NATIONAL EXAMS MAY 2016

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.
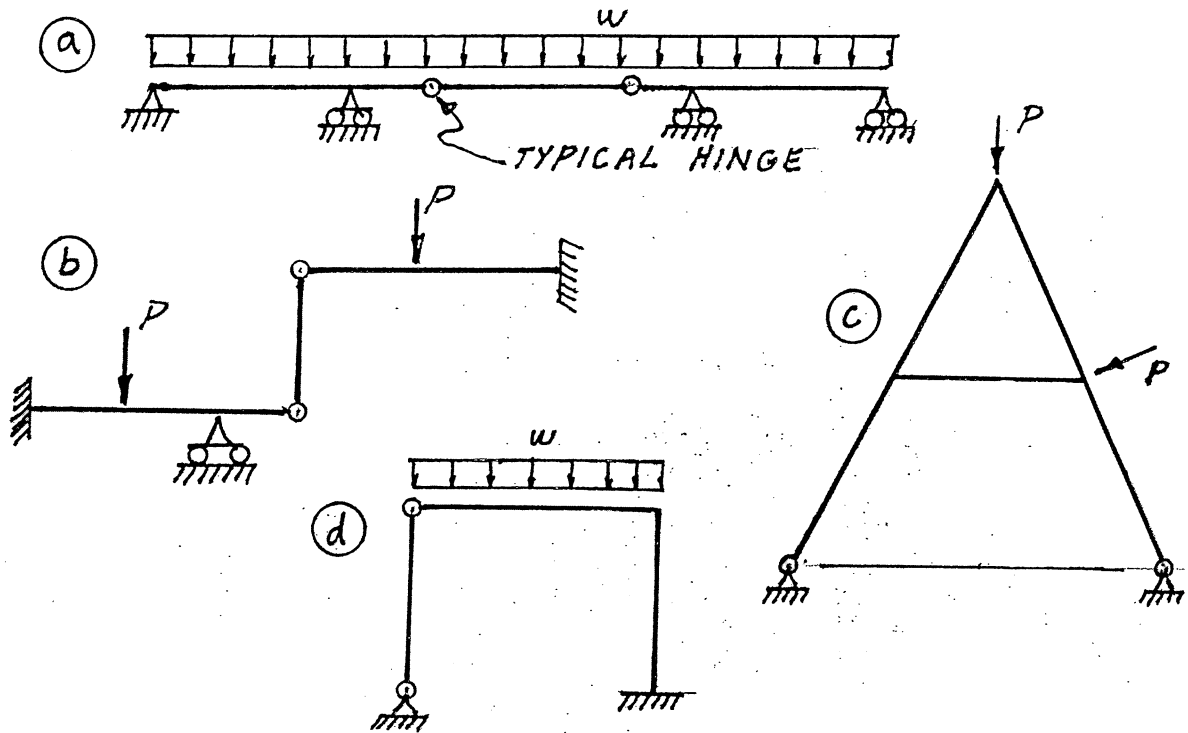

Structures e) and f) have truss-type members.
Diagonals are not connected where they cross.
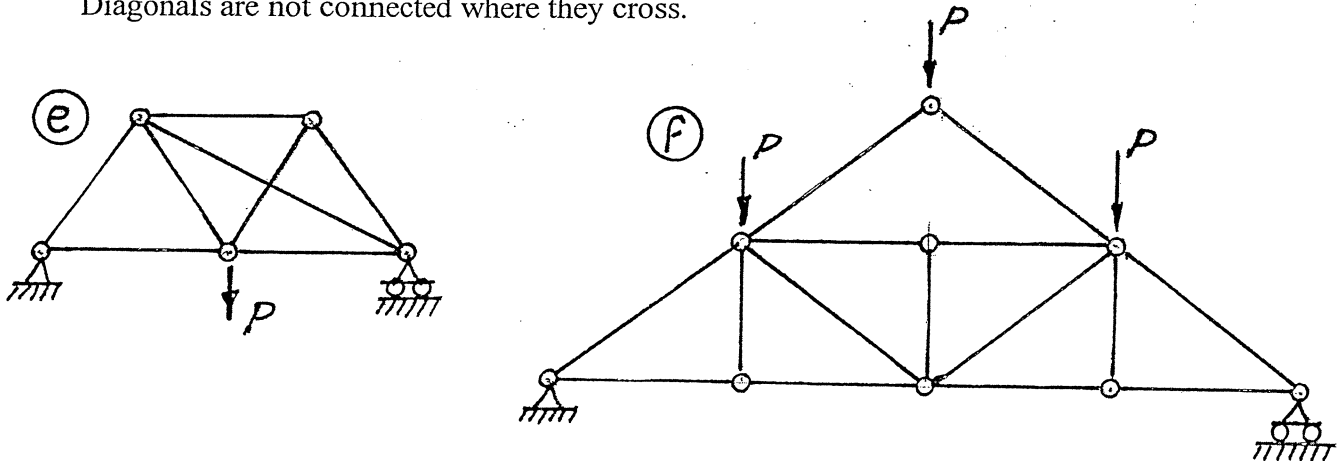
(18) 2.   For each structure shown, compute the reactions and draw shear and bending moment
            diagrams. Indicate which are positive and which are negative segments of each bending
            moment diagram. For each shear and bending moment diagram, calculate and indicate
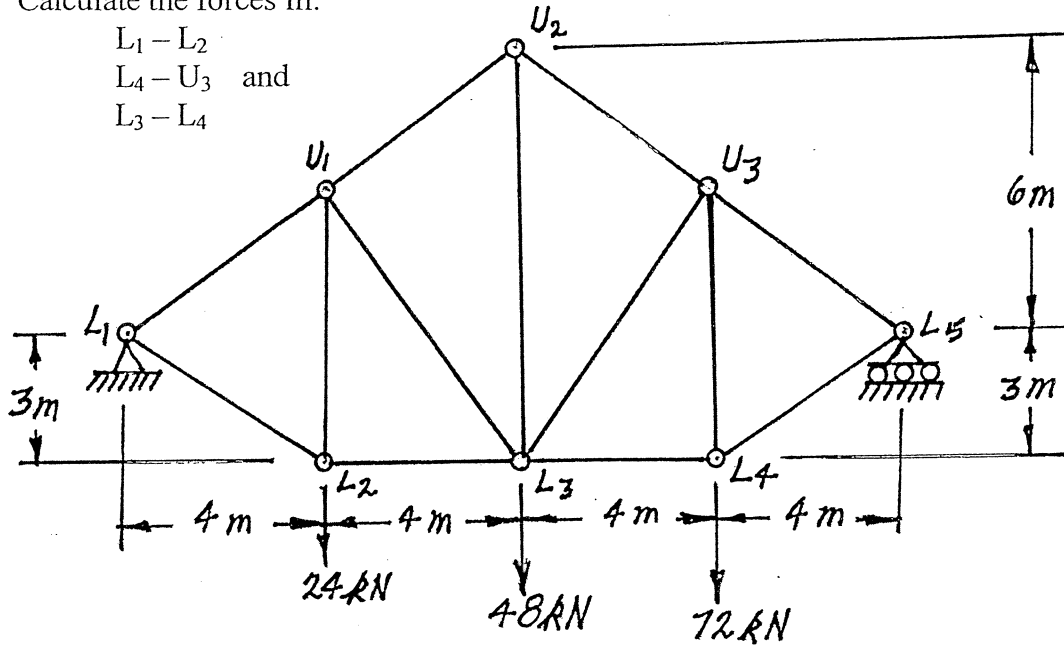   the magnitudes of the maximum positive and negative ordinates.
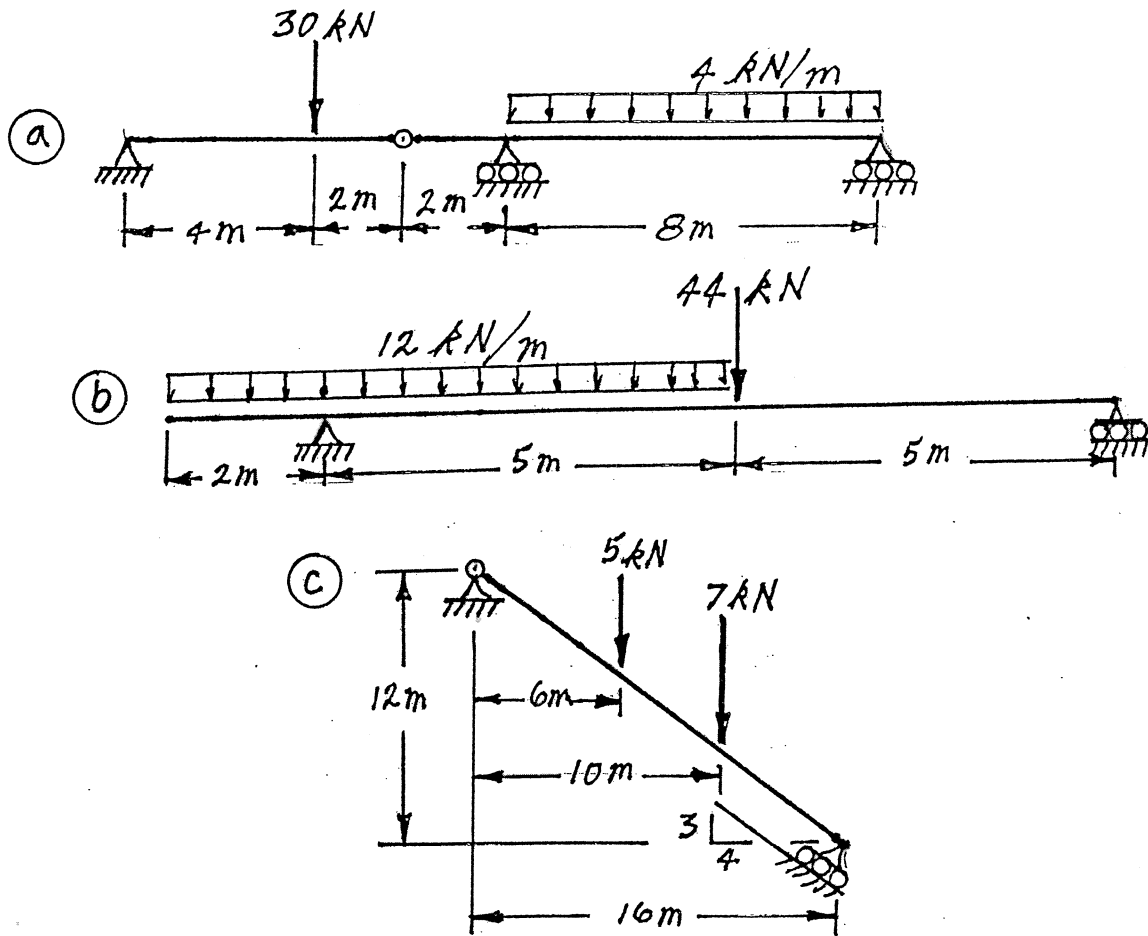
(15) 3.   Calculate the vertical deflection at point B on the beam structure shown below.
            $EI = 15,000$ kN.m^2 for all spans.
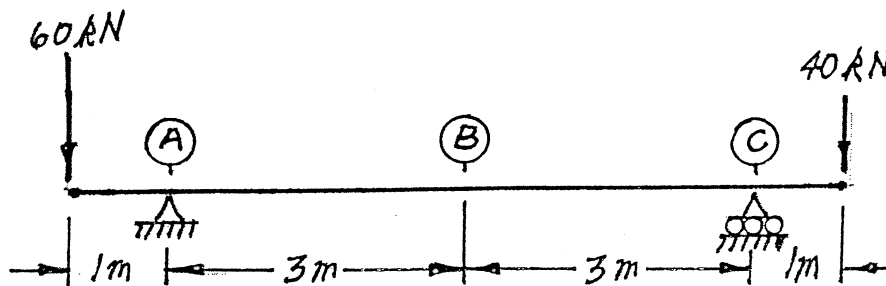
(18)   4.   For the trusses shown below, calculate the forces in the members that are listed. For each
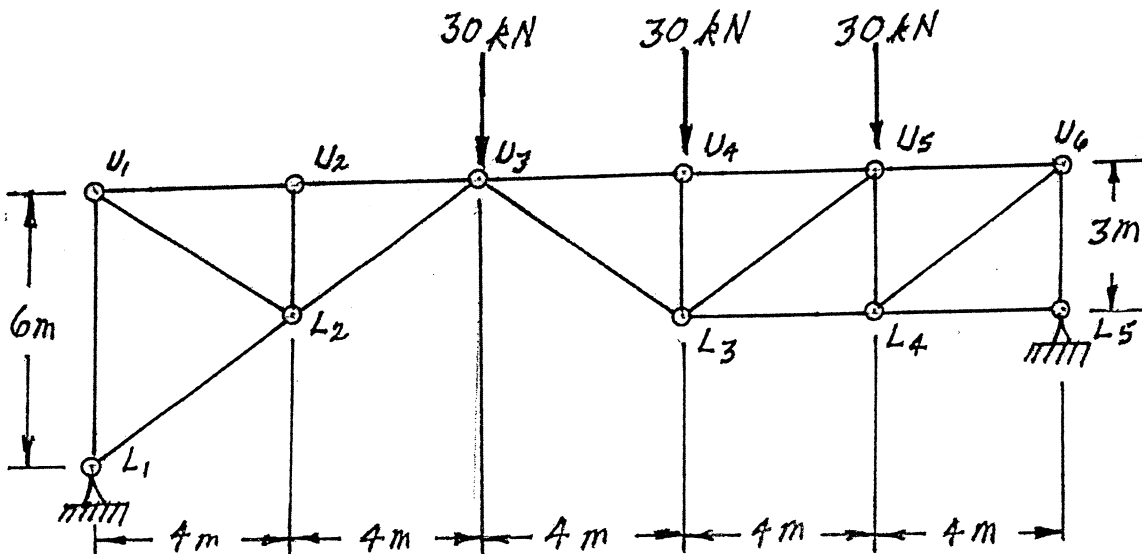   force, indicate whether it is tension or compression.

   a)   Calculate the forces in:
 $L_1 - L_2$
         $L_4 - U_3$ and
         $L_3 - L_4$

   b)   Calculate the forces in:
         $U_3 - L_3$
         $L_4 - U_6$ and
         $L_3 - L_4$

(9)   5. a)   For the determinate beams below, draw the influence lines from support (A) to support (D)
                 for:
                 i) reaction at support (B)
                 ii) bending moment over support (B), and
                 iii) shear force immediately left of support (C).
                 For each influence line, calculate and indicate the value of the influence
                 coefficient that has the maximum absolute value.
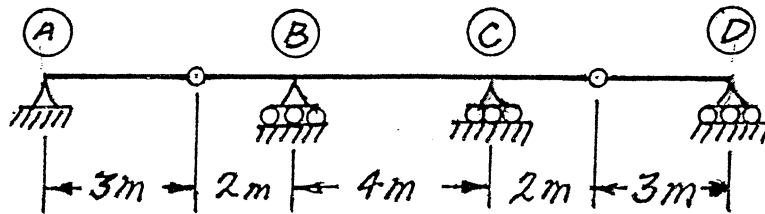
(12)   5. b)   A vehicle, which is idealized as three point loads shown on the left below, moves over
                 the beam structure shown. Draw the influence lines for i) bending moment at point (C)
                 and ii) shear force at point (C). Label the maximum and minimum ordinates on both
                 influence lines. Calculate the bending moment and shear force that have the maximum
                 absolute values at point (C) caused as the idealized vehicle crosses the structure.

Idealized Vehicle   Direction of Travel
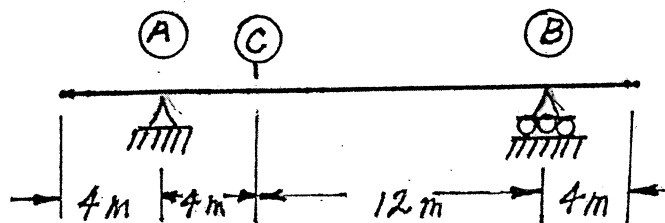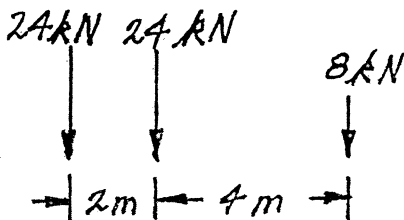
Select and answer ONE QUESTION ONLY from Question #6, #7 or #8.

(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, calculate and label the maximum and minimum ordinates (Minimum ordinates are frequently negative values). All members have the same EI value and are inextensible.
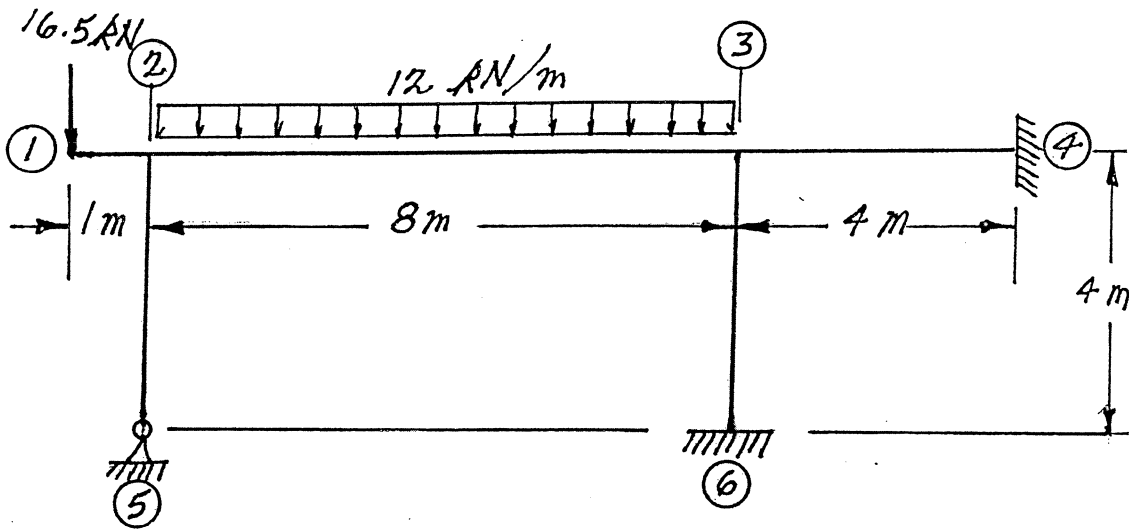
(22)   7.   Use the **principle of virtual work** to calculate the vertical deflection at point ④ on the frame structure shown below. All members are inextensible and have the same EI value which is 2,000 kN.m^2.
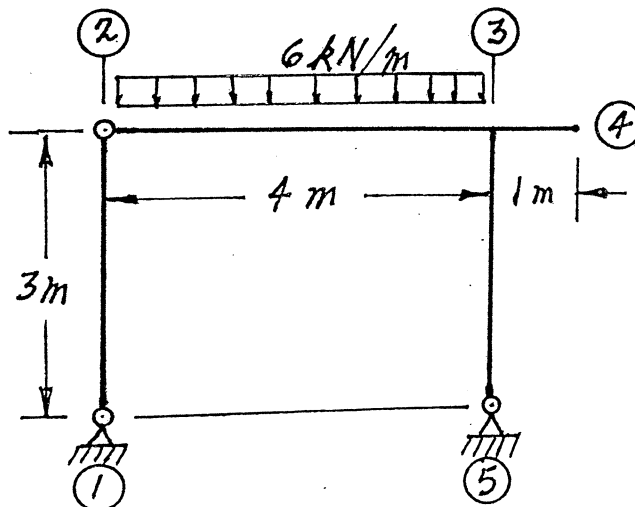
Select and answer ONE QUESTION ONLY from Question #6, #7 or #8.

(22)   8.   For the structure shown below, compute the reactions and draw shear force and bending moment diagrams. On both diagrams, for each member, calculate and label the maximum and minimum ordinates (Minimum ordinates are frequently negative values).