NATIONAL EXAMS DECEMBER 2016

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.
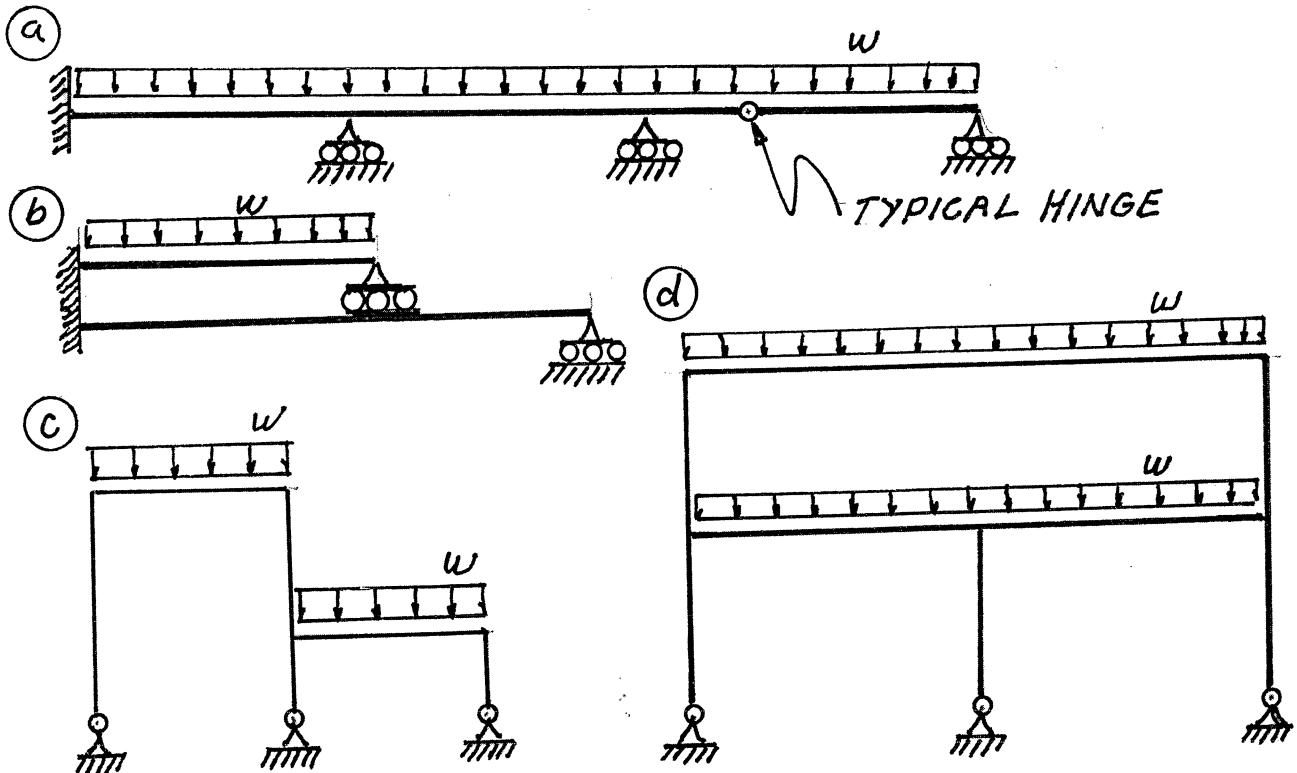

Structures e) and f) have truss-type members.
Diagonals are not connected where they cross.
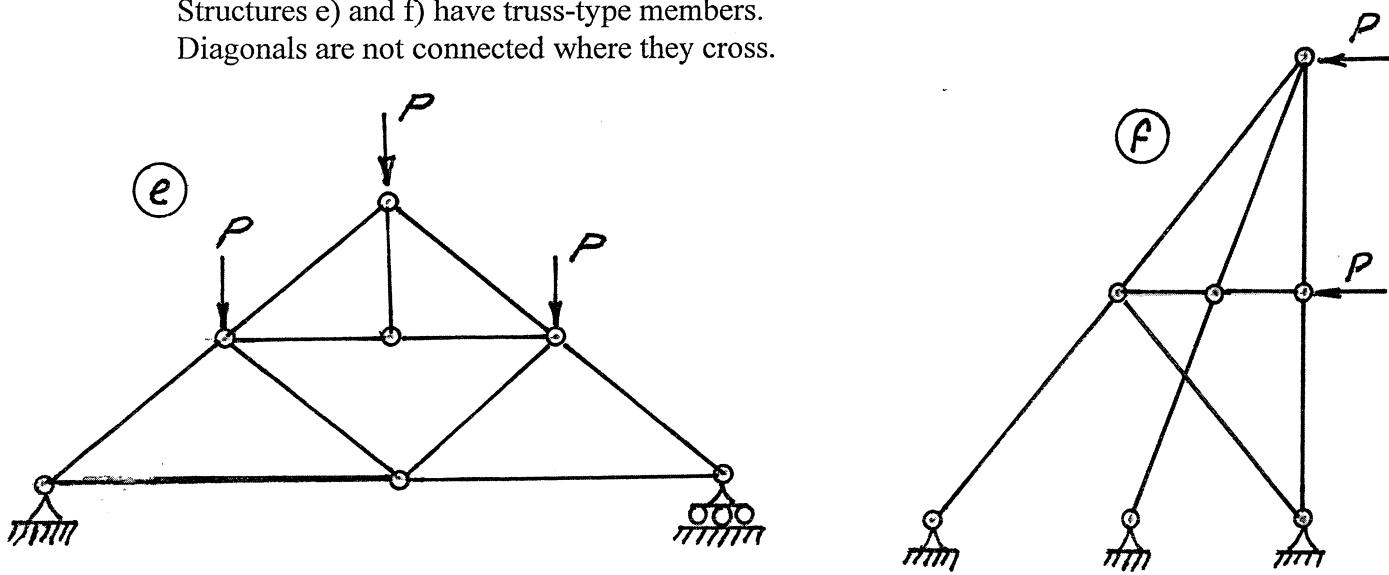
(18)   2.   For each structure shown, compute the reactions and draw shear and bending moment diagrams. Indicate which are positive and which are negative segments of each bending moment diagram. For each member on the shear and bending moment diagrams, calculate and indicate the magnitudes of the maximum and minimum ordinates (Minimum ordinates are frequently negative.).

(a)
60 kN   6 kN/m

6 m — 6 m — 4 m

(b)
6 kN/m

4 m — 6 m — 4 m

(c)
10 kN/m

9 m

4 m

12 m — 3 m
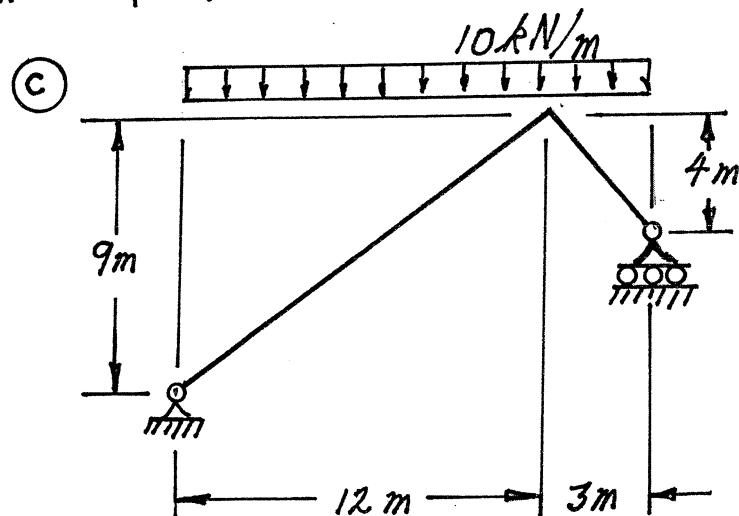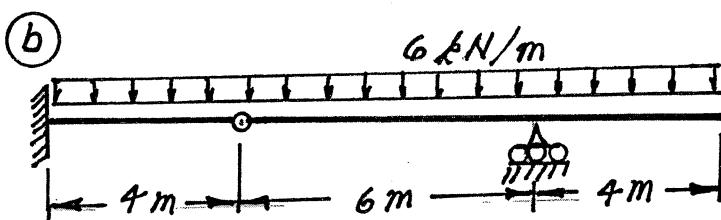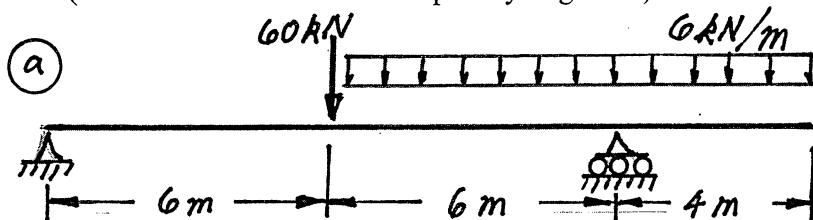
(18)   3.   Calculate the vertical deflection at point (A) on the continuous beam shown below. EI = 2000 kN·m² for all beam segments. Take advantage of symmetry.

12 kN/m   6 kN/m   ℄   12 kN/m

2 m   4 m — 4 m   2 m

A   B   C   D   E
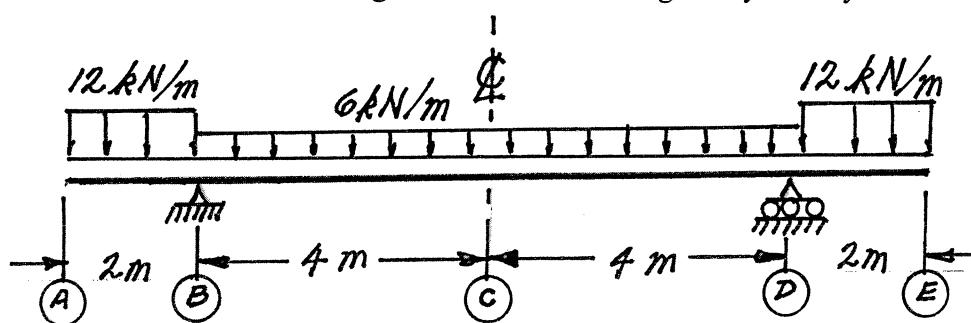
(20)   4.   For the trusses shown below, calculate the forces in the members that are listed. For each
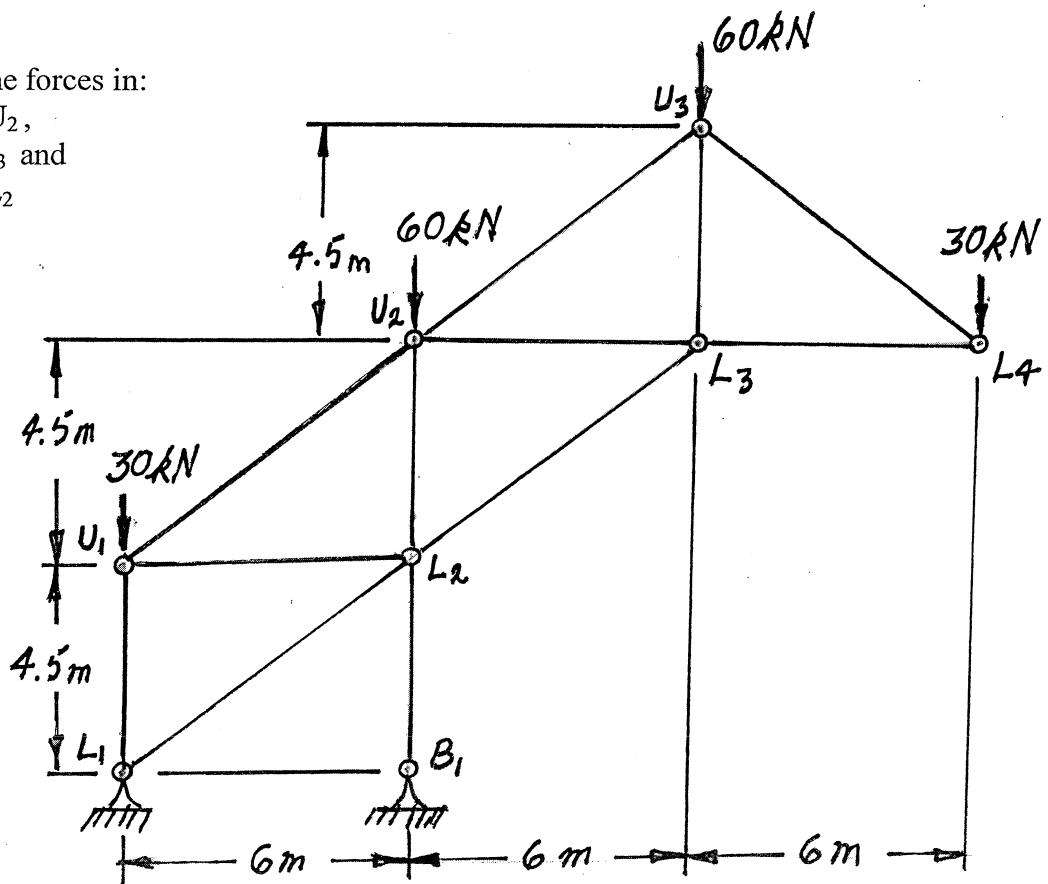   force, indicate whether it is tension or compression.

a)   Calculate the forces in:
     $L_2 - L_3$,
 $U_1 - U_2$ and
     $L_3 - U_3$
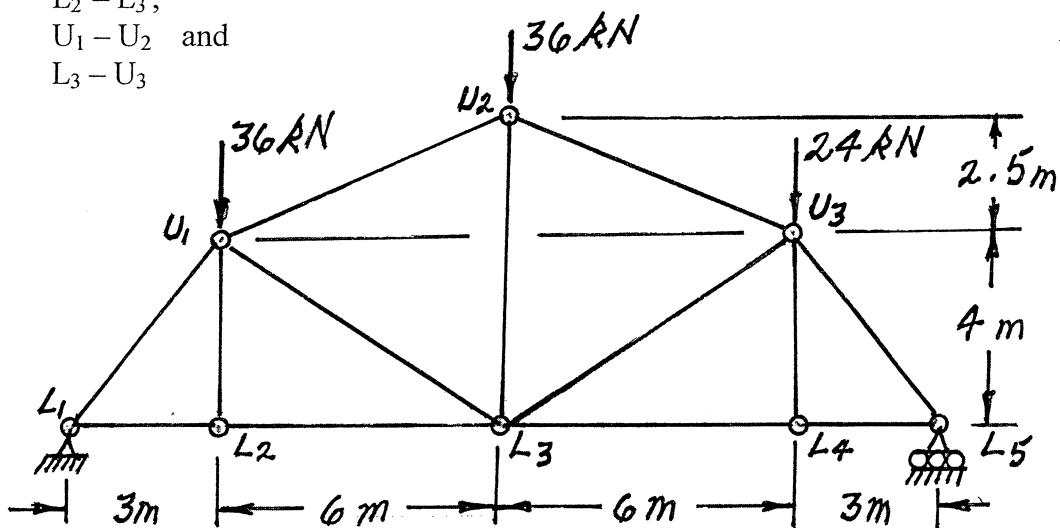
b)   Calculate the forces in:
 $U_1 - U_2$,
     $L_2 - L_3$ and
     $U_2 - L_2$

(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 values.) All members have the same EI value and are inextensible.
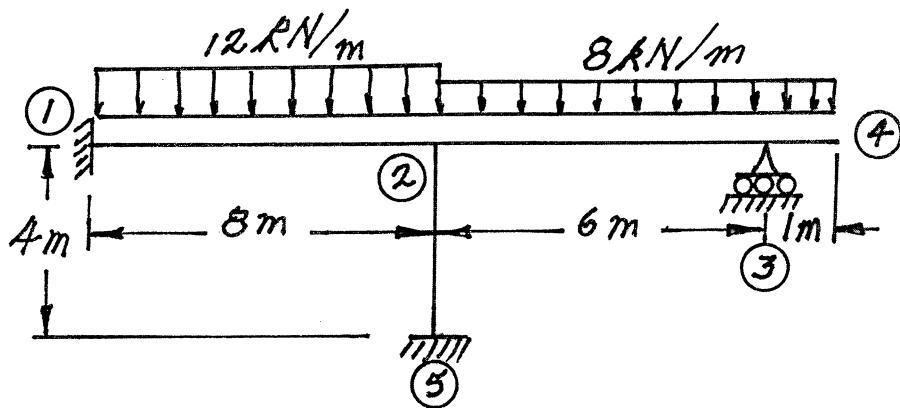
Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8.

(20)   6.   For the structure shown below, compute the reactions and draw shear and bending moment diagrams for members ②–③ and ③–④. On both diagrams, for each member, label the maximum and minimum ordinates. (Minimum ordinates are frequently negative values.)

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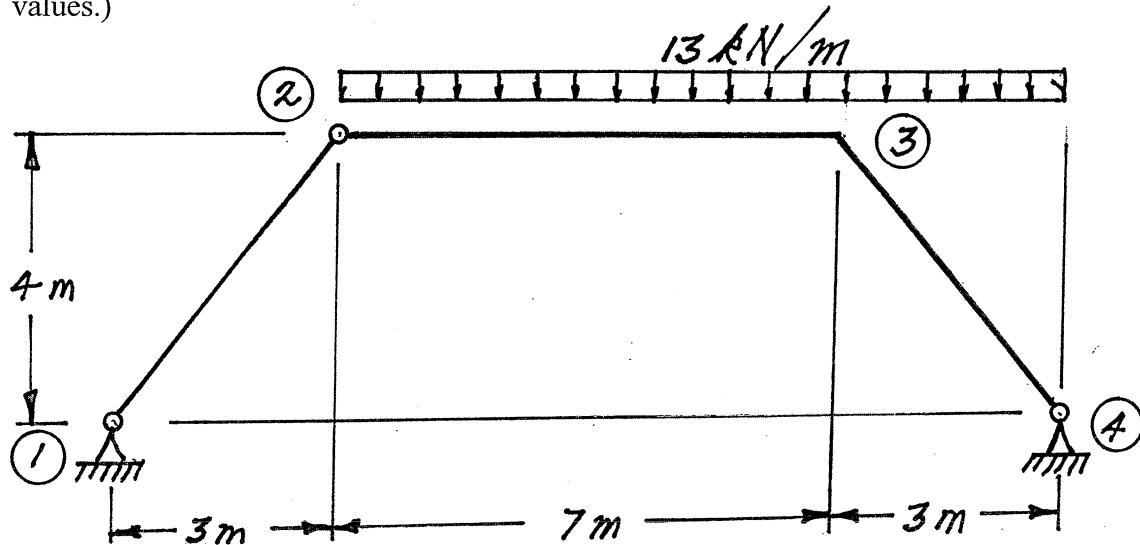
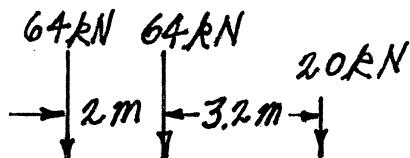Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8.

(20)   7.   a) Loads move along beams at the top chord level of the truss shown. Draw influence
                lines for forces in the three members listed above the truss. For each influence line,
                calculate and indicate the values of the influence coefficients that have the maximum
                tension and compression values.

                Members U_2–U_3, L_1–U_3 and L_2–L_3
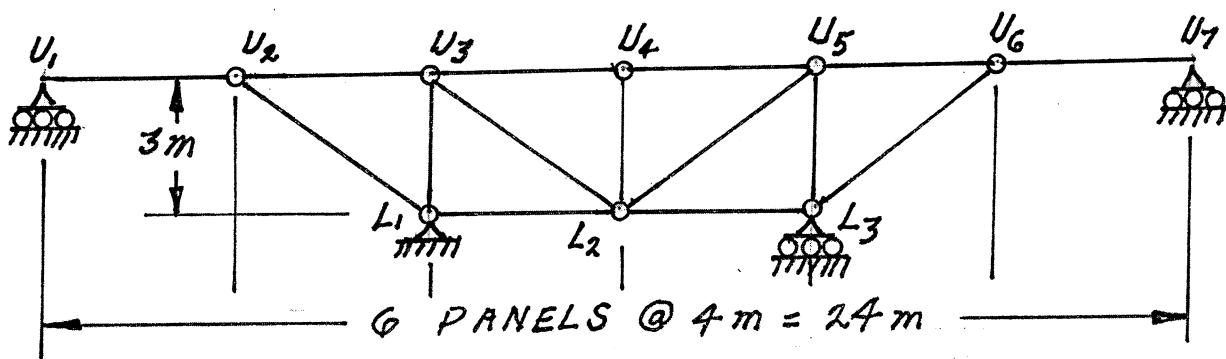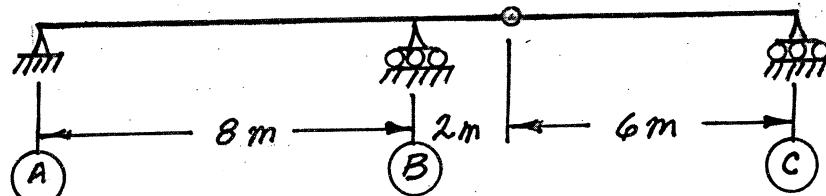

                b) A vehicle, which is idealized as three point loads shown on the left below, moves
                across the beam structure shown. Calculate and show the influence line for shear
                force immediately left of support Ⓑ. Also calculate the largest shear force
                immediately left of support Ⓑ that would occur while the idealized vehicle crosses
                the structure.

                Direction of Travel ⟶

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

(20) 8. Use the principle of virtual work to calculate the vertical deflection at the centre of span ②-③ on the structure shown below. Consider only flexural strain. All members have the same EI value which is 4000 kN.m^2