NATIONAL EXAMS MAY 2009

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.

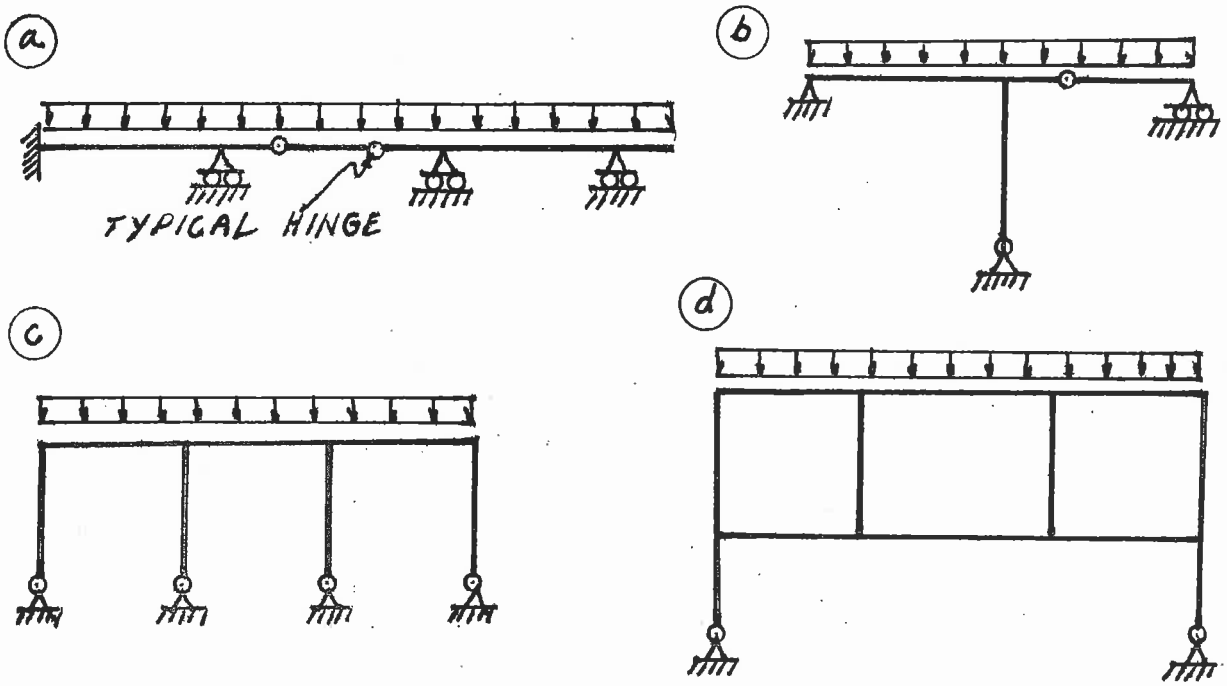
2. Each candidate may use an approved model of Sharp or Casio calculator; otherwise, this is a CLOSED BOOK Examination.

3. Six questions constitute a complete paper. Answer ALL questions #1 through #5. Answer ONLY ONE of #6, #7 or #8.

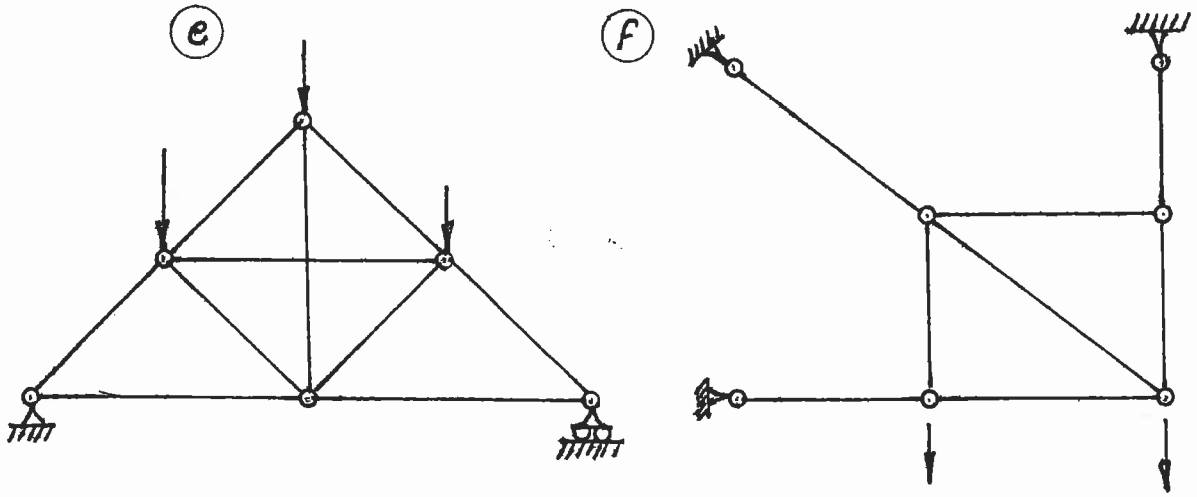
4. The marks assigned to each question are shown in the left margin.

FRONT PAGE

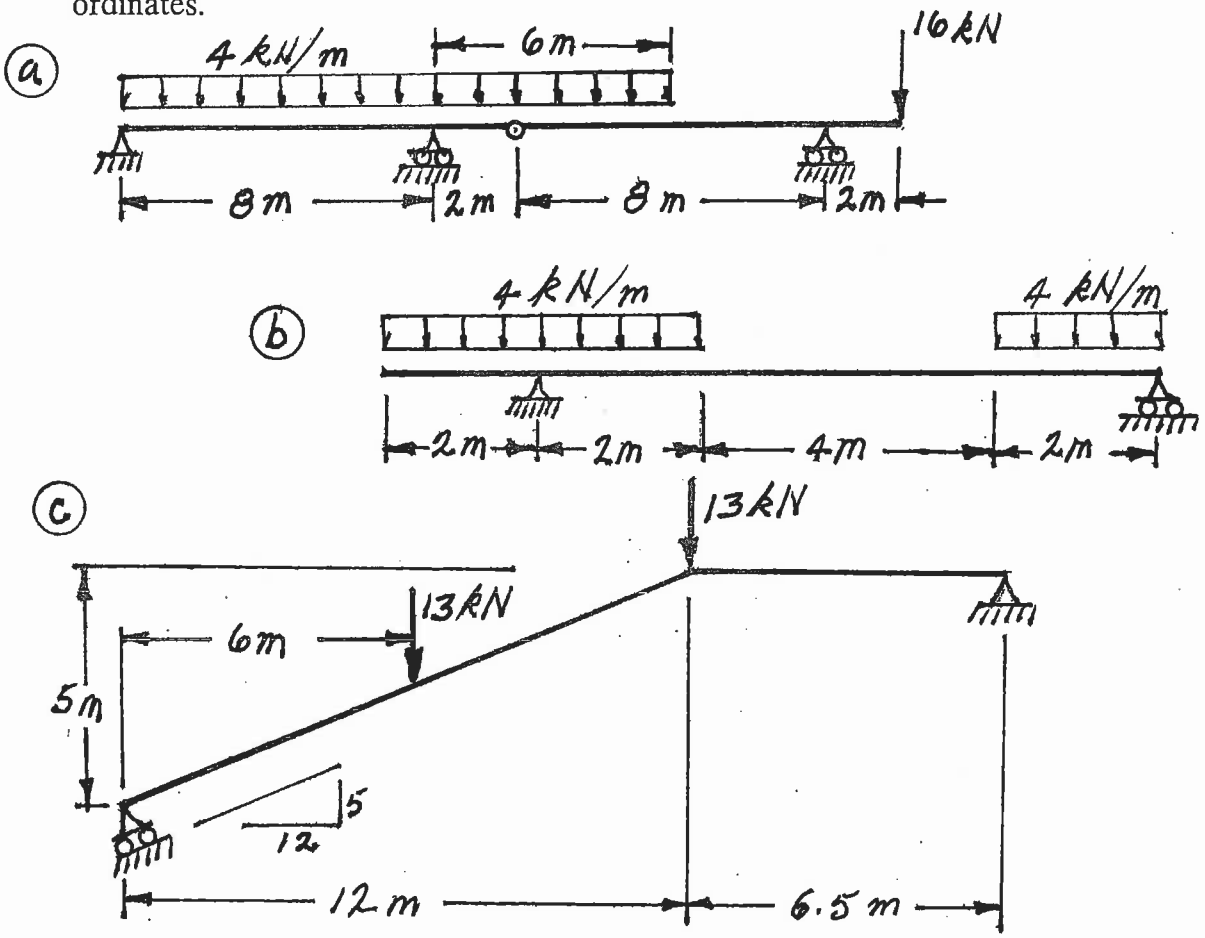
(6) 1. For each of the structures shown state whether it is unstable, statically determinate, or statically indeterminate. If the structure is statically indeterminate, state the degree of indeterminacy. Structures a) through d) have beam-type members.



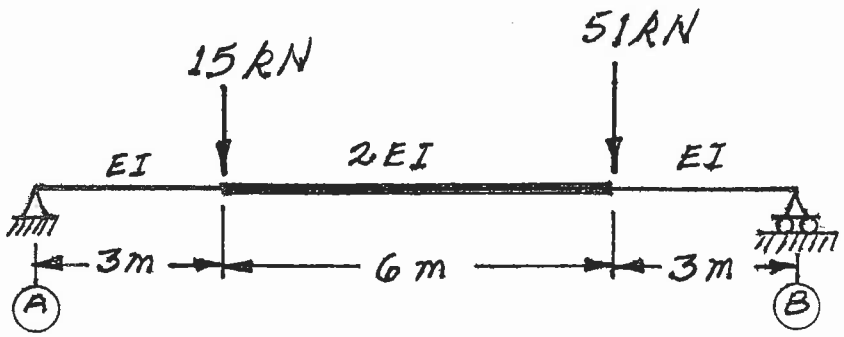
Structures e) through f) have truss-type members.
The central members of structure e) are not connected where they cross.



(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.



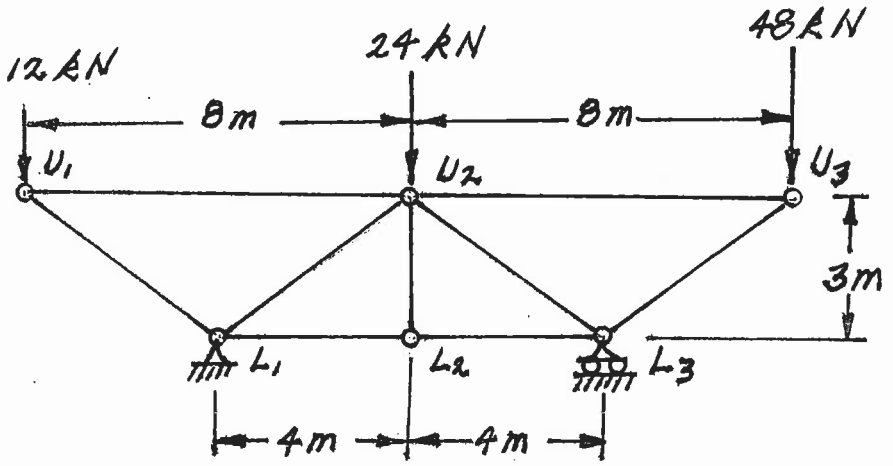
(16) 3. Calculate the vertical deflection at the <u>centre</u> of span Ⓐ – Ⓑ of the non-prismatic beam shown below. EI = 3.25×10^4 kN.m^2.



(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.

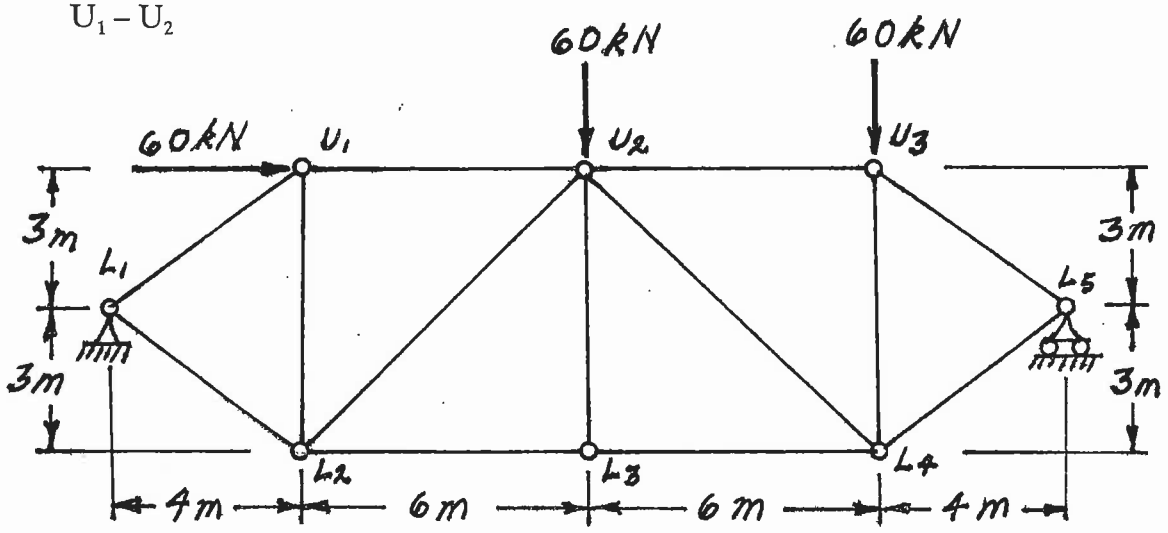
a) Calculate the forces in:

$L_1 - L_2$
$L_1 - U_2$ and
$U_2 - L_3$

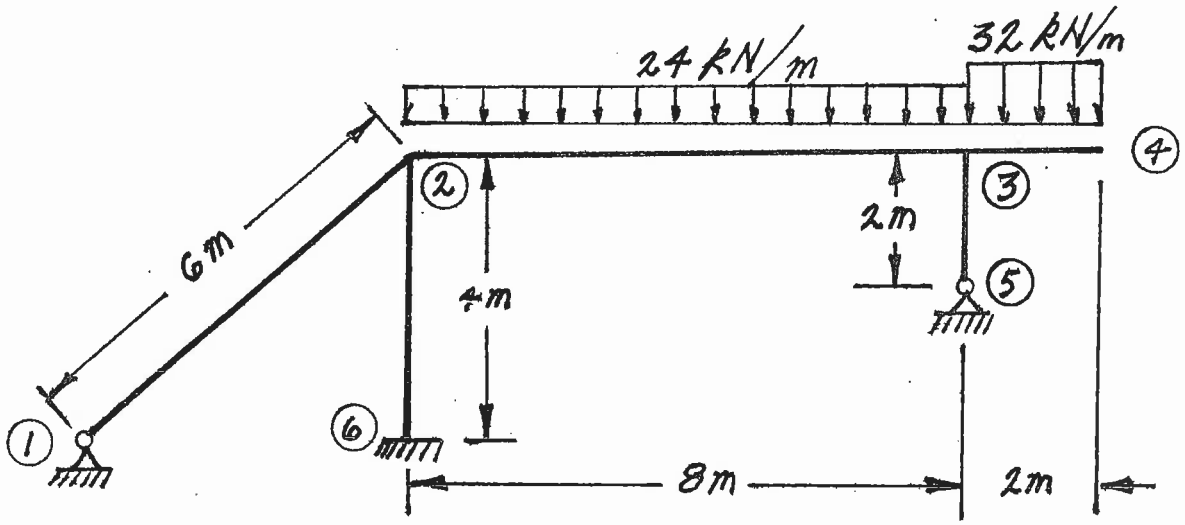


b) Calculate the forces in:

$L_1 - L_2$
$U_1 - L_2$ and
$U_1 - U_2$



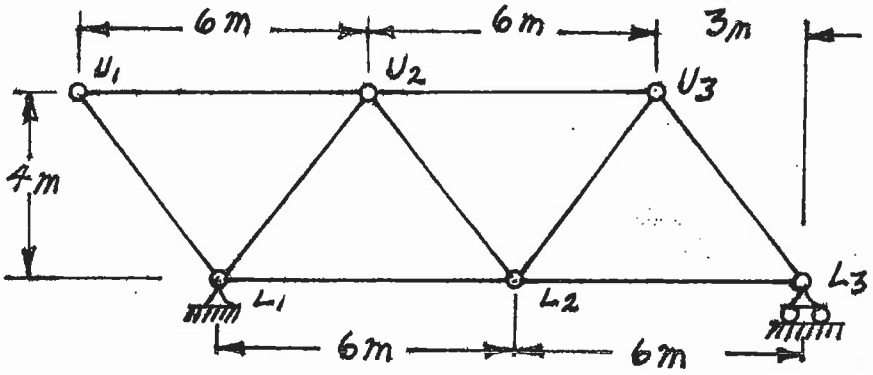
(18) 5. For the frame shown below, using the moment-distribution method or the slope-deflection method, calculate and plot the shear force and bending moment diagrams. On both diagrams, for each member, label the maximum and minimum ordinates (Minimum ordinates are frequently negative). All members have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



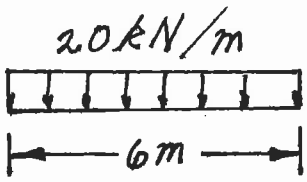
Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8.

(24) 6. 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.

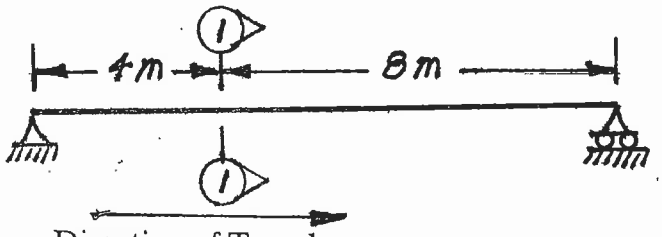
$U_1 - U_2$
$L_1 - L_2$ and
$U_2 - L_2$



b) A vehicle, which is idealized as a uniformly distributed loading over a length of 6 m, moves across the simply supported beam structure shown below. Draw the influence line for bending moment at Section (1)-(1) and calculate the maximum bending moment that occurs while the idealized vehicle crosses the beam.



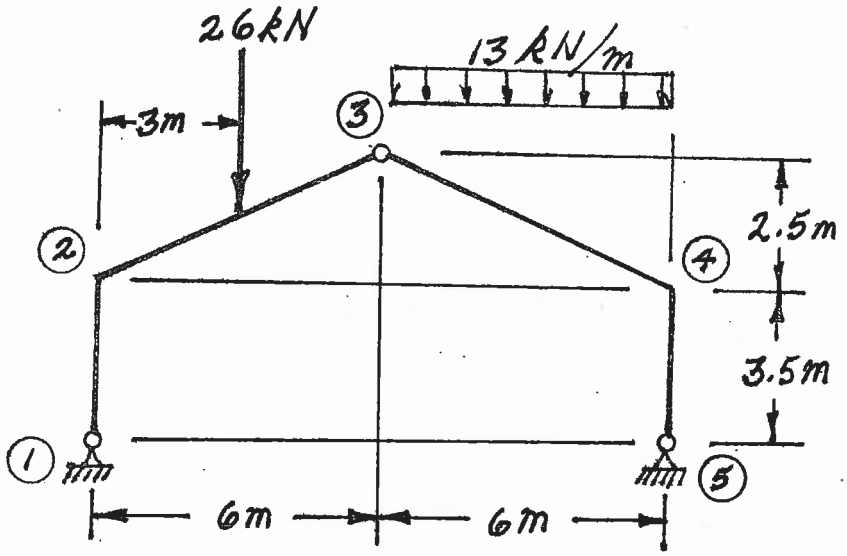
Idealized Vehicle



Direction of Travel

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

(24) 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 and minimum ordinates (Minimum ordinates are frequently negative).



(24) 8. Using the principle of virtual work, calculate the horizontal deflection at joint (3) of the structure shown below. Both beams are inextensible and have EI = 8.0×10^3 kN.m^2.