

## ES201 Homework Set #10

**WARNING:** Do not start with  $F=ma$  for either of these problems. Always start with the conservation of linear momentum equation and construct an appropriate solution.

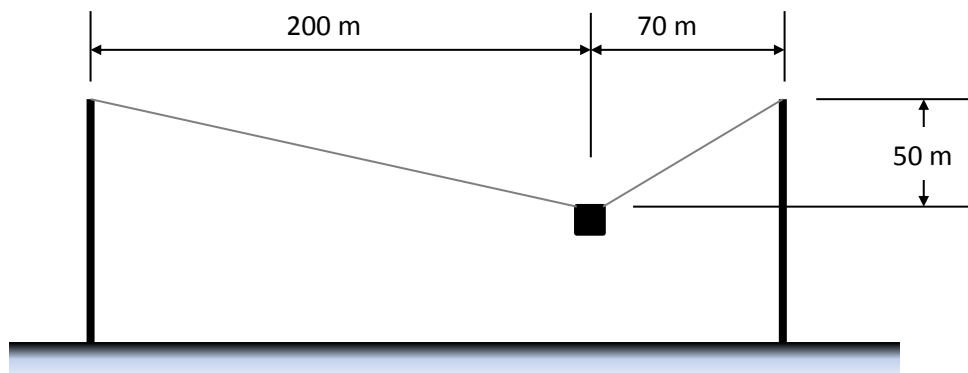
### Problem 10.1

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A small, traveling video camera used to cover NFL games is suspended by two cables as shown in the figure. The camera weighs 120 N. For purposes of analysis, you may assume the cables have negligible mass, so they hang “straight” as shown in the figure. In addition all motion is in the plane of the paper.

Safety concerns have been raised about how the motion of the camera could change the tension forces in the two cables. For the camera position shown in the figure, determine the tension, in newtons, in each cable under three *different* operating conditions:

- the camera is stationary;
- the camera is traveling horizontally to the right with a constant velocity of 2 m/s;
- the camera is traveling horizontally to the left with a constant acceleration of  $4 \text{ m/s}^2$ .



### Problem 10.2

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A rocket sled has a mass of 1500 kg and travels on a horizontal surface with a constant speed of 400 m/s. The sled brake is a drag chute that deploys and produces a drag force of  $F_{\text{drag}} = kV^2$  that opposes the direction of motion, where  $k$  is a constant. During the braking process the only significant force acting on the sled is the force produced by the chute.

(a) The sled is to be slowed from 400 m/s to 40 m/s over a distance of 1000 m. What value of  $k$ , measured in  $\text{N}\cdot\text{s}^2/\text{m}^2$ , is required? [Hint: Although you can integrate twice with respect to time, you may find it easier to change the independent variable from  $t$  to  $x$  and integrate directly with distance. To do this change the independent variable and use the relationship  $dV/dt = V(dV/dx)$  discussed in the text.]

Using the value of  $k$  you determined in part (a) determine the following information:

- the maximum acceleration of the sled, in  $\text{m/s}^2$  and in  $g$ 's, immediately after the drag chute deploys.
- the time, in seconds, required to slow the sled from 400 m/s to 40 m/s.
- the distance, in meters, required to bring the sled from 40 m/s to a complete stop.