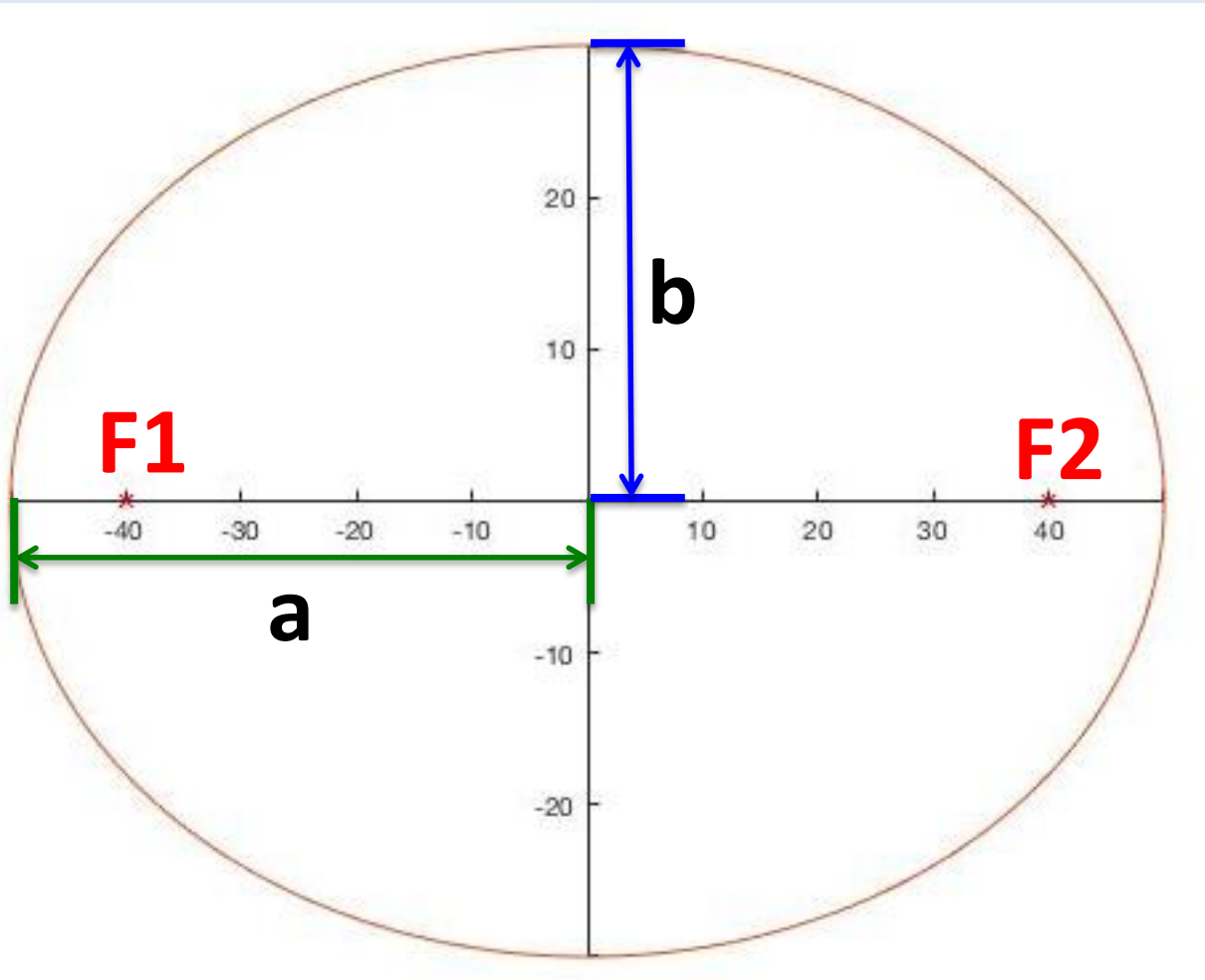


Ellipses

# What makes an ellipse?



$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

**F1 and F2 = foci**

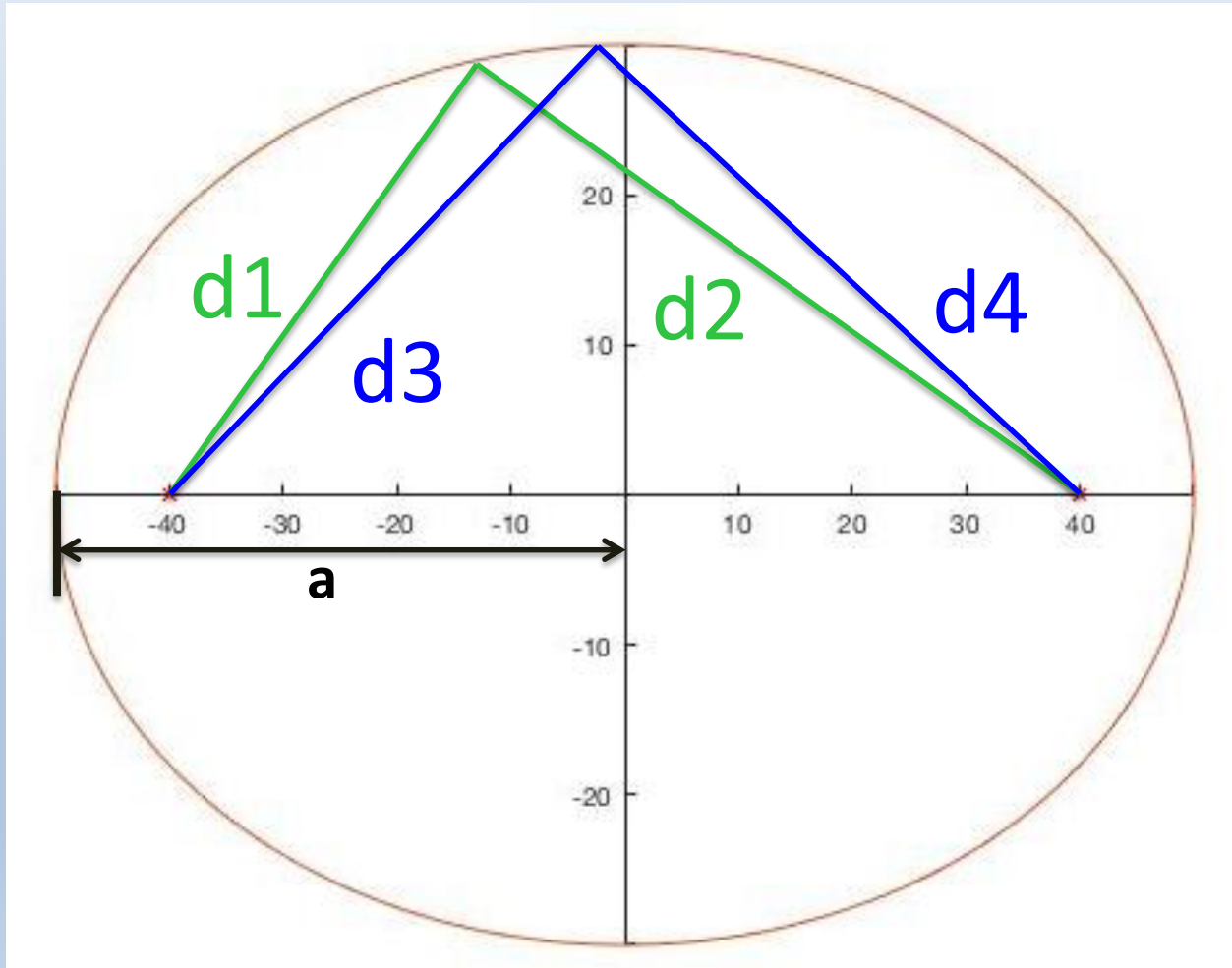
**a = major axis**

**b = minor axis**

# What makes an ellipse?

- Definition:
  - A curve in a plane surrounding 2 focal points
  - The sum of the distances from each focal point to the curve is constant for every point of the curve
- Major axis is the longer axis
- Foci always located along the major axis
- A circle is one type of ellipse

# Special property of ellipses

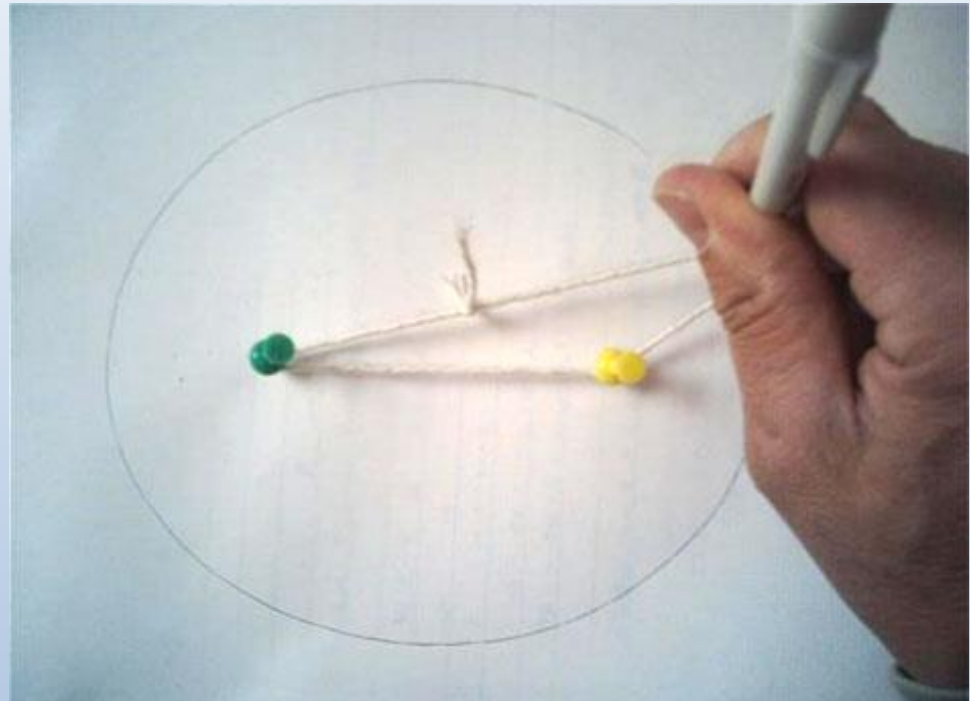


The sum of the distances from each focal point to the curve is constant for every point of the curve

$$d1+d2=2a$$

$$d3+d4=2a$$

# Test this property yourself



Use graph paper to draw an ellipse:

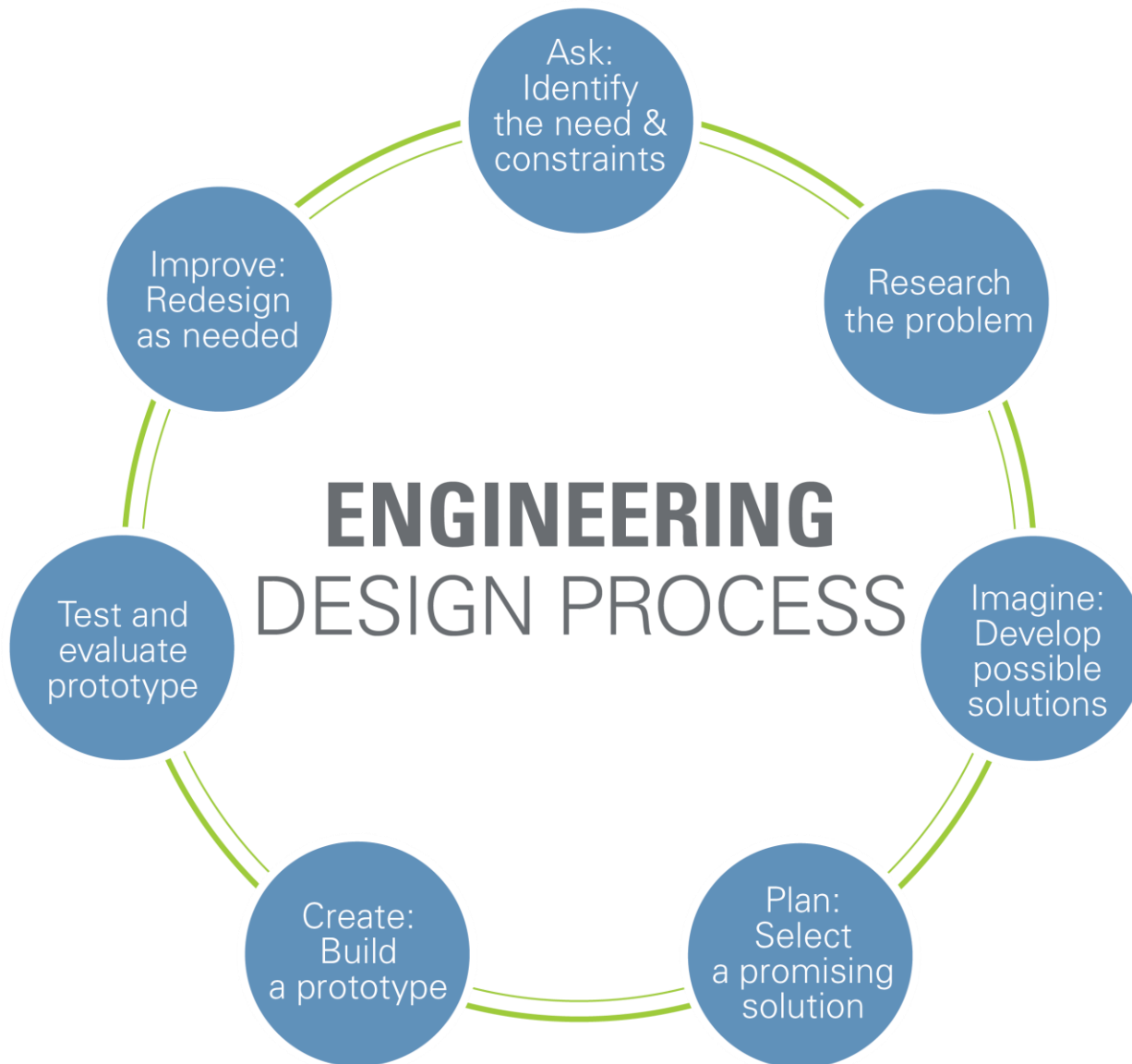
- Find the foci
- Cut a length of string that is equal to  $2a$
- Pin down each end of the string to the foci
- Trace the string around the edge of the ellipse

# Your engineering design challenge

Today's task is to demonstrate your knowledge of ellipses by creating an **elliptical pool table**



# Steps to guide you...



Follow the steps of the **engineering design process** to create your table

Note the brainstorming, planning and redesigning steps!

# Design Constraints

- Elliptical-shaped pool table
  - One focal point is the pocket
  - The other focal point is the break spot
- Group budget = \$10
- Maximum table size = 2 feet x 2 feet

For engineers, design constraints are the requirements and limitations that final design solutions must meet.



# Past student examples (for the teacher)

Standard formula of An Ellipse

$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

Meaning of These Terms

$(h, k)$  - center of ellipse  
 $a$  -  $\frac{1}{2}$  Length of Major Axis  
 $b$  -  $\frac{1}{2}$  Length of Minor Axis

Our Table and Lesson

Dimensions:  
 Minor Axis - 24 in or 2 ft  
 Major Axis - 36 in or 3 ft

The concept of this pool table is to demonstrate the foci property of an ellipse which indicates that if an object is "launched" within an ellipse from one focal point it will eventually go through the other focal point. This concept was what we applied to this table.

## Adnan Desai

Deriving The Standard Form Continued

Substitute values of  $h$  and  $k$  into the general formula

Standard Form

Deriving The Standard Form

$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

For this table we calculate  $a$  and  $b$  as following

$a = \frac{1}{2}$  Major Axis or  $2a =$  Major Axis  
 $2a = \frac{36 \text{ inches}}{2}$  or 3 feet

$a = 18$  inches

SIMILARLY

$b = \frac{1}{2}$  Minor Axis or  $2b =$  Minor Axis  
 $2b = \frac{24 \text{ inches}}{2}$  or 2 feet  
 $b = 12$  inches

## Shervin Nouri

Calculating The Foci

Calculate the foci of an ellipse you use the following formula

$$c^2 = a^2 - b^2$$

where  $c$  is the distance from center outward on the major axis to the foci

In the equation we used units of feet then converted back

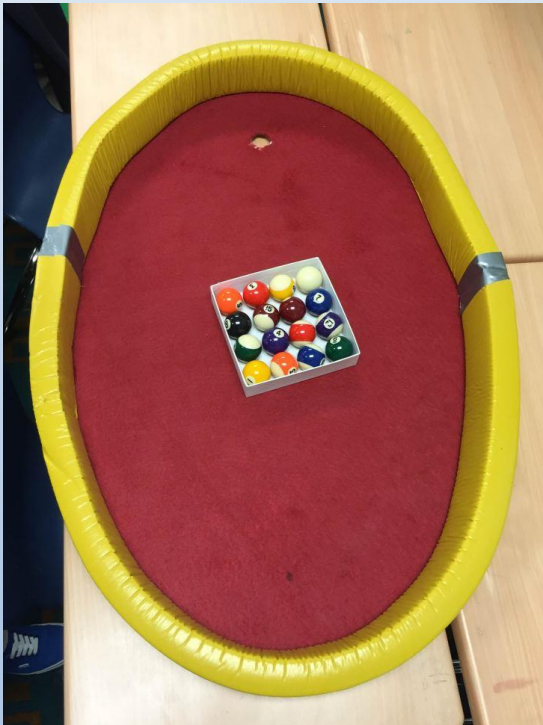
$$c^2 = 15^2 - 12^2$$

$$c^2 = 225 - 144$$

$$c^2 = 81$$

$$c = \sqrt{81} = 9 \text{ feet}$$

# Past student examples (for the teacher)





Past  
student  
examples  
(for the teacher)

