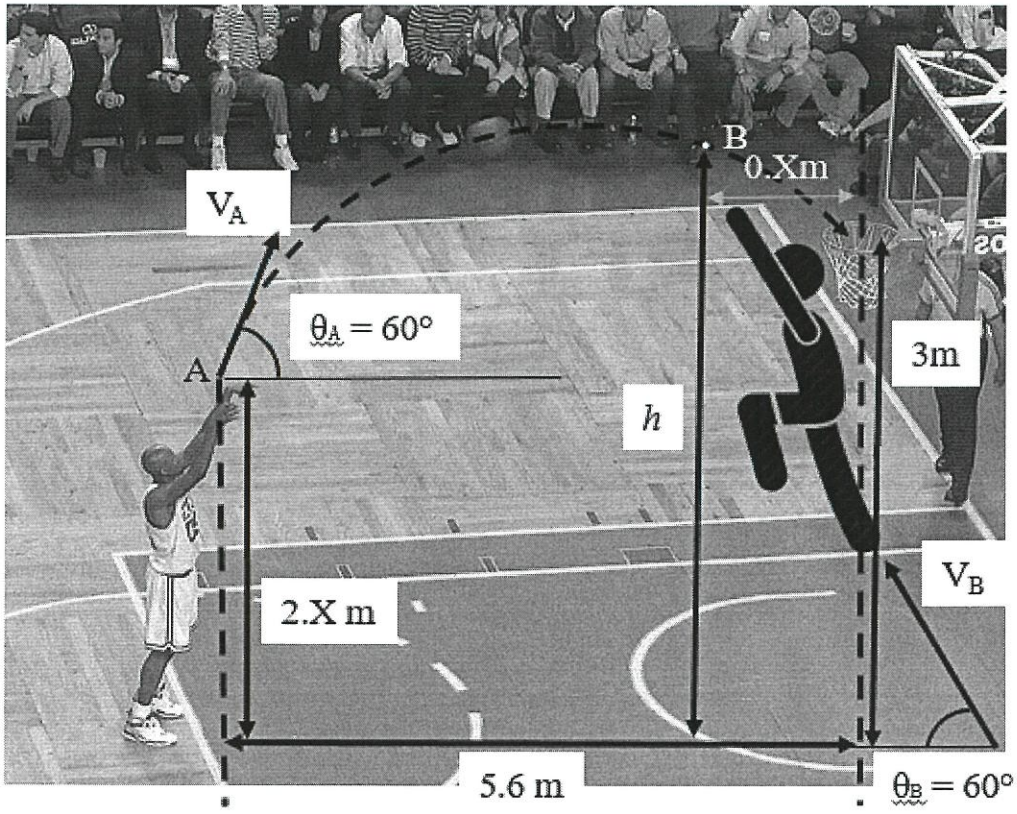

Figure Q1 (a)

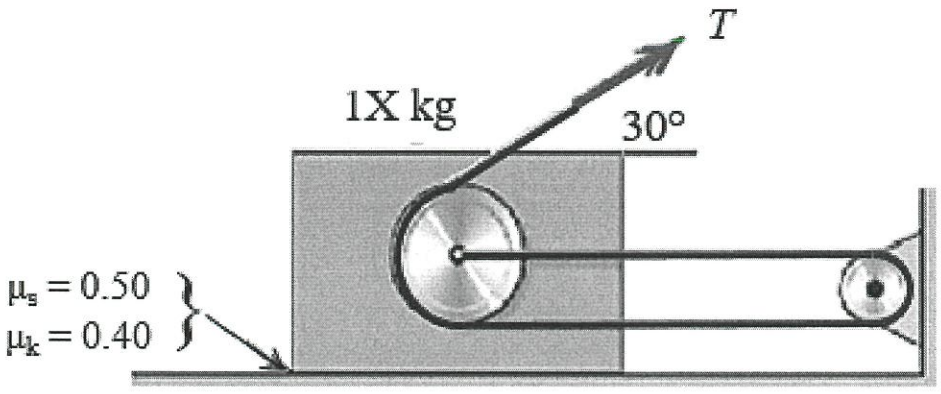

Figure Q2 (b)

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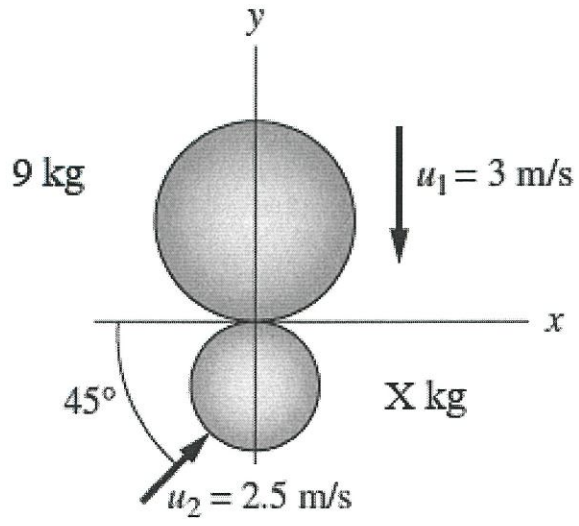

Figure Q2 (c)

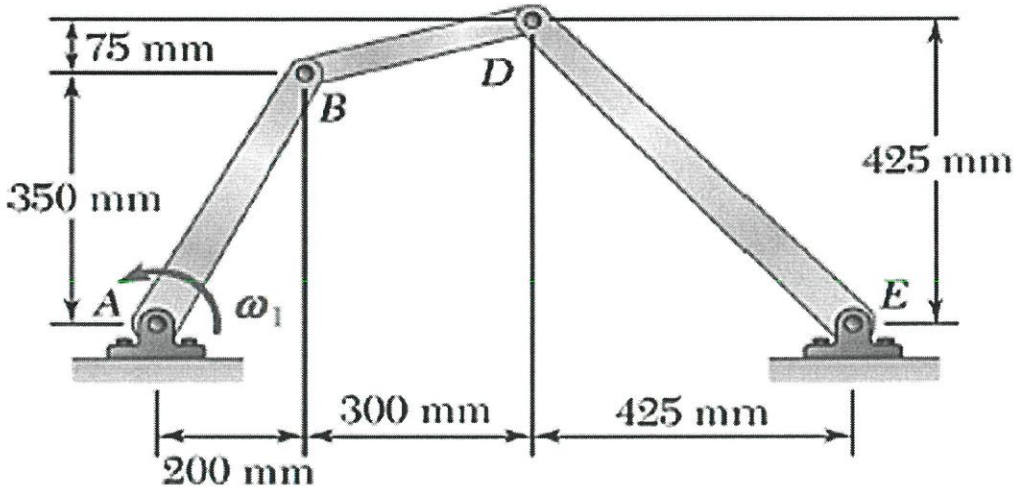

Figure Q3 (b)

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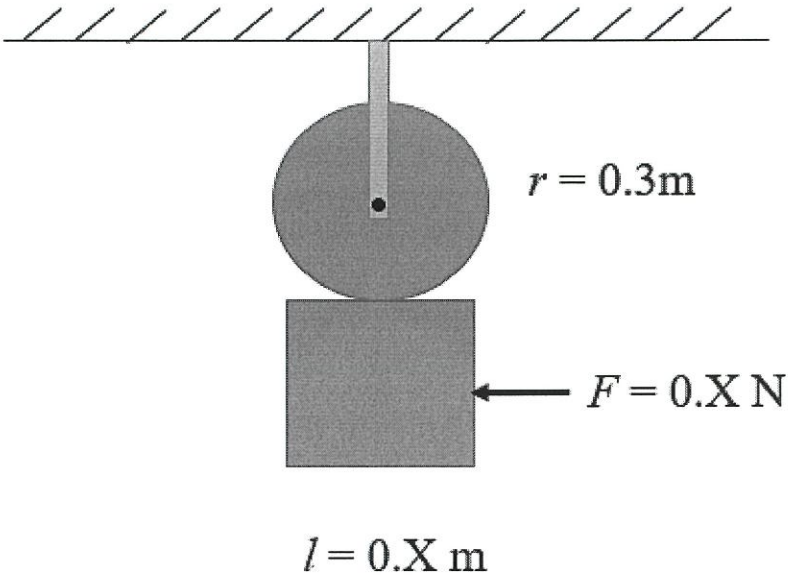

Figure Q4 (a)