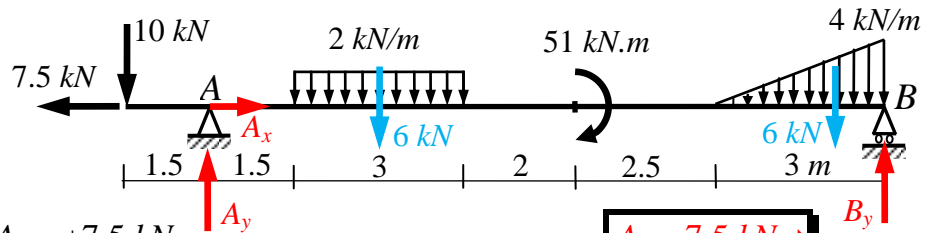


Answer of Final Exam

Total Marks: **90**

No. of Questions: **3** (Attempt all questions)

Question (1)a: (15 Marks)



$$\rightarrow \sum F_x = 0: -7.5 + A_x = 0 \quad \therefore A_x = +7.5 \text{ kN}$$

$$A_x = 7.5 \text{ kN} \rightarrow$$

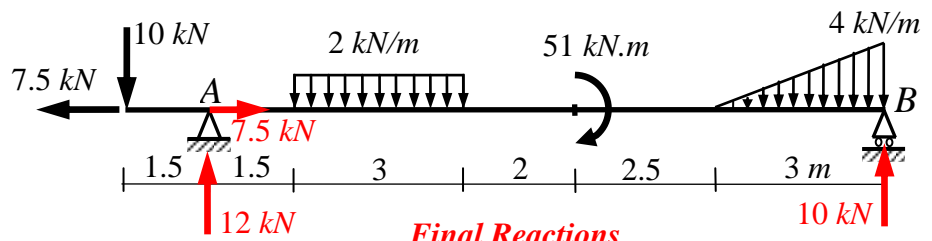
$$+\circlearrowleft \sum M_B = 0: -10(13.5) + A_y(12) - 6(9) + 51 - 6(1) = 0 \quad \therefore A_y = +14 \text{ kN}$$

$$A_y = 12 \text{ kN} \uparrow$$

$$+\circlearrowleft \sum M_A = 0: -10(1.5) + 6(3) + 51 + 6(11) - B_y(12) = 0 \quad \therefore B_y = +10 \text{ kN}$$

$$B_y = 10 \text{ kN} \uparrow$$

Check: $+\uparrow \sum F_y = -10 + A_y - 6 - 6 + B_y = -10 + 12 - 6 - 6 + 10 = 0$ **O.K.**



Question (1)b: (15 Marks)

Start with Part **CED**

$$+\rightarrow \sum F_x = 0 \rightarrow C_x = 8 \text{ kN} \rightarrow$$

$$+\circlearrowleft \sum M_D = 0 \rightarrow C_y = 28 \text{ kN} \uparrow$$

$$+\uparrow \sum F_y = 0 \rightarrow D_y = 8 \text{ kN} \uparrow$$

Another solution:

Start with Part **ACDE** and

Take moment about **D**

$$\rightarrow A_y = 14 \text{ kN} \uparrow$$

Another solution:

Part DB:

$$-\circlearrowleft \sum M_D = 0: M_B - B_y(4) = 0$$

$$\therefore M_B = 4B_y \quad \boxed{M_B = 4B_y} \quad \dots (1)$$

Entire (Total) Structure

$$-\circlearrowleft \sum M_A = 0: 36(6) - 8(5) - B_y(12) + 4B_y = 0$$

$$\therefore B_y = 22 \uparrow$$

$$\boxed{B_y = 22 \text{ kN} \uparrow}$$

From (1) $\therefore M_B = 4B_y = 4(22) = 88 \circlearrowleft$

$$\boxed{M_B = 88 \text{ kN.m} \circlearrowleft}$$

$$-\circlearrowright \sum F_x = 0: B_x - 8 = 0$$

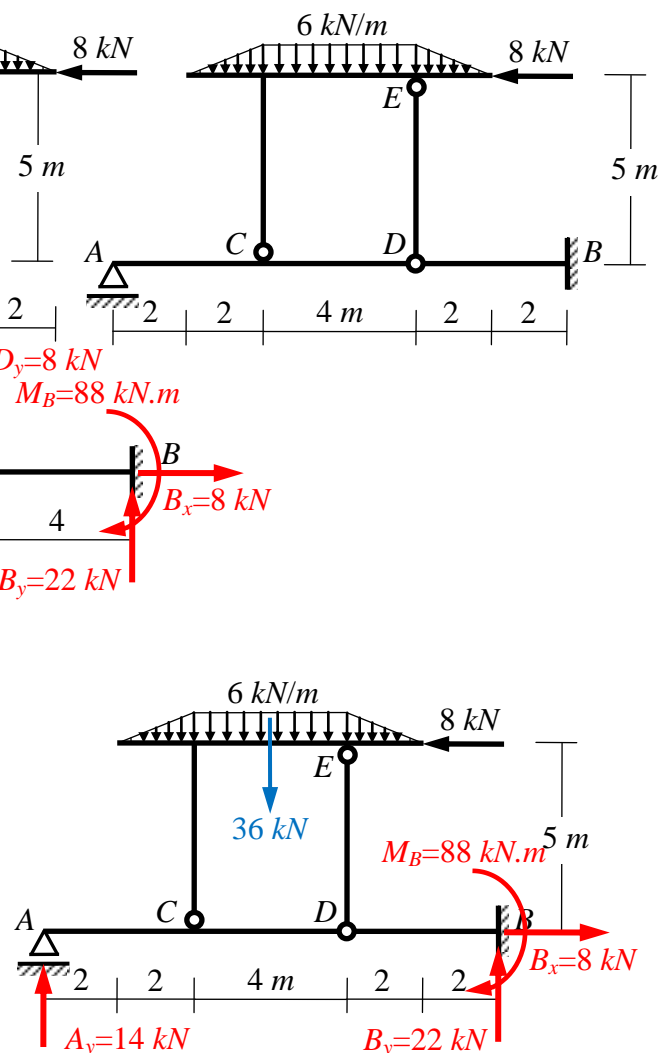
$$\therefore B_x = +8 \rightarrow$$

$$\boxed{B_x = 8 \text{ kN} \rightarrow}$$

$$-\uparrow \sum F_y = 0: A_y + B_y - 36 = 0$$

$$\therefore A_y = 14 \uparrow$$

$$\boxed{A_y = 14 \text{ kN} \uparrow}$$

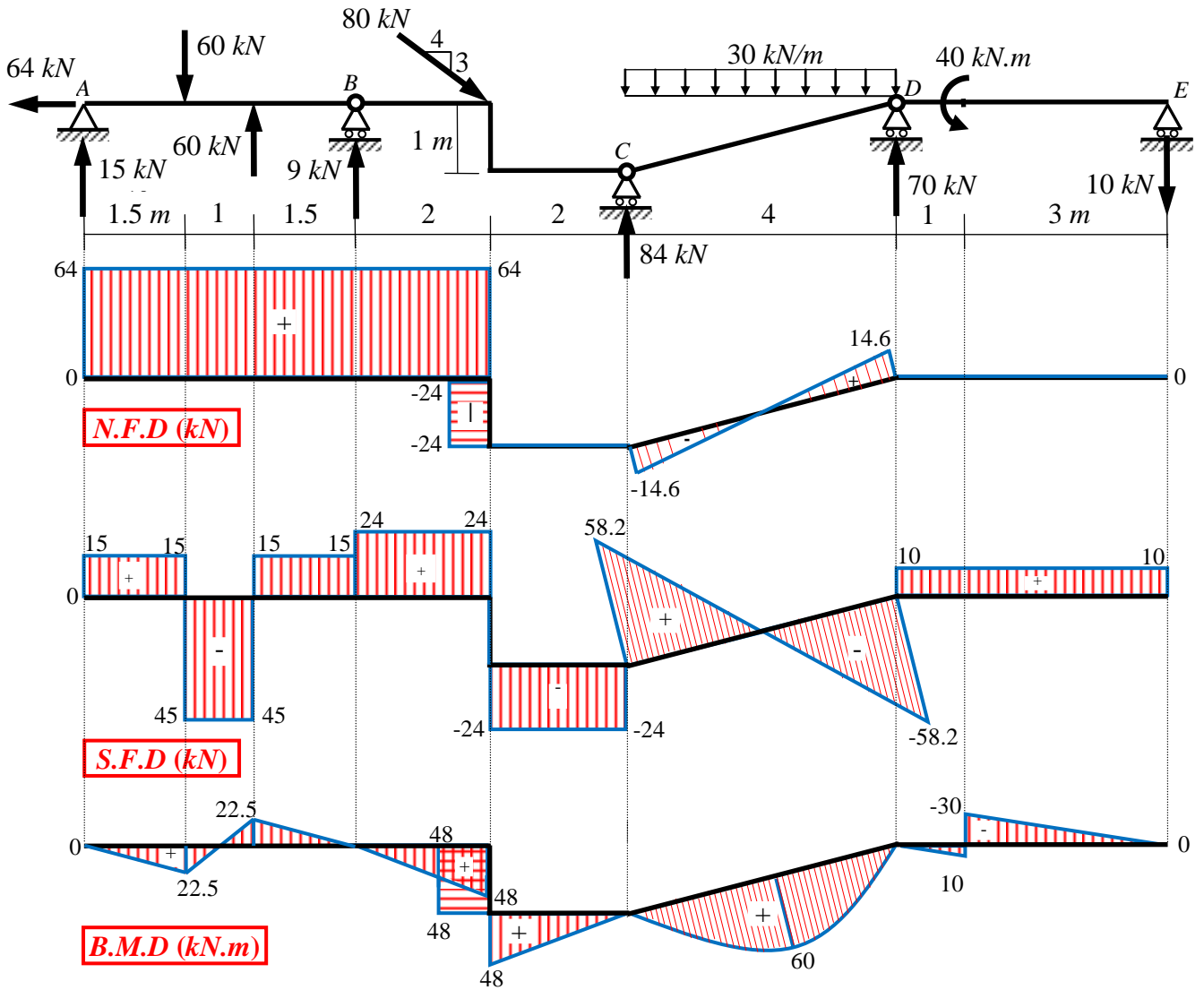


Final Reactions

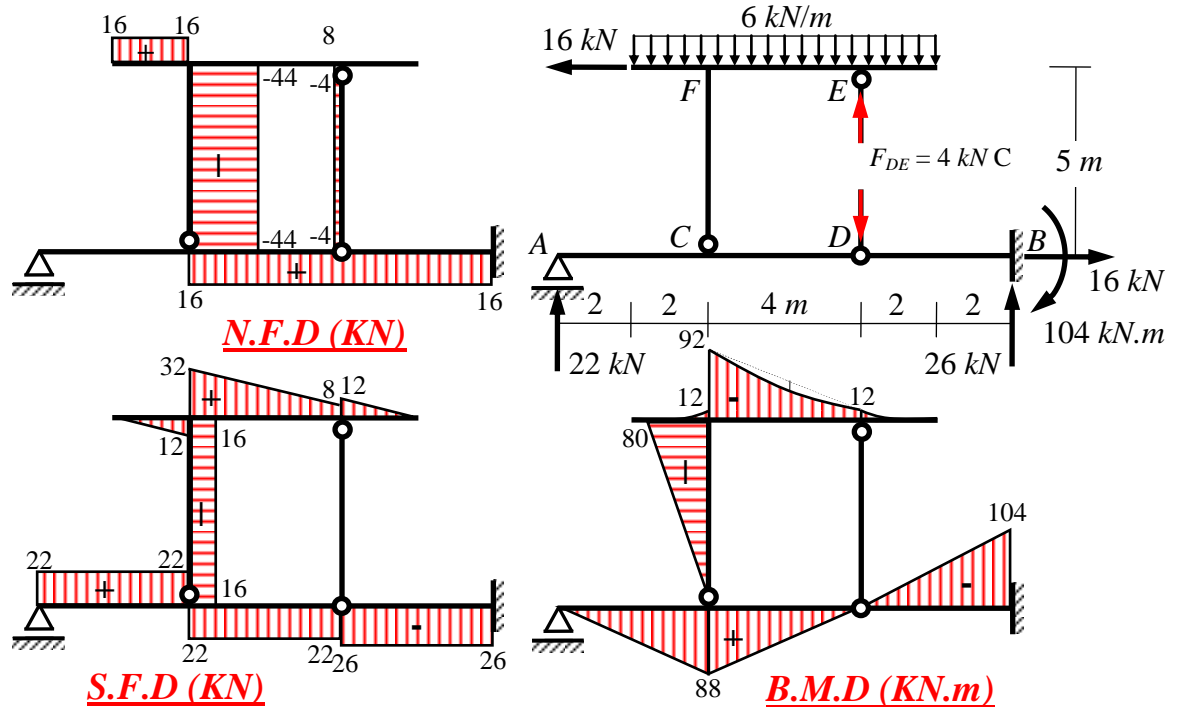
With my best wishes

Dr. M. Abdel-Kader

Question (2)a: (15 Marks)



Question (2)b: (15 Marks)



Question (3)a: (20 Marks)

Solution:

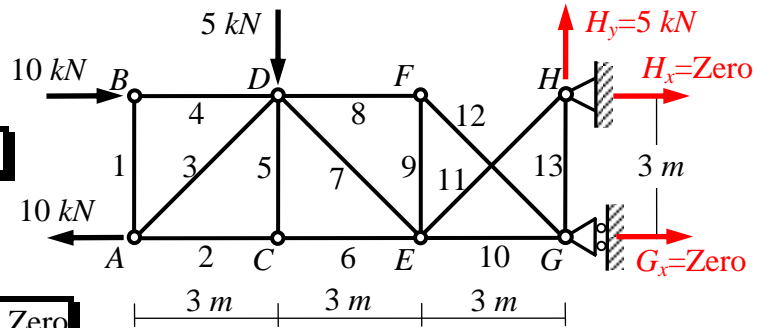
(i) Reactions:

$+\uparrow \sum F_y = H_y - 5 = 0 \therefore H_y = 5 \uparrow$ $H_y = 5 \text{ kN } \uparrow$

$+\circlearrowleft \sum M_G = H_x(3) + 10(3) - 5(6) = 0 \therefore H_x = 0$

$H_x = \text{Zero}$

$+\rightarrow \sum F_x = H_x + G_x + 10 - 10 = 0 \therefore G_x = 0$ $G_x = \text{Zero}$



(ii) Forces in members:

Joint B: $+\rightarrow \sum F_x = F_{BD} + 20 = 0$ $F_4 = F_{BD} = 10 \text{ C}$ and $+\uparrow \sum F_y = F_{BA} = 0$ $F_1 = F_{BA} = 0$

Joint A: $F_2 = F_{AC} = 10 \text{ T}$ and $F_3 = F_{AD} = 0$

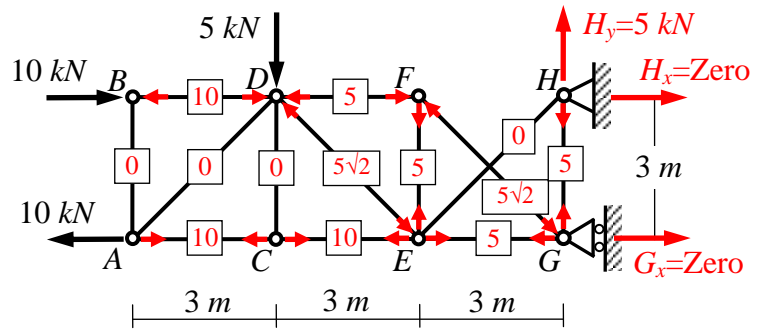
Joint C: $F_5 = F_{CD} = 0$ and $F_6 = F_{CE} = 10 \text{ T}$

Joint D: $+\uparrow \sum F_y = 0$ $F_7 = F_{DE} = 5\sqrt{2} \text{ C}$ and $+\rightarrow \sum F_x = 0$ $F_8 = F_{DF} = 5 \text{ C}$

Joint F: $+\rightarrow \sum F_x = 0$ $F_{12} = F_{FG} = 5\sqrt{2} \text{ C}$ and $+\uparrow \sum F_y = 0$ $F_9 = F_{FE} = 5 \text{ T}$

Joint H: $+\rightarrow \sum F_x = 0$ $F_{11} = F_{HE} = \text{Zero}$ and $+\uparrow \sum F_y = 0$ $F_{13} = F_{HG} = 5 \text{ T}$

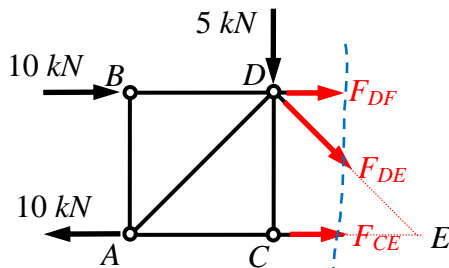
Joint G: $+\rightarrow \sum F_x = 0$ $F_{10} = F_{GE} = 5 \text{ T}$



Forces in Members (kN)

(iii) Forces in members DE and FG:

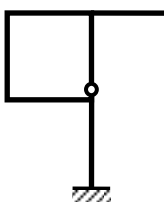
Forces in member 8 (DF):



$+\circlearrowleft \sum M_E = 0: 10(3) - 5(3) + (F_{DE})(3) = 0 \therefore F_{DE} = -5$

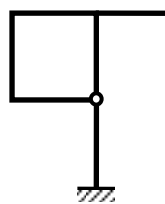
$F_8 = F_{DE} = 5 \text{ kN } \text{C}$

(b)



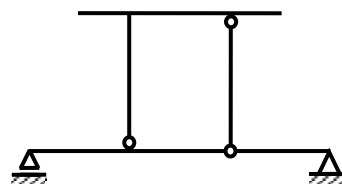
Stable + Stat. Indet. to the 2nd degree.

(1)



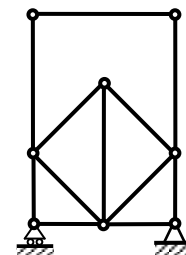
Unstable

(2)



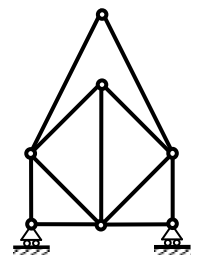
Unstable

(3)



Unstable

(4)



Unstable

(5)