

**Exercise 1.** We will explore a surface through contour lines.

- The vertical contour lines are all of the form  $\underline{x^2 + y^2 = 9}$ .
- Horizontal contour lines across the  $y$  direction are of the form  $\underline{x^2 = 9 - a^2}$  with  $-3 \leq a \leq 3$ . These lines live in planes parallel to the  $xz$ -plane.

A key fact is that this shape is *symmetric across the origin*. Do the following:

1. Draw an example of the vertical contour lines on a plane. What figure are they?
2. Draw the horizontal contour lines at the values of  $a = -3$  and  $a = 0$ . Describe the figures and mention what happens for values  $-3 < a < 0$ .
3. Draw a diagram in 3 dimensions joining both sets of contour lines. What is the surface that we obtain?

**Exercise 2.** Consider the expressions

$$z = (x+y)(x-y), \quad \begin{cases} x = r\cos(\theta) \\ y = r\sin(\theta) \end{cases}$$

Calculate the partial derivatives  $\frac{\partial z}{\partial r}$  and  $\frac{\partial z}{\partial \theta}$ .