NATIONAL EXAMS MAY 2015

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.

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.

a

w

TYPICAL HINGE

b

w

c

w

w

d

P

P

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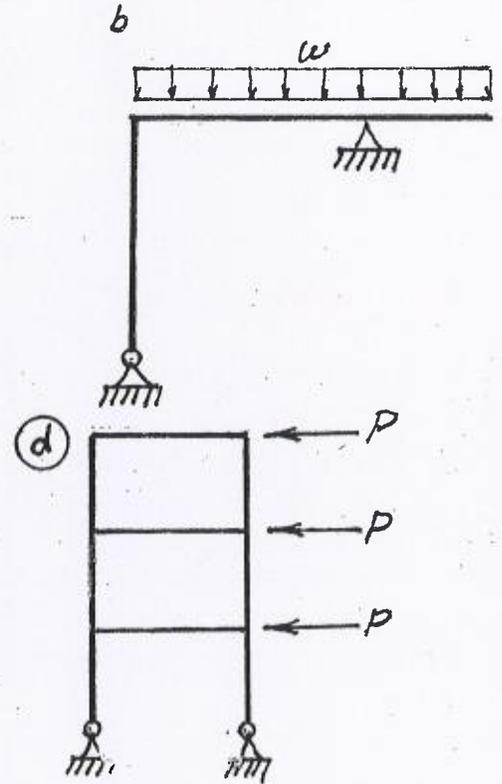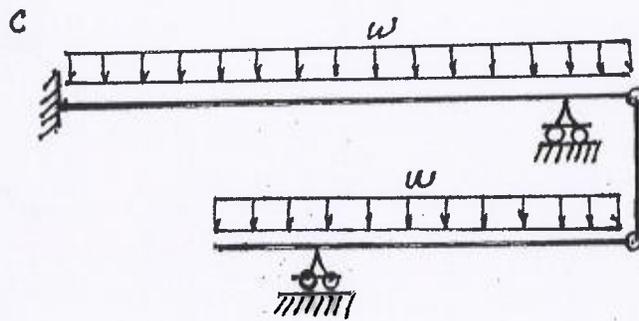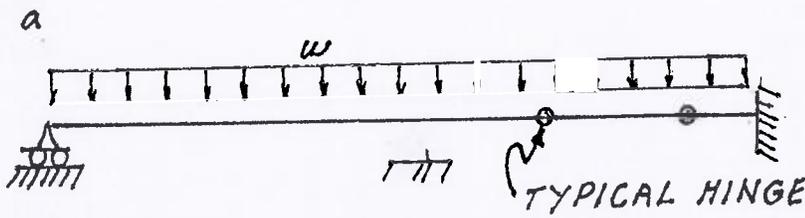
Structures e) through f) have truss-type members.
Diagonals are not connected where they cross.

e

P   P   P

f

P

P

....
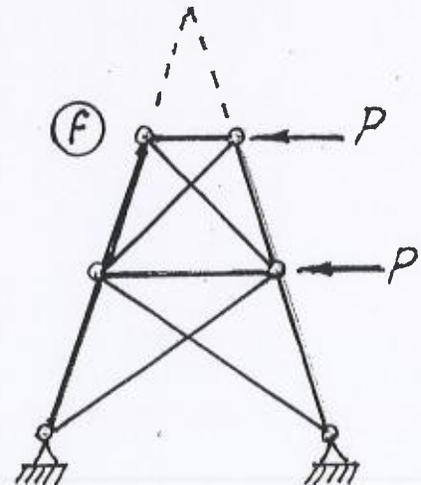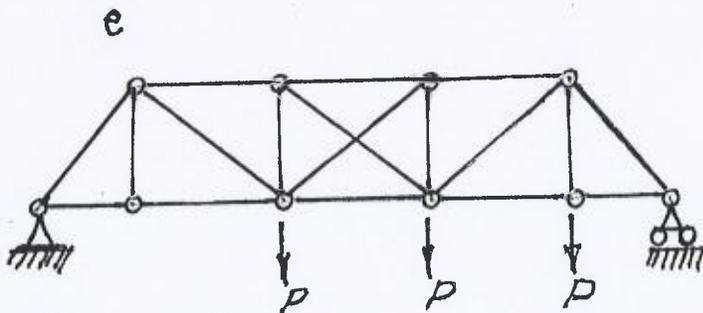
(18)   2.   For each structure shown, compute the reactions and draw shear and bending moment
              diagrams. Indicate which are positive and which are negative segments of each bending
              moment diagram. For each shear and bending moment diagram, calculate and indicate
              the magnitudes of the maximum positive and negative ordinates.
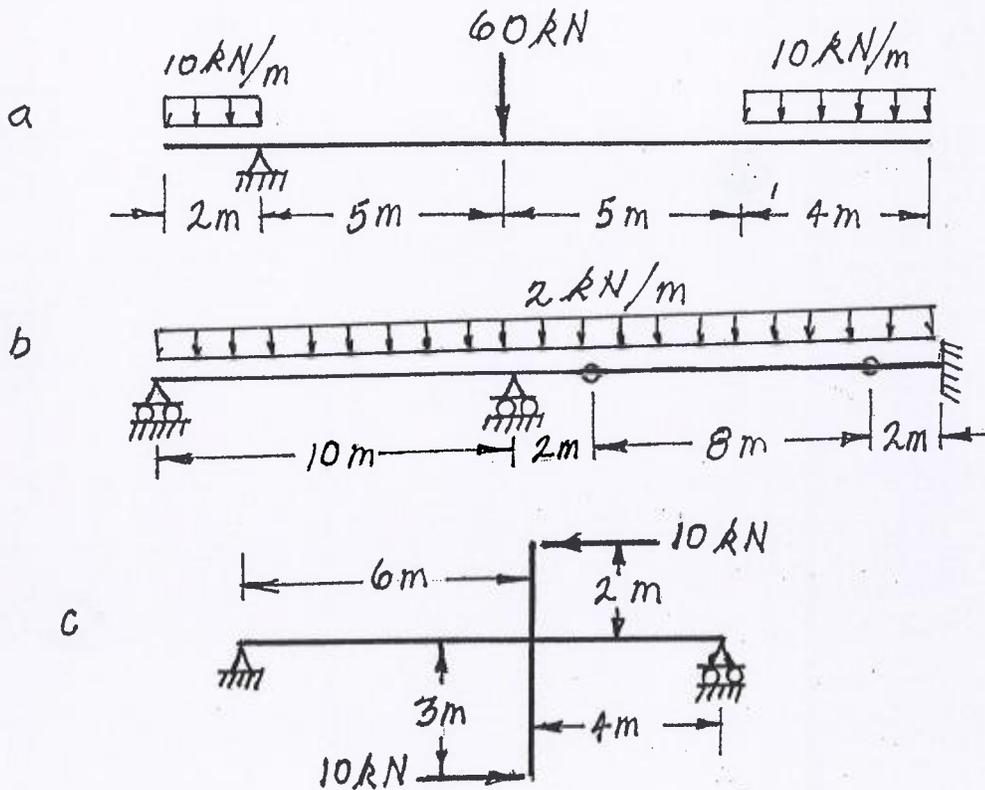
(16)   3.   Calculate the vertical deflection at joint L_3 of the pin-jointed truss shown below. For all
              members EA = 69,800 kN. Take advantage of symmetry.
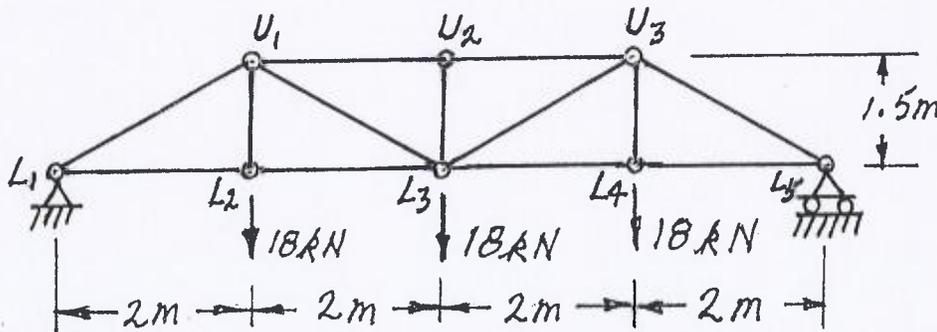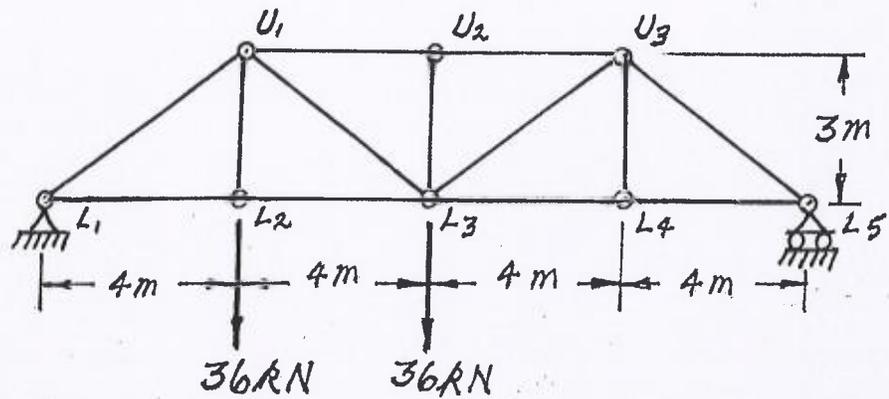
(18)   4.   For the trusses shown below, calculate the forces in the members that are listed. For each
              force, indicate whether it is tension or compression.

    a)   Calculate the forces in:
              $U_1 - U_2$
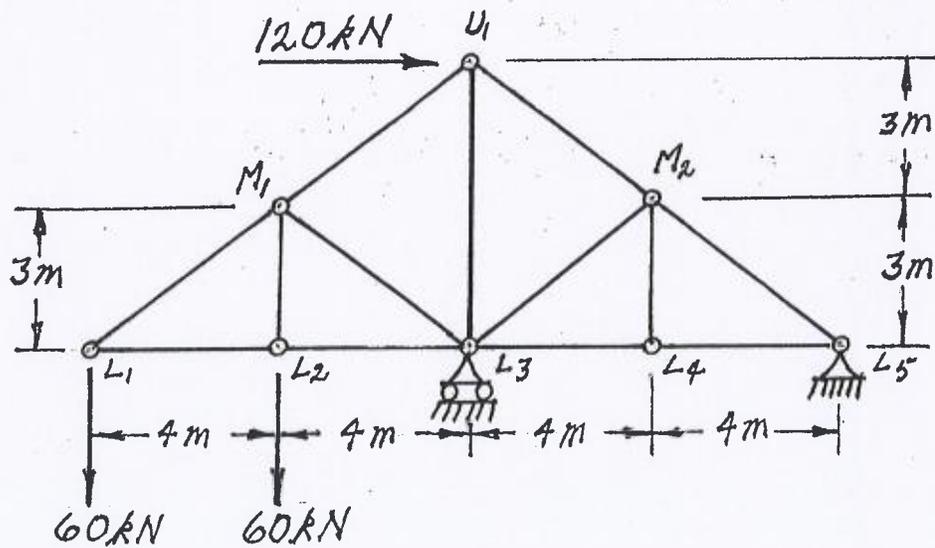 $U_1 - L_3$ and
              $L_3 - U_3$

    b)   Calculate the forces in:
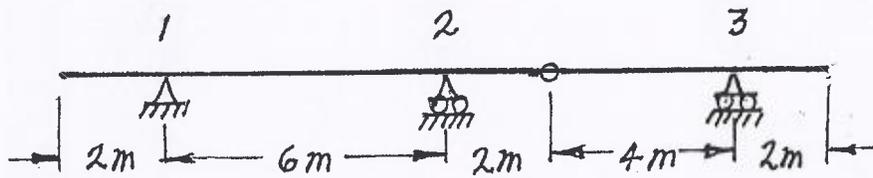 $L_2 - L_3$
              $L_3 - L_4$ and
              $M_1 - L_3$

(20)   5.   a)For the determinate structure shown, draw the influence lines for:

i) bending moment at point 2
ii) bending moment at mid span of span 1 – 2
iii) shear immediately left of support 2

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 on beams at the bottom chord level of the truss shown. The shape of the
influence line for force in member $U_1 – L_3$ is shown below the truss. Calculate
and show the ordinates of the influence line and calculate the maximum force
caused by the vehicle as it crosses the structure.

Idealized Vehicle

Direction of Travel

Influence Line

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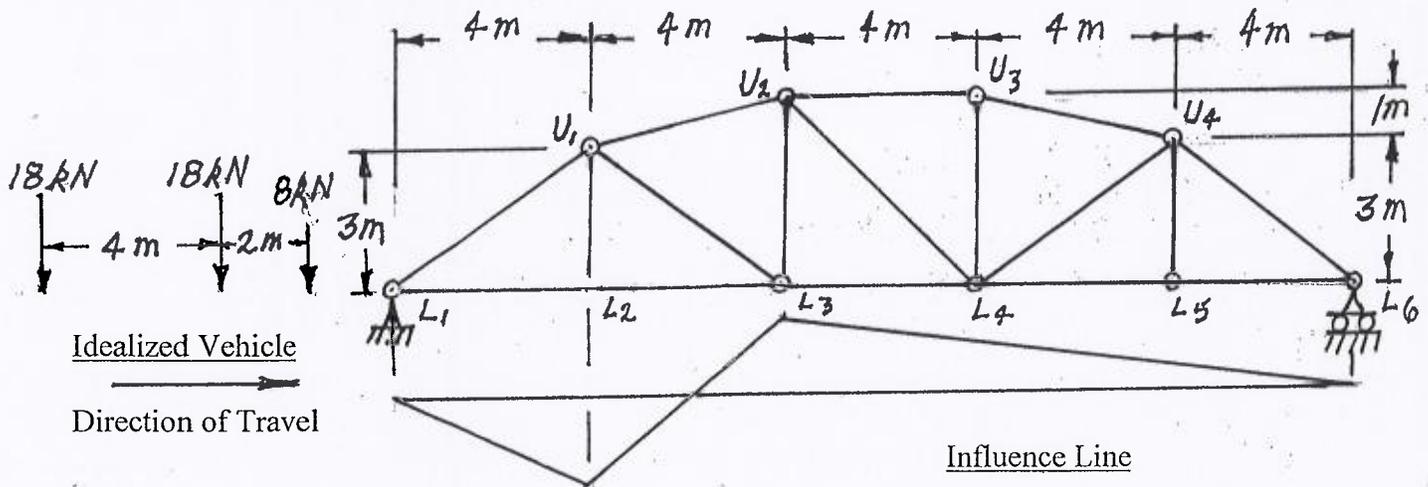
Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8.

(22)   6.   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 magnitude of the maximum and minimum ordinates (Minimum ordinates are frequently negative values). All members have the same EI value and are inextensible.
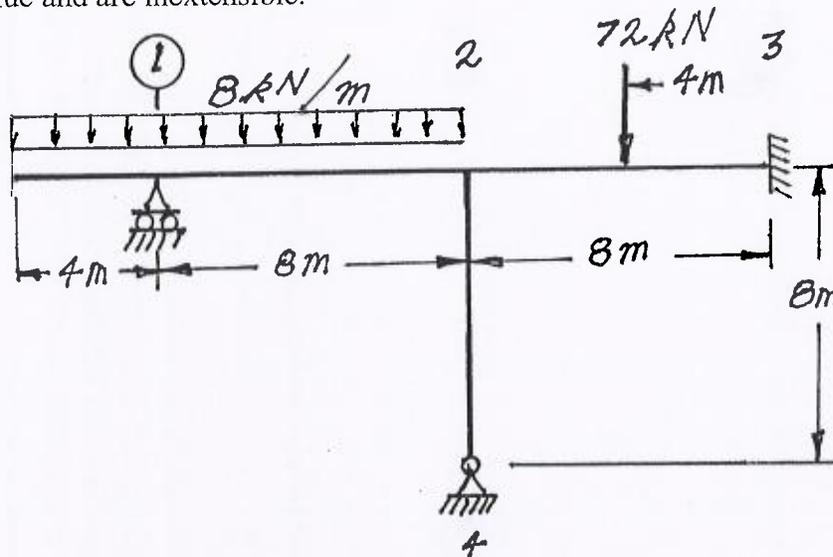
(22)   7.   a)   Use the principle of virtual work to calculate the vertical deflection at point 4 . Both beams have the same EI = 36,000 kN.m^2 and both are inextensible. The tie rod has EA = 25,000 kN.

       b)   If the 48 kN vertical load were at point 4 instead of point 2 , what would be the vertical deflection at point 2 ?
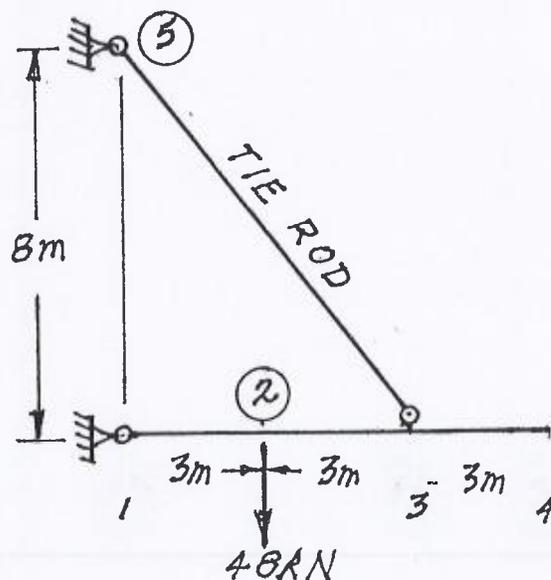
Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8.

(22)   8.   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
                  magnitude of the maximum and minimum ordinates (Minimum ordinates are frequently
                  negative values).