

MAY 2011 NATIONAL EXAMS

98-CIV-A1 ELEMENTARY

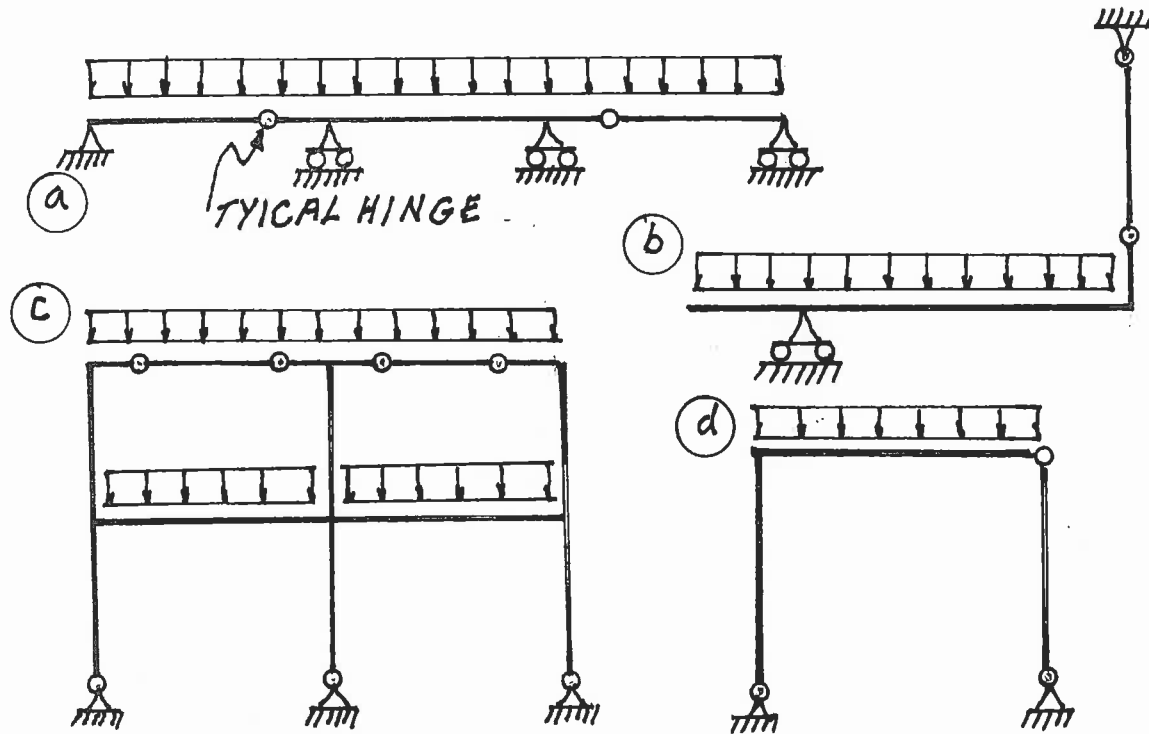
STRUCTURAL ANALYSIS

3 HOURS DURATION

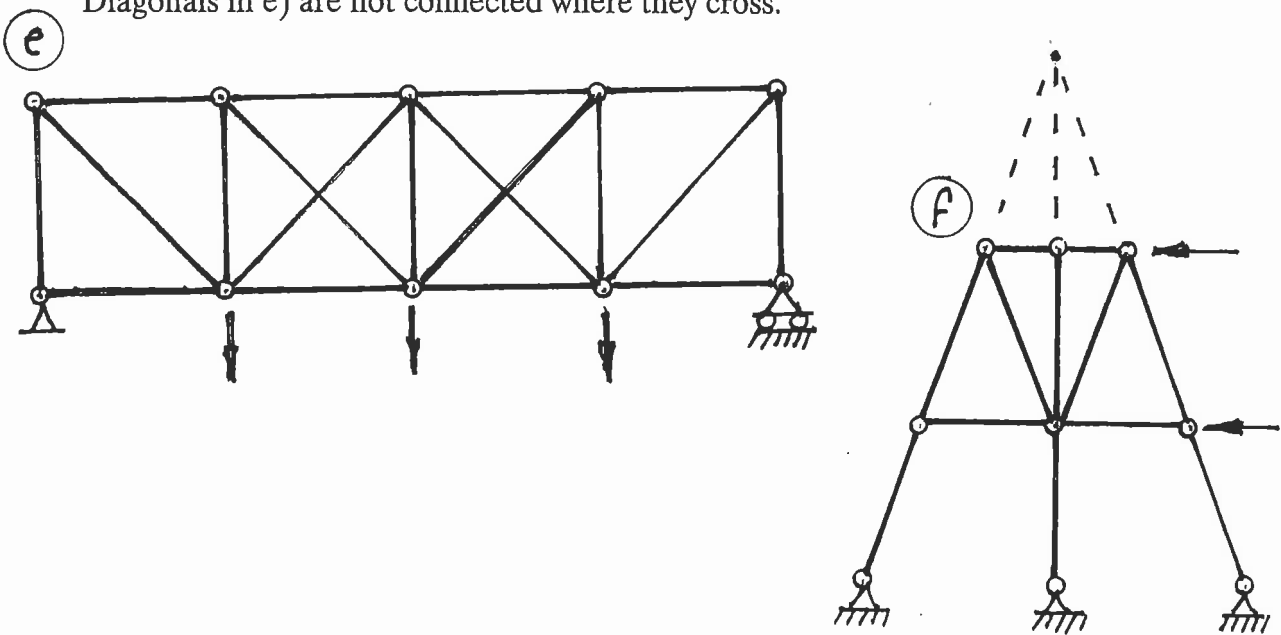
NOTES:

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 #4; answer ONLY ONE of #5 OR #6 and ONLY ONE of #7, #8 OR #9.
4. The marks assigned to each question are shown in the left margin.

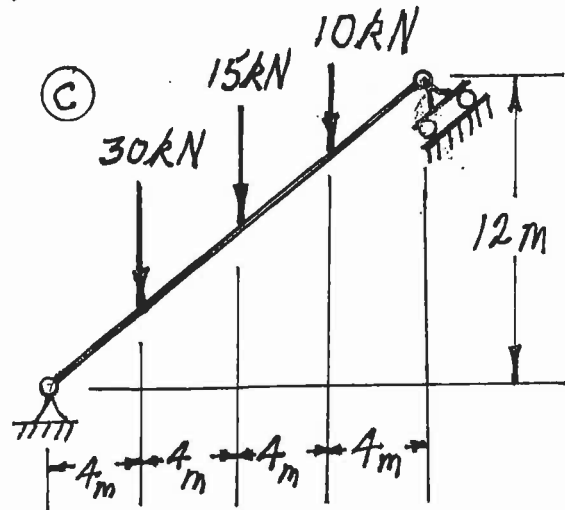
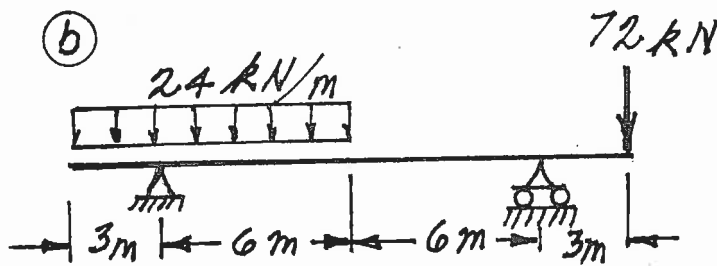
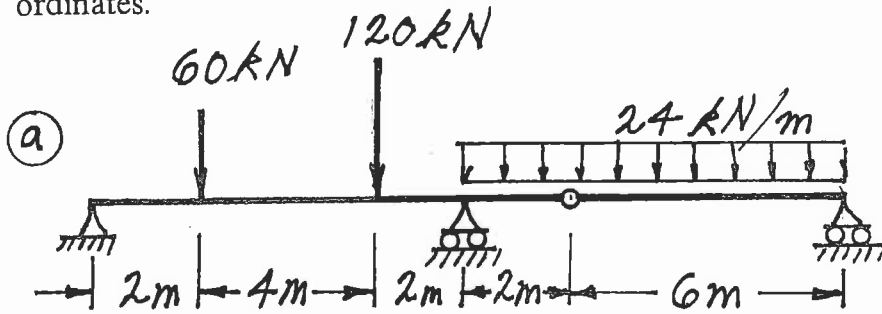
- (6) 1. For each of the structures shown state whether it is unstable, statically determinate, or statically indeterminate. If the structure is statically indeterminate, state the degree of indeterminacy. Structures a) through d) have beam-type members.



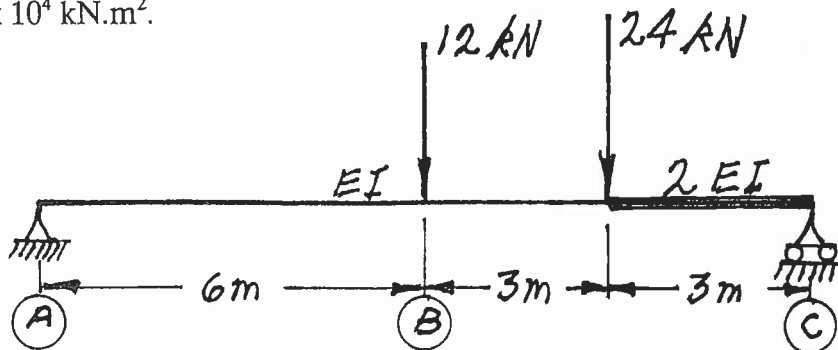
Structures e) and f) have truss-type members.  
 Diagonals in e) are not connected where they cross.



- (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 positive and negative ordinates.



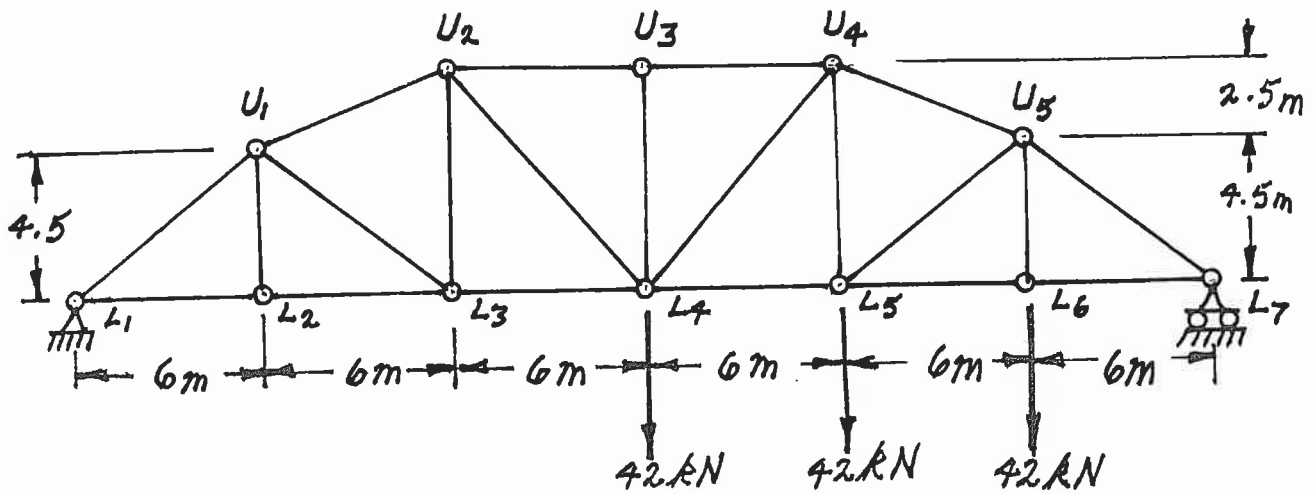
- (16) 3. At point (B) calculate the vertical deflection of the non-prismatic beam shown below.  $EI = 4.0 \times 10^4 \text{ kN.m}^2$ .



- (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.

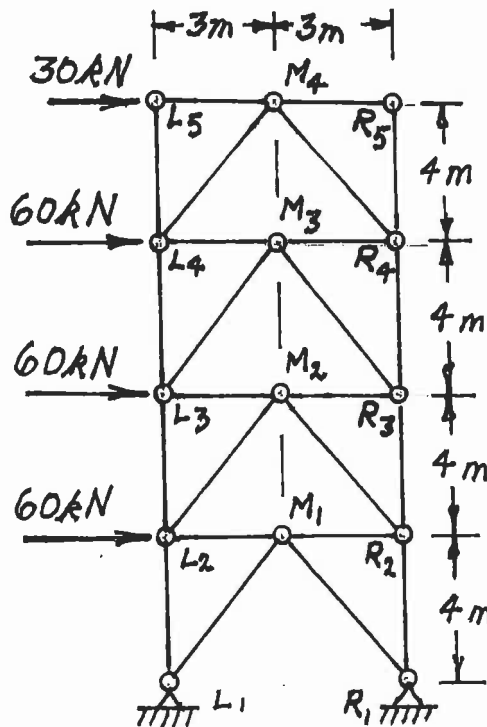
a) Calculate the forces in:

- $L_4 - L_5$
- $U_4 - L_5$  and
- $L_5 - U_5$



b) Calculate the forces in:

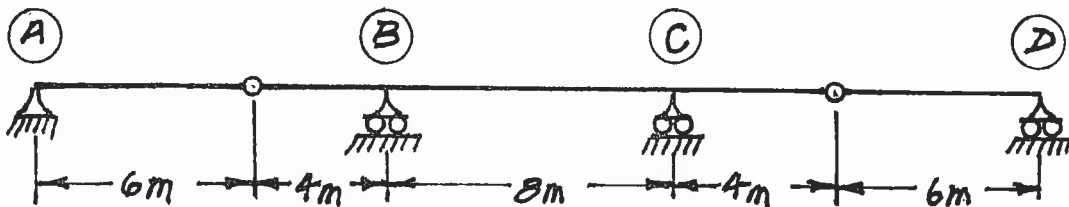
- $L_1 - L_2$
- $L_2 - M_2$  and
- $L_2 - M_1$



Select and answer ONE QUESTION ONLY from Questions #5 or #6.

- (20) 5. a) For the determinate beams shown, draw the influence lines for:  
 i) reaction at support (B)  
 ii) shear immediately right of support (B).

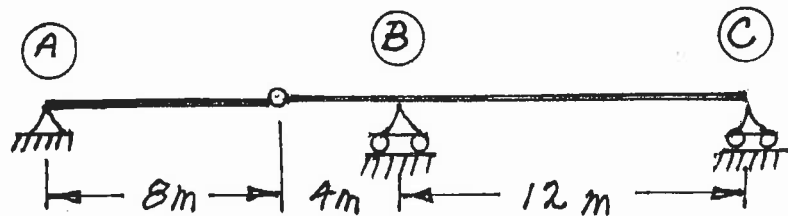
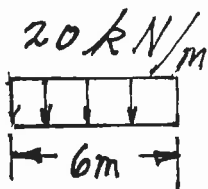
For each influence line, calculate and indicate the value of the influence coefficient that has the maximum absolute value.



- b) A vehicle is idealized as a uniformly distribution load over a length of 6 m. The vehicle moves across the beam structure shown below. Draw the influence line for bending moment over support (B); calculate and show the magnitude of the largest negative influence coefficient. Calculate the largest negative bending moment caused while the idealized vehicle crosses the structure.

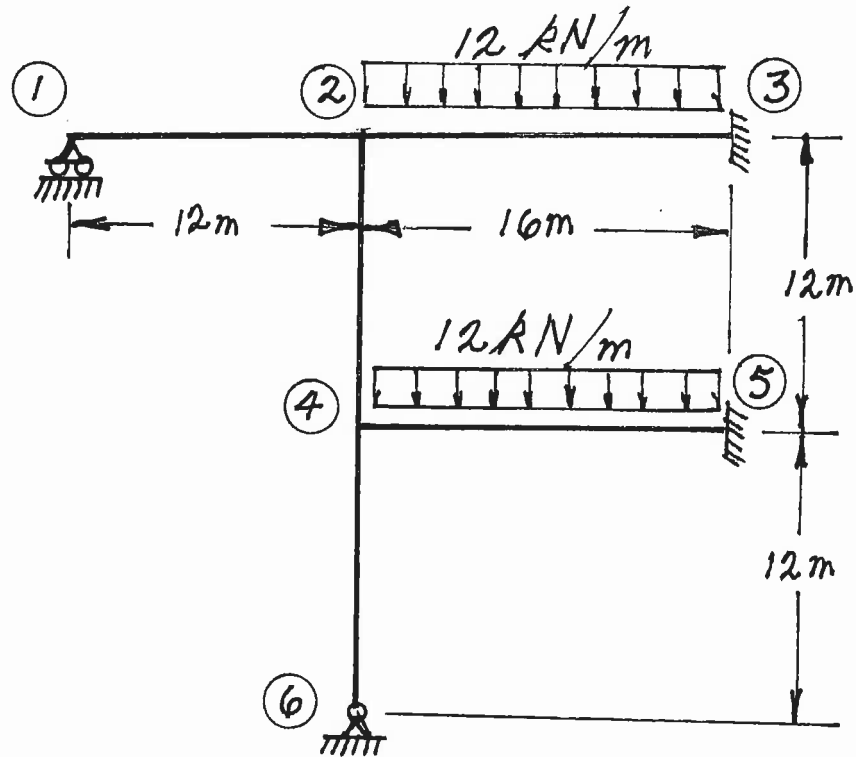
IDEALIZED VEHICLE

DIRECTION OF TRAVEL



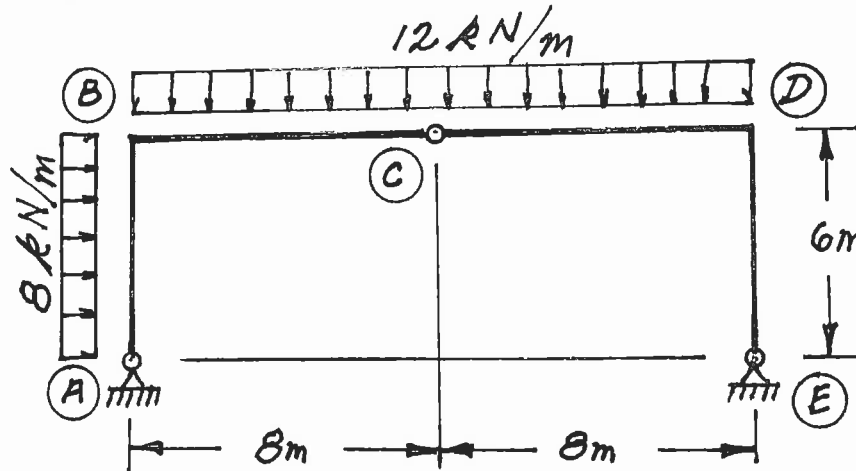
Select and answer ONE QUESTION ONLY from Questions #5 or #6.

- (20) 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. For both diagrams and each member, calculate and indicate the maximum and minimum ordinates (Minimum ordinates are frequently negative values). All members are inextensible and have the same value of  $EI$ .

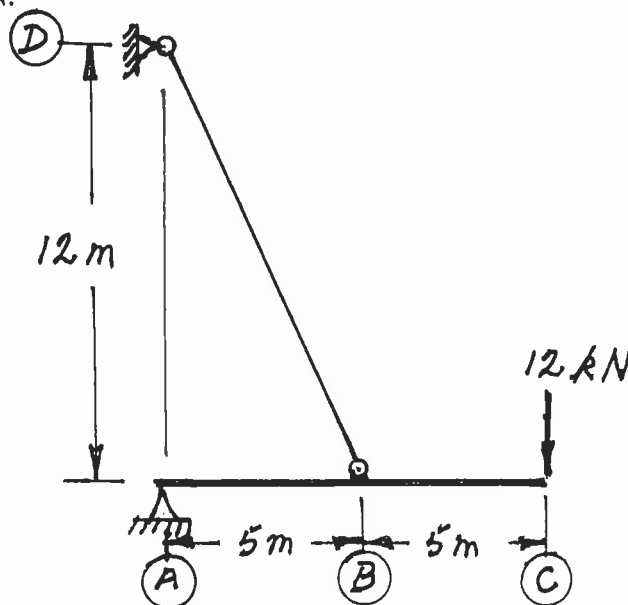


Select and answer ONE QUESTION ONLY from Questions #7, #8 or #9.

- (22) 7. 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).



- (22) 8. Use the principle of virtual work to calculate the vertical deflection at point C on beam A-C of the structure shown. The beam is inextensible and has  $EI = 5.0 \times 10^4 \text{ kN.m}^2$ . The tie rod does not take moment and has an  $AE = 5200 \text{ kN}$ .



Select and answer ONE QUESTION ONLY from Questions #7, #8 or #9.

(22) 9. Loads move along beams at the top chord level of the truss shown below. Draw the influence lines for forces in members:

- a)  $U_1 - M_2$
- b)  $U_2 - U_3$
- c)  $M_2 - U_3$  and
- d)  $L_1 - M_2$

For each influence line, calculate and indicate the value of the influence ordinate that has the maximum absolute value; indicate whether the ordinate is tension or compression.

e) Calculate the force in member  $L_1 - M_2$  caused by a uniformly distributed load of 8 kN/m applied as a gravity load to the beams at the top chord level from  $U_1$  to  $U_5$ .

