Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	ENGINEERING MECHANICS
COURSE CODE	:	BDX 10603
PROGRAMME CODE	:	BDX
EXAMINATION DATE:		JULY/AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **FIVE (5)** QUESTIONS **ONLY** FROM **SIX (6)** QUESTIONS GIVEN
		2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSE** BOOK
		3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSE BOOK

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1. (a) A torque is applied to a flywheel causes it to accelerate uniformly from a speed of 300 rev/min to a speed of 900 rev/min in 6 seconds. Determine the number of revolutions N through which the wheel turns during this interval.

(5 marks)

(b) The T-shaped shown in **Figure Q1(b)** body rotates about a horizontal axis through point O. at the instant represented, its angular velocity is ω= 3rad/s and its angular acceleration is α= 14 rad/s^2 in the directions indicated. Determine the velocity and acceleration of :

i. Point A
ii. Point B

(10 marks)

(c) Two particles of mass 3 kg and 5 kg are connected by light inextensible string passing over a smooth pulley which is fixed to the ceiling of a lift. Find the tension in the string when the system is moving freely and the lift has a downward acceleration g ms^{-2}

(5 marks)

Q2 (a) A test car starts from rest on a horizontal circular track of 80 m radius and increase its speed at a uniform rate to reach 100 km/h in 10 seconds. Determine the magnitude a of the total acceleration of the car 8 seconds after the start.

(7 marks)

(b) The jet transport B is flying North with a velocity V_B = 600 km/h when a smaller aircraft A passes underneath the transport headed in the 60^o direction shown in **Figure Q2(b)**. To passengers in B, however A appears to be flying sideways and moving east. Determine the actual velocity of A and the velocity which A appears to have relative to B.

(5 marks)

(c) A small airplane flying horizontally with a speed of 180 mi/hr at an altitude of 400 ft above a remote valley drops an emergency medical package at A shown in **Figure Q2(c)**. The package has a parachute which deploys at B and allows the package to descend vertically at the constant rate of 6 ft/sec. if the drop is designed so that the package is to reach the ground 37 seconds after release at A, determine the horizontal lead L so that the package hits the target.

(8 marks)

Q3 (a) A man of mass M carries in his hand a parcel of mass m. he stands in a lift of mass X which is descending with an acceleration a (a<g). Find

i. The reaction R1 between his hand and the parcel
ii. The reaction R2 between is feet and the lift
iii. The tension T in the cable supporting the lift

(6 marks)

(b) A cylinder of mass m rest in a supporting carriage as shown in **Figure Q3(b)**. If $\beta = 45^{\circ}$ and $\theta = 30^{\circ}$, calculate the maximum acceleration a which the carriage may be given up the incline so that the cylinder does not lose contact at B.

(4 marks)

(c) The 10 kg steel sphere is suspended from the 15 kg frame which slide down the 20° incline as shown in **Figure Q3(c)**. If the coefficient of kinetic friction between the frame and incline is 0.15, compute the tension in each of the supporting wires A and B.

(10 marks)

Q4 (a) Calculate the vertical acceleration a of the 100 lb cylinder for each of the two cases illustrated in **Figure Q4(a)**. Neglect friction and the mass of the pulleys.

(6 marks)

(b) The crawler wrecking crane shown in **Figure Q4(b)** is moving with a constant speed of 2 mi/hr when it is suddenly brought to a stop. Compute the maximum angle θ through which the cable of the wrecking ball swings.

(4 marks)

(c) A small rocket propelled test vehicle with a total mas of 100 kg starts from rest at A and moves with negligible friction along the track in the vertical plane as shown in **Figure Q4(c)**. If the propelling rocket exerts a constant thrust T of 1.5 kN from A to position B where it is shut off, determine the distance s which the vehicle rolls up the incline before stopping. The loss of mass due to the expulsion of gases by the rocket is small and maybe neglected.

(10 marks)

Q5 (a) A 60 g bullet is fired horizontally with a velocity v_1= 600 m/s into the 3 kg block of soft wood initially at rest on the horizontal surface as shown in **Figure Q5(a)**. The bullet emerges from the block with the velocity v_2 = 400 m/s and the block is observed to slide a distance of 2.70 m before coming to rest. Determine the coefficient of kinetic friction μ_k between the block and the supporting surface.

(6 marks)

(b) A person who walks through the revolving door exerts a 90 N horizontal force on one of the four door panels and keeps the 15° angle constant relative to a line which is normal to the panel shown in **Figure Q5(b)**. If each panel is modeled by a 60kg uniform rectangular plate which is 1.2 m in length as viewed from above, determine the final angular velocity ω of the door if the person exerts the force for 3 seconds. The door is initially at rest and friction maybe neglected.

(6 marks)

(c) The velocity of the 8 kg cylinder is 0.3 m/s at a certain instant shown in **Figure Q5(c)**. What is its speed v after dropping an additional 1.5 m?
The mass of the grooved drum is 12 kg, its centroidal radius of gyration is k = 210 mm and the radius of its groove is r_i = 200mm. The frictional moment at O is a constant 3 Nm.

(8 marks)

Q6 (a) For the spring mass system shown in **Figure Q6(a)**, determine the static deflection δ_{st} the system period τ, and the maximum velocity v_{max} which result if the cylinder is displaced 100 mm downward from its equilibrium position and released.

(10 marks)

(b) The cylinder from **Figure Q6(a)** is then displaced from its equilibrium position and released at time $t = 0\ s$. Determine the position y, velocity v and acceleration a when $t = 3s$. What is the maximum acceleration?

(10 marks)

-END OF QUESTION-

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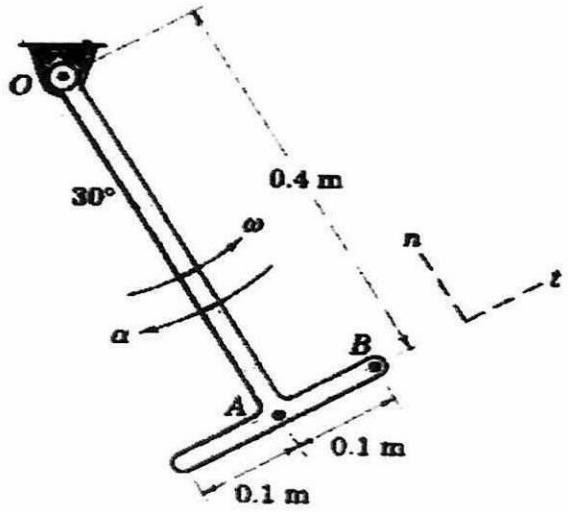

Figure Q1(b)

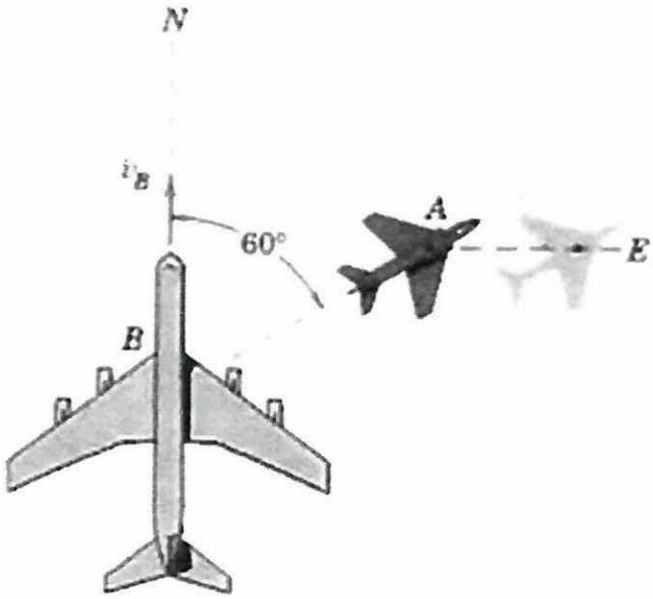

Figure Q2(b)

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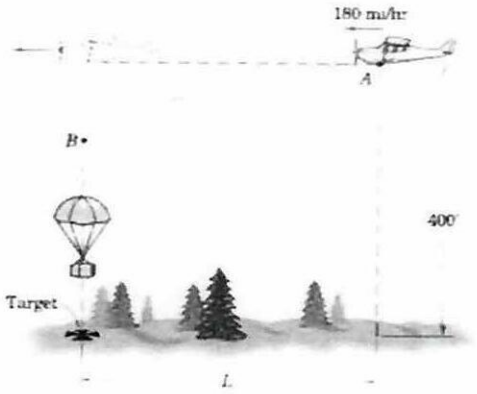

Figure Q2(c)

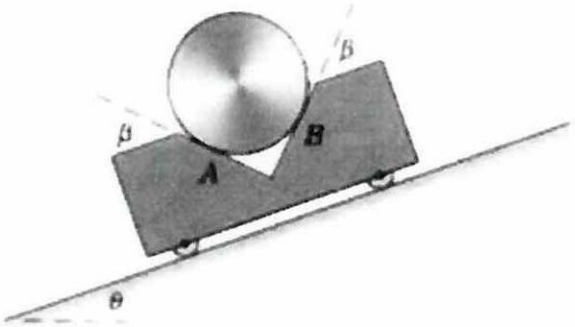

Figure Q3(b)

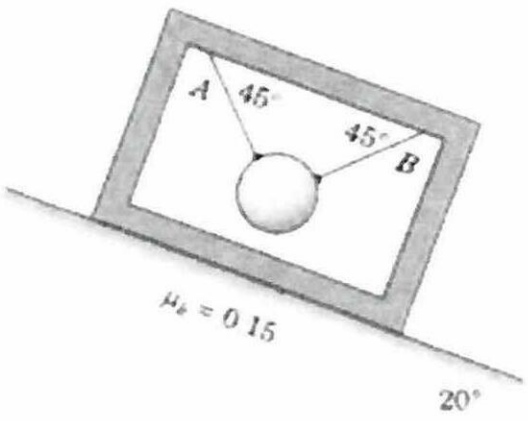

Figure Q3(c)

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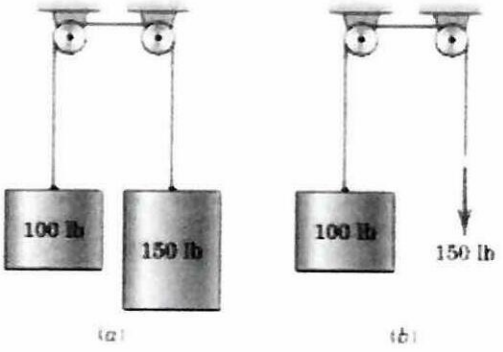

Figure Q4(a)

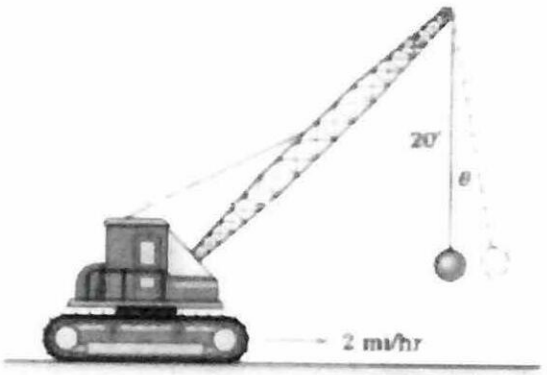

Figure Q4(b)

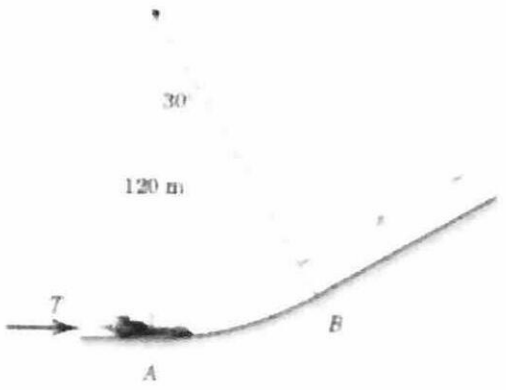

Figure Q4(c)

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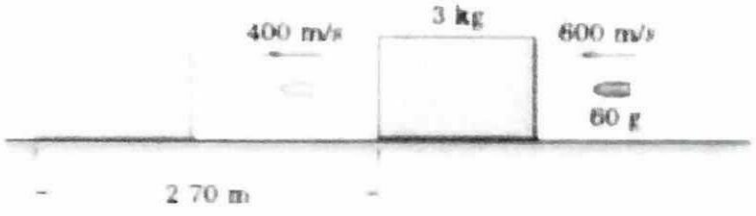

Figure Q5(a)

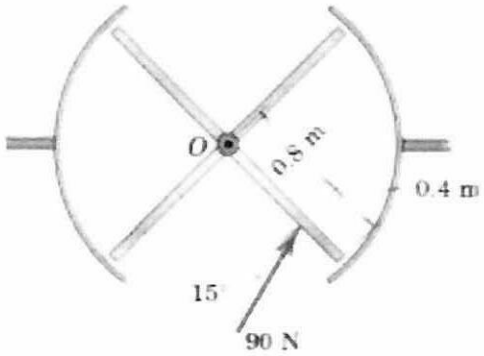

Figure Q5(b)

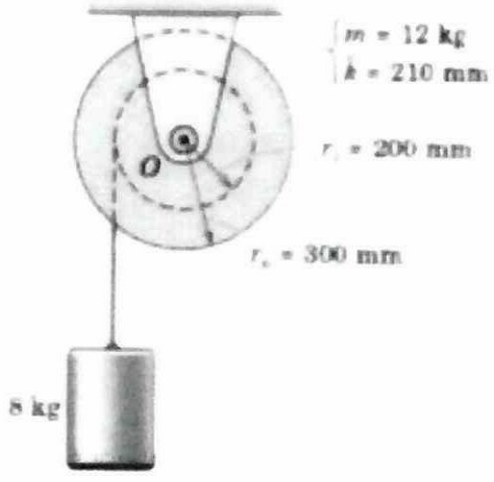

Figure Q5(c)

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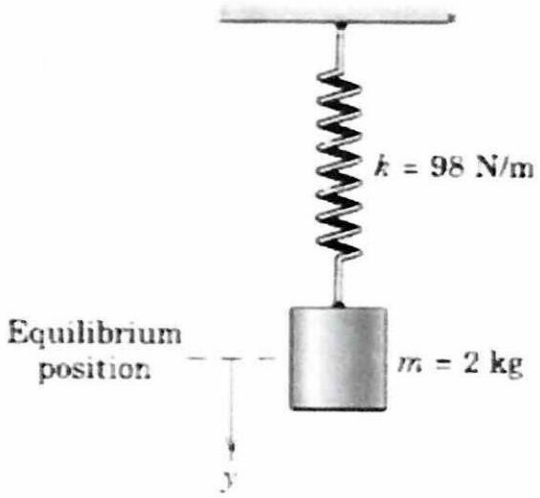

Figure Q6(a)