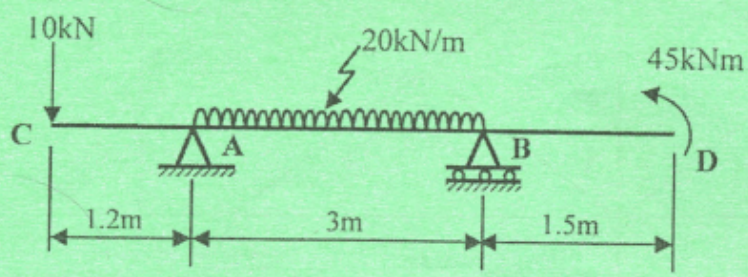
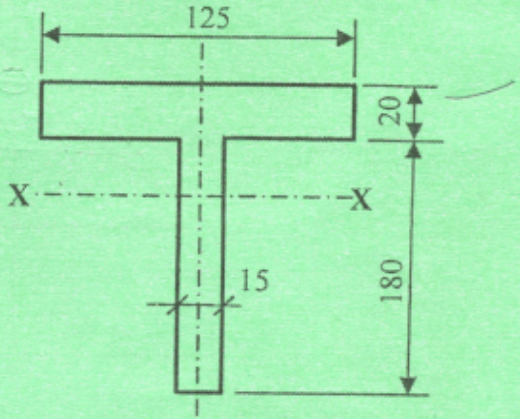
4. Figure 4 shows the loading and cross-section details of a simply supported beam.

(i) Sketch the shear force and bending moment diagrams showing all critical values.

(ii) Sketch the horizontal shear stress diagram at the point of contraflecture showing all the critical values. (20 marks)



(a)



(b)

Fig. 4

Horizontal Shear Stress 2016

(b) The cross-section of a T-section beam is 80 mm x 130 mm x 10 mm with the 80 mm side horizontal. Determine the maximum intensity of shear stress at the section subjected to a shear force of 60 kN. (8 marks)

2017

2. (a) **Figure 2** shows the cross section of a beam. Plot the horizontal shear stress distribution diagram given a shear force of 35 kN. (15 marks)

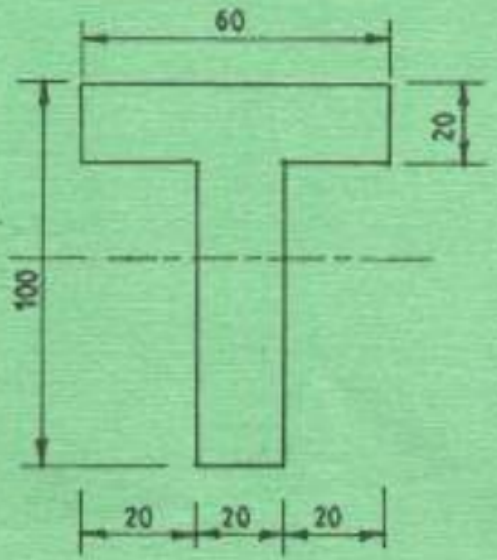


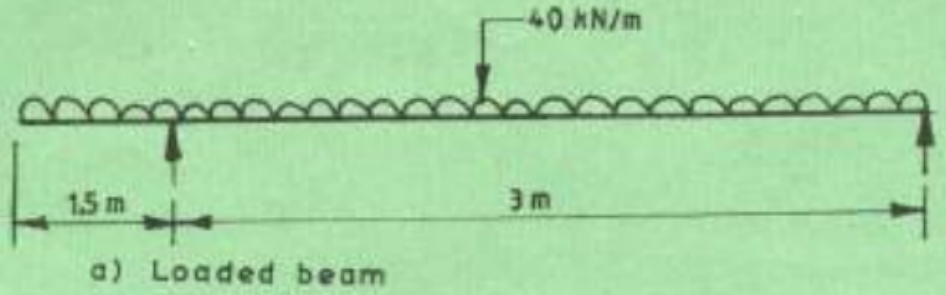
Fig. 2

2. **Figure 1** shows a loaded beam and its cross-section. Determine:

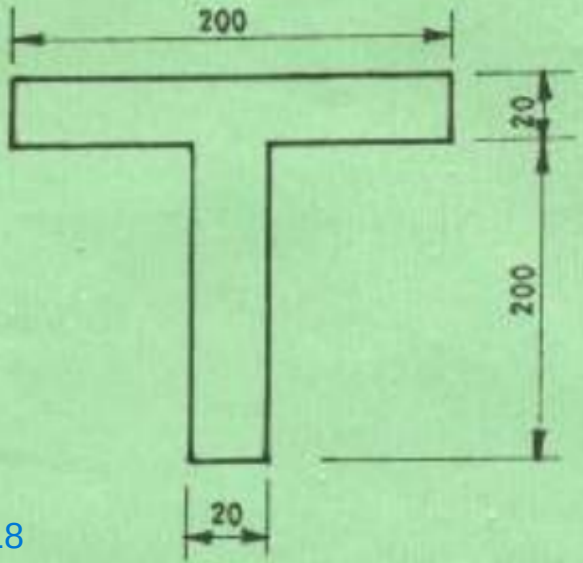
(i) the maximum horizontal shear stress developed in the beam section; (14 marks)

(ii) the maximum extreme fibre stress in bending developed in the beam section from the applied loads. (6 marks)

2018



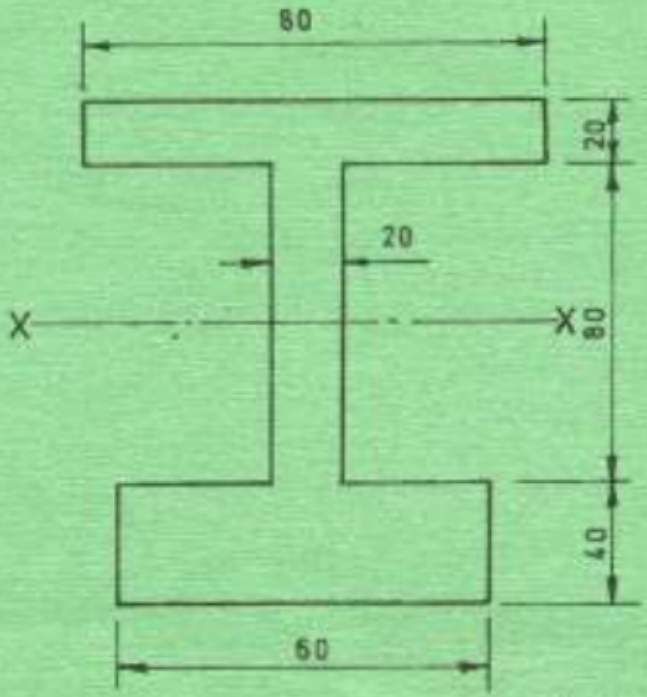
a) Loaded beam



$E = \frac{\text{stress}}{\text{strain}}$

$\text{strain} = \frac{\Delta L}{10}$

(b) **Figure 2** shows a loaded beam and its cross section. Plot the horizontal shear stress distribution diagram. (8 marks)



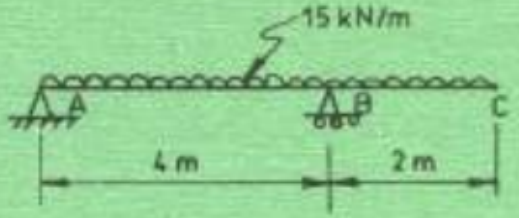


Fig. 2

2. (a) Define the following terms:

(i) point of contraflecture;
(ii) maximum bending moment.

(2 marks)

(b) (i) Sketch the shear force and bending moment diagram for the beam in **figure 3** indicating values at critical points.

(ii) Determine the position of the point of contraflecture from point B.

(18 marks)

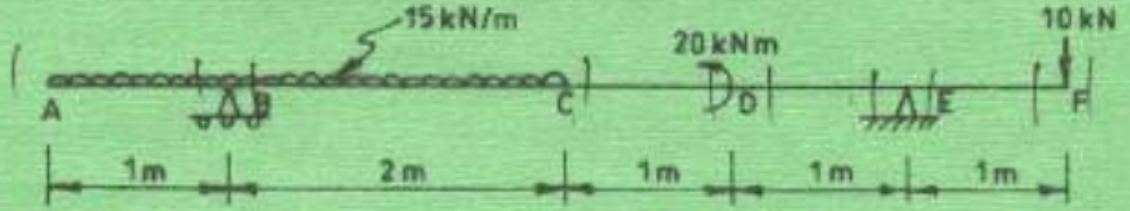
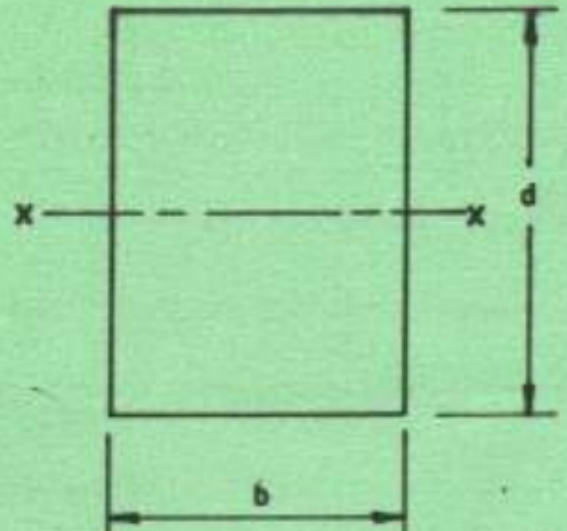


Fig. 3

(c) Calculate the extreme fibre stress for a rectangular section of a beam 200 mm in breadth and 500 mm deep, when subjected to a bending moment of 150 kN/m. (5 marks)

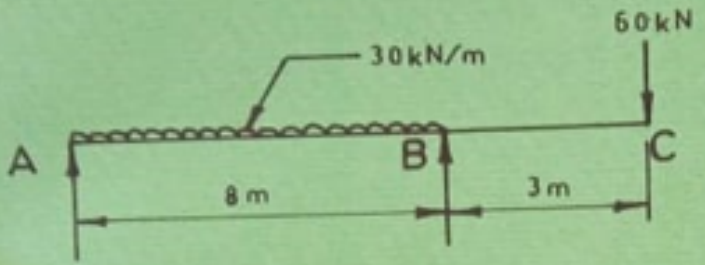
2019

(b) **Figure 3** shows a cross section through a rectangular beam. Derive the maximum horizontal shear stress. Take the maximum shear force as Q and hence sketch the horizontal stress distribution diagram. (8 marks)



2019

(b) **Figure 3** shows a loaded beam and its cross section. Using the point of maximum shear force, determine the horizontal shear stress at all critical points of the section and hence sketch the shear distribution diagram. (14 marks)



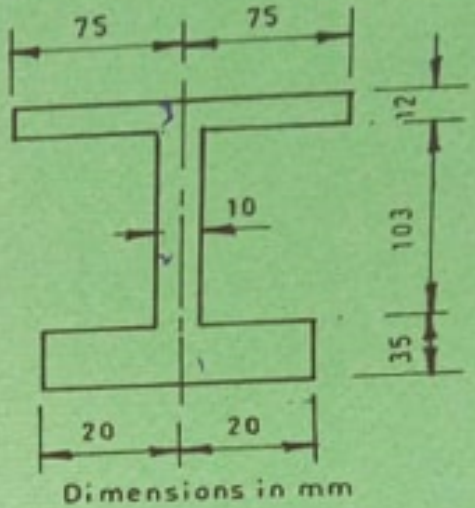


Fig. 3

4. (a) A hollow alloy tube 3m long with external and internal diameters of 50mm and 40mm respectively was found to extend 4mm under a tensile load of 20KN.
Determine Euler's buckling load for the tube when used as a column with both ends pinned. (8 marks)

struts and columns 2013

(b) (i) Illustrate **two** end fixity conditions for columns showing how effective lengths are determined in each case.

(ii) Define the term 'slenderness ratio'.

(iii) Using Rankine's formula determine the critical buckling load for a 4 m long column of equilateral triangular hollow section of side 120 mm and 5 mm thickness. One end of the column is held in position and direction while the other end is only held in position but not in direction.

Take $a = \frac{1}{6500}$

Actual height = 2.5 m

Yield stress = 115 N/mm^2

2014

(10 marks)

Fig. 1

(b) (i) A column 200 x 100 x 5 m long is fixed at both ends. Determine the Eulers buckling load on the column.
take $E = 210\ KN/mm^2$

(6 marks)

(ii) List any **two** assumptions made in Euler's analysis.

(2 marks)

2015

4. (a) State the Rankine's crippling load for a column giving all the symbols and their meanings. (4 marks)

2017

3. (a) State **three** assumptions made in Euler's column theory on buckling loads. (3 marks)

(b) A hollow allow tube 5 m long with diameters 40 mm and 25 mm external and internal respectively was found to extend 6.5 mm under a tensile load of 60 kN. Find:

(i) the buckling load for the tube, when used as a strut both ends pinned;

(ii) the safe load on the tube, taking factor of safety as 4. (7 marks)
Take E as 210 kN/mm^2.

(b) A solid timber column of cross-section 125 mm × 125 mm and actual length of 3.5 m is restrained at both ends in position and at one end in direction only. Calculate the safe buckling load the column can carry using Euler's formula.

2019

Take $E_{timber} = 10\,kN/mm^2$. (8 marks)

Fig. 2

3. (a) Determine the Euler's critical buckling length for an alloy, circular section 50 mm external diameter and wall thickness of 8 mm carrying an axial load of 50 kN, if both ends are pinned.

2021 Take $E = 180\ kN/mm^2$ (6 marks)

(d) (i) State **four** assumptions made in Eulers formula.

(ii) Calculate the load on a column 50 mm diameter that is fixed on one end and free in the other using Eulers formula. The column is 3.5 m long.

$E = 210\ kN/mm^2$

(8 marks)

2017

(b) Figure 1, shows a symmetrical frame:

(i) Determine the reactions;
(ii) Using the method of joint resolution, determine the magnitude and nature of force in each member of the frame.

(15 marks)

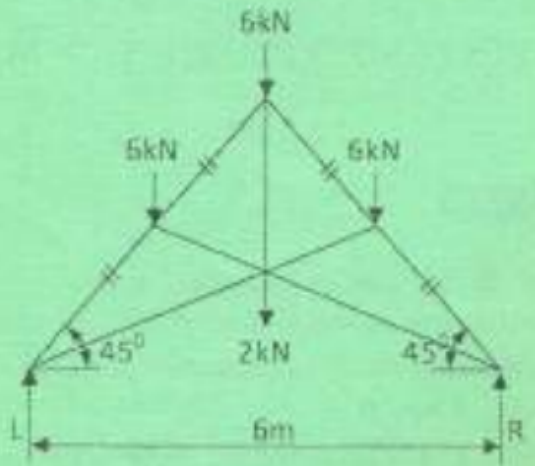


Figure 1

(b) Using the method of joint resolution, determine the magnitude and nature of forces for all the members of the frame shown in figure 3. ($13\frac{1}{2}$ marks)

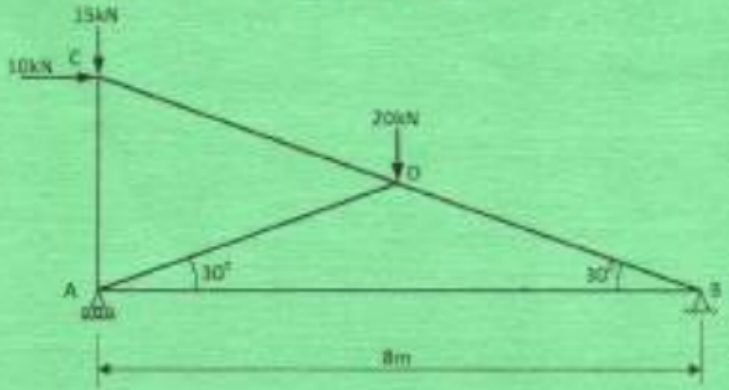


Fig. 3

2014

2705/103 **2709/103**

2. Determine the forces in the members of the frame shown in figure 2, using the method of the joint resolution.

(20 marks)

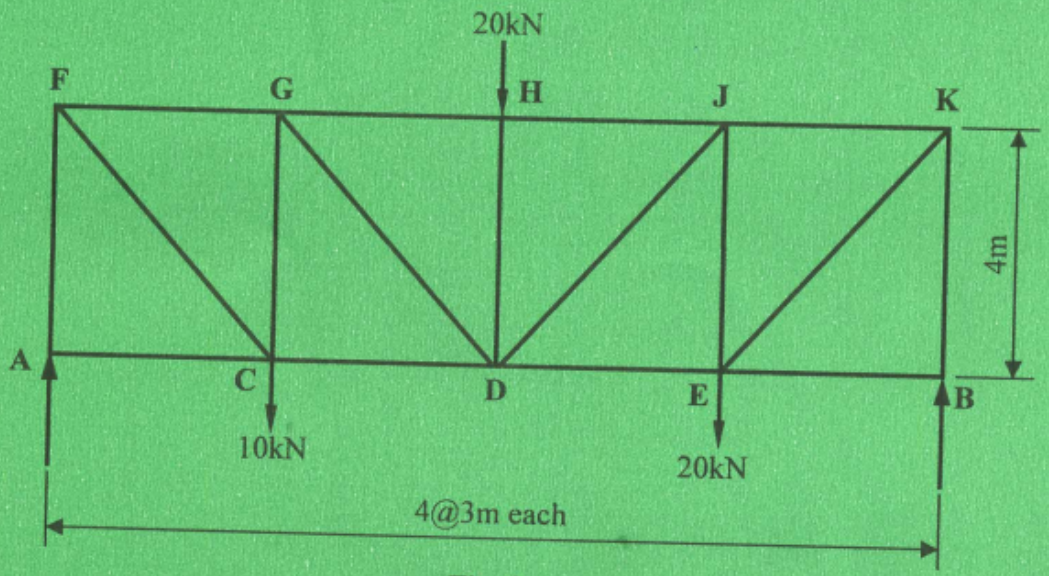


Fig. 2

2015

(b) Using the method of joint resolution, determine the magnitude and nature of forces for all the members of the Warren girder shown in **figure 4**. (16 mark

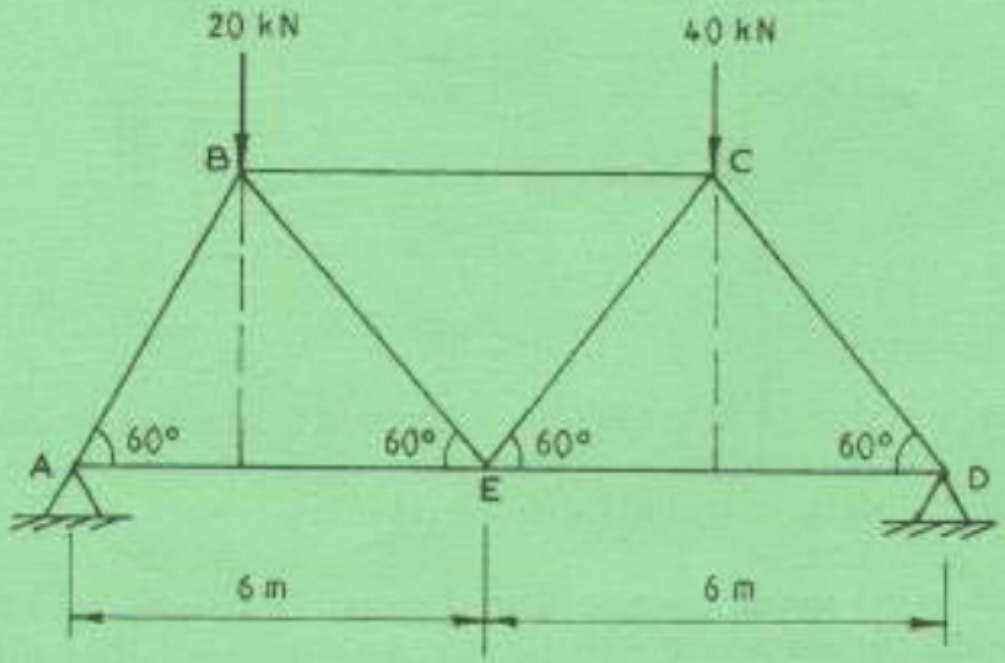


Figure 4

1. (a) Determine the magnitude and nature of the forces in each member of the framework shown in **figure 1** using the method of tension coefficients. (12 marks)

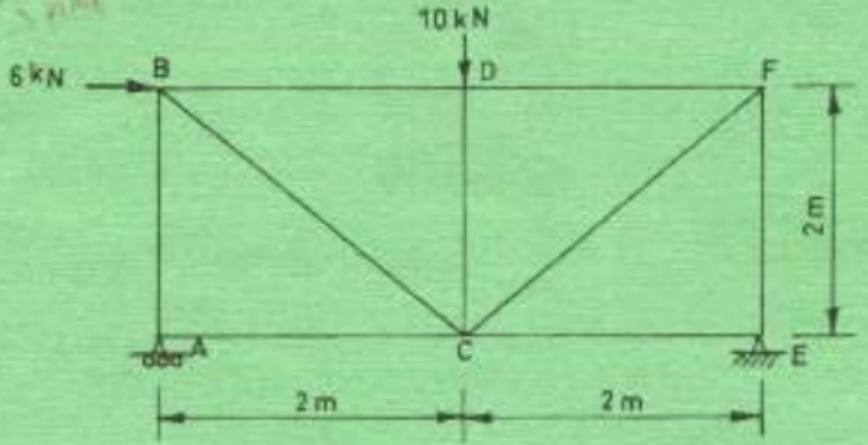
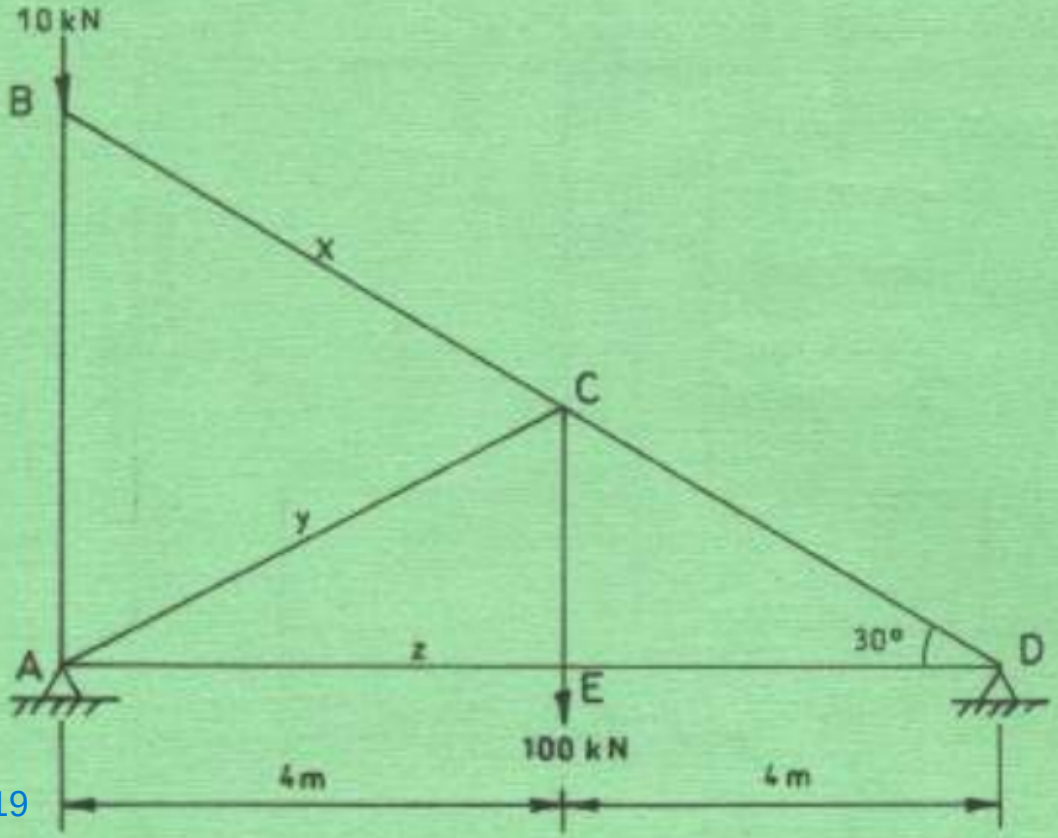


Fig 1

2018

(a) Using the method of section, analyse the forces and state the nature of forces for members x, y and z for the plane frame shown in **figure 4**. (12 marks)



2. ***Figure 2*** *shows the plan of a space frame which consists of six pin jointed members. The members D E is horizontal and 4 m above the horizontal plane containing A, B and C, while the loads applied at D and E act in a horizontal plane. Using the method of tension co-efficient, determine the magnitude and nature of all the members.* (20 marks)

Analysis of simple frames 2021

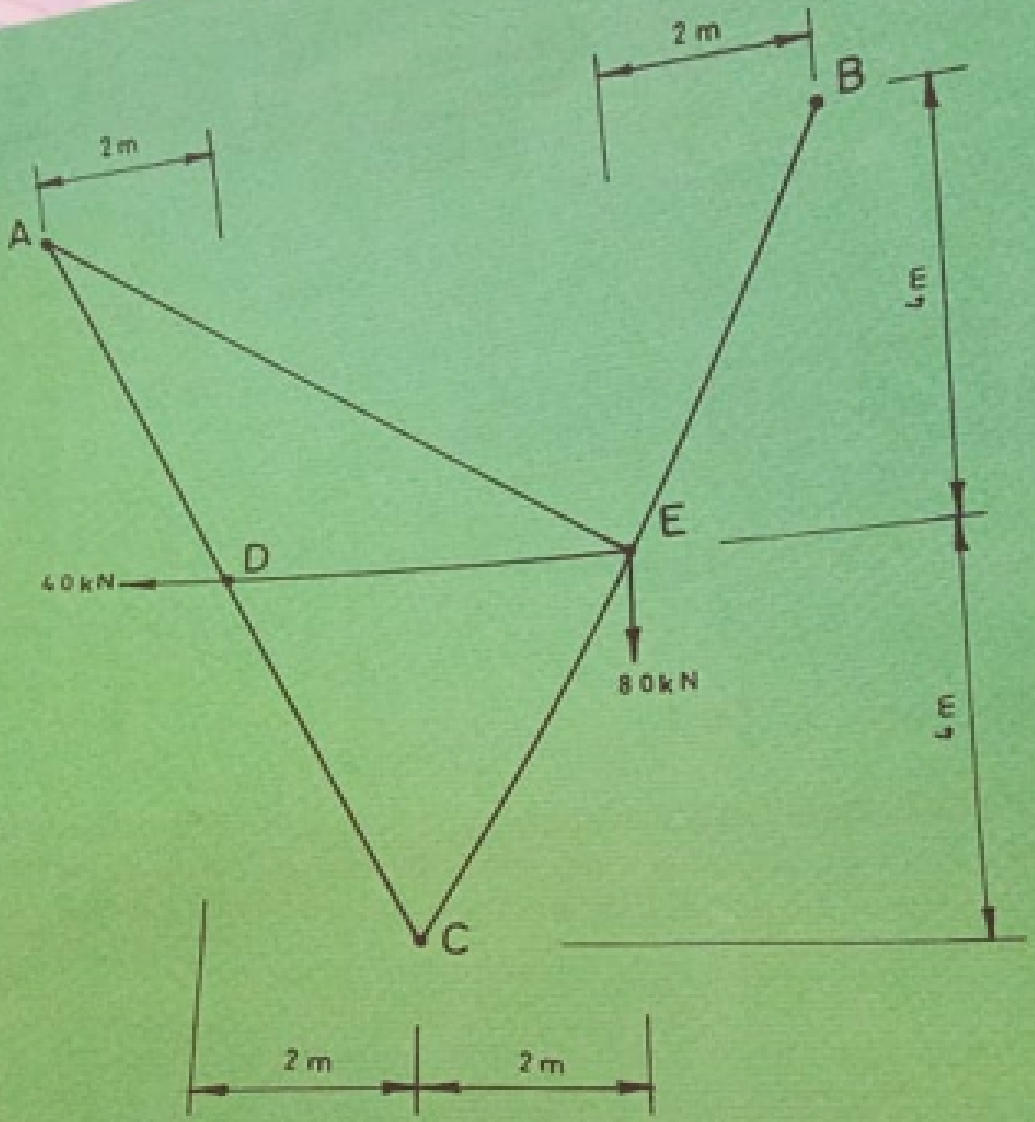


Fig 2

2. Using the method of joint resolution, determine the magnitude and nature of forces in all the members of the truss shows in figure 3. (20 marks)

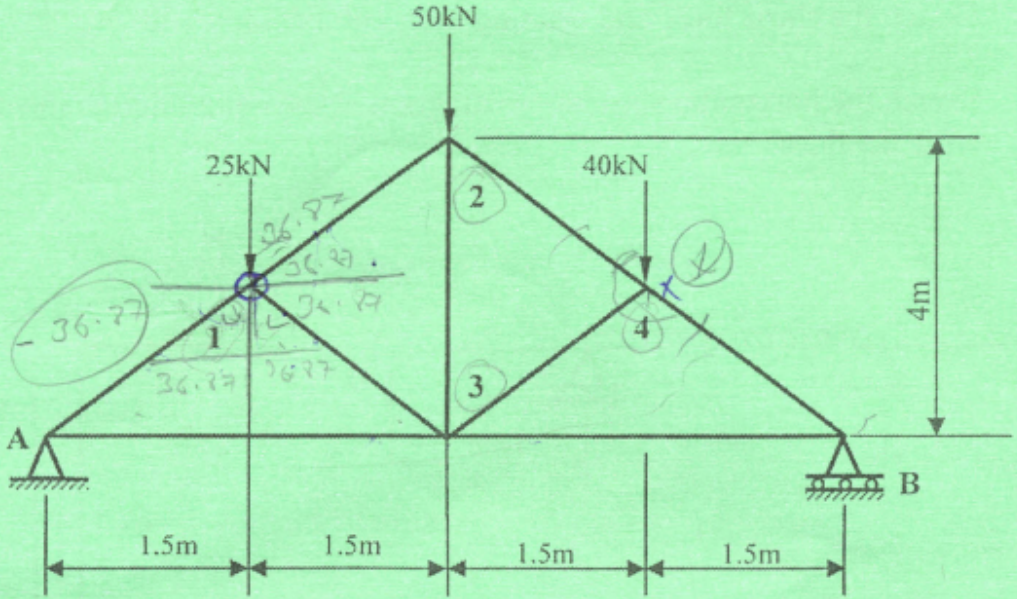


Fig. 3

2016