

SA-I

(3 Hours)

[Total Marks: 80]

N.B: (1) Question No. 1 is compulsory.

(2) Attempt any **three** questions out of remaining five questions.

(3) Assume suitable data wherever required and state it clearly.

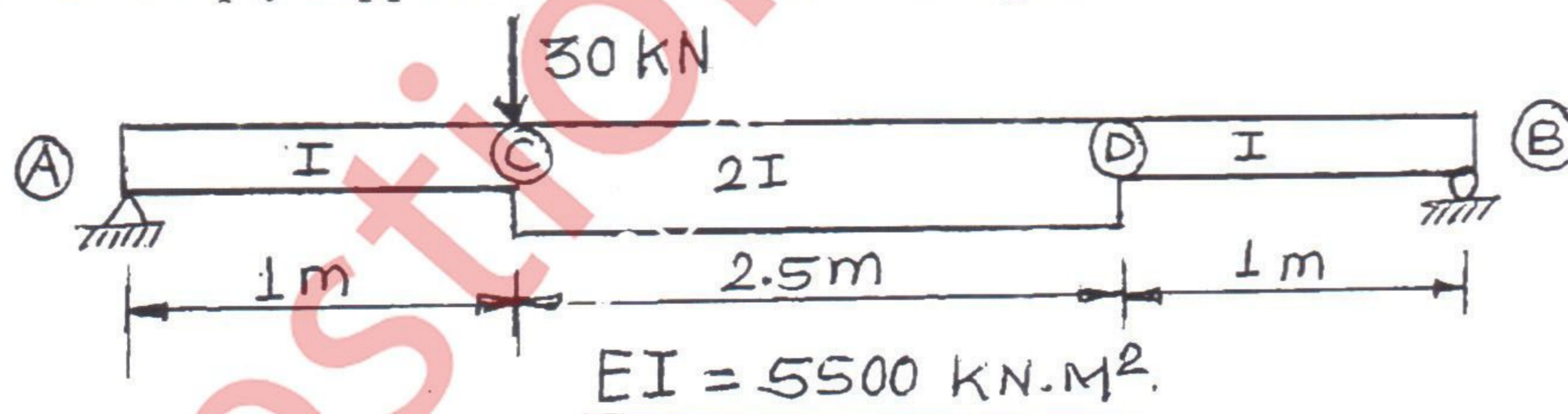
(4) Illustrate your answers with neat component sketches wherever required.

(5) Answers should be written in the legible handwriting, stepwise and in the systematic manner.

1. Attempt any four of the following

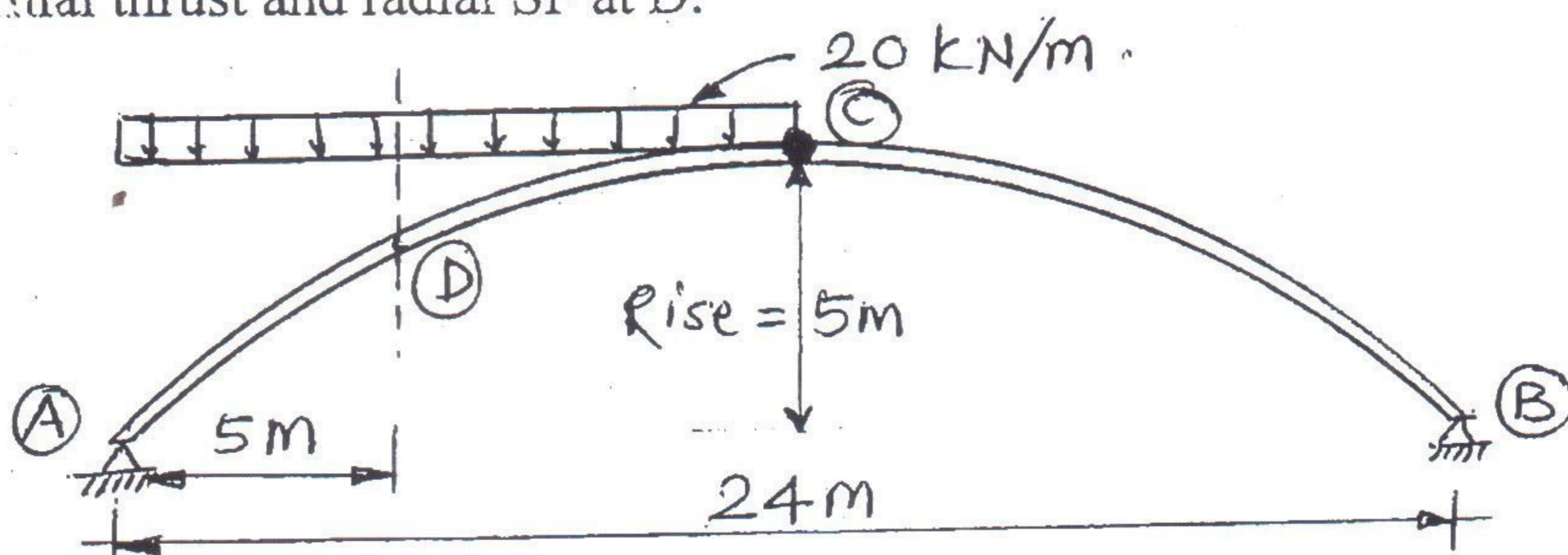
- (a) Enlist various methods for finding deflection in structures. Also state the suitability of each method. 05
- (b) State and explain Maxwell's Reciprocal theorem and Betti's theorem. 05
- (c) Explain unsymmetrical bending and the concept of shear center in brief 05
- (d) A symmetrical cable of span 80m with central dip 12m is loaded with udl of 20 kN/m. Find the maximum and minimum tension in the cable. 05
- (e) Define strain energy. Write the expression for strain energy stored due to shear force, bending moment and twisting moment. 05

2. (a) Using Conjugate beam method, find the vertical deflection at C and slope at B for the simply supported beam as shown in figure. 08



(b) A three hinged symmetrical parabolic arch is loaded as shown in figure. Calculate: 12

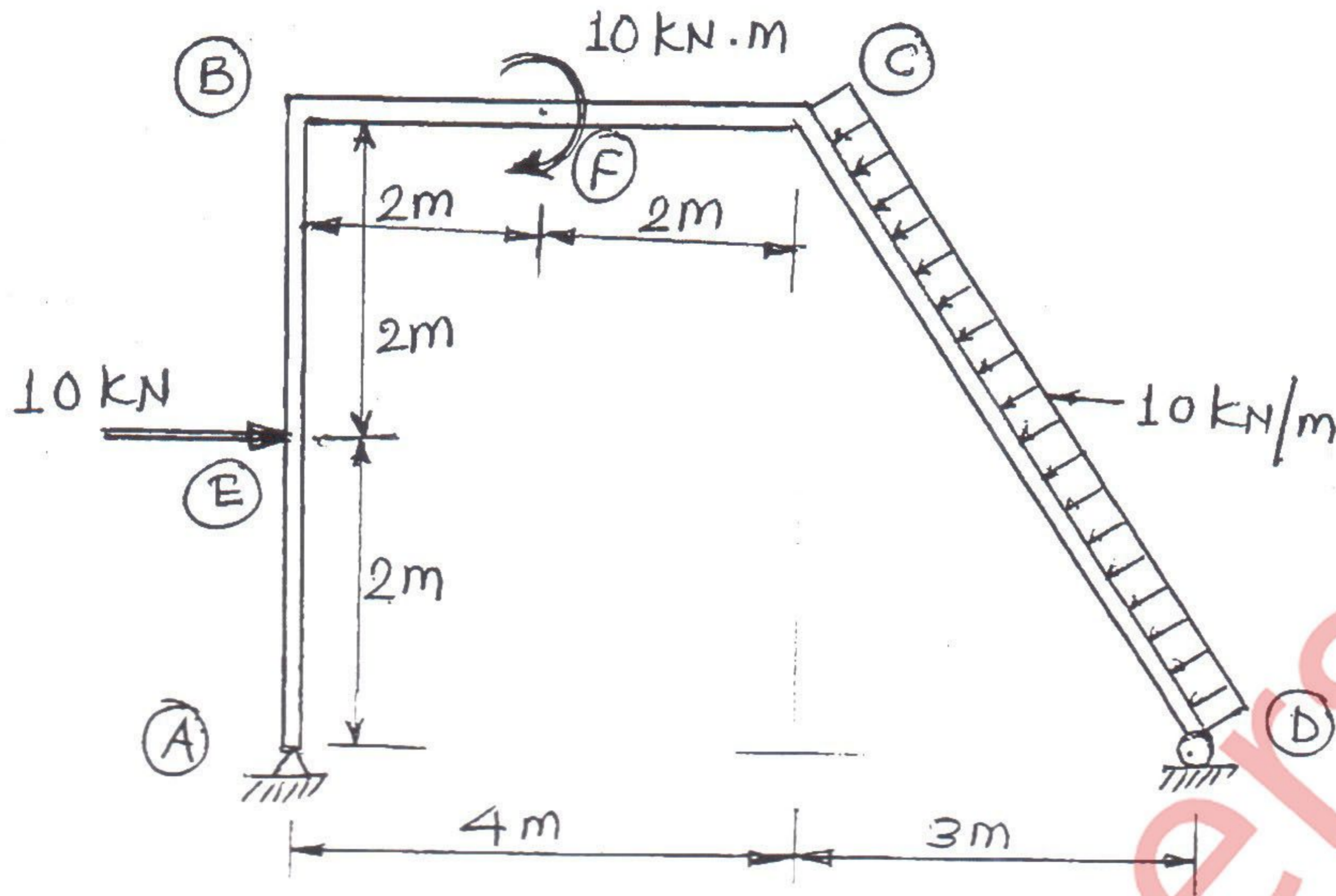
- (i) Support reaction
- (ii) Maximum bending moment in the portion AC and BC (Draw neat sketch).
- (iii) Normal thrust and radial SF at D.



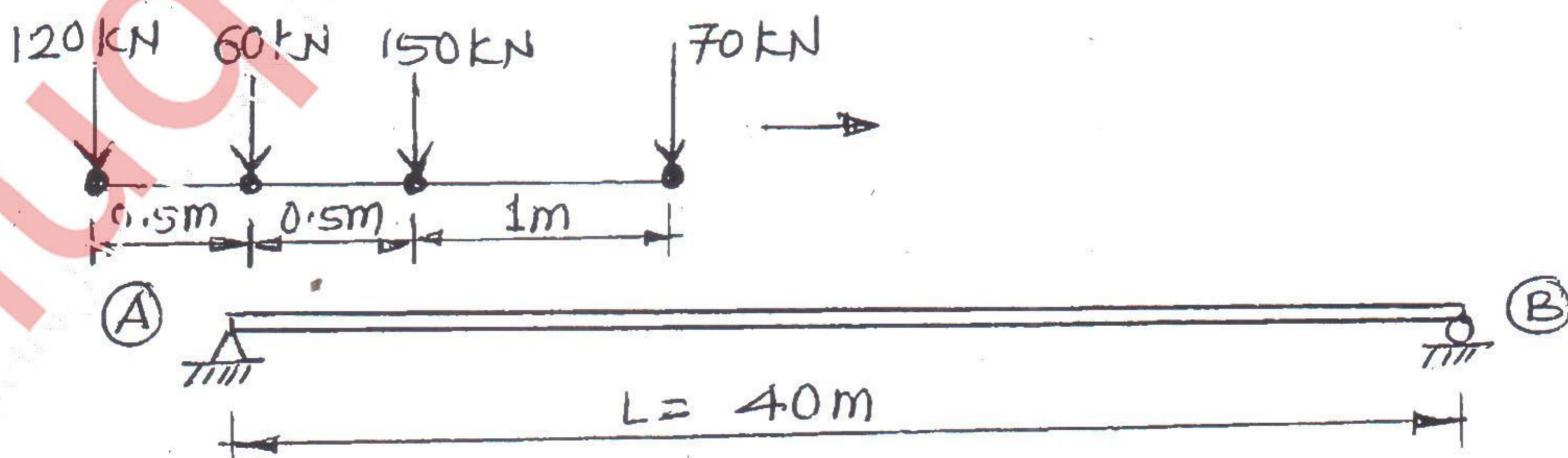
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3. (a) Analyse the frame as shown in fig. Draw free body diagram of each member 13  
and construct AFD, SFD and BMD.



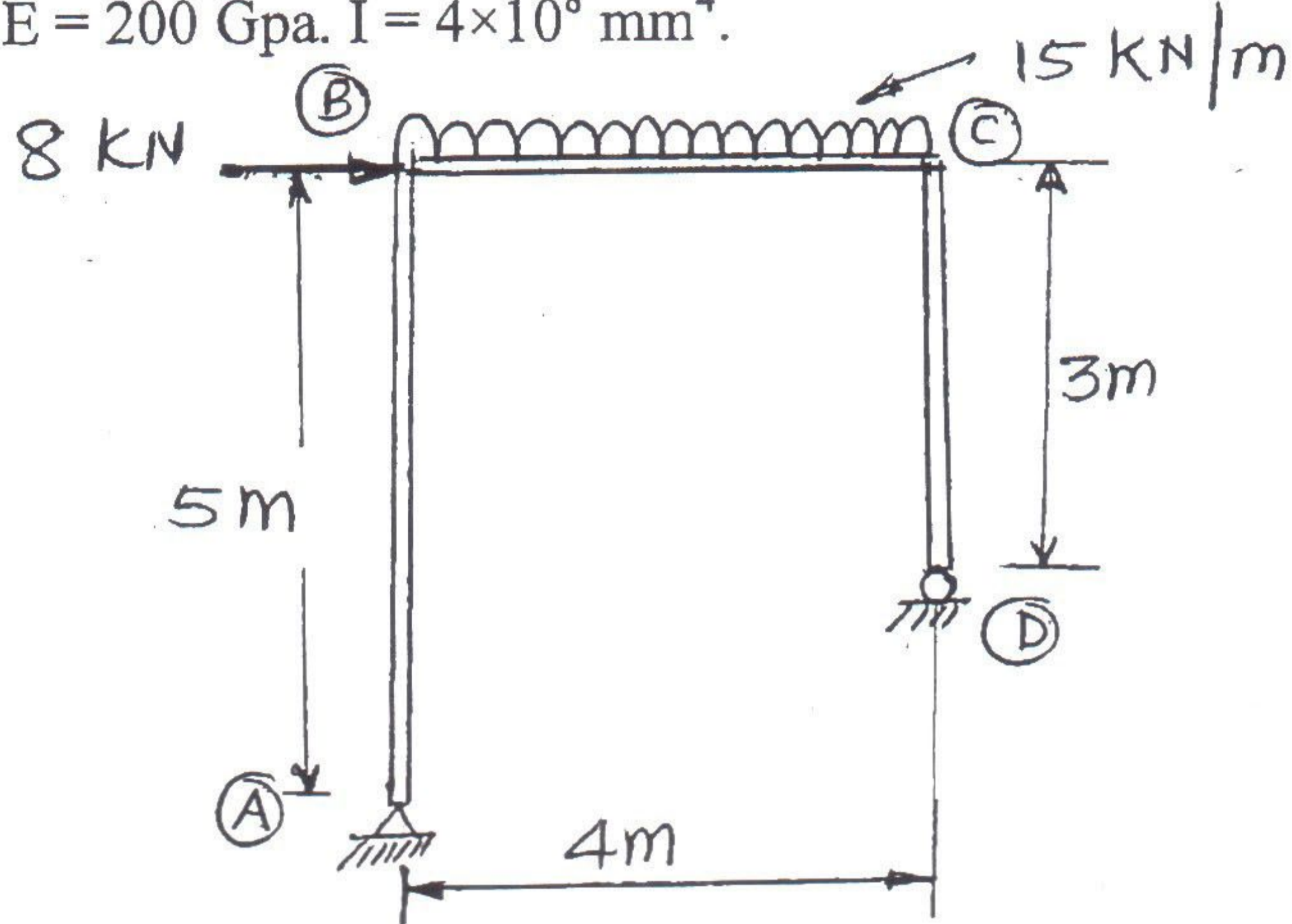
- (b) A column of hollow circular section with external diameter 300 mm and 07  
thickness 40 mm is 4 m long. It is pinned at both the ends. The column carries  
a load of 100 kN at an eccentricity of 40 mm, find out the stresses produced at  
extreme fibre of the column section. Take  $E = 200 \text{ Gpa}$ .
4. (a) The cables of a suspension bridge have span of 60 m and a central dip of 7.5 12  
m. Each cable is stiffened by a girder hinged at the ends and also at the  
middle so as to retain a parabolic shape of the cables. The girder is subjected  
to a load of 10 kN/m and live load of 20 kN/m, 15 m long. Find the maximum  
tension in the cable when the leading edge of the live load (udl) is just at the  
center of the girder. Also draw S.F and B.M diagram for the girder.
- (b) A series of concentrated load traverses on a simply supported beam as shown 08  
in fig. Calculate absolute maximum bending moment in the beam.



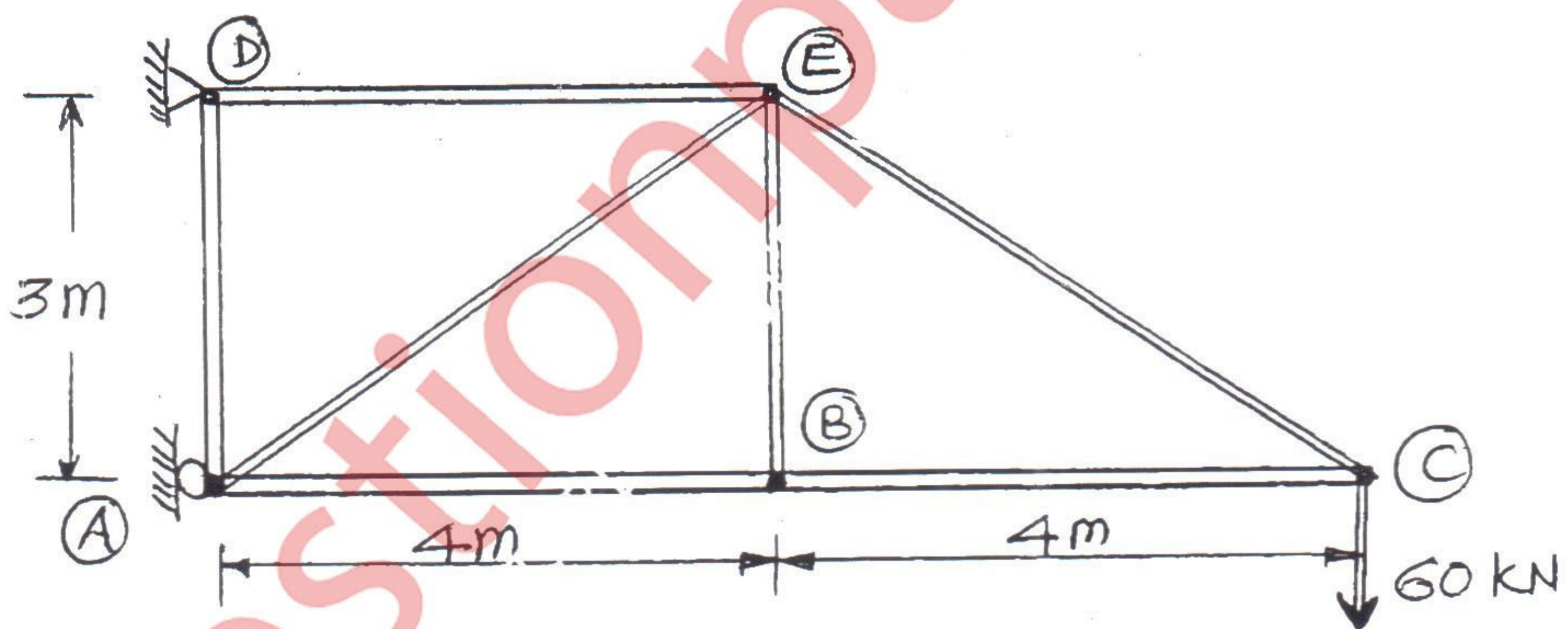
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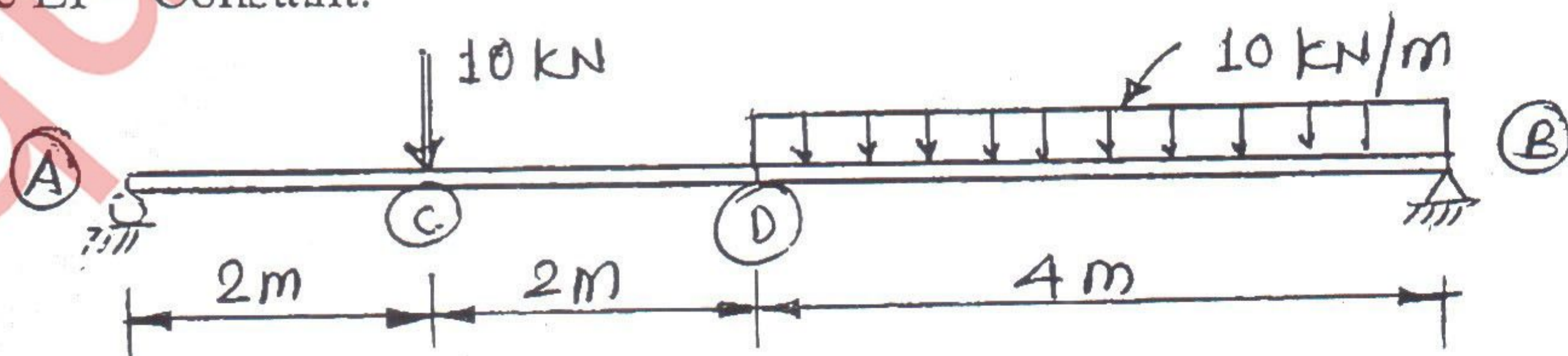
5. (a) Using unit load method or Castigliano's second theorem, for the rigid jointed frame shown in fig. Calculate a horizontal displacement of roller support at D. Take  $E = 200 \text{ Gpa}$ .  $I = 4 \times 10^8 \text{ mm}^4$ . 10



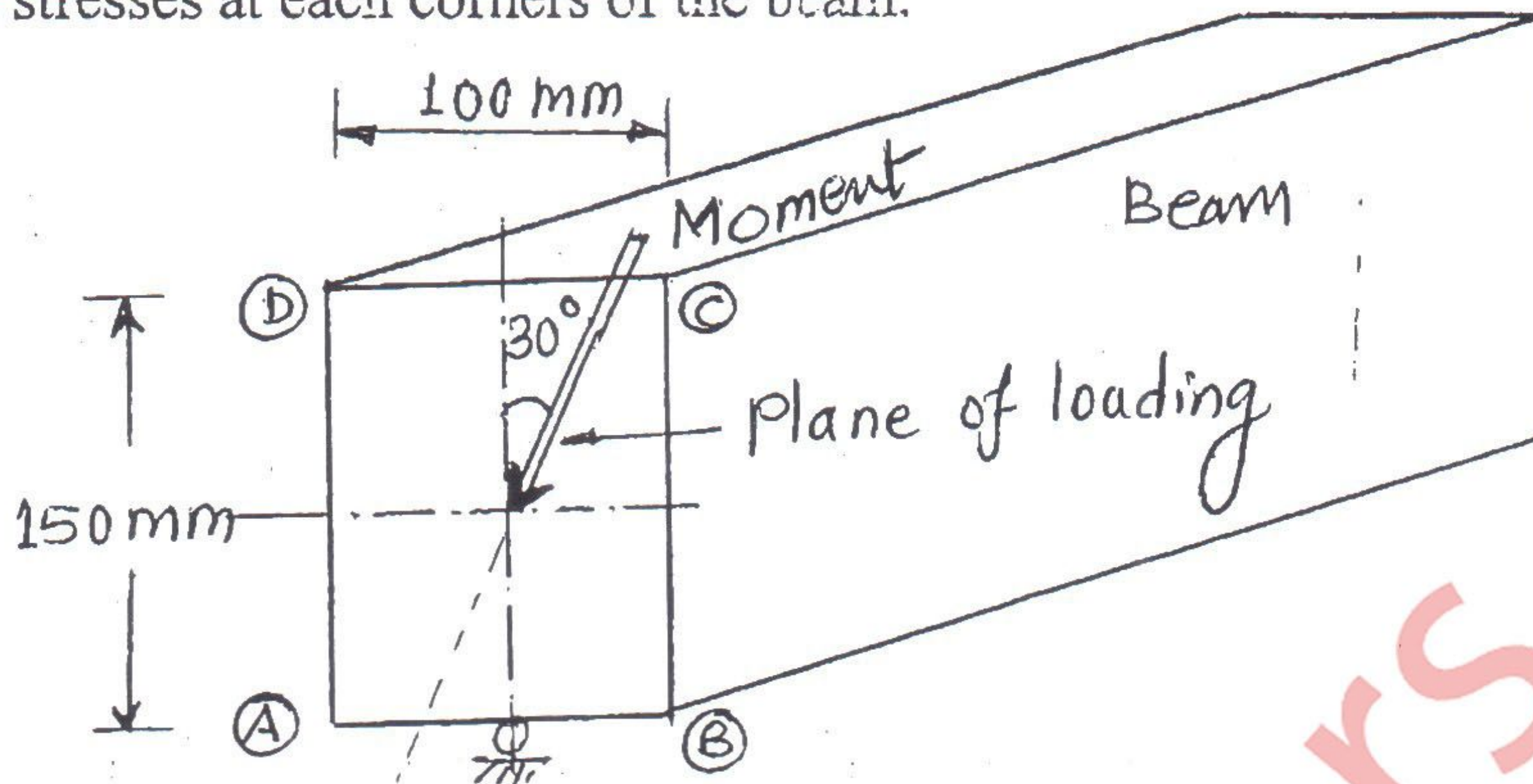
- (b) Using unit load method or any other energy method, find the vertical deflection of joint C of a pin jointed truss loaded and supported as shown in fig. Take  $AE = \text{Constant}$  for all members. 10



6. (a) Using Macaulay's method determine maximum deflection and slope at A and B. Take  $EI = \text{Constant}$ . 06



- (b) A beam of rectangular cross section 100 mm wide and 150 mm deep is subjected to bending moment of 15 kN.m in the plane as shown in fig. Find the stresses at each corners of the beam.



- (C) Using moment area method, determine the vertical deflection and slope at free end of the beam as shown in figure.

