

# Quiz 1

Key

This is a two-stage quiz. During the first stage, use your knowledge & calculator. You have 15 min. In the second stage, you are now welcome to use your books, notes, and students in the class to retake the same quiz. You have the remainder of the quiz time to write one solution (with everyone's name on it!!!) to be turned in for the group.

1. Consider the set of axis on the right.

(a) [1] Label the positive z axis.

(b) [1] Plot the point  $P(2, -1, -2)$

(c) [1] Find the distance between  $P$  and the  $xy$  plane.

the  $|z \text{ coord}| \Rightarrow 2$   
or

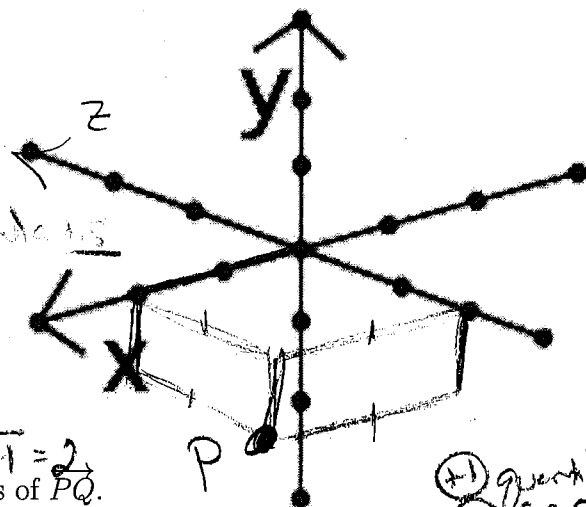
dist between  $P$  and  $(2, -1, 0)$

$$\sqrt{(2-2)^2 + (-1-(-1))^2 + (-2-0)^2} = \sqrt{4} = 2$$

(d) [2] Let  $Q(-1, 0, -1)$ . Find the components of  $\vec{PQ}$ .

Start at  $P$  + go to  $Q \Rightarrow \langle -3, 1, 1 \rangle$   
or

$$\langle q_1 - p_1, q_2 - p_2, q_3 - p_3 \rangle = \langle -1 - 2, 0 - (-1), -1 - (-2) \rangle = \langle -3, 1, 1 \rangle$$



(+1) guesses  
(-1) sign  
(-1) notation

2. Let  $\vec{u}$ ,  $\vec{v}$ , and  $\vec{w}$  be the vectors shown on the right.

Assume  $\vec{u}$  is a unit vector and that  $\|\vec{v}\| = \sqrt{3}$ .

(a) [2] Sketch  $\vec{v} - \vec{w}$

Sketch  $-\vec{w}$  (+1.5)  
tip to tail (+1.5)  
correct vector (+1)

(b) [1] Find  $\vec{v} \cdot \vec{v}$

$$\vec{v} \cdot \vec{v} = \|\vec{v}\|^2 = (\sqrt{3})^2 = 3$$

Put axis on the graph so  $\vec{v} = \langle 0, \sqrt{3} \rangle$  (+1.5)

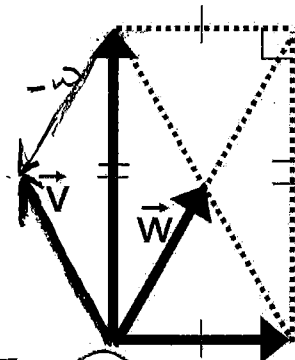
$$\Rightarrow \vec{v} \cdot \vec{v} = \langle 0, \sqrt{3} \rangle \cdot \langle 0, \sqrt{3} \rangle = 0 \cdot 0 + \sqrt{3} \sqrt{3} = 3$$

(c) [2] What is the angle between  $\vec{u}$  and  $\vec{w}$ ?



$$\tan \theta = \frac{\sqrt{3}}{1}$$

$$\Rightarrow \theta = \arctan(\sqrt{3}) = 60^\circ \text{ or } \pi/3$$



$$\text{OR } \vec{w} = \langle 1, 0 \rangle \quad \vec{w} = \langle \frac{1}{2}, \frac{\sqrt{3}}{2} \rangle$$

$$\vec{u} \cdot \vec{w} = \|\vec{u}\| \cdot \|\vec{w}\| \cos \theta$$

$$\frac{1}{2} \cdot 1 + 0 \cdot \frac{\sqrt{3}}{2} = 1 \cdot \sqrt{\left(\frac{1}{2}\right)^2 + \left(\frac{\sqrt{3}}{2}\right)^2} \cos \theta$$

$$\frac{1}{2} = \cos \theta \Rightarrow \theta = \arccos\left(\frac{1}{2}\right)$$

$$\theta = 60^\circ \text{ or } \pi/3$$