Uniform Circular Motion

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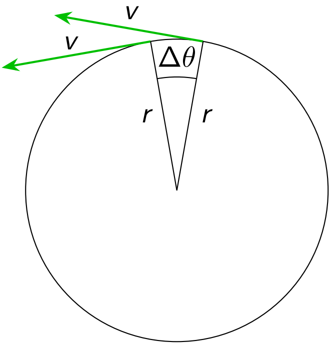
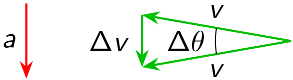
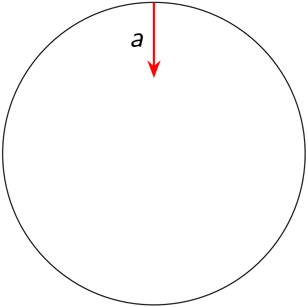
Uniform circular motion







$$v = \frac{r\Delta\theta}{\Delta t}$$

$$a = \frac{\Delta v}{\Delta t} = \frac{v\Delta\theta}{\Delta t} = \frac{v^2}{r}$$

Uniform circular motion

Uniform = constant speed

If you know that an object is in uniform circular motion, then you know two things:

1. The direction of its acceleration is *inward*.
2. The magnitude of its acceleration is $\frac{v^2}{r}$.

(Recall that velocity and acceleration are perpendicular when an object changes direction at constant speed.)

Period and frequency for circular motion

- r = radius of circle
- T = period = time for one revolution
- f = frequency = number of revolutions per second

$$f = \frac{1}{T}$$

- v = speed of object in circular motion

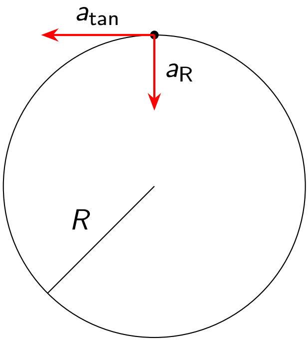
$$v = \frac{2\pi r}{T}$$

Speed, direction, and acceleration

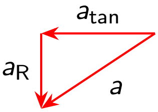
	Speed constant	Speed changing
Direction constant	$a = 0$	$a \neq 0$
Direction changing	$a \neq 0$	$a \neq 0$

	Speed constant		Speed changing	
Direction constant	$a_{\mathrm{tan}} = 0$	$a_{\mathrm{R}} = 0$	$a_{\mathrm{tan}} = \frac{\Delta v}{\Delta t}$	$a_{\mathrm{R}} = 0$
Direction changing	$a_{\mathrm{tan}} = 0$	$a_{\mathrm{R}} = \frac{v^2}{r}$	$a_{\mathrm{tan}} = \frac{\Delta v}{\Delta t}$	$a_{\mathrm{R}} = \frac{v^2}{r}$

Nonuniform Circular Motion



$$a_{\text{R}} = \frac{v^2}{R}$$



- In nonuniform circular motion, the acceleration is not necessarily inward, but the inward component of acceleration is still v^2/R.

Comparison of Uniform and Nonuniform Circular Motion

	Uniform circular motion	Nonuniform circular motion
a_R	v^2/R	v^2/R
a_{tan}	zero	not zero
direction of a	inward	not exactly inward