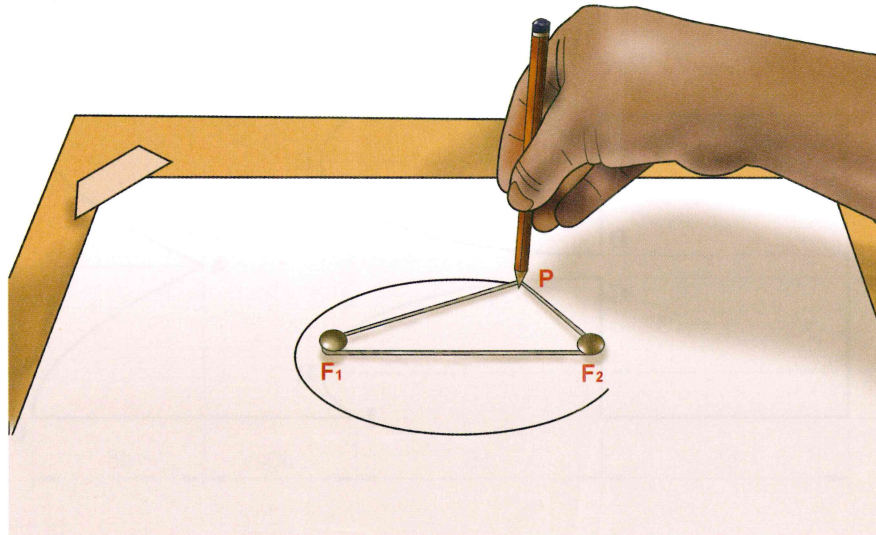


Focal Points of an Ellipse

The simplest way to draw an ellipse is to use two thumbtacks and a piece of string. Stick the thumbtacks in a sheet of paper and hook a piece of string around them. Keep the string stretched with the point of a pencil as shown in the figure below, and move the pencil around the tacks to trace an ellipse.

The thumbtacks are positioned at the **focal points** of the ellipse. The sum of the distances from the pencil point to the focal points is always the same and is equal to the length of the major axis.



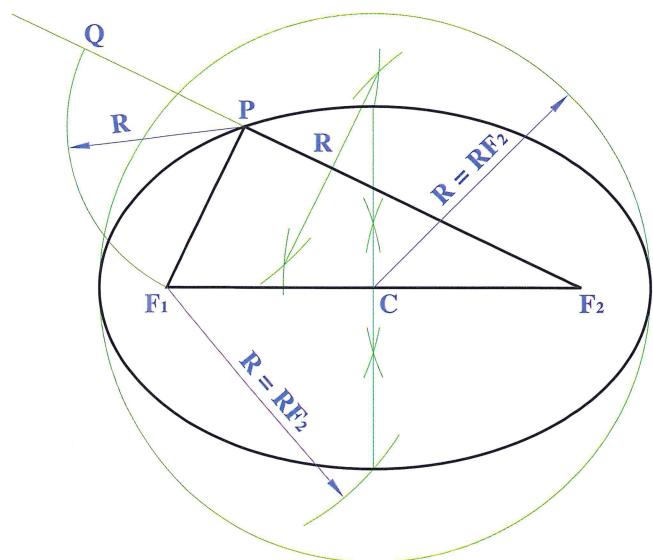
$$PF_1 + PF_2 = \text{major axis.}$$

This property holds for every point on the ellipse.

Example

In the triangle PF_1F_2 , P is a point on an ellipse and F_1 and F_2 are the focal points. Construct the ellipse.

1. Bisect F_1F_2 to locate the centre C of the ellipse.
2. Extend F_2P . With centre P and radius PF_1 , draw an arc to locate Q . $PF_1 + PF_2 = \text{major axis} = F_2Q$.
3. Bisect F_2Q to locate R . $RF_2 = \text{half the major axis}$.
4. Draw the major auxiliary circle of radius RF_2 about C .
5. With centre F_1 and radius RF_2 (half the major axis), swing an arc to locate one end of the minor axis. Construct the ellipse using any of the methods.



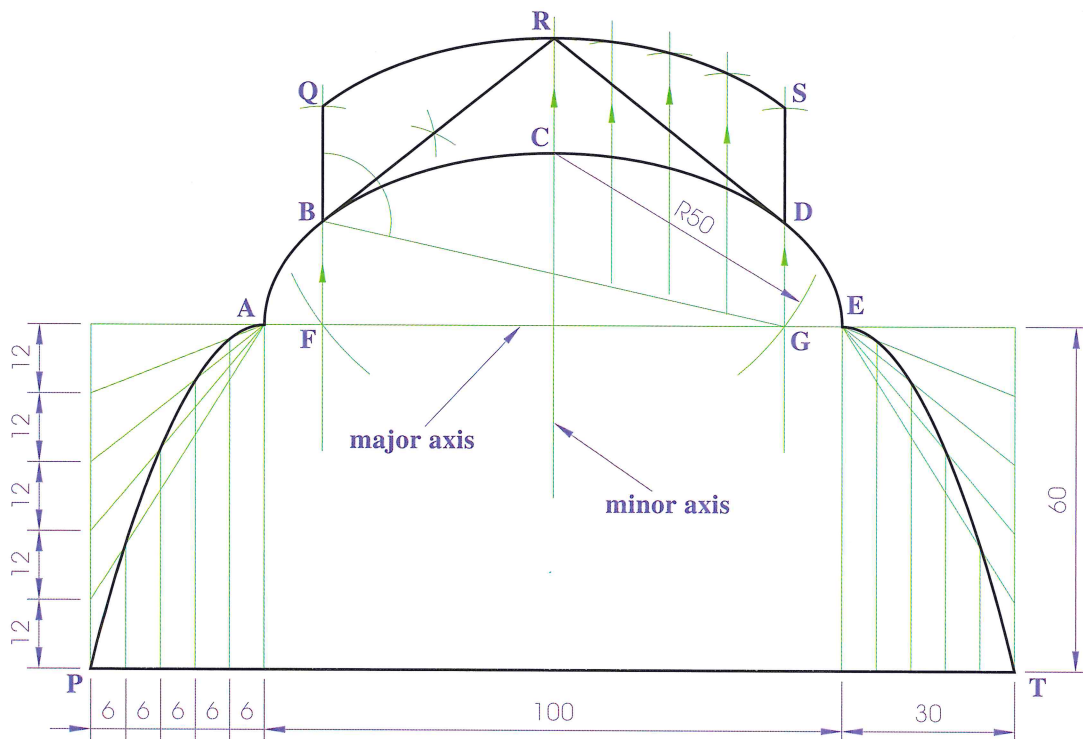
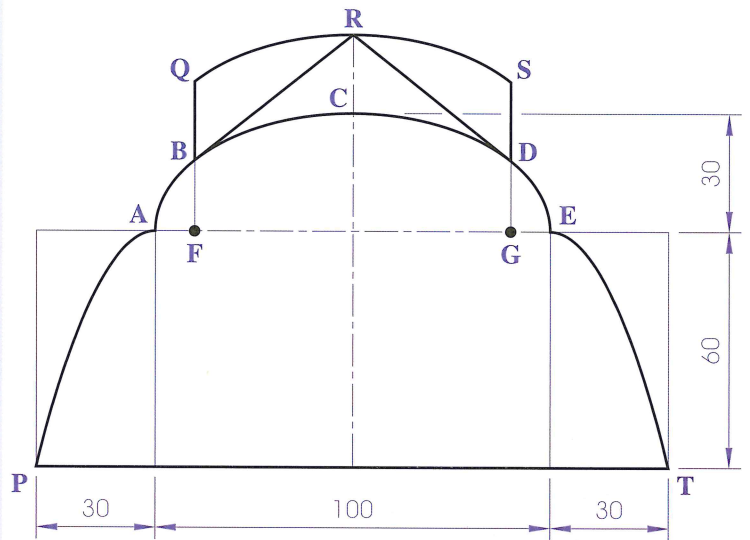
Example

The figure shows a design based on the elevation of a **sports stadium**. The curve ABCDE is based on a **semi-ellipse** with **major axis** 100 mm and **minor axis** 60 mm. The **focal points** F and G are indicated.

The lines BR and DR are tangential to the ellipse at points B and D respectively. The curve QRS is based on the same ellipse.

The curves AP and ET are **semi-parabolas** with vertices at A and E respectively.

Draw the design showing all construction lines.



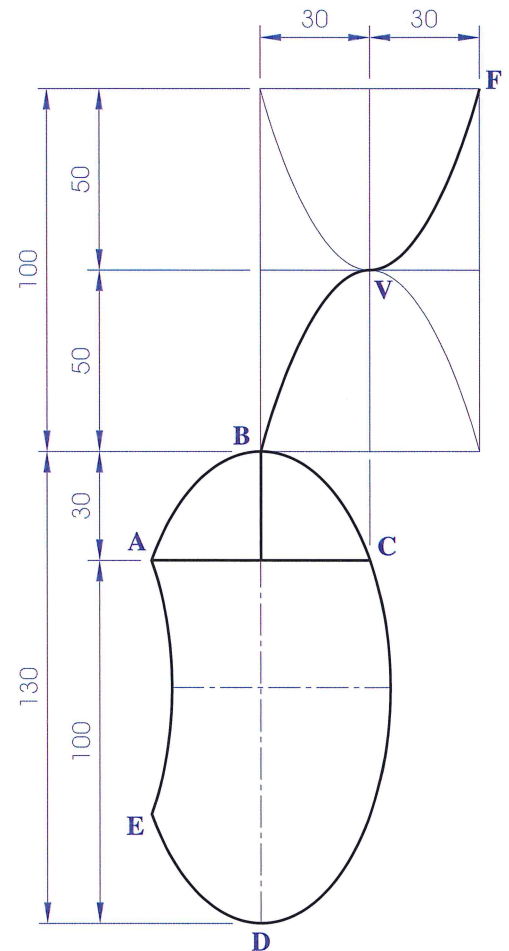
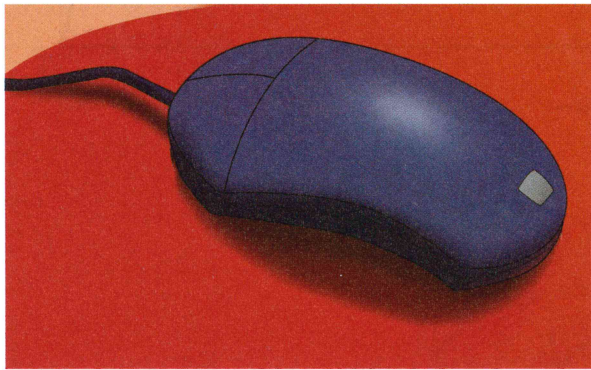
1. Draw the line PT and the two rectangles measuring 60 mm \times 30 mm. Construct a semi-parabola in each of the rectangles using the method outlined on page 165.
2. Draw the major and minor axes of the ellipse. Any suitable method for drawing the semi-ellipse may be used.
3. Locate the focal points F and G of the ellipse. Locate the points B and D on the semi-ellipse directly above F and G respectively. Construct the tangent BR, using the method outlined on page 113. Join D to R to obtain the second tangent.
4. The curve QRS is obtained by **translating** the portion BCD of the semi-ellipse upwards a distance equal to CR.

Exercises

- The figure represents a two-button **computer mouse** and **cable**. The curve ABCDE is based on an **ellipse** with **major axis** 130 mm long. The curve AE is based on the same ellipse.

The curves VB and VF are based on the same **semi-parabola** with the vertex at V for each parabola.

Draw the figure to the dimensions given showing all construction lines.



- The figure represents a design for a **mask**. The curve ABCDE is based on an **ellipse** having a **minor axis** of 60 mm and the curve JKL is based on the same ellipse. The curve AFE is **parabolic**.

Draw the figure to the dimensions given showing all constructions clearly.

