



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMM 207: ENGINEERING MECHANICS I

DATE: 27/9/2019

TIME: 8.30-10.30 AM

INSTRUCTIONS:

Answer question 1 (compulsory) and any other TWO questions

1. a) Distinguish between the following terms the following terms as used in Engineering Mechanics
 - i. Moment and momentum
 - ii. Equilibrant and resultant
 - iii. Coplanar and concurrent forces (6 marks)
- b) i) Derive the equation for the resultant of two forces A and B, acting at an acute angle θ between them in both magnitude and direction.
ii) Using the equation derived in b(i) above, show that if the forces are collinear, the resultant is the arithmetic sum of their magnitudes. (8 marks)
- c) A simple lifting machine has a velocity ratio of 22. On test, it was found that an effort of 70N will lift a load of 1200N, and that an effort of 120N will lift a load of 2200N. Determine;
 - i. the law of the machine
 - ii. the effort and efficiency at a load of 3000N (6 marks)
- d) i) Distinguish between work and energy energy

- ii) A lorry hauls a trailer at 72km/h when exerting a steady pull of 880N on the tow rope. Calculate i) the work done in 20 mins measured in megajoules and kilowatt hours
- iii) A block of mass 2.5kg falls freely from a height of 25m above the ground. Determine its velocity at the instant it strikes the ground (10 marks)
2. a) State the following laws of static forces: i) Triangular law ii) Polygon law (4 marks)
- b) Describe the conditions necessary for a body to be in equilibrium under the action of a system of forces (2 marks)
- c) Determine the magnitude and direction of the equilibrant for the unbalanced force system shown in Figure 2c below (7 marks)

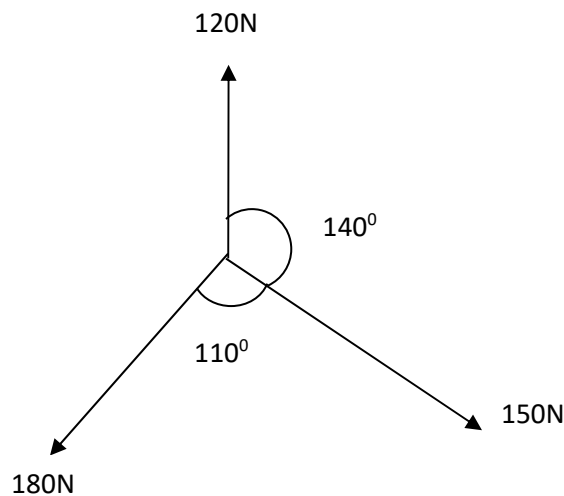


Figure 2c

- d) i) State the principle of moments
- ii) A beam is simply supported and loaded as shown in **Figure 2c**. Determine the reactions at the two supports

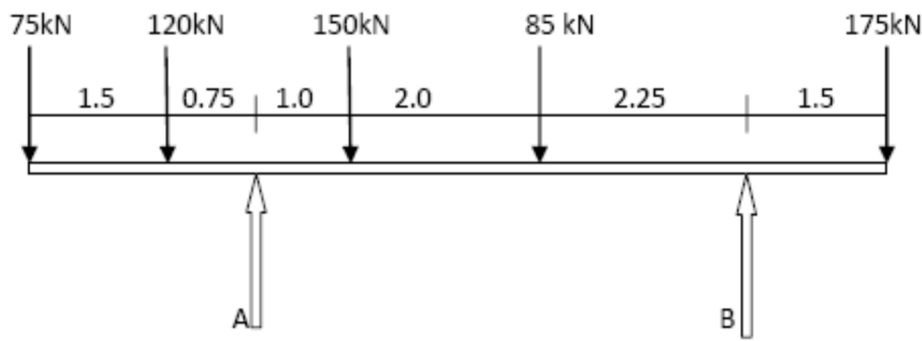


Fig.2c; All length dimensions in m

(7 marks)

3.
 - a)
 - i) Distinguish between ties and struts as used in frameworks
 - ii) state three assumptions made in the analysis of trusses.
 - iii) Differentiate between an imperfect and a redundant frame (7 marks)
 - b) Determine and tabulate the magnitude and nature of the forces in all the members of the truss shown in Figure 3. The truss is fixed to a wall along AE

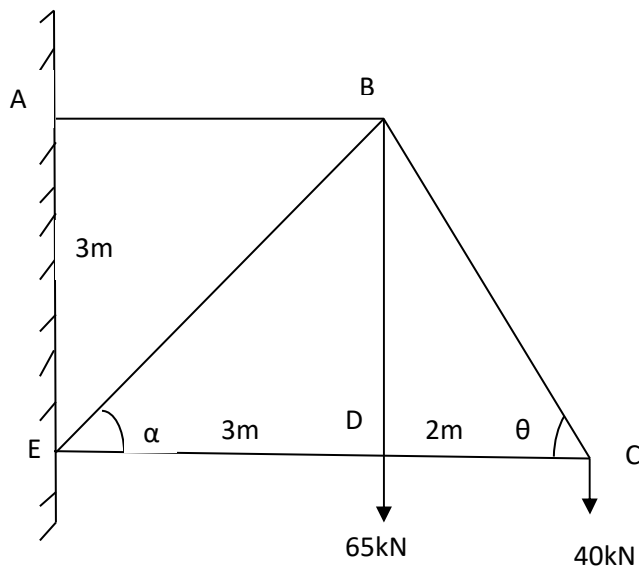


Figure 3

(13 marks)

4.
 - a)
 - i) Distinguish between the terms **weight** and **centre of gravity**
 - ii) Show that the centroid of a triangular section of base width **b** and height **h** about its base occurs at some height: $\frac{h}{3}$ (8 marks)

- b). The cross section of a Symmetrical T-Section is shown in **Fig.4c**

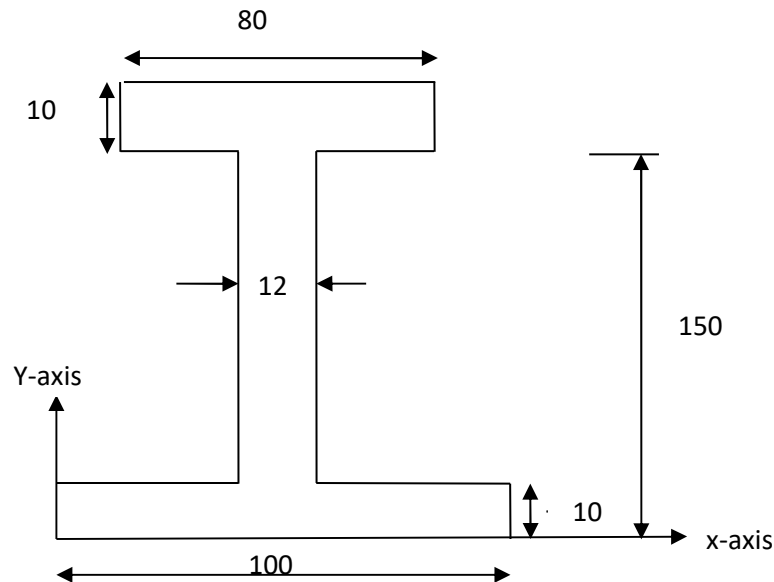


Fig.4c: All dimensions are in mm

Determine for this section, the position of the centroid with reference to the given axes (12 marks)

5. a) State three laws of dry friction friction. (3 marks)
- b) A carriage box of mass 450 kg is acted upon by a force P as shown in figure 5b below.

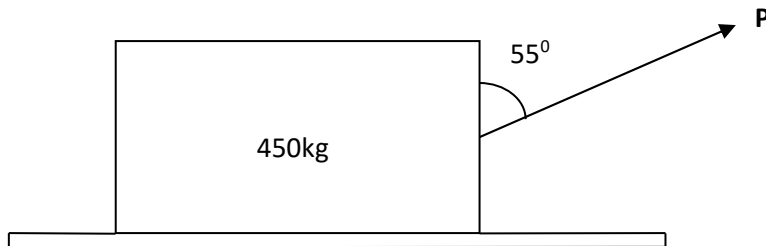


Figure 5b

- i) If $\mu = 0.25$, determine the value of P when the box is just about to start moving.
- ii) find the new value of P , if its direction is reversed and μ is unchanged (8 marks)
- c) i) With the aid of suitable sketches, distinguish between open and crossed belt drives, showing clearly the tight and slack sides of each drive.
- ii) A countershaft has a pulley 1200 mm diameter keyed to it and it is to have a speed of 200 rpm. It is to be driven by an electric motor which has a speed of 1000 rpm. What is the diameter of the pulley that should be fitted to the electric motor? (9 marks)