

NATIONAL EXAMS DECEMBER 2012

98-CIV-A1 ELEMENTARY

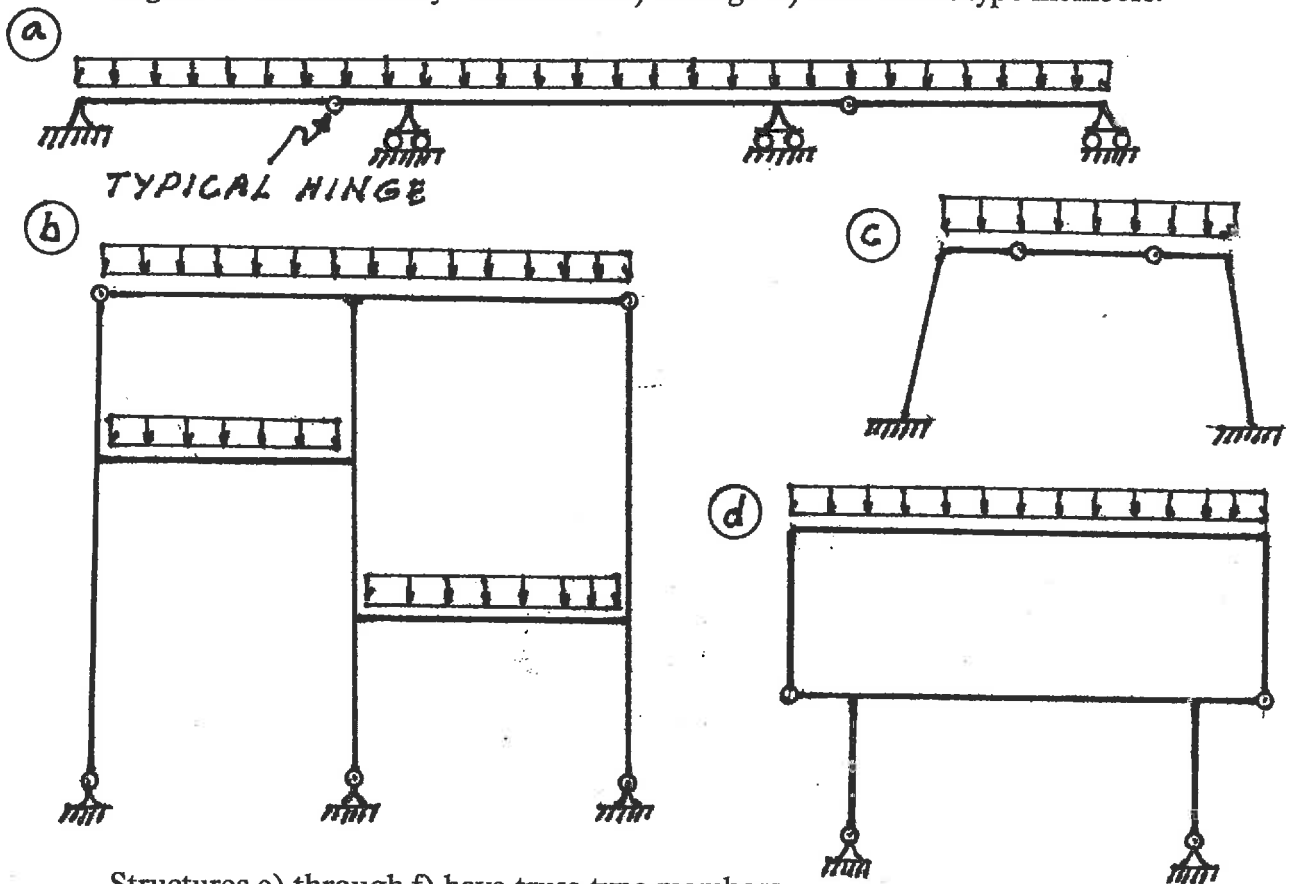
STRUCTURAL ANALYSIS

3 HOURS DURATION

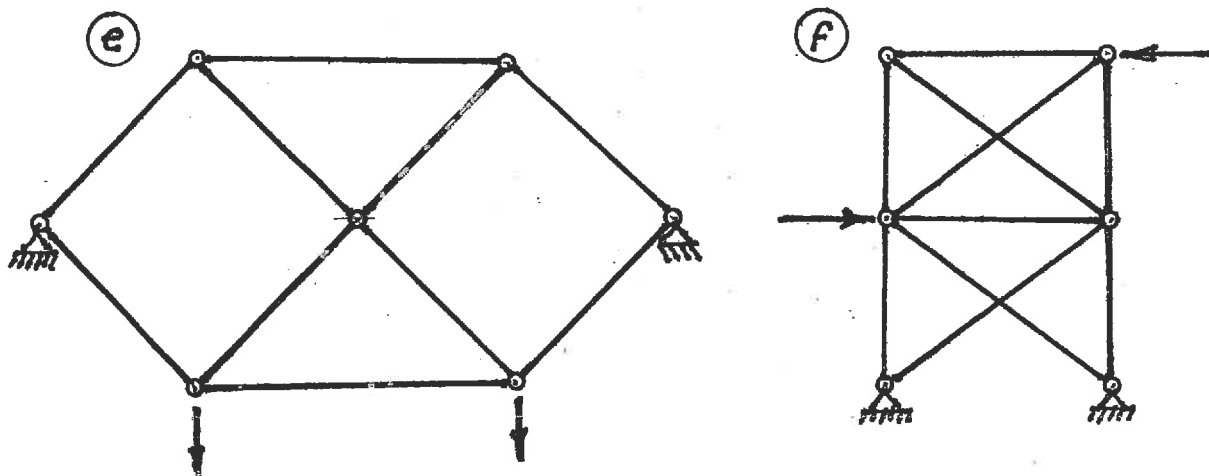
NOTES:

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. Each candidate may use an approved model of Sharp or Casio calculator; 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.
4. The marks assigned to each question are shown in the left margin.

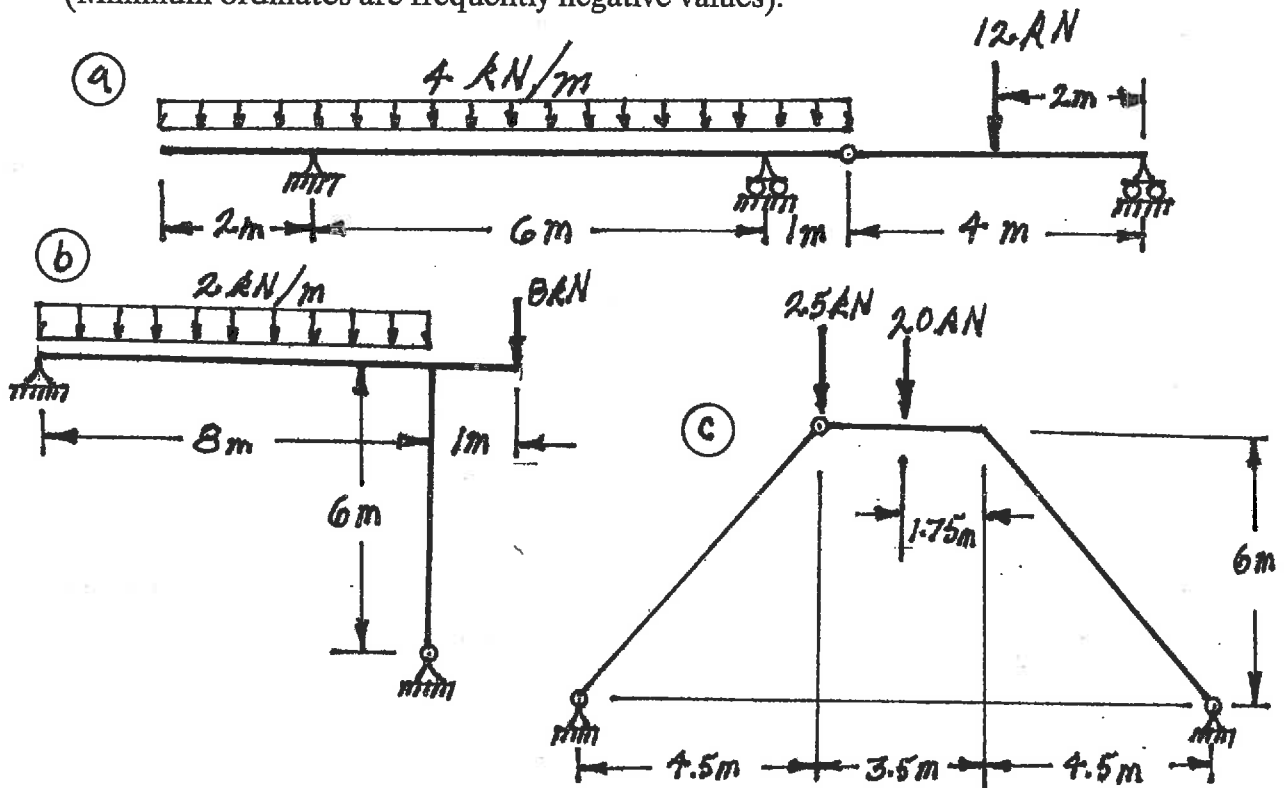
- (6) 1. For each of the structures shown state whether it is unstable, statically determinate, or statically indeterminate. If the structure is statically indeterminate, state the degree of indeterminacy. Structures a) through d) have beam-type members.



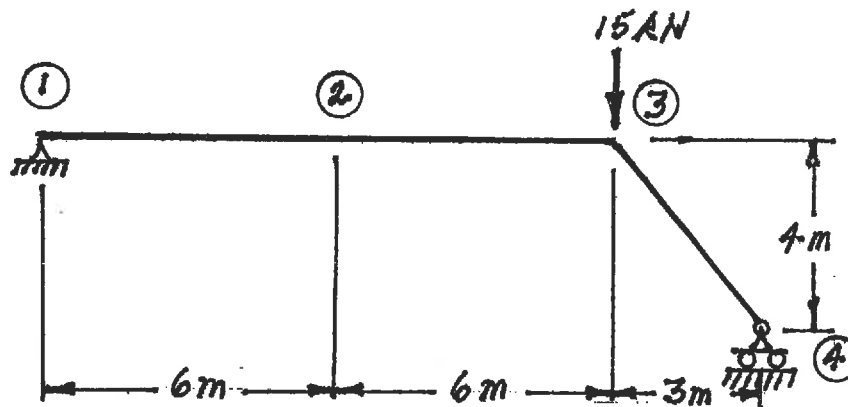
Structures e) through f) have truss-type members. Diagonals are not connected where they cross.



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



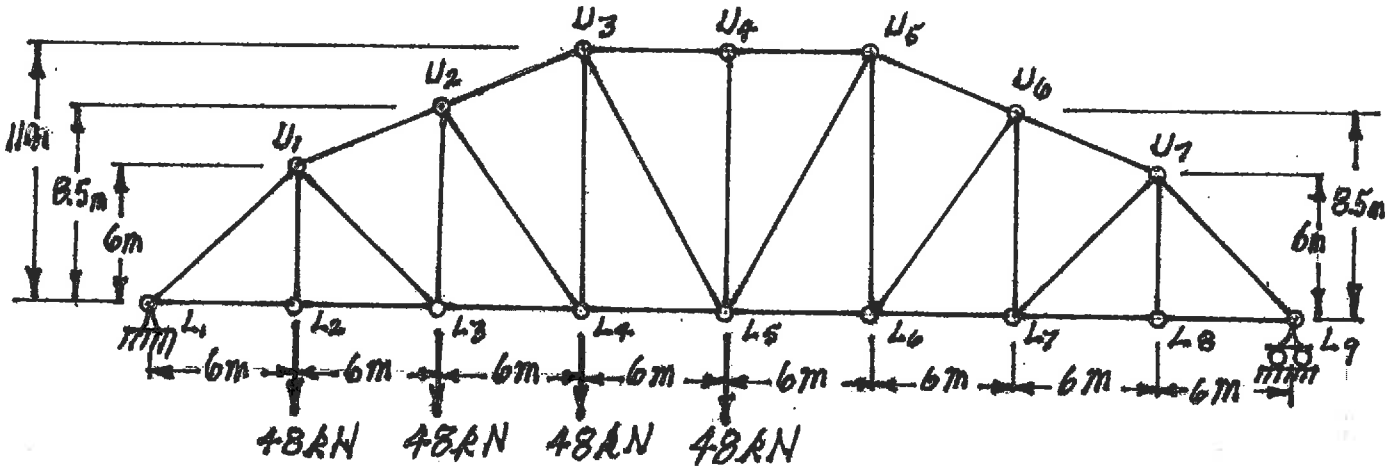
- (18) 3. (a) Calculate the vertical deflection at point ② on the structure shown below. $EI = 1.6 \times 10^4 \text{ kN.m}^2$ for both members.
 (b) If the 15 kN vertical load were at point ② instead of point ③, what would be the vertical deflection be at point ③?



(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.

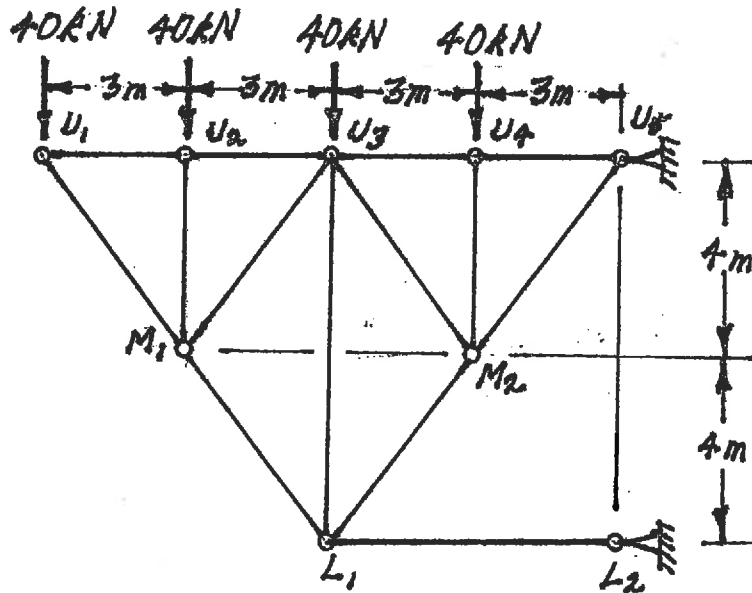
a) Calculate the forces in:

- $U_3 - L_5$
- $U_1 - L_3$ and
- $L_3 - U_2$

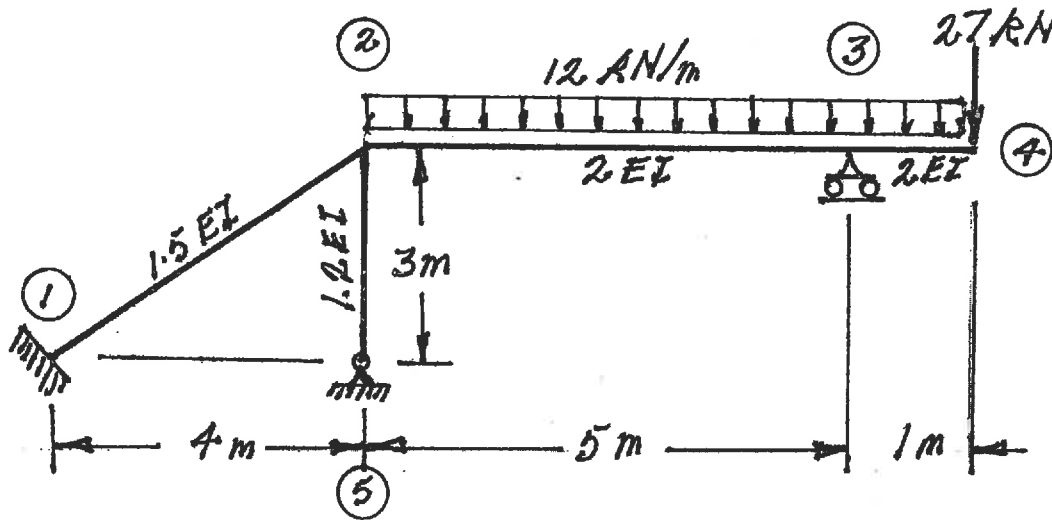


b) Calculate the forces in:

- $U_3 - M_1$
- $U_3 - L_1$ and
- $L_1 - M_2$

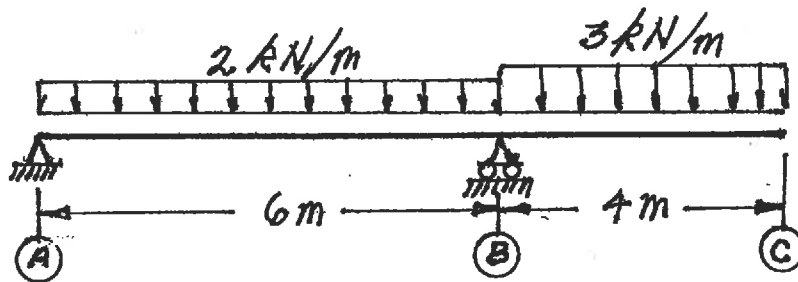


- (20) 5. For the frame shown below, using the moment-distribution method or the slope-deflection method, calculate and plot the shear force and bending moment diagrams. On both diagrams for each member, show the value of the maximum and minimum ordinate (Minimum ordinates are frequently negative.). The members have the relative EI values shown and are inextensible.



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

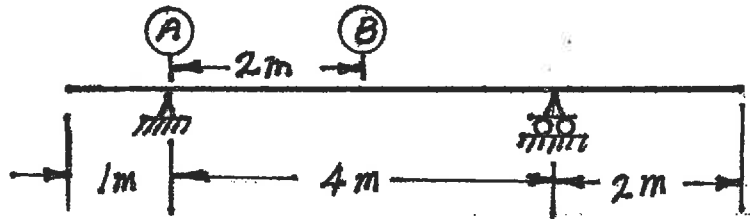
- (20) 6. Use the principle of virtual work to calculate the vertical deflection at point C on the two-beam structure shown below. Both beams have the same EI value which is 6000 kN.m².



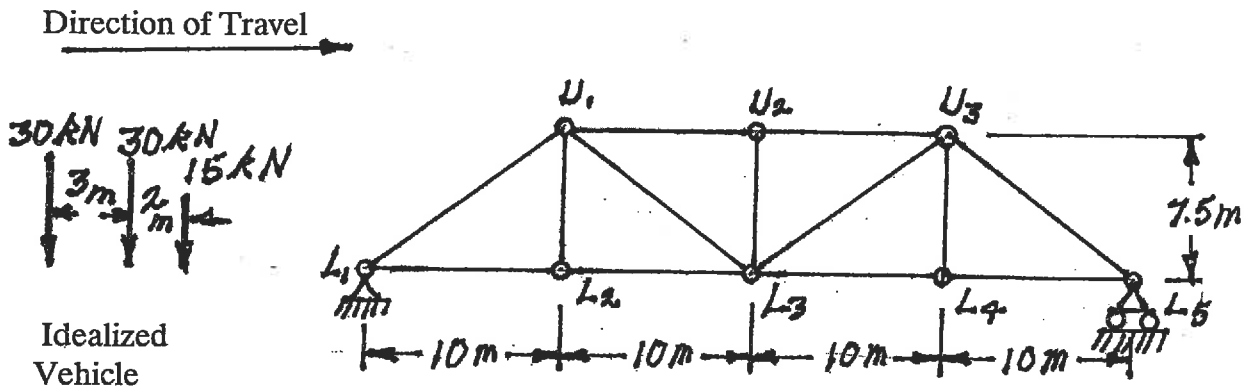
Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8.

- (20) 7. a) For the determinate beam structure shown, draw the influence lines for:
- i) bending moment at point (B)
 - ii) shear force at point (B)
 - iii) reaction at support (A)

For each influence line, calculate and indicate the value of the influence coefficient that has the maximum absolute value.



- b) A vehicle, which is idealized as the three point loads spaced as shown below, moves across the truss on beams at the lower chord level of the truss. Calculate and show the influence line for force in member $U_3 - L_3$. Show the maximum and minimum ordinates on a sketch of the influence line and calculate the maximum tension force in member $U_3 - L_3$ caused by the vehicle as it crosses the structure.



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

- (20) 8. For the structure shown below, compute the reactions and draw shear and bending moment diagrams. On both diagrams for each member, calculate and indicate the maximum and minimum ordinates (Minimum ordinates are frequently negative values).

