

NATIONAL EXAMS DECEMBER 2009

07-STR-A1, ELEMENTARY

STRUCTURAL ANALYSIS

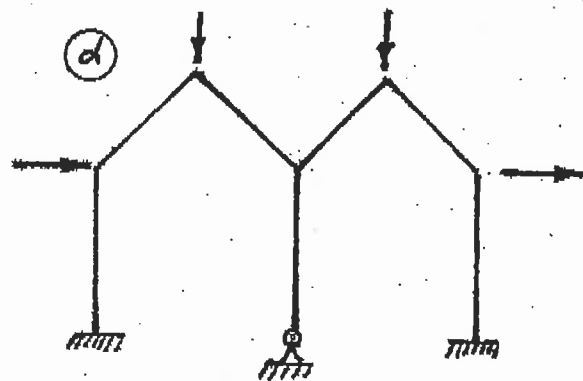
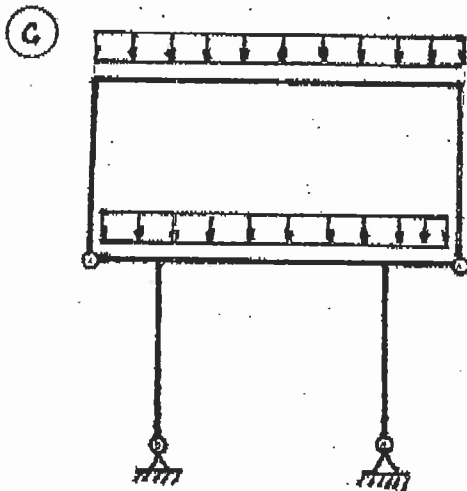
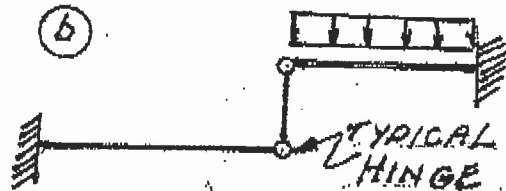
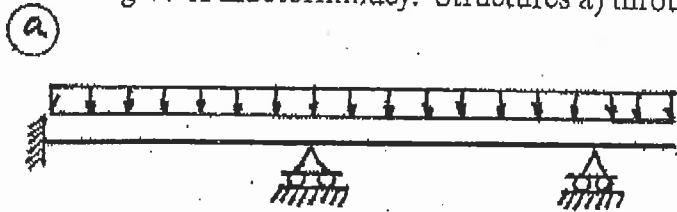
3 HOURS DURATION

NOTES:

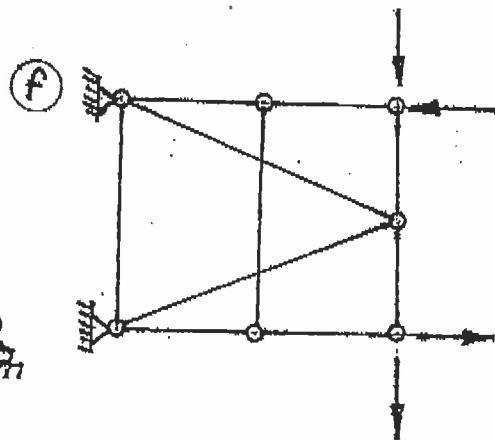
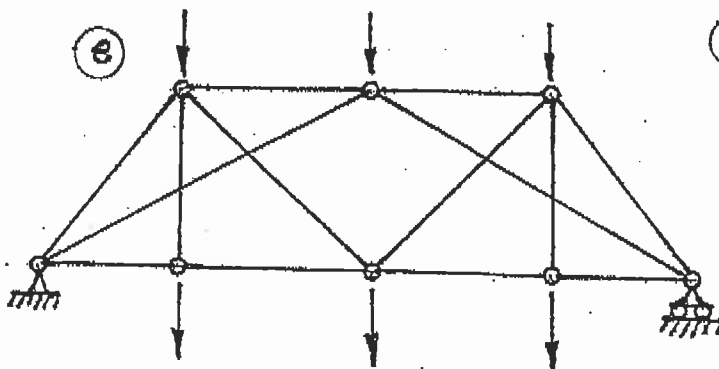
1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumption made.
2. Each candidate may use an approved model of Sharp or Casio calculator; otherwise, this is a CLOSED BOOK Examination.
3. Six questions constitute a complete paper. Answer ALL questions #1 through #4; answer ONLY TWO of #5, #6, #7 or #8.
4. The marks assigned to each question are shown in the left margin.

FRONT PAGE

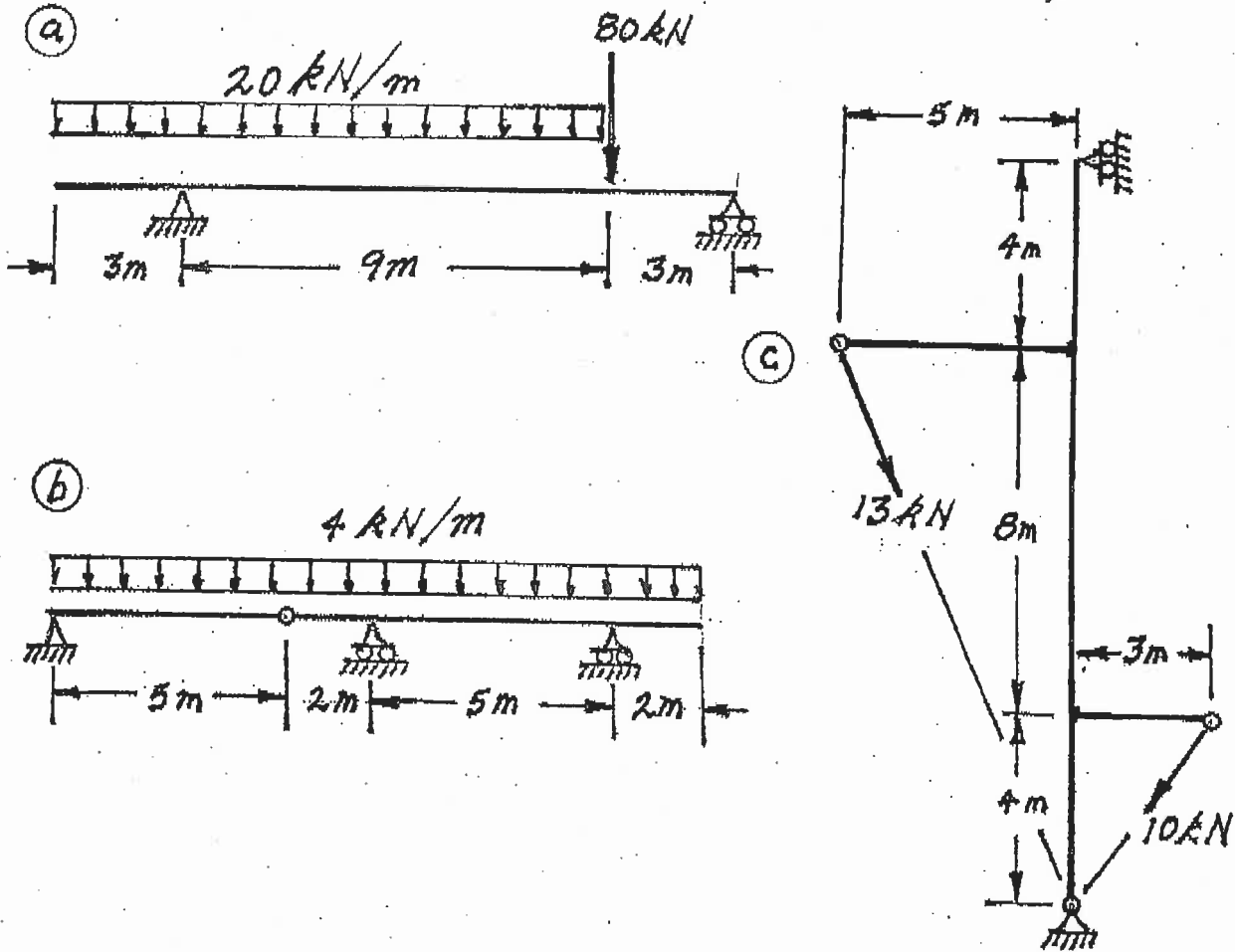
- (6) 1. For each of the structures shown state whether it is unstable, statically determinate, or statically indeterminate. If the structure is statically indeterminate, state the degree of indeterminacy. Structures a) through d) have beam-type members.



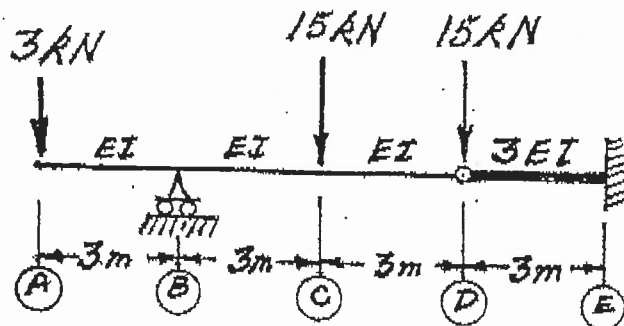
Structures e) through f) have truss-type members. Diagonals are not connected where they cross.



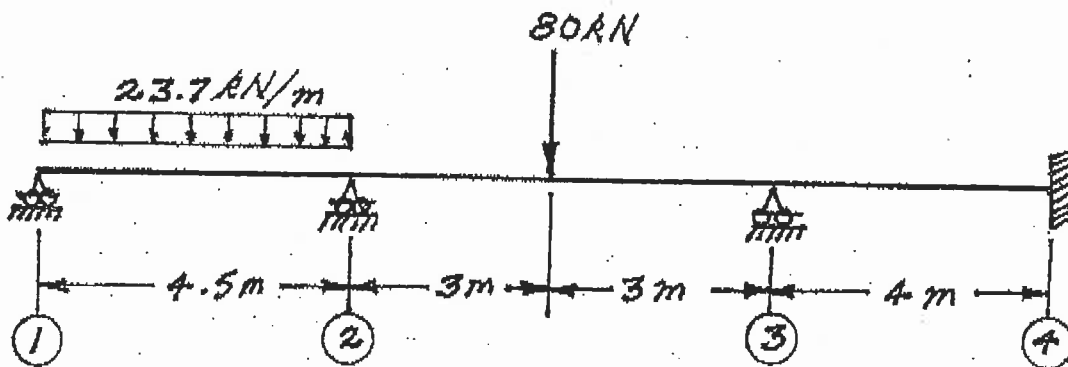
- (18) 2. For each structure shown, compute the reactions and draw shear and bending moment diagrams. Indicate which are positive and which are negative segments of each bending moment diagram. For each member on the shear and bending moment diagrams, calculate and indicate the magnitudes of the maximum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



- (18) 3. Calculate the vertical deflections at points C and D on the beam structure shown below. Relative EI values are shown; $EI = 10000 \text{ kN.m}^2$.

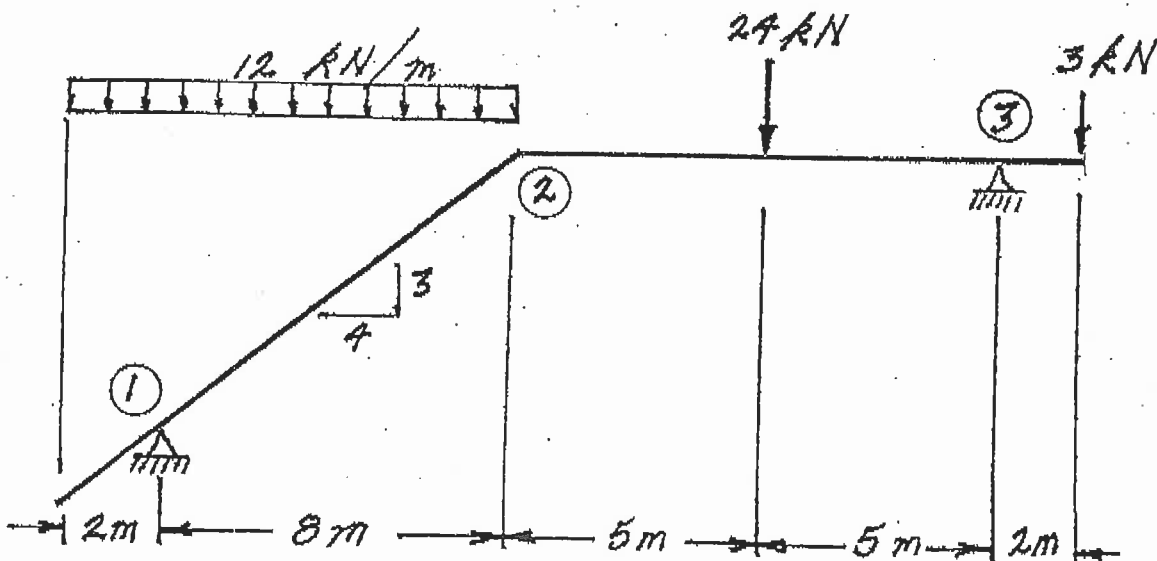


- (18) 4. For the continuous beam shown below, use the moment-distribution method to analyze the structure. Calculate and plot the shear force and bending moment diagrams. On both diagrams, for each member, indicate the values of the maximum and minimum ordinates (Minimum ordinates are frequently negative values). All members have the same EI value and are inextensible.



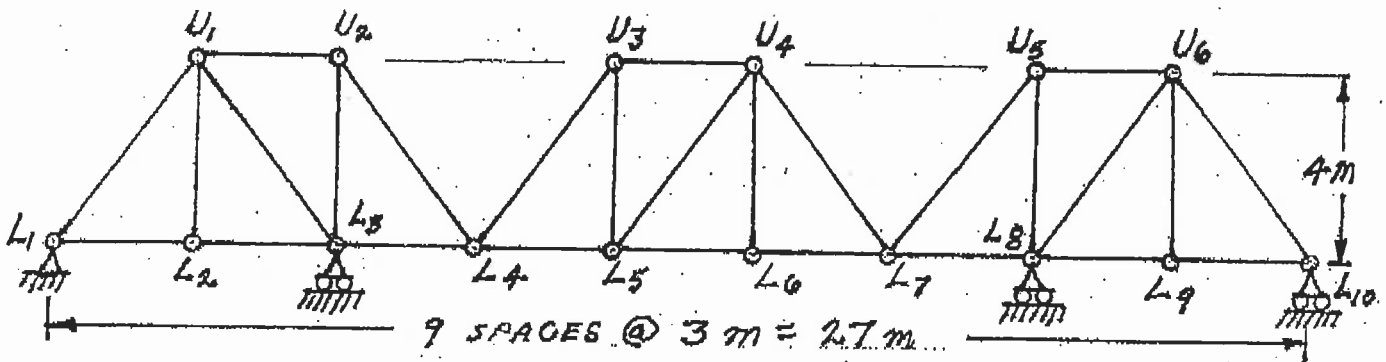
Select and answer TWO QUESTIONS ONLY from Questions #5, #6, #7 or #8.

- (20) 5. For the frame shown below, analyze the structure 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, indicate the values of the maximum and minimum ordinates (Minimum ordinates are frequently negative values). All members have the same EI value and are inextensible.



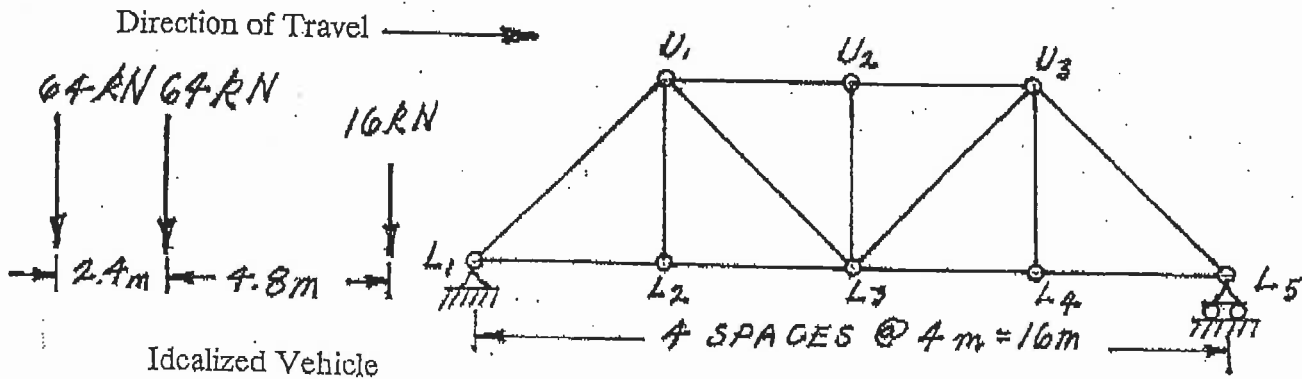
Select and answer TWO QUESTIONS ONLY from Questions #5, #6, #7 or #8.

- (20) 6. a) Loads move at the bottom chord level of the truss shown below. Draw the influence lines for forces in:
 $U_1 - L_3$
 $U_2 - L_3$
 and $L_5 - U_4$



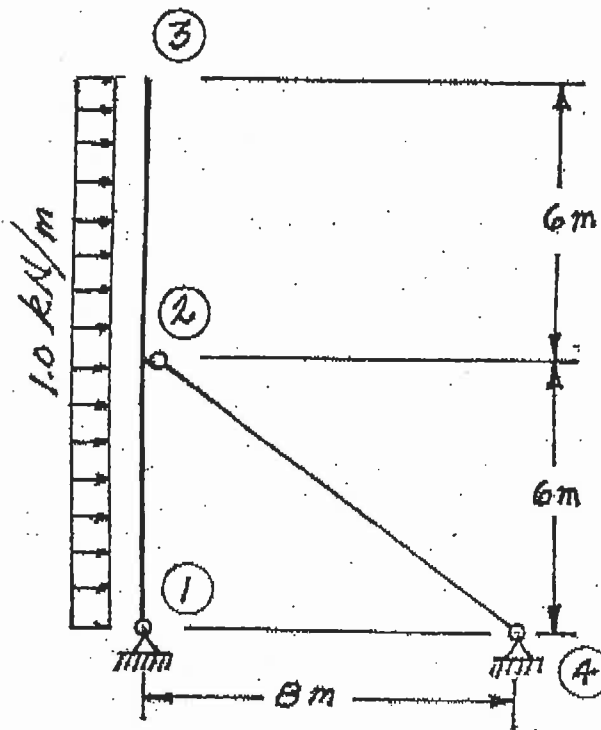
For each influence line, calculate and indicate the value of the influence coefficient that has the maximum absolute value.

- b) A vehicle, which is idealized as the three point loads spaced as shown below, moves across the structure on beams at the level of the lower chord of the truss. Calculate and show the influence line for force in member $L_2 - L_3$. Show the maximum ordinate on a sketch of the influence line and calculate the maximum tension force in member $L_2 - L_3$ caused by the vehicle as it crosses the structure.



Select and answer TWO QUESTIONS ONLY from Questions #5, #6, #7 or #8.

- (20) 7. Use the principle of virtual work to calculate the horizontal deflection at point ③ on the structure shown below. The EA value for the strut ②-④ is 3750 kN. For both flexural members, $EI = 6000 \text{ kN.m}^2$ and both are inextensible.



Select and answer TWO QUESTIONS ONLY from Questions #5, #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 value of the maximum and minimum ordinates (Minimum ordinates are frequently negative values).

