

**Geometric Algebra HW 1 (Wedge Product)**  
**MultiV 2021-22 / Dr. Kessner**

1. For each of the following pairs of vectors  $\mathbf{u}$  and  $\mathbf{v}$ , find the wedge product  $\mathbf{u} \wedge \mathbf{v}$ . Draw the vectors and make sure your answer makes sense geometrically.

a.  $\mathbf{u} = \begin{pmatrix} 2 \\ 0 \end{pmatrix}, \mathbf{v} = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$

b.  $\mathbf{u} = \begin{pmatrix} 0 \\ 2 \end{pmatrix}, \mathbf{v} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$

c.  $\mathbf{u} = \begin{pmatrix} 3 \\ 0 \end{pmatrix}, \mathbf{v} = \begin{pmatrix} 3 \\ 3 \end{pmatrix}$

d.  $\mathbf{u} = \begin{pmatrix} 3 \\ 1 \end{pmatrix}, \mathbf{v} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$

2. Find the area of the triangle determined by the two vectors  $\mathbf{u} = \begin{pmatrix} 2 \\ 2 \end{pmatrix}$  and  $\mathbf{v} = \begin{pmatrix} -2 \\ 2 \end{pmatrix}$ .

Find a general formula for the area of a triangle determined by two vectors  $\mathbf{u}$  and  $\mathbf{v}$ .

3. Find the distance from the point  $(2, 2)$  to the line  $2x + 2y = 2$ .

4. Find the distance from the point  $(7, 7)$  to the line  $6x + 8y = 48$ .

*Answers:*

1a.  $2\mathbf{e}_1 \wedge \mathbf{e}_2$

1b.  $-2\mathbf{e}_1 \wedge \mathbf{e}_2$

1c.  $9\mathbf{e}_1 \wedge \mathbf{e}_2$

1d.  $8\mathbf{e}_1 \wedge \mathbf{e}_2$

2.  $A = \frac{1}{2}|\mathbf{u} \wedge \mathbf{v}| = \frac{1}{2}(8) = 4$

3.  $\frac{3\sqrt{2}}{2}$

4. 5