Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	ENGINEERING MECHANICS
COURSE CODE	:	BDU10503
PROGRAMME CODE	:	BDC
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. PART A: ANSWER ALL QUESTIONS. PART B: ANSWER **ONE (1)** QUESTION FROM TWO (2) QUESTIONS ONLY. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

PART A

Q1 (a) List four (4) characteristics that characterized the kinematics of a particle.

(2 marks)

(b) Based on the answer given in Q1(a), define any two of the characteristics.

(4 marks)

(c) A runner jogs in three stages from his house to a nearby park as follows:

First stage	:	The runner starts from rest and accelerates at $0.06\ m/s^2$ for 60 s.
Second stage	:	The runner runs with a constant velocity for 15 min.
Third stage	:	The runner slows down at $0.03\ m/s^2$ and stop at the park.

Based on the conditions stated above, calculate the distance covered by the runner in all three stages to determine the distance between his house and the park.

(10 marks)

(d) Explain the following terms:
(i) Impulse
(ii) Momentum.

(5 marks)

(e) A 0.03-lb bullet shown in **Figure Q1.1** travelling at 1300 ft/s strikes the 10-lb wooden block and exits the other side at 50 ft/s. Calculate the speed of the block just after the bullet exits the block.

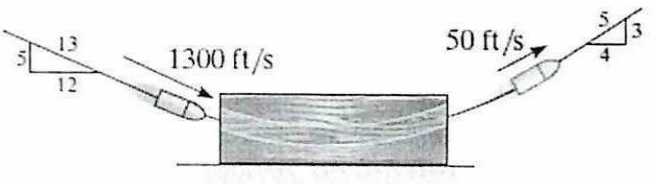

Figure Q1.1 Bullet striking wooden block.

(4 marks)

Q2 (a) Describe these two types of motions: translational and rotational.

(4 marks)

(b) Describe Newton's second law of motion and its relationship to acceleration.

(2 marks)

(c) A crate is placed on a conveyor as shown in **Figure Q2.1**. If the speed of the crate at A is v = 15 ft/s, which is increasing at a rate $\dot{v}$ = 3 ft/s^2, determine the magnitude of the acceleration of the crate at this instant.

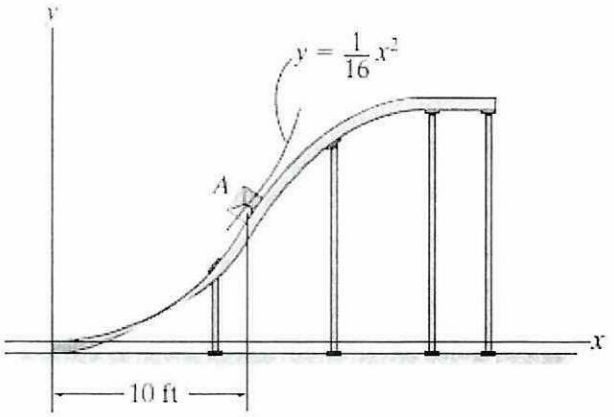

Figure Q2.1 Conveyor system.

(7 marks)

(d) A man is trying to move a 50-kg block from rest by applying a force ***P*** as indicated in **Figure Q2.2**. The block achieves a velocity of v = 4 m/s when the block moves 5 m to the right. The coefficient of kinetic friction between the block and the ground is μ_k = 0.3.

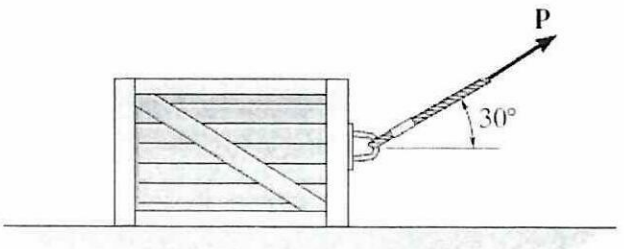

Figure Q2.2 Block at rest.

(12 marks)

Q3 (a) Draw the trajectory of a projectile and then explain how the horizontal and vertical components of velocity change during the trajectory of a projectile.

(8 marks)

(b) A rubber glider is launched with a horizontal velocity v_A strikes the smooth ground at B and bounces upward at $\theta = 30°$ with a final velocity v_B, as shown in **Figure Q3.1**. By examining the observable facts, determine the coefficient of restitution between the glider and the ground.

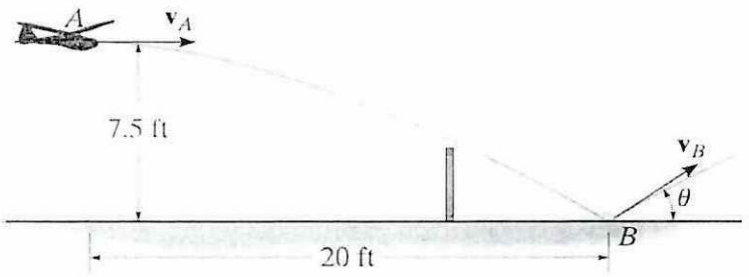

Figure Q3.1 Rubber glider.

(11 marks)

(c) Two boats leave the shore at the same time and travel in the speeds and directions shown in **Figure Q3.2**. Determine the velocity of boat A with respect to boat B and analyse how long after leaving the shore will the boats be 600 m apart. Provide a free body diagram in your analysis.

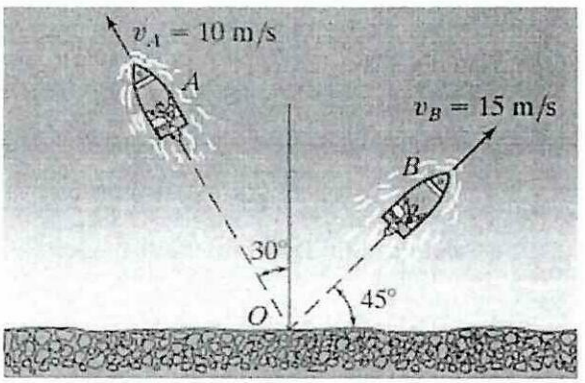

Figure Q3.2 Boats leaving the shore.

(6 marks)

PART B

Q4 a) A dragster shown in **Figure Q4.1** is a specialized competition automobile used in drag racing. If the jet on the dragster supplies a constant thrust force of 20 kN, Sketch the free body diagram and determine the power generated by the jet as a function of time. The mass of the dragster is 1 Mg and starts from rest. Neglect drag and rolling resistance, and the loss of fuel.

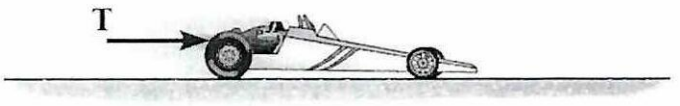

Figure Q4.1 A dragster.

(7 marks)

(b) In order to keep a hot air balloon from flying away during a tethered ride, the balloon is tied to the ground with three strong ropes as shown in **Figure Q4.2**. The tension in cable AC is found to be 500 N. A vertical force **Q** is exerted by the balloon at A. Examine the figure and determine magnitude of **Q** and forces in cables AB and AD.

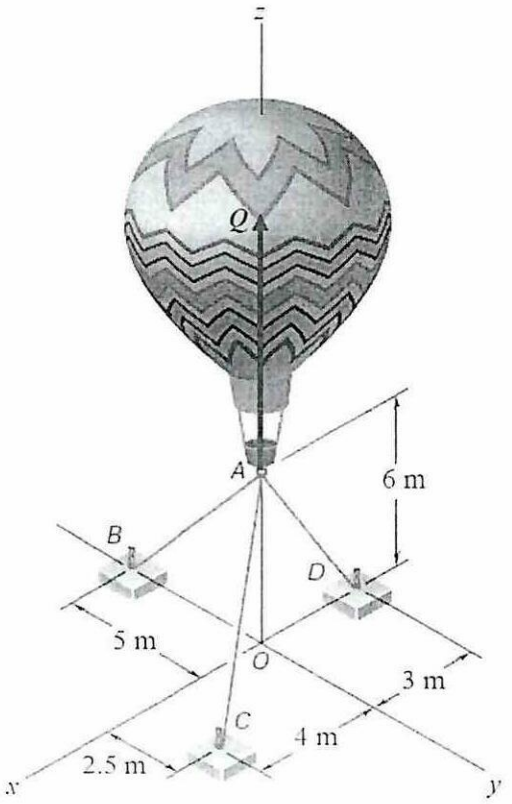

Figure Q4.2 Hot air balloon.

(18 marks)

Q5 Examine a roof truss shown in **Figure Q5.1**. It carries a horizontal load at points B, C, E, F and H. Model the supports at A and I as roller supports and then:

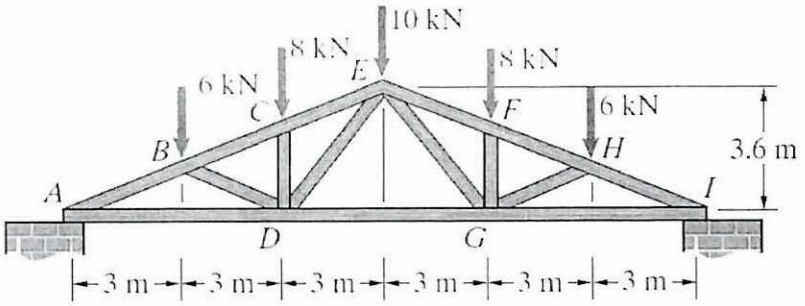

Figure Q5.1 Roof truss.

(a) sketch the free-body diagram of the entire truss and provide appropriate labels.

(3 marks)

(b) determine the support reaction at A.

(4 marks)

(c) analyse the axial forces in member AD, BD, DE, and DG.

(18 marks)

- END OF QUESTIONS -