Warmups

① $z = \sqrt{x^2+y^2}$

② $z = x^2+y^2$

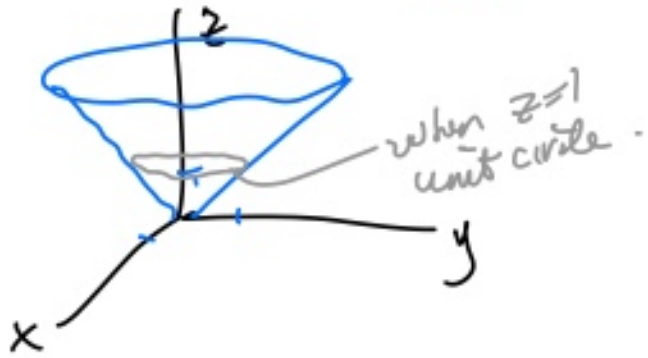
③ $z = -x^2+y^2$.

for each:
(a) graph
(b) In xy plane, graph slices where z = constant.
(eg $z=0$, $z=1$, $z=-1$, $z=2$).

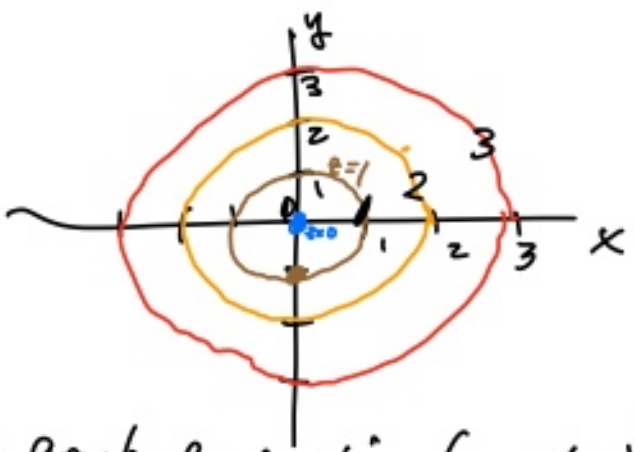
In each of these cases, these are graphs of functions $f: \mathbb{R}^2 \to \mathbb{R}$, i.e. $f(x,y)$ = function of x & y

$z = f(x,y)$ = output $\Leftrightarrow$ height above the xy plane = value of the function.

① $z = \sqrt{x^2+y^2} = r$



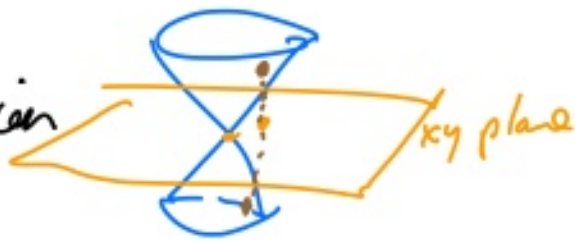
Contour Diagram (z = constant)



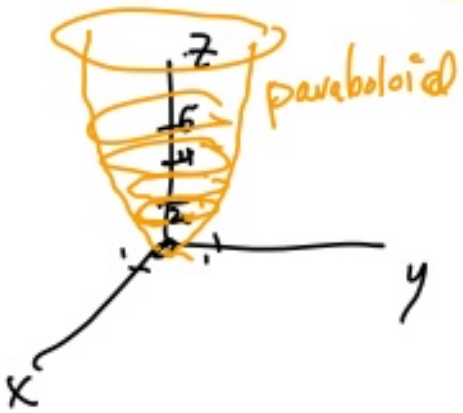
Note: In $\mathbb{R}^3$, a graph is the graph of a function ($z = g(x,y)$) if every vertical line (from a point in the xy plane) hits the graph only once.

eg $z = \sqrt{x^2+y^2}$ function

$z^2 = x^2+y^2$ not a function



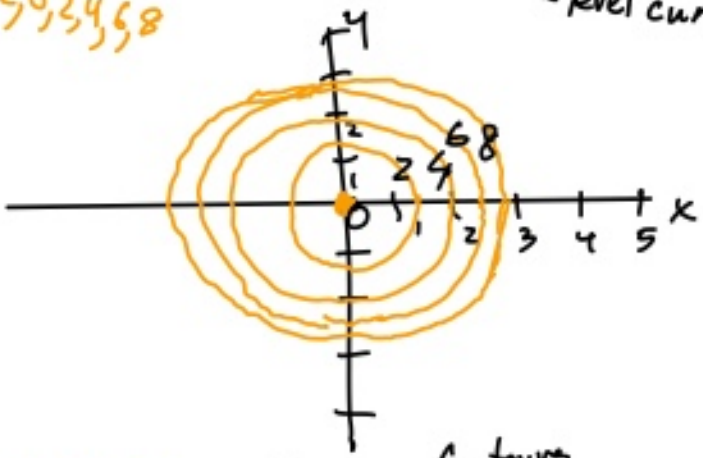
(2) $z = x^2 + y^2$



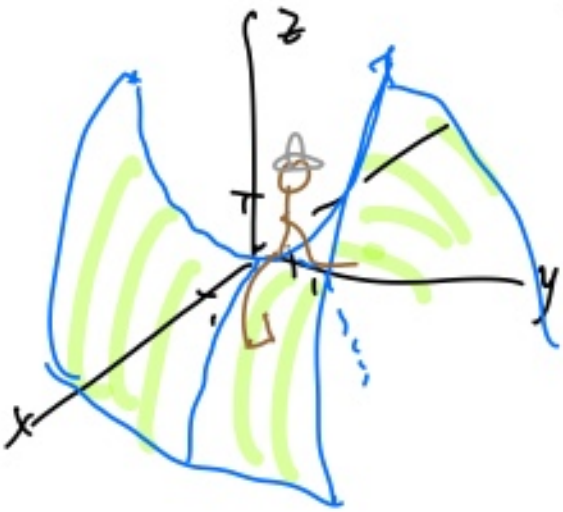
Contour Diagram

$z = 0, 2, 4, 6, 8$

Contours = level sets = level curves

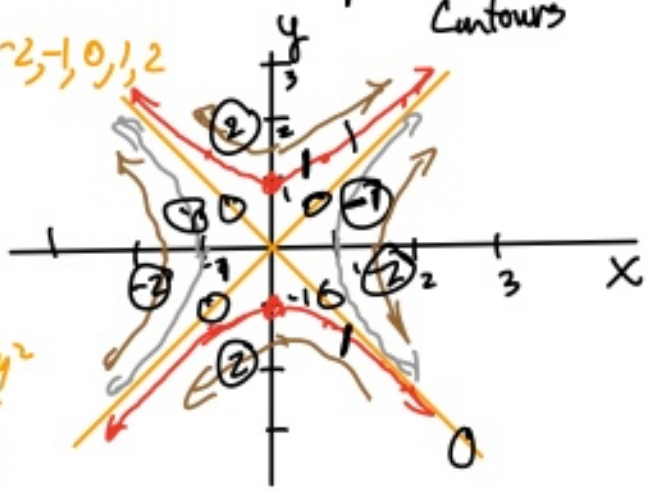


(3) $z = -x^2 + y^2$ "saddle surface"



Contours

$z = -2, -1, 0, 1, 2$



$z = 0$

$0 = -x^2 + y^2$

$x^2 = y^2$

$\pm x = y$

$1 = y^2 - x^2$

$-1 = y^2 - x^2$

$1 = x^2 - y^2$

(4) $z = 2x^2 - 8y^2$

(5) $z = xy$

SageMathCell

ype some Sage code below and press Evaluate.

```
1  f(x,y)=-x^2+y^2
2  a= contour_plot(f(x,y),(-3,3),(-3,3),labels=True,contours=10)
3  show(a)
4  var("x,y,z")
5  b=plot3d(f(x,y),(x,-3,3),(y,-3,3))
6  show(b)
```

Test Corrections

① On a separate paper, redo questions where you did not get full credit.

② In sentences, explain the math mistake(s) made on each of those in ①.

③ If both ① & ② are correct, I will return ½ of the points on that question(s).

& Can do this multiple times — final version should be done by March 19.

Work should be done by yourself or with consultation with me.