21) $f(x,y) = 3x - 6y + 18 = z$ $z - 3x + 6y = 18$ Plane $\vec{n} = \langle -3, 6, 1 \rangle$
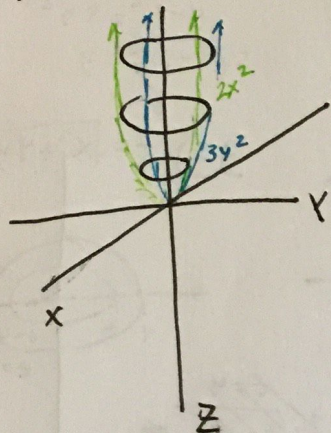
x cross: $-3x = 18$ y cross: $6y = 18$ z cross: $z = 18$ $D : \mathbb{R}^2$

$y = 0, z = 0$ $x = -6$ $x = 0, z = 0$ $y = 3$ $x = 0, y = 0$ $R : \mathbb{R}$

22) $f(x,y) = 2x^2 + 3y^2 = z$

In the xz plane, $y = 0$

In the yz plane $x = 0$

$\begin{cases} \text{Range} : \mathbb{R} & \text{Range} : \mathbb{R} \\ \text{Domain } \mathbb{R}^2 & \text{Domain } \mathbb{R}^2 \end{cases}$
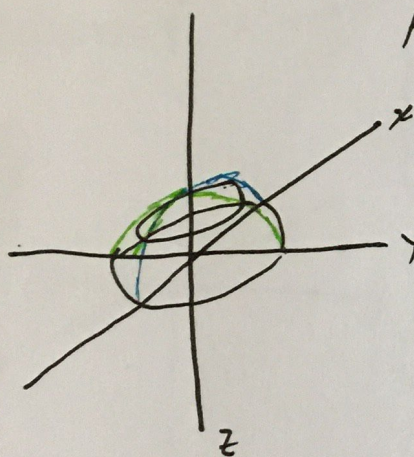
In xz plane, $y = 0$

In yz plane $x = 0$
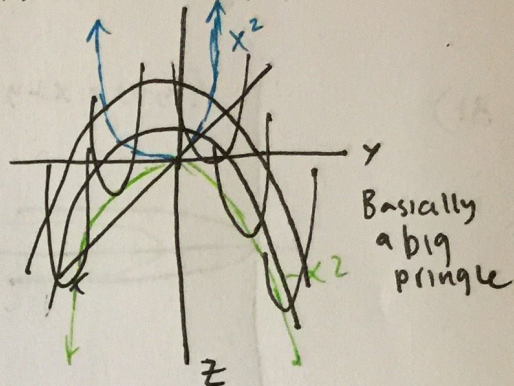
23) $f(x,y) = x^2 - y^2$

Basically a big pringle

24) $f(x,y) = \sqrt{1 - x^2 - y^2}$

In the xz, $y = 0$

In yz, $x = 0$

semicircle

Range $f \in \mathbb{R} : 0 \leq f \leq 1$

Domain $(x,y) \in \mathbb{R}^2 : (x^2 + y^2) \leq 1$
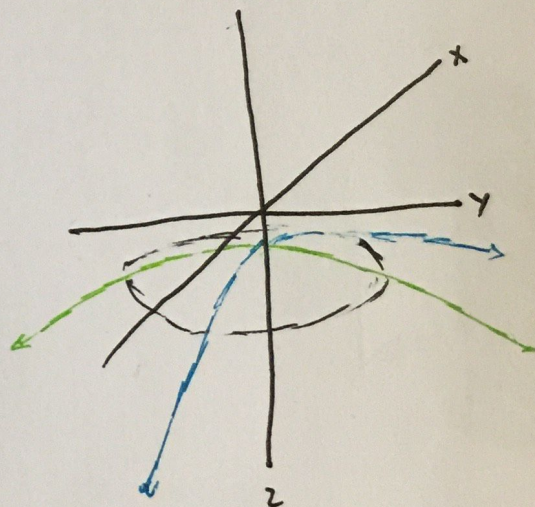
25) $-\sqrt{1 + x^2 + y^2} = f(x,y)$

In the xz, $y = 0$

In the yz, $x = 0$

Range $f \in \mathbb{R} : -1 \geq f$

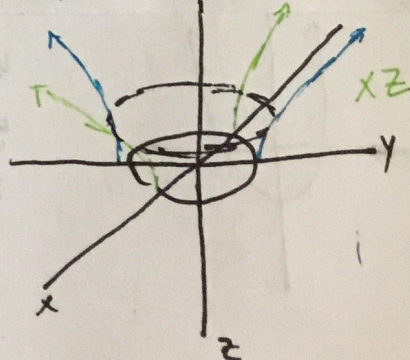Domain $(x,y) \in \mathbb{R}^2$

26) $f(x,y) = \sqrt{x^2 + y^2}$

XZ

YZ

only pos

$\sqrt{x^2}$
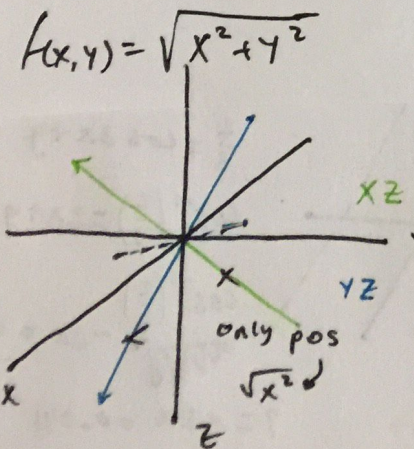
$\begin{cases} \text{Range} : f \in \mathbb{R} : f \geq 0 \\ \text{Domain} : \mathbb{R}^2 \end{cases}$

27) $f(x,y) = \sqrt{x^2 + y^2 - 1}$

XZ

Range: $f \in \mathbb{R} : f \geq 0$
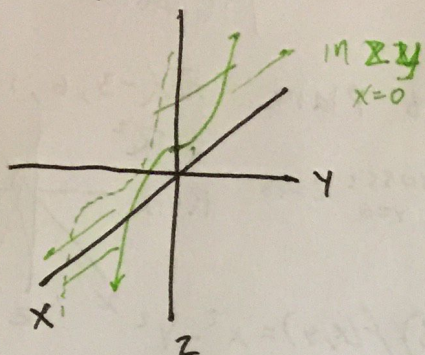
Domain: $(x,y) \in \mathbb{R}^2 : (x^2 + y^2) \leq 1$

28) $f(x,y) = y^3 + 1$

Domain $(x,y) \in \mathbb{R}^2$
Range: $f \in \mathbb{R}$

29) a) A
b) D
c) B
d) C

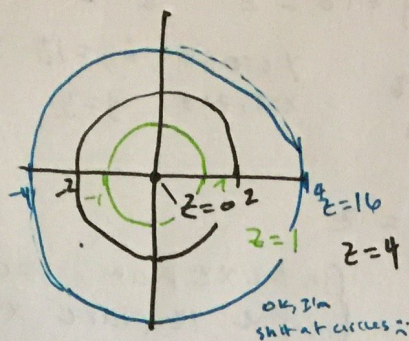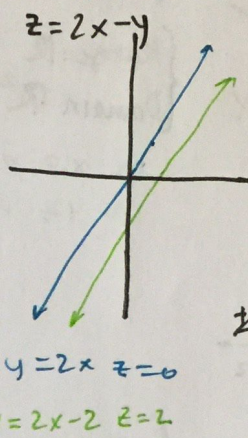**30)**

$z = 2$
$2 = \sqrt{x^2 + 4y^2}$
$4 = x^2 + 4y^2$
$4 - x^2 = 4y^2$
$\pm\sqrt{1 - \frac{1}{4}x^2} = y$
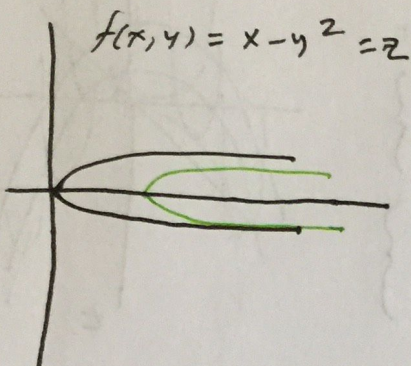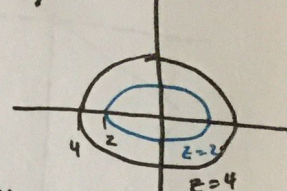
ok, I'm
shit at circles :(

31) $f(x,y) = x - y^2 = z$

$z = x - y^2$ $z = 0$
$x - y^2 = 0$ $y = \pm\sqrt{x}$

$z = x - y^2$ $x - 2 = y^2$
$2 - x = -y^2$ $\sqrt{x-2}$

32) $z = 2x - y$

$y = 2x$ $z = 0$
$y = 2x - 2$ $z = 2$

33) $z = \sqrt{x^2 + 4y^2}$

$z = 2$
$z = 4$

$\pm\frac{1}{2}\sqrt{x^2} \neq 0$

$0 = \sqrt{x^2 + 4y^2}$

$4y^2 = -x^2$

$\sqrt{y^2} = \pm\frac{1}{4}x^2$
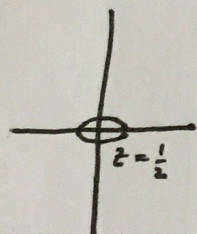
34) $z = e^{-x^2 - 2y^2}$

$z = \frac{1}{2}$

$1 = e^{-x^2 - 2y^2}$
$\ln 1 = -x^2 - 2y^2$
$2y^2 = e^{-x^2} - \ln 1$
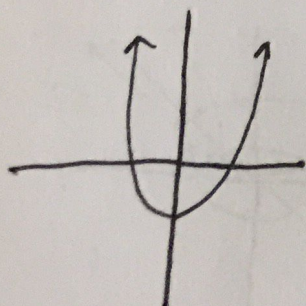$y = \sqrt{\dfrac{-x^2 - \ln 1}{2}}$

35)

$z = 4$
$z = 2$
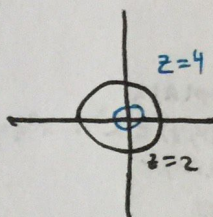
$z = \sqrt{25 - x^2 - y^2}$
$2 = \sqrt{25 - x^2 - y^2}$
$4 = 25 - x^2 - y^2$
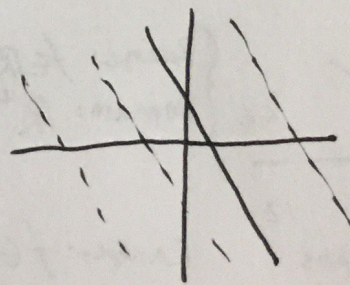$-21 = -x^2 - y^2$ $y = \pm\sqrt{-x^2 + 21}$

36) $z = \sqrt{y - x^2 - 1}$

$z = 2$ $4 = y - x^2 - 1$
$4 - y = -x^2 - 1$
$y = x^2 + 1 + 4$
$y = x^2 + 3$

37) $z = 3\cos 2x + y$

$z = 2$

$2 = 3\cos 2x + y$
$\frac{2}{3} = \cos 2x + y$
$\cos^{-1}\left(\frac{2}{3}\right) = 2x + y$
$\cos^{-1}\left(\frac{2}{3}\right) - 2x = y$

$y = -2x + 0.841$