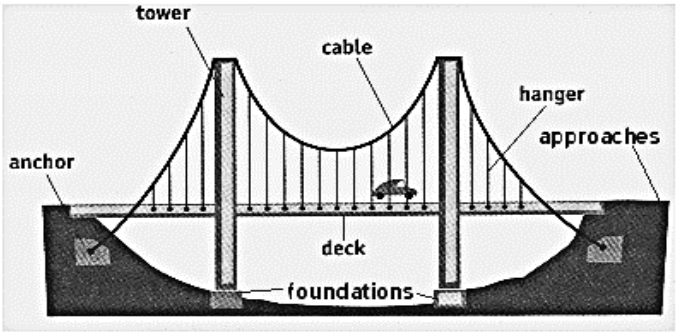
Performance task 1: Suspension Bridge

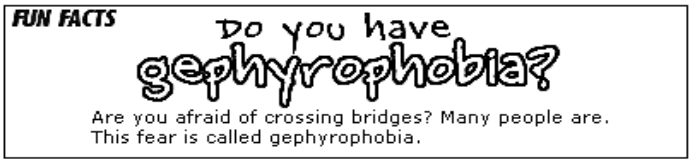
By pair. You may choose anyone from your class as partner. You may communicate through whatever is convenient for both of you.
Use 2 short bond papers, 1 for the illustration and the other for the Q&A part. (25 points)
For the illustration, make sure to label all points that you used in computations.
For Q&A, show your solution wherever possible.

In this activity, you will investigate the wonder of suspension bridges and the science behind their construction. You will learn about tension and compression forces and how a parabolic curve between supports on a bridge helps achieve maximum strength. You will also design your own bridge and plot the points on a coordinate plane paying special attention to the coordinates of the intersection of the cable and hangers.

Anatomy of a Bridge

Deck - For pedestrian, train, and/or automobile traffic.
Supports - The towers are the supports.
Span - Describes the distance between towers.
Foundations - The supports rest on the foundations.
Approaches - The approaches are the roads leading up to the bridge.
Long wire cables are strung over the towers and secured to the **anchors** on land.
Hangers run from the cables to the deck hold it up.





- But before that, you might want to view first the short video in the given link below for some simple explanation of suspension bridges:
  http://www.carondelet.pvt.k12.ca.us/Family/Math/03210/page4.htm
  https://www.youtube.com/watch?v=caTaBeKUh-U

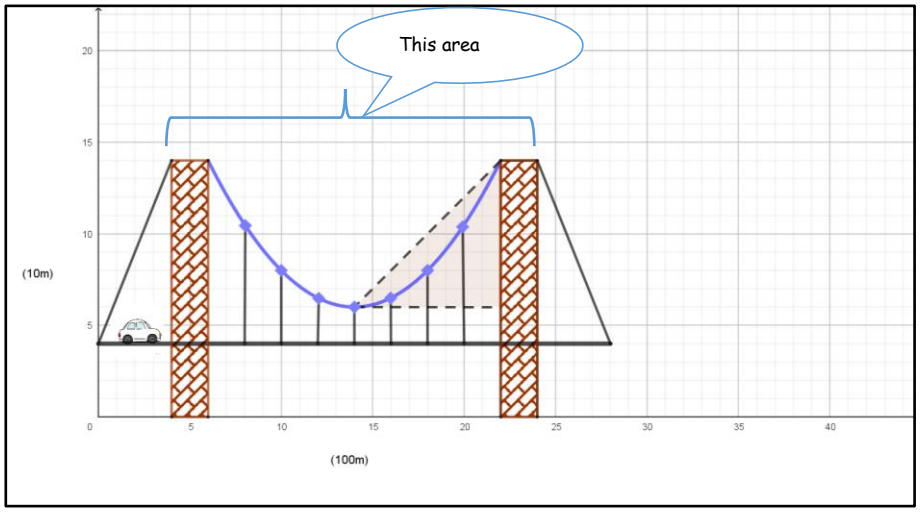
Scenario:

A bridge has failed. As an up and coming engineer, you have been asked to help with the design of a new bridge. In the preliminary stages, you are mostly concerned with the area between the two pillars of the bridge as that is where the problem originated.

The bridge must span a 2000 meter section of a bay. For the purposes of your early design you are to assume the following:

- The end of the approach from the west side of the bay will represent point (0, 40) on your coordinate plane.
- There is a 40 m drop from the end of the approaches to the body of water below.
- Let each mark on the x-axis represent 100m and each mark on the y-axis represent 10m

Draw a plan for a bridge on the coordinate plane (as shown above) that includes two square supports, at least one cable from support to support on each side of the road, and hangers (between 5 to 10) as you feel are necessary to attach the road to the cables. Remember, you are dealing with the area between the supports. Another engineering firm is being brought in to address the anchors of the bridge. Label the axes according to the instructions.



Answer the following base on your design:

1. How tall and wide are your supports?
2. What are the coordinates of the top your supports?
3. What is the length of your shortest hanger?
4. What are the coordinates of the vertex of the cable that extends from support to support?
5. What is the equation of your parabolic cable?
6. How many additional hangers are you using on your bridge between the two supports?
7. What are the intersections of your other hangers with the parabolic cable?
8. How much steel cable will you need for all your hangers on both sides of the road?
9. Try to estimate how much cable you will need for the parabolic cable that stretches between the two supports. (Hint: use the concept of a right triangle to estimate)

*This activity was adapted from https://www.radford.edu/rumathsmpdc/Performance/src/Adam%20Keith%20%20Suspension%20Bridges%20and%20the%20Parabolic%20Curve.pdf

GRAPHING RUBRIC

Component	Level		
	1	2	3
Labels – The axes of the graph contains labels.	Does not label axes of graph, or labels are incorrect, unclear	Has correct labels for graph axes, but does not have units of measure	Has correct labels and units of measure for graph axes
Numbering – Axes of graph are numbered to allow for locating of data on each number line.	Axes are number, but numbers are not in order or evenly spaced.	Axes are numbered evenly and in order, but are either number too high or too low.	Axes are numbered evenly, in order, and are numbered no higher than twice the biggest data value
Plotting points – Using each pair of data points, placing a dot on the graph where their values intersect on the graph.	Neither the x-axis or y-axis points match the data. For example a value of 25 on the x-axis is plotted closer to 35, and the value of 15 on the y-axis is plotted closer to 20.	Most of the points are plotted correctly, however this are 2-3 that are incorrect.	All points are plotted correctly and match up with the data.
Line – Line is drawn from point to point to help determine the relationship between to two types of data.	Points are connected in a random manner. They are not plotted from left to right, but instead in the order they were plotted.	Points are connected from left to right, but 1-2 points are incorrect. Lines are crooked, curved.	Points are connected correctly from left to right with no mistakes. Lines are straight from point to point.