

Unless otherwise mentioned, these problems should be solvable using a basic calculator. Practice clear communication by showing all work (free body diagrams, algebra, etc). This will be required to receive full credit on any graded problems.

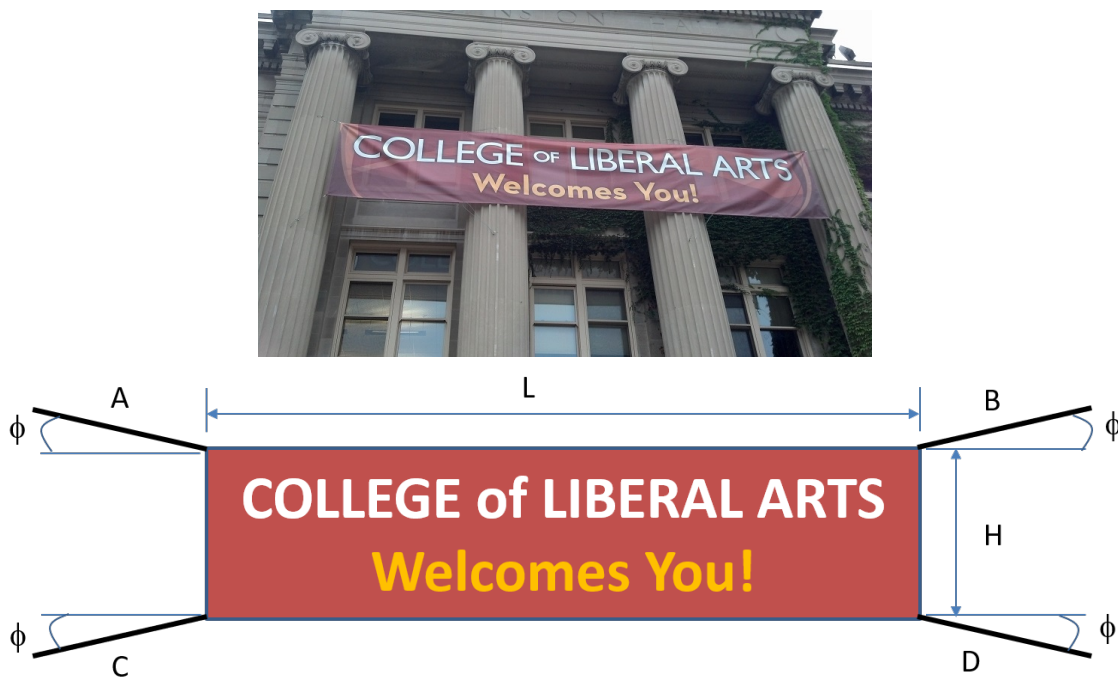
1. A disabled lift has the loading shown at point B and is being supported by a cable pulling along BC . Find the required tension in cable BC so that the resultant of the three forces at point B is directed along the lift boom (i.e. member AB).



2. The figure below shows a banner hanging on campus along with an idealized diagram for this banner. The banner has length $L = 7.5m$, height $H = 1.5m$, and mass $m = 5kg$. Assume:

- (a) the cables directions are as shown with $\tan(\phi) = \frac{H}{L}$
- (b) the tension in cable A is twice that of cable C
- (c) the tension in cable B is twice that of cable D

Given these assumptions estimate the tension in each cable so that there is zero net force on the banner.

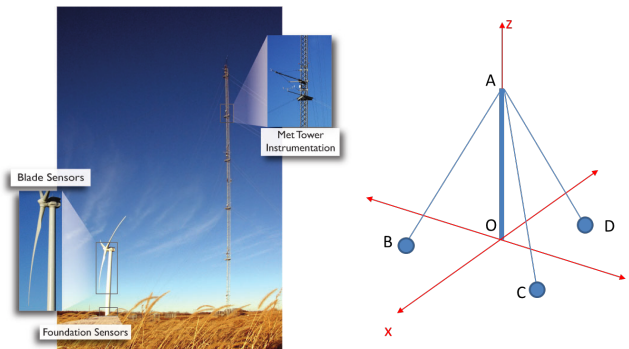


3. The space shuttle is headed in a direction that is 80° relative to horizontal and 45° west of north. The rocket thrust acts opposite the direction of travel of the space shuttle. Assume that the x , y , and z coordinate axes are directed east, up, and south, respectively.
- (a) Draw the space shuttle and the assumed coordinate system.
 - (b) Determine the x , y , and z -components of the thrust force.

4. A wind turbine is installed at the University of Minnesota Eolos Wind Research Field Station. The field station also has a $130m$ ($426ft$) tall meteorological tower with sensors for research purposes. The met tower is supported by cables. For simplicity, assume that the tower has three cables attached to the pin at A and anchored on the ground at points B, C, and D. The locations of the various points are given by:

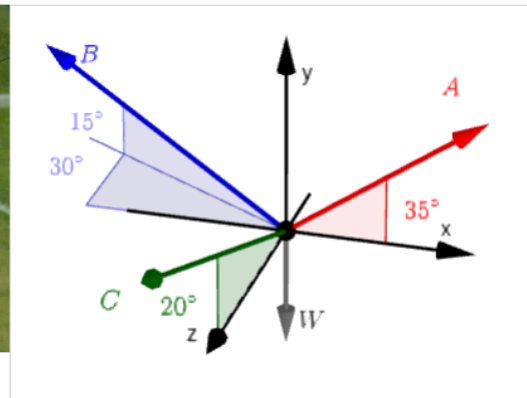
- $\bar{A} = 130m\mathbf{k}$
- $B = 60m\mathbf{i} - 40m\mathbf{j}$
- $C = 60m\mathbf{i} + 40m\mathbf{j}$
- $D = -40m\mathbf{i} + 30m\mathbf{j}$

Determine the tension in each cable if the met tower exerts an upward vertical force of $4000N$ on the pin at A. Reflect on the tensions computed. What does this say about the supports provided by the assumed cable structure?



Left: Eolos Field Station (Image courtesy of eolos.umn.edu), Right: Simplified diagram

5. The skycam at Stanford University Stadium has a mass of 20 kg and is supported by three cables as shown. Assuming that it is currently in equilibrium, find the tension in each of the three supporting cables.



6. A hot air balloon 30 ft above the ground is tethered by three cables as shown in the diagram. If the balloon is pulling upwards with a force of 900 lb , what is the tension in each of the three cables? The grid lines on the ground plane are spaced 10 ft apart.

