Homework Section 12.3
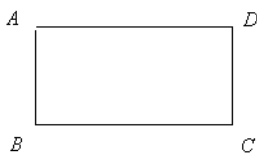
1. Use the below picture to write the following as single vectors:
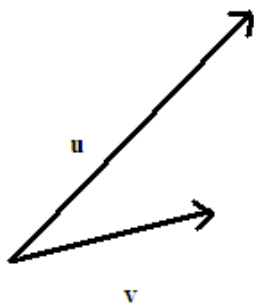
   a) $\overrightarrow{AB} + \overrightarrow{BC}$ b) $\overrightarrow{CD} + \overrightarrow{DA}$ c) $\overrightarrow{AB} - \overrightarrow{BC}$

2. Consider the following vectors given in the picture below.

   Draw the following.

   a) $\mathbf{u} + \mathbf{v}$ b) $\mathbf{u} - \mathbf{v}$
   c) $2\mathbf{u}$ d) $2\mathbf{u} + \mathbf{v}$
   e) $-2\mathbf{u}$ f) $-2\mathbf{u} + \mathbf{v}$

3. Consider the planar points P(2, 4), Q(-1, 5):
   a)   Graph the vector $\overrightarrow{PQ}$.
   b)   Convert $\overrightarrow{PQ}$ to component form and include this vector on the graph from part (a).

4. Repeat number three for the points P(1, 2, 4) and Q(3, 5, 6) in R^3.

5. Let $\mathbf{u} = \langle -2, 5, -7 \rangle$ and $\mathbf{v} = \langle 2, -3, -6 \rangle$.

   a)   Find $\mathbf{u} + \mathbf{v}$, $\mathbf{u} - \mathbf{v}$, $-2\mathbf{v}$, $5\mathbf{u} - 2\mathbf{v}$, $|\mathbf{u}|$, and $|\mathbf{v}|$
   b)   Find the unit vector that has the same direction as $\mathbf{u}$.
   c)   Find the unit vector that has the same direction as $\mathbf{v}$
   d)   Find a vector of length 5 with the same direction as $\mathbf{v}$.

6. Let $\mathbf{u} = -\mathbf{i} - 5\mathbf{j} + 7\mathbf{k}$ and $\mathbf{v} = 6\mathbf{i} + 4\mathbf{j} - 3\mathbf{k}$. Find $\mathbf{u} + \mathbf{v}$, $\mathbf{u} - \mathbf{v}$, $-2\mathbf{v}$, $5\mathbf{u} - 2\mathbf{v}$ and $|\mathbf{u}|$.

7. A plane flies at a constant groundspeed of 400 mph due east and encounters a 50 mph wind from the northwest. Find the airspeed and compass direction that will allow the plane to maintain its ground speed and eastward direction.

8. The picture below represents the application of two forces, $\mathbf{u}$ and $\mathbf{v}$, on an object located at point A. If $\mathbf{u}$ and $\mathbf{v}$ have magnitudes 12 pounds and 8 pounds, respectively, determine the resultant force, $\mathbf{u} + \mathbf{v}$, along with the magnitude and direction of $\mathbf{u} + \mathbf{v}$.
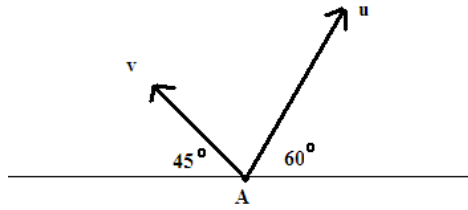
9. A **matrix** is a rectangular array of numbers. We add, subtract, and scalar multiply matrices in the same way we do vectors. Perform the indicated operations on the following matrices:

    a) $\begin{bmatrix} 2 & -3 & 8 \\ -5 & 1 & 0 \end{bmatrix} + \begin{bmatrix} -4 & 3 & 2 \\ 4 & 7 & 9 \end{bmatrix}$

    b) $\begin{bmatrix} 2 & -3 & 8 \\ -5 & 1 & 0 \end{bmatrix} - \begin{bmatrix} -4 & 3 & 2 \\ 4 & 7 & 9 \end{bmatrix}$

    c) $3\begin{bmatrix} 2 & -3 & 8 \\ -5 & 1 & 0 \end{bmatrix}$

10. We usually define matrices using capital letters. Operations are performed in the usual order.
    Let $A = \begin{bmatrix} 2 & -3 & 8 \\ -5 & 1 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} -4 & 3 & 2 \\ 4 & 7 & 9 \end{bmatrix}$. Compute $3A - 2B$.

11. In a matrix, **rows** run horizontally and **columns** run vertically. The order (or dimension) of a matrix is given by the number rows by the number of columns. For example, matrix A from the previous problem has order 2×3. What is the order of the matrix $C = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \end{bmatrix}$?