



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 210: ENGINEERING MECHANICS I

DATE: 25/7/2019

TIME: 2.00-4.00 PM

INSTRUCTIONS:

Answer Question One and Any Other Two Questions

1. a) Define the following terms as used in Engineering Mechanics
 - i. Inertia
 - ii. Particle
 - iii. Rigid body (6 marks)
- b) i Distinguish Between the terms **Resultant** and **Equilibrant** for a given system of Forces.
ii Determine fully the Resultant of two forces of magnitudes 145 N and 275N acting at an angle of 110° from each other (7 marks)
- c) A simple lifting machine has a velocity ratio of 20. On test, it was found that an effort of 75N will lift a load of 1100N, and that an effort of 120N will lift a load of 2000N. Determine;
 - i. the law of the machine
 - ii. the effort and efficiency at a load of 3000N (10 marks)
- d) i Distinguish between kinetic and potential Energy
ii State the principle of conservation of energy.
iii A block of mass 4.5kg falls freely from a height of 85m above the ground. Determine its velocity at the instant it strikes the ground (7 marks)

2. a) Describe the three laws of forces as used in statics (6 marks)
- b) Determine analytically, the resultant of the system of forces shown in **Figure 2b** (7 marks)

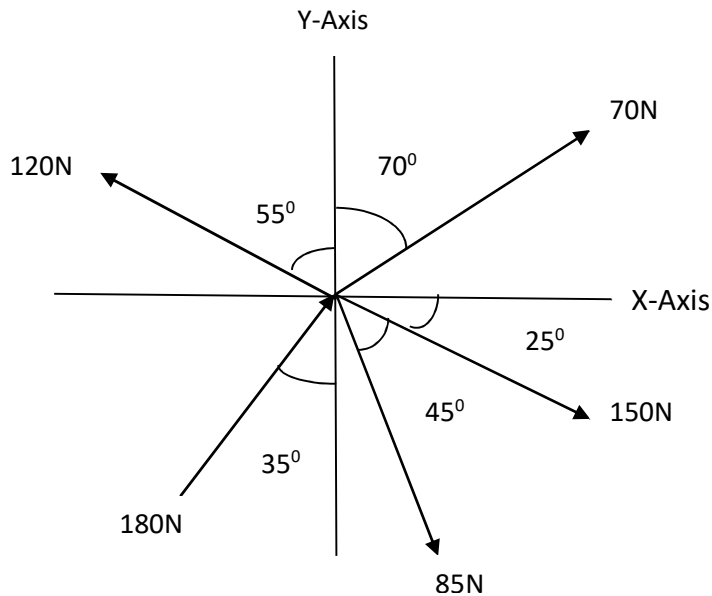


Figure 2b State the principle of moments

- ii) A beam is simply supported and loaded as shown in **Figure 2c**. Determine the reactions at the two supports (7 marks)

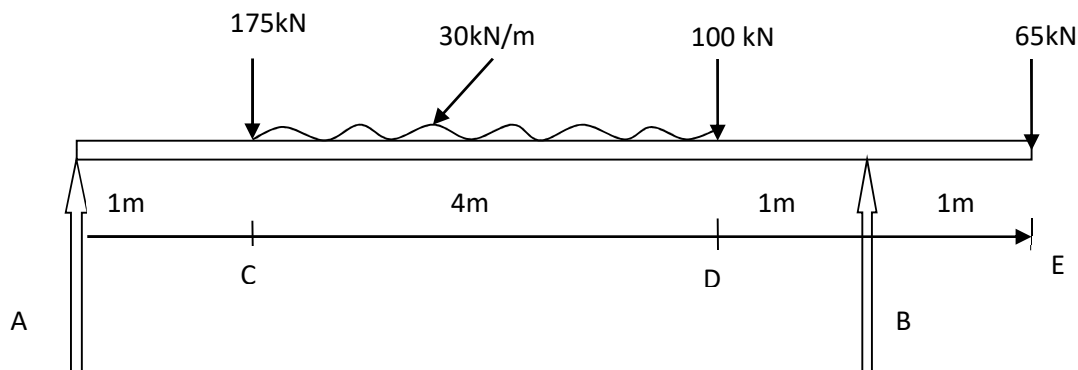


Fig.2c

3. a) i) Distinguish between ties and struts as used in frameworks (5 marks)
- ii) state three assumptions made in the analysis of trusses.
- b) Determine 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

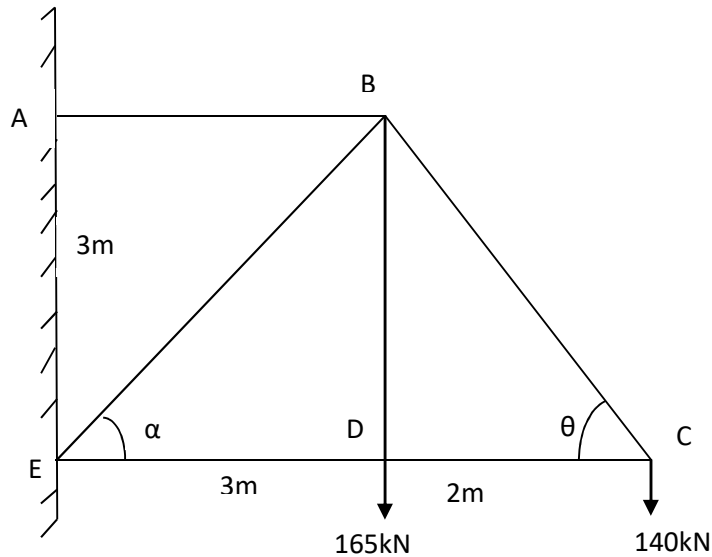


Figure 3

(15 marks)

4. a) i) Distinguish between the terms **centre of gravity** and **centroid**
- ii) Show that the moment of inertia I_{xx} of a triangular section of base width b and height h about its centroidal axis parallel to the base is given:

$$I_{xx} = \frac{bh^3}{12} \quad (7 \text{ marks})$$

- b) State the two theorems of area moment of inertia (4 marks)
- c) The cross section of a symmetrical I-beam is shown in **Fig.4c**

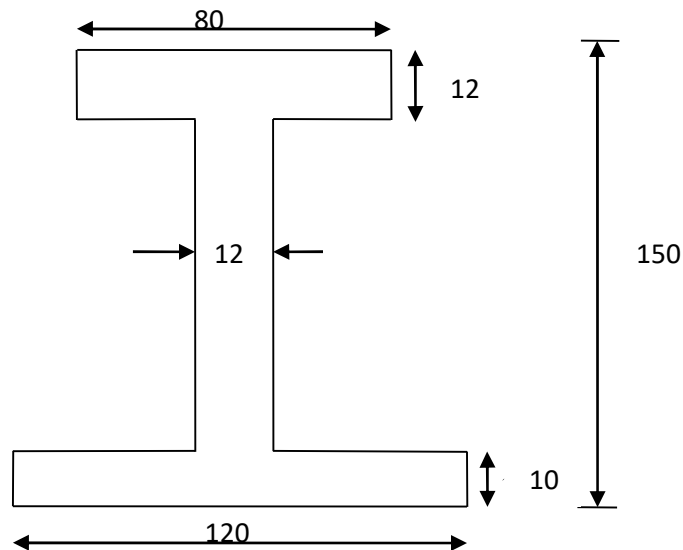


Fig.4c: All dimensions are in mm

Determine for this section:

- i. the centroid with reference to the base
 - ii. area moment of inertia of the section about a centroidal axis parallel to the base (9 marks)
5. a) State three laws of dry friction. (3 marks)
- b) A carriage box of mass 250 kg is acted upon by a force P as shown in figure 5b below.

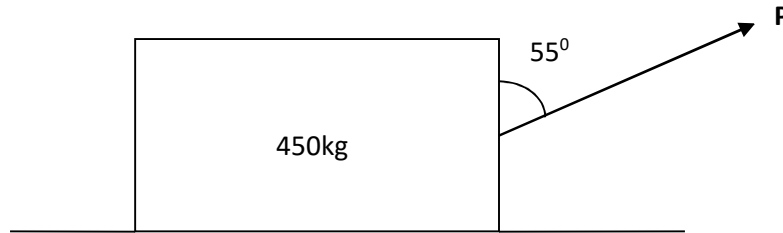


Figure 5b

- i) If $\mu = 0.3$, 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 closed belt drives, showing clearly the tight and slack sides of each drive.
- ii) A countershaft has a pulley 1200mm diameter keyed to it and it is to have a speed of 200 rev/min. 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)