14.1, number 47: **Let $f(x, y) = \sqrt{x^2 + y^2 + 4}$.**

(a) **Graph the surface $z = f(x, y)$.**

(b) **Draw a few level sets of f.**

Answer:

We have graphed $z = \sqrt{x^2 + y^2 + 4}$ before! Square both sides and get $z^2 = x^2 + y^2 + 4$, which is a hyperboloid of two sheets with the z-axis in the middle. (It looks like one drew the hyperbola $z^2 - y^2 = 4$ in the yz-plane and then rotated it about the z-axis.

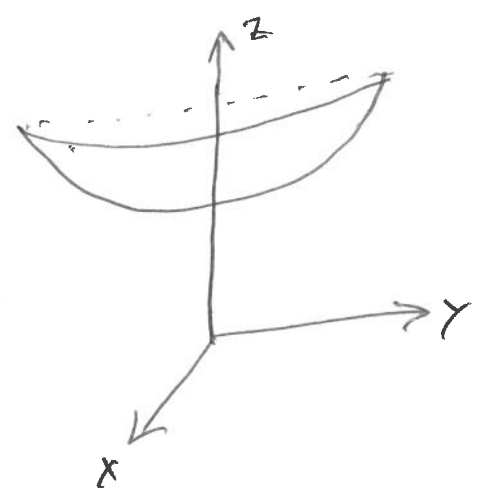
Of course, $z = \sqrt{x^2 + y^2 + 4}$ is the top sheet of the hyperboloid, because z is always at least 2.

The level sets of f are the origin and a bunch of concentric circles with center at the origin. The origin is the level set $f(x, y) = 2$; the circle of radius 1 is the level set for $f(x, y) = \sqrt{5}$, etc.

There is a picture on the next page.

Picture 14.1 number 47

The Graph of $z = f(x,y)$ for $f(x,y) = \sqrt{x^2+y^2+4}$



Level sets for $f(x,y) = \sqrt{x^2+y^2+4}$