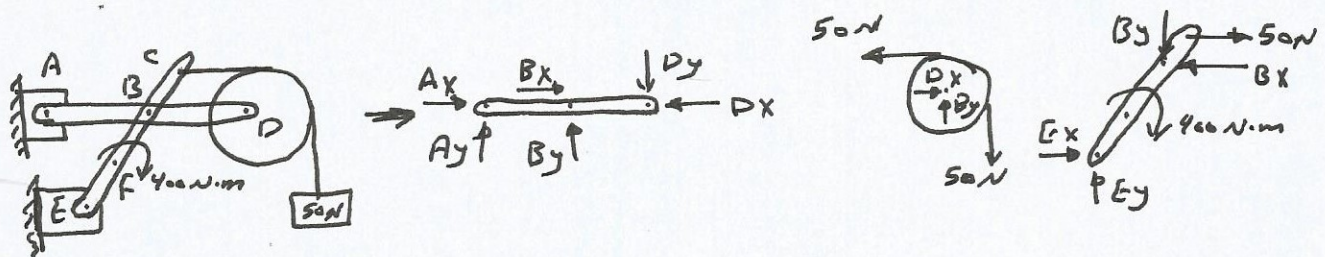


Ex. No. 2:- Draw free body for the structure shown in figure?



I- Equilibrium of concurrent, coplanar force system:-

$$R = \sqrt{R_x^2 + R_y^2} \quad , \text{ To satisfy equilibrium } \Rightarrow R = 0 \Rightarrow R_x = 0, R_y = 0$$

$\sum F_x = 0 + \sum F_y = 0$ only two unknowns can be determined.

Ex. No. 3:- A system of cables connected together at A and B support the weights as shown in figure. Compute the tension in cables?

Sol:-

$$\rightarrow \sum F_x = 0$$

$$-T_1 \sin 60 + T_2 \sin 75 = 0$$

$$-0.866 T_1 + 0.966 T_2 = 0 \quad \text{--- (1)}$$

$$\uparrow \sum F_y = 0$$

$$T_1 \cos 60 + T_2 \cos 75 - 300 = 0$$

$$0.5 T_1 + 0.259 T_2 = 300 \quad \text{--- (2)}$$

By solving eqs (1) & (2) simultaneously $\rightarrow T_1 = 409.792 \text{ N}, T_2 = 367.197 \text{ N}$

$$\rightarrow \sum F_x = 0$$

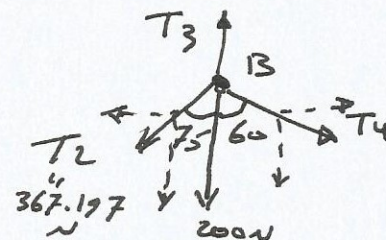
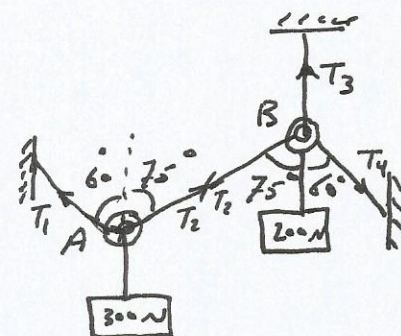
$$-367.197 \sin 75 + T_4 \sin 60 = 0$$

$$-359.685 + 0.866 T_4 = 0$$

$$\therefore T_4 = \frac{359.685}{0.866} = 409.567 \text{ N}$$

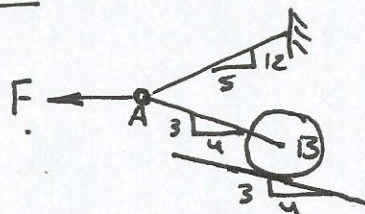
$$\uparrow \sum F_y = 0 \Rightarrow T_3 - 200 - 409.567 \cos 60 - 367.197 \cos 75 = 0$$

$$T_3 = 499.821 \text{ N}$$



H.w. no. 12:- Determine force of figure which must be applied to ring A in order to keep the 300 N cylinder B in equilibrium?

Ans:- $F = 188.966 \text{ N}$ ←



II - Equilibrium of parallel coplanar force system:-

* The resultant of this system is either a single force or couple.

* To satisfy equilibrium $\rightarrow R=0$

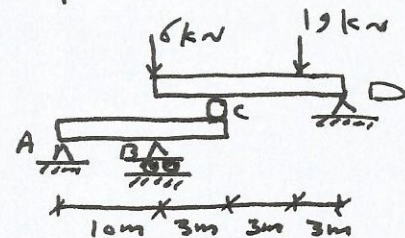
$$\sum F=0 \quad , \quad \sum M=0$$

* only two unknowns can be determined.

Ex. No. 1:- Determine the reactions at supports A, B, C and D for the upper and lower beams shown in figure?

Sol:-

$\uparrow \sum M_D = 0$
 $R_C \times 6 - 19 \times 3 - 6 \times 9 = 0$
 $6R_C = 111$
 $\therefore R_C = 18.5 \text{ kN} \uparrow$



$$+\uparrow \sum F_y = 0 \Rightarrow 18.5 + D_y - 19 - 6 = 0 \Rightarrow D_y = 6.5 \text{ kN} \uparrow$$

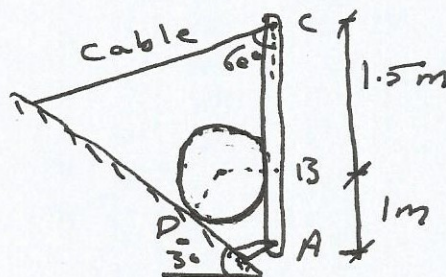
$$\uparrow \sum M_A = 0 \Rightarrow 18.5 \times 13 - R_B \times 10 = 0 \Rightarrow R_B = \frac{240.5}{10} = 24 \text{ kN} \uparrow$$

$$+\uparrow \sum F_y = 0 \Rightarrow A_y + 24 - 18.5 = 0 \Rightarrow A_y = -5.5 \text{ kN} = 5.5 \text{ kN} \downarrow$$

III - Equilibrium of General coplanar force system:-

$$\left. \begin{array}{l} \sum F_x = 0 \text{ --- (1)} \\ \sum F_y = 0 \text{ --- (2)} \\ \sum M_A = 0 \text{ --- (3)} \end{array} \right\} \text{ * only three unknowns can be determined.}$$

Ex. No. 1:- Determine the tension in cable and the reaction at A, B, D knowing that the weight of the cylinder is 1000 N?



Sol:- For cylinder:-

$$+\rightarrow \sum F_x = 0$$

$$R_D \sin 30^\circ - R_B = 0$$

$$0.5 R_D - R_B = 0 \text{ --- (1)}$$

$$+\uparrow \sum F_y = 0$$

$$R_D \cos 30^\circ - 1000 = 0 \Rightarrow R_D = \frac{1000}{\cos 30^\circ} = 1159.7 \text{ N}$$

$$\text{substitute in eq. (1)} \Rightarrow 0.5 (1159.7) - R_B = 0 \Rightarrow R_B = 577.35 \text{ N}$$