

NATIONAL EXAMS DECEMBER 2010

07-Str-A1. ELEMENTARY

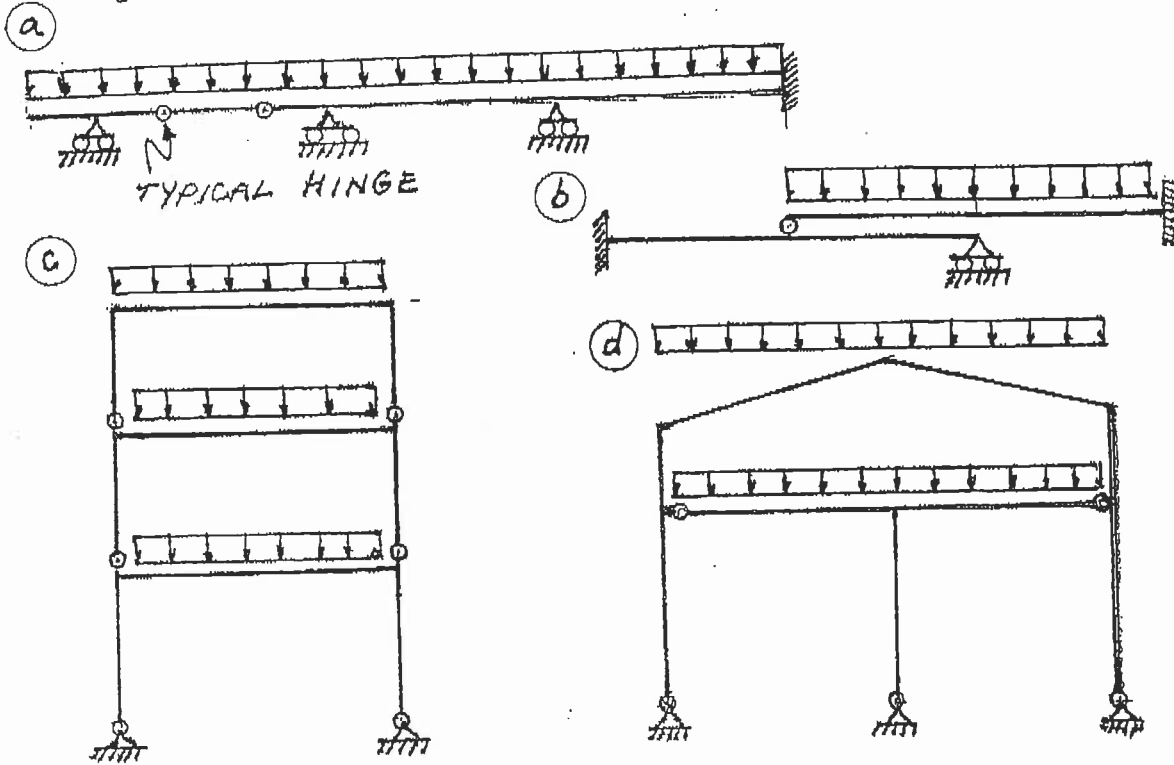
STRUCTURAL ANALYSIS

3 HOURS DURATION

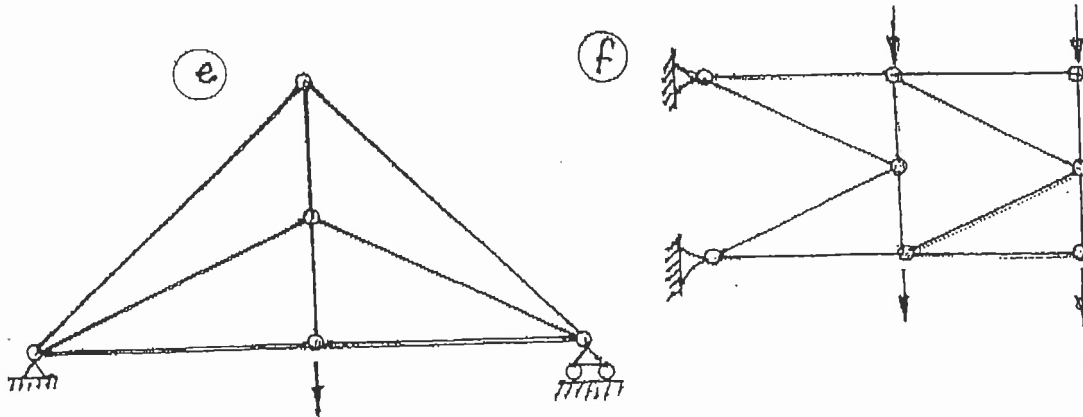
NOTES:

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.

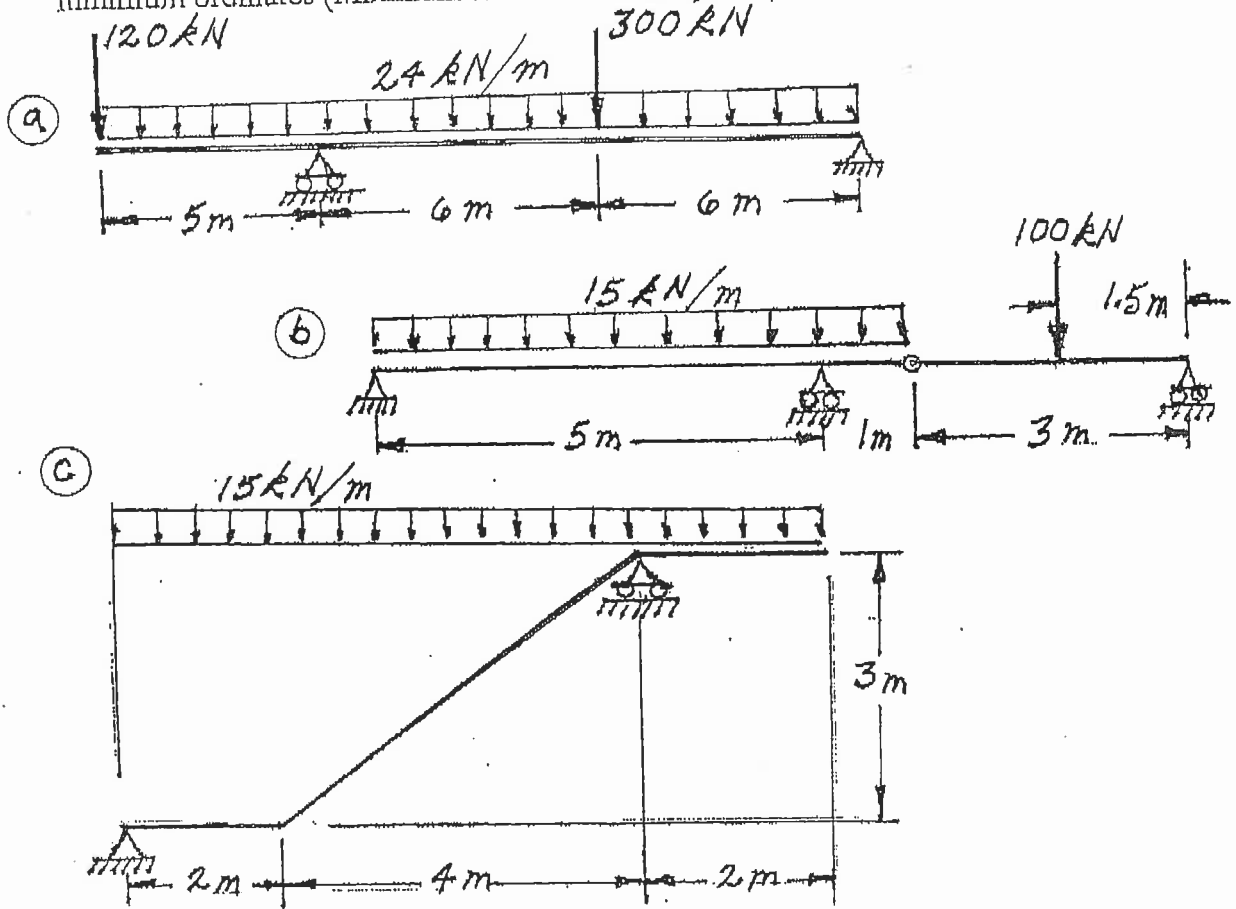
- (6) 1. For each of the structures shown state whether it is unstable, statically determinate, or statically indeterminate. If the structure is statically indeterminate, state the degree of indeterminacy. Structures a) through d) have beam-type members.



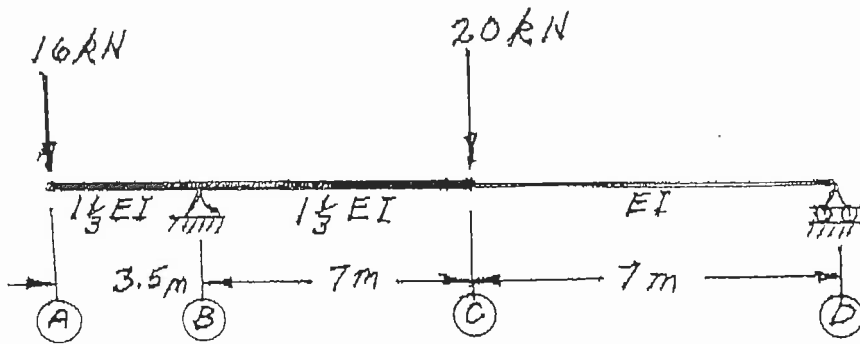
Structures e) and f) have truss-type members. Diagonals are not connected where they cross.



- (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 member on the shear and bending moment diagrams, calculate and indicate the magnitudes of the maximum and minimum ordinates (Minimum ordinates are frequently negative.).



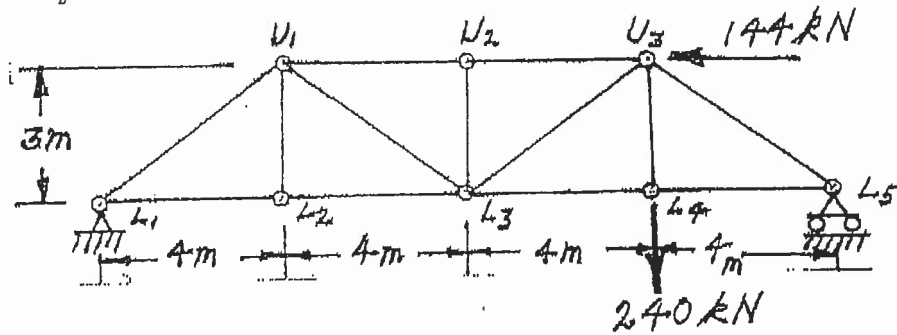
- (18) 3. Calculate the vertical deflection at point: (C) on the continuous beam shown below. $EI = 7000 \text{ kN.m}^2$.



(20) 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.

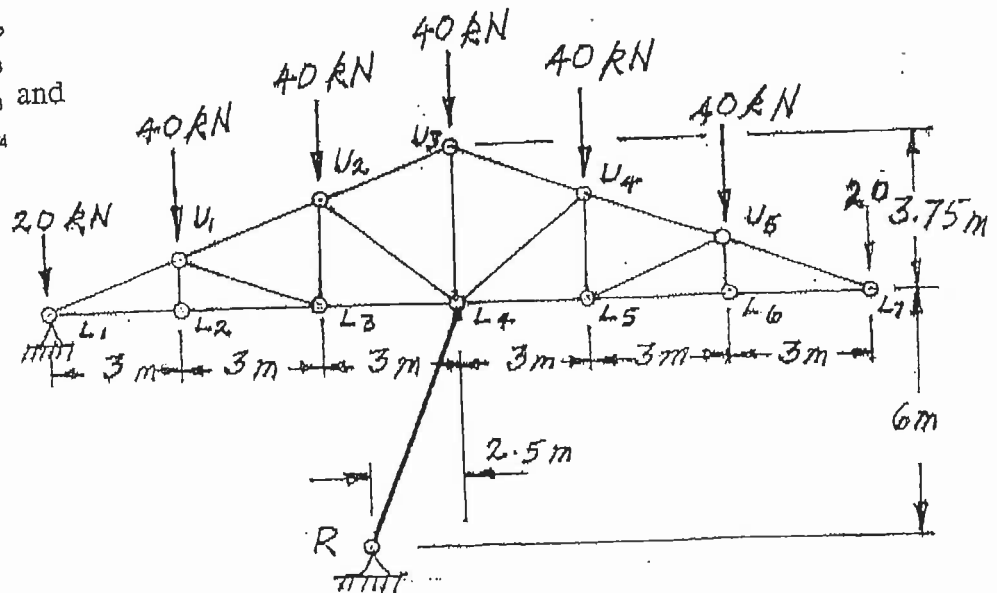
a) Calculate the forces in:

- $U_1 - L_3$,
- $L_3 - L_4$ and
- $U_1 - U_2$

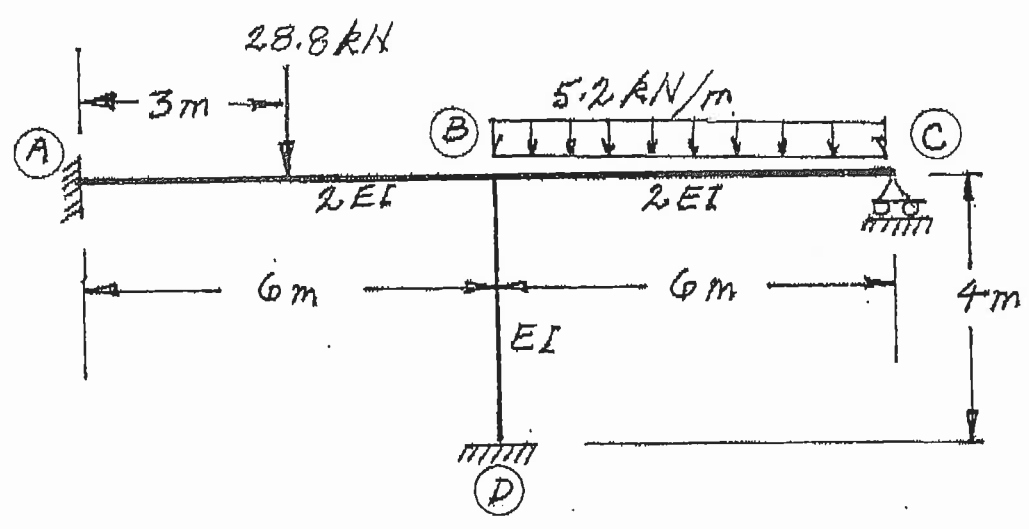


b) Calculate the forces in:

- $R - L_4$,
- $U_2 - U_3$
- $U_2 - L_3$ and
- $U_2 - L_4$



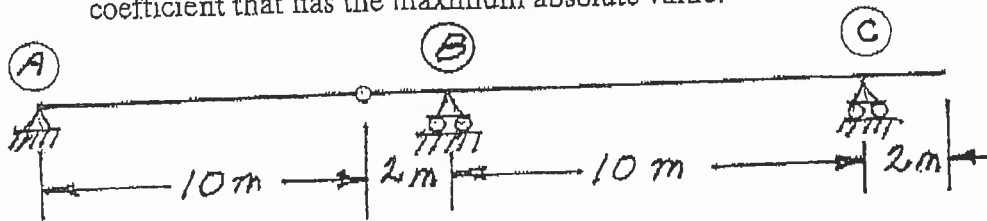
- (18) 5. For the frame shown below, using the moment-distribution method, calculate and plot the shear force and bending moment diagrams. On both diagrams, for each member, label the maximum and minimum ordinates (Minimum ordinates are frequently negative values). Members have the relative EI values shown and all members are inextensible.



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

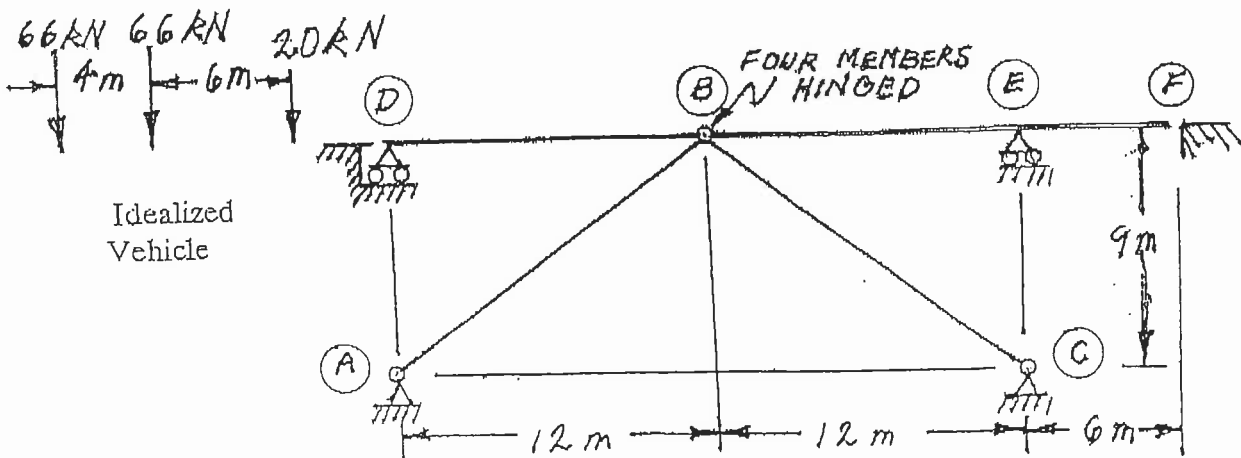
- (20) 6. a) For the determinate, two-span beam shown, draw the influence lines for:
- i) bending moment over support (B)
 - ii) shear force immediately right of support (B), and
 - iii) reaction at support (B)

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



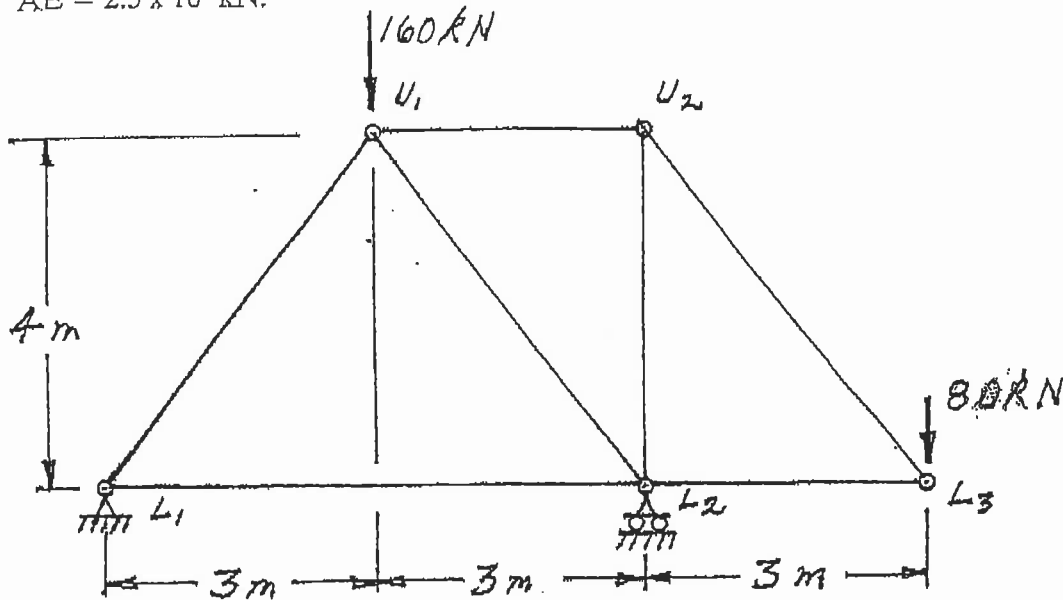
- b) A vehicle, which is idealized as the three point loads spaced as shown below, moves across the structure on the upper beams supported by the three-hinge arch shown. Calculate and show the influence line for force in member (A) - (B). Show the maximum and minimum ordinates on a sketch of the influence line and calculate the maximum compression force in member (A) - (B) caused by the vehicle as it crosses the structure.

Direction of Travel →



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

- (20) 7. Use the principle of virtual work to calculate the vertical deflection at joint U_1 of the truss shown below. All members are prismatic and have the same AE value; $AE = 2.5 \times 10^4 \text{ kN}$.



- (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 magnitudes of the maximum and minimum ordinates (Minimum ordinates are frequently negative).

