

NATIONAL EXAMS MAY 2002

98-CIV-A1 ELEMENTARY

STRUCTURAL ANALYSIS

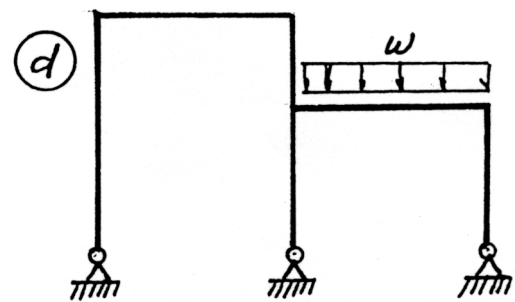
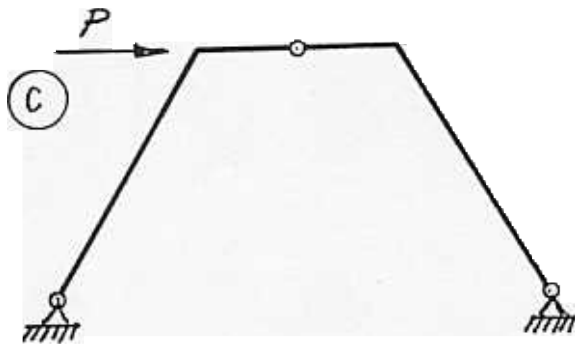
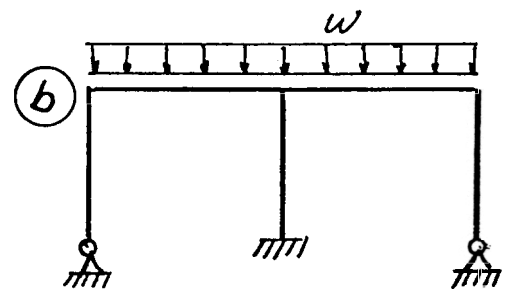
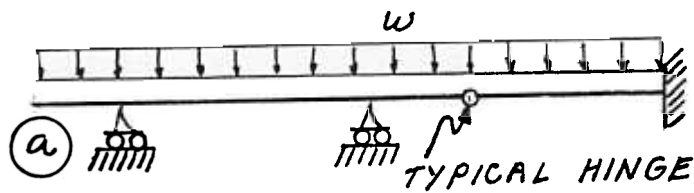
3 HOURS DURATION

**NOTES:**

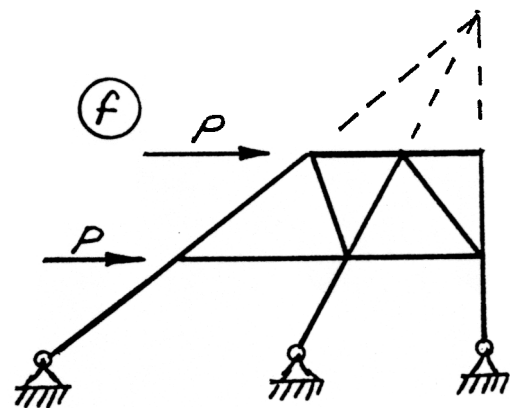
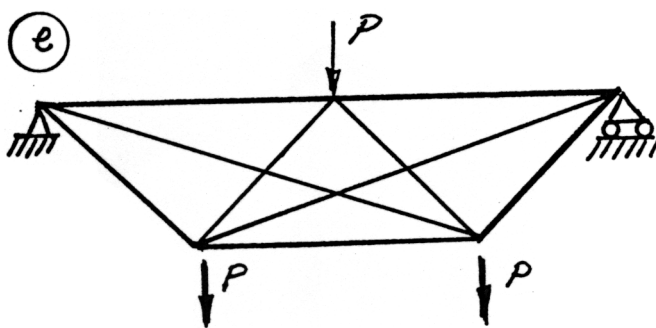
1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumption made.
2. Candidates may use one of two calculators, a Casio FX-991 or a Sharp EL-540; otherwise, this is a CLOSED BOOK Examination.
3. Six questions constitute a complete paper. Answer ALL questions #1 through #5; answer ONLY ONE of #6, #7 or #8. Six questions constitute a complete paper.
4. The marks assigned to each question are shown in the left margin.

FRONT PAGE

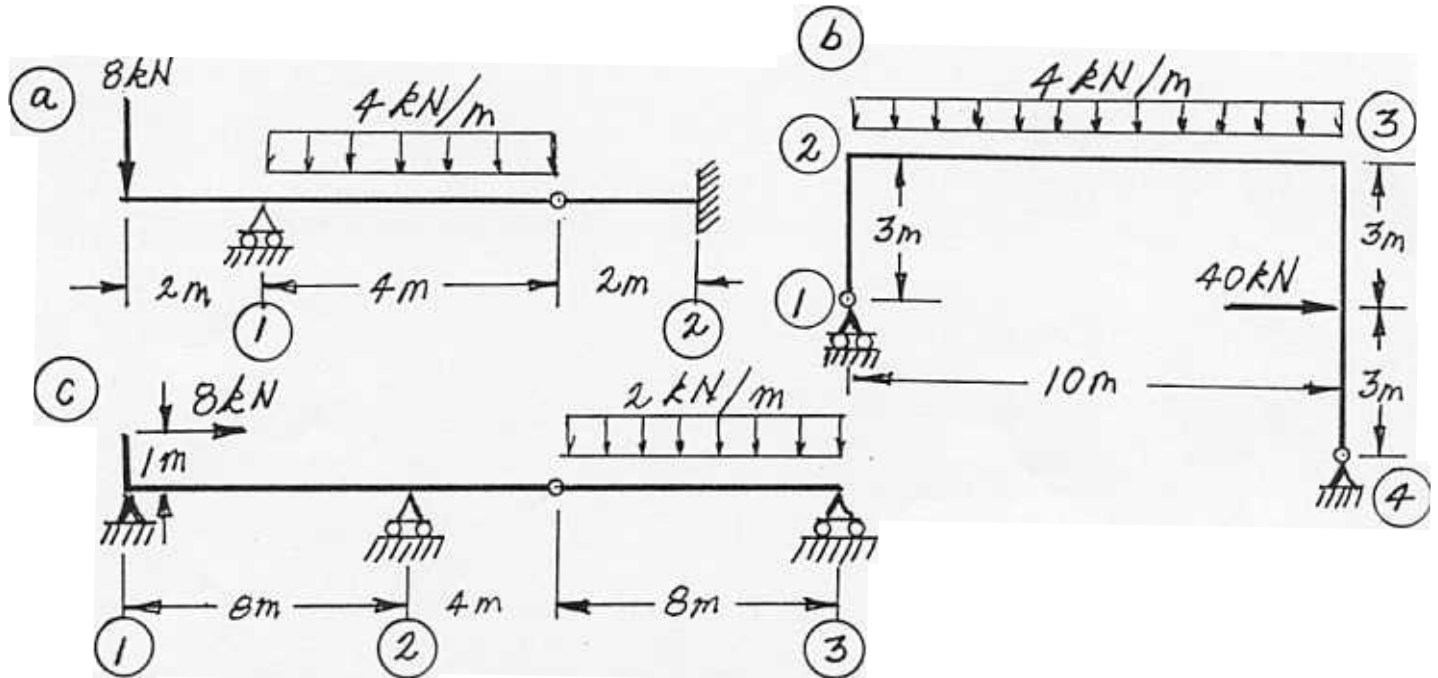
- (6) 1. For each of the structures shown state whether it is unstable, statically determinate, or statically indeterminate. If the structure is statically indeterminate, state the degree of indeterminacy. Structures a) through d) have beam-type members.



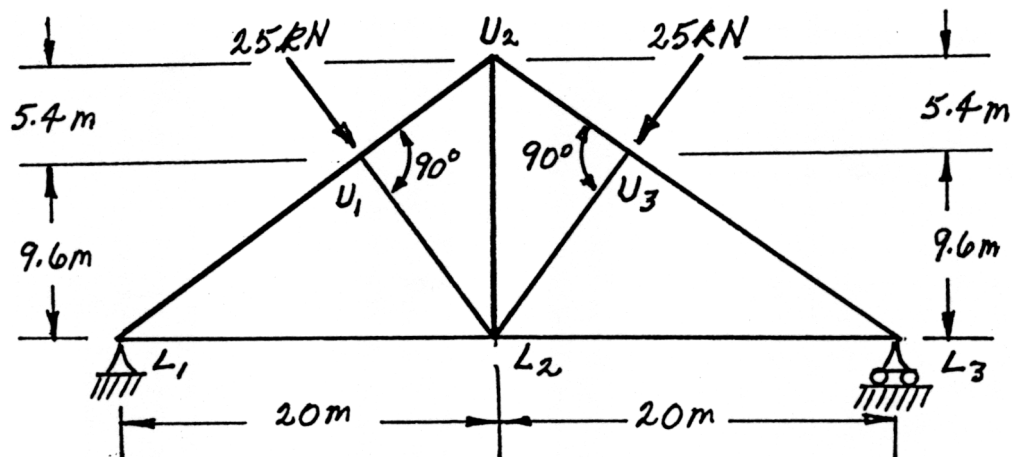
Structures e) and f) have truss-type members. Diagonals are not connected where they cross.



- (18) 2. For each structure shown, compute the reactions and draw shear and bending moment diagrams. Indicate which are positive and which are negative segments of each bending moment diagram. For each shear and bending moment diagram, calculate and indicate the magnitudes of the maximum positive and negative ordinates.



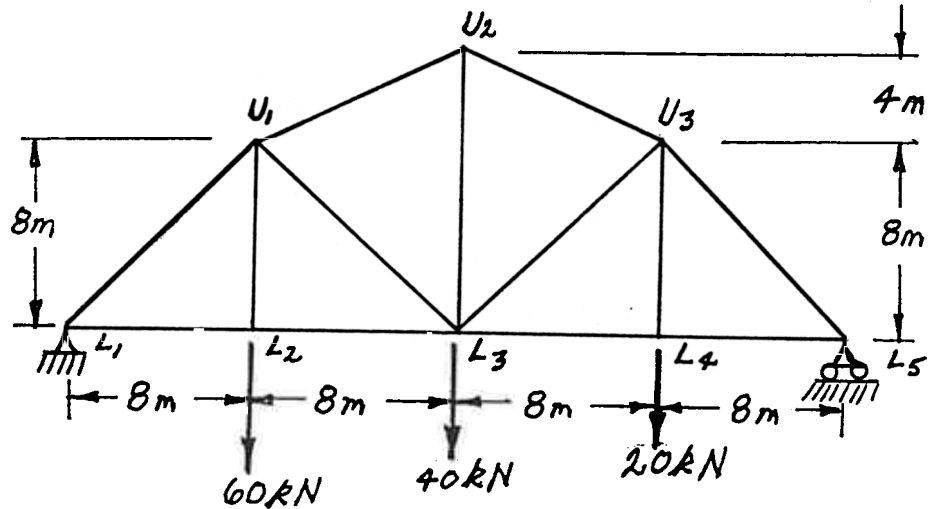
- (16) 3. Calculate the vertical deflection of joint  $U_2$  of the truss shown below. All members have the same  $EA = 5.0 \times 10^5$  kN. Take advantage of symmetry.



(18) 4. For the trusses shown below, calculate the forces in the members that are listed. For each force, indicate whether it is tension or compression.

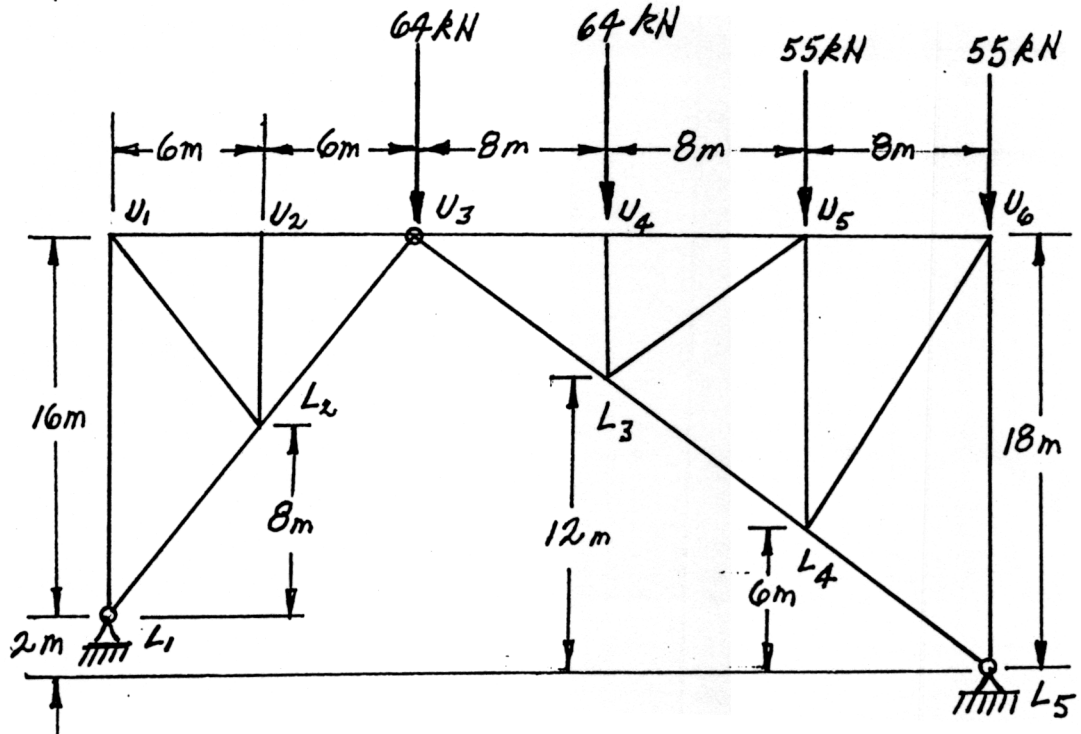
a) Calculate the forces in:

- $L_2 - L_3$
- $L_3 - U_3$  and
- $U_2 - U_3$

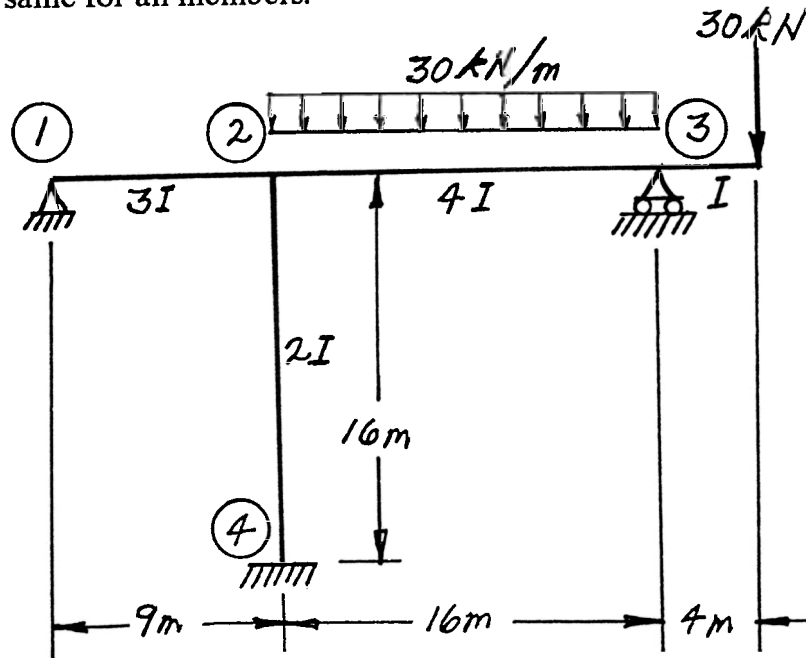


b) Calculate the forces in:

- $U_3 - U_4$
- $L_3 - U_5$  and
- $L_3 - L_4$

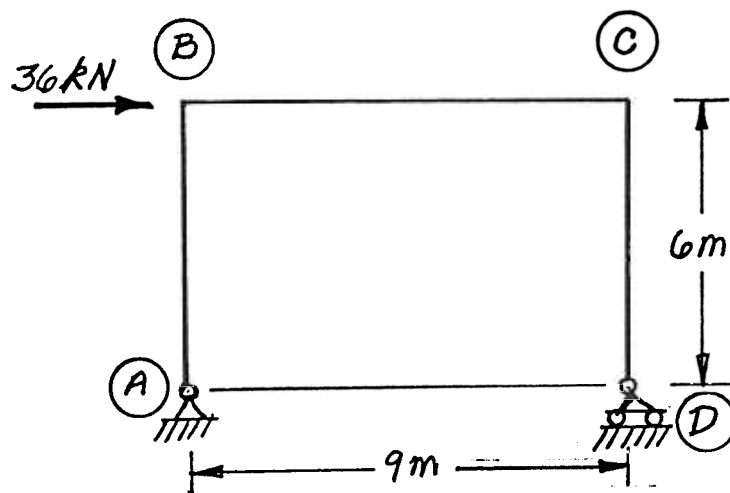


5. For the frame shown below, using the moment-distribution method or the slope-deflection method, calculate and plot the shear force and bending moment diagrams. On both diagrams, for each member, label the maximum positive and negative values. The members have the  $I$  values shown and are inextensible; the value of  $E$  is the same for all members.



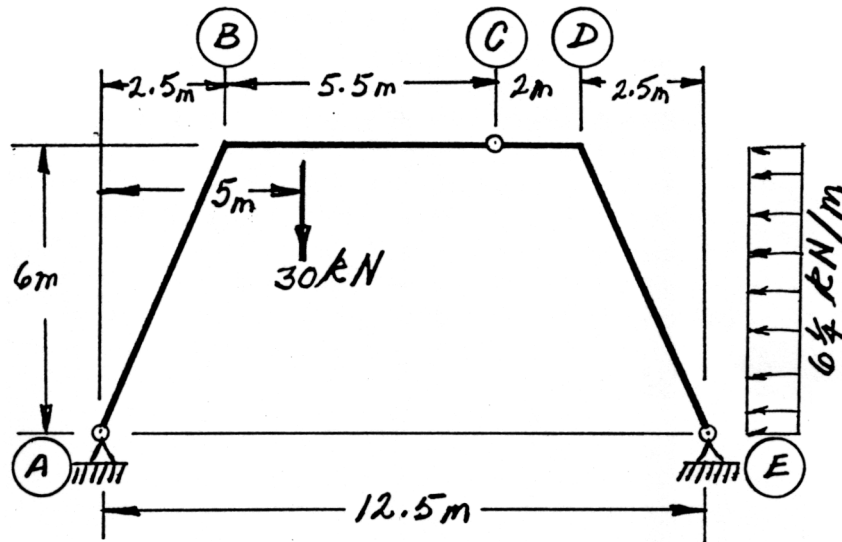
Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8.

6. Calculate the horizontal deflections of joints B and C on the frame shown below.  $EI = 12.0 \times 10^5 \text{ kN.m}^2$  for all members and all are inextensible.



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 Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8.

- (22) 7. For the structure shown below, compute the reactions and draw shear and bending moment diagrams. On both diagrams, for each member, calculate and label the maximum positive and negative values. The magnitude of the uniformly distributed loading that acts horizontally is given per vertical metre.



Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8

- (22) 8. a) Loads move along beams at the top chord level of the pin-jointed truss shown. Draw influence lines for forces in the members listed below. For each influence line, calculate and indicate the value of the influence coefficient that has the maximum absolute value. Indicate the influence coefficient as tension or compression with "T" or "C" respectively.

- $L_1 - L_2$
- $M_1 - L_2$
- $M_1 - M_2$
- $U_3 - M_2$

- b) Calculate the force in member  $U_3 - M_2$  caused by a uniformly distributed load of 6 kN/m applied as a gravity load to all the beams at the top chord level of the truss.

