Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	ENGINEERING MECHANICS
COURSE CODE	:	BDU 10503
PROGRAMME CODE	:	BDC / BDM
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. PART A: ANSWER **ALL** QUESTIONS. PART B: ANSWER **ONE (1)** QUESTION ONLY. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**. 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE FINAL EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

PART A: Answer **ALL** questions.

Q1 (a) Idealizations are commonly made in engineering mechanics.

(i) Explain the importance of idealizations.

(2 marks)

(ii) Describe **TWO (2)** idealizations used in engineering mechanics.

(6 marks)

(iii) Describe **ONE (1)** situation where the idealization is appropriate.

(2 marks)

(iv) Explain **ONE (1)** limitation or drawback of using idealization in the analysis of real-world engineering problems.

(2 marks)

(b) Two ground handling workers apply forces to push an aircraft container. As indicated in **Figure Q1(b)**, worker A applies a force in the negative a direction and worker B applies a force in two different directions, with the goal of producing a resultant force of 250 N in the c direction. While at Position 1, worker B applies a force in the positive b direction before moving 45° to the left to be at Position 2.

Examine the magnitude of forces that these two workers must apply. By comparing the results of the different positions, conclude which position will require less forces from both workers. Express the answers in terms of the magnitude and provide an appropriate parallelogram for each case.

(13 marks)

Q2 (a) Two forces are exerted on the post as shown in **Figure Q2(a)**. Represent each force as a Cartesian vector and determine the magnitude as well as the coordinate direction angles of the resultant force acting at point A.

(17 marks)

(b) **Figure Q2(b)** shows an aircraft flying in the vertical plane and its free-body diagram. The forces acting on the airplane are its weight W, the thrust T exerted by its engines, and aerodynamic forces resulting from the pressure distribution on the aircraft's surface. The dashed line indicates the path along which the aircraft is moving. The aerodynamic forces are resolved into a component perpendicular to the path, the lift L, and a component parallel to the path, the drag D. The angle γ between the horizontal and the path is called the flight path angle, and α is the angle of attack. If the aircraft remains in equilibrium for an interval of time, it is said to be in steady flight.

If $\gamma = 6°$, $D = 125\ kN$, $L = 680\ kN$, and the mass of the aircraft is 72,000 kg, determine the values of T and α that are necessary to maintain steady flight.

(8 marks)

Q3 (a) State the characteristics of a couple in the context of engineering mechanics.

(4 marks)

(b) A force system acting on a post is given in **Figure Q3(b)**. Replace the force system by a resultant force and couple moment at point O.

(9 marks)

(c) Compare the concurrent, coplanar, and parallel force systems by providing a brief description and a sketch for each system.

(6 marks)

(d) A distribution of loading for a beam is shown in **Figure Q3(d)**. Replace the distributed loading with a single resultant force and specify its line of action on the beam, measured from A and sketch a free-body diagram.

(6 marks)

PART B: Answer **ONE (1)** question only.

Q4 A truss shown in **Figure Q4** carries a horizontal load of 3 kN at point D and a vertical load of 4 kN at the point B. Examine the truss and then:

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

(5 marks)

(b) determine the support reactions

(6 marks)

(c) analyze the force in each member of the truss and evaluate whether it acts in tension or compression.

(14 marks)

Q5 Examine the loaded truss shown in **Figure Q5**. The truss is composed of nine members. By setting $P_1 = 9\ kN$, $P_2 = 12\ kN$ and $P_3 = 6\ kN$:

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

(2 marks)

(b) determine the support reactions.

(6 marks)

(c) sketch a free-body diagram of the right portion of the truss if the truss is cut with a section *a-a* through member EF, BE and BC.

(3 marks)

(d) analyze the force in members EF, BE, BC, and BF of the truss and evaluate whether these members are in tension or compression.

(14 marks)

– END OF QUESTIONS –

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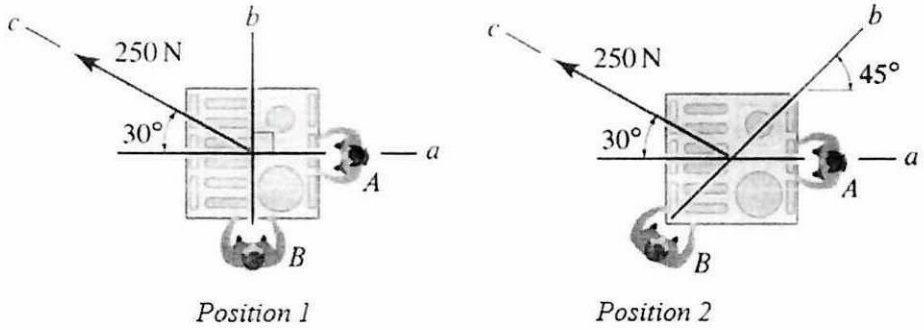

Figure Q1(b)

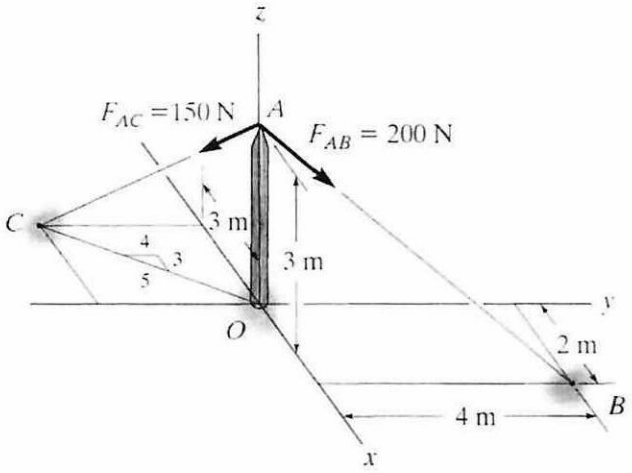

Figure Q2(a)

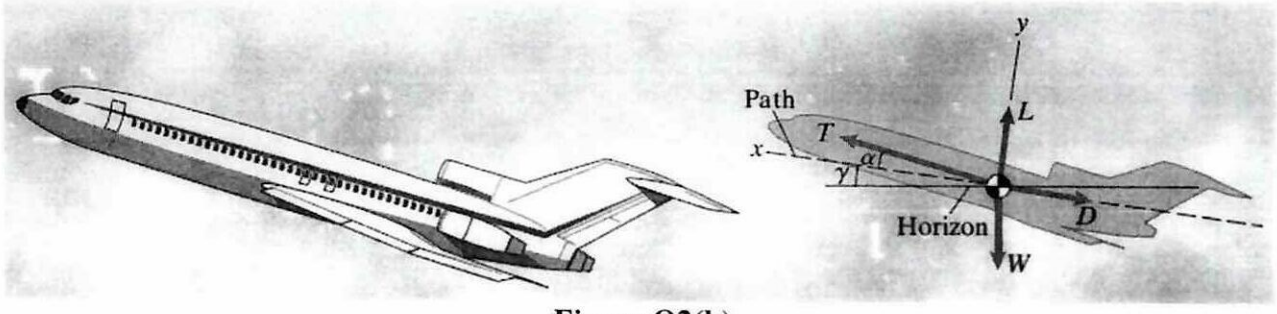

Figure Q2(b)

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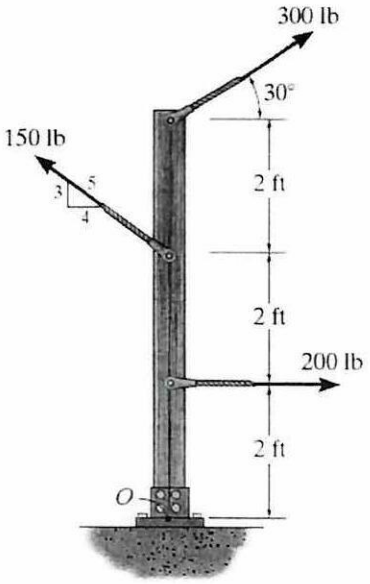

Figure Q3(b)

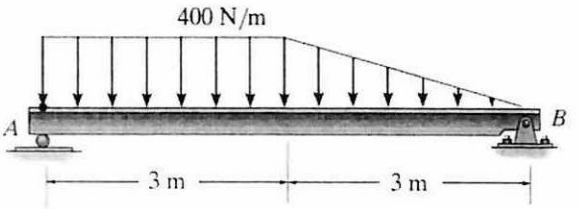

Figure Q3(d)

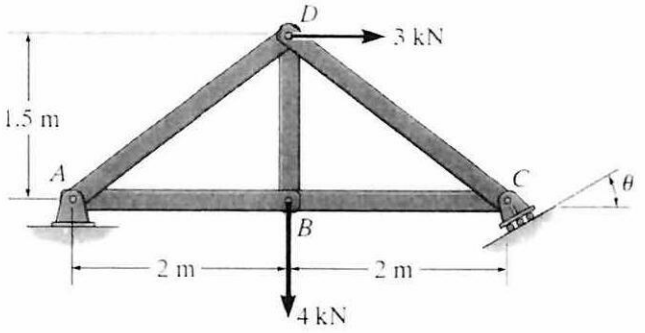

Figure Q4

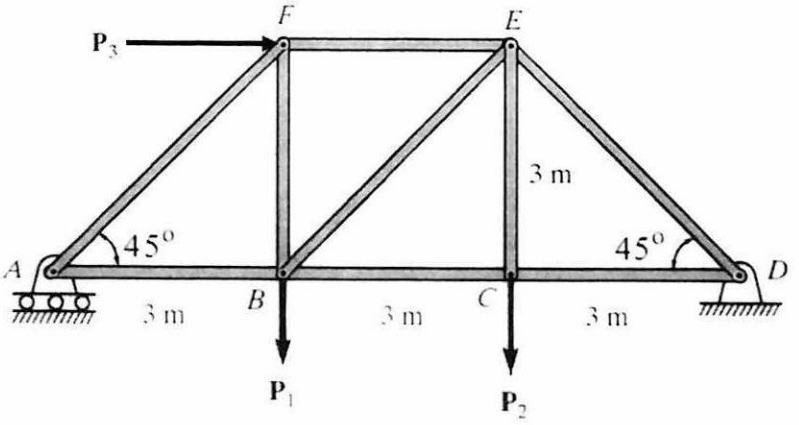

Figure Q5