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11.2 Representing Vectors

1. $a = -7i + 3j$
   $b = 2i - 5j$

   a) $3a = 3(-7i + 3j)$
   $= -21i + 9j$

   b) $a - 2b = -7i + 3j - 2(2i - 5j)$
   $= -7i + 3j - 4i + 10j$
   $= -11i + 13j$

   c) $3b - a = 3(2i - 5j) - (-7i + 3j)$
   $= 6i - 15j + 7i - 3j$
   $= 13i - 18j$

2. $a = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$ $b = \begin{pmatrix} 6 \\ -1 \end{pmatrix}$ $c = \begin{pmatrix} -3 \\ -5 \end{pmatrix}$

   a) $\frac{1}{2}a = \frac{1}{2}\begin{pmatrix} -2 \\ 4 \end{pmatrix} = \begin{pmatrix} -1 \\ 2 \end{pmatrix}$

   b) $a + b + c = \begin{pmatrix} -2 \\ 4 \end{pmatrix} + \begin{pmatrix} 6 \\ -1 \end{pmatrix} + \begin{pmatrix} -3 \\ -5 \end{pmatrix}$
   $= \begin{pmatrix} 1 \\ -2 \end{pmatrix}$

   c) $c + 2b - \frac{3}{2}a = \begin{pmatrix} -3 \\ -5 \end{pmatrix} + 2\begin{pmatrix} 6 \\ -1 \end{pmatrix} - \frac{3}{2}\begin{pmatrix} -2 \\ 4 \end{pmatrix}$
   $= \begin{pmatrix} -3 \\ -5 \end{pmatrix} + \begin{pmatrix} 12 \\ -2 \end{pmatrix} - \begin{pmatrix} -3 \\ 6 \end{pmatrix}$
   $= \begin{pmatrix} 12 \\ -13 \end{pmatrix}$

3.

$a = -6i + 7j$

$b = 3i - 5j$

Resultant $= -6i + 7j + 3i - 5j$

$= -3i + 2j$

4. $\overrightarrow{AB} = -8i + 7j$

$\overrightarrow{AC} = 11i - j$

$\overrightarrow{BC} = \overrightarrow{BA} + \overrightarrow{AC}$

$= 8i - 7j + 11i - j$

$= 19i - 8j$

5. $a = \begin{pmatrix} 2 \\ p \end{pmatrix}$ $b = \begin{pmatrix} -3 \\ -4 \end{pmatrix}$ $c = \begin{pmatrix} q \\ 11 \end{pmatrix}$

$2b - c = a$

$2\begin{pmatrix} -3 \\ -4 \end{pmatrix} - \begin{pmatrix} q \\ 11 \end{pmatrix} = \begin{pmatrix} 2 \\ p \end{pmatrix}$

$\begin{pmatrix} -6 \\ -8 \end{pmatrix} - \begin{pmatrix} q \\ 11 \end{pmatrix} = \begin{pmatrix} 2 \\ p \end{pmatrix}$

$-6 - q = 2$

$q = -8$

$-8 - 11 = p$

$-19 = p$

$p = -19$, $q = -8$

6. $a = -2i + 7j$
$b = 3i - 2j$
$c = -i - 6j$
$d = 2i - 2j$

$2a + 5b = 2(-2i + 7j) + 5(3i - 2j)$
$= -4i + 14j + 15i - 10j$
$= 11i + 4j$

$2d - c = 2(2i - 2j) - (-i - 6j)$
$= 4i - 4j + i + 6j$
$= 5i + 2j$

$11i + 4j$ and $5i + 2j$ are not multiples of each other
$\therefore$ the vectors are not parallel

7. $a = 2pi + 3qj$
$b = -4qi + pj$

$b - a = -10i + 10j$

$-4qi + pj - 2pi + 3qj = -10i + 10j$

$\begin{pmatrix} -4q \\ p \end{pmatrix} - \begin{pmatrix} 2p \\ 3q \end{pmatrix} = \begin{pmatrix} -10 \\ 10 \end{pmatrix}$

$-4q - 2p = -10$
$p - 3q = 10$

Simultaneous equations
$-4q - 2p = -10$ $\quad q = -1$
$-3q + p = 10$ $\quad p = 7$