NATIONAL EXAMS - DECEMBER 2018

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 a Casio or Sharp 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.

TYPICAL HINGE
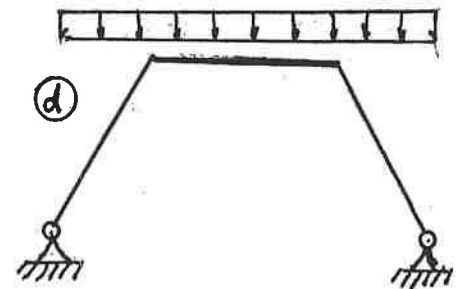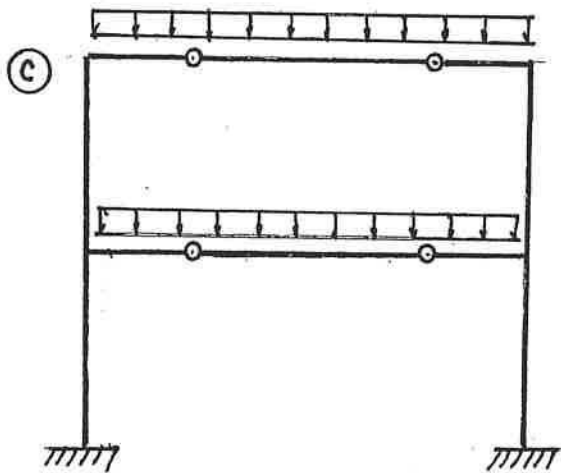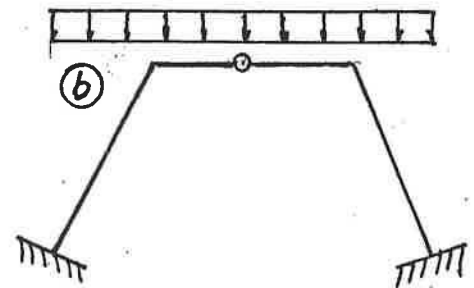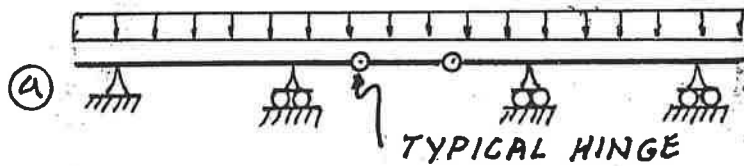
Structures e) and f) have truss-type members.
Diagonals are not connected where they cross.
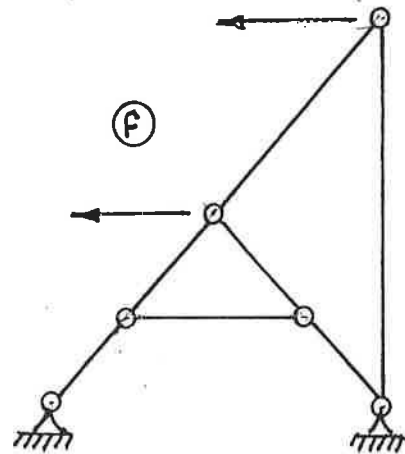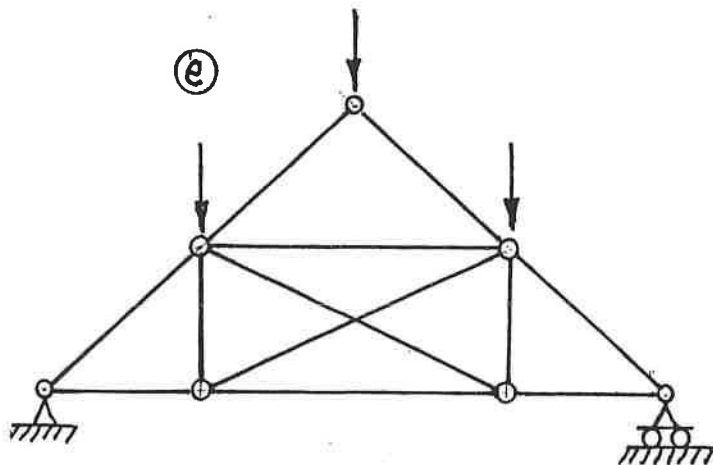
(18)   2.   For each structure shown, compute the reactions and draw shear and bending moment diagrams (Choose one sign convention for plotting bending moments; use it consistently). For each member on the shear and bending moment diagrams, calculate and indicate the magnitudes of the maximum and minimum ordinates (Minimum ordinates are frequently negative values).
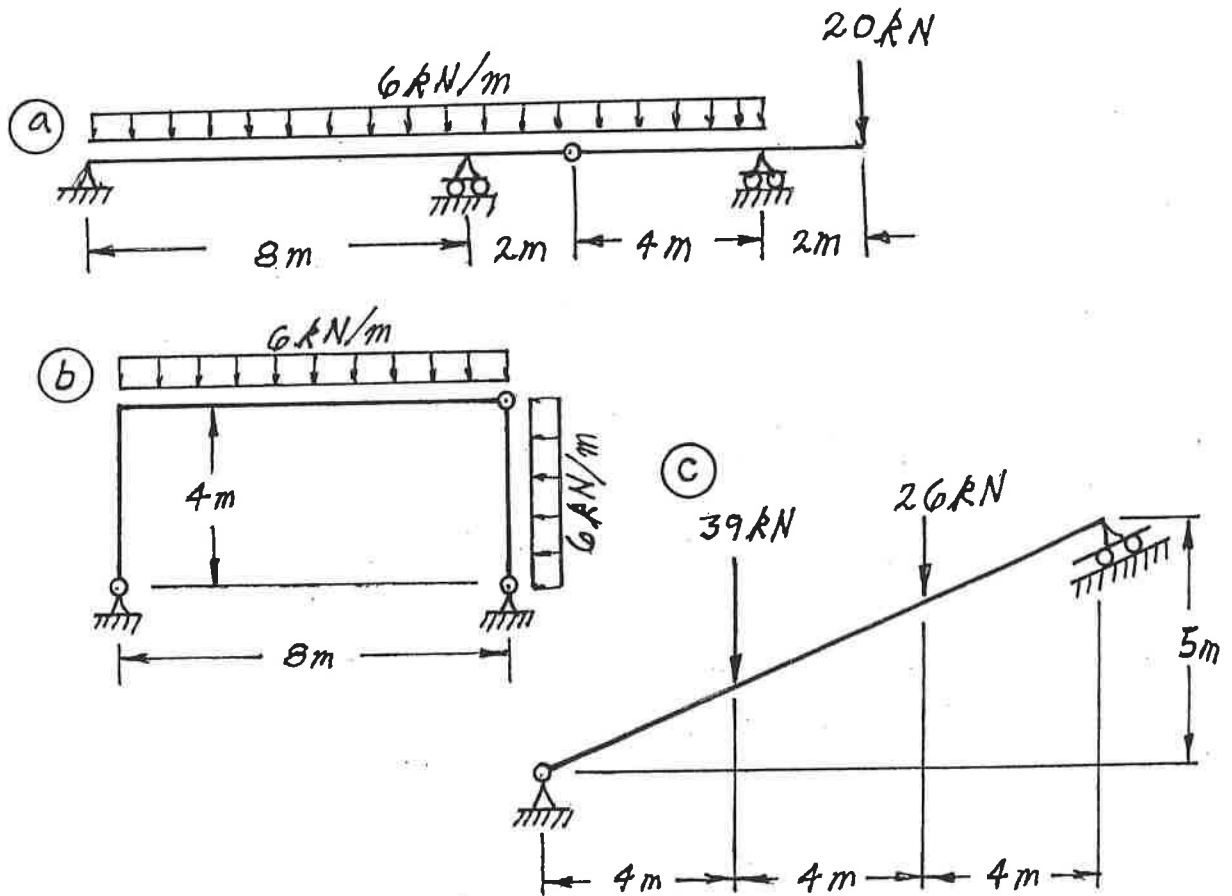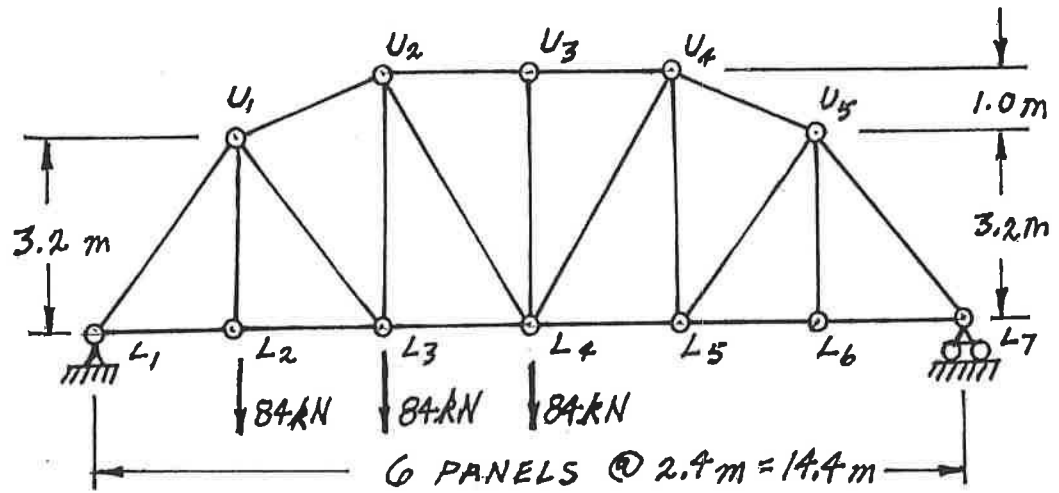

(18)   3.   Calculate the vertical deflections at points (B) and (D) on the continuous beam shown below. $EI_0 = 18000$ kN.m^2.
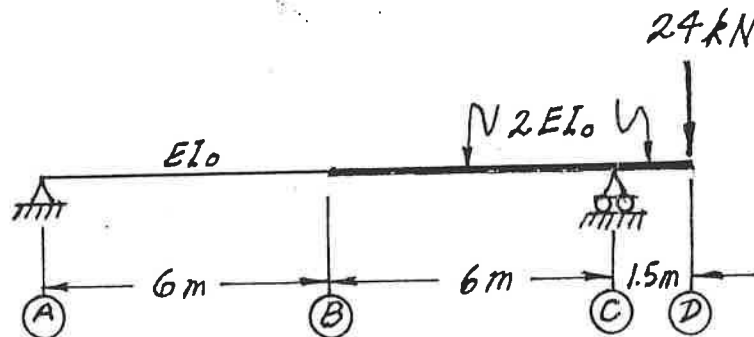
(18)   4.   For the trusses shown below, calculate the forces in the members that are listed. For each force, indicate whether it is tension or compression.
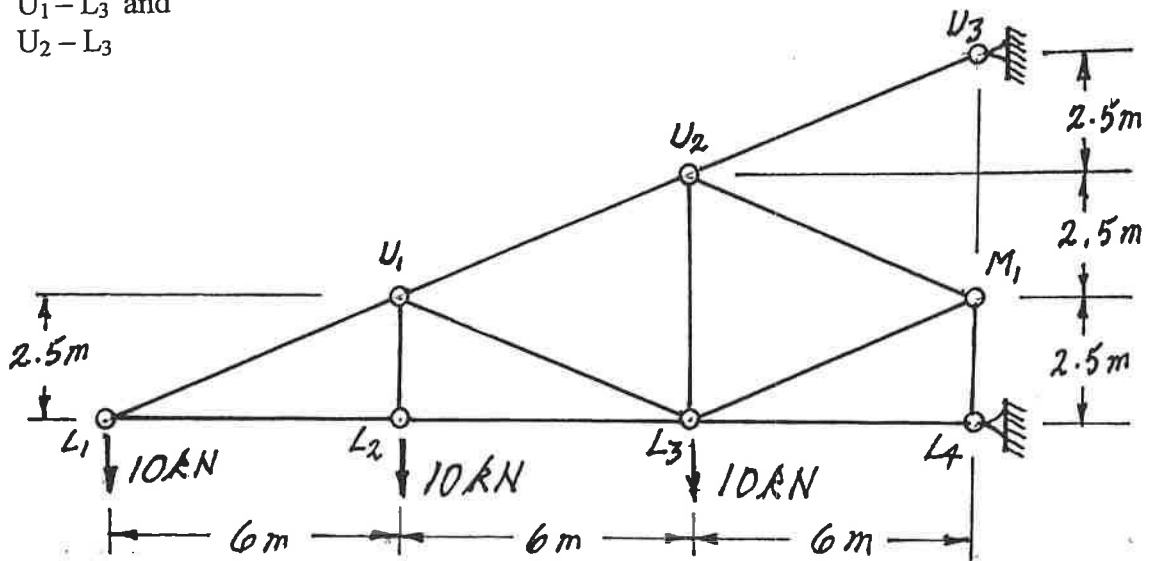
    a)   Calculate the forces in:
        $U_1 - U_2$,
        $U_1 - L_3$ and
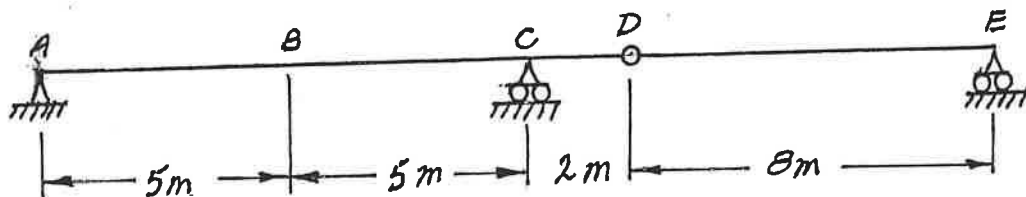 $U_2 - L_3$

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

(18) 5.a)   For the determinate, two-span beam shown, draw the influence lines for:

    i) bending moment at point B

    ii) shear force immediately right of point C, and

    iii) reaction at support C

    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 across the truss on beams at the level of the upper chord of the truss.
      Calculate and show the influence line for force in member $U_2 - L_1$. Show the
      maximum and minimum ordinates on a sketch of the influence line and calculate
      the maximum compression force in member $U_2 - L_1$ caused by the vehicle as it
   crosses the structure.

Direction of Travel ⟶
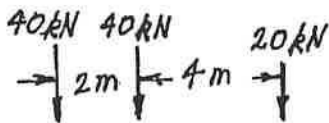
Idealized
Vehicle
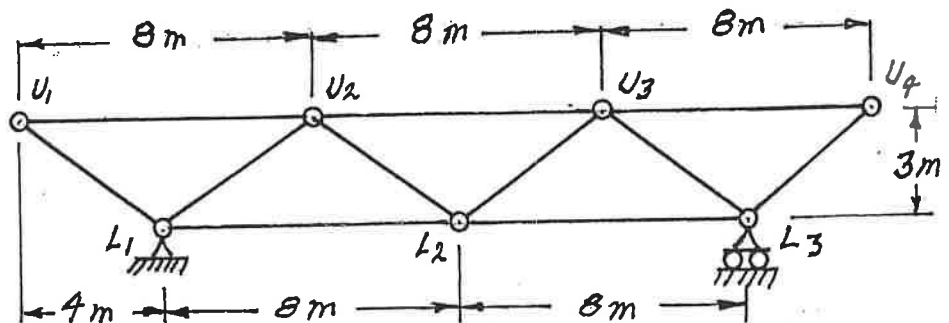
Select and answer ONE QUESTION <u>ONLY</u> from Questions #6, #7 or #8.

(22)   6.   For the frame shown below, using the moment-distribution 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.
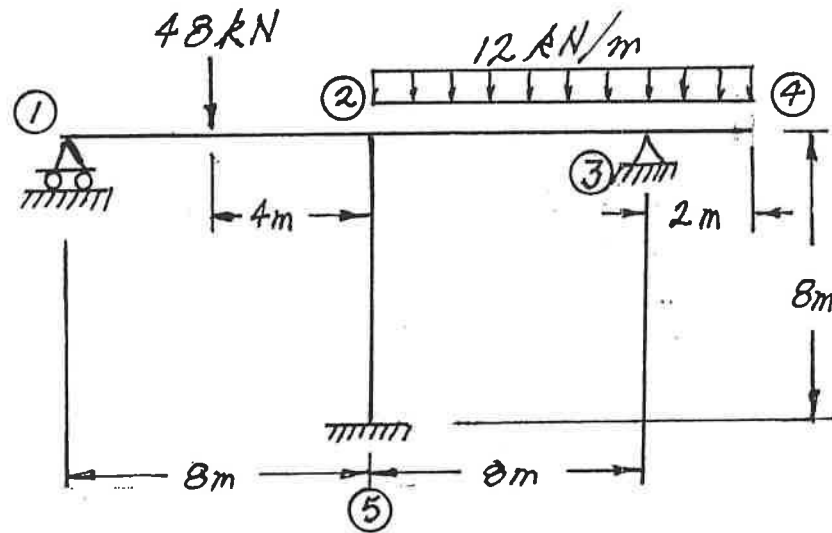
(22)   7.   Use the principle of virtual work to calculate the vertical deflection at joint L_1 of the truss shown below. All members are prismatic and have the same AE value; $AE = 36.0 \times 10^3$ kN.
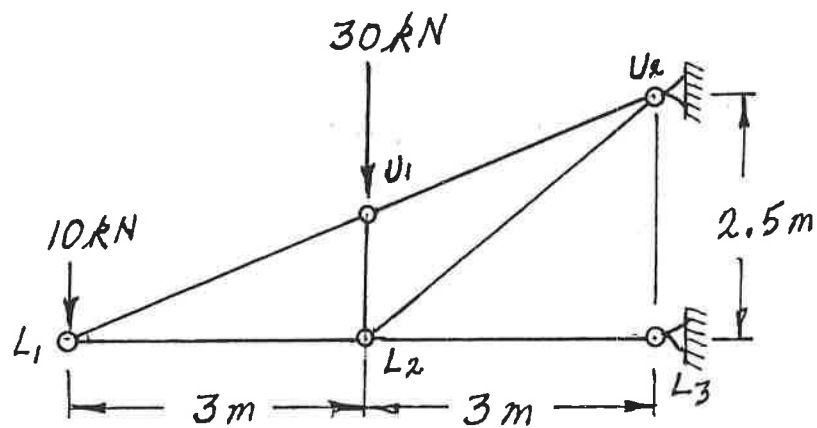
Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8.

(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 maximum and minimum ordinates (Minimum ordinates are frequently negative values).