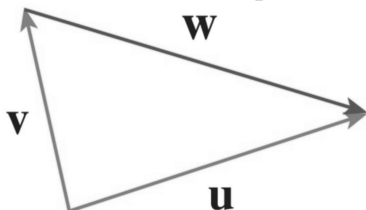


NOTE #1: SECTIONS 12.1-12.5

- Problem 1.** a) Find the center and radius of the sphere  $x^2 + y^2 + z^2 - x + 4y - 10z - 1 = 0$ .  
b) Find the equation of the sphere with center  $(1, 4, 3)$  that touches the  $xy$  plane.

**Problem 2.** For the picture seen below, write  $\mathbf{v}$  in terms of  $\mathbf{u}$  and  $\mathbf{w}$ .



- Problem 3.** Given  $\mathbf{a} = \langle 1, -1, 5 \rangle$  and  $\mathbf{b} = \langle -3, 2, 1 \rangle$ ,  
a) find a unit vector in the direction of  $\mathbf{a} + 2\mathbf{b}$ .  
b) find the vector that has the same direction as  $\mathbf{a} + 2\mathbf{b}$  but has length 4.

- Problem 4.** Compute  $\mathbf{a} \cdot \mathbf{b}$  if  
a)  $\mathbf{a} = \langle 4, 5, -1 \rangle$  and  $\mathbf{b} = \langle 2, 1, 3 \rangle$ .  
b)  $|\mathbf{a}| = 2$ ,  $|\mathbf{b}| = 5$  and  $\theta = 120^\circ$ .  
c)  $|\mathbf{a}| = 6$ ,  $|\mathbf{b}| = 4$  and  $\mathbf{a}$  is perpendicular to  $\mathbf{b}$ .  
d)  $|\mathbf{a}| = 6$ ,  $|\mathbf{b}| = 4$  and  $\mathbf{a}$  is parallel to  $\mathbf{b}$ .

**Problem 5.** The points  $A(0, -1, 6)$ ,  $B(2, 1, -3)$  and  $C(5, 4, 2)$  form a triangle. Find  $\angle C$ .

**Problem 6.** Let  $\mathbf{a}$ ,  $\mathbf{b}$ , and  $\mathbf{c}$  be three dimensional vectors. Which of the following expressions are meaningful? Which are meaningless?

- a)  $\mathbf{a} \cdot (\mathbf{b} + \mathbf{c})$   
b)  $\mathbf{a} \cdot \mathbf{b} + \mathbf{c}$

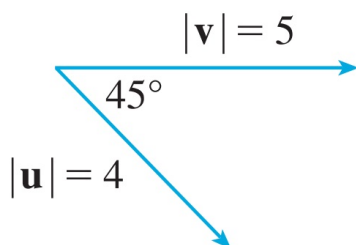
**Problem 7.** Determine whether the given vectors are orthogonal, parallel, or neither.

- a)  $\mathbf{a} = \langle 3, -1, 2 \rangle$ ,  $\mathbf{b} = \langle 6, -2, 4 \rangle$   
b)  $\mathbf{a} = \langle 1, 2, -1 \rangle$ ,  $\mathbf{b} = \langle 2, 3, -1 \rangle$   
c)  $\mathbf{a} = 2\mathbf{i} - \mathbf{j} + 2\mathbf{k}$ ,  $\mathbf{b} = -2\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$

**Problem 8.** Find the scalar and vector projections of  $\langle 2, 4, 6 \rangle$  onto  $\langle 1, 3, 5 \rangle$ .

**Problem 9.** Find the cross product of  $\langle 1, 1, 3 \rangle$  and  $\langle -2, -1, -5 \rangle$ .

**Problem 10.** Find  $|\mathbf{u} \times \mathbf{v}|$  and determine if  $\mathbf{u} \times \mathbf{v}$  points in or out of the page.



**Problem 11.** Find the area of the parallelogram determined by  $\mathbf{a} = \langle 3, 0, 2 \rangle$  and  $\mathbf{b} = \langle 1, -4, 5 \rangle$ .

**Problem 12.** Find a vector equation of the line that passes through the point  $(2, -5, 1)$  and is parallel to the vector  $\langle 8, 10, -7 \rangle$ .

**Problem 13.** Find parametric equations and a symmetric equation for the line passing through the points  $(-2, 3, 4)$  and  $(5, 2, 8)$ .

**Problem 14.** Find an equation of the plane passing through the point  $(3, 4, 5)$  and perpendicular to  $\langle -1, 2, 5 \rangle$ .

**Problem 15.** Find an equation of the plane passing through the point  $(1, 5, -3)$  and perpendicular to the line  $x = 2 - 4t, y = 2t, z = -1 + t$ .

**Problem 16.** Find the equation of the plane that passes through the points  $P(1, 0, 1)$ ,  $Q(2, 3, 4)$  and  $R(2, 1, 1)$ .

**Problem 17.** Find an equation of the plane passing through the point  $(-1, -3, 2)$  that contains the line  $x = -1 - 2t, y = 4t, z = 2 + t$ .

**Problem 18.** Consider the lines  $\mathbf{r}_1(t) = \langle 2 + t, 2t, 5 + t \rangle$  and  $\mathbf{r}_2(s) = \langle s, -4 + 4s, 3 + s \rangle$ .

- a) Find the point of intersection of the lines
- b) Find an equation of the plane that contains these lines.

**Problem 19.** Consider the planes  $z = x + y$  and  $2x - 5y - z = 1$ .

- a) Find the angle between the planes.
- b) Find the line of intersection of the planes.