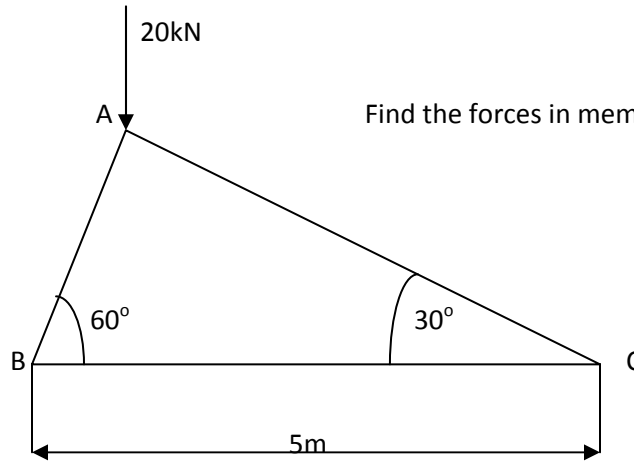
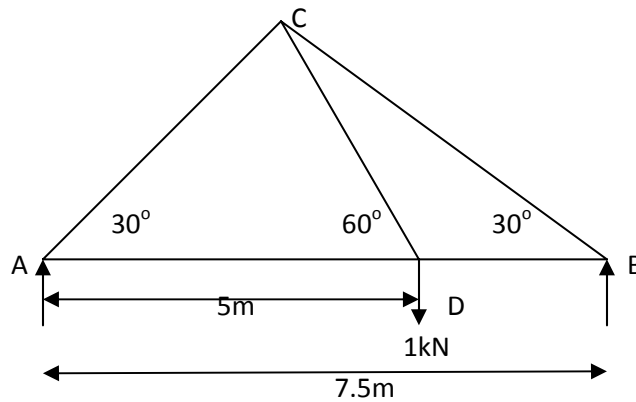


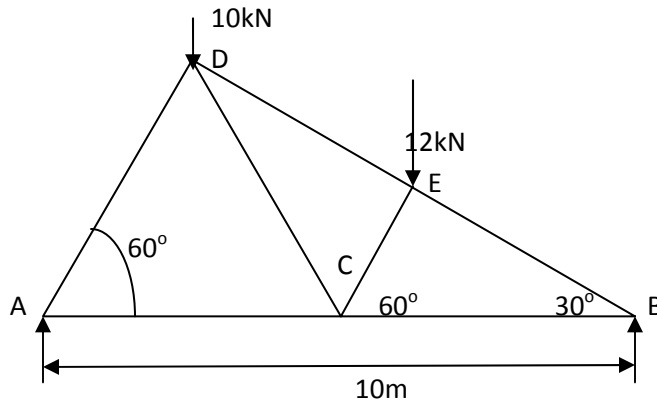
Q.1.



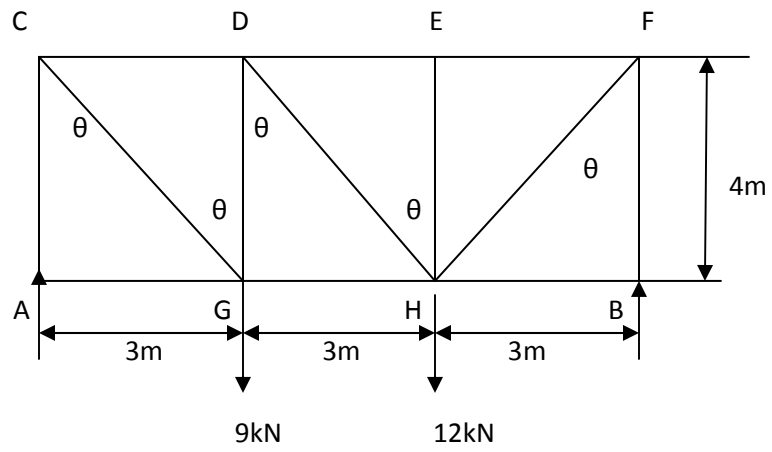
Q.2. Find the forces in members AD, AC, BC, DC & BD



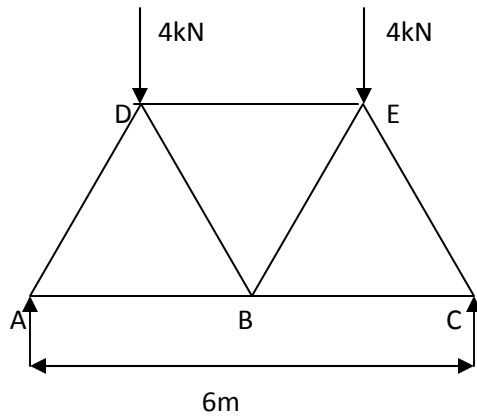
Q.3. AD=AC=CD, Find forces in all members. AB=5m



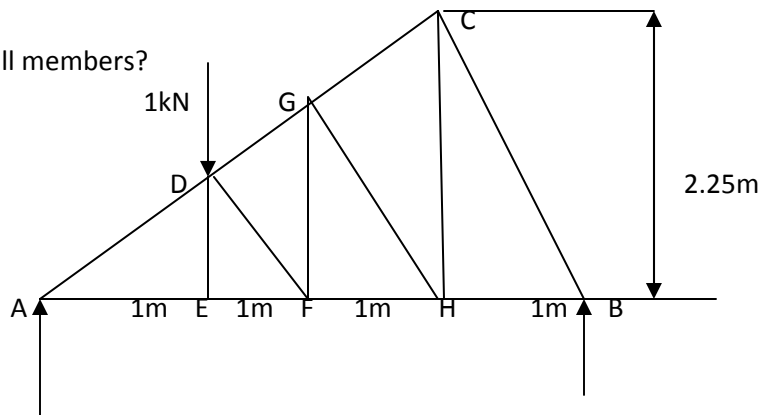
Q.4. Find the forces in all members?



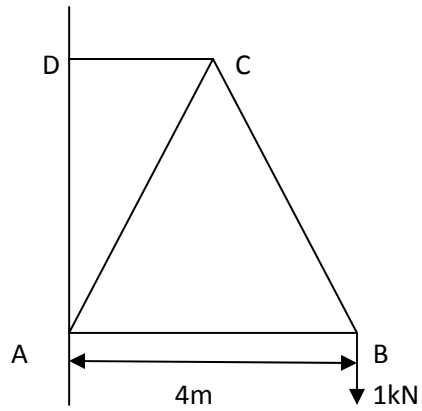
Q.5. Find the forces in all members? $AB=BD=AD=3m$



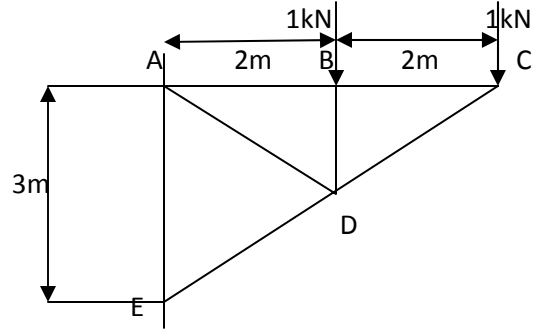
Q.6. Find forces in all members?



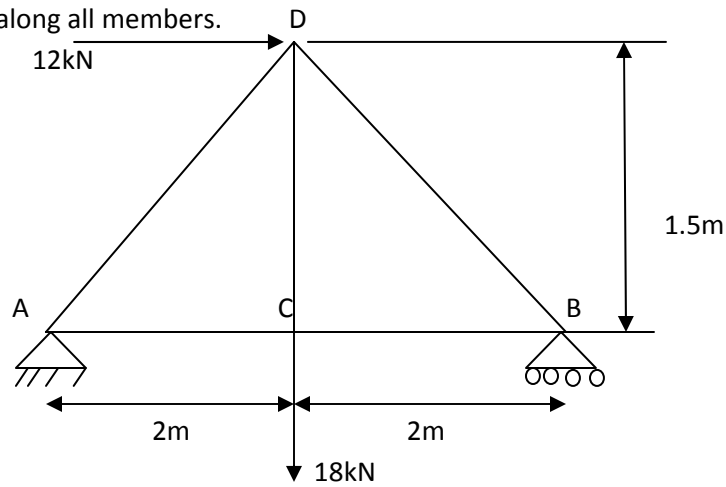
Q.7. Find forces along all members.



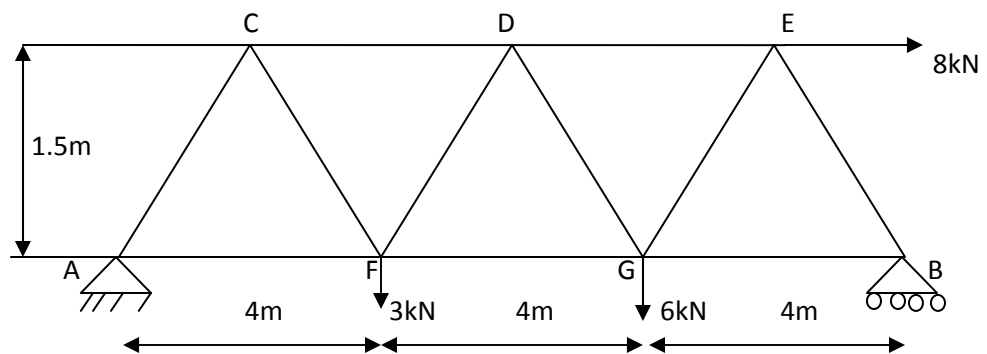
Q.8 Find forces along all members.



Q.9. Find forces along all members.

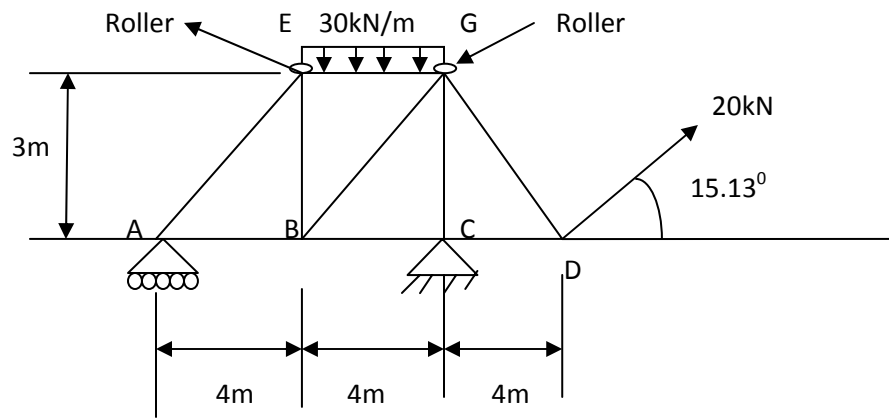


Q.10. Find forces along all members.



Some Typical Problems:

Q.1. Determine the forces in members BC, BG, EG & GD of the truss shown in Fig below?



ANS: BC=21.33(T),
BG=36.66(T),
GD=26.67(T),
EG=50.66(C)

Q.1.Which law gives the definition of force?

Q.2 .Velocity is a vector/ scalar quantity.

Q.3.Lami's theorem is applied for concurrent /non-concurrent force system.

Q.4.Forces on a rope in a tag of war is an example of collinear force/ non-collinear force.

Q.5.Equilibrium is the equal and opposite of resultant True/False.

Q.6.The point about which moment is considered is called-----.

Q.7.The effect of a couple is unchanged if the couple is shifted to any other position. True/False

Q.8.The maximum value of frictional force which comes into play when motion is impending is known as -----

Q.9.Frictional force is dependent / independent of the area of contact between the two surfaces.

Q.10. Rolling friction is dynamic/ static friction

Q.11.The point at which shear force is zero , bending moment is -----

Q.12.At point of contraflexure

a) Shear force =0 b) Bending moment =0 c)

TRUSS & FRAME

A **frame** is a structural system that supports other components of a physical construction.

In architecture and structural engineering, a **truss** is a structure comprising one or more triangular units constructed with straight slender members whose ends are connected at joints referred to as nodes. External forces and reactions to those forces are considered to act only at the nodes and result in forces in the members which are either tensile or compressive forces.

Types of Truss:

1. Perfect Truss
2. Deficient Truss
3. Redundant Truss

In structural analysis there is a relation between number of members (m) and number of joints (j)

$$m = 2j - 3$$

If $m = 2j - 3$, the truss is perfect truss

If $m < 2j - 3$, the truss is deficient truss

If $m > 2j - 3$, the truss is redundant truss

Assumption made in truss analysis:

- Members in truss are pin jointed
- External loads are applied at the joints only
- Self weight of the bars is neglected.
- The truss is a perfect truss

Methods of Truss analysis:

1. Methods of joints
2. Methods of sections
3. Graphical methods

METHODS OF JOINTS:

Step-1: Find reactions at the support considering only external loads applied on the truss.

Step-2: Take tensile force in all the members and name them as F_1, F_2, F_3, \dots so on.

Step-3: Take a joint which has maximum number of 2 unknown forces and draw the free body diagram of that joint.

Step-4: Use Equilibrium equations $\sum F_x=0$ and $\sum F_y=0$ and find the unknown force.

Step-5: Repeat step-3 and step-4 until and unless all the forces in members are calculated

NOTE: 1. For cantilever types of truss start from step-2

2. If three members are acting at a joint and two of them are along the same straight line, then for the equilibrium of the joint, the force in the third member should be equal to zero.

METHODS OF SECTION:

Step-1: Find reactions at the support considering only external loads applied on the truss.

Step-2: Take tensile forces to those members in which forces are to be calculated and name them as F_1, F_2, F_3, \dots

Step-3: Cut the truss by passing a section through the members in which forces are to be calculated. The section should not pass through maximum number of three members.

Step-4: Take right or left part of the section and use equilibrium equations $\sum F_x=0, \sum F_y=0$ and $\sum M=0$ on that section and unknown force can be calculated.

NOTE: While using equilibrium equations to the right or left part of the section only external loads, reactions and forces on the members to be calculated are considered.

Do not consider the forces on the members in which forces are not to be calculated.

Statically determinate and indeterminate beam

In statics, a structure is **statically indeterminate** when the static equilibrium equations are not sufficient for determining the internal forces and reactions on that structure.

Based on Newton's laws of motion, the equilibrium equations available for a two-dimensional body are

- : the vectorial sum of the forces acting on the body equals zero. This translates to

$\Sigma H = 0$: the sum of the horizontal components of the forces equals zero;

$\Sigma V = 0$: the sum of the vertical components of forces equals zero;

- : the sum of the moments (about an arbitrary point) of all forces equals zero.

Free body diagram of a statically indeterminate beam.

In the beam construction on the right, the four unknown reactions are V_A , V_B , V_C and H_A . The equilibrium equations are:

$\Sigma V = 0$:

$$V_A - F_v + V_B + V_C = 0$$

$\Sigma H = 0$:

$$H_A - F_h = 0$$

$\Sigma M_A = 0$:

$$F_v \cdot a - V_B \cdot (a + b) - V_C \cdot (a + b + c) = 0.$$

Since there are four unknown forces (or variables) (V_A , V_B , V_C and H_A) but only three equilibrium equations, this system of simultaneous equations cannot be solved. The structure is therefore classified *statically indeterminate*. Considerations in the material properties and compatibility in deformations are taken to solve statically indeterminate systems or structures.

Statically determinate

If the support at B is removed, the reaction V_B cannot occur, and the system becomes **statically determinate**. Note that the system is *completely constrained* here. The solution to the problem is

$$H_A = F_h,$$

,

$$V_A = F_v - V_C.$$

If, in addition, the support at A is changed to a roller support, the number of reactions are reduced to three (without H_A), but the beam can now be moved horizontally; the system becomes *unstable* or *partially constrained*. In order to distinguish between this and the situation when a system under equilibrium is perturbed and becomes unstable, it's preferable to use the phrase *partially constrained* here. In this case, the 2 unknowns V_A and V_C can be determined by resolving the vertical force equation and the moment equation simultaneously. The solution yields the same results as previously obtained. However, it's not possible to satisfy the horizontal force equation unless $F_h = 0$.

Static indeterminacy

A system can be statically indeterminate even though its reactions are determinate as shown in Fig.(a) on the right. On the other hand, the system in Fig.(b) has indeterminate reactions, and yet, the system is determinate because its member forces, and subsequently the reactions, can be found by statics. Thus, in general, the static indeterminacy of structural systems depends on the internal structure as well as on the external supports.

The degree of static indeterminacy of a system is $M-N$ where

- M is the number of unknown member forces, and optionally, reactions in the system;
- N is the number of independent, non-trivial equilibrium equations available for determining these M unknown forces.

If M includes reaction components, then N must include equilibrium equations along these reaction components, one for one. Thus, we may, in fact, choose to exclude reactions from the above relation.