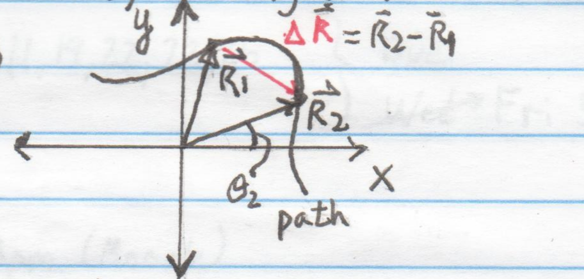
2-D Motion -- Position, Velocity & Acceleration

Ex)



- Motion in x-y plane.

$*\ \vec{R}_1$ = position vector at time t_1

$*\ \vec{R}_2$ = position vector at time t_2.

$\vec{R}_2 = R_{2x}\,\hat{i} + R_{2y}\,\hat{j}$

$R_{2x} = R_2 \cos\theta_2$

$R_{2y} = R_2 \sin\theta_2$

* Displacement $\Delta\vec{R} \equiv \vec{R}_f - \vec{R}_i$

$|\Delta\vec{R}| \leq$ path length

* Average velocity, $\vec{v}_{avg} \equiv \dfrac{\Delta\vec{R}}{\Delta t}$

textbook uses arrows & boldface for vectors

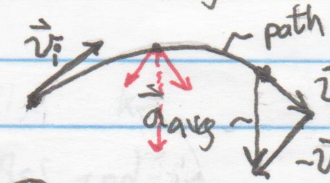
- Points in same direction as $\Delta\vec{R}$

* Instantaneous velocity, $\vec{v} \equiv \lim_{\Delta t \to 0} \dfrac{\Delta\vec{R}}{\Delta t} = \dfrac{d\vec{r}}{dt}$

- "speed" $v = v_{inst} = |\vec{v}|$ ------------> $v = \sqrt{v_x^2 + v_y^2}$

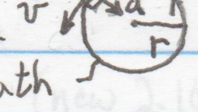
* Average Acceleration $\vec{a}_{avg} = \dfrac{\Delta\vec{v}}{\Delta t}$

* Points (roughly) towards center of curvature of path:



* Instantaneous Acceleration $\vec{a} = \dfrac{d\vec{v}}{dt}$

* Special case: Uniform Circular Motion:



$|\vec{a}| = a_c = \dfrac{v^2}{r}$

"centripetal accel."

Uniform $\vec{a}$ >>