PHY2053 Practice Exam I Spring 2012

1.) At time t_1, a point mass M is observed at a position given by

$$\vec{\boldsymbol{r}}_1 = -6.00\ m\ \hat{\boldsymbol{i}} + 3.00\ m\ \hat{\boldsymbol{j}}\ ,$$

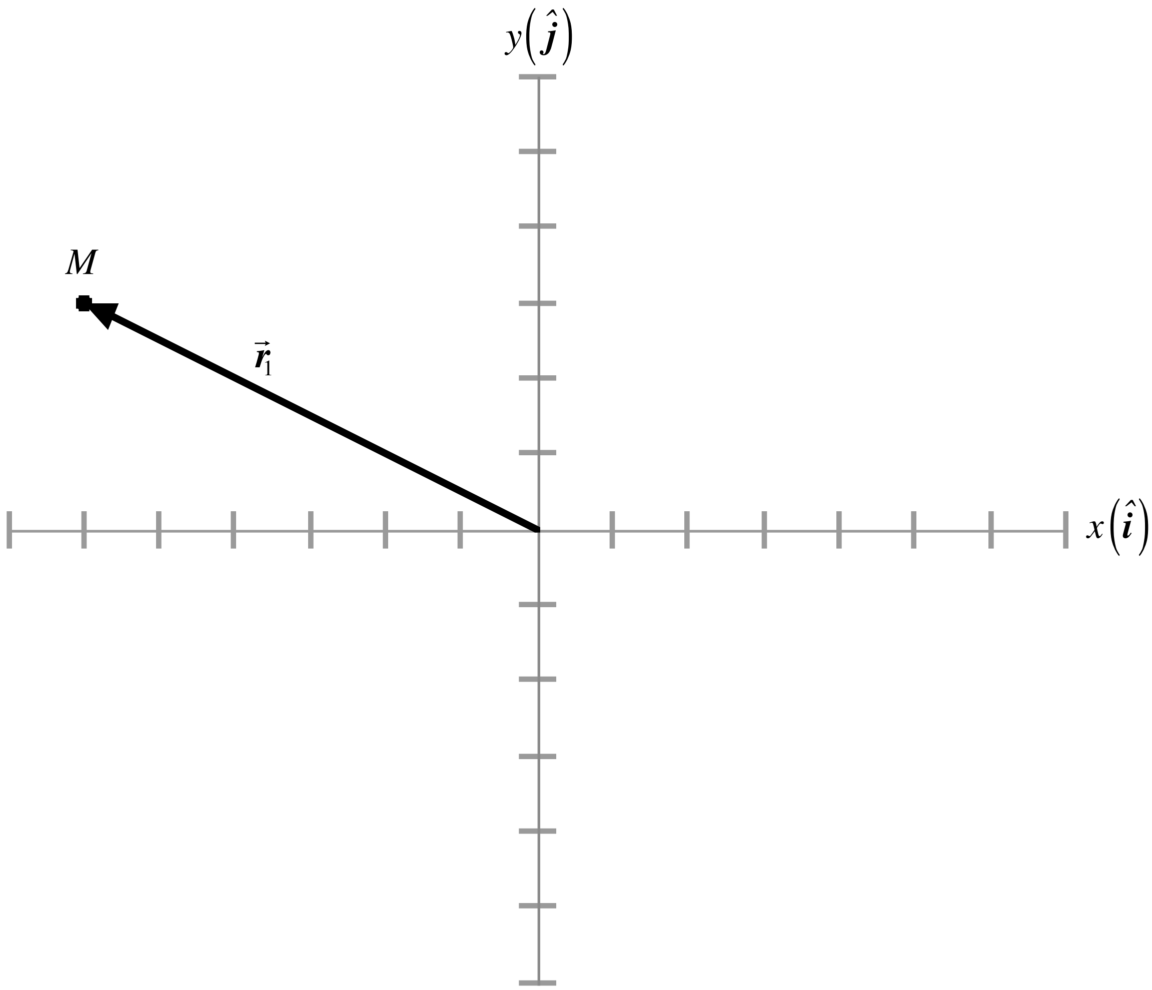
as represented in the diagram below. Do the following:

a) Calculate r_1, the magnitude of this position vector.

b) Calculate $\hat{\boldsymbol{r}}_1$, the unit vector representing the direction of this position vector.

c) Calculate θ_x, the angle this position vector makes to the positive branch of the x-axis. Clearly indicate this angle on the diagram below.

d) Calculate θ_y, the angle this position vector makes to the positive branch of the y-axis. Clearly indicate this angle on the diagram below.



2.) An initial observation of a point mass M, established its position as

$$\vec{\boldsymbol{r}}_o = -5.00\ m\ \hat{\boldsymbol{i}} - 4.00\ m\ \hat{\boldsymbol{j}}\ .$$

A short time later, a second observation confirmed a position given by

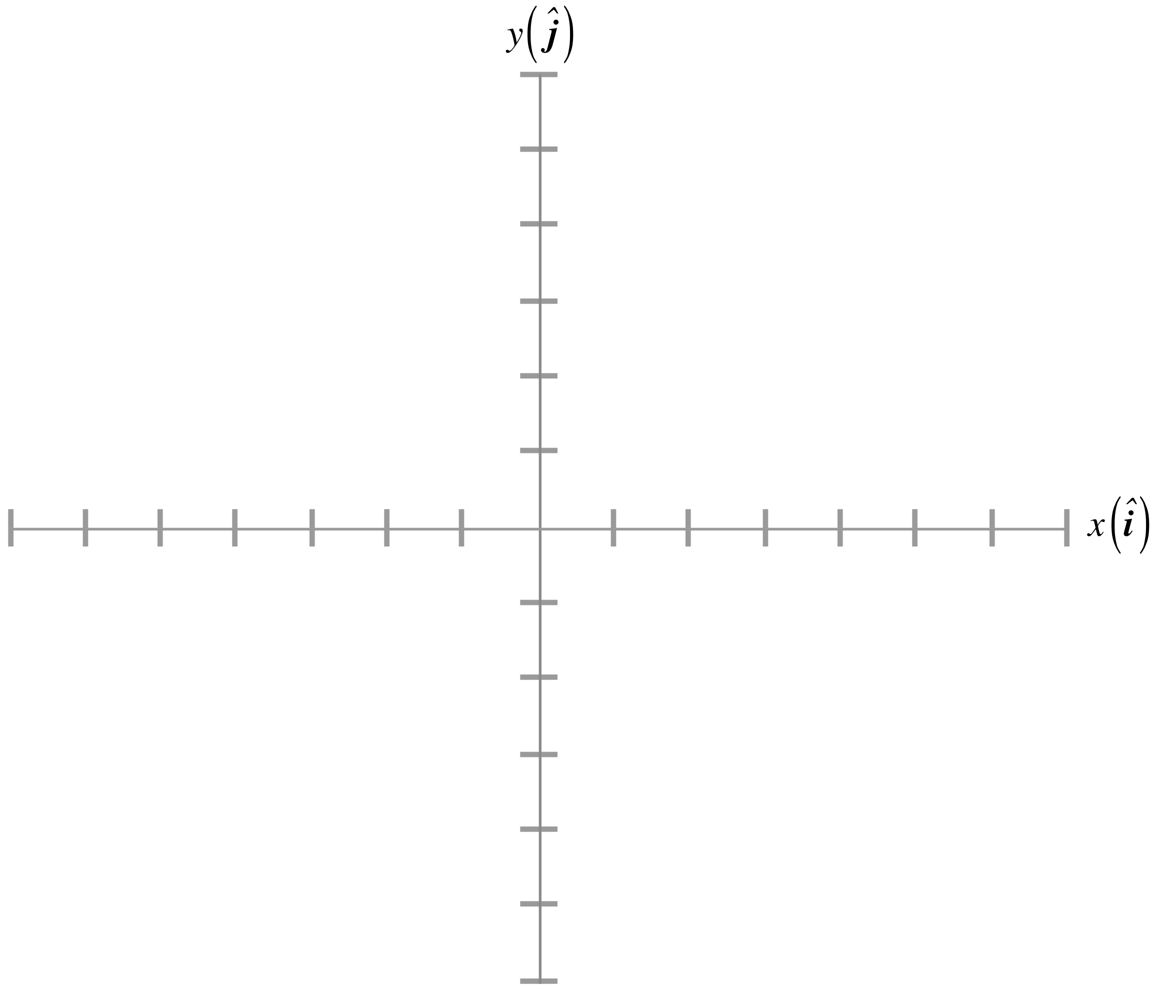
$$\vec{r}_L = -2.00\ m\ \hat{i} + 6.00\ m\ \hat{j}\ .$$

Do the following:

a) On the graph provided below, draw a correct graphic representation of $\vec{r}_o$, $\vec{r}_L$, and the change in position vector $\Delta\vec{r}$.

b) Calculate Δr , the magnitude of this change in position vector.

c) Calculate $\widehat{\Delta r}$, the unit vector representing the direction of this change in position vector.



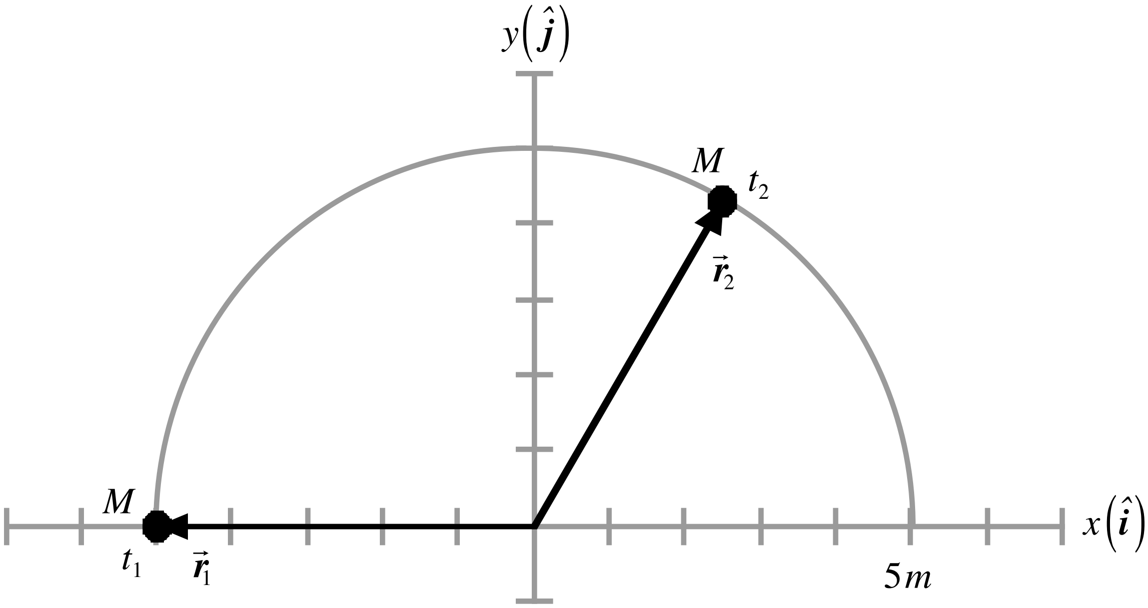
3.) A point mass M is constrained to move on a circular path of radius $R = 5.00\ m$ at a constant speed $v = 5.2360\ m/s$. The point mass is initially observed at a position given by $\vec{r}_1 = -R\ \hat{i}$. Two *seconds* later, the point mass is observed at the position $\vec{r}_2 = 2.5000\ m\ \hat{i} + 4.3301\ m\ \hat{j}$, as represented in the diagram below. Do the following:

a) Calculate $\vec{v}_{ave}$, the average velocity vector for this scenario.

b) Calculate v_{ave} , the magnitude of this average velocity vector.

c) Calculate $\hat{v}_{ave}$, the unit vector that represents the direction of this average velocity vector.

d) For **three extra credit points**, calculate the actual distance the point mass moves in this time interval.



4.) A point mass M is initially observed a vertical distance $h_o = 105.9\ m$ above level ground moving **upward** with an instantaneous speed $v_o = 20.6\ m/s$. Three *seconds* later, the point mass was at a vertical height of $h_L = 123.6\ m$ moving **downward** with an instantaneous speed $v_L = 8.8\ m/s$. Do the following:

a) Calculate $\vec{a}_{ave}$, the average acceleration of the point mass over this time interval.

b) Calculate a_{ave}, the magnitude of this average acceleration.

c) Calculate $\hat{a}_{ave}$, the unit vector that represents the direction of this average acceleration.

d) For **three extra credit points**, calculate at what vertical distance the point mass will be two *seconds* after the later observation. (Hint, a clear diagram with an appropriate coordinate system will prove useful.)

5.) At time t_1, a point mass M is observed at a position given by

$$\vec{r}_1 = -3.00\ m\ \hat{\boldsymbol{i}} - 5.00\ m\ \hat{\boldsymbol{j}}\ ,$$

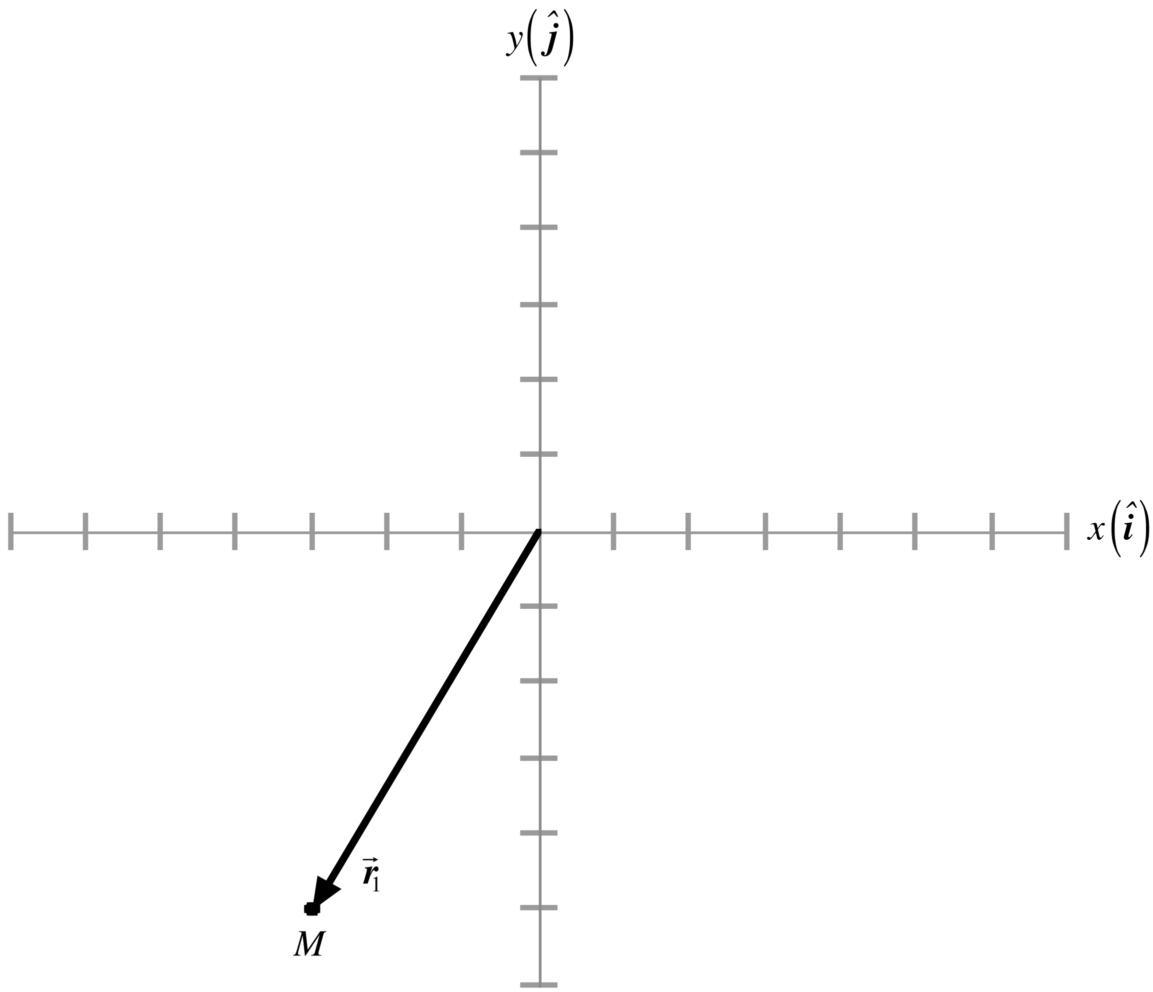
as represented in the diagram below. Do the following:

a) Calculate r_1, the magnitude of this position vector.

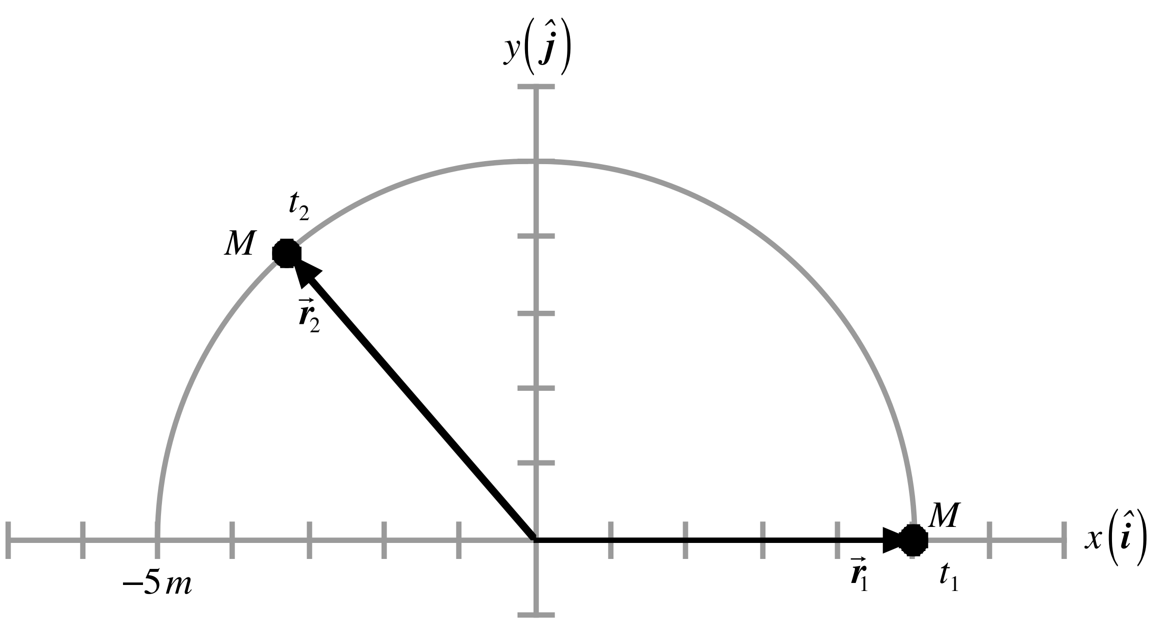
b) Calculate $\hat{r}_1$, the unit vector representing the direction of this position vector.

c) Calculate θ_x, the angle this position vector makes to the positive branch of the x-axis. Clearly indicate this angle on the diagram below.

d) Calculate θ_y, the angle this position vector makes to the positive branch of the y-axis. Clearly indicate this angle on the diagram below.



6.)



A point mass M is constrained to move on a circular path of radius $R = 5.00\ m$ at a constant speed $s = 5.6723\ m/s$. The point mass is initially observed at a position given by $\vec{r}_1 = R\ \hat{\boldsymbol{i}}$. Two *seconds* later, the point mass is observed at the position $\vec{r}_2 = -3.2139\ m\ \hat{\boldsymbol{i}} + 3.8302\ m\ \hat{\boldsymbol{j}}$, as represented in the diagram above. Do the following:

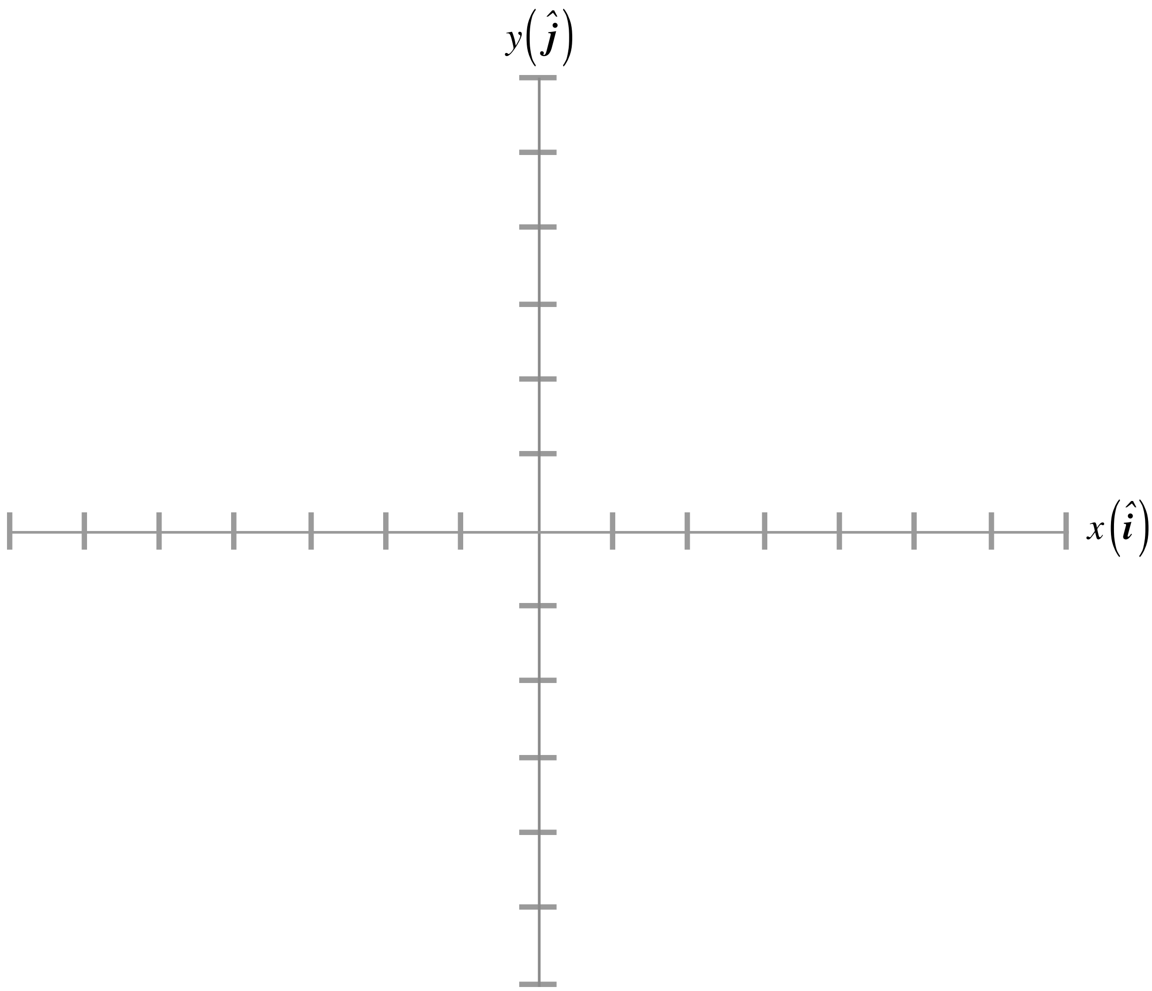
a) Calculate $\vec{\boldsymbol{v}}_{ave}$, the average velocity vector for this scenario.

b) Calculate v_{ave}, the magnitude of this average velocity vector.

c) Calculate $\hat{\boldsymbol{v}}_{ave}$, the unit vector that represents the direction of this average velocity vector.

d) For **three extra credit points**, calculate the actual distance the point mass moves in this time interval.

7.)



An initial observation of a point mass M, established its position to be given by

$$\vec{r}_o = 4.00\ m\ \hat{\boldsymbol{i}} - 5.00\ m\ \hat{\boldsymbol{j}}\ .$$

A short time later, a second observation confirmed a position given by

$$\vec{r}_L = 6.00\ m\ \hat{\boldsymbol{i}} + 2.00\ m\ \hat{\boldsymbol{j}}\ .$$

Do the following:

a) On the graph provided above, draw a correct graphic representation of $\vec{r}_o$, $\vec{r}_L$, and the change in position vector $\Delta\vec{r}$.

b) Calculate Δr , the magnitude of this change in position vector.

c) Calculate $\hat{\Delta r}$, the unit vector representing the direction of this change in position vector.

8.) A car of mass $M = 1,200\ kg$ is initially observed moving due west with a speed of $v_o = 8.941\ m/s$. Six seconds later, the car was observed moving due south with a speed of a $v_L = 26.822\ m/s$. Do the following:

a) Calculate $\vec{a}_{ave}$, the average acceleration of the car over this time interval.

b) Calculate a_{ave} , the magnitude of this average acceleration.

c) Calculate $\hat{a}_{ave}$, the unit vector that represents the direction of this average acceleration.

(A clear diagram with an appropriate coordinate system will prove useful.)