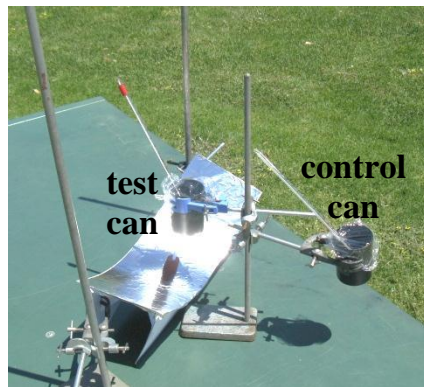


Aim: Your task will be to build a parabolic reflecting surface which will reflect and concentrate sunlight. It will be made of cardboard and aluminium foil. You will then test the parabolic reflecting surface to see how effective it is at concentrating sunlight and heating up water in a can.

Equipment: card (4-sheet thickness or above), A3 graph paper, scissors, glue, Aluminium foil, 2 cans, 2 thermometers, 3 or 4 retort stands, 4 boss heads, 4 clamps, sticky tape, rubber stopper, pencil.



Results	
x	y
-20	
-19	
-18	
-17	
-16	
-15	
-14	
-13	
-12	
-11	
-10	
-9	
-8	
-7	
-6	
-5	
-4	
-3	
-2	
-1	
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Method (Part A): Making Your Parabolic Reflector

- Fill in the table at right showing the values for the curve $y = \frac{1}{40} x^2$ (to one decimal place).

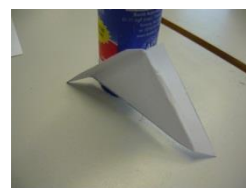
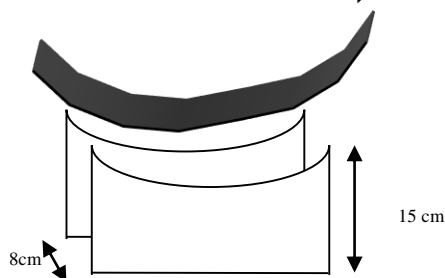
- Plot the points onto an A3 sheet of graph paper.
- Join the point with a smooth parabolic curve.
- Cut out the shape and use it to cut out two parabolic curves in 2 cardboard pieces.



cut out the square

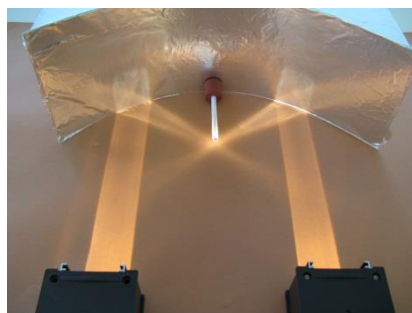
triangular strut

fold along the dotted lines the opposite way



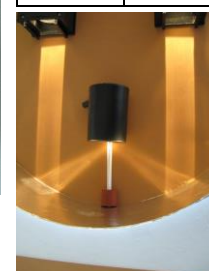
- Cut out a large rectangular piece of cardboard measuring 15cm x 46cm.
- Curve the rectangular cardboard around so that it rests on the 2 parabolic outlines.

- Using at least 8 triangular struts, paste the 15cm x 46cm piece of cardboard onto the other two.



- Cut out a 48cm x 15cm sheet of aluminium foil and glue it onto the parabolic dish. The focus of the dish is now 10 cm from the bottom of the curve.

- Finally, place a 10cm-long, rolled up piece of paper through the hole in a rubber stopper and glue the stopper onto the reflector at its vertex. This piece of paper will help you align the reflector and shows you where the reflector's focus point is.



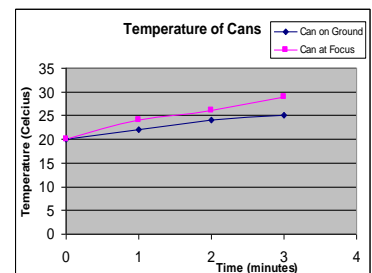
Part B: Testing Your Parabolic Reflector

- Put exactly **30ml of water** into each can.
- **Measure the temperature** of the water in both cans.
- Use **clamps** to position the parabolic reflector so that the vertex of the parabola is facing directly towards the sun. You'll know that the parabola is facing the sun if the rolled up paper is **not casting a shadow**.
- Use a retort stand, a boss head, and a clamp to hold the test can exactly **10 cm** above the reflector's vertex (**since the focal length of the parabola is 10cm**).
- Clamp the other can at a similar height to the other can, but away from the reflector. This can will be your "control" can.
- Wrap cling wrap around the top of each can to stop any evaporation.
- If you have done it correctly, the can at the focus of the parabola will be bathed in sunlight from above and below, while the control can will only be getting direct sunlight.
- **Record the temperature** of both cans **every minute for 20 minutes**.



Note: Every five minutes or so, you may want to reposition the reflector slightly as the sun moves across the sky. You may also wish to remove the rolled-up paper once you have set everything up so as to adjust the height of the test can if you need to.

Time (minutes)	Temperature (°Celsius)	
	Can at focus of parabola	"Control" Can
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		



Questions:

1. Draw a graph of Temperature vs Time on graph paper or using a spreadsheet. Label the axes and place a title on the graph. See example shown.
2. How does a parabolic reflector work? Include a diagram

3. Compare and contrast the results of the can at the focus of the parabola (the test can) with the results of the control can?

4. Why was the control can used?

5. How might your solar reflector be improved?

6. Explain why parabolic dishes are used in space communications (and other long-range communications).



Canberra Deep Dish Communications Complex
nasa.gov

7. Solar energy is used in many homes to heat water. The water passes through pipes in which it is heated by the sun. (However, most hot water systems don't use parabolic reflectors.) What are the advantages of solar hot water systems?



8. Why aren't solar hot water systems more common? (ie what are their disadvantages?)

9. What would you need to know about before deciding to install a solar hot water system?

10. List the knowledge and skills that you needed to complete this task.