M182 Lecture Worksheet, Sec. 10.6, Part II **Name:**_____

Conic Sections (with a focus on the applications). Conic sections include circles, ellipses, parabolas, and hyperbolas; they are so named because they can be obtained by intersecting a cone with an appropriately placed plane.

Parabolas and ellipses are two types of conic sections that have important properties that make them especially useful for certain physical applications.

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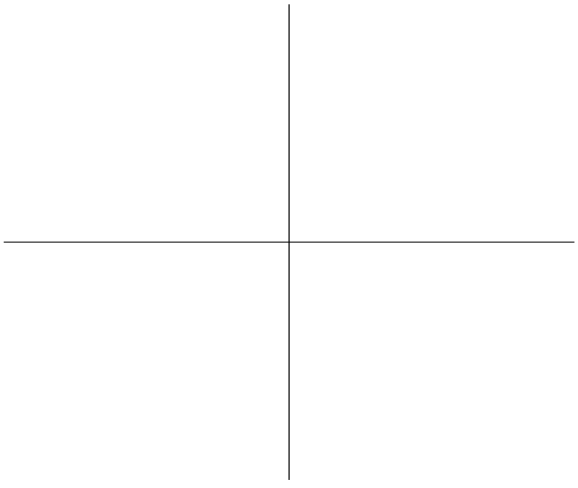
1. **Parabolas:**

   A **parabola** is the set of points in a plane that are equidistant from a fixed point F (called the **focus**) and a fixed line (the **directrix**). Your text derives the following formula for the equation of a parabola with focus $(0, p)$ and directrix $y = -p$.

   $$x^2 = 4py$$

   Sketch the graph of such a parabola on the axes below:

   (a) Why is the point F called the focus?

   (b) Based on your answer above, list some good physical applications for parabolas.

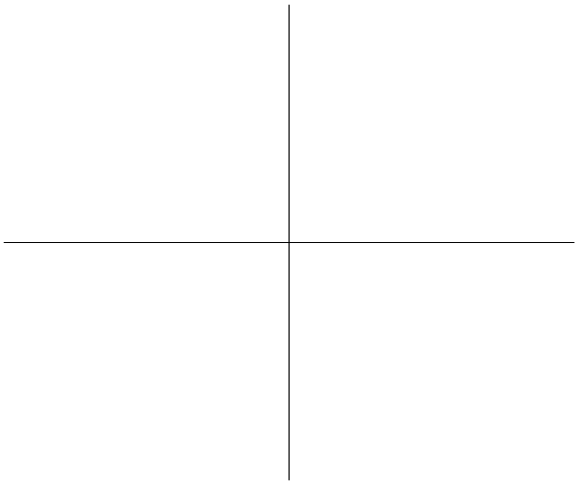
(a) **Example:** If a radio telescope is created by revolving the curve $y = 2x^2/25$ about the y-axis, where should the receiver be placed in order to take advantage of the focal point of the parabola?

(b) **Example:** A natural limestone depression on a small (imaginary) island off the coast of Africa has been selected as the site of a new giant radio telescope. The depression is 200 meters across and 20 meters deep. How high should the receiver be placed in order to best capture the incoming signals from outer space?

2. **Ellipses:**

The equation $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is an equation for an ellipse centered at the origin with focal points (i.e. foci) located at $(\pm c, 0)$, where $c^2 = a^2 + b^2$.

Sketch such an ellipse on the axes below:



Ellipses are important in engineering applications because any sound / light / radio waves emitted from one focus will be concentrated at the other focus.

List several uses for ellipses in physical applications.

(a) **Example (Number 43, page 681):** The point in lunar orbit nearest the surface of the moon is called **perilune**, and the point farthest from the surface is called **apolune**. The Apollo 11 spacecraft was placed in an elliptical orbit with perilune altitude 110 km and apolune altitude 314 km (above the moon).

Find an equation for this elliptical orbit, given that the radius of the moon is 1728km and the center of the moon is located at one focus.

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3. **Assigned Homework**: 3, 5, 7, 9, 13, 15, 17, 23, 29, 33, 39, *45, **53