



MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EMM 210: ENGINEERING MECHANICS I

DATE: 10/8/2021

TIME:

INSTRUCTIONS

Answer question ONE and any other two questions.

QUESTION ONE (30 MARKS) (COMPULSORY)

- a) Distinguish between the following terms as used in engineering mechanics:
- External and internal forces,
 - Moments and couples
 - Co-planer forces and concurrent forces (6 marks)
- b) i Two forces A and B act at an angle Θ between them. If $\Theta = 180^\circ$ and $A=B$, Show from first principles that their resultant is zero (5 marks)
- ii Determine fully, the resultant of the system of coplanar concurrent forces shown in Figure Q1b (6 marks)

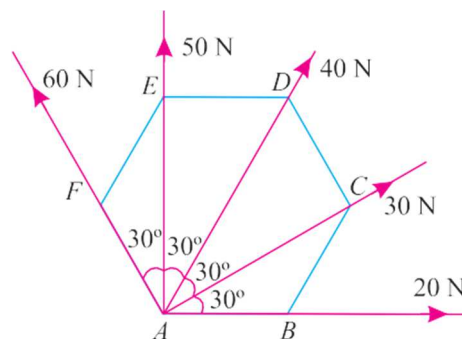


Figure Q1b

- c) i. State the conditions required for a system of forces to be in equilibrium (2 marks)
- ii. Determine the support reactions at A and B for the beam shown in Fig Q1c (5 marks)

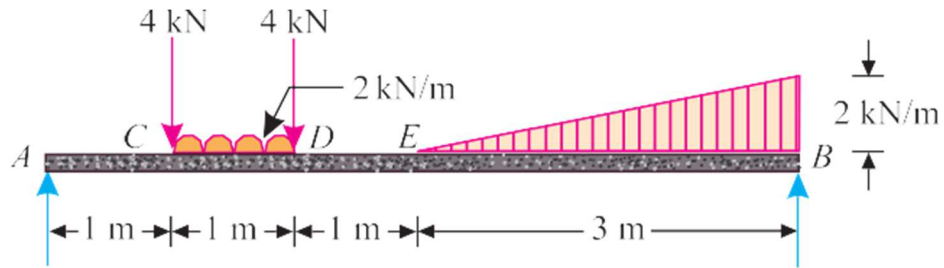


Fig.Q1c

- iii. Discuss the three types of equilibrium (6 marks)

QUESTION TWO (20 MARKS)

- a) Distinguish between work and energy (2 marks)
- b) A truck of mass 5 tonnes has tractive resistance of 150 N/t. Find the power required to propel the truck at a uniform speed of 36 km.p.h.
- up an incline of 1 in 100
 - on a level track
 - down an incline of 1 in 100. (10 marks)
- c) i. Distinguish between Potential and kinetic energy
- ii A drum of mass 40 kg was released and allowed to fall freely into a swimming pool from a tower of height 30 m. The drum was found to go down into the water by 2 m and then started rising. Find the average resistance of the water and state one assumption in your calculation. (8 marks)

QUESTION THREE (20 MARKS)

- a) i. Distinguish between centre of gravity and centroid. (2 marks)
- ii. With reference to moments of inertia, state the parallel axis theorem. (2 marks)
- b) Determine the moment of inertia for the section shown in Figure Q3b:
- About the base AB. (4 marks)
 - About a centroidal axis x-x parallel to the base AB (4 marks)

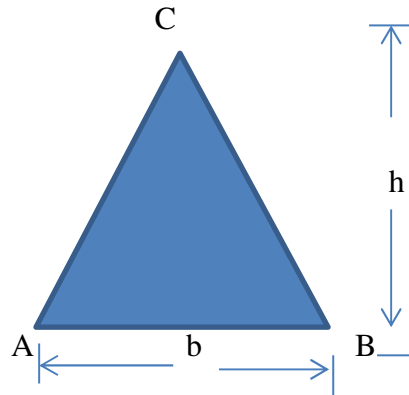


Figure Q3 (b)

- c) Figure Q3(c) shows a semicircular area removed from a trapezium.

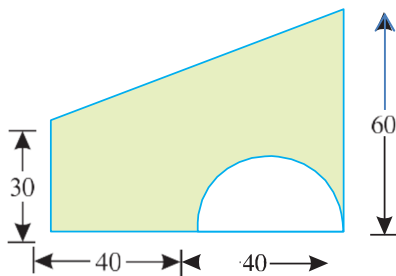


Figure Q3(c)

Determine the centroid of the shaded surface (Take the reference point as the intersection of the base with the vertical edge on the left. (8 marks)

QUESTION FOUR (20 MARKS)

- a) i) Distinguish between ties and struts as used in frameworks (2 marks)
 ii) State three assumptions made in the analysis of trusses. (3 marks)
- b) Figure Q4b. shows the members of a truss which is fixed to a wall along AE.

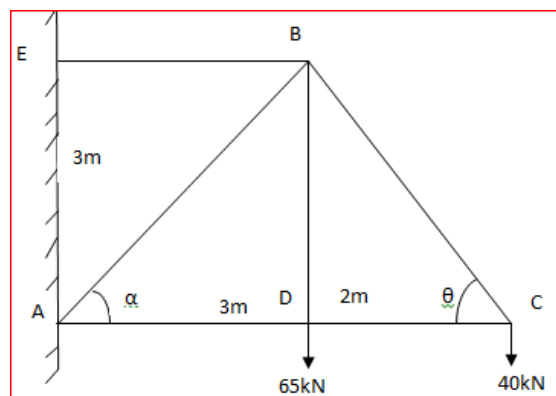


Figure Q4b

Determine the magnitude and nature of the forces in all the members of the truss and tabulate your results. (8 marks)

- c) i) State Lami's Theorem. (2 marks)
- ii) The jib crane shown in Fig. Q4c is required to lift a load of 5 kN. Determine the forces in AC and BC and state their nature. (5 marks)

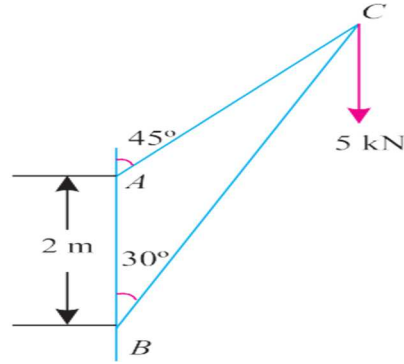


Fig. Q4c

QUESTION FIVE (20 MARKS)

- a) i) Distinguish between static and dynamic friction (2 marks)
- ii. State two laws of static friction (2 marks)
- iii. A body resting on a rough horizontal plane required a pull of 180 N inclined at 30° to the plane to just move it. It was found that a push of 220 N also inclined at 30° to the plane just moved the body. Determine the weight of the body and the coefficient of friction. (8 marks)
- b) i. State the principle of virtual work. (2 marks)
- ii. A beam AB of span 5 metres is carrying a point load of 2 kN at a distance 2 metres from A. Using the principle of the virtual work, determine the support reactions of the beam (6 marks)