

## Chapter 1

# Vectors

### 1.1 Vectors in Two and Three Dimensions

1. Draw (or just construct) the points (1) (2) in the picture below.



2. Although more difficult for students to represent this on paper, the diagram should look something like the following. Note that the origin is not at a vertex of the triangle, but that it is at the tail of the three vectors.



In problems 3 and 4, you supply each student with a worksheet to provide an excellent initial perspective on being used.

3. Let  $\vec{a} = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$ ,  $\vec{b} = \begin{bmatrix} -1 \\ 7 \end{bmatrix}$ ,  $\vec{c} = \begin{bmatrix} 2 \\ -4 \end{bmatrix}$ ,  $\vec{d} = \begin{bmatrix} 5 \\ 0 \end{bmatrix}$ ,  $\vec{e} = \begin{bmatrix} 1 \\ 6 \end{bmatrix}$ ,  $\vec{f} = \begin{bmatrix} 4 \\ 8 \end{bmatrix}$ .  
 then  $\vec{a} + \vec{b} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} + \begin{bmatrix} -1 \\ 7 \end{bmatrix} = \begin{bmatrix} 2 \\ 9 \end{bmatrix}$ ,  $\vec{b} + \vec{c} = \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \end{bmatrix}$ ,  $\vec{c} + \vec{d} = \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} = \begin{bmatrix} 7 \\ -4 \end{bmatrix}$ ,  
 then  $\vec{a} + \vec{b} + \vec{c} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} + \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} = \begin{bmatrix} 4 \\ 5 \end{bmatrix}$ ,  $\vec{b} + \vec{c} + \vec{d} = \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} = \begin{bmatrix} 6 \\ 3 \end{bmatrix}$ ,  
 then  $\vec{a} + \vec{b} + \vec{c} + \vec{d} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} + \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} = \begin{bmatrix} 9 \\ 5 \end{bmatrix}$ ,  $\vec{b} + \vec{c} + \vec{d} + \vec{e} = \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} + \begin{bmatrix} 1 \\ 6 \end{bmatrix} = \begin{bmatrix} 7 \\ 9 \end{bmatrix}$ ,  
 then  $\vec{a} + \vec{b} + \vec{c} + \vec{d} + \vec{e} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} + \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} + \begin{bmatrix} 1 \\ 6 \end{bmatrix} = \begin{bmatrix} 10 \\ 11 \end{bmatrix}$ ,  
 then  $\vec{a} + \vec{b} + \vec{c} + \vec{d} + \vec{e} + \vec{f} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} + \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} + \begin{bmatrix} 1 \\ 6 \end{bmatrix} + \begin{bmatrix} 4 \\ 8 \end{bmatrix} = \begin{bmatrix} 15 \\ 19 \end{bmatrix}$ .  
 4. Let  $\vec{a} = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$ ,  $\vec{b} = \begin{bmatrix} -1 \\ 7 \end{bmatrix}$ ,  $\vec{c} = \begin{bmatrix} 2 \\ -4 \end{bmatrix}$ ,  $\vec{d} = \begin{bmatrix} 5 \\ 0 \end{bmatrix}$ ,  $\vec{e} = \begin{bmatrix} 1 \\ 6 \end{bmatrix}$ ,  $\vec{f} = \begin{bmatrix} 4 \\ 8 \end{bmatrix}$ .  
 then  $\vec{a} + \vec{b} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} + \begin{bmatrix} -1 \\ 7 \end{bmatrix} = \begin{bmatrix} 2 \\ 9 \end{bmatrix}$ ,  $\vec{b} + \vec{c} = \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \end{bmatrix}$ ,  $\vec{c} + \vec{d} = \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} = \begin{bmatrix} 7 \\ -4 \end{bmatrix}$ ,  
 then  $\vec{a} + \vec{b} + \vec{c} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} + \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} = \begin{bmatrix} 4 \\ 5 \end{bmatrix}$ ,  $\vec{b} + \vec{c} + \vec{d} = \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} = \begin{bmatrix} 6 \\ 3 \end{bmatrix}$ ,  
 then  $\vec{a} + \vec{b} + \vec{c} + \vec{d} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} + \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} = \begin{bmatrix} 9 \\ 5 \end{bmatrix}$ ,  $\vec{b} + \vec{c} + \vec{d} + \vec{e} = \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} + \begin{bmatrix} 1 \\ 6 \end{bmatrix} = \begin{bmatrix} 7 \\ 9 \end{bmatrix}$ ,  
 then  $\vec{a} + \vec{b} + \vec{c} + \vec{d} + \vec{e} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} + \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} + \begin{bmatrix} 1 \\ 6 \end{bmatrix} = \begin{bmatrix} 10 \\ 11 \end{bmatrix}$ ,  
 then  $\vec{a} + \vec{b} + \vec{c} + \vec{d} + \vec{e} + \vec{f} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} + \begin{bmatrix} -1 \\ 7 \end{bmatrix} + \begin{bmatrix} 2 \\ -4 \end{bmatrix} + \begin{bmatrix} 5 \\ 0 \end{bmatrix} + \begin{bmatrix} 1 \\ 6 \end{bmatrix} + \begin{bmatrix} 4 \\ 8 \end{bmatrix} = \begin{bmatrix} 15 \\ 19 \end{bmatrix}$ .  
 5. We start with the three vectors  $\vec{a}$ ,  $\vec{b}$ , and  $\vec{c}$ . We then complete the parallelogram as in the figure on the left. The vector from the origin to the same vertex is the vector  $\vec{a} + \vec{b}$ . In the figure on the right we have translated vector  $\vec{b}$  so that its tail is the head of vector  $\vec{a}$ . The vector  $\vec{a} + \vec{b}$  is the directed third side of this triangle.

# Vector Calculus 5th Edition Marsden Solutions Manual

**S Ashworth**



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