NATIONAL EXAMS MAY 2014

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.

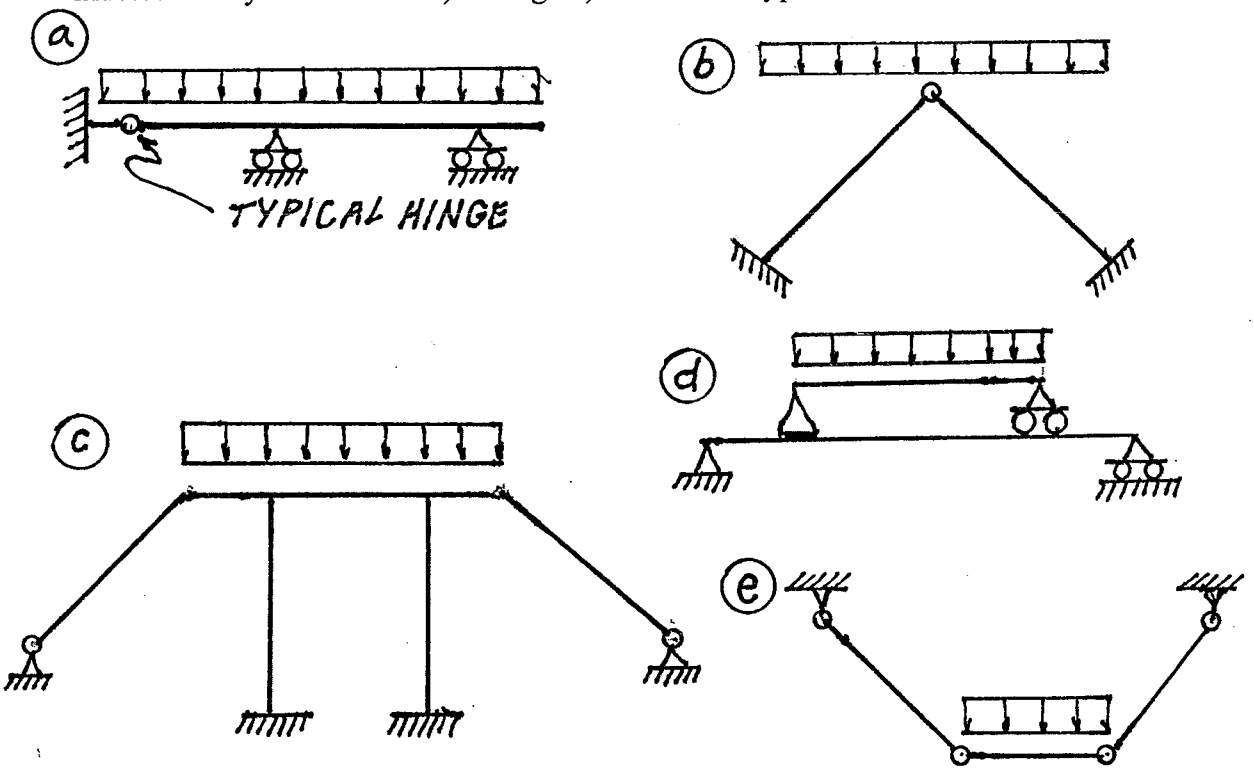
2. Each candidate may use an approved model of Sharp or Casio calculator; otherwise, this is a CLOSED BOOK Examination.

3. Six questions constitute a complete paper. Answer ALL questions #1 through #4; answer ONLY ONE of #5 or #6 and ONLY ONE of #7 or #8.

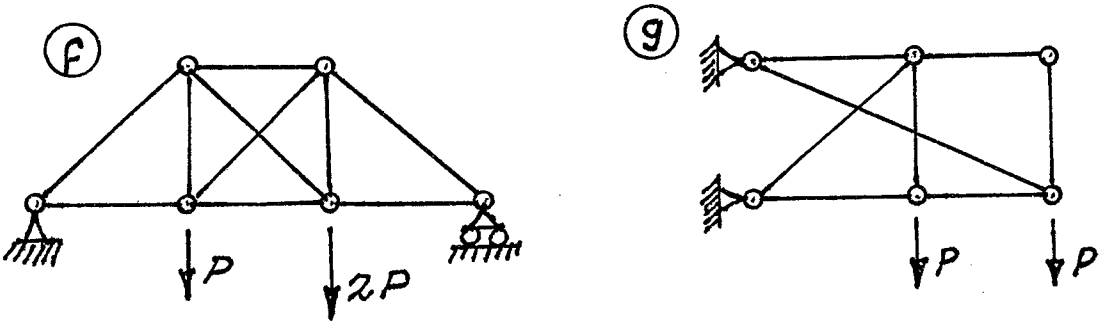
4. The marks assigned to each question are shown in the left margin.

FRONT PAGE

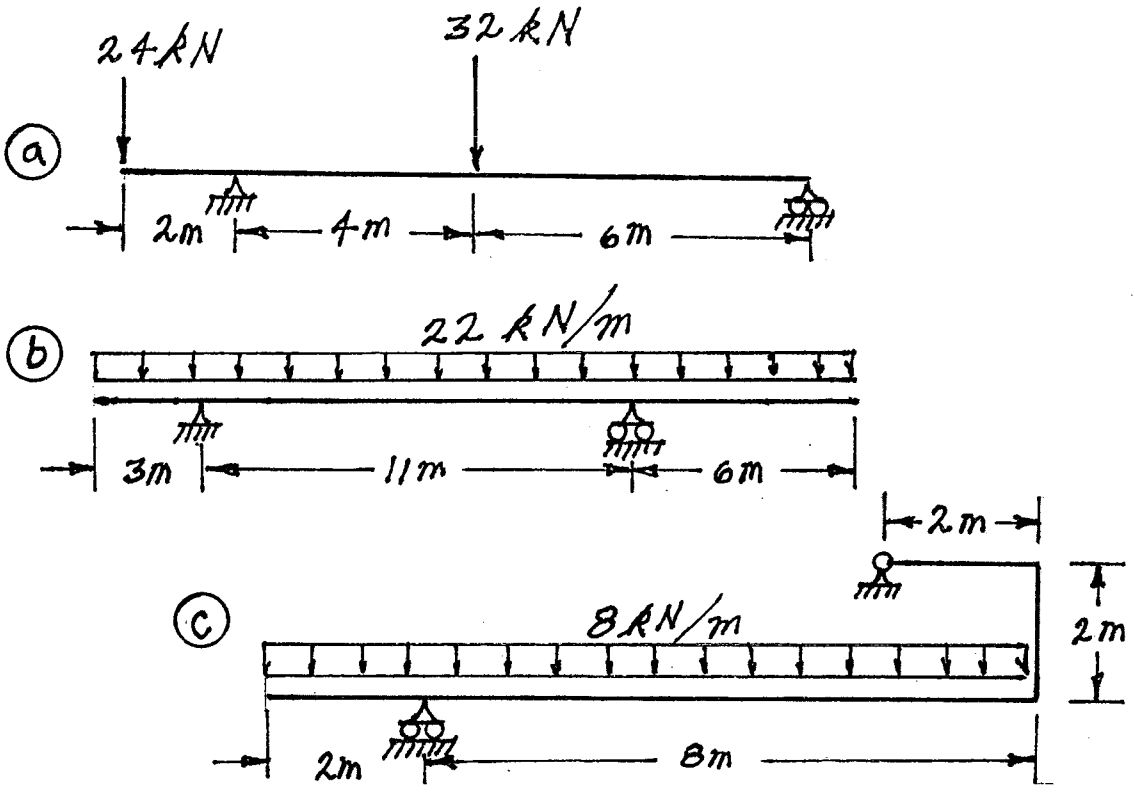
(7) 1. For each of the structures shown state whether it is unstable, statically determinate, or statically indeterminate. If the structure is statically indeterminate, state the degree of indeterminacy. Structures a) through e) have beam-type members.



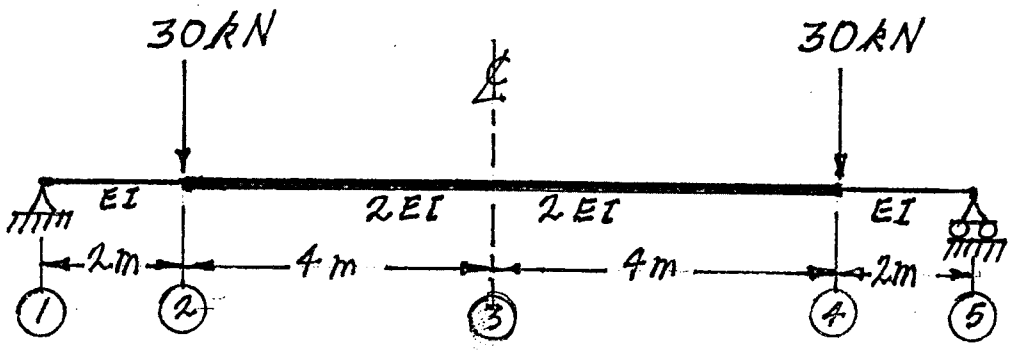
Structures f) and g) have truss-type members.
Diagonals are not connected where they cross.



(18) 2. For each structure shown, compute the reactions and draw shear and bending moment diagrams. For each beam segment on each shear and bending moment diagram, calculate and indicate the magnitudes of the maximum and minimum ordinates (Minimum ordinates are frequently negative values). The three flexural members in 2 c) are continuous – moment is transferred at their connections.

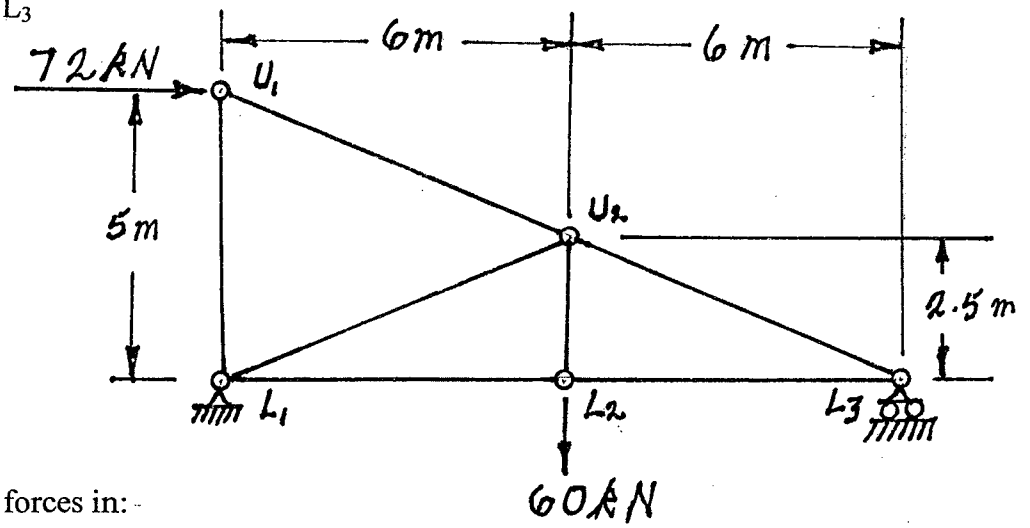


(15) 3. Calculate the vertical deflection at the beam centre line, point (3), in the diagram shown below. EI = 1.6 x 10^4 kN.m^2.

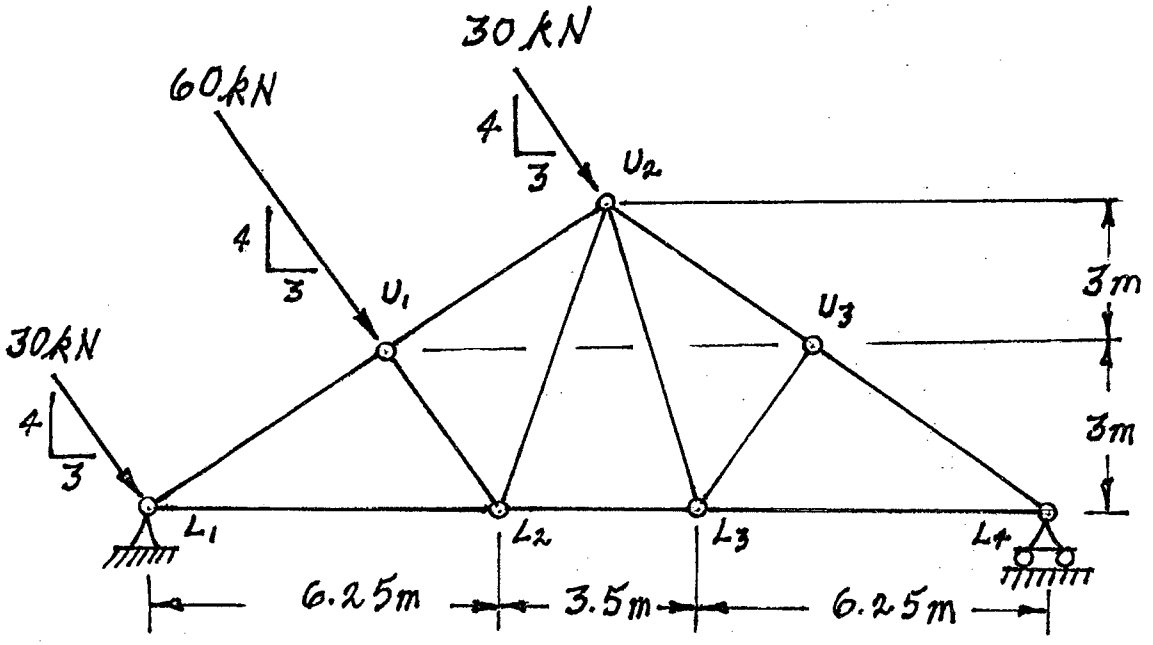


(18) 4. For the trusses shown below, calculate the forces in the members that are listed. For each force, indicate whether it is tension or compression.

a) Calculate the forces in:
$U_1 - U_2$
$L_1 - U_2$ and
$L_2 - L_3$

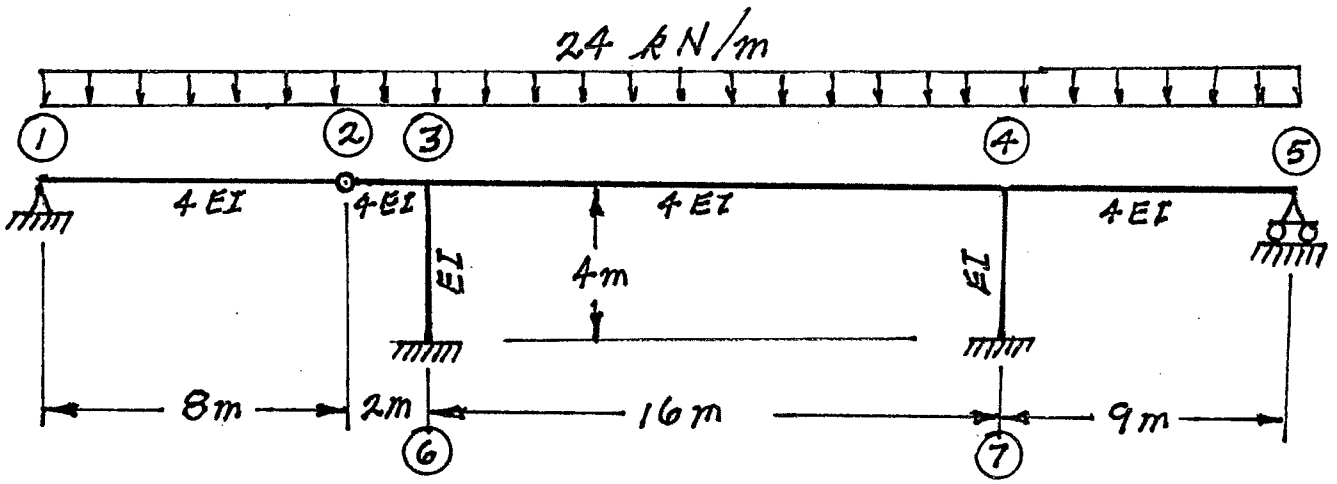


b) Calculate the forces in:
$L_1 - U_1$
$L_1 - L_2$ and
$L_2 - U_2$



Select and answer ONE QUESTION ONLY from Questions #5 or #6.

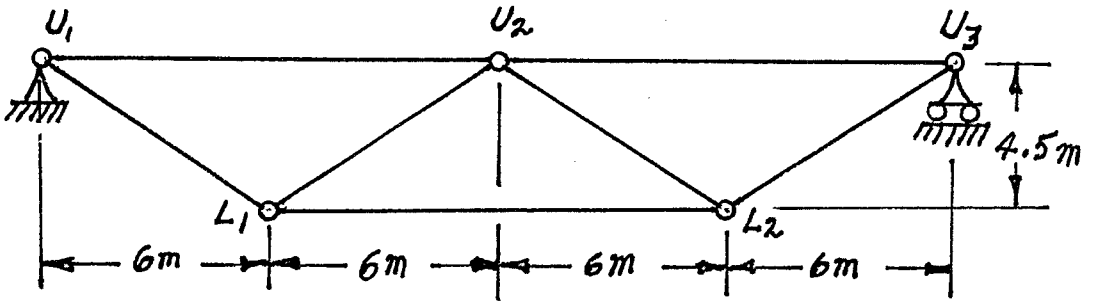
(20) 5. Analyze the frame shown below using the moment-distribution method or the slope-deflection method. Calculate and plot the shear force and bending moment diagrams. On both diagrams for each member, label the maximum and minimum ordinates (Minimum ordinates are frequently negative values). The members have the relative EI values shown on the diagram and are inextensible.



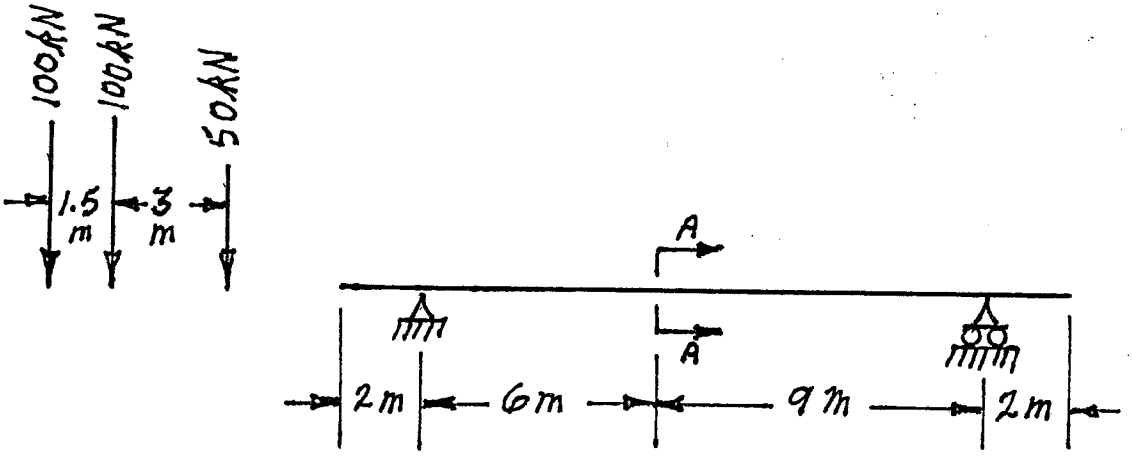
Select and answer ONE QUESTION ONLY from Questions #5 or #6.

(20) 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.

$U_1 - U_2$
$U_2 - L_2$

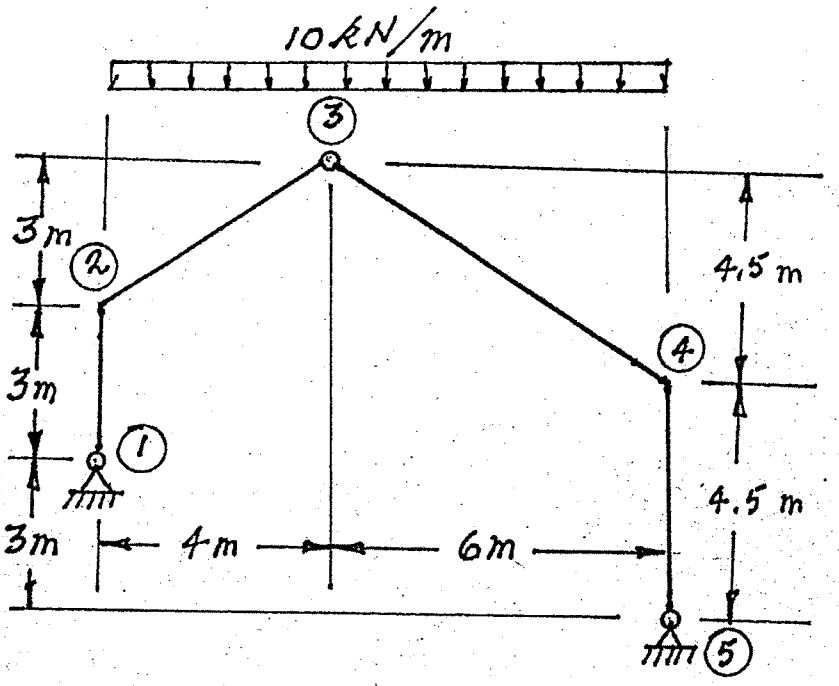


b) The loads shown represent an idealized vehicle about to cross the beam shown. Draw the influence line for shear at section A-A labelling maximum and minimum ordinates. Calculate the maximum shear force at Section A-A which would occur while the idealized vehicle crossed the beam.



Select and answer ONE QUESTION ONLY from Questions #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 and minimum ordinates (Minimum ordinates are frequently negative values).



(22) 8. Use the principle of virtual work to obtain the vertical deflection at point (3) of the beam shown below. EI is constant and equal to 1.7×10^3 kN.m^2.