Torque

Cantilevers

Sample Problem

The uniform board is 8 meters long and has a mass of 100 kg. Determine F_1 and F_2.
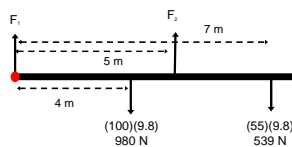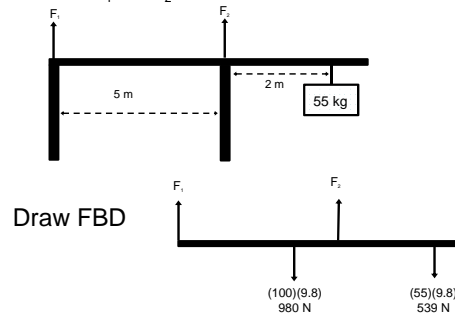
F_1 F_2

5 m   2 m

55 kg

F_1 F_2

Draw FBD

(100)(9.8)
980 N

(55)(9.8)
539 N

F_1 F_2 7 m

5 m

4 m

(100)(9.8)
980 N

(55)(9.8)
539 N

Write Net Force Equations

Pick a place for the hinge

Determine Distances

Write Net Torque Equations

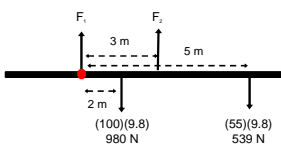$$\Sigma F_y : F_1 + F_2 - 980\,N - 539\,N = 0$$

$$F_1 + 1538.6\,N - 980\,N - 539\,N = 0$$

$$F_1 = -19.6\,N$$

$$\Sigma \tau : F_2(5\,m) - 980\,N(4\,m) - 539\,N(7\,m) = 0$$

$$F_2 = 1538.6\,N$$

Sample Problem

The uniform board is 10 meters long and has a mass of 100 kg. Determine F_1 and F_2.

F_1 F_2

55 kg

3 m   3 m   2 m

F_1 F_2

Draw FBD

(100)(9.8)
980 N

(55)(9.8)
539 N

F_1 F_2

3 m   5 m

2 m

(100)(9.8)
980 N

(55)(9.8)
539 N

Write Net Force Equations

Pick a place for the hinge

Determine Distances

Write Net Torque Equation

$$\Sigma F_y : F_1 + F_2 - 980N - 539N = 0$$
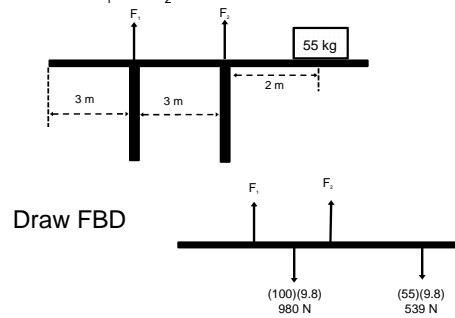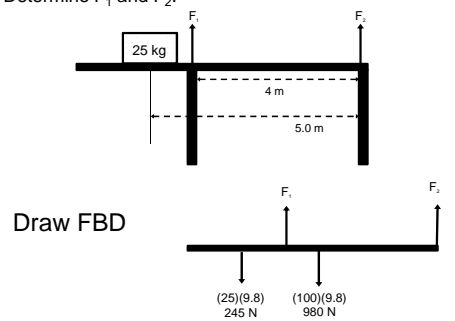
$$F_1 + 1551.7N - 980N - 539N = 0$$
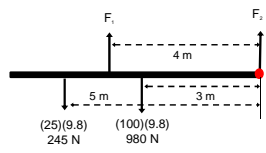
$$F_1 = 32.7N$$

$$\Sigma \tau : F_2(3m) - 980N(2m) - 539N(5m) = 0$$

$$F_2 = 1551.7N$$

Practice

The uniform board is 6 meters long and has a mass of 100 kg. Determine F_1 and F_2.

F_1 F_2

25 kg

4 m

5.0 m

F_1 F_2

Draw FBD

(25)(9.8)
245 N

(100)(9.8)
980 N

F_1 F_2

4 m

5 m 3 m

(25)(9.8) (100)(9.8)
245 N 980 N

Write Net Force Equations

Pick a place for the hinge

Determine Distances

Write Net Torque Equations

$\Sigma F_y : F_1 + F_2 - 980N - 245N = 0$

$1041.25 + F_2 - 980N - 245N = 0$

$F_2 = 183.75N$

$\Sigma \tau : -F_1(4m) + 980N(3m) + 245N(5m) = 0$

$F_1 = 1041.25N$