Ministry of Higher Education
Giza Higher Institute for Eng. & Tech.
Civil Engineering Department
Course Name: **Theory of Structures (1)**
Course Code : **CIV 201**

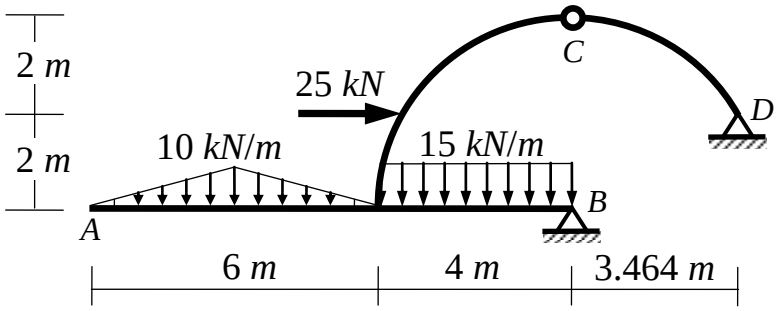
Academic Year : **2015-2016**
Semester : **First**
Level : **Second**
Time : **3 Hours**
Date : **2 / 1 / 2016**
Examiner: ***Dr. M. Abdel-Kader***

Answer of First Semester Final Exam

Question (1): (20 Marks)

For the shown structures, determine the reactions at the supports.

Note: *In your answer sheet (in the first page), draw the final reactions (direction and magnitude) on the structures.*



Solution:

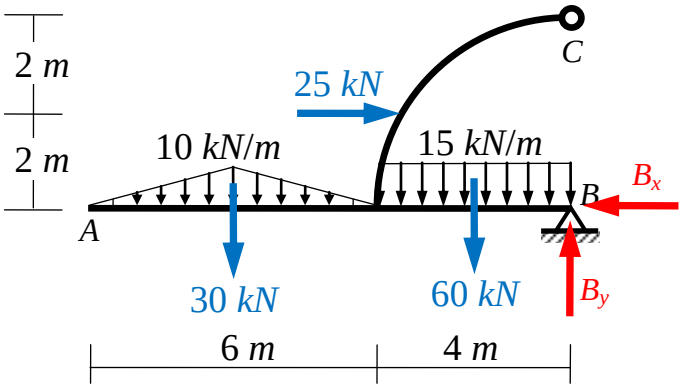
(1-a)

Part *ABC*:

$+\circlearrowleft \sum M_C = 0:$

$B_x(4) - 30(7) - 60(2) - 25(2) = 0$

$\therefore \; B_x = +95 \leftarrow$ $\quad$ $B_x = 95\ kN \leftarrow$

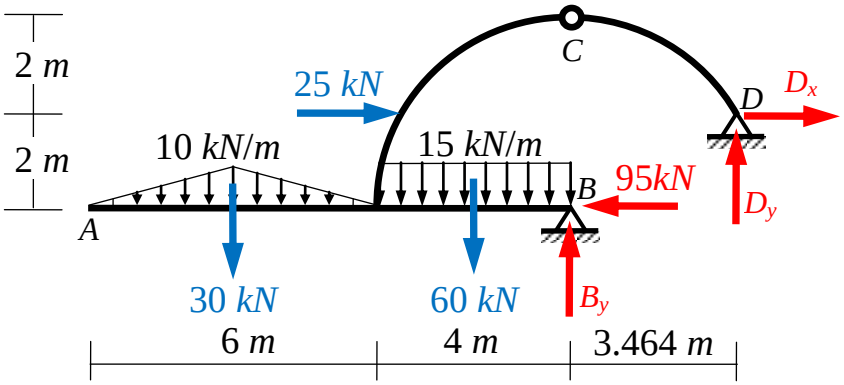


Entire Structure

$+\rightarrow \sum F_x = 0:$

$D_x + 25 - 95 = 0$

$\therefore \; D_x = +70 \rightarrow$ $\quad$ $D_x = 70\ kN \rightarrow$



Part *CD*

$+\circlearrowleft \sum_{C}^{D} M_C = 0:$

$-D_y(3.464) - D_x(2) = 0$

$-D_y(3.464) - 70(2) = 0$

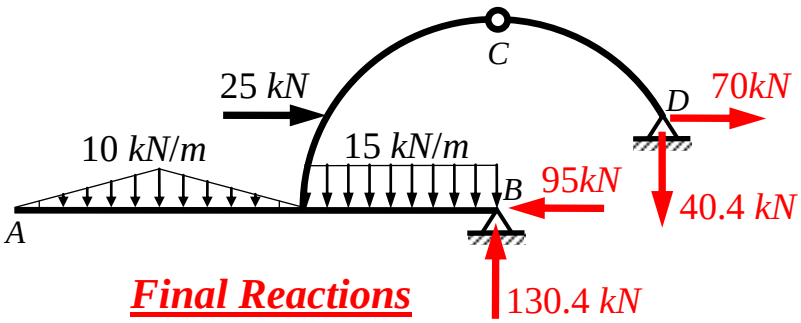
$\therefore \; D_y = -40.4157 \uparrow$ $\quad$ $D_y = 40.4157\ kN \downarrow$

Entire Structure

$+\uparrow \sum F_y = 0:$

$B_y + D_y - 30 - 60 = 0$

$B_y - 40.4147 - 30 - 60 = 0$ $\quad$ $\therefore \; B_y = +130.4147 \uparrow$ $\quad$ $B_y = 130.4157\ kN \uparrow$



Final Reactions

Check

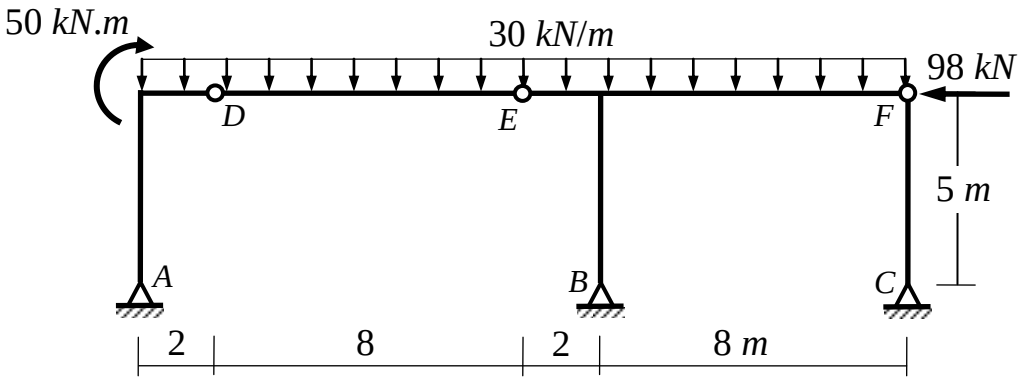
$+\circlearrowleft \sum M_A = 30(3) + 60(8) + 25(2) - 130.4147(10) + 40.4147(13.464) + 70(2) \cong 0$ $\quad$ ***O.K.***

With my best wishes
Dr. M. Abdel-Kader

Question (1): (20 Marks)

For the shown structures, determine the reactions at the supports.

Note: *In your answer sheet (in the first page), draw the final reactions (direction and magnitude) on the structures.*



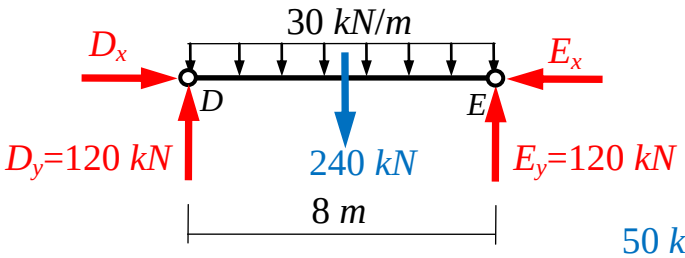
Solution:

(1-b)

Part *DE*

From symmetry:

$D_y = E_y = 120\ kN \uparrow$



Part *AD*

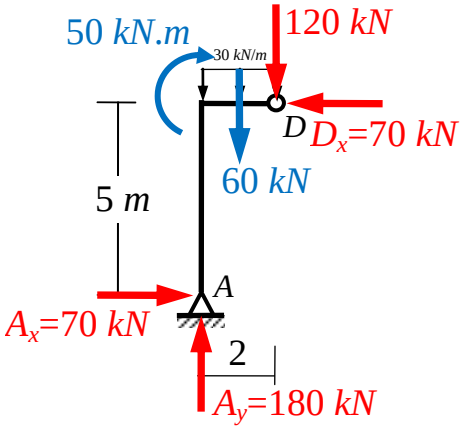
$+\uparrow \sum F_y = 0: \quad A_y - 60 - 120 = 0 \quad \therefore A_y = +180 \uparrow$ $\boxed{A_y = 180\ kN \uparrow}$

$+\circlearrowleft \sum_{A}^{D} M_D = 0: \quad A_y(2) - A_x(5) - 60(1) + 50 = 0$

$180(2) - A_x(5) - 60(1) + 50 = 0$

$\therefore A_x = +70 \rightarrow$ $\boxed{A_x = 70\ kN \rightarrow}$

$+\rightarrow \sum F_x = 0: \quad A_x - D_x = 0 \quad \therefore D_x = +70 \leftarrow$

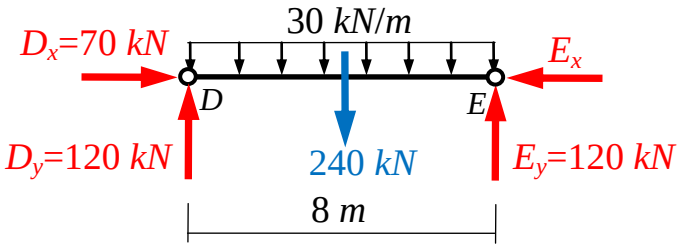


Part *DE*

$+\rightarrow \sum F_x = 0:$

$D_x - E_x = 0$

$\therefore E_x = +70 \leftarrow$



Part *BEFC*

$+\rightarrow \sum F_x = 0:$

$B_x + E_x - 98 = 0$

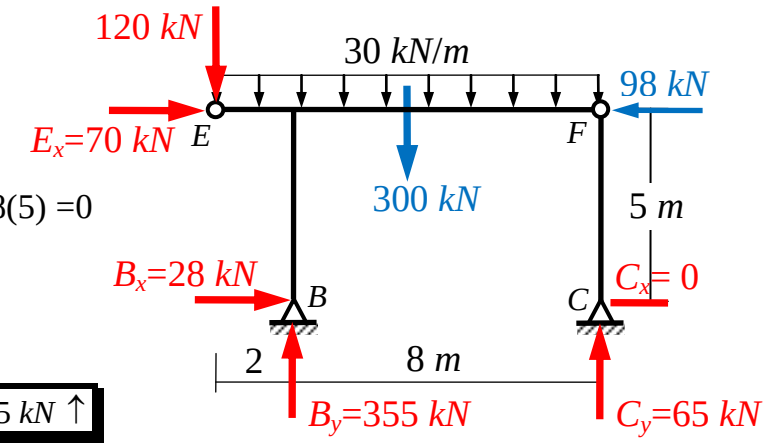
$\therefore B_x = +28 \rightarrow$ $\boxed{B_x = 28\ kN \rightarrow}$

$+\circlearrowleft \sum M_C = B_y(8) + 70(5) - 120(10) - 300(5) - 98(5) = 0$

$\therefore B_y = +355 \uparrow$ $\boxed{B_y = 355\ kN \uparrow}$

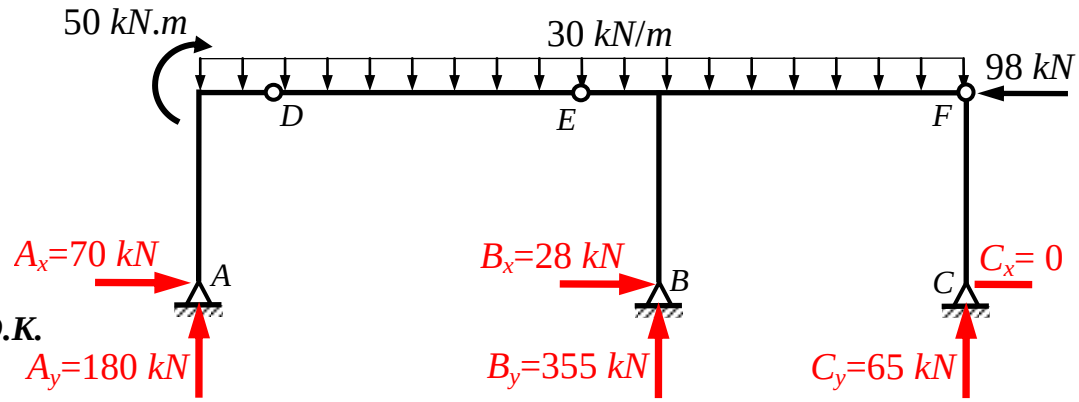
$+\uparrow \sum F_y = 0: \quad B_y + C_y - 120 - 300 = 0$

$\therefore C_y = +65 \uparrow$ $\boxed{C_y = 65\ kN \uparrow}$



Check

$+\circlearrowleft \sum M_E = +180(10) - 70(5) + 50 - 355(2) - 28(5) - 65(10) = 0$ ***O.K.***



Final Reactions

With my best wishes

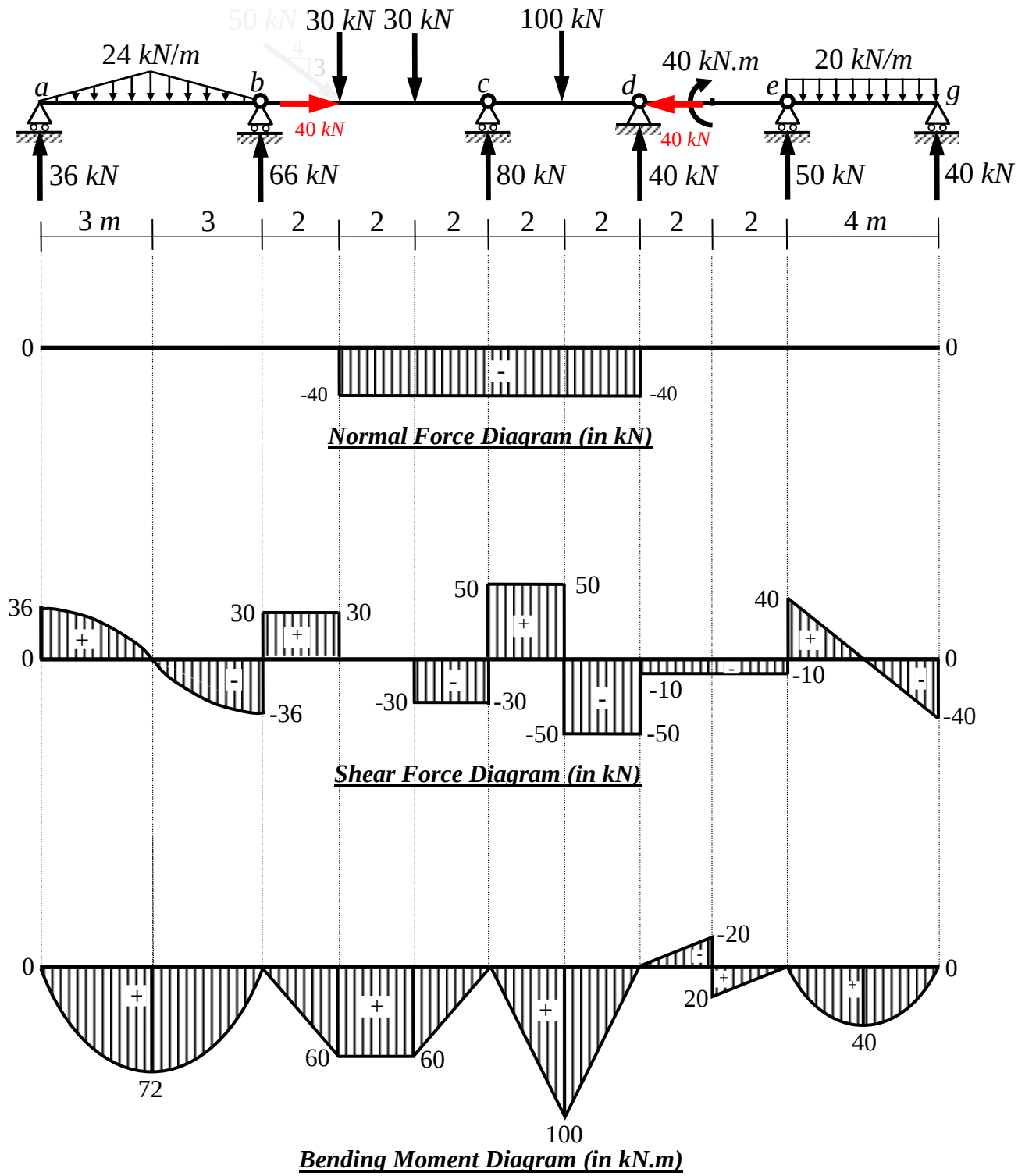
Dr. M. Abdel-Kader

Question (2): (20 Marks)

(a) For the shown beam, draw (*in the second page of your answer sheet*) the normal force, shear force and bending moment diagrams. ***Note***: *Only the vertical reactions are given.*

Solution:

(2-a)



Normal Force Diagram (in kN)

Shear Force Diagram (in kN)

Bending Moment Diagram (in kN.m)

With my best wishes

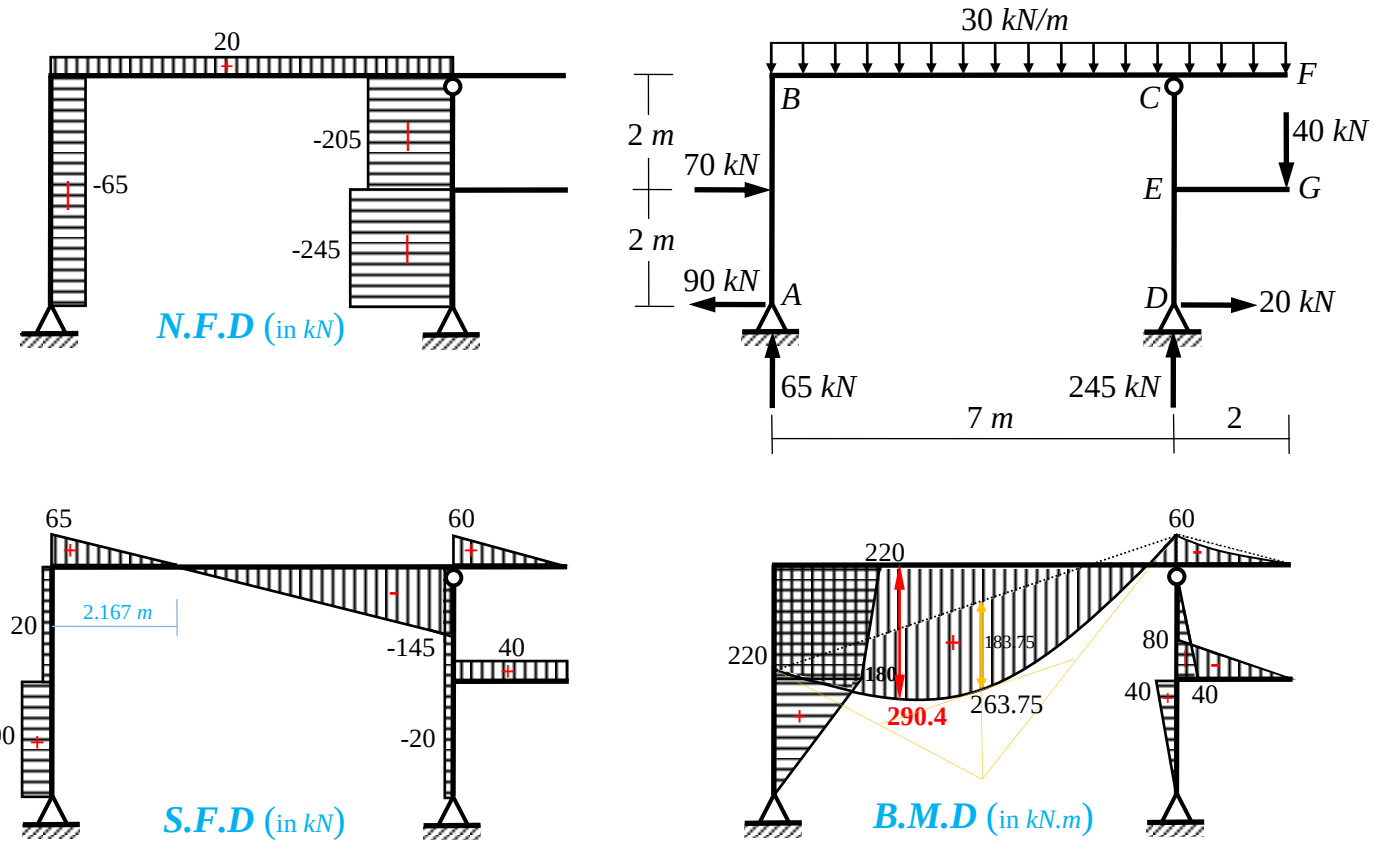
Dr. M. Abdel-Kader

(b) For the shown frame, draw (*in the third page of your answer sheet*) the normal force, shear force and bending moment diagrams.

***Note**: The reactions are given.*

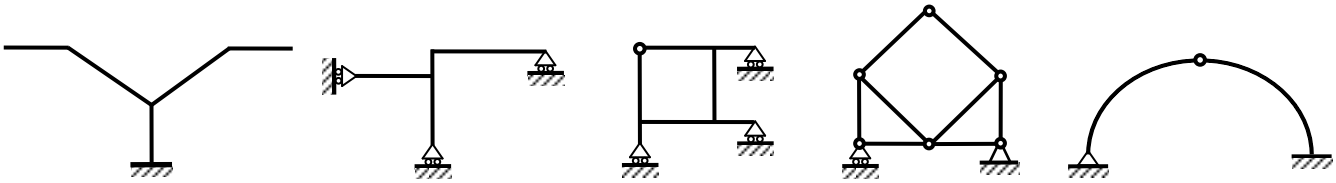
Solution:

(2-b)



(3-b) Determine whether each of the shown structures is stable or unstable. If stable, determine whether it is statically determinate or indeterminate. If statically indeterminate, determine the degree of indeterminacy.

Solution:



3 = 3
(1) Stable + Det.

3 = 3
(2) Stable + Det.

Parallel reactions
(3) Unstable.

11 < 12
(4) Unstable.

5 > 4
(5) Stable + Indet. to the 1st degree.

With my best wishes
Dr. M. Abdel-Kader

Question (3): (20 Marks)

(a) For the shown truss:

(i) Determine the reactions at the supports *A* and *E*.

(ii) Using the method of joints, determine the forces in all truss members.

(iii) Using the method of sections, determine the force in member *CE*.

Note: *In your answer sheet (in the last page), draw the truss and put the force magnitude and the indication (Tension or Compression) on each member.*

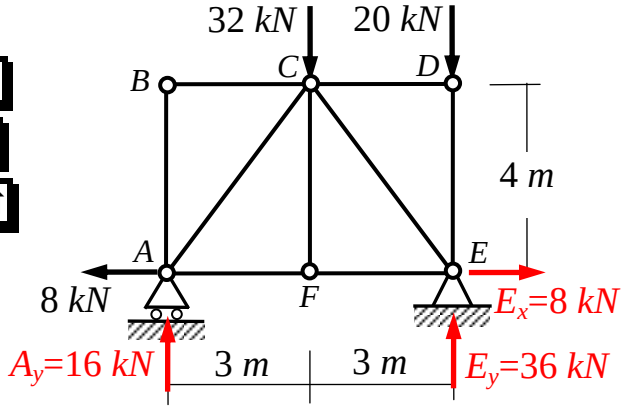
Solution:

(i) Reactions:

$+\rightarrow \sum F_x = -8 + E_x = 0 \quad \therefore E_x = +8 \rightarrow$ $\boxed{E_x = 8\ kN \rightarrow}$

$+\circlearrowleft \sum M_E = A_y(6) - 32(3) = 0 \quad \therefore A_y = 16 \uparrow$ $\boxed{A_y = 16\ kN \uparrow}$

$+\uparrow \sum F_y = A_y + E_y - 32 - 20 = 0 \quad \therefore E_y = 36 \uparrow$ $\boxed{E_y = 36\ kN \uparrow}$



(ii) Forces in members:

Joint *B*:

$+\rightarrow \sum F_x = F_{BC} = 0 \quad \therefore$ $\boxed{F_{BC} = 0}$

$+\uparrow \sum F_y = F_{BA} = 0 \quad \therefore$ $\boxed{F_{BA} = 0}$

Joint *D*:

$+\rightarrow \sum F_x = F_{DC} = 0 \quad \therefore$ $\boxed{F_{DC} = 0}$

$+\uparrow \sum F_y = -20 - F_{DE} = 0 \quad F_{DE} = -20 \quad \therefore$ $\boxed{F_{DE} = 20\ \text{Comp.}}$

Joint *F*:

$+\uparrow \sum F_y = F_{FC} = 0 \quad \therefore$ $\boxed{F_{FC} = 0}$

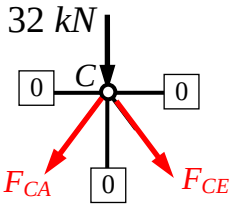
Joint *C*:

$+\rightarrow \sum F_x = F_{CE}(0.6) - F_{CA}(0.6) = 0 \quad \therefore F_{CE} = F_{CA} \quad \ldots\ldots (1)$

$+\uparrow \sum F_y = -32 - F_{CE}(0.8) - F_{CA}(0.8) = 0 \quad \ldots\ldots\ldots (2)$

From (1) in (2) $F_{CA} = -32 / (2 \times 0.8) = -20$ and $F_{CE} = -20$

$\therefore$ $\boxed{F_{CA} = 20\ \text{Comp.}}$ and $\boxed{F_{CE} = 20\ \text{Comp.}}$



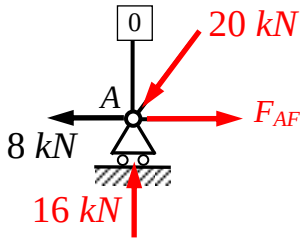
FBD of Joint C

Joint *A*:

$+\rightarrow \sum F_x = F_{AF} - 8 - 20(0.6) = 0 \quad \therefore$ $\boxed{F_{AF} = 20\ \text{Tension}}$

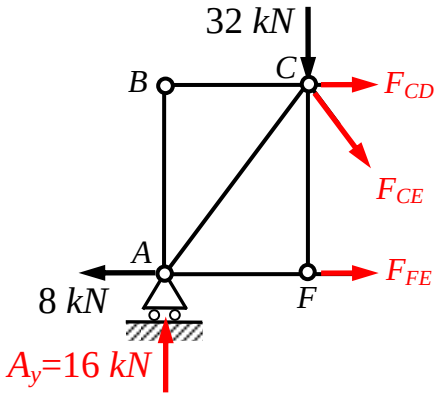
Joint *F*:

$+\rightarrow \sum F_x = 0: \quad F_{FE} = F_{FA} = 20 \quad \therefore$ $\boxed{F_{FE} = 20\ \text{Tension}}$



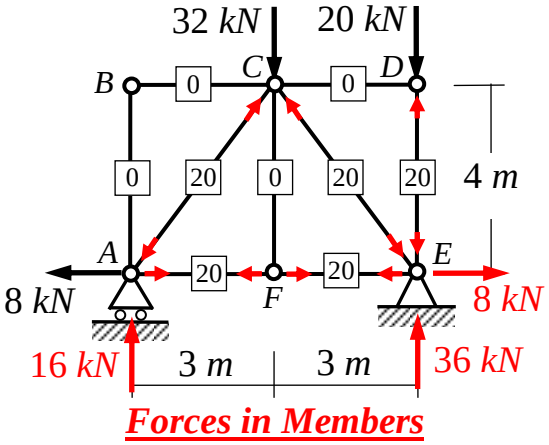
FBD of Joint A

(iii) Forces in member *CE*:



$+\uparrow \sum F_y = 16 - 32 - F_{CE}(0.8) = 0$

$F_{CE} = -16 / 0.8 = -20 \quad \therefore$ $\boxed{F_{CE} = 20\ \text{Comp.}}$



Forces in Members

With my best wishes

Dr. M. Abdel-Kader