Question # 1:-

Write detailed note in your own words on different types of loads that different types of structures are designed to support throughout its life. Elaborate with examples.

Answer:-

Loads:-

It's the dimensional requirement for a structure necessary to determine the loads the structure must support.

Types Of Loads:-

There are different types of loads which are;

1) Dead Loads:-

It consists of structural members that are permanently attached to structure. Dead load includes the weight of columns, beams, girders, electrical fixtures and other attachments.

2) Live Loads:-

Live load can vary both in their magnitude and location. These loads are caused by weights of temporarily objects, moving vehicles, natural forces. Consists of additional protection against excess deflection and overload.

Examples:-

The live floor loading in classroom: consists of desks, chairs and laboratory equipment.

Types Of Structures :-

The combination of structural elements and the material which functions as a structural system. Each system consists of one or more of four types of structures.

Different types of structures are :-

1) Trusses :-

Trusses consist of slender elements in triangular form. Due to geometric arrangements of its members bends are converted into tensile or compressive forces in members.

→ Planar trusses are composed of members, lies in same plane and used for bridges and roof support.

→ Space trusses have members extending in three dimensions and used for derricks and towers.

2) Cables And Arches :-

It's the type of structures used to span long distances.

→ Cables are flexible and carry loads in tension. They are commonly used to support bridges, roofs.

→ Arches achieve strength in compression and has a reverse curvature to cable. It must be rigid to maintain its shape. Consists of shear and moment. They are used in bridge structures, dome roofs and openings.

3) Frames :-

Type of structure which are used in buildings and consists of beam and column,

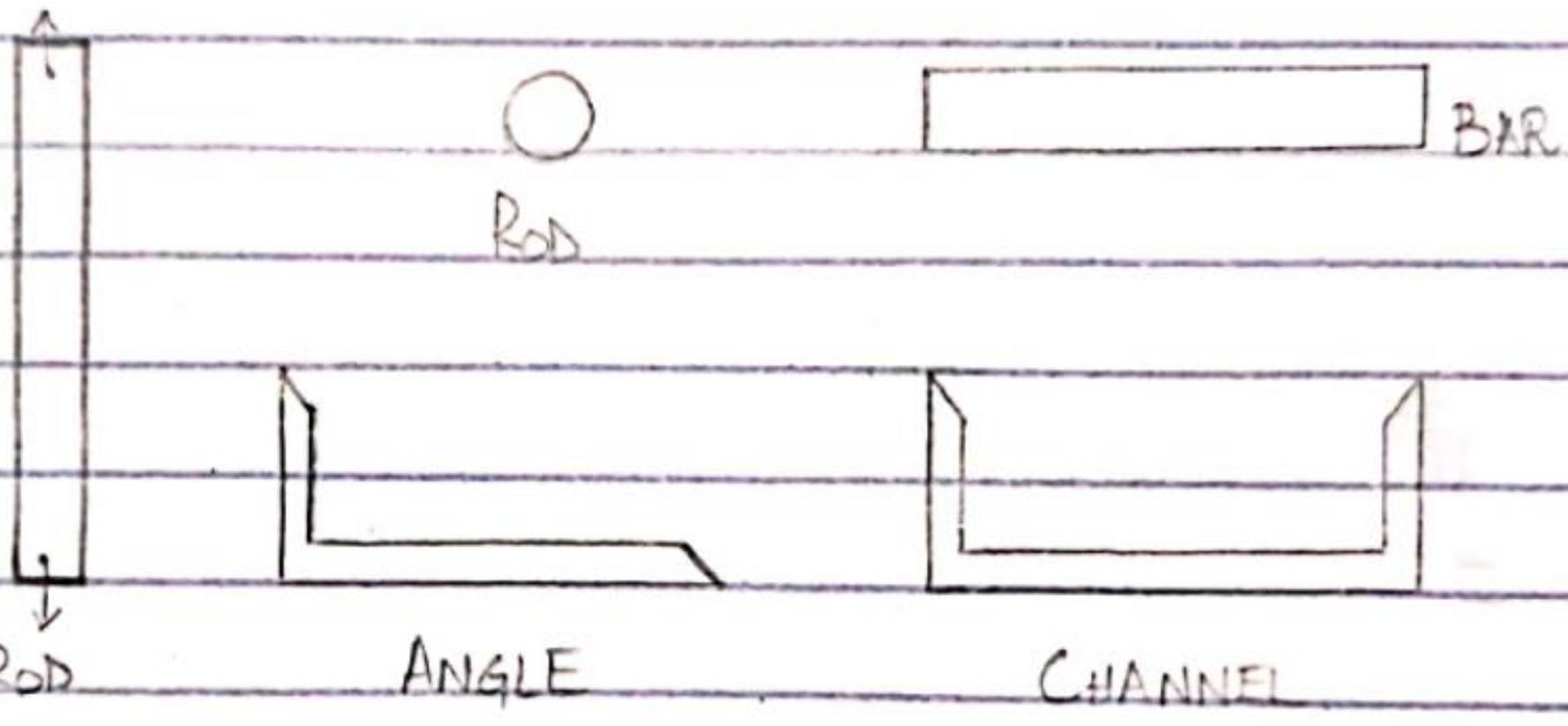
which are fixed or pin connected. The load on frames causes bindings of its members and has rigid joint connections. This structure is indeterminate.

Structural Elements:-

Some of the elements are;

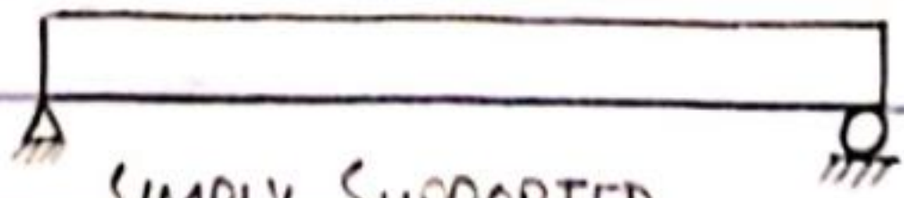
1) Tie Rods:-

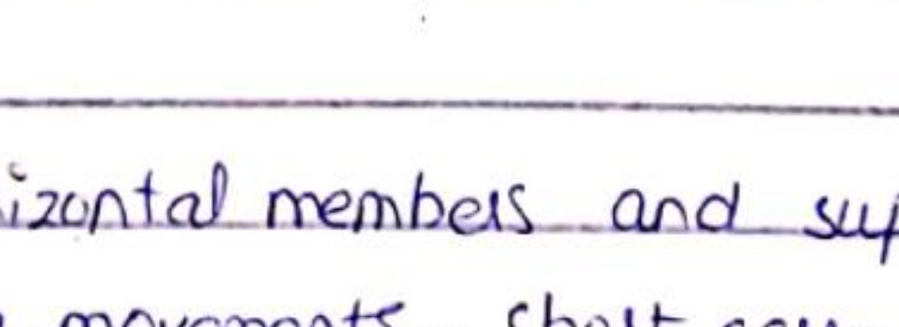
Consists of tensile force. These members are slender, bars or rods.



2) Beams:-

They're horizontal members and supports vertical loads. It resists bending movements, short cassy large loads.

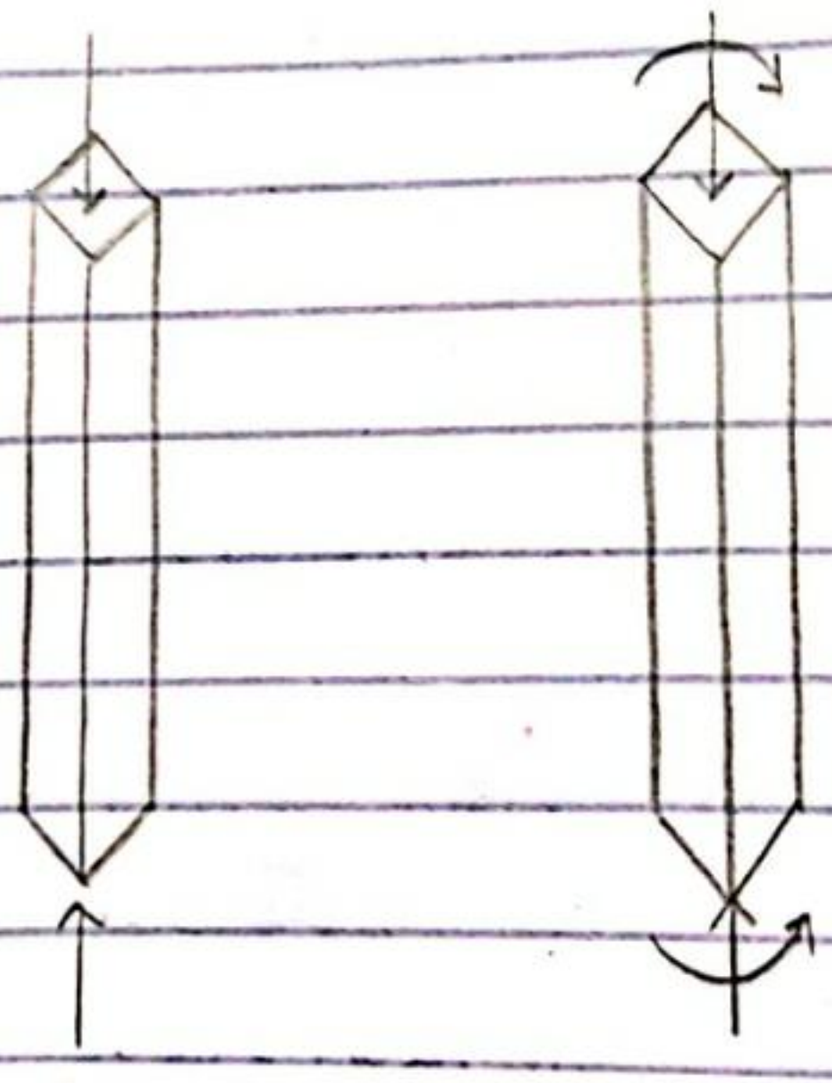




3) Columns:-

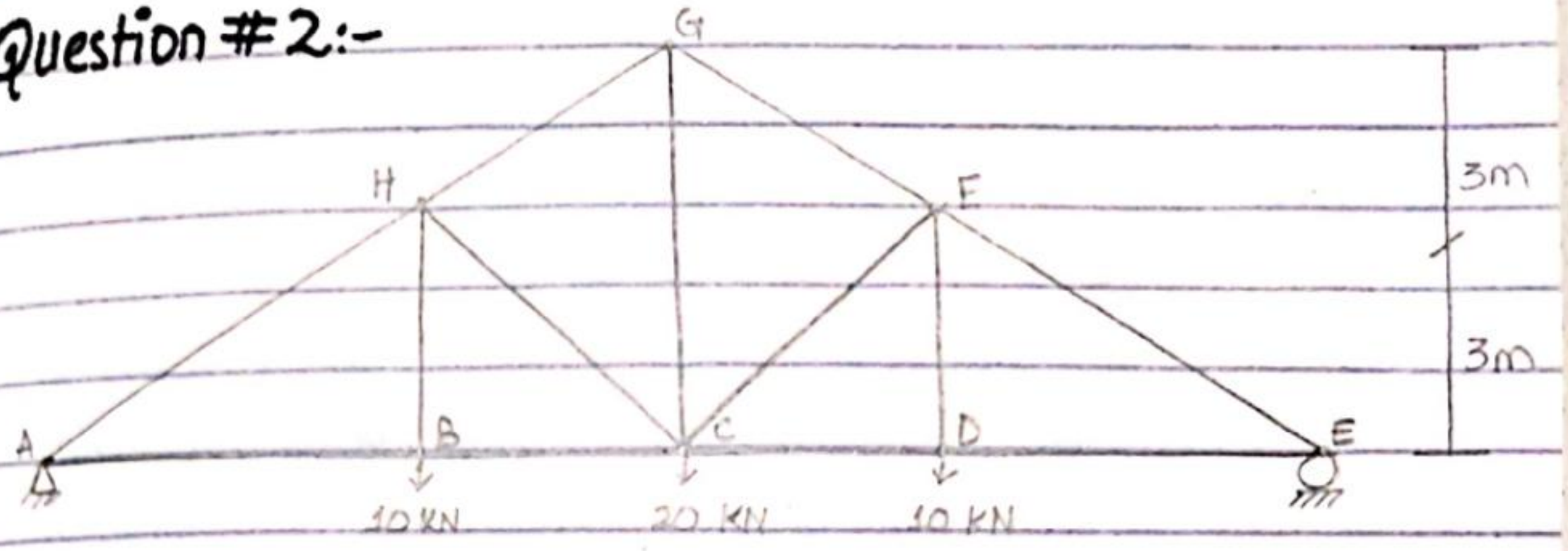
They consist of vertical members and resist compressive loads.

Tubes and wide-flange across sections are used for metal columns and square cross-sections rods are used for concrete work.



COLUMN BEAM-COLUMN

Question #2:-



Forces in each member:?

Solution:-

Support reactions:

$\Sigma f_y = 0 \quad +\uparrow\downarrow$

$R_A + R_E = 40 \quad \text{---} (A)$

$\Sigma M_A = 0 \quad \circlearrowleft$

$R_E(16) + 10(12) + 20(8) + 10(4) = 0$

$R_E = 320/16 = 20\ KN$

$R_{ut} = 40 - 20 \Rightarrow R_A = 20\ KN$

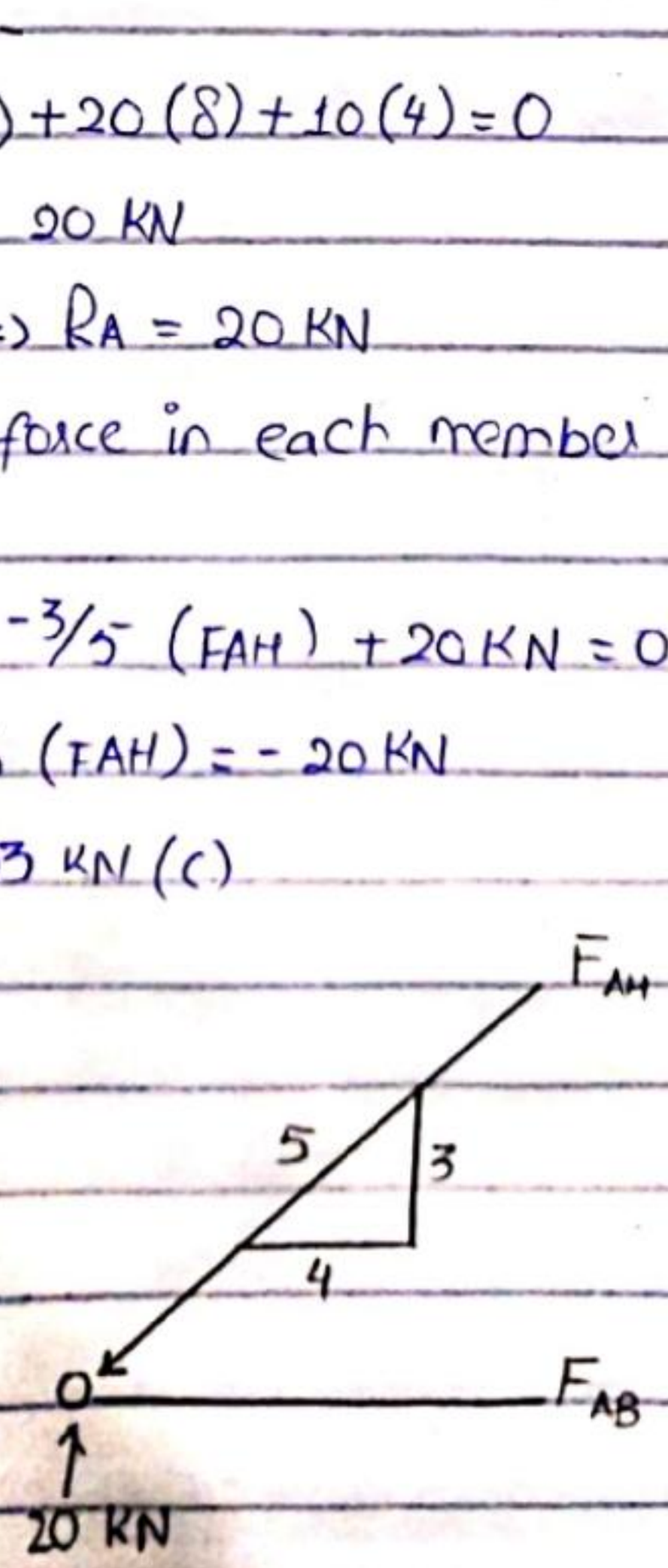
Now determining force in each member

Joint A:

$\Sigma f_y = 0; \quad -3/5\ (F_{AH}) + 20\ KN = 0$

$= -0.6\ (F_{AH}) = -20\ KN$

$F_{AH} = 33.33\ KN\ (C)$



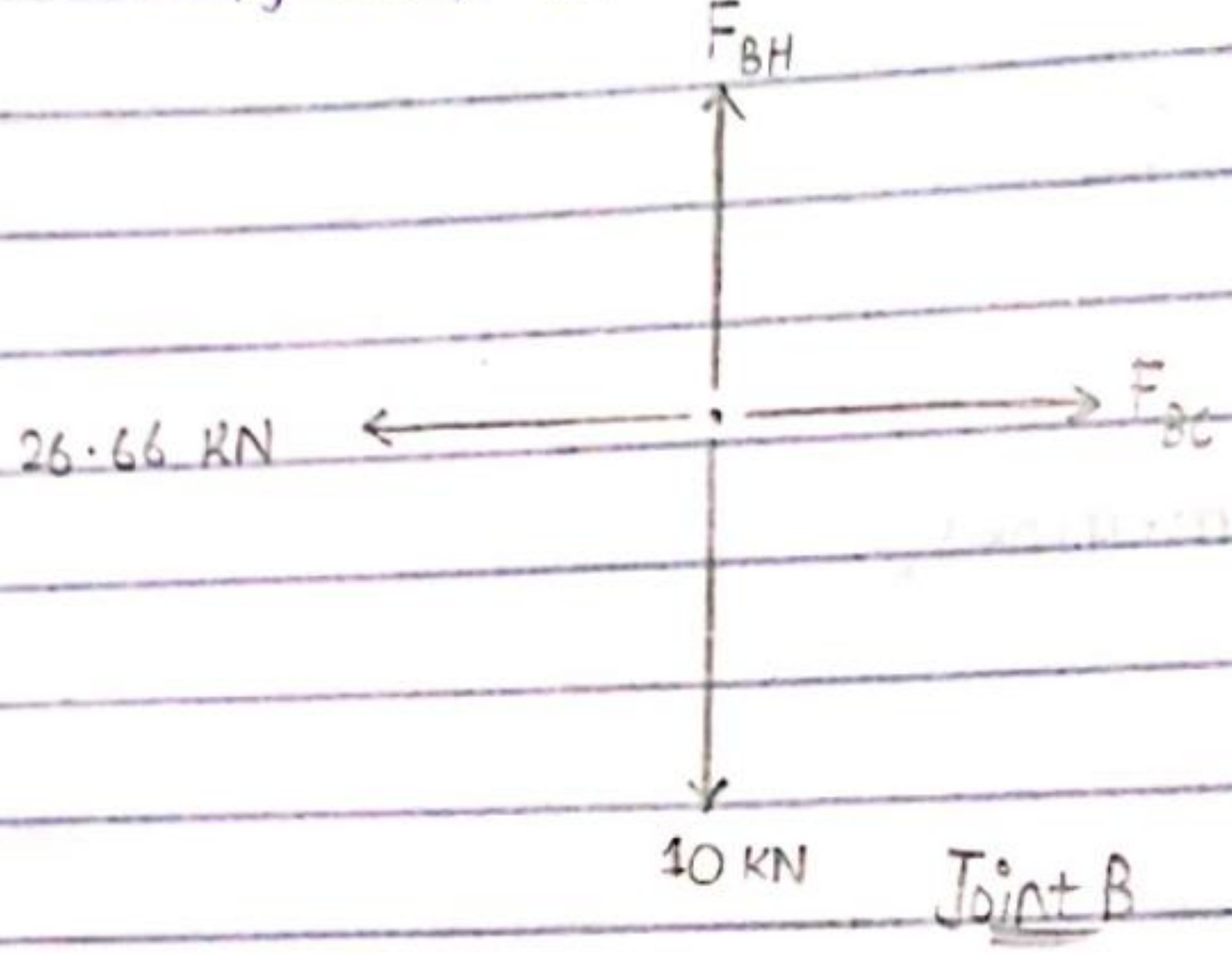
$\Sigma fx = 0$; $-4/5\ (33.33) + F_{AB} = 0$

$= F_{AB} = 26.66\ KN\ (T)$

Joint B:

$\Sigma fx = 0$; $F_{BL} = 26.66\ KN (T)$

$\Sigma fy = 0$; $F_{BH} = 10\ KN\ (T)$



Joint B

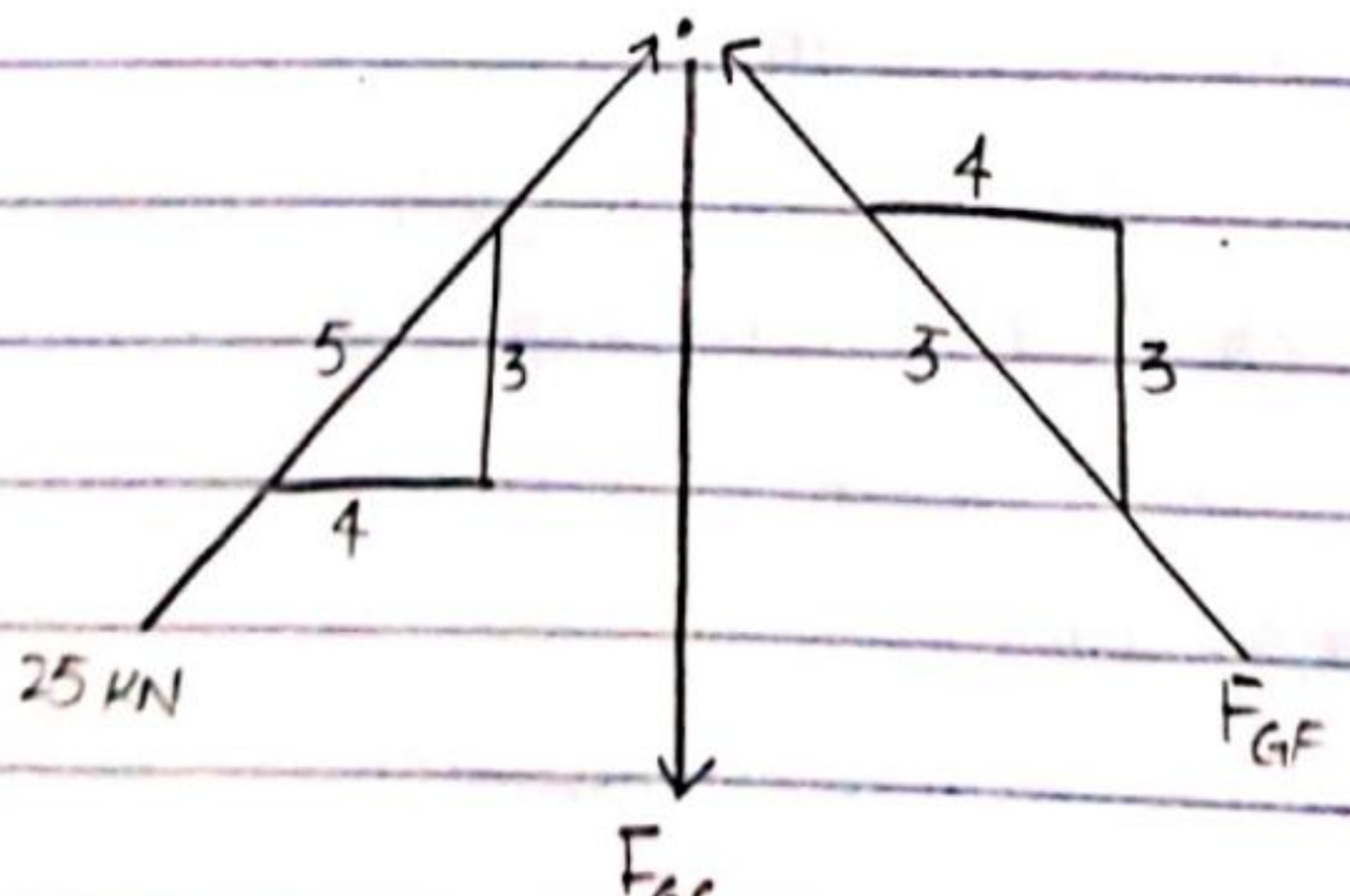
Joint G:

$\Sigma fx = 0$; $4/5\ (25) - 4/5\ (F_{GF}) = 0$

$F_{GF} = 25\ KN\ (C)$

$\Sigma fy = 0$; $3/5\ (25) + 3/5\ (25) - F_{GC} = 0$

$F_{GC} = 30\ KN\ (C)$



Joint G

Joint H:

$\Sigma fy = 0$; $3/5\ (33.33) - 10\ KN + 3/5\ (F_{HC}) - 3/5\ (F_{HG})$ — ①

$\Sigma fx = 0$; $4/5\ (33.33\ KN) - 4/5\ (F_{HC}) - 4/5\ (F_{HG})$ — ②

Solving eq-① and eq-②

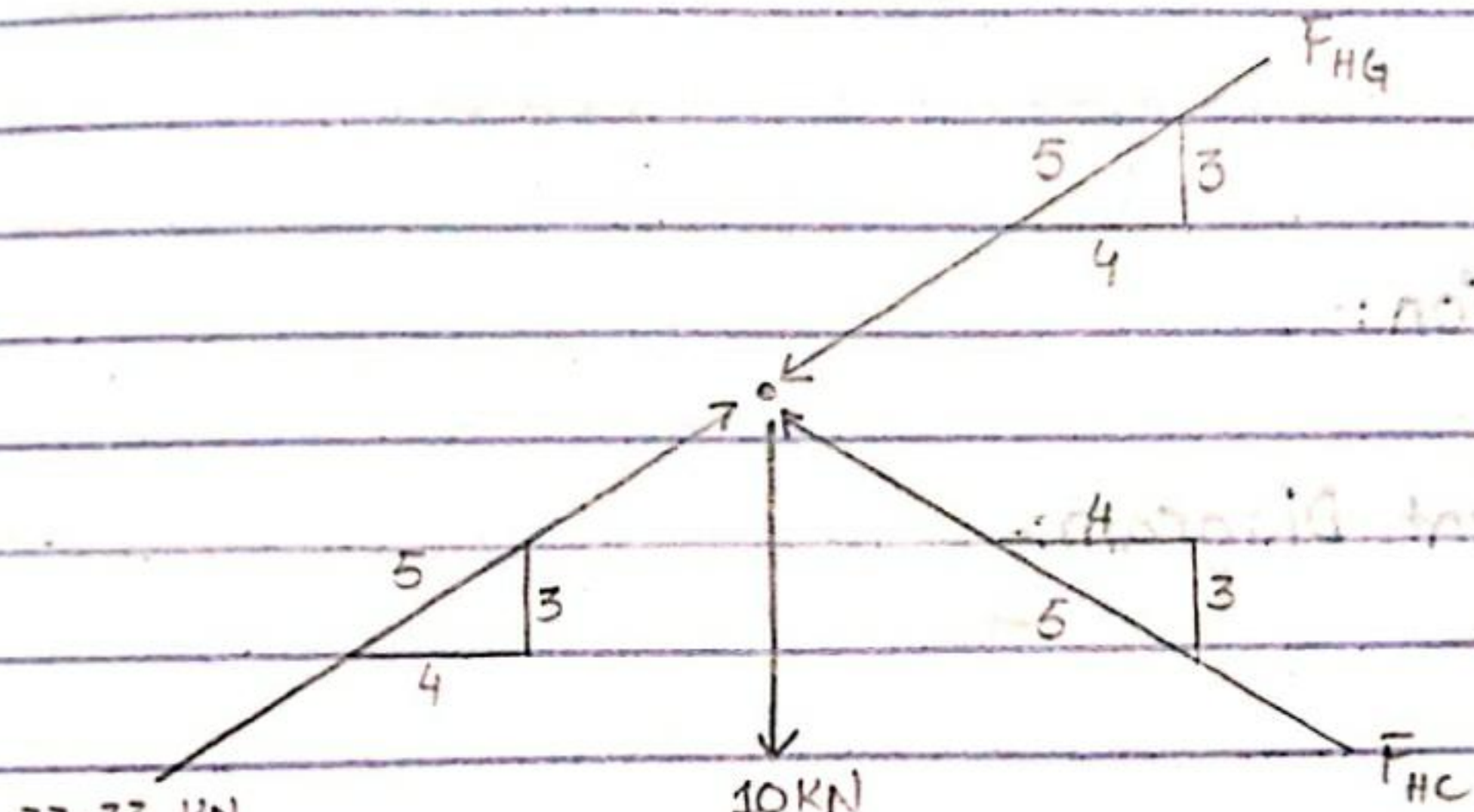
$19.98 - 10 + 0.6\ F_{HC} - 0.6\ F_{HG} = 0$ ——— (A)

$26.66 - 0.8\ F_{HC} - 0.8\ F_{HG} = 0$ ——— (B)

Multiplying eq (A) by 1.34 and then add with eq (B) we get

$F_{HG} = 25$ KN (C)

$F_{HC} = 8.34$ KN (C)



Joint H

Due to symmetrical load and geometry.

$F_{AB} = F_{ED} = 26.66$ KN (T)

$F_{BC} = F_{DC} = 26.66$ KN (T)

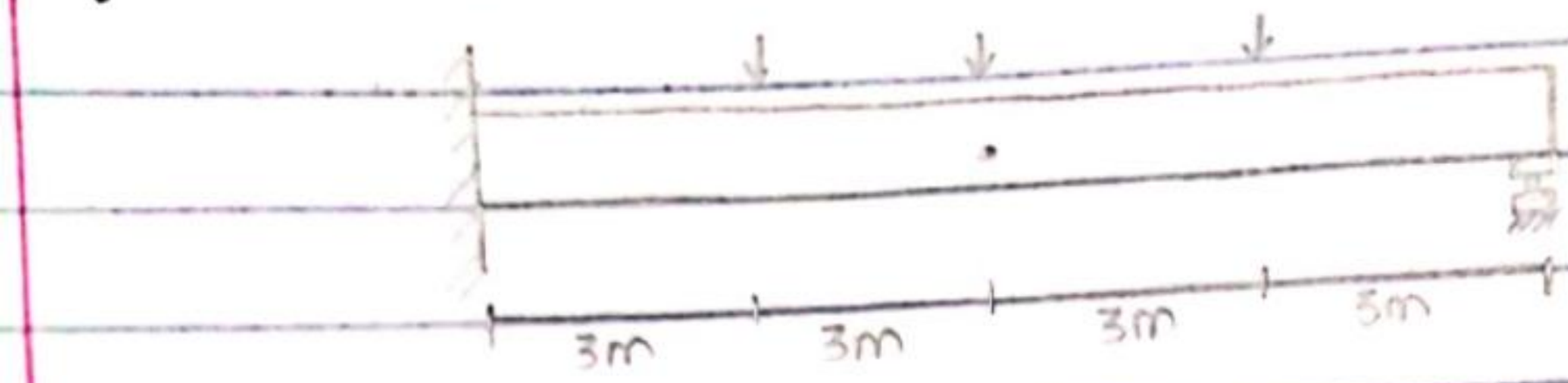
$F_{BH} = F_{DF} = 10$ KN (T)

$F_{HG} = F_{FG} = 25$ KN (C)

$F_{HC} = F_{FC} = 8.34$ KN (C)

$F_{AH} = F_{EF} = 33.33$ KN (C)

Question #3:



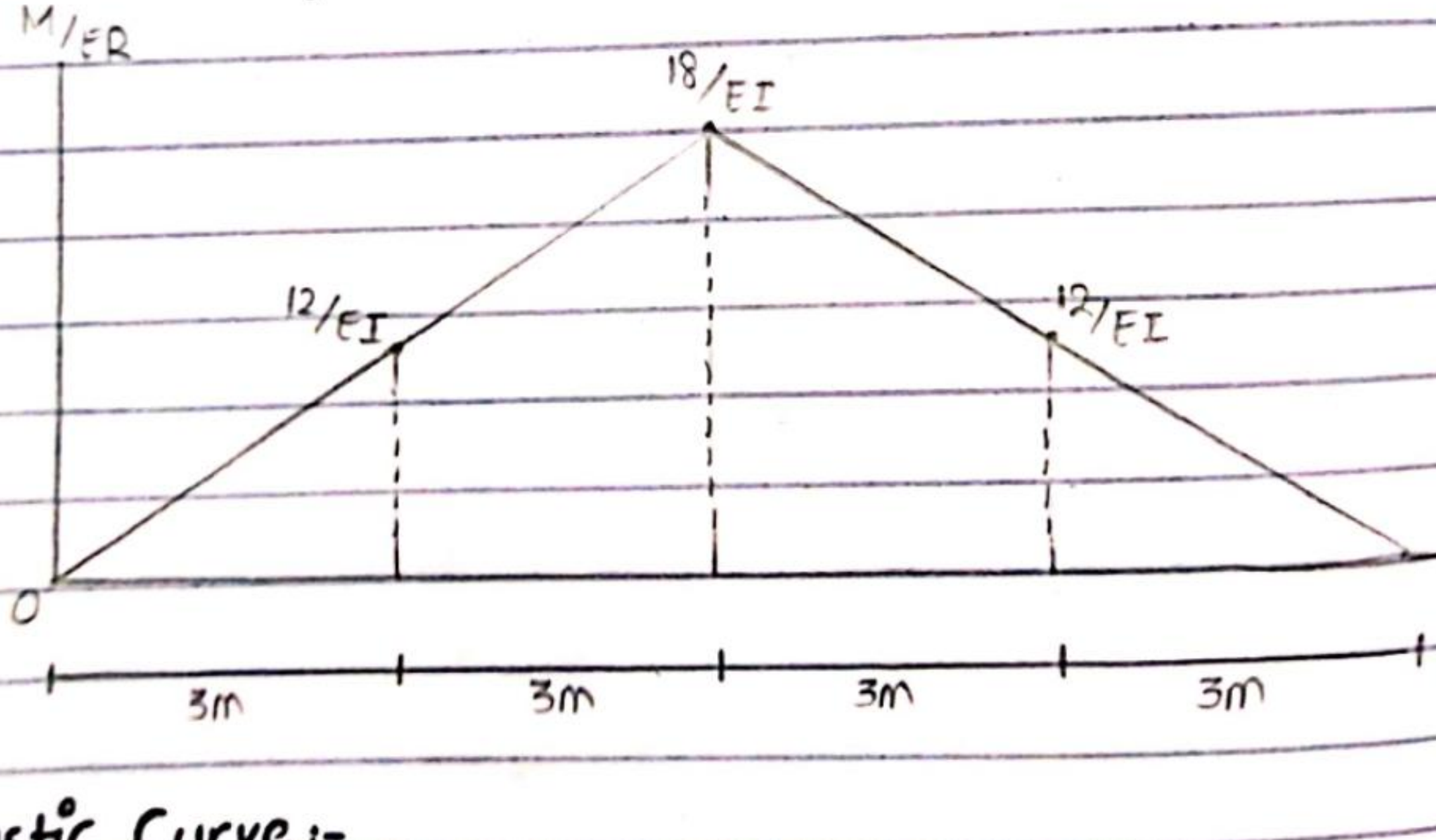
Given : $E = 200\ GPa$, $I = 6 \times 10^6\ mm$.

Determine slope at point 'A' and displacement at 'C' using Moment Area Theorem.

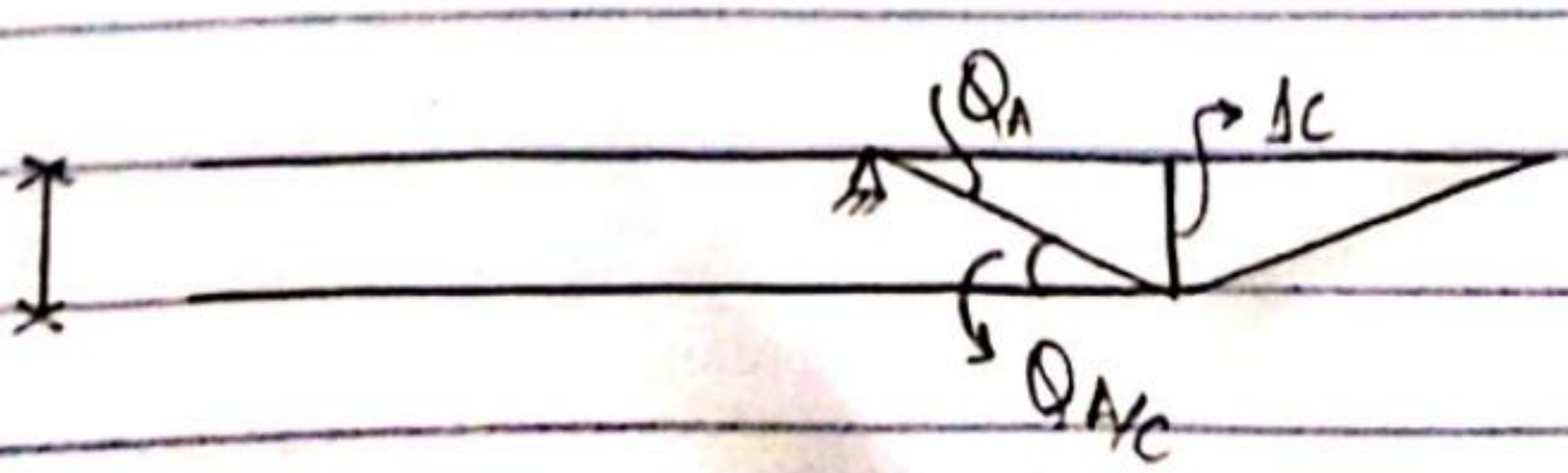
Solution:-

Finding out M/EI Diagram and Elastic Curve

Moment Diagram:-



Elastic Curve:-



$\theta_{A/C} = (12/EI)(3) + (12/EI)(3) + 1/2(6/EI)(3)$

$\theta_{A/C} = (18/EI) + (36/EI) + (9/EI)$

$\theta_{A/C} = 63/EI \Rightarrow 63/(200\times10^6)(6\times10^6)(1000)^{-4}$

$\theta_{A/C} = 0.0525$ rad.

$\theta_A = 0.0525$ rad Ans.

$$t_{A/C} = \left[\frac{1}{2}\left(\frac{12}{EI}\right)(3)\right]\left(\frac{2}{3}(3)\right) + \left[\frac{12}{EI}(3)\right]\left(3+\frac{1}{2}(3)\right) +$$

$$\left[\frac{1}{2}\left(\frac{6}{EI}\right)(3)\right]\left(3+\frac{2}{3}(3)\right)$$

$= 0.202$ m

So

$\Delta C = t_{A/C} = 0.202$ m

$= 202$ mm Ans.