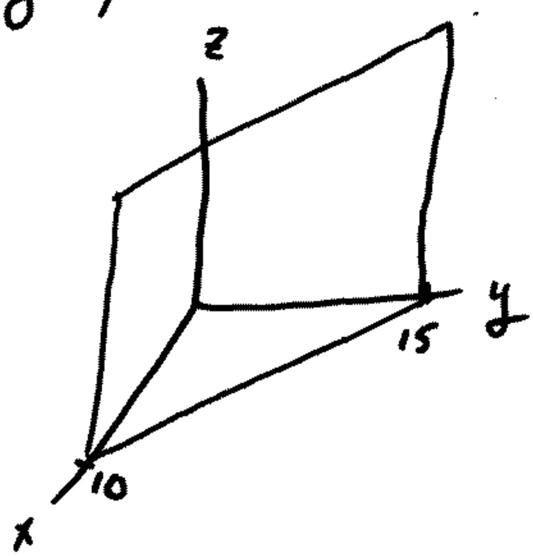
11.7/2 $3x + 2y = 30$ (z = anything)

This is a plane with normal vector $\langle 3, 2, 0 \rangle$

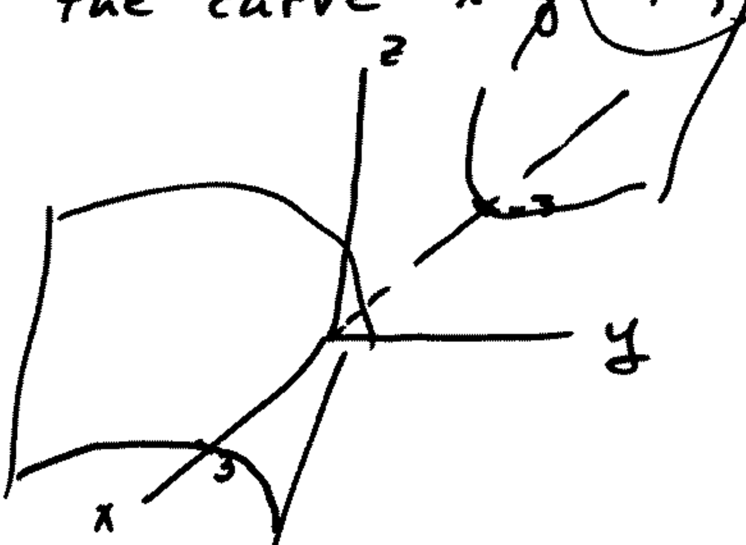
$3(x-10) + 2(y-0) + 0(z-0) = 0$

It goes through the point $(10, 0, 0)$

The plane can also be thought of as a cylinder on the line $3x + 2y = 30$ in the xy-plane.

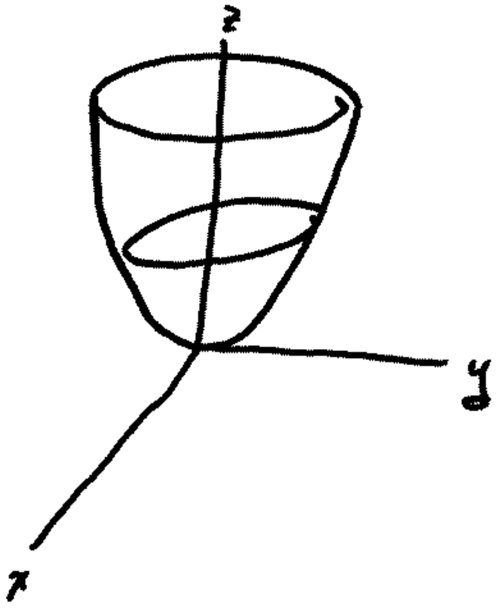


11.7/4 $y^2 = x^2 - 9$. This is a cylinder on the curve $x^2 - y^2 = 9$, which is a hyperbola



11.7/6 $\quad z = 4x^2 + 4y^2$

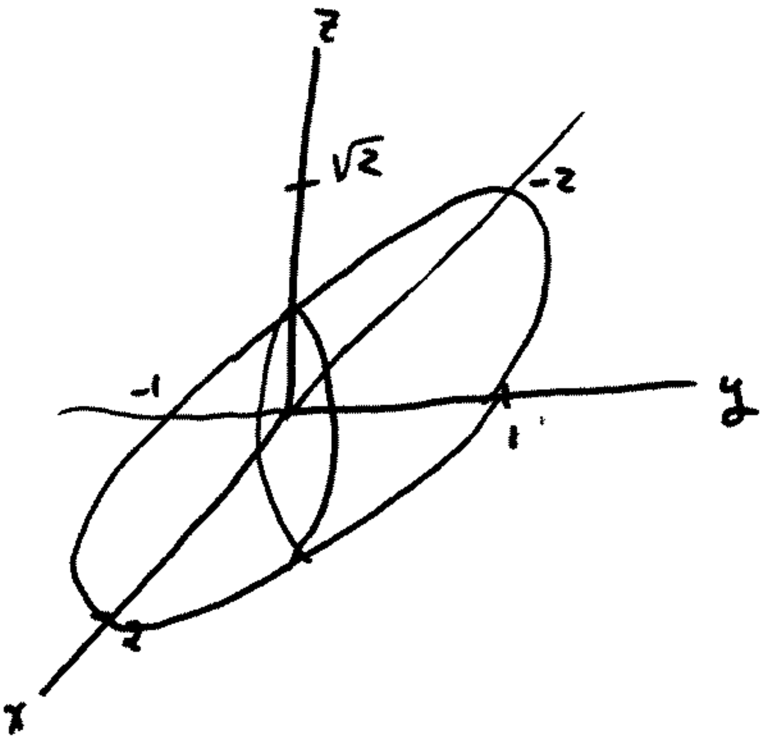
$x^2 + y^2 = \frac{z}{4}$ This is an elliptic paraboloid.



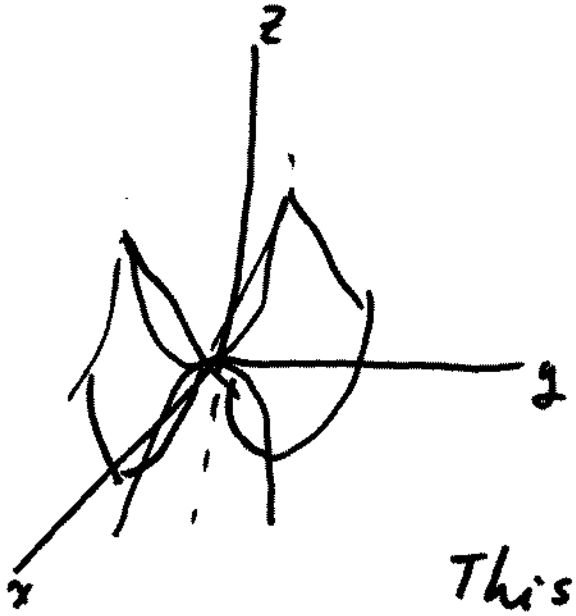
For $z = z_0$ constant, the trace is a circle.
For $x = x_0$ constant or for $y = y_0$ constant, the trace is a parabola.

11.7/24 $\quad x^2 + 4y^2 + 2z^2 = 4$

$\frac{x^2}{4} + \frac{y^2}{1} + \frac{z^2}{2} = 1$ <u>ellipsoid</u>.



11.7/20 $x^2 - 4y^2 = z$



When $x=0$,
parabola opening down

When $y=0$, parabola
opening up.

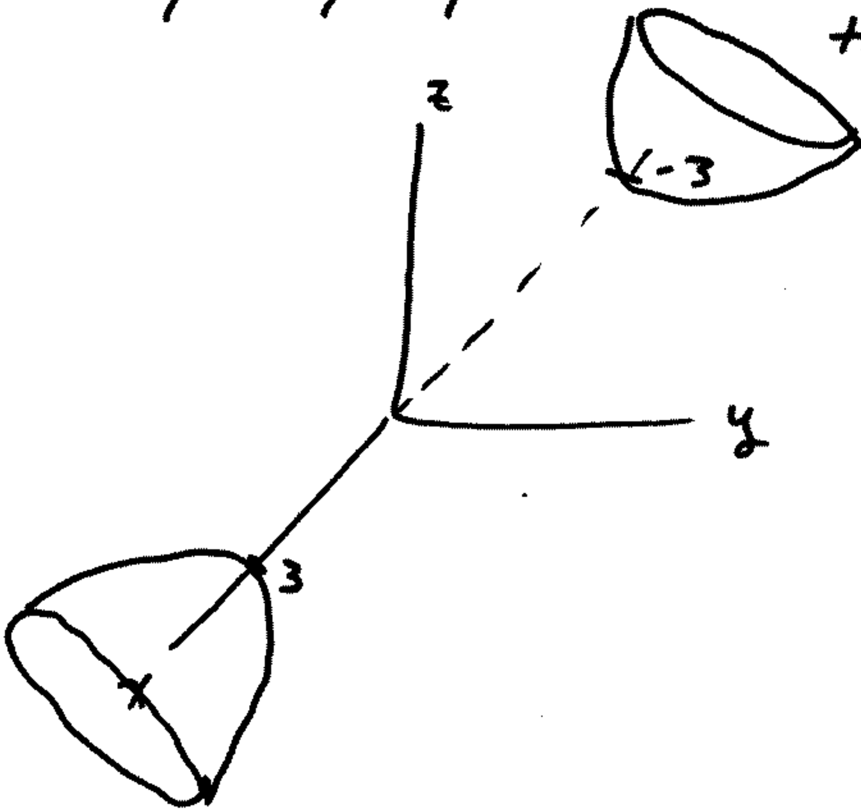
when $z=$ constant, hyperbola

This is a hyperbolic
paraboloid

11.7/26 $x^2 - y^2 - 9z^2 = 9$

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

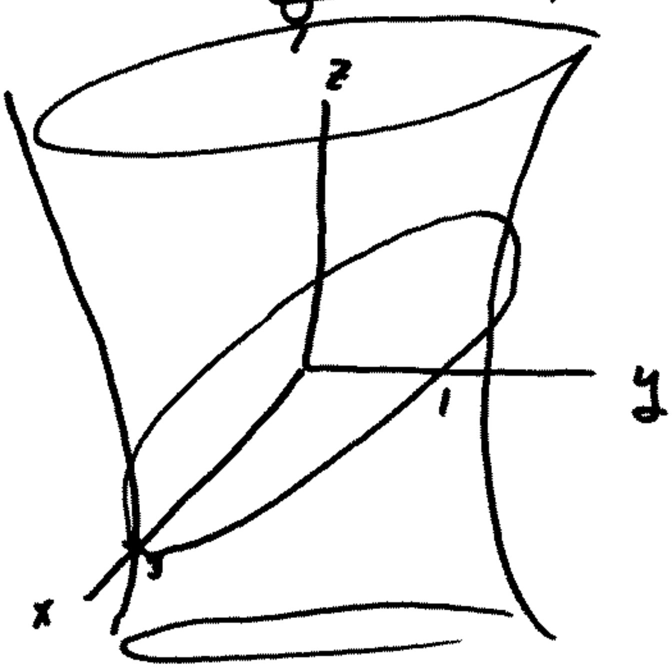
hyperboloid of two sheets



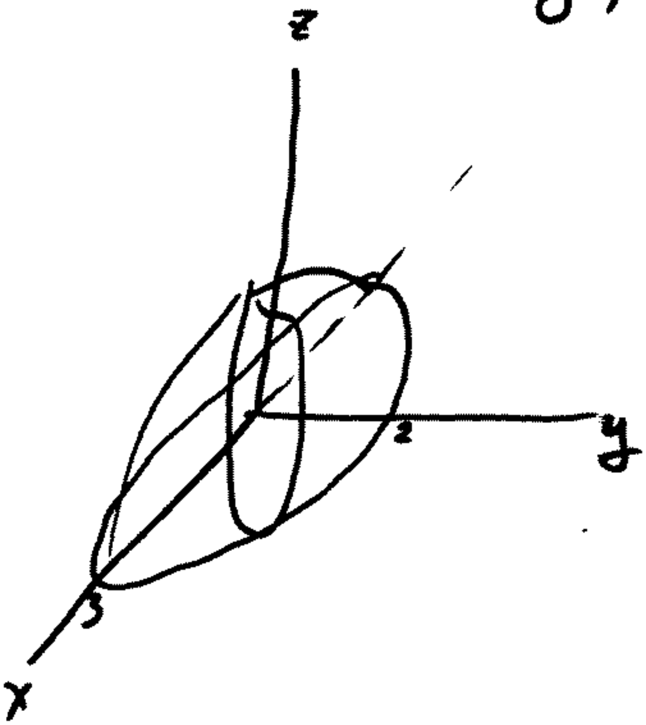
11.7/28 $y^2 + 4x^2 - 9z^2 = 36$

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

hyperboloid of one sheet



11.7/32. $4x^2 + 9y^2 = 36$ is an ellipse in the xy plane



Rotate around y-axis.

We replace x by $\sqrt{x^2+z^2}$. So x^2 is replaced by x^2+z^2

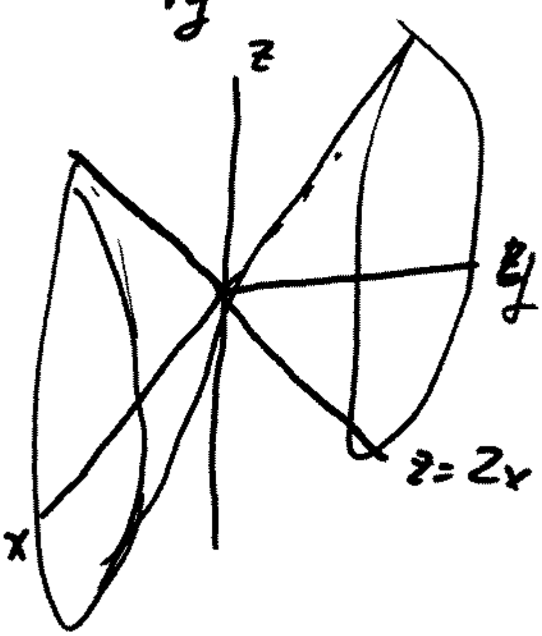
$$4x^2 + 4z^2 + 9y^2 = 36$$

11.7/40 $z = 2x$ around x-axis.

Replace z with $\sqrt{y^2+z^2}$

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

$\cancel{z^2 = x^2}$ This is a double cone



11.8/2 $\quad r=3, \quad \theta=\frac{3\pi}{2}, \quad z=-1$

so $x=3\cos\frac{3\pi}{2}=3\cdot 0=0$

$y=3\sin\frac{3\pi}{2}=3\cdot(-1)=-3$

$(x,y,z)=(0,-3,-1)$

11.8/3 $\quad r=2 \quad \theta=\frac{3\pi}{4} \quad z=3$

$x=2\cdot\cos\frac{3\pi}{4}=2\cdot\frac{-\sqrt{2}}{2}=-\sqrt{2}$

$y=2\cdot\sin 3\pi/4=2\cdot\frac{\sqrt{2}}{2}=\sqrt{2}$

$(x,y,z)=(-\sqrt{2},\sqrt{2},3)$

11.8/10 $\quad \rho=4 \quad \phi=\pi/6 \quad \theta=\frac{2\pi}{3}$

$x=4\sin\frac{\pi}{6}\cos\frac{2\pi}{3}=4\cdot\frac{1}{2}\cdot\frac{-1}{2}=-1$

$y=4\sin\pi/6\sin\frac{2\pi}{3}=4\cdot\frac{1}{2}\cdot\frac{\sqrt{3}}{2}=\sqrt{3}$

$z=4\cos\pi/6=4\cdot\frac{\sqrt{3}}{2}=2\sqrt{3}$

$(x,y,z)=(-1,\sqrt{3},2\sqrt{3})$

11.8/23 $r=5$ cylindrical coordinates.

This is a cylinder of radius 5.

11.8/24 $\theta = \frac{3\pi}{4}$ cylindrical or spherical coordinates

This is a plane containing the z-axis. It makes an angle of $\frac{3\pi}{4}$ radians with the x-z plane

11.8/26 $\rho = 5$ spherical coords.

This is a sphere of radius 5, centered at the origin.

11.8/28 $\phi = \frac{5\pi}{6}$ spherical coords.

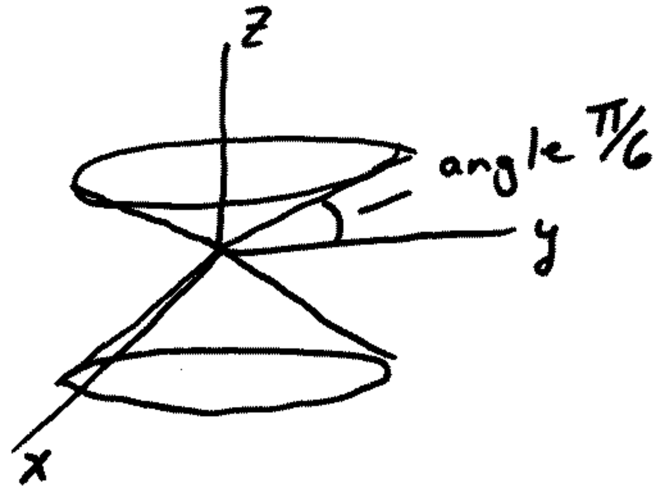
This is a cone

$x = \rho \cdot \frac{1}{2} \cos\theta$

$y = \rho \cdot \frac{1}{2} \sin\theta$

$z = \rho \cdot -\sqrt{3}/2$

$$\boxed{z^2 = 3x^2 + 3y^2}$$



cylindrical coords.

11.8/33 $\quad r = 4\cos\theta.$ Multiply both sides by r: $\quad r^2 = 4r\cos\theta$

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

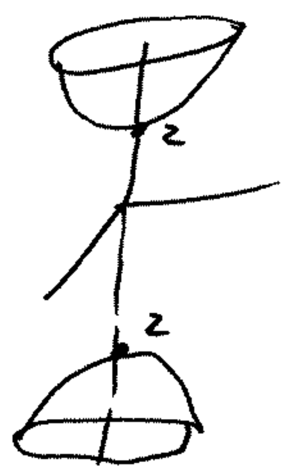
$$x^2 - 4x + 4 + y^2 = 0 + 4$$

$$(x-2)^2 + y^2 = 4 \qquad (z \text{ can be anything})$$

this is a cylinder of radius 2, with axis being the ~~z~~ vertical line through $(x, y, z) = (2, 0, 0)$

11.8/32 $\quad z^2 - 2r^2 = 4 \qquad$ cylindrical coords.

$z^2 - 2x^2 - 2y^2 = 4.$ This is a hyperboloid of two sheets.



11.8/40 $x^2+y^2=2x$

Cylindrical: $r^2=2r\cos\theta$

Spherical: $\rho^2\sin^2\phi\cos^2\theta+\rho^2\sin^2\phi\sin^2\theta=$

$2\rho\sin\phi\cos\theta$

Since $\cos^2\theta+\sin^2\theta=1$, this becomes

$$\rho^2\sin^2\phi=2\rho\sin\phi\cos\theta$$

$$\boxed{\rho\sin\phi=2\cos\theta}$$

11.8/39 $x^2+y^2+z^2=25$

Cylindrical: $r^2+z^2=25$

Spherical: $\rho^2=25$ or $\rho=5$

11.8/54 $y^2-z^2=1$, rotated around z-axis

We must replace y with $\sqrt{x^2+y^2}$ (See 11.7),

which is r in cylindrical coords.

$$\boxed{r^2-z^2=1}$$