VECTOR WORKSHEET

NAME: _____

1. An object moves in 2D space. Its position at three points in time are given as $\vec{r}_1$, $\vec{r}_2$, and $\vec{r}_3$. Find the magnitude and direction (as an angle between 0° and 360°) of each of the position vectors:

$\vec{r}_1 = \langle -7, \quad -6 \rangle$ m mag: $r_1 =$ _____ m; dir: $\theta_1 =$ _____°

$\vec{r}_2 = \langle -9, \quad 2 \rangle$ m mag: $r_2 =$ _____ m; dir: $\theta_2 =$ _____°

$\vec{r}_3 = \langle 4, \quad -7 \rangle$ m mag: $r_3 =$ _____ m; dir: $\theta_3 =$ _____°

2. Find the displacement between each of the following sets of position vectors. Give your answer as both a vector and magnitude/direction:

$\Delta\vec{r}_{12} = \Delta\vec{r}_{1\to2} = \vec{r}_2 - \vec{r}_1 = \langle \quad \rangle$ m; mag: $r_{12} =$ _____ m; dir: $\theta_{12} =$ _____°

$\Delta\vec{r}_{23} = \Delta\vec{r}_{2\to3} = \vec{r}_3 - \vec{r}_2 = \langle \quad \rangle$ m; mag: $r_{23} =$ _____ m; dir: $\theta_{23} =$ _____°

$\Delta\vec{r}_{13} = \Delta\vec{r}_{1\to3} = \vec{r}_3 - \vec{r}_1 = \langle \quad \rangle$ m; mag: $r_{13} =$ _____ m; dir: $\theta_{13} =$ _____°

3. What is the total distance traveled if the movement happens in a straight line from position #1 to position #2, then on to position #3? How is this different from the displacement from position #1 to position #3?

$d_{total} = r_{12} + r_{23} =$ _____ m

$d_{total} - r_{13} =$ _____ m

4. The object was at positions 1, 2, and 3 at times 9, 12, and 16 seconds, respectively. Find the average velocity between each set of position vectors. Give your answer as both a magnitude/direction:

$\bar{\vec{v}}_{12} = \frac{\Delta\vec{r}_{12}}{\Delta t_{12}} = \langle \quad \rangle$ m/s; mag: $\bar{v}_{12} =$ _____ m/s; dir: $\theta_{12} =$ _____°

$\bar{\vec{v}}_{23} = \frac{\Delta\vec{r}_{23}}{\Delta t_{23}} = \langle \quad \rangle$ m/s; mag: $\bar{v}_{23} =$ _____ m/s; dir: $\theta_{23} =$ _____°

$\bar{\vec{v}}_{13} = \frac{\Delta\vec{r}_{13}}{\Delta t_{13}} = \langle \quad \rangle$ m/s; mag: $\bar{v}_{13} =$ _____ m/s; dir: $\theta_{13} =$ _____°

5. After reaching position #3, the object experiences a constant acceleration of $\vec{a} = \langle -5, \quad 2 \rangle$ m/s². What is the object's new position and velocity 3 seconds after leaving position #3?

$\Delta\vec{r}_4 = \vec{r}_3 + \bar{\vec{v}}_{23}\Delta t_{34} + \frac{1}{2}\vec{a}(\Delta t_{34})^2 = \langle \quad \rangle$ m; mag: $r_{34} =$ _____ m; dir: $\theta_{34} =$ _____°

$\vec{v}_4 = \vec{v}_3 + \vec{a}t = \langle \quad \rangle$ m/s; mag: $\bar{v}_{34} =$ _____ m/s; dir: $\theta_{34} =$ _____°

Note: Compare these equations with the kinematic equations by substituting vectors for all of the variables (except for time).