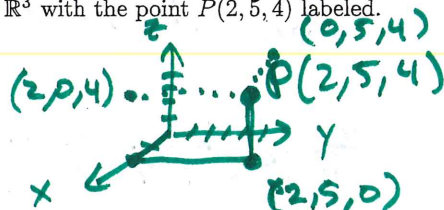


1. Sketch a picture of  $\mathbb{R}^3$  with the point  $P(2, 5, 4)$  labeled.



2. Find the distance of the point  $P(2, 5, 4)$  to the  $xy$ -plane, the  $xz$ -plane, and the  $yz$ -plane. Which plane is it closest to?

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ z=0 & y=0 & x=0 \\ \text{distance: } & 4 & 5 & 2 \end{array}$$

closest to  $yz$ -plane.

3. For each of the following sets of equations, describe the object formed in  $\mathbb{R}^3$ .

(a)  $x = 3$

plane

(b)  $\begin{cases} x = 3 \\ y = 5 \end{cases}$

line

(c)  $\begin{cases} x = 3 \\ y = 5 \\ z = -6 \end{cases}$

point.

4. What region is represented by  $1 \leq x^2 + y^2 + z^2 \leq 4$ .

Hollow Ball of radius 2  
with inside ball of radius 1 missing

5. Consider the vectors  $\vec{a} = \langle 3, 1, 5 \rangle$  and  $\vec{b} = \langle 0, 2, 0 \rangle$ . Which vector is longer,  $\text{proj}_{\vec{a}} \vec{b}$  or  $\text{proj}_{\vec{b}} \vec{a}$ ?

$$\text{proj}_{\vec{a}} \vec{b} = \frac{\vec{b} \cdot \vec{a}}{\vec{a} \cdot \vec{a}} \vec{a} = \frac{3 \cdot 0 + 1 \cdot 2 + 5 \cdot 0}{3^2 + 1^2 + 5^2} \langle 3, 1, 5 \rangle$$

$$= \frac{2}{35} \langle 3, 1, 5 \rangle$$

$$\left| \frac{2}{35} \langle 3, 1, 5 \rangle \right|$$

$$= \left| \frac{2}{35} \right| \cdot \sqrt{9+1+25}$$

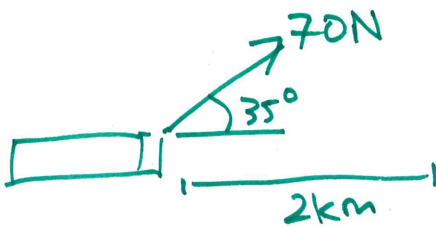
$$= \frac{2}{35} \cdot \sqrt{35} = \frac{2}{\sqrt{35}}$$

$$\text{proj}_{\vec{b}} \vec{a} = \frac{\vec{a} \cdot \vec{b}}{\vec{b} \cdot \vec{b}} \vec{b} = \frac{2}{4} \langle 0, 2, 0 \rangle = \langle 0, 1, 0 \rangle$$

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

$\text{proj}_{\vec{a}} \vec{b}$  is shorter  $\text{proj}_{\vec{b}} \vec{a}$  is longer.

6. A wagon is pulled a distance of 2km along a horizontal path by a constant force of 70N. The handle of the wagon is held at an angle of  $35^\circ$  above the horizontal. Find the work done by the force.



$$\text{Work} = |F| |D| \cos \theta$$

$$\text{Work} = 70 \cdot 2000 \cdot \cos 35^\circ$$

7. A particle is moved from the point  $P(0, 2, 1)$  to  $Q(3, 4, 2)$  by a force given by the vector  $\vec{F} = 2\mathbf{i} + \mathbf{j} + 4\mathbf{k}$ . Find the work done.

$$\vec{D} = \vec{PQ} = \langle 3, 2, 1 \rangle$$

$$\vec{F} = \langle 2, 1, 4 \rangle$$

$$\text{Work} = \vec{F} \cdot \vec{D} = 3 \cdot 2 + 2 \cdot 1 + 1 \cdot 4$$

$$= 12$$