### Vector Components Worksheet

1. Using dotted lines, draw the horizontal and vertical components for each vector shown below. Show only one pair of the components.

<table>
<thead>
<tr>
<th>Vector</th>
<th>Components</th>
</tr>
</thead>
</table>
| 40 m, 40° from horizontal | $A_x = 40 \cos 40° = 30.2 m$  
$A_y = 40 \sin 40° = 25.8 m$ |
| 9 lb, 20° from horizontal | $A_x = 9 \cos 20° = 8.5 lb$  
$A_y = 9 \sin 20° = 3.08 lb$ |
| 20 km 15° from vertical | $A_x = 20 \cos 15° = 19.19 km$  
$A_y = 20 \sin 15° = 5.18 km$ |
| 15 m/s, 50° from vertical | $A_x = 15 \cos 50° = 9.6 m/s$  
$A_y = 15 \sin 50° = 11.7 m/s$ |
| 45 N, 70° from vertical | $A_x = 45 \cos 70° = 14.8 N$  
$A_y = 45 \sin 70° = 43.1 N$ |
| 15 ft, 80° from horizontal | $A_x = 15 \cos 80° = 2.86 ft$  
$A_y = 15 \sin 80° = 14.8 ft$ |
| 6 mi, 0° from vertical | $A_x = 6 \cos 0° = 6 mi$  
$A_y = 6 \sin 0° = 0$ |
| 50 m/s², 0° from horizontal | $A_x = 50 \cos 0° = 50 m/s²$  
$A_y = 50 \sin 0° = 0$ |
| 100 m/s, 30° from horizontal | $A_x = 100 \cos 30° = 86.8 m/s$  
$A_y = 100 \sin 30° = 50 m/s$ |

2. Using the angles given on the diagrams in problem #1 above, calculate the values of the horizontal ($x$) and vertical ($y$) components for each diagram you did above, showing your work in the box for each below.

**Note:** Be sure your calculator is in **“DEGREE” mode** before doing your calculations.

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<th>$x$-Component</th>
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| 50 m/s², 0° from horizontal | $A_x = 50 \cos 0° = 50 m/s²$  
$A_y = 50 \sin 0° = 0$ |
| 100 m/s, 30° from horizontal | $A_x = 100 \cos 30° = 86.8 m/s$  
$A_y = 100 \sin 30° = 50 m/s$ |
3. A dodgeball player is trying to avoid getting hit by the opposing team. The player runs 2.7 m at an angle 37° south of west. They then run 4.9 m at an angle of 62° east of south. Then then run 1.7 m at an angle of 13° north of west.

a. Draw the x and y components of the individual vectors on the diagram below.

b. Calculate the resultant displacement.

\[ A_x = A \cos \theta = 2.7 \ m \cos 217° = -2.16 \ m \]
\[ A_y = A \sin \theta = 2.7 \ m \sin 217° = -1.62 \ m \]

\[ B_x = B \cos \theta = 4.9 \ m \cos 332° = 4.32 \ m \]
\[ B_y = B \sin \theta = 4.9 \ m \sin 332° = -2.30 \ m \]

\[ C_x = C \cos \theta = 1.7 \ m \cos 167° = -1.65 \ m \]
\[ C_y = C \sin \theta = 1.7 \ m \sin 167° = 0.38 \ m \]

\[ R_x = A_x + B_x + C_x = -2.16 \ m + 4.32 \ m + (-1.65 \ m) = 0.51 \ m \]
\[ R_y = A_y + B_y + C_y = -1.62 \ m + (-2.30 \ m) + 0.38 \ m = -3.54 \ m \]

\[ R = \sqrt{R_x^2 + R_y^2} = \sqrt{(0.51 \ m)^2 + (-3.54 \ m)^2} = 3.58 \ m \]

\[ \theta = \tan^{-1} \left( \frac{R_y}{R_x} \right) = \tan^{-1} \left( \frac{-3.54 \ m}{0.51 \ m} \right) = -81.8° \]

\[ R = 3.58 \ m @ 81.8° \text{ South of East} \]
4. A plane heads at an angle of 40° West of North at a speed of 150 m/s.

   a. Draw the vector representing the plane’s flight and show the westward and northward components of it’s velocity.

   b. Calculate the westward and northward components of the plane’s velocity.

\[ A_x = A \cos \theta = 150 \text{ m/s} \cos 130^\circ = -96.4 \text{ m/s, or 96.4 m/s West} \]
\[ A_y = A \sin \theta = 150 \text{ m/s} \sin 130^\circ = 114.9 \text{ m/s, or 114.9 m/s North} \]
5. A rocket hits the ground at an angle of $60^\circ$ from the horizontal at a speed of 300 m/s.
   a. Draw the vector representing the rocket’s impact and show the westward and eastward components of its velocity.
   b. Calculate the horizontal and vertical components of the rocket’s impact velocity.

\[
A_x = A \cos \theta = 300 \text{ m/s} \cos 60^\circ = 150 \text{ m/s horizontal}
\]
\[
A_y = A \sin \theta = 300 \text{ m/s} \sin 60^\circ = 259.8 \text{ m/s vertical}
\]
6. A squirrel runs out into the street in front of your car. The squirrel runs 39° north of west for 3.0 m, turns around and runs 5.5 m at an angle of 51° east of south. a. Draw the individual vectors. b. Calculate the resultant vector.

\[
\begin{align*}
A_x &= A \cos \theta = 3.0 \text{ m} \cos 141° = -2.33 \text{ m} \\
A_y &= A \sin \theta = 3.0 \text{ m} \sin 141° = 1.89 \text{ m} \\
B_x &= B \cos \theta = 5.5 \text{ m} \cos 321° = 4.27 \text{ m} \\
B_y &= B \sin \theta = 5.5 \text{ m} \sin 321° = -3.46 \text{ m} \\
R_x &= A_x + B_x = -2.33 \text{ m} + 4.27 \text{ m} = 1.94 \text{ m} \\
R_y &= A_y + B_y = 1.89 \text{ m} + (-3.46 \text{ m}) = -1.57 \text{ m} \\
R &= \sqrt{R_x^2 + R_y^2} = \sqrt{(1.94 \text{ m})^2 + (-1.57 \text{ m})^2} = 2.50 \text{ m} \\
\theta &= \tan^{-1} \left( \frac{R_y}{R_x} \right) = \tan^{-1} \left( \frac{-1.57 \text{ m}}{1.94 \text{ m}} \right) = -39.0° \\
R &= 2.50 \text{ m} @ 39.0° \text{ South of East}
\end{align*}
\]