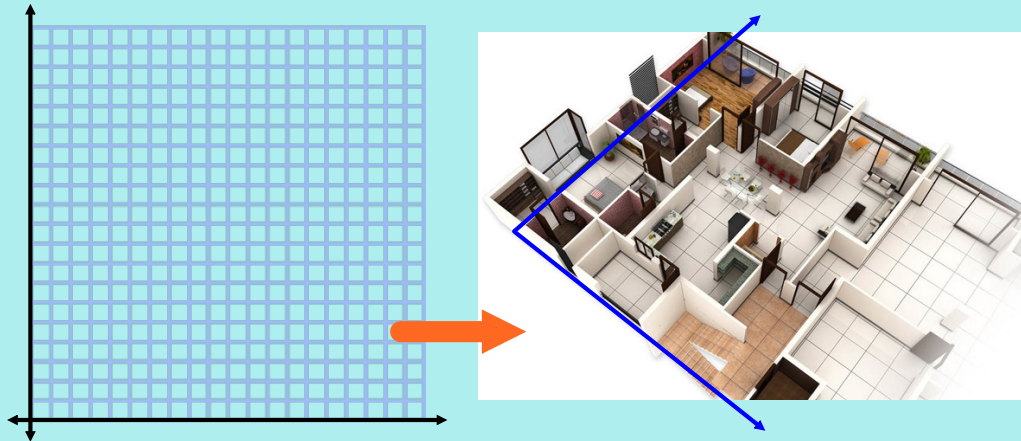


Vectors in \mathbb{R}^3

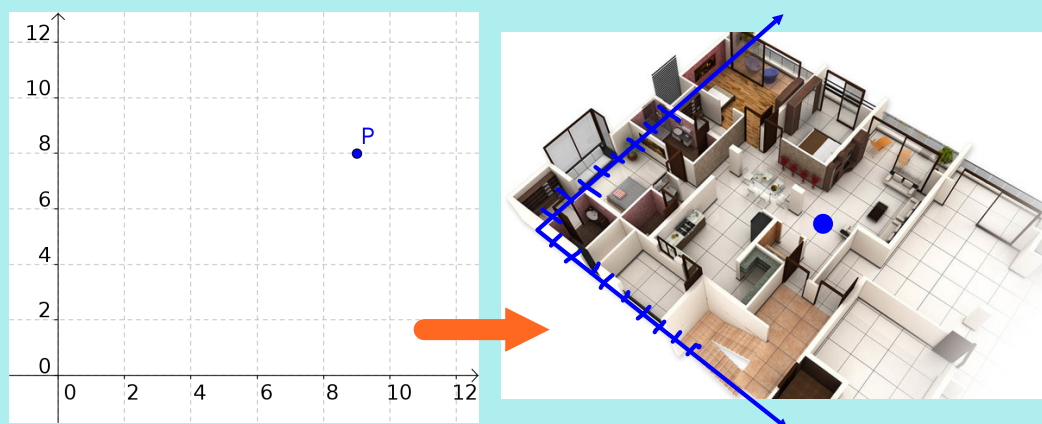
To extend from a two-dimensional space, \mathbb{R}^2 , to a three-dimensional space, \mathbb{R}^3 , consider the floor plan for a room or building.



Apr 22-8:33 AM

Vectors in \mathbb{R}^3

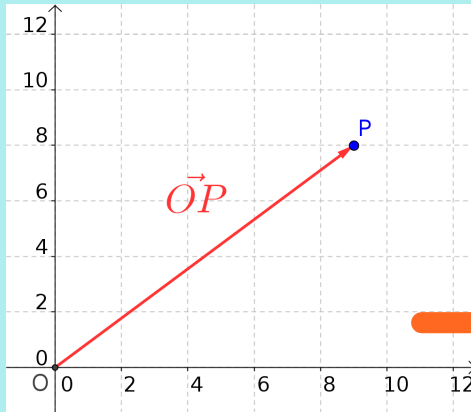
Given an appropriate scale, any point in the room can be assigned x- and y-coordinates, $P(x,y)$.



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Vectors in R^3

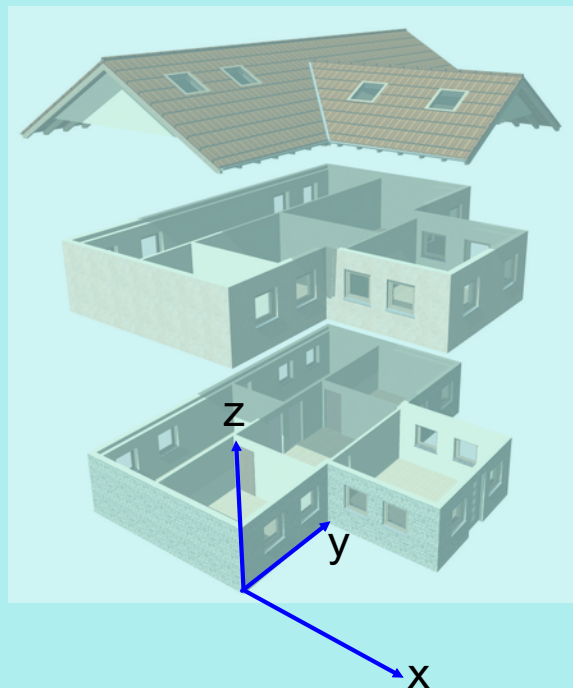
The point can also be described in terms of a position vector from the origin (O) to the point (P).



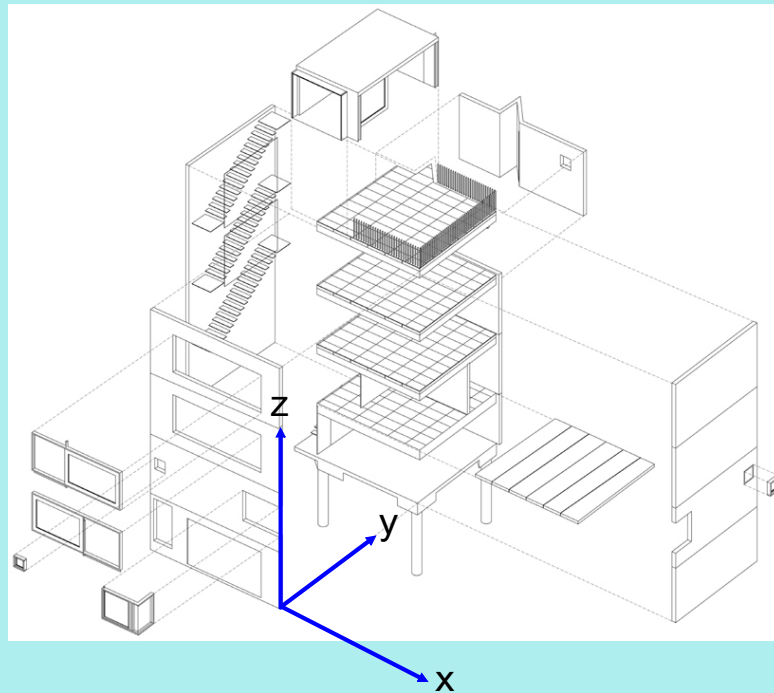
Apr 22-8:33 AM

For a multi-level building, we need a third dimension to represent the vertical position of the various levels.

In R^3 , this requires the introduction of the z-axis.

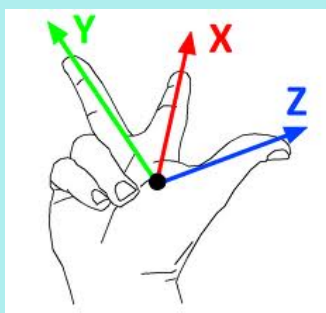


Apr 22-8:36 AM



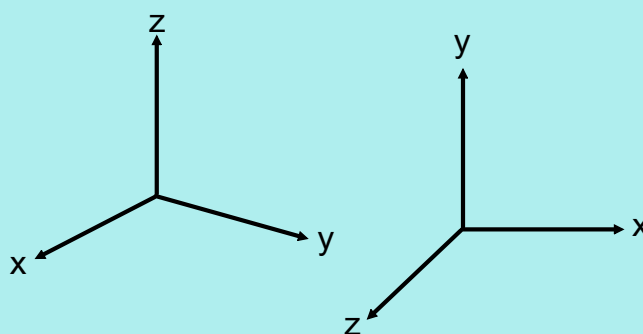
Apr 22-8:34 AM

There are various correct ways to represent the coordinate axes in \mathbb{R}^3 , but they must always be a right-handed, orthogonal system.



the right-hand rule

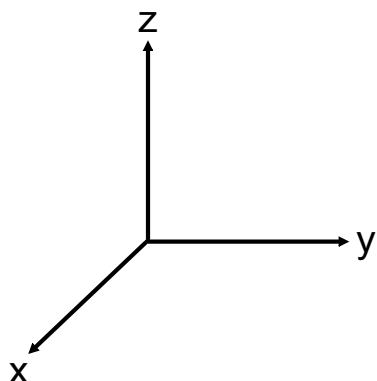
"orthogonal" means all axes are perpendicular to each other



Apr 25-8:23 AM

Vectors in R^3

In three dimensions, we add the z-axis, forming R^3 . The three axes (x, y, and z) form an orthogonal right-handed system.



$$\overrightarrow{OP} = (x, y, z)$$

$$|\overrightarrow{OP}| = \sqrt{x^2 + y^2 + z^2}$$

Any point, $P(x, y, z)$, can be described by the position vector from the origin $O(0, 0, 0)$ to the point $P(x, y, z)$.

Apr 25-8:23 AM

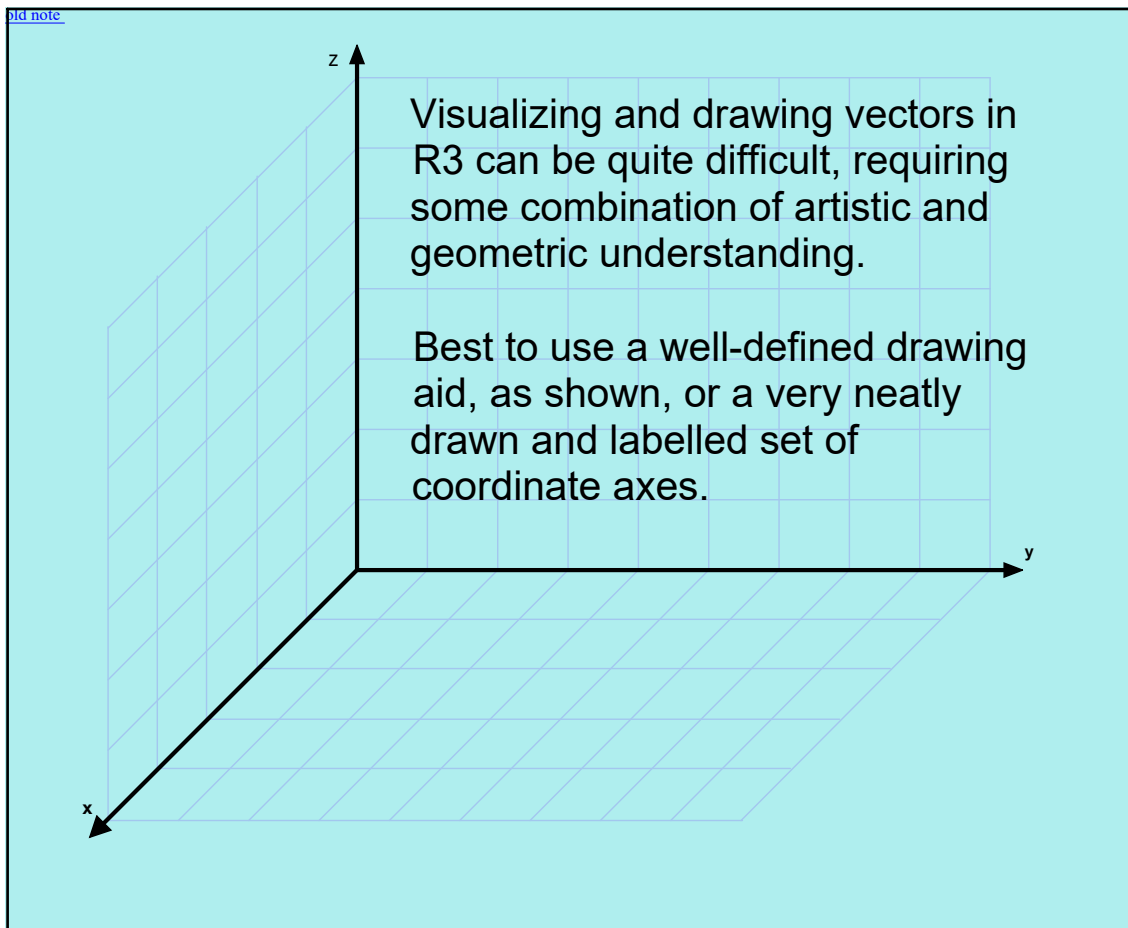
As was the case in R^2 , vectors in R^3 can also be expressed in terms of component vectors.

$$\begin{aligned}\vec{u} &= (2, 3, 4) \\ &= (2, 0, 0) + (0, 3, 0) + (0, 0, 4) \\ &= \vec{a} + \vec{b} + \vec{c}\end{aligned}$$

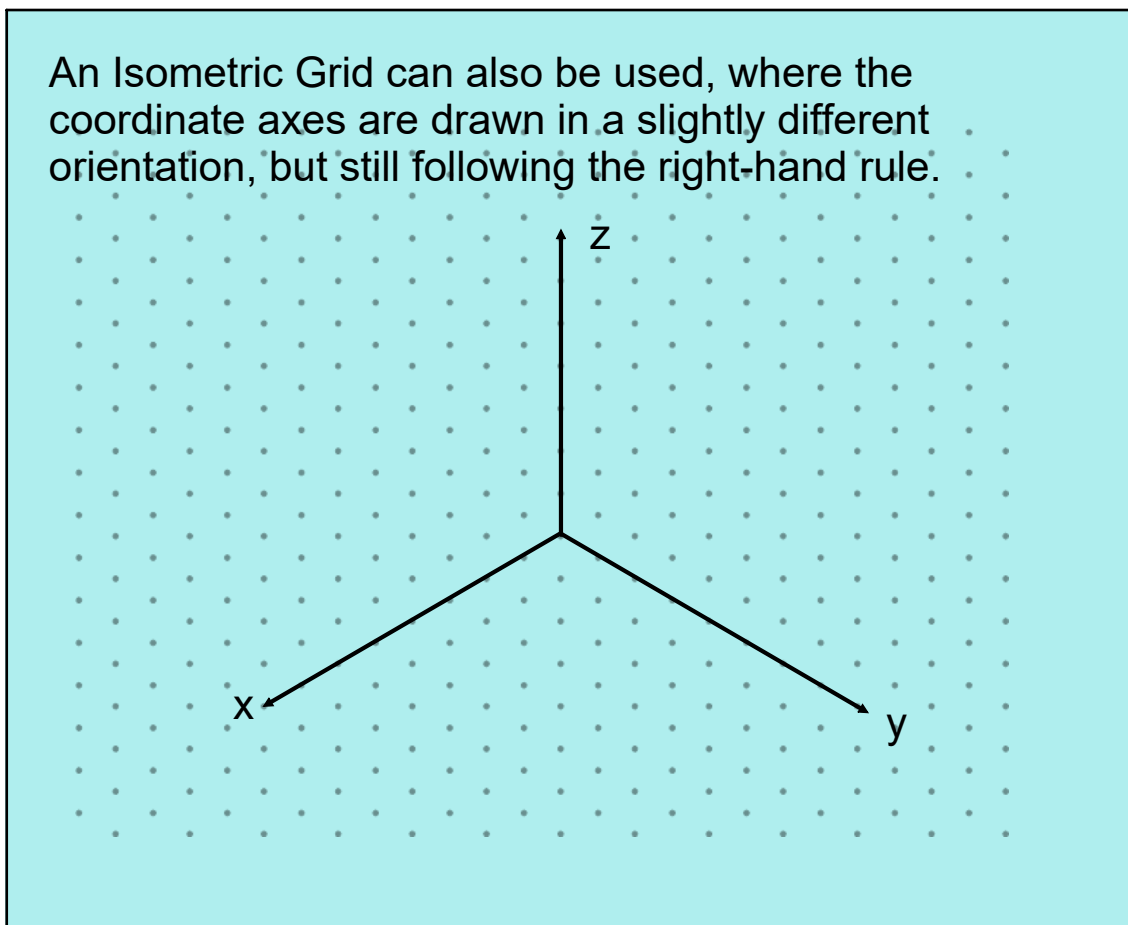
$$\text{where } \vec{a} = (2, 0, 0) \quad \vec{b} = (0, 3, 0) \quad \vec{c} = (0, 0, 4)$$

Vectors in R^3 are typically drawn using a rectangular prism as a framework (see following discussion).

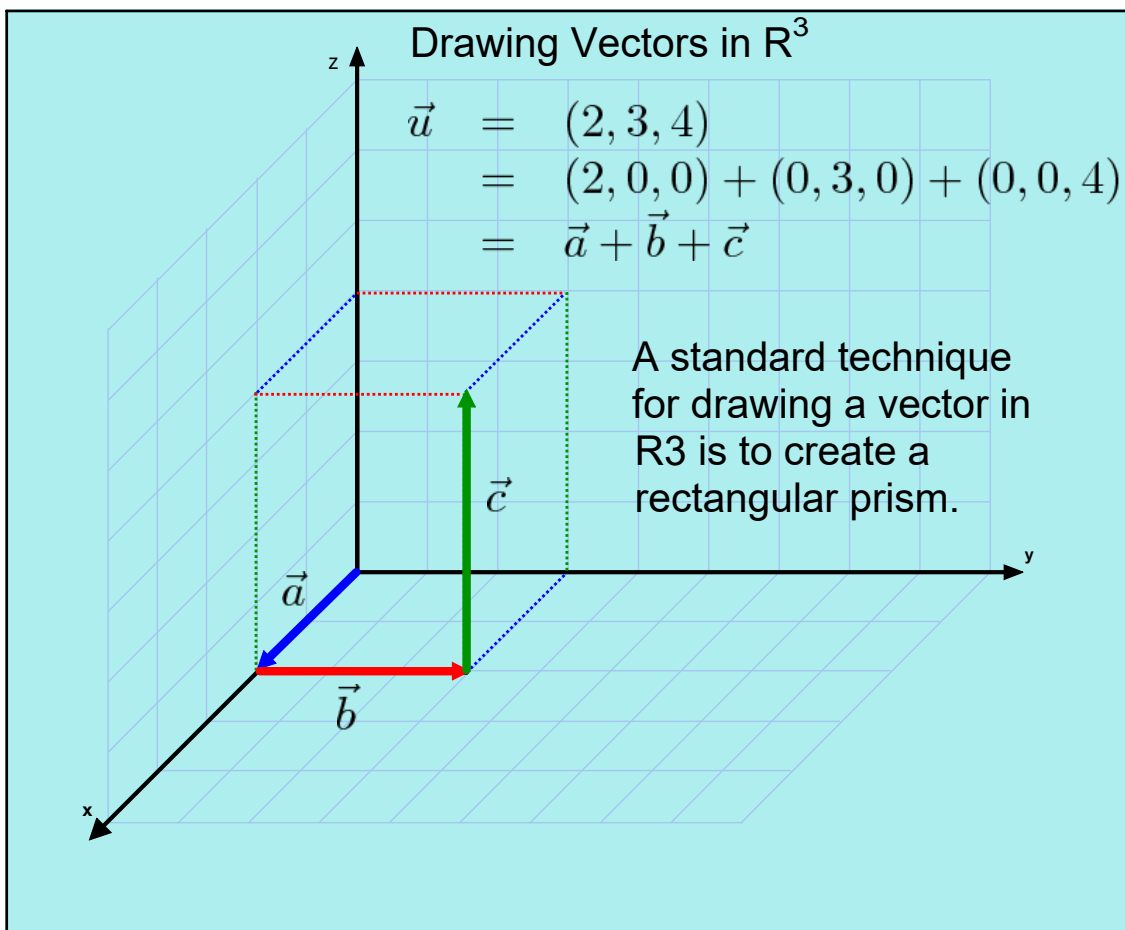
Apr 22-8:46 PM



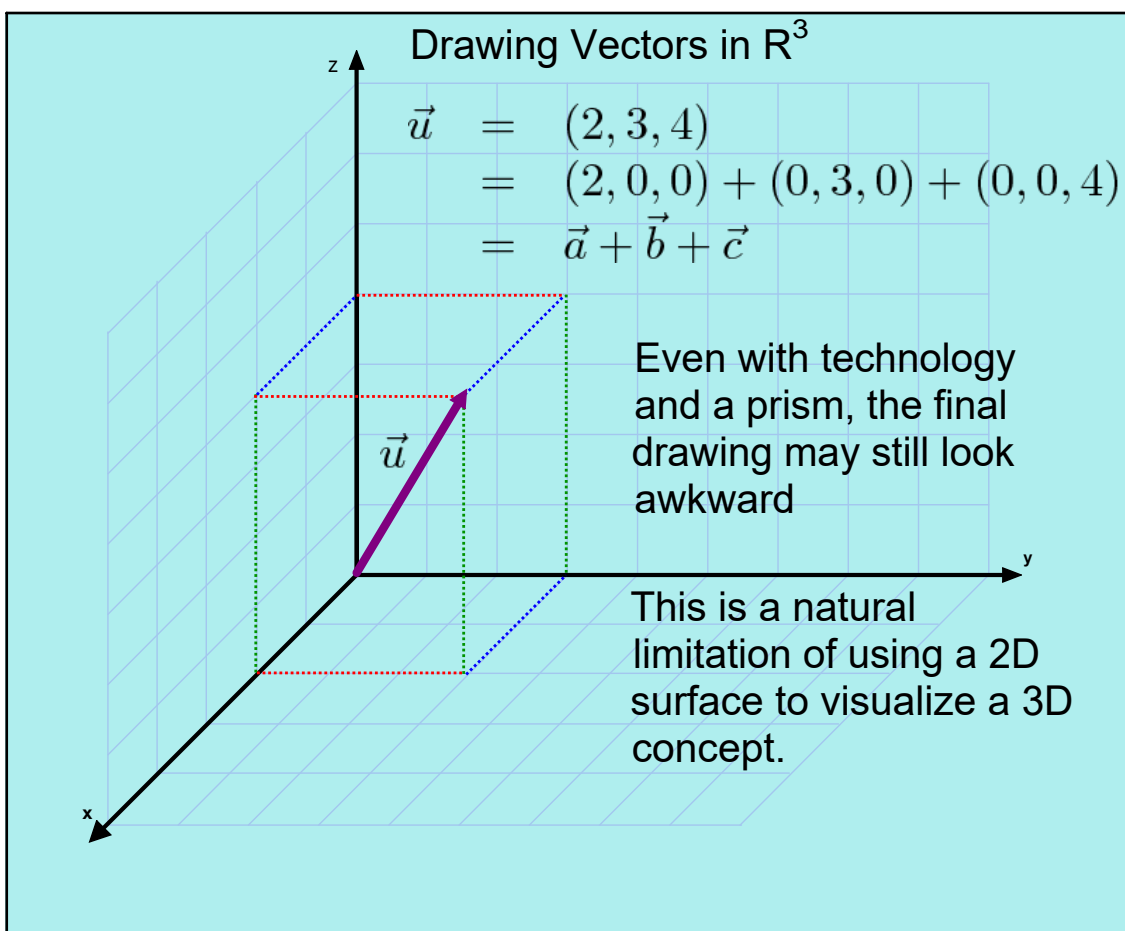
Apr 26-7:24 PM



Apr 29-10:18 AM



Apr 26-7:24 PM



Apr 26-7:24 PM

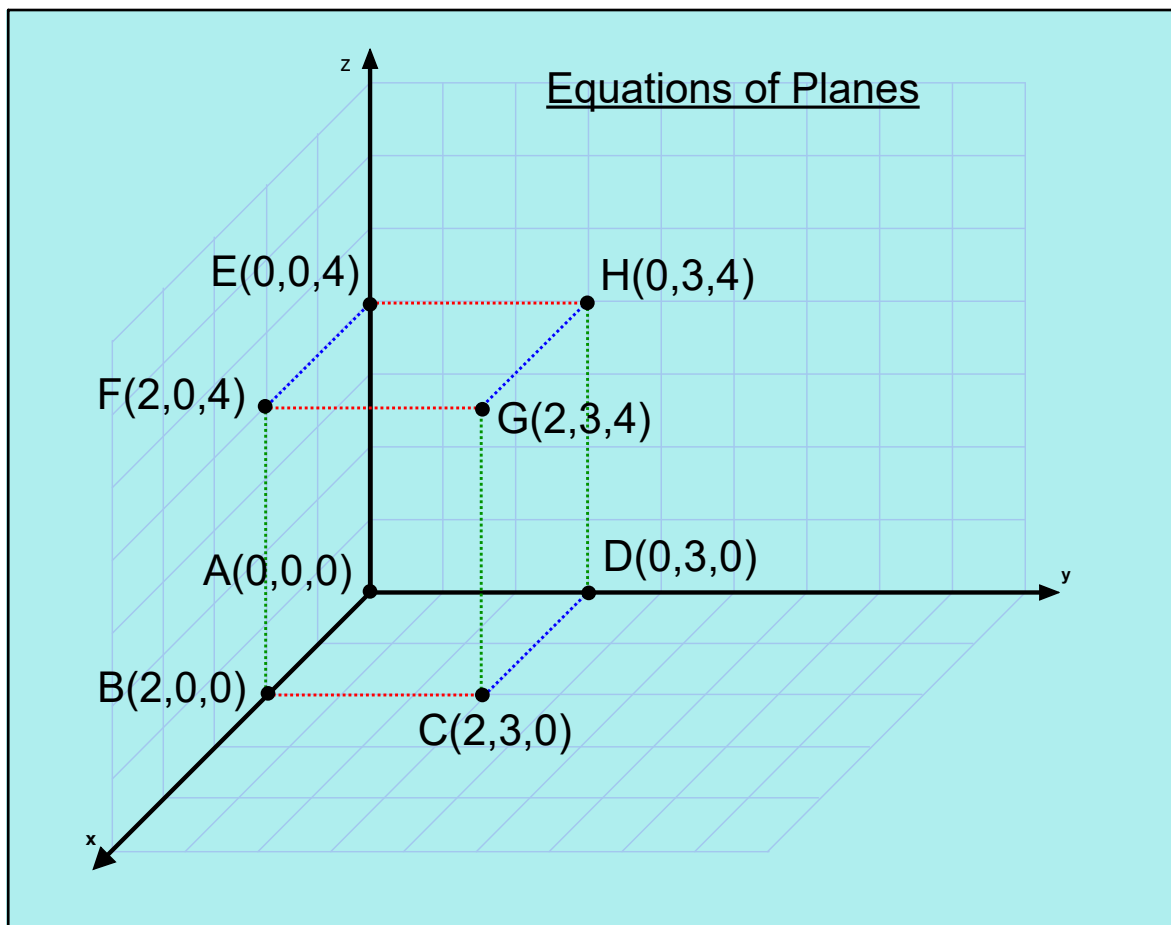
The sides of the rectangular prism are flat surfaces, which can be extended into infinite flat planes.

These planes will always be parallel to one of the planes formed naturally by our orthogonal coordinate system, which are the x-y plane, x-z plane, and y-z plane.

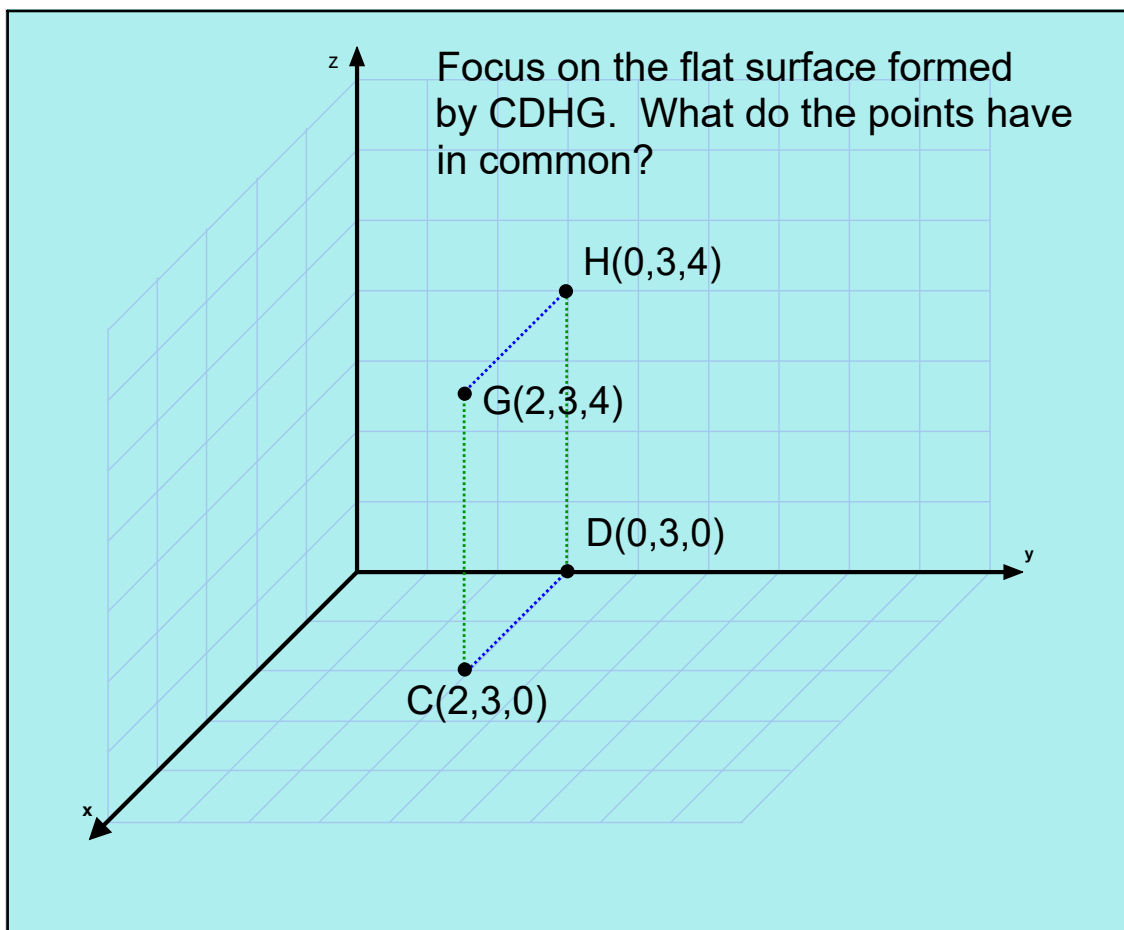
These planes will have one of the following equations:

parallel to:	x-y plane	x-z plane	y-z plane
equation:	$z = \text{constant}$	$y = \text{constant}$	$x = \text{constant}$

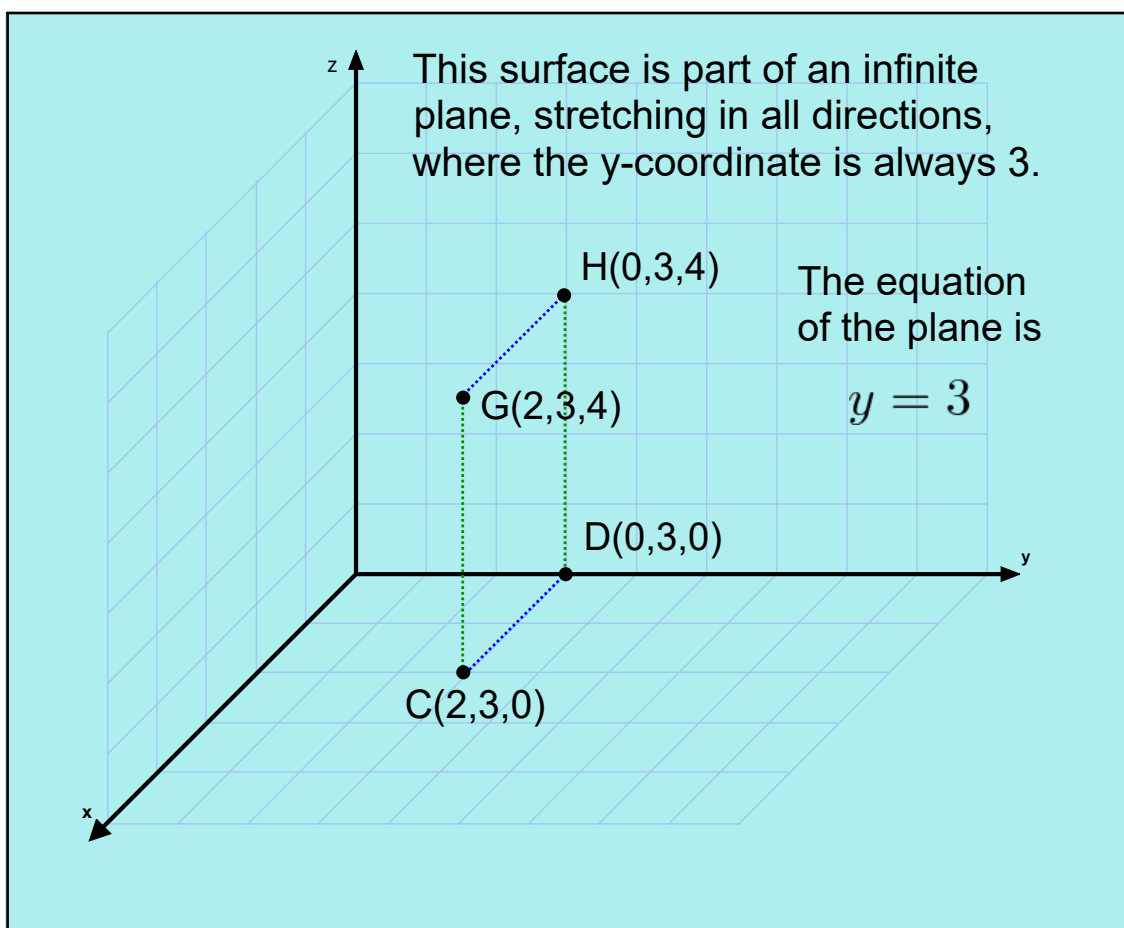
Apr 22-8:52 PM



Apr 26-7:24 PM



Apr 26-7:24 PM



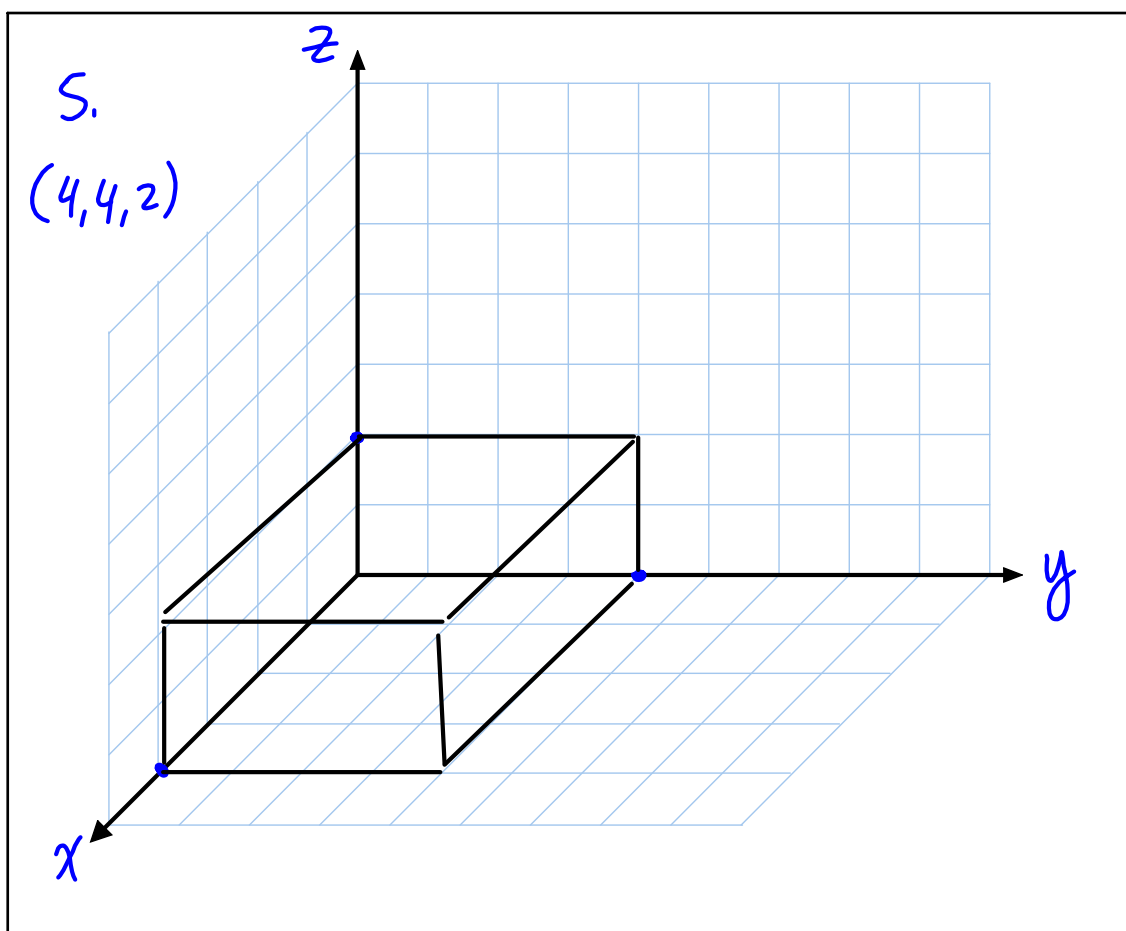
Apr 26-7:24 PM

Assigned work:

p. 316 # 1, 4, 5, 6, 7ab, 8, 12a, 15

5.

May 1-1:44 PM



Apr 26-1:57 PM