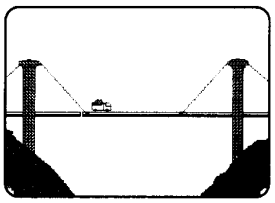
Name _____ Class _____ Date _____

12 Suspension Bridge

This simulation investigates the use of vectors to solve physics problems.



Situation A

Michelle is an engineer designing a bridge that will span a river gorge. She wants to study how changing the distance between the support towers affects the tension created in the cables that support the center portion of the roadway. Michelle knows that by increasing the distance between the towers she can reduce the construction cost of the bridge. (Less material is required if the towers do not have to extend far down into the gorge.)

Make a Prediction

1. How will increasing the distance between the towers affect the tension in the suspension cables? Assume the height of the tower above the roadway doesn't change. Place a check next to your prediction.
   - **a.** ___ The tension in the cable will decrease as the distance between the towers increases.
   - **b.** ___ The tension in the cable will not change as the distance between the towers increases.
   - **c.** ___ The tension in the cable will increase as the distance between the towers increases.

Run Simulation Set *Distance between towers* to 300.00 m. Set *Tower height* to 100.00 m. Set *Truck position* to *Middle*. Click the *Run* button and observe the simulation. Record the values for *Tension in cable 1* and *Tension in cable 2* in Table 1. Click the *Reset* button. Set *Distance between towers* to 400.00 m. Click the *Run* button and observe the simulation. Notice how changing the distance between the towers affects the angle of the support cables and the tension in the cables. Record the values for *Tension in cable 1* and *Tension in cable 2* in Table 1.

Table 1 Effect of Distance Between Towers on Cable Tension

	Distance between towers	
	300.00 m	400.00 m
Tension in cable 1 (N)		
Tension in cable 2 (N)		

2. Was your prediction in Question 1 correct? How does changing the distance between the support towers affect the tension in the cables?

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3. When the distance between towers was increased from 300 m to 400 m, what happened to the angles formed by the support cables and the towers? Explain what happens to the tension in the cable using vector components.

Make a Prediction

4. How will increasing the height of the towers above the roadway affect the tension in the suspension cables? Assume the distance between the towers doesn't change. Place a check next to your prediction.
   a. ___ The tension in the cable will decrease as the tower height increases.
   b. ___ The tension in the cable will not change as the tower height increases.
   c. ___ The tension in the cable will increase as the tower height increases.

Run Simulation Click the *Reset* button. Set *Distance between towers* to 300.00 m. Set *Tower height* to 100.00 m. Set *Truck position* to *Middle*. Click the *Run* button and observe the simulation. Record the values for *Tension in cable 1* and *Tension in cable 2* in Table 2. Click the *Reset* button. Set *Tower height* to 150.00 m. Click the *Run* button and observe the simulation. Notice how changing the tower height affects the angle of the support cables and the tension in the cables. Record the values for *Tension in cable 1* and *Tension in cable 2* in Table 2.

Table 2 Effect of Tower Heights on Cable Tension

	Height of tower	
	100.00 m	150.00 m
Tension in cable 1 (N)		
Tension in cable 2 (N)		

5. Was your prediction in Question 4 correct? How does changing the height of the towers affect the tension in the cables?

6. How does the angle of the support cables affect the results? Explain your answer using vector components.

7. What is the most important factor affecting the tension in the suspension cable? Place a check next to the correct answer.
   - **a.** ___ height of the towers
   - **b.** ___ distance between the towers
   - **c.** ___ the angle of the suspension cable
   - **d.** ___ the position of the truck on the bridge

Run Simulation Questions 8–10 require you to vary the settings for *Distance between towers, Tower height,* and *Truck position* based upon what is asked in the question. You need to determine how to set the simulation controls, then run the simulation. Remember to always click the *Reset* button before altering any of the settings.

8. The amount of steel required to construct the bridge is minimized when the *Tower height* is minimized and the *Distance between towers* is maximized. Run the simulation to determine the tension in the support cables when the amount of steel used to construct the bridge is minimized. Record the tension in the cables. Explain why minimizing the use of steel may not be practical.

9. Run the simulation to determine the *Distance between towers* which will result in the *Tower height* having no effect on the tension in the support cables. What is the tension in the cables for this situation? Using vectors, explain why the tower height has no effect on the tension.

10. Does the position of the truck on the bridge affect the tension in the cables? Run several simulations with the truck in various positions. Explain and summarize your results below.