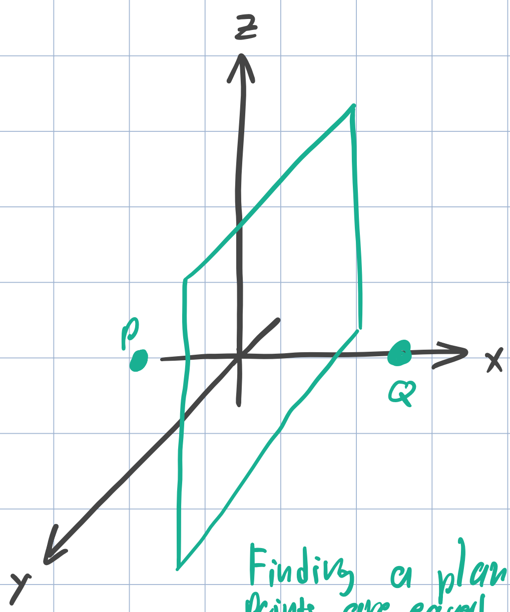
Find an equation, or a set of equations, to describe the set of points that are equidistant from the points $P(-4, 0, 0)$ and $Q(6, 0, 0)$. (Enter your answers as a comma-separated list of equations.)

Set of equidistant points : $N(x, y, z)$



Finding a plane whose points are equal distance from P and Q.

$$\vec{r}_{p \text{ to } N} = N - P$$

$$= \langle x+4, y, z \rangle$$

$$|\vec{r}_{p \text{ to } N}| = \sqrt{(x+4)^2 + y^2 + z^2}$$

$$\vec{r}_{q \text{ to } N} = N - Q$$

$$= \langle x-6, y, z \rangle$$

$$|\vec{r}_{Q \text{ to } N}| = \sqrt{(x-6)^2 + y^2 + z^2}$$

Let $|\vec{r}_{p \text{ to } N}| = |\vec{r}_{Q \text{ to } N}|$

$$\sqrt{(x+4)^2 + y^2 + z^2} = \sqrt{(x-6)^2 + y^2 + z^2}$$

$$(x+4)^2 \cancel{+y^2} \cancel{+z^2} = (x-6)^2 \cancel{+y^2} \cancel{+z^2}$$

$$\cancel{x^2} + 8x + 16 = \cancel{x^2} - 12x + 36$$

$$20x = 20$$

$$x = 1$$

Find an equation of the plane that is parallel to the *xz*-plane and is located 13 units to the left of the *xz*-plane in standard perspective.

Define the new plane with normal vector $\vec{n}$ and point p.

$\hat{n} = \langle 0, 1, 0 \rangle$

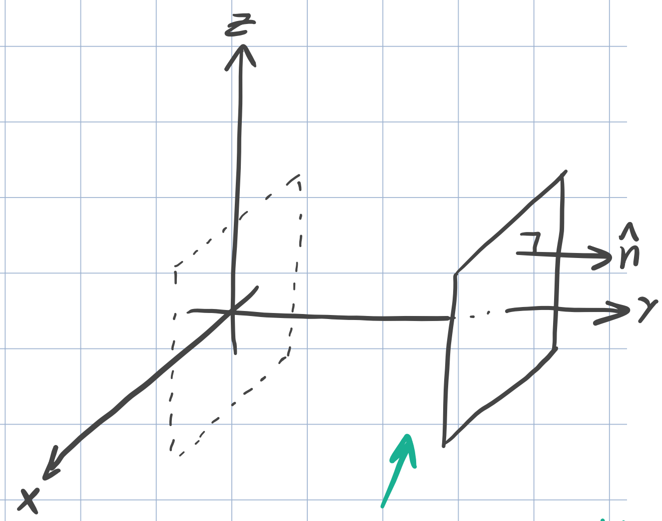
$P = (0, -13, 0\rangle$

Equation for a plane

$1(y+13) = 0$

$y + 13 = 0$

$y = -13$

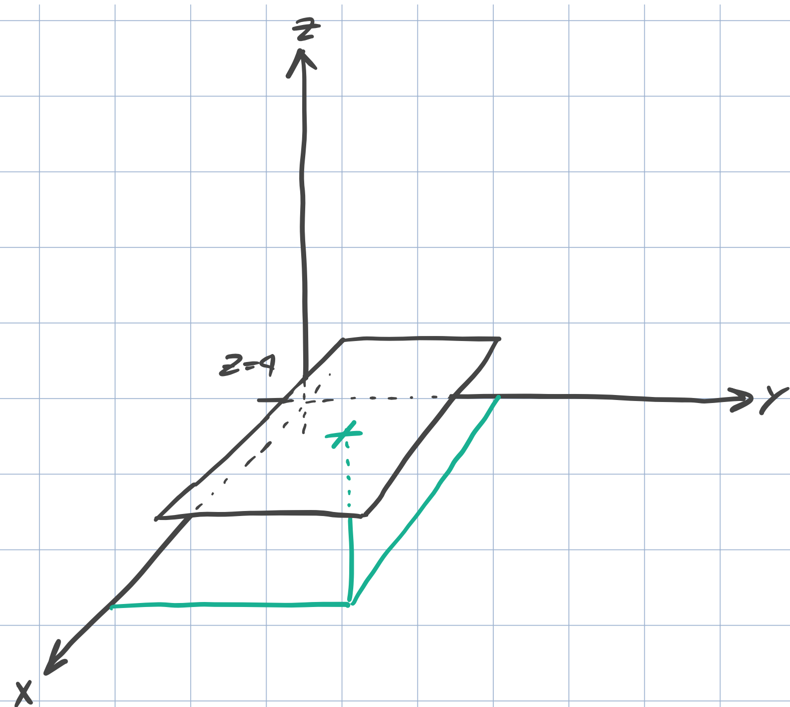


pretend this is in the -y direction

Find an equation of the plane that passes through the point $P_0 = (7, 4, 4)$ and is parallel to the *xy*-plane.

Sketch the plane.

$z = 4$



Find the equations that describe the circle of radius 2 centered at (4, 3, 8) that is parallel to the *xy*-plane. (Enter your answers as a comma-separated list of equations.)

Combine the equation of a circle with $z = 8$

$r = 2$

$c = (4, 3)$

$(x-4)^2 + (y-3)^2 = 2^2, \quad z = 8$

Find equations of the line that is parallel to the *z*-axis and passes through the midpoint between the two points (0, −3, 3) and (−6, 4, 5). (Enter your answers as a comma-separated list of equations.)

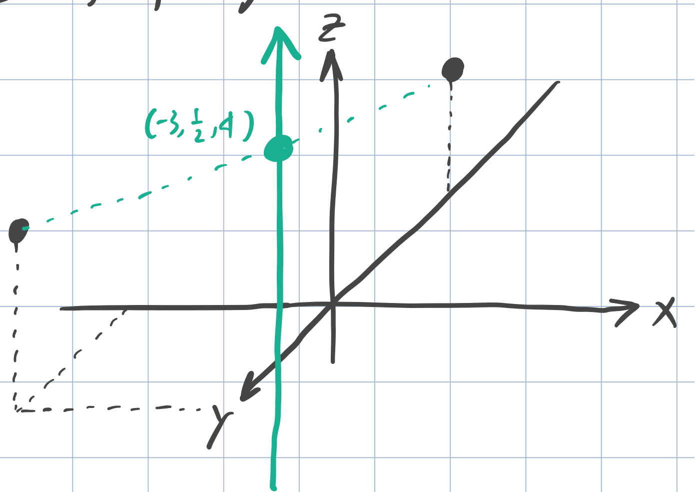
$p =$ Midpoint of $(0, -3, 3)$ and $(-6, 4, 5)$

$p = \left(\frac{-6}{2}, \frac{4-3}{2}, \frac{5+3}{2}\right)$

$= \left(-3, \frac{1}{2}, 4\right)$

$\hat{n} = \langle 0, 1, 0 \rangle$

$x = -3, \; y = \frac{1}{2}$



Determine an equation of the sphere with center *P*(1, 2, −7) that passes through the point *Q*(2, 4, −9).

$(x-h)^2 + (y-k)^2 + (z-i)^2 = r^2$

Center at $(1, 2, -7)$

$(x-1)^2 + (y-2)^2 + (z+7)^2 = r^2$

Passes through $(2,4,-9)$, solve for r

$$(2-1)^2+(4-2)^2+(-9+7)^2=r^2$$

$$1+4+4=r^2$$

$$r^2=9$$

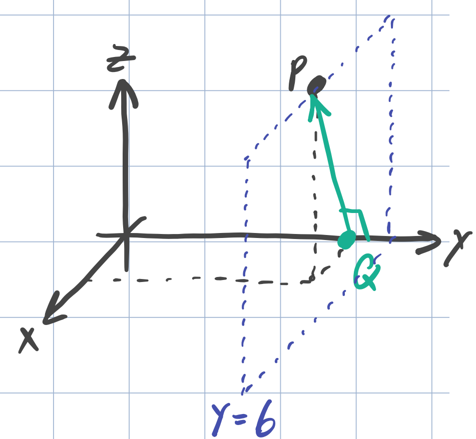
$$r=3$$

Final Equation

$$(x-1)^2+(y-2)^2+(z+7)^2=9$$

Find the perpendicular distance from the point $P(1, 6, 5)$ to the y-axis.

Define point Q as the point on the y-axis closest to P



$$Q=(0,6,0)$$

$$\vec{r}_{Q\text{ to }P}=P-Q$$

$$=\langle 1,0,5\rangle$$

$$|\vec{r}_{Q\text{ to }P}|=\sqrt{26}$$

Find the distance from the point $P(5, 9, 4)$ to the center of the given sphere.

$$x^2 + y^2 + z^2 + 6x - 10y - 2z = -26$$

Complete the square with the following equations:

$$x^2 + 6x = 0$$
$$x^2 + 6x + 9 = 9$$
$$(x+3)^2 = 9$$

$$y^2 - 10y = 0$$
$$y^2 - 10y + 25 = 25$$
$$(y-5)^2 = 25$$

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

Equation of the sphere

$$(x+3)^2 + (y-5)^2 + (z-1)^2 = -26 + 9 + 25 + 1$$

$$(x+3)^2 + (y-5)^2 + (z-1)^2 = 9$$

Center of sphere $C = (-3, 5, 1)$

$$\vec{r}_{C\ to\ P} = C - P$$

$$= (-8, -4, -3)$$

$$|\vec{r}_{c\ to\ p}| = \sqrt{64 + 16 + 9}$$