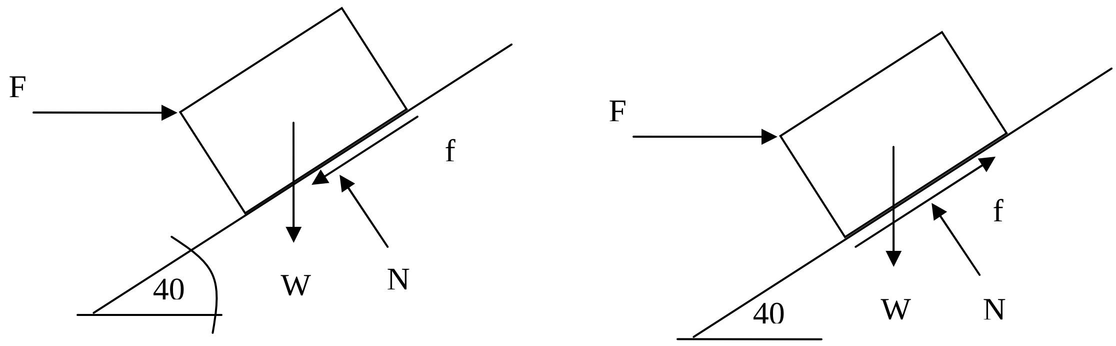
1.050 Solid Mechanics, Fall, 2004
Problem Set#1 Solution

Problem 1.1



(a) Push the box up (b) Support the box not to slide down

Figure 1.1 (a) and (b) shows the directions of forces acting on the box in both cases.

Case 1: Pushing the box up.

$$\sum F_x = F - f(\cos 40) - \mathrm{N}(\sin 40) = 0$$

$$\sum F_y = N(\cos 40) - W - f(\sin 40) = 0$$

$$f = \mu N = 0.35\mathrm{N}$$

$$F = 0.911N$$

$$N = 1.848W$$

$$F = 1.684W$$

Case 2: Support the box not to slide down

$$\sum F_x = F + f(\cos 40) - \mathrm{N}(\sin 40) = 0$$

$$\sum F_y = N(\cos 40) - W + f(\sin 40) = 0$$

$$N = 1.01W$$

$$F = 0.378W$$

Problem 1.2

See comments on your problem set and in the class.

Problem 1.3

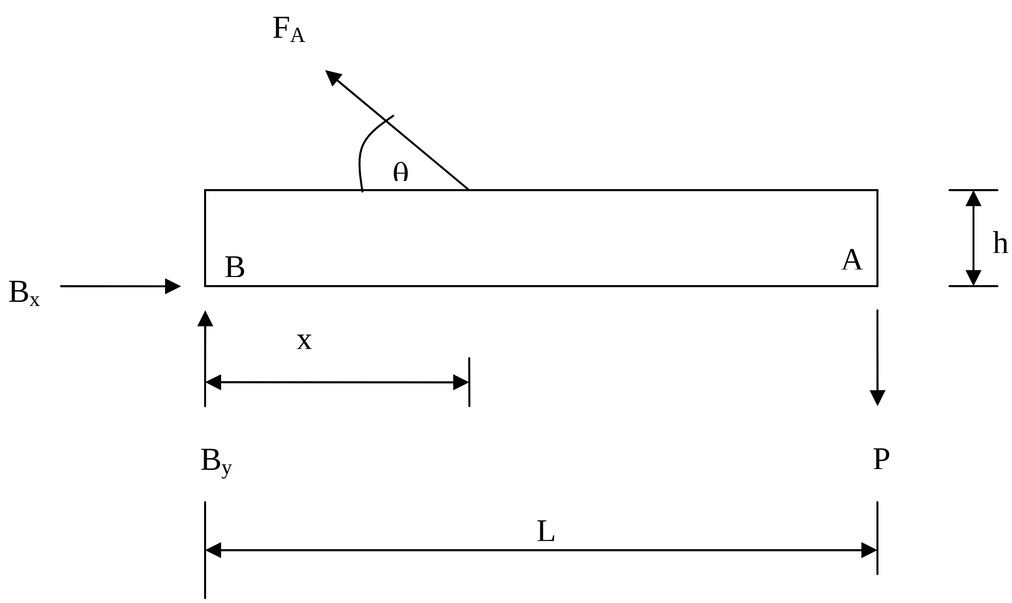


Figure 3.1 shows the FBD of the beam

Let's consider a more generic situation where the load F_A is acting at a distance x from point B and acting at an angle of θ.

$$\sum F_x = F_A(\cos\theta) - B_x = 0$$

$$\sum F_y = F_A(\sin\theta) + B_y - P = 0$$

$$\sum M_B = F_A(\cos\theta)(h) + F_A(\sin\theta)(x) - PL = 0$$

$$F_A\left[h(\cos\theta) + x(\sin\theta)\right] = PL$$

$$F_A = \frac{PL}{\left[h(\cos\theta) + x(\sin\theta)\right]}$$

$$B_x = \frac{PL(\cos\theta)}{\left[h(\cos\theta) + x(\sin\theta)\right]}$$

$$B_y = P - \frac{PL(\sin\theta)}{\left[h(\cos\theta) + x(\sin\theta)\right]}$$

<u>Problem 1.4</u>

This problem is similar to the one in the problem 1.3. We can use the equations we developed in the 1.3 to solve this problem. We get that x = 9*l*/2, h = *l*/2, and θ = 30 degree.

We get that

$$F_A = \frac{PL}{\left[h(\cos\theta) + x(\sin\theta)\right]} = \frac{7Pl}{2.683l} = 2.609P$$

$$B_x = \frac{PL(\cos\theta)}{\left[h(\cos\theta) + x(\sin\theta)\right]} = \frac{6.062Pl}{2.683l} = 2.259P$$

$$B_y = P - \frac{PL(\sin\theta)}{\left[h(\cos\theta) + x(\sin\theta)\right]} = P - \frac{3.5Pl}{2.683l} = -0.305P$$

The negative sign of B_y means that the actual direction of the reaction B_y is opposite of the one we assumed in the figure 3.1.