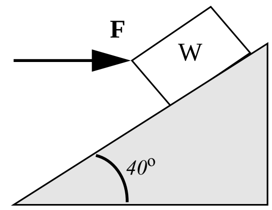
# SOLID MECHANICAL (SAMPLE ASSIGNMENT)

## Problem 1.1

*Show that* if the coefficient of friction between the block and the plane is 0.35, the force required to just start the block moving **up** the $40^o$ incline is $F$ = ?? $W$ while the force required to hold the block from sliding **down** the plane is
$F$= ?? $W$.

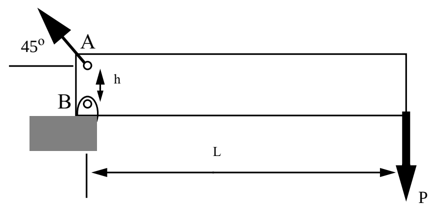



## Problem 1.2

*Estimate* the angle of a hill upon which you can safely park your car under dry road conditions; under icy conditions. (Prob. 2.3 text)

## Problem 1.3

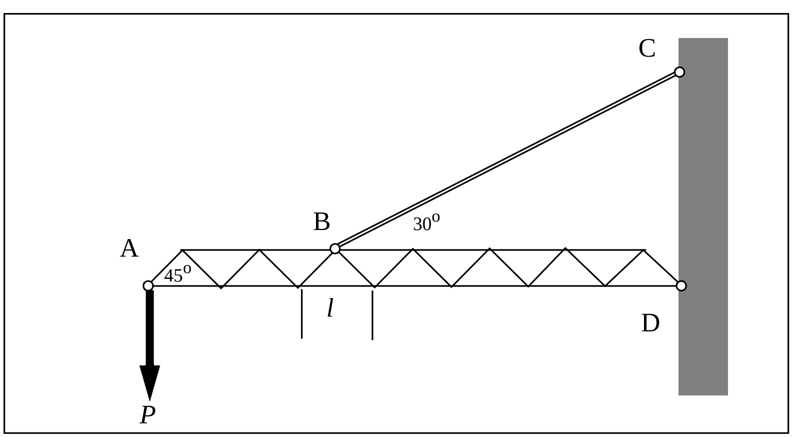
The rigid, weight-less, beam carries a load P at its right end and is supported at the left end by two (frictionless pins). The pin at the top is pulled upwards and held in place by a cable inclined at a 45 degree angle with the horizontal.



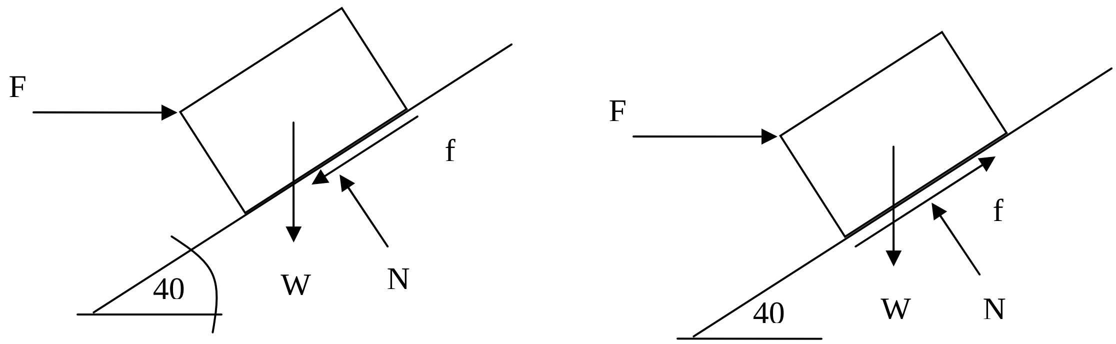

Draw a free body diagram of the beam, isolated from its environment i.e., show all the forces acting on the beam alone; show all relevant dimensions; show a reference cartesian axes system.
Explain how you would go on to determine the magnitude of the cable force acting at pin A and the magnitude and direction of the reaction force at B. (Prob. 2.13 text, amended).

## Problem 1.4

The (weight-less) truss structure shown carries a load **P** and is supported by a cable, *BC*, and pinned at *D* to the wall. Determine the force in the cable *BC* and the reaction force components at *D* in terms of P.



**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**

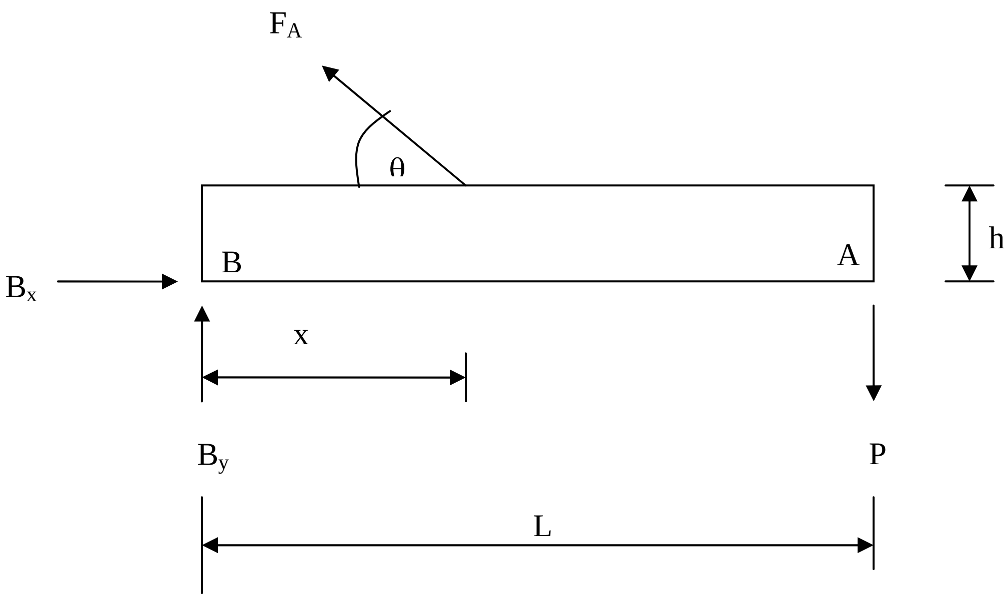



Figure 3.1 shows the FBD of the beam

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.

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

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

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

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

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

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

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

**Problem 1.4**

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.

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