14) $4x^2+9y^2+9z^2=36$

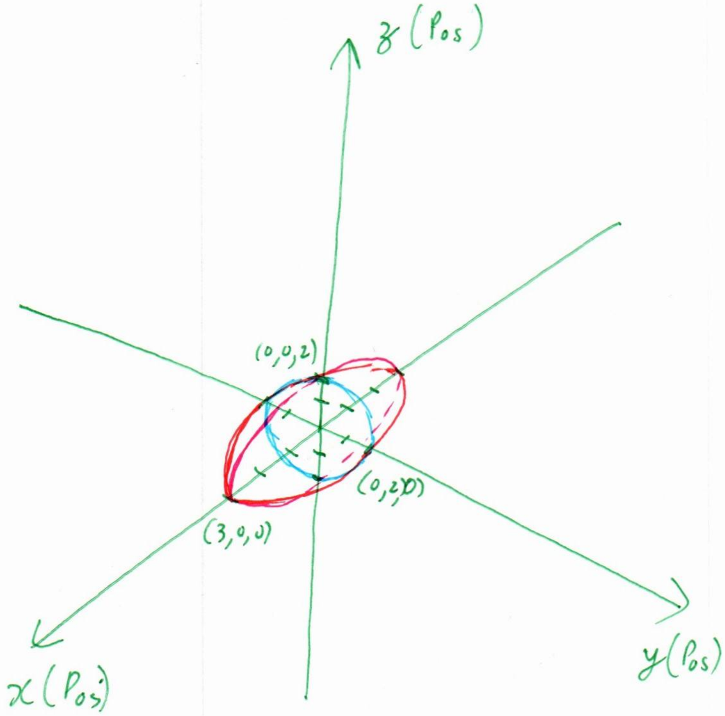
$$\frac{4x^2}{36}+\frac{9y^2}{36}+\frac{9z^2}{36}=1$$

$$\frac{x^2}{9}+\frac{y^2}{4}+\frac{z^2}{4}=1$$

$$\frac{x^2}{(3)^2}+\frac{y^2}{(2)^2}+\frac{z^2}{(2)^2}=1$$

if $x=0$ then $\frac{y^2}{(2)^2}+\frac{z^2}{(2)^2}=1$

circle of radius: $r=2$



if $y=0$ then

$$\frac{x^2}{(3)^2}+\frac{z^2}{(2)^2}=1$$

ellipse with longer side on x

if $z=0$ then

$$\frac{x^2}{(3)^2}+\frac{y^2}{(2)^2}=1$$

ellipse with longer side on x

ellipsoid with centered at origin
with intercepts: $x=\pm 3$, $y=\pm 2$, $z=\pm 2$

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16) $z^2-4x^2-y^2=4$

if $x=k$ then

$z^2-4k^2-y^2=4$

$z^2-y^2=4k^2+4$

hyperbola opening on z

if $y=k$ then

$z^2-4x^2-k^2=4$

$z^2-4x^2=k^2+4$

hyperbola opening on z

16) continued...

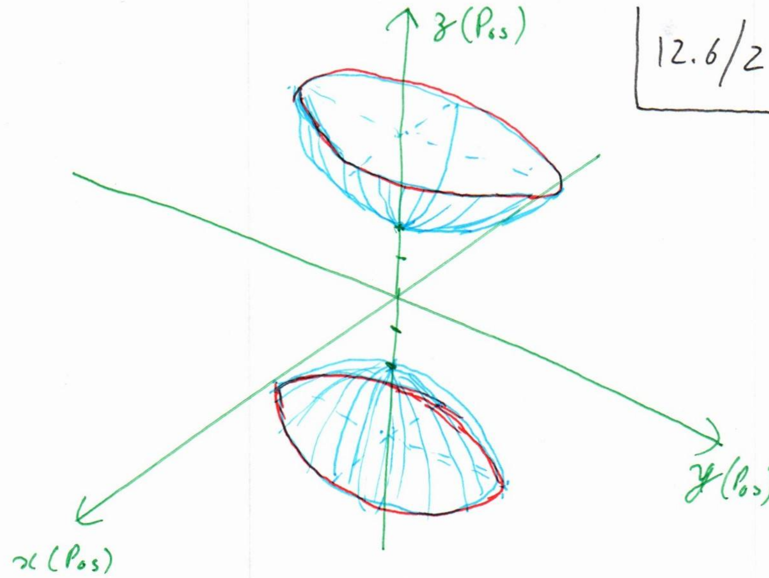
if $z = k$ then

$k^2 - 4x^2 - y^2 = 4$

$k^2 - 4 = 4x^2 + y^2$

$1 = \frac{x^2}{\frac{k^2-4}{4}} + \frac{y^2}{k^2-4}$

ellipse with longer side on y



hyperboloid of 2 sheets (with z-axis)

18) $3x^2 + y + 3z^2 = 0$

$y = -3x^2 - 3z^2$

if $x = 0$, then

$y = -3z^2$

parabola opening toward -y

if $z = 0$, then

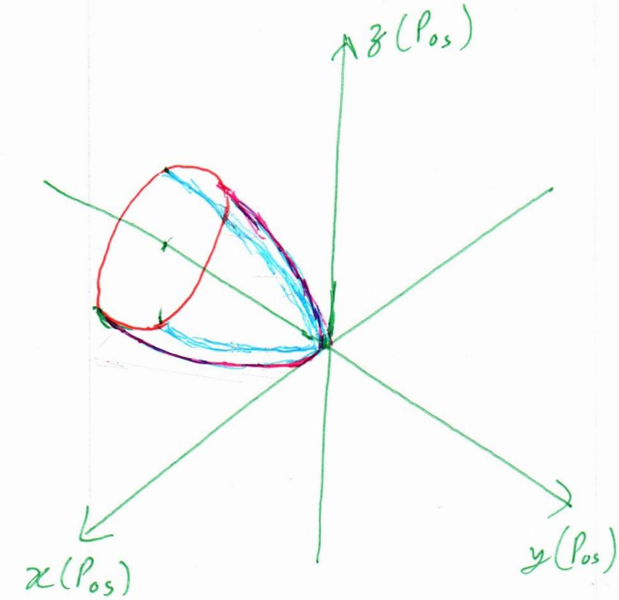
$y = -3x^2$

parabola opening toward -y

if $y = k$, then

$k = -3x^2 - 3y^2$ or $-k = 3x^2 + 3y^2$

so if $k < 0$, then it is a circle



a circular paraboloid with the y-axis, opening in the negative y-direction, and vertex the origin.

20) $3x^2 - y^2 + 3z^2 = 0$

if $x = k$, then

$3k^2 - y^2 + 3z^2 = 0$

$3k^2 = y^2 - 3z^2$

hyperbolas opening on y

if $k \neq 0$

and if $k = 0$, a line

$y = \sqrt{3}z$

if $y = k$, then

$3x^2 - k^2 + 3z^2 = 0$

$3x^2 + 3y^2 = k^2$

circle if $k \neq 0$

and a point if $k = 0$

if $z = k$, then

$3x^2 - y^2 + 3k^2 = 0$

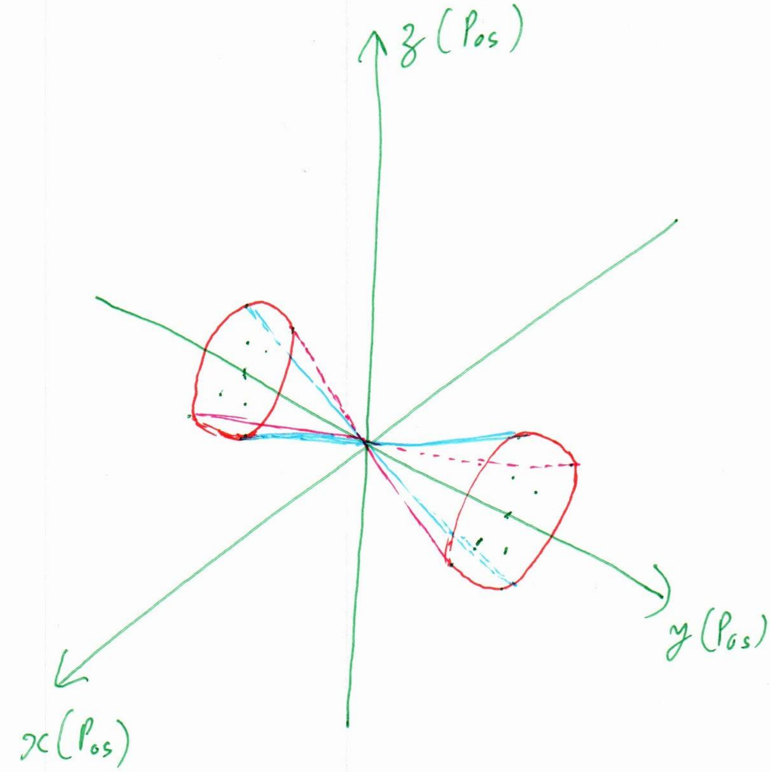
$3k^2 = y^2 - 3x^2$

hyperbolas opening on y

if $k \neq 0$

and if $k = 0$, a line

$y = \sqrt{3}x$



a circular cone with the y-axis and vertex the origin.

22) $x = y^2 - z^2$

if $x = k$, then

$k = y^2 - z^2$

if $k = 0$, then 2 lines $y = \pm z$

if $k > 0$, then
hyperbola opening on y

if $k < 0$, then
hyperbola opening on z

if $y = k$, then

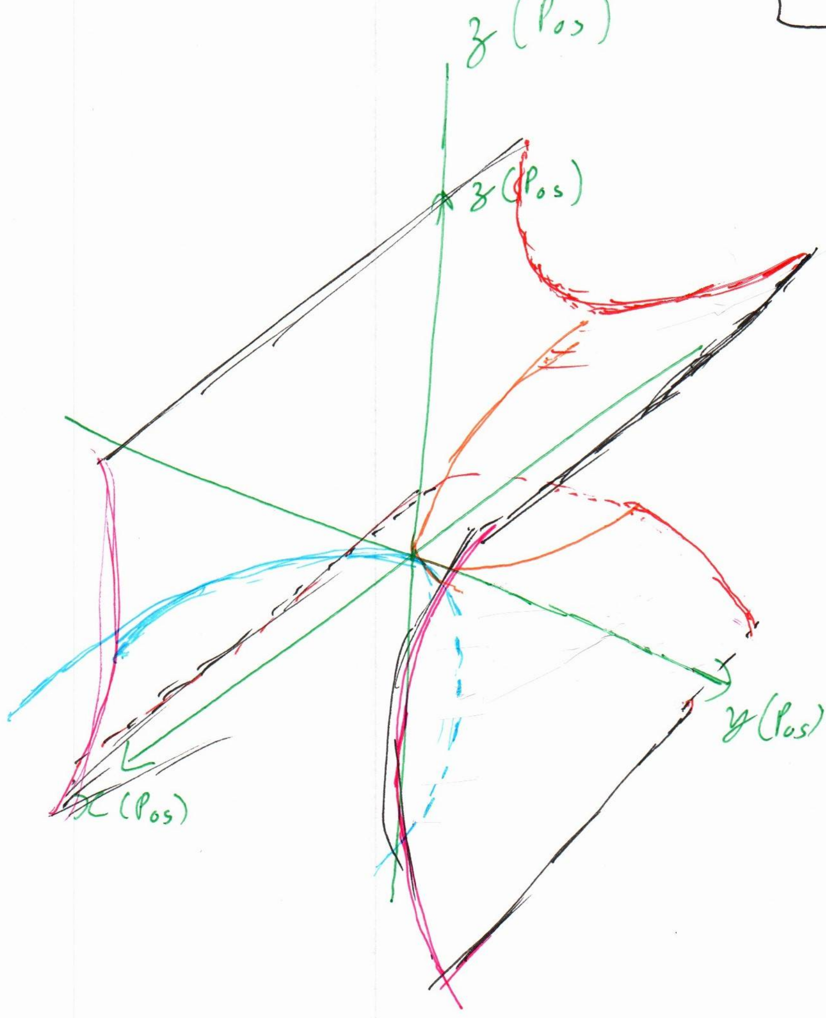
$x = k^2 - z^2$

parabola opening on $-x$ direction

if $z = k$, then

$x = y^2 - k^2$

parabola opening on $+x$ direction



hyperbolic paraboloid
centered at $(0,0,0)$
also known as saddle surface.

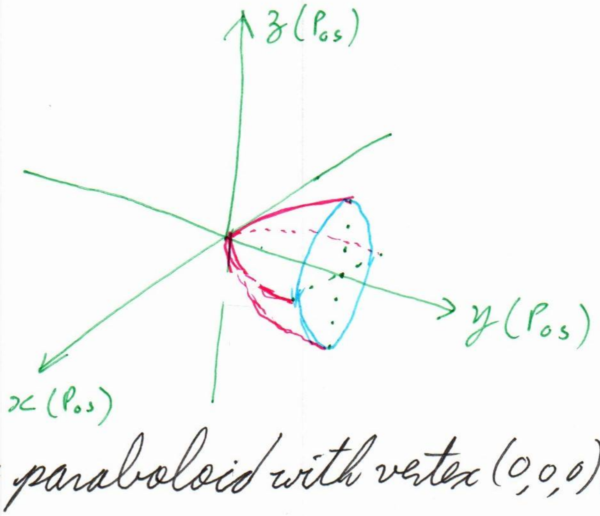
---

34) $4x^2 - y + 2z^2 = 0$

$4x^2 + 2z^2 = y$

$$\frac{x^2}{\frac{1}{4}} + \frac{z^2}{\frac{1}{2}} = y$$

$$\frac{x^2}{\left(\frac{1}{2}\right)^2} + \frac{z^2}{\left(\frac{1}{\sqrt{2}}\right)^2} = y$$



elliptic paraboloid with vertex $(0,0,0)$ and the y-axis

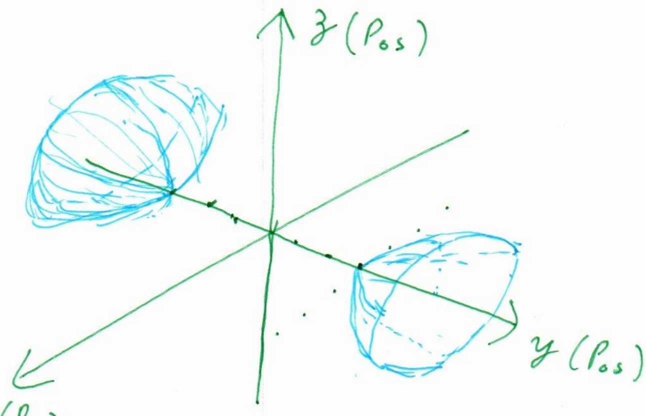
12.6/5

36) $y^2 = x^2 + 4z^2 + 4$

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

$\frac{-x^2}{4} + \frac{y^2}{4} - z^2 = 1$

$\frac{-x^2}{(2)^2} + \frac{y^2}{(2)^2} - \frac{z^2}{(1)^2} = 1$



hyperboloid of 2 sheets with the y-axis

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38) $x^2 - y^2 - z^2 - 4x - 2z + 3 = 0$

$\frac{b_x}{2} = \frac{-4}{2} = -2$

$\left(\frac{b_x}{2}\right)^2 = (-2)^2 = 4$

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

$\left(\frac{b_z}{2}\right)^2 = (1)^2 = 1$

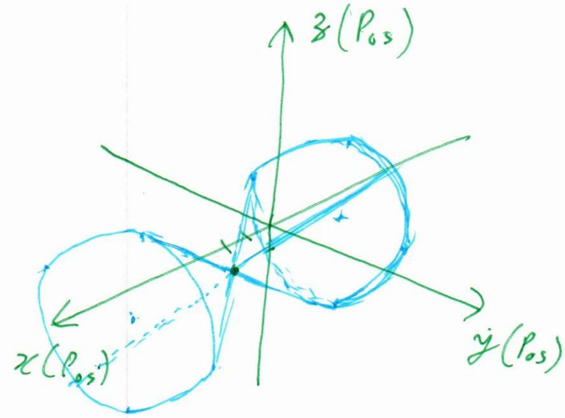
$x^2 - 4x - y^2 - z^2 - 2z = -3$

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

$(x-2)^2 - (y-0)^2 - (z+1)^2 = 0$

$(x-(2))^2 - (y-(0))^2 - (z-(-1))^2 = 0$

$(x-(2))^2 = (y-(0))^2 + (z-(-1))^2$



a circular cone with vertex $(2, 0, -1)$ and axis the horizontal line $y = 0, z = -1$.

12.6/6

40) $4x^2+y^2+z^2-24x-8y+4z+55=0$

$\frac{b_x}{2}=\frac{-6}{2}=-3$ $\left(\frac{b_x}{2}\right)^2=(-3)^2=9$

$\frac{b_y}{2}=\frac{-8}{2}=-4$ $\left(\frac{b_y}{2}\right)^2=(-4)^2=16$

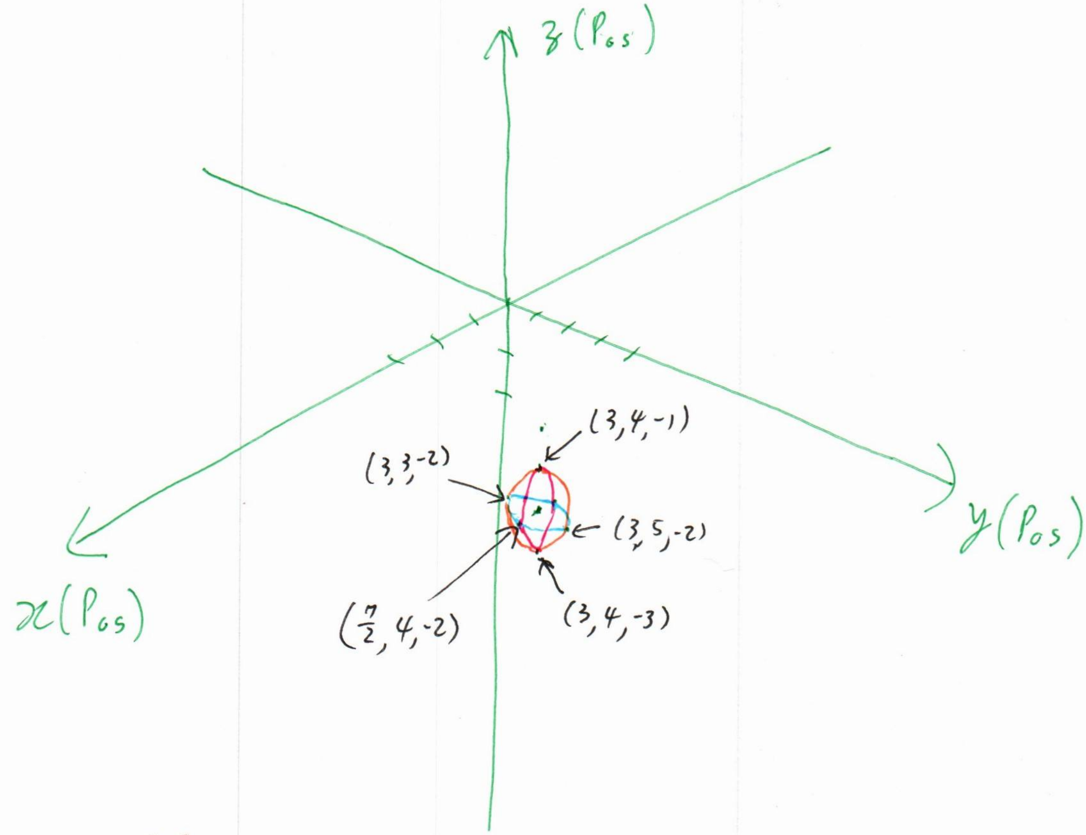
$\frac{b_z}{2}=\frac{4}{2}=2$ $\left(\frac{b_z}{2}\right)^2=(2)^2=4$

$4x^2-24x+y^2-8y+z^2+4z=-55$

$4(x^2-6x+9)+(y^2-8y+16)+(z^2+4z+4)=-55+4(9)+(16)+(4)$

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

$$\frac{(x-(3))^2}{\left(\frac{1}{2}\right)^2}+\frac{(y-(4))^2}{(1)^2}+\frac{(z-(-2))^2}{(1)^2}=1$$



an ellipsoid with center (3,4,-2)