# NATIONAL EXAMS MAY 2017

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 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.
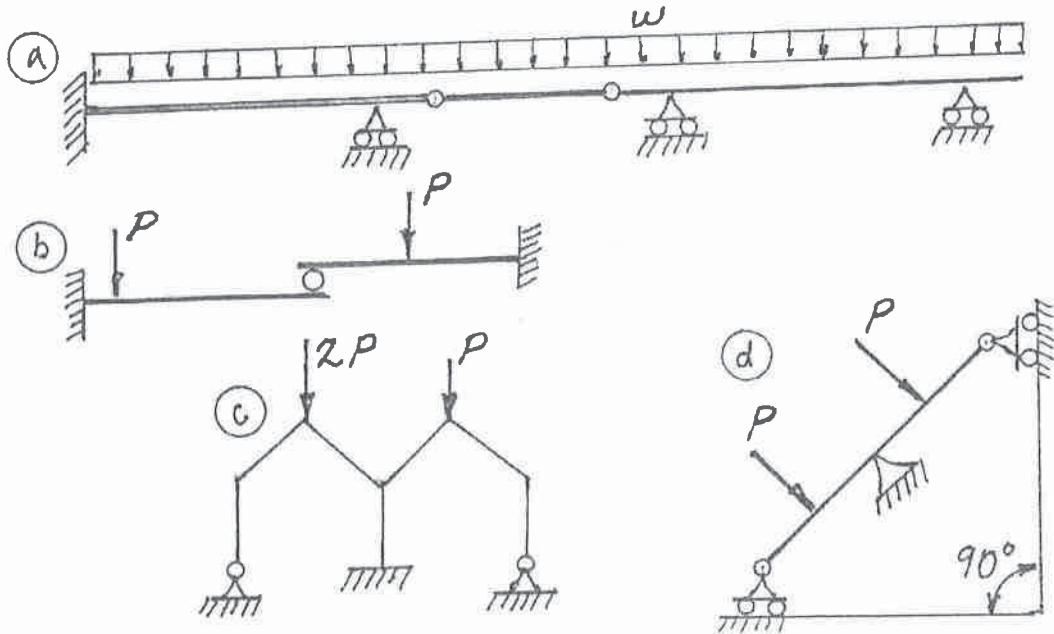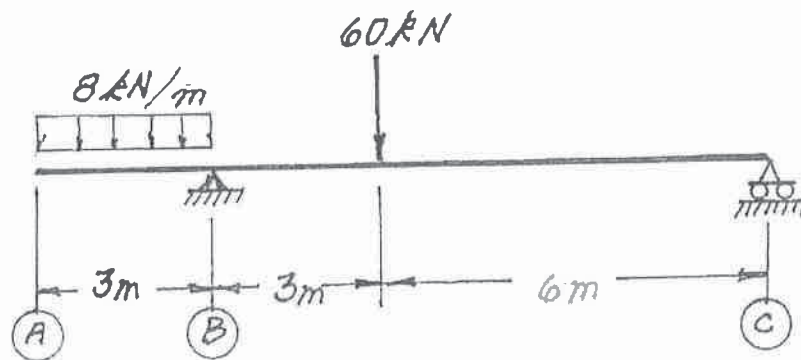

Structures e) and f) have truss-type members.
Diagonals in e) are not connected where they cross.
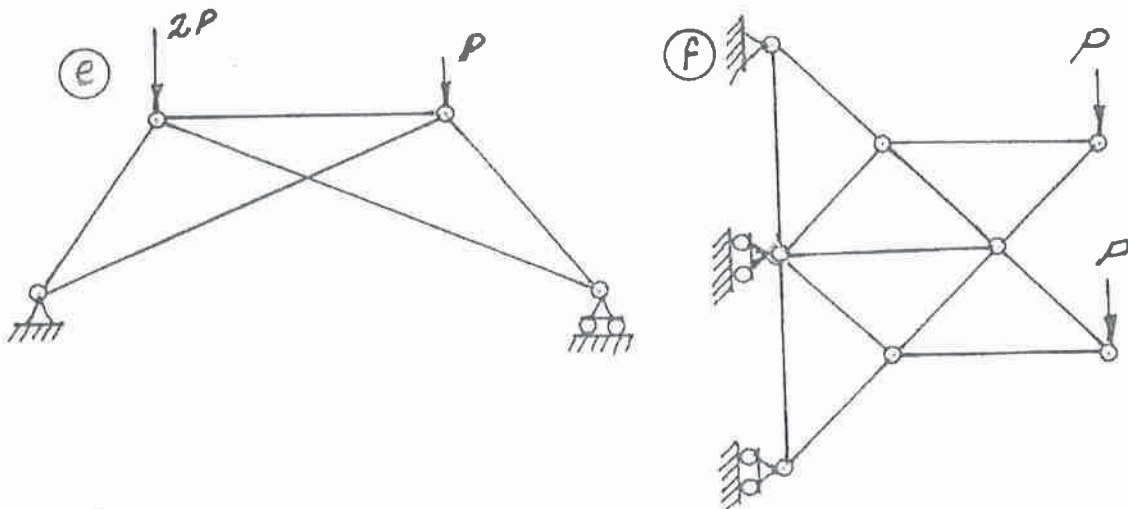
(18) 2. For each structure shown, compute the reactions and draw shear and bending moment diagrams. Indicate which are positive and which are negative segments of each bending moment diagram. For each shear and bending moment diagram, calculate and indicate the magnitudes of the maximum positive and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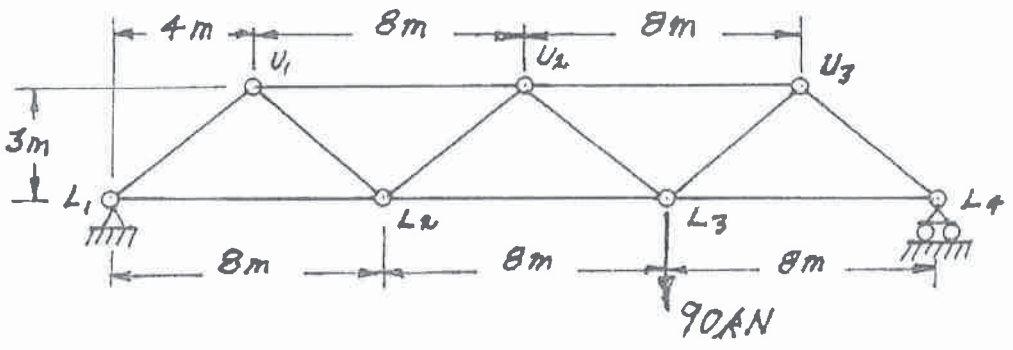
(a)

12 kN/m

30 kN

6 m   2 m

(b)

8 kN/m

4 kN/m

3 m

1.5 m   6 m

(c)

16 kN

15 kN   2 m

3 m

8 m   4.5 m

6 m
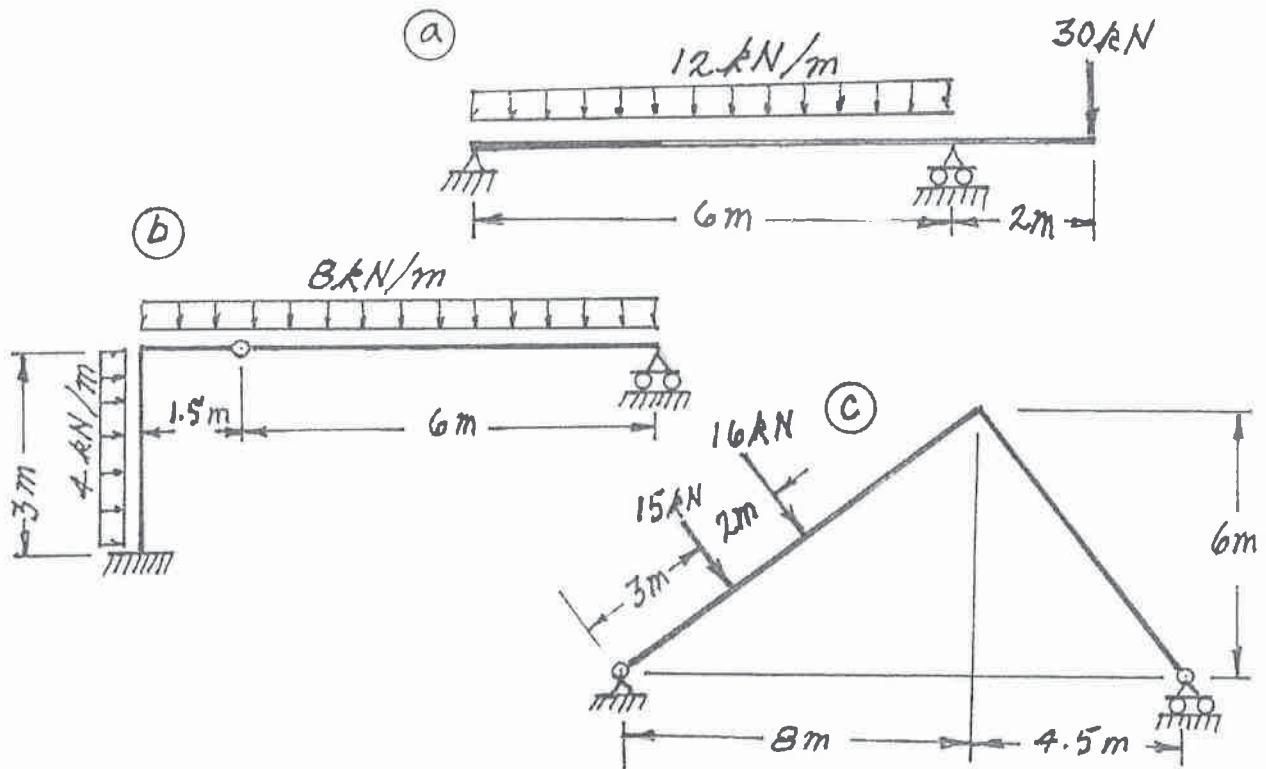
(16) 3. At point Ⓐ calculate the vertical deflection of the beam shown below.
EI = 2.7 x 10⁴ kN.m².

60 kN

8 kN/m

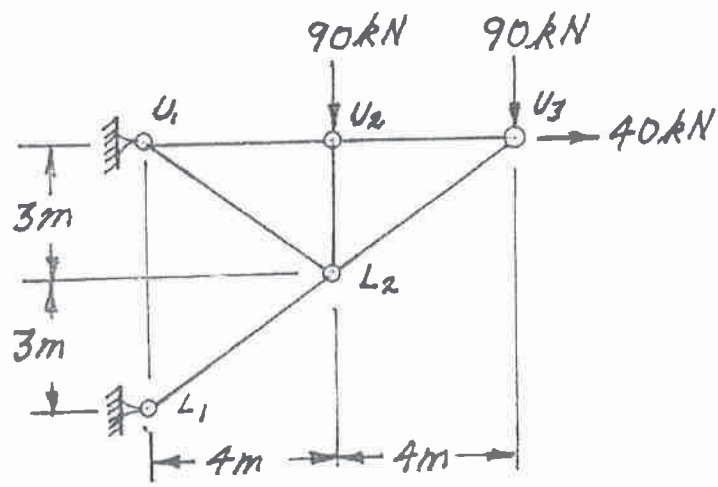3m   3m   6m

Ⓐ   Ⓑ   Ⓒ

(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.
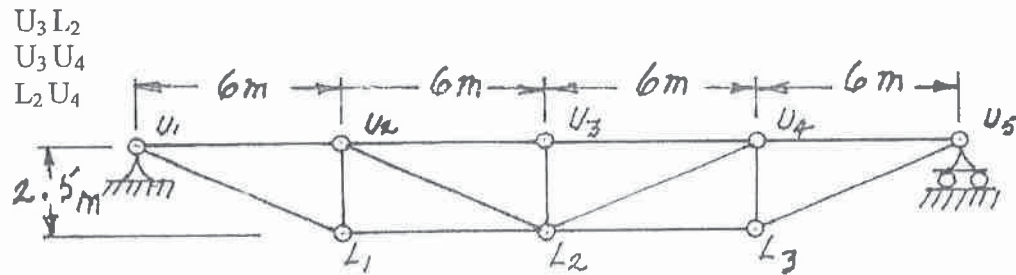
a)   Calculate the forces in:
         $L_2 - L_3$
         $U_2 - L_3$ and
         $U_3 - L_3$

b)   Calculate the forces in:
         $U_1 - L_2$
 $U_1 - U_2$ and
         $L_1 - L_2$

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

$U_3 L_2$
$U_3 U_4$
$L_2 U_4$

For each influence line, calculate and indicate the value of the influence ordinate
at the ¼ , ½ and ¾ points along the truss span.

(11)   b)   A vehicle, which is idealized as the uniformly distributed load over a length of
10 m., moves across the simple beam shown. Draw the influence line for shear at
Section①–①; calculate and label the ordinates of the influence line. Calculate
the maximum absolute value of the shear at Section①–①caused by the vehicle
as it crosses the structure.

Idealized
Vehicle

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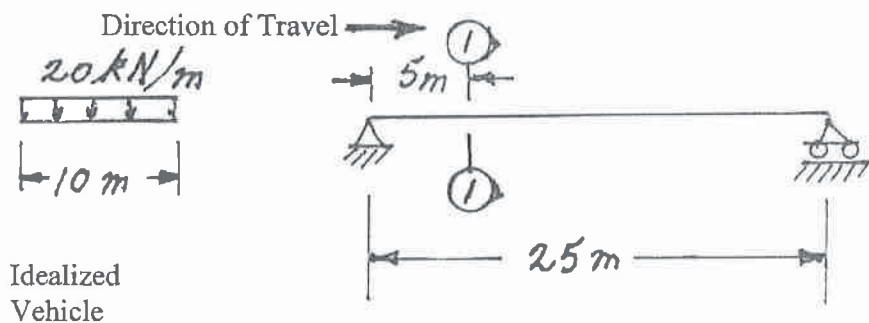
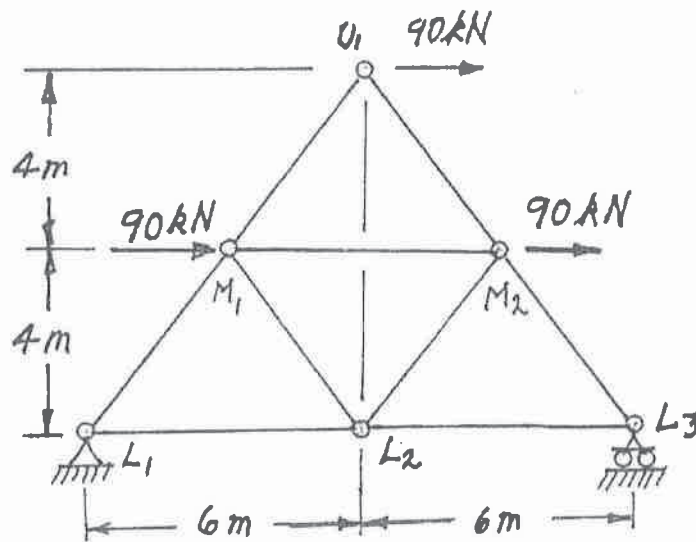Select and answer ONE QUESTION ONLY from Questions #6, #7 or #8.

(9)   6.   a) For the truss shown below, calculate the forces in the members that are listed
                immediately below. For each force, indicate whether it is tension or
                compression.
 $L_2 M_1$
                                $L_2 M_2$
                                $M_1 M_2$
(13)   b) Using the principle of virtual work, calculate the horizontal deflection at joint
                U_1 . All members have the same AE value which is 1.5×10^5 kN.

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 value 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.
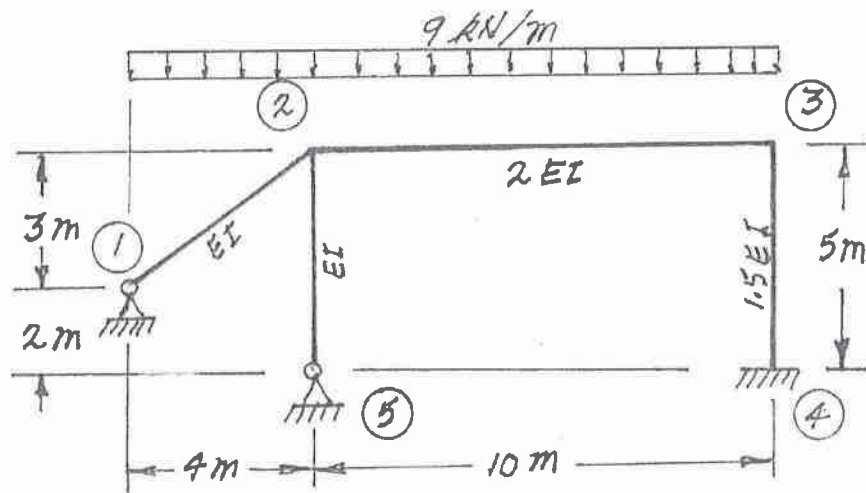
(22)   8.   Use the principle of virtual work to calculate the vertical deflection at point Ⓒ on the structure shown below. Both beam members are inextensible and their relative EI values are shown on the diagram; $EI = 3500$ kN.m^2. For the strut, $AE = 25000$ kN.