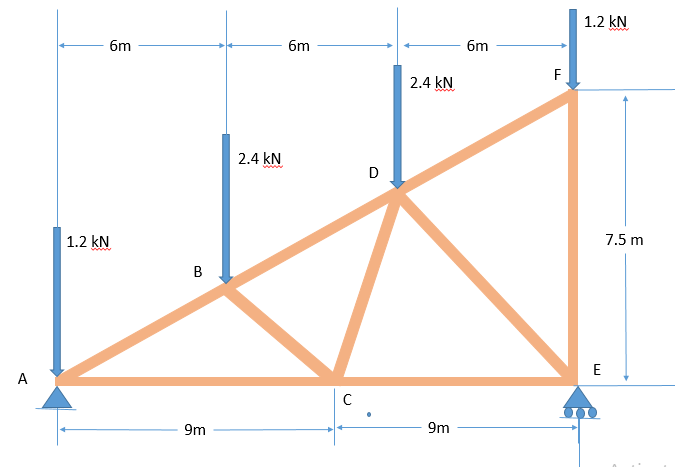
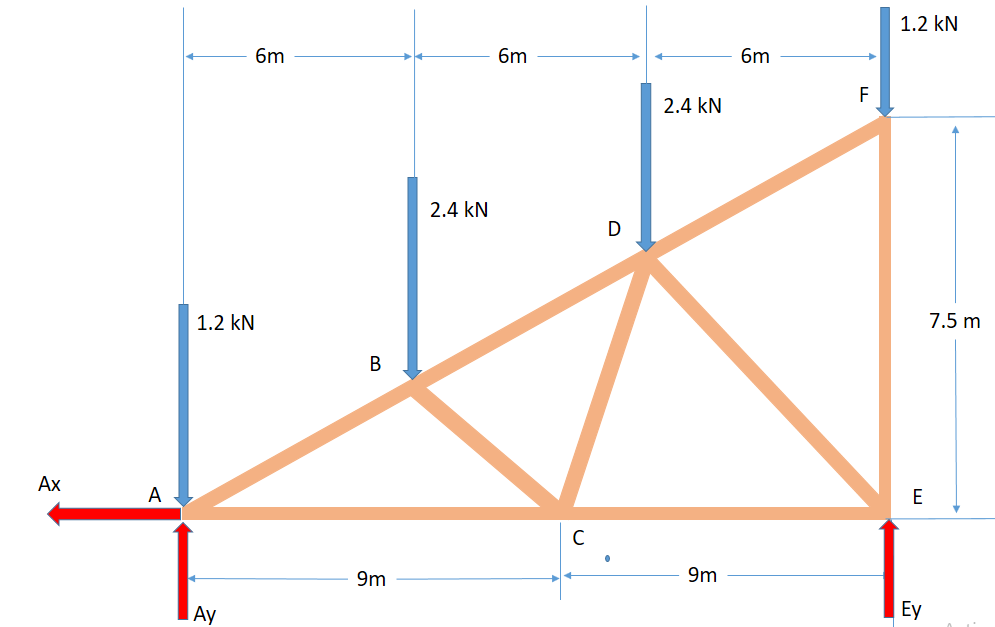
**WEEK 6: ANALYSIS OF STRUCTURES**

Question 1. Using the method of joints, determine the force in each member of the roof truss shown. State whether each member is in tension or compression. 

**Theoretical concept: Use Method of Joints**

SOLUTION:

Free Body Diagram for external forces:



∑MA = 0: (18 kN )Ey = 2.4 kN (6) + 2.4 kN (6) + 1.2 kN (18)

**Ey = 3.6 kN**

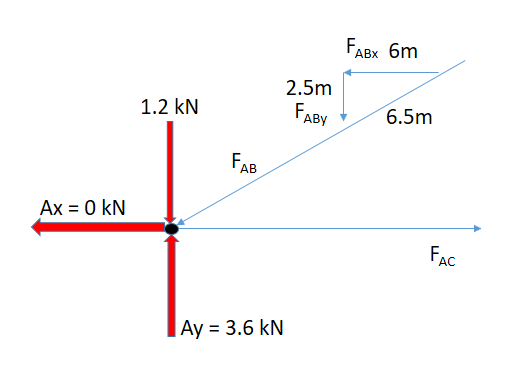
∑Fv = 0: Ay + Ey = 1.2 kN + 2.4 kN + 2.4 kN + 1.2 kN

Ay = 1.2 kN + 2.4 kN + 2.4 kN + 1.2 kN – 3.6 kN

**Ay = 3.6 kN**

∑FH = 0: **Ax = 0 kN**

**At Joint A:**



∑FH = 0: Ax + FABx = FAC

0 + FAB = FAC

∑Fv = 0: 3.6 kN = 1.2 kN + FABy

FAB = 2.4 kN

FAB = 2.4 kN / (

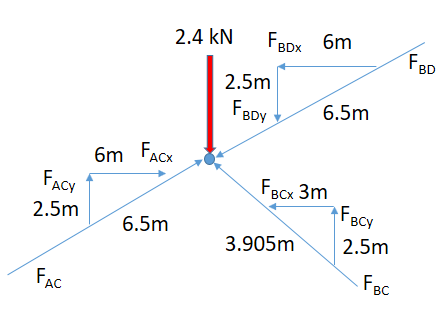
**FAB = 6.24 kN (Compression)**

Thus, FAB = FAC

FAC =

**FAC = 5.76 kN (Tension)**

**At joint B:**

FAB = 6.24 kN

FABx = = 5.76 kN

FABy = = 2.4 kN

∑FH = 0: FABx = FBDx + FBCx

FBD + FBC = 5.76 kN (1)

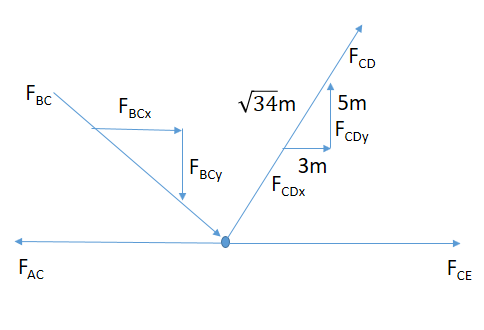
∑Fv = 0: FACy + FBCy = FBDy + 2.4kN

FBC - FBD = 2.4 kN - 2.4 kN = 0 (2)

**FBD = 4.16 kN (Compression)**

**FBC = 2.5 kN (Compression)**

**At joint C:**



FBC = 2.5 kN

FBCx =

FBCy =

FAC = 5.76 kN

∑Fv = 0: FBCy  = FCDy

FCD =

**FCD = 1.87 kN (Tension)**

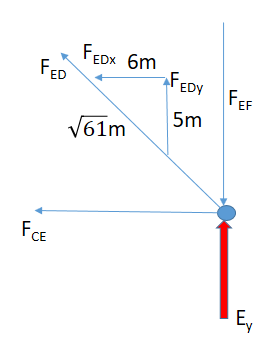
∑FH = 0: FAC = FCE + FCDx + FBCx

FCE = FAC - FCDx - FBCx

= 5.76 kN - (1.87 kN) -

**FCE = 2.88 kN (Tension)**

**At Joint D:**

FCE = 2.88 kN

Ey = 3.6 kN

∑FH = 0: FEDx + FCE = 0

FED = - 2.88 kN

**FED = 3.75 kN (Compression)**

∑Fv = 0: Ey - FEDy = FEF

FEF = 3.6 kN - (3.75 kN)

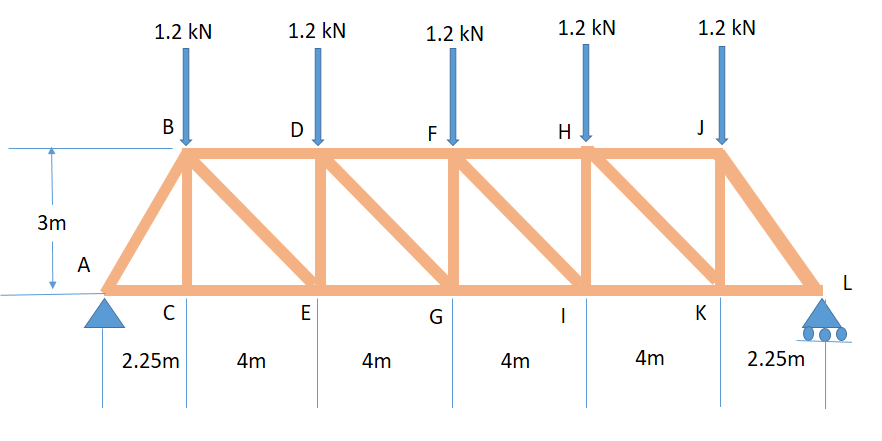
**FEF = 1.2 kN**

**Thus, FDF = 0 kN**

**Critical Thinking:**

In doing an assumption of the direction of every forces acting on every joints, the right direction can be determined without getting negative value by balancing the forces acting on it. That is forces in tension equals forces in compression.

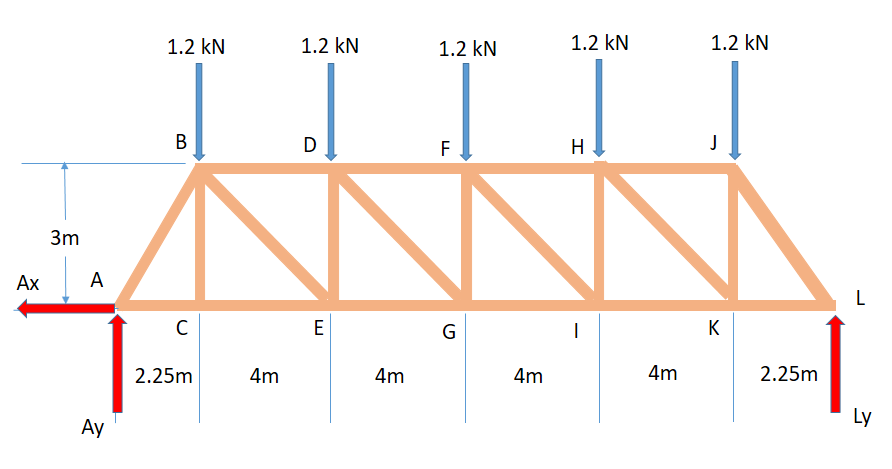
Question 2. A Mansard roof truss is loaded as shown. Determine the force in members DF, DG, and EG.



**Theoretical concept: Use Method of Section**

SOLUTION:

Free Body Diagram for external forces:



∑MA = 0: (20.5m) Ly = 1.2 kN (2.25m + 6.25m + 10.25m + 14.25m + 18.25m + 20.25m)

**Ly = 3 kN**

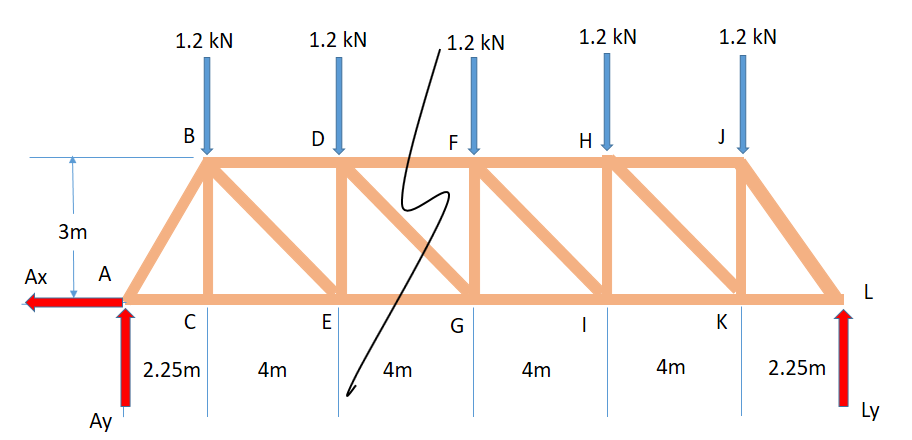
∑Fv = 0: Ax + Ly = 5 (1.2 kN)

Ax = 5 (1.2 kN) – 3 kN

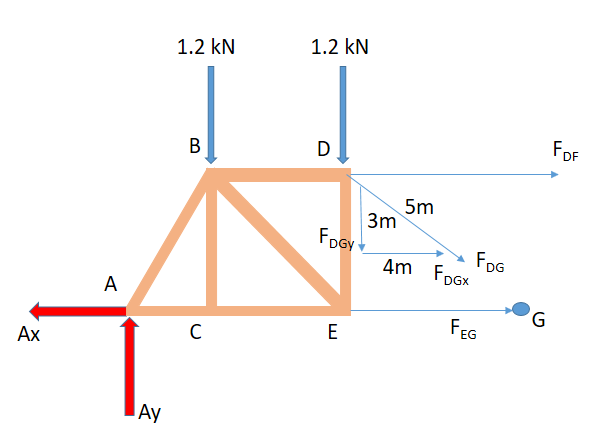
**Ax = 3 kN**

∑FH = 0: **Ax = 0 kN**

By cutting the section shown in the figure below:



Free body diagram of the half section:



∑MD = 0: 1.2 kN (4m) + (3m) FEG = Ay (2.25m + 4m)

(3m)FEG = 3 kN (2.25m + 4m) - 1.2 kN (4m)

**FEG = 4.65 kN (Tension)**

∑MG = 0: Ay (2.25m + 4m + 4m) + (3m) FDF = 1.2 kN (4m) + 1.2 kN (8m)

(3m) FDF = 1.2 kN (4m) + 1.2 kN (8m) - Ay (2.25m + 4m + 4m)

FDF = -5.45 kN

**FDF = 5.45 kN (Compression)**

∑MA = 0:

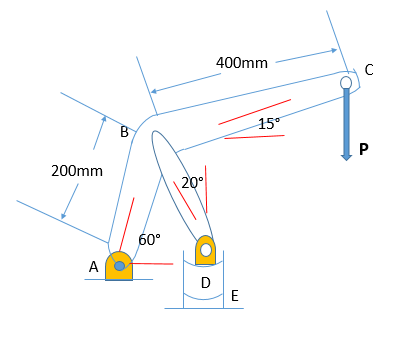
1.2 kN (2.25m) + 1.2 kN (2.25m + 4m) + (3m) FDF +  FDG (3m) + FDG (2.25m + 4m) = 0

FDG ((3m) + (2.25m + 4m)) = (1.2 kN (2.25m) + 1.2 kN (2.25m + 4m) + (3m) (5.45 kN))

**FDG  = 1 kN (Tension)**

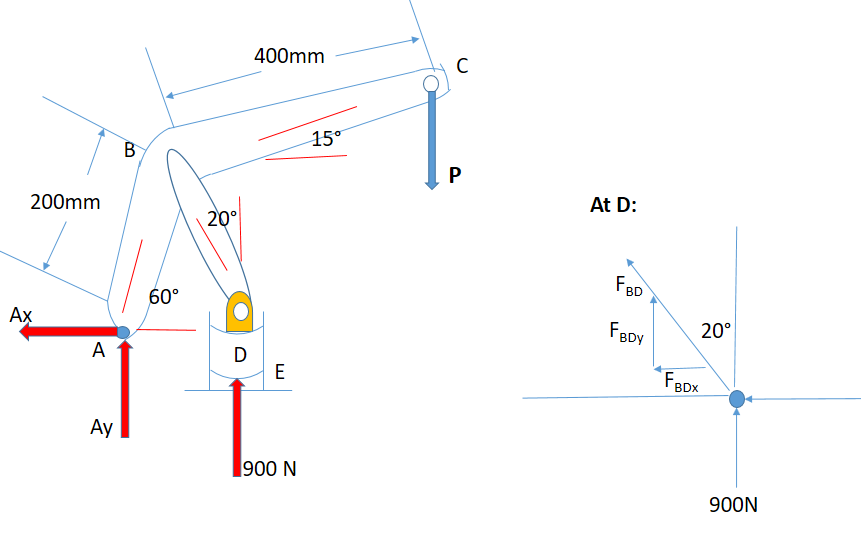
**Critical Thinking:**

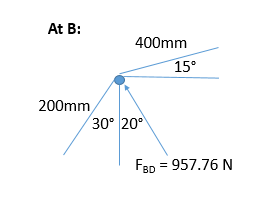
Method of section can easily be done by getting the moment of the point where more forces are acting on it. In this way, unknown values can be solved easily.

**Question 3:** The press shown is used to emboss a small seal at E. Knowing that the vertical component of the force exerted on the seal must be 900 N, determine (a) the required vertical force P, (b) the corresponding reaction at A. 

**Theoretical concept:**

Free body diagram for the external force of the whole system:



1. Solving for **P**

Solving the force FBD at D,

∑FV = 0: 900N = FBDy

FBD cos (20°)= 900N

FBD = 900N / cos (20°)

FBD = 957.76 N

∑MA = 0:

(FBDy + (FBDx = ( ( P

(FBD cos (30°) + (FBD sin (30°) =

( ( P

((957.76) cos (30°) + ((957.76) sin (30°) =

( ( P

P =

**P = 301.70 N**

1. Solving for the reactions of A

∑FH = 0: Ax + FBDx = 0

Ax = FBDx

Ax = 957.76 N sin (20°)

**Ax = 327. 57 N**

∑FV = 0: Ay + FBDy = P

Ay = P - FBDy

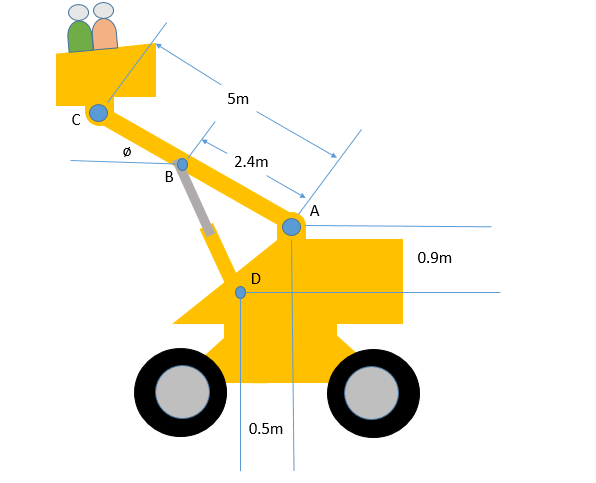
Ay = 301.7 N – 957.76cos (30°)

**Ay = 598.30 N**

**Critical Thinking:**

To withstand the applied force 900N applied on at C, there must be enough value of force exerted at E for it nor to break.

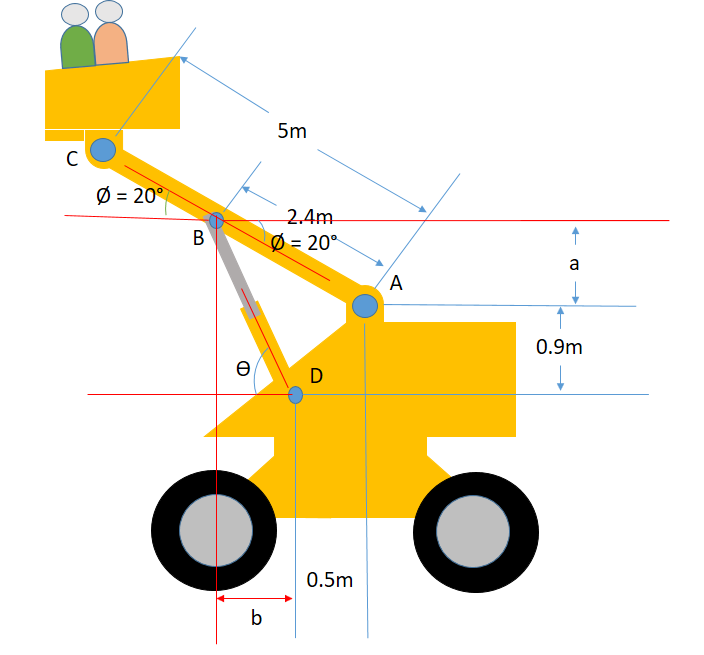
**Question 4:** The telescoping arm ABC is used to provide an elevated platform for construction workers. The workers and the platform together have a mass of 200 kg and have a combined center of gravity located directly above C. For the position when T 20q, determine (a) the force exerted at B by the single hydraulic cylinder BD, (b) the force exerted on the supporting carriage at A.



**Thheoritical concept:**

**SOLUTION:**

Free Body Diagram:



Solving for the value of ϴ

tan ϴ =

sin 20° =

a = 2.4m sin 20° = 0.8208 m

b = 2.4m cos 20° - 0.5m = 1.755 m

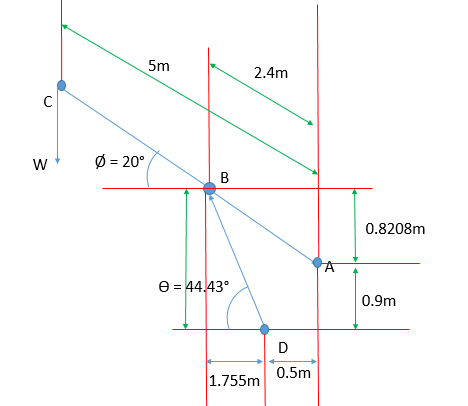
thus, tan ϴ =

ϴ = arctan = 44.43°

At C:

W = mg = (200kg)(9.81m/s2)

W = 1962 N



1. Solving the value of FBD :

∑MA = 0: (5m cos 20°) W - (2.54m cos 24°) FBDx + (0.8208m) FBDy = 0

(5m cos 20°) (1.962 kN) - (2.54m cos 24°) FBD sin 44.43° + (0.8208m) FBD cos 44.43° = 0

FBD = -(5m cos 20°) (1.962 kN)/( (0.8208m) cos 44.43° - (2.54m cos 24°) sin 44.43°))

**FBD = 9.2867 kN with angle +44.43°**

1. Reactions at A

∑FH = 0: Ax = FBDx

Ax = 9.2867 kN cos 44.43°

**Ax = 6.63 kN**

∑FH = 0: Ay + FBDy = W

Ay = 1.962 kN + 9.2867 kN sin 44.43°

**Ay = 4.539 kN**

**A = (Ax2 + Ay2)1/2 = ((6.63 kN)2 + (4.539 kN)2)1/2**

**A = 8.04 kN**

**ϴA = arctan (4.539/6.63) = 34.4°**

**Critical Thinking:**

With the resulting values, the hydraulic cylinder was still able to carry its load. By increasing the load of it, we can calculate its maximum load capacity.