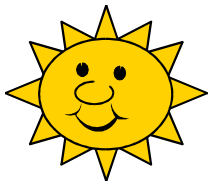
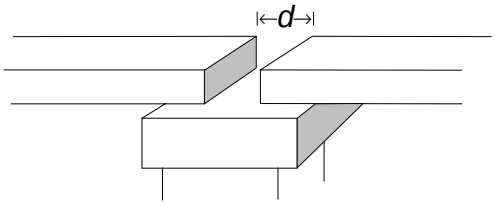
BUILDING BRIDGES 1



When building a bridge or railway line, engineers have to leave small gaps between sections to allow for heat expansion. This gap should not be too small (why not?), but also not too large (why not?).

For a certain bridge the size of the gap is 2,3 cm at a temperature of 0°C. For each 1°C that the temperature rises, the gap becomes smaller by 0,05 cm.



1. Complete the following table showing the size of the gap at different temperatures. Explain your method.

Temperature (t°C)	0	1	2	3	4	10	20	25	30	40
Gap size (d cm)										

2. On the day they built the bridge the temperature was 28°C.
   What size should the engineers make the gap?

3. Predict the size of the gap at a temperature of $^{-}5$°C and at $^{-}10$°C. Discuss!

4. At what temperature will the size of the gap be
   (a) 1,15 cm (b) 0,7 cm?

5. At what temperature will the gap close completely?
   What happens physically at temperaures higher than this?
   Would the temperature ever be likely to get so high?

6. Draw a graph of d against t. *Interpret* the situations in questions 1-5 in the graph.

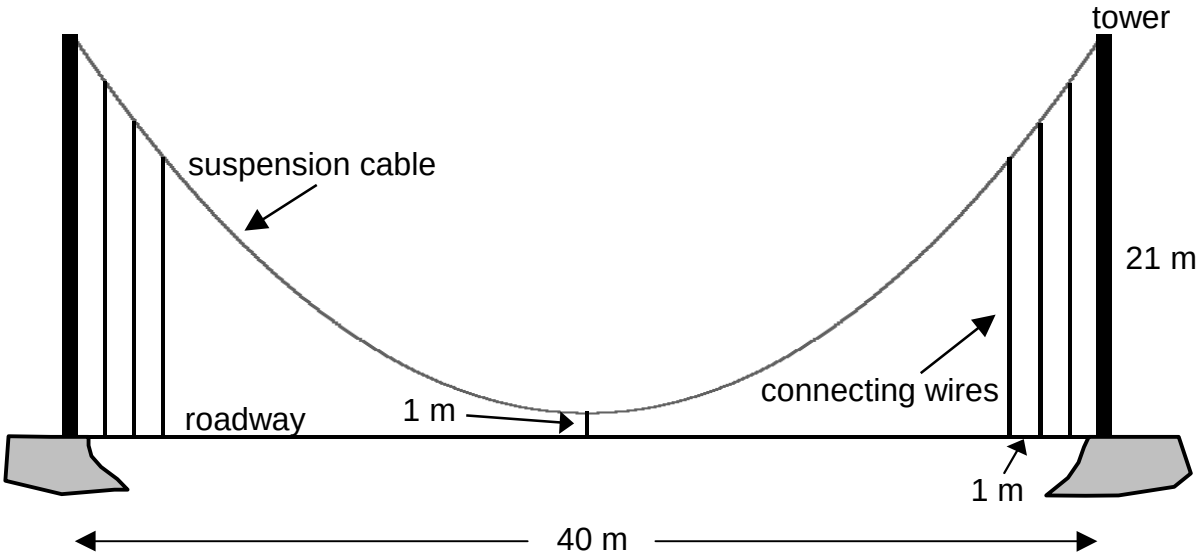
7. Write down the relationship between d and t as a formula. How does this formula describe and mimic the physical situation?

8. Suppose a similar bridge must be built in the desert where it is known that the temperature can be as high as 55°C. Suggest a suitable formula that the engineers can use for the size of the gap. Explain what it means, physically!

BUILDING BRIDGES 2

The famous Golden Gate hanging bridge in San Francisco, USA

Engineers must build a hanging bridge over a river. The roadway of the bridge will be hung from a suspension cable with connecting wires, 1 m apart. At its lowest point, the connecting wire is 1 m long. The suspension cable is supported by two towers at the ends, which are each 21 m high and are 40 m apart.



It is essential that the lengths of the connecting wires should be *exact*, otherwise the bridge is unsafe! The lengths cannot be found by *practical measurement while* building the bridge! This is how engineers do it: They imagine a system of axes, find a *formula* for the shape of the suspension cable, then they use this formula as a *model* to *calculate* the lengths of all the connecting wires *beforehand*.

1. Now you do it! Make a table giving the length of each of the connecting wires. Describe *patterns* in the table.

Can you, after calculating a few values, use the *table* as a *model* to easily calculate the other lengths?

2. The *choice* of the system of axes influences the *form* of the formula and the *complexity* of the calculations! Choose at least *four* different positions for the axes, give the corresponding formula for the shape of the suspension cable and discuss the advantages/disadvantages of the four systems.

Read more about suspension bridges on the internet at http://www.brantacan.co.uk/suspension.htm