

NATIONAL EXAMS MAY 2018

16-CIV-A1 ELEMENTARY

STRUCTURAL ANALYSIS

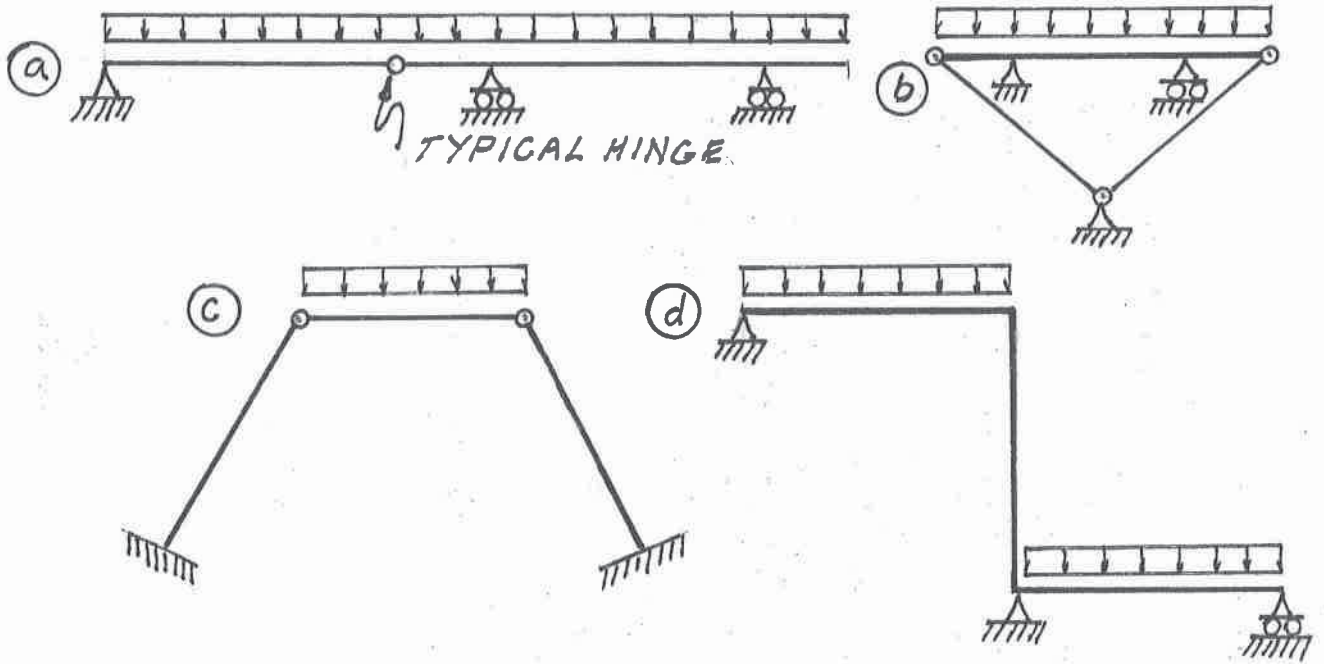
3 HOURS DURATION

NOTES:

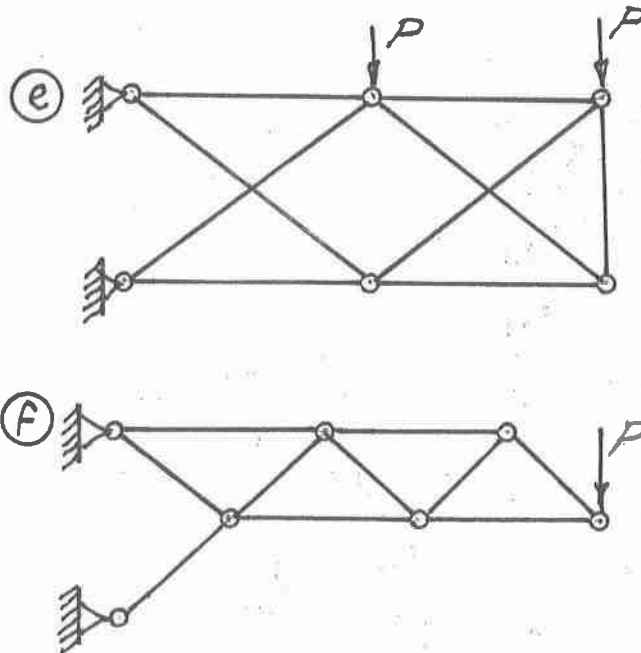
1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumption made.
2. Each candidate may use an approved model of a Casio or Sharp calculator; otherwise, this is a CLOSED BOOK Examination.
3. Six questions constitute 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

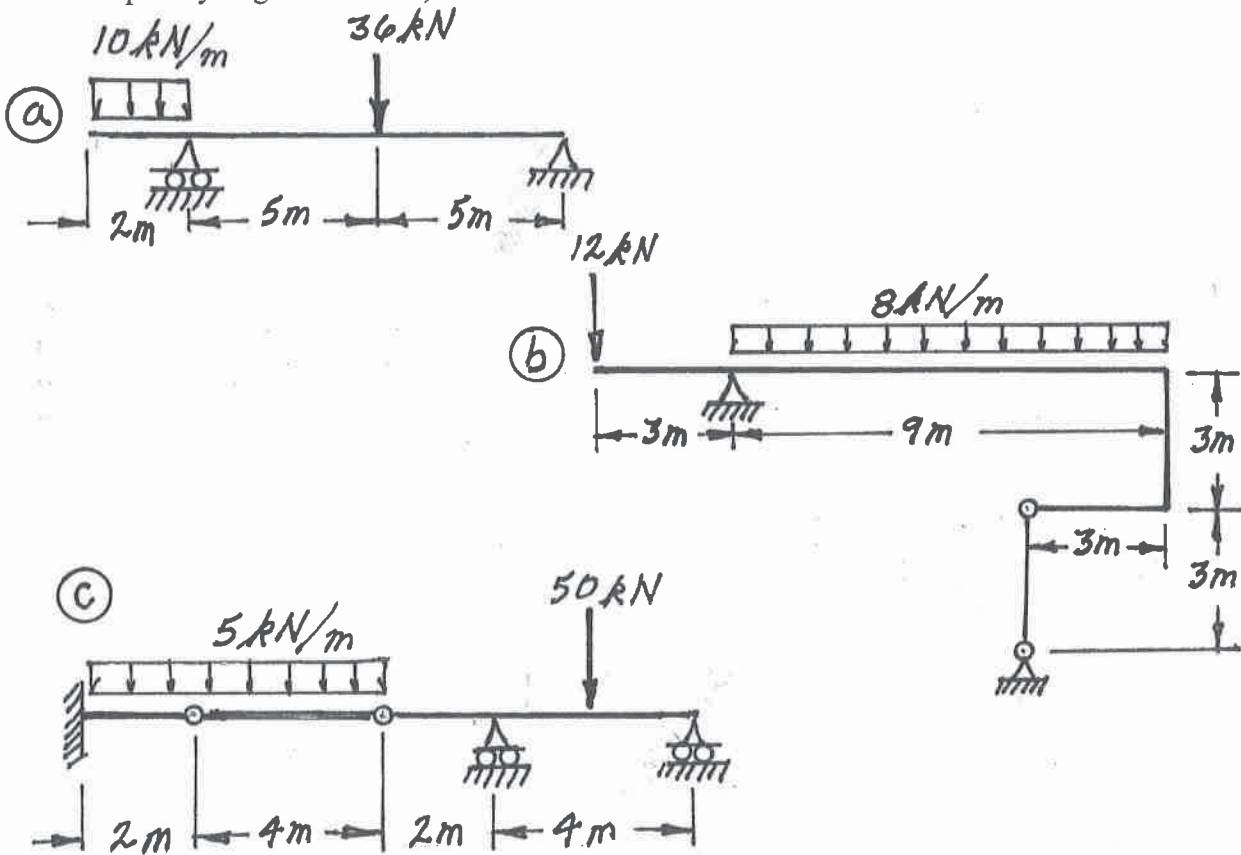
- (6) 1. For each of the structures shown state whether it is unstable, statically determinate, or statically indeterminate. If the structure is statically indeterminate, state the degree of indeterminacy. Structures a) through d) have beam-type members.



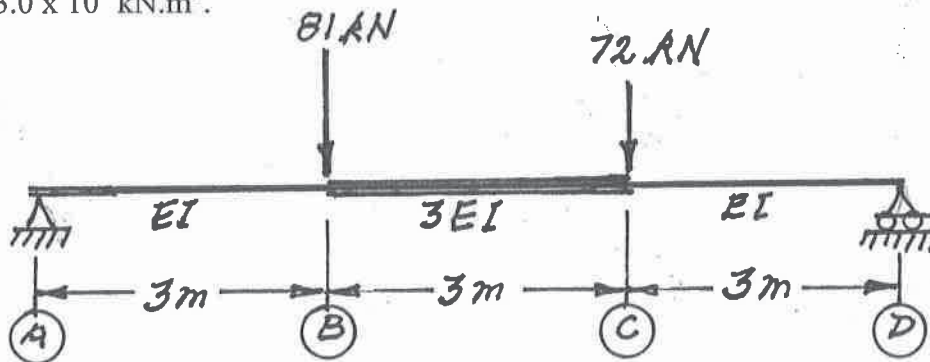
Structures e) and f) have truss-type members.  
 Diagonals in e) are not connected where they cross.



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



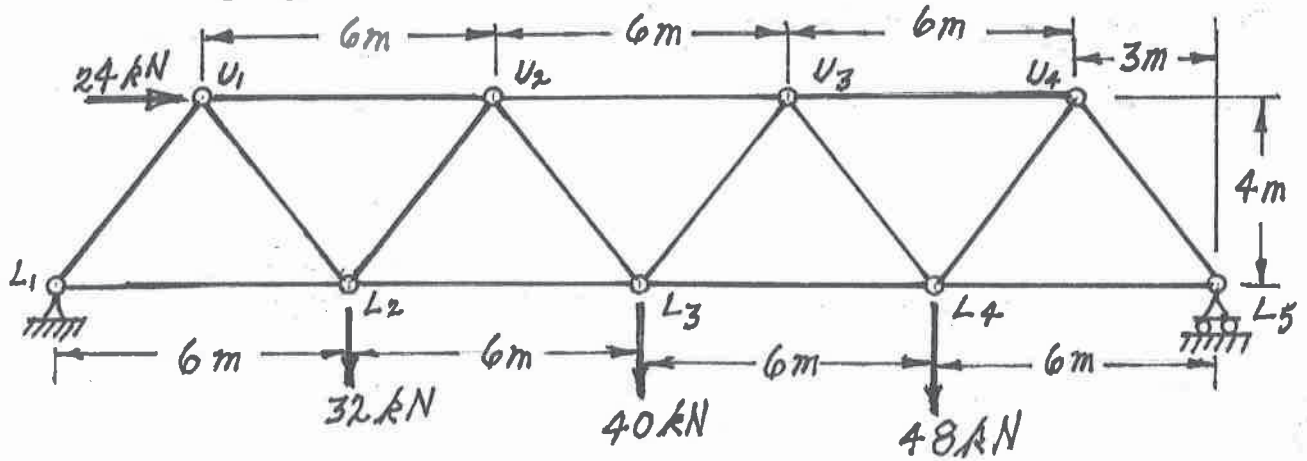
- (16) 3. At point (B), calculate the vertical deflection of the non-prismatic beam shown below.  
 $EI = 3.0 \times 10^4 \text{ kN.m}^2$ .



(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:

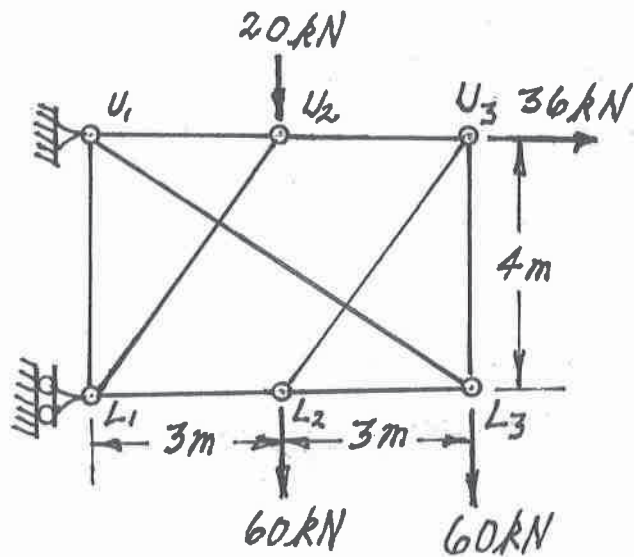
- $U_1 - U_2$
- $L_2 - U_2$  and
- $L_2 - L_3$ .



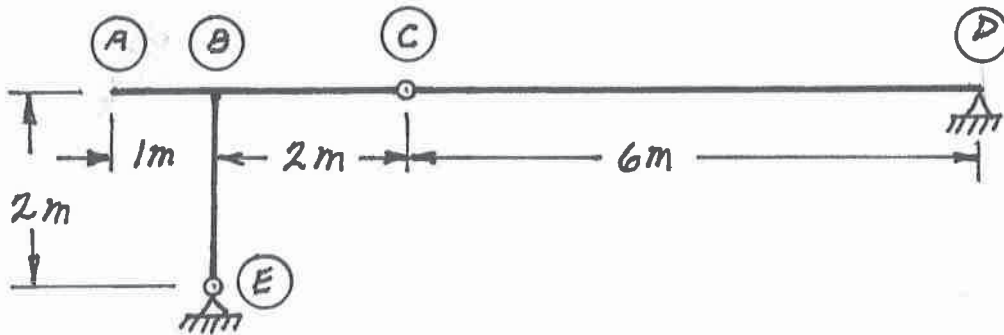
b) Calculate the forces in:

- $L_1 - U_2$
- $L_1 - L_2$  and
- $U_1 - L_3$

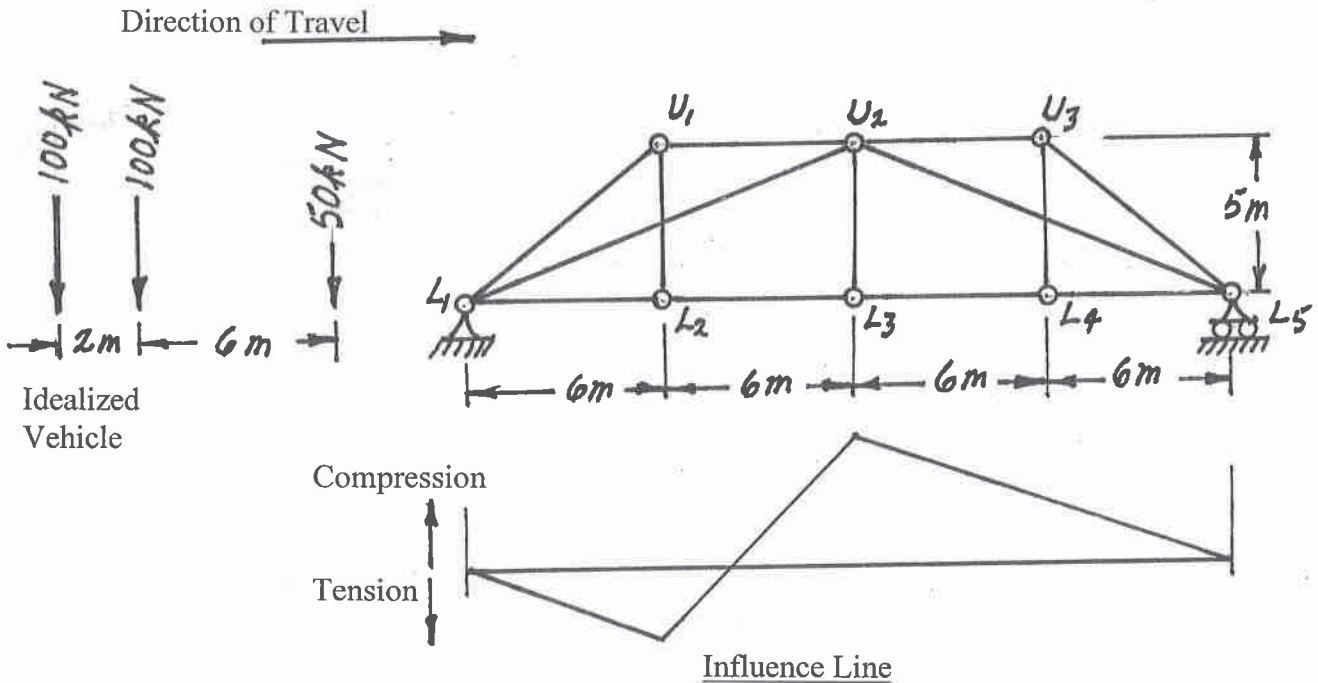
Diagonals are not connected where they cross.



- (9) 5. a) Loads move along the top beams of the frame shown below. Draw the influence lines for: (i) the moment immediately right of joint (B). (ii) the shear immediately right of joint (B). (iii) the horizontal reaction at support (E).

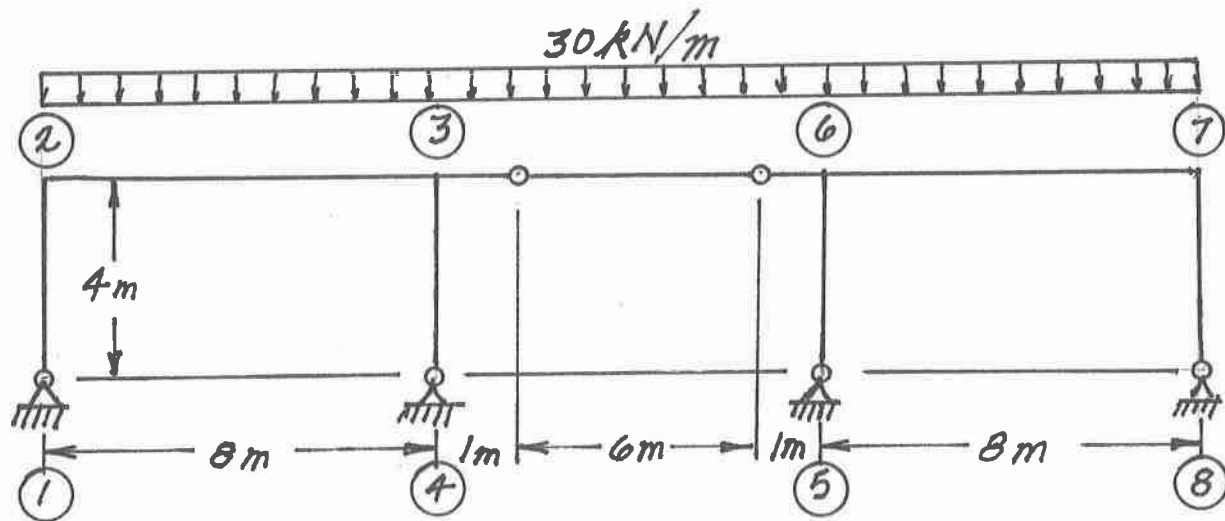


- (11) b) A vehicle, which is idealized as the three point loads shown, moves across beams at the bottom chord level of the truss shown. The shape of the influence line for force in member  $L_1 - U_2$  is also shown below the truss. Calculate the ordinates of the influence line and calculate the maximum (i) compression force and (ii) maximum tension force caused by the vehicle as it crosses the structure. Note: The diagonal members are not connected to vertical members where they cross.



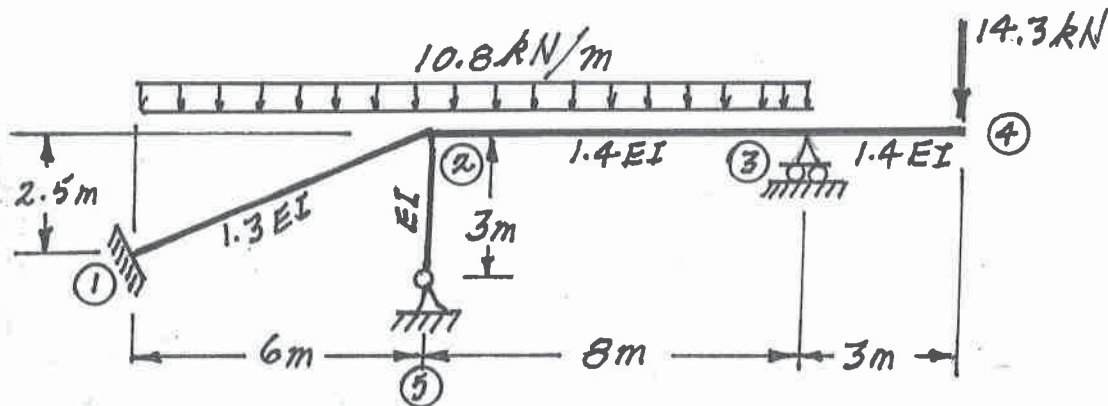
Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8.

- (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, indicate the value of the maximum and minimum ordinates (Minimum ordinates are frequently negative values). All members have the same EI value and are inextensible. Take account of symmetry.



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

- (22) 7. 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, indicate the values of the maximum and minimum ordinates (Minimum ordinates are frequently negative values). Members are inextensible and have the relative EI values shown on the diagram.



- (22) 8. Use the principle of virtual work to calculate the vertical deflections at joints  $L_1$  and  $L_2$  on the truss shown below. All members have the same AE value which is  $3.9 \times 10^4$  kN.

