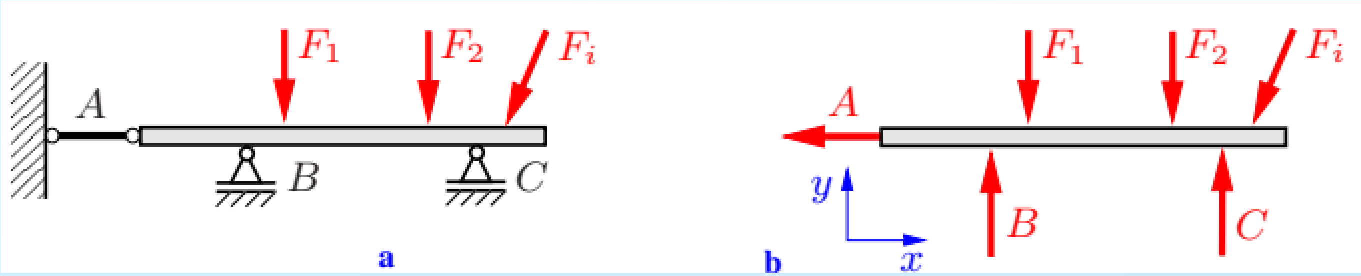
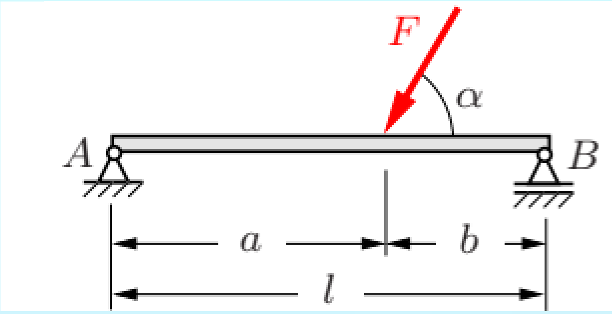
1.3 Determination of the Support Reactions إيجاد ردود أفعال المساند

In order to determine the support reactions, the method of free body diagram is applied: the body is freed from its supports and their action on the body is replaced by the unknown reactions.

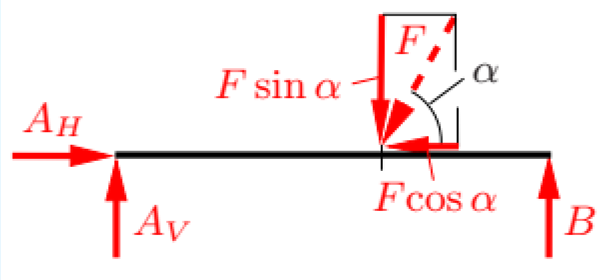


$$\sum F_{ix} = 0, \qquad \sum F_{iy} = 0, \qquad \sum M_{i/O} = 0.$$

Example 1 The beam shown in figure a is loaded by the force *F* which acts under an angle α. Determine the reaction forces at the supports *A* and *B*.

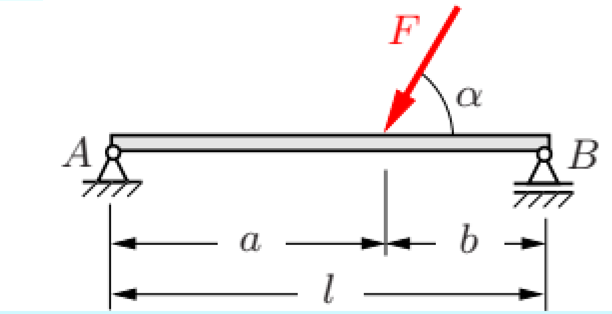


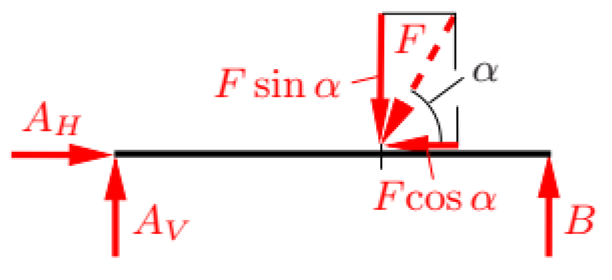
Solution: The beam is rigidly supported; the support *A* transmits two reactions and support *B* one reaction. In total, the three unknown reaction forces A_H, A_V & B exist, therefore, the beam is statically determinate.



We free the beam from its supports and make the reaction forces visible in the free-body diagram where we choose their senses of direction along the action lines freely. Hence, the equilibrium conditions are given by

$$\sum F_{ix} = 0, \qquad \sum F_{iy} = 0, \qquad \sum M_{i/O} = 0.$$





$$\sum F_{ix} = 0, \qquad \sum F_{iy} = 0, \qquad \sum M_{i/O} = 0.$$

$$\sum \vec{F}_{ix} = 0: \qquad A_H - F\cos\alpha = 0, \qquad (1)$$

$$\uparrow \sum F_{iy} = 0: \quad A_V + B - F\sin\alpha = 0, \qquad (2)$$

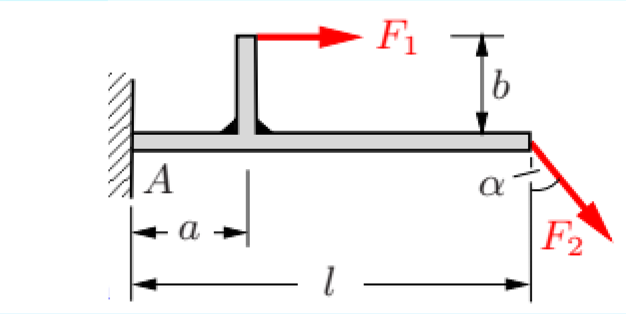
$$\downarrow\uparrow \sum M_{i/A} = 0: \qquad lB - aF\sin\alpha = 0, \qquad (3)$$

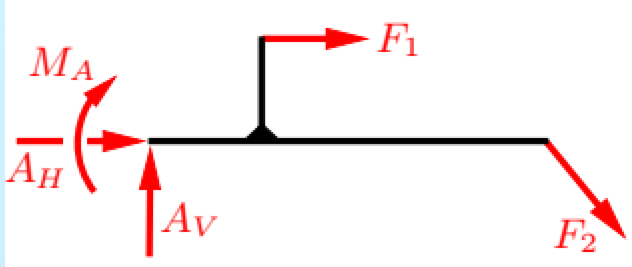
Solving (1) $\Rightarrow A_H = F\cos\alpha$

Solving (3) $\Rightarrow B = (a/l)F\sin\alpha$

Sub. in (2) $\Rightarrow A_V = (b/l)F\sin\alpha$

Example 2 The clamped beam shown in figure a is loaded by the two forces F_1 and F_2.
Determine the reactions at the support.





Solution:

We free the beam from its supports and make the reaction forces visible in the free-body diagram where we choose their senses of direction along the action lines freely.
Hence, the equilibrium conditions are given by

$$\sum F_{ix} = 0, \qquad \sum F_{iy} = 0, \qquad \sum M_{i/O} = 0.$$

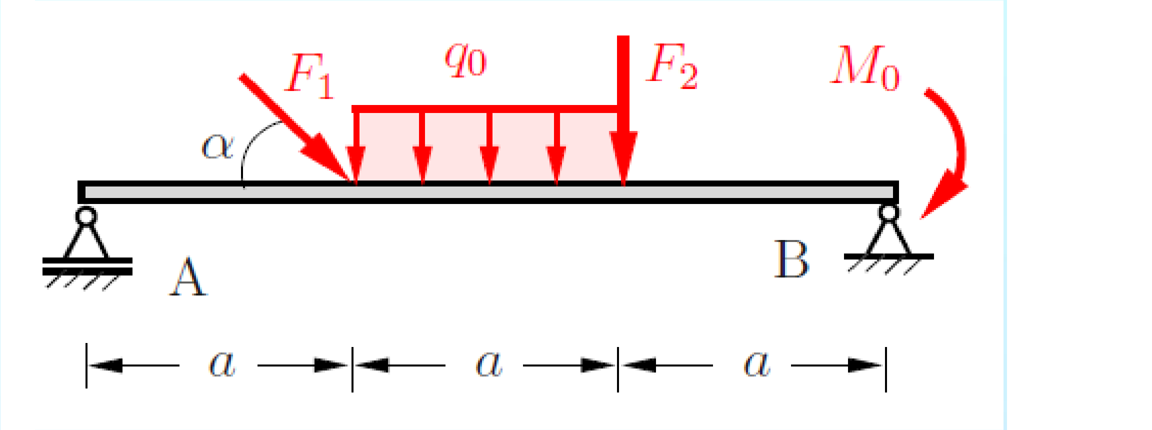
$$\overset{\rightarrow}{\sum} F_{ix} = 0: \quad A_H + F_1 + F_2 \sin\alpha = 0 \Rightarrow \quad A_H = -(F_1 + F_2 \sin\alpha)$$

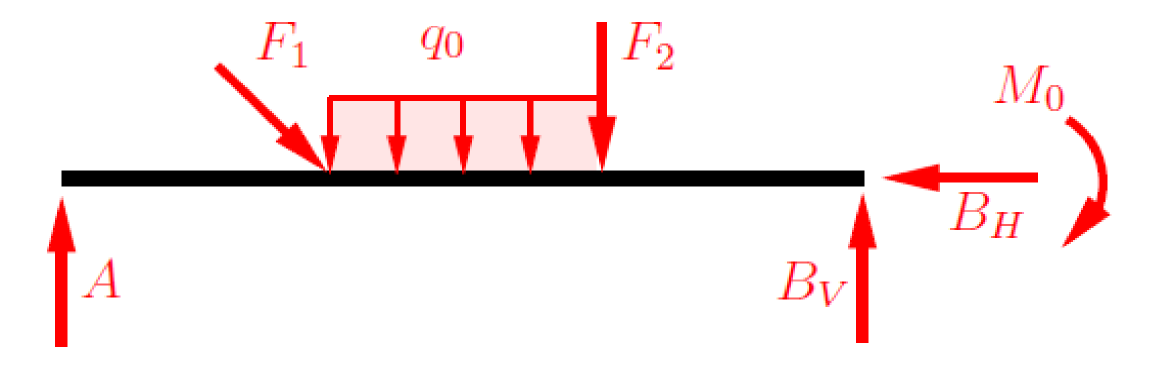
$$\uparrow \sum F_{iy} = 0: \quad A_V - F_2 \cos\alpha = 0 \Rightarrow A_V = F_2 \cos\alpha$$

$$\downarrow\uparrow \sum M_{i/A} = 0: -M_A - bF_1 - lF \cos\alpha = 0 \Rightarrow M_A = -(bF_1 + lF \cos\alpha)$$

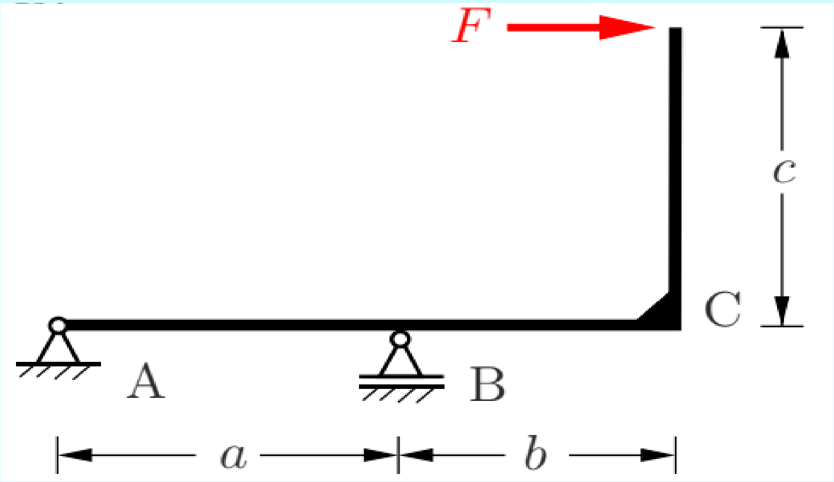
Example 3. Determine the support reactions for the depicted system.

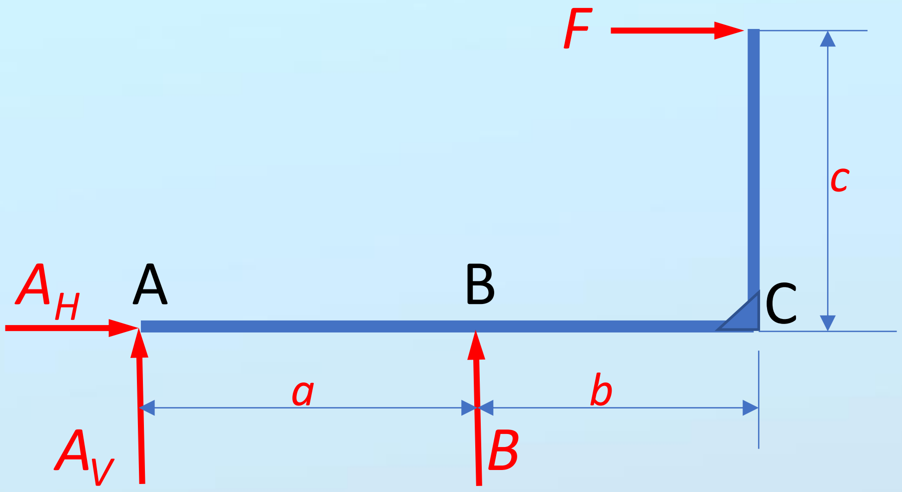
Given: F_1 = 2 kN, F_2 = 3 kN, a = 1m, M_0 = 4 kNm, q_0 = 5 kN/m, α = 45°.



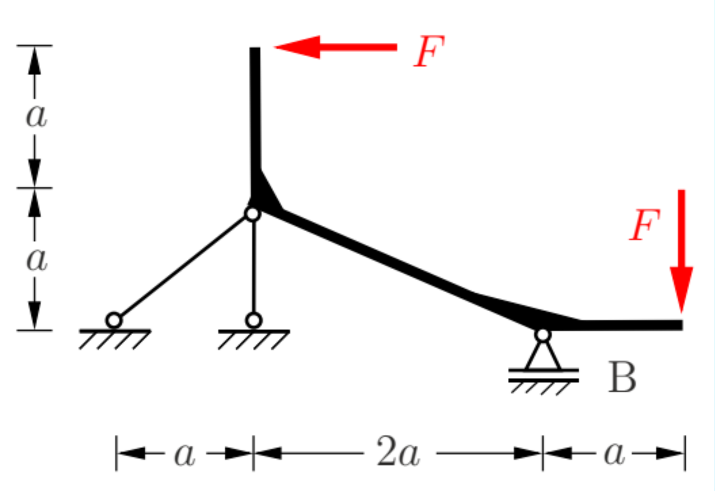


Problem 1. Determine the support reactions for the depicted systems





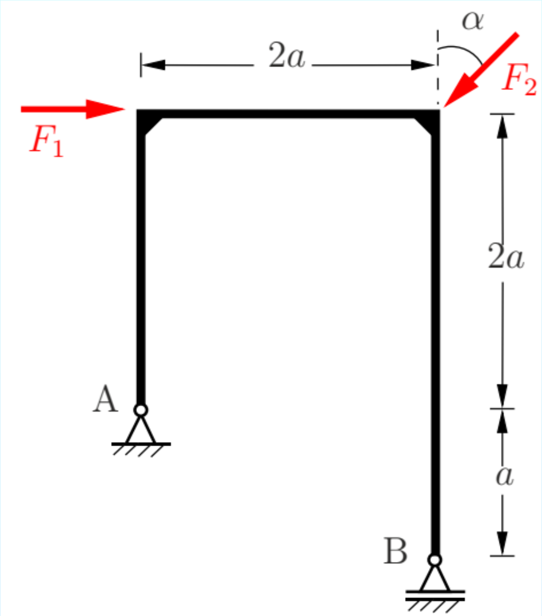
Problem 2. Determine the support reactions for the depicted systems



Problem 3.

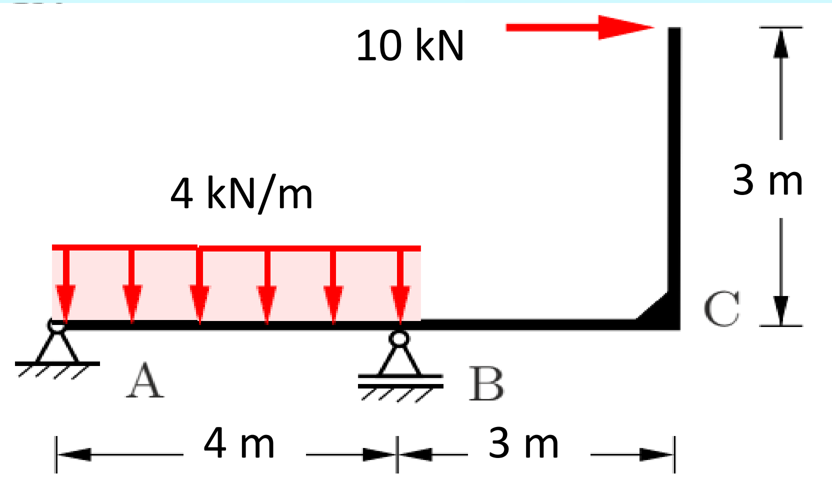
Determine the support reactions for the depicted frame.

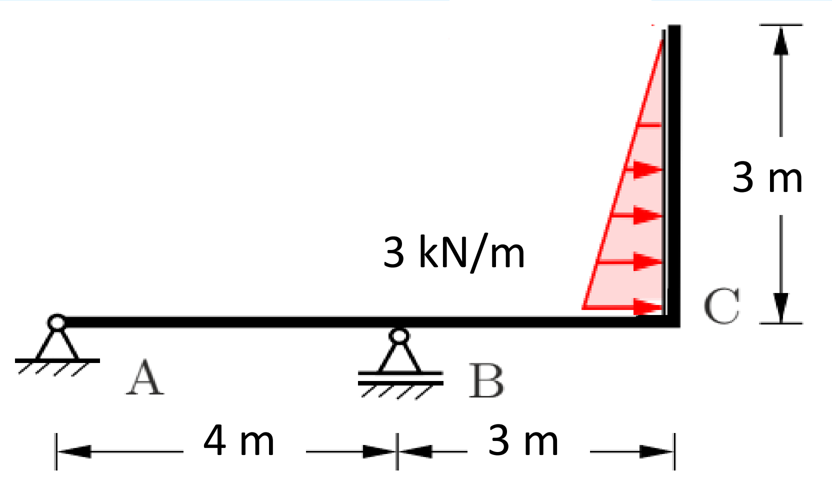
Given: F_1 = 2000 N, F_2 = 3000 N, α = 45 °, a = 5 m.



Problem 4.

1. Draw the free Body Diagram of the shown frame
2. Find the reactions of the supports

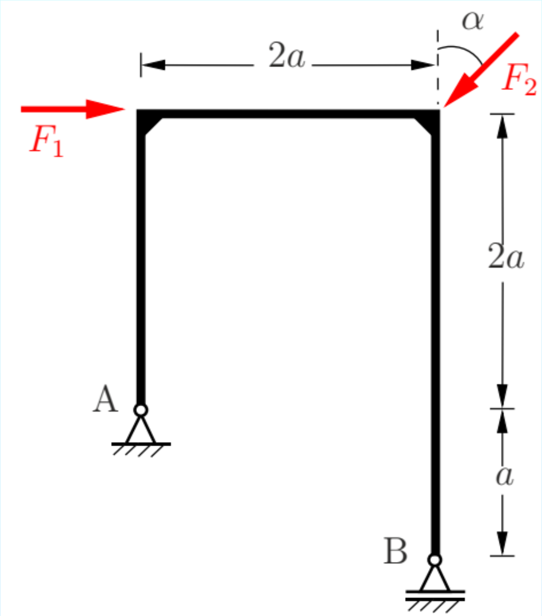




Problem 5.

Determine the support reactions for the depicted frame.

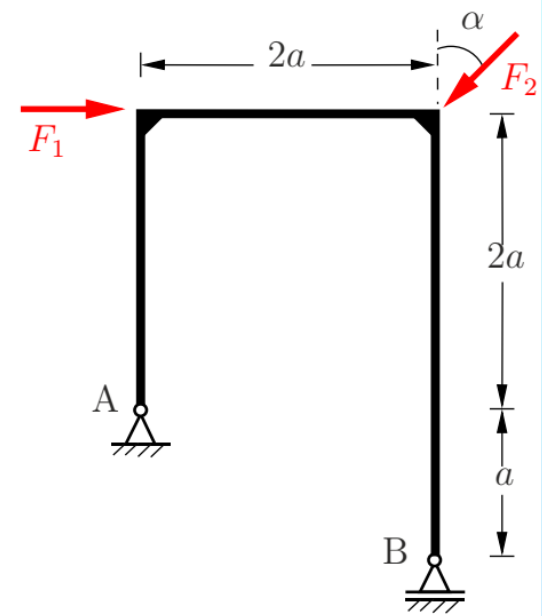
Given: F_1 = 3 kN, F_2 = 5 kN, α = 40°, a = 3 m.



Problem 6.

Determine the support reactions for the depicted frame.

Given: F_1 = 3 kN, F_2 = 5 kN, α = 30°, a = 3 m.



Problem 6.

Determine the support reactions for the depicted frame.