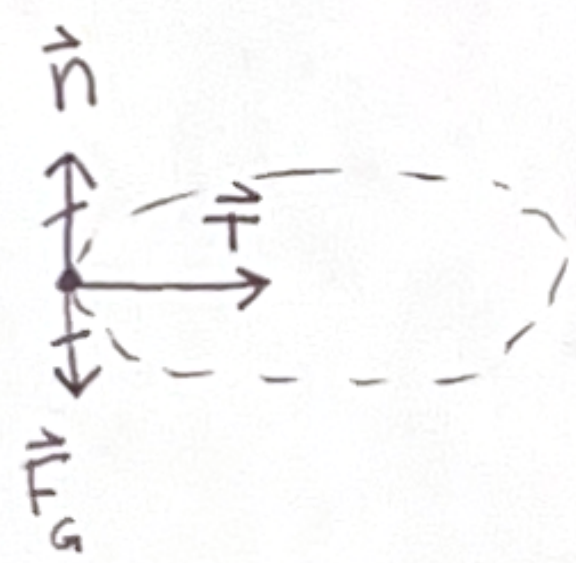
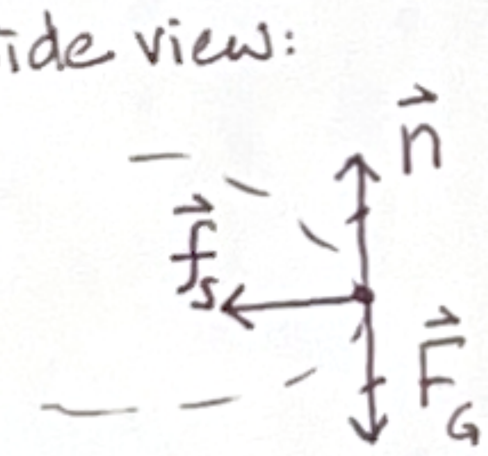
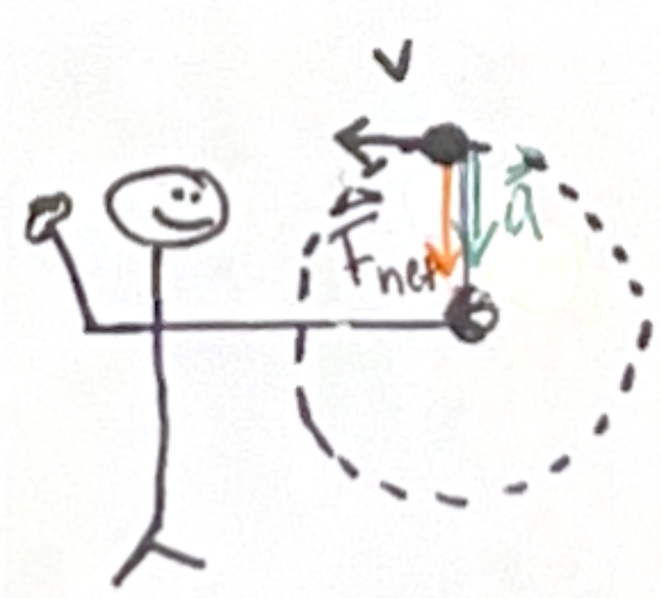
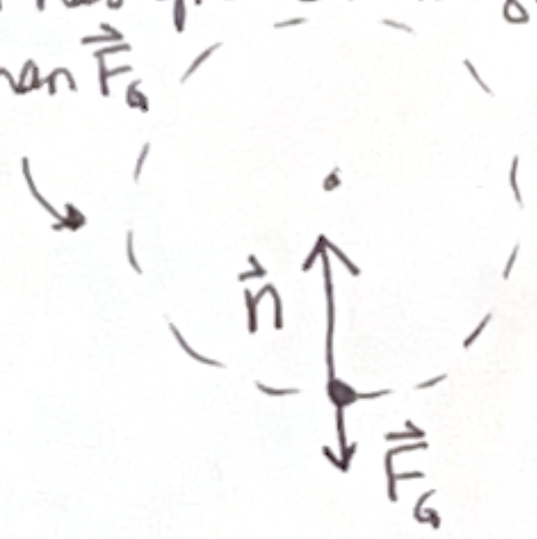
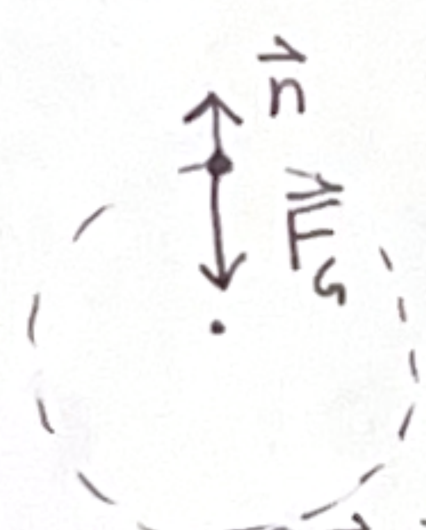
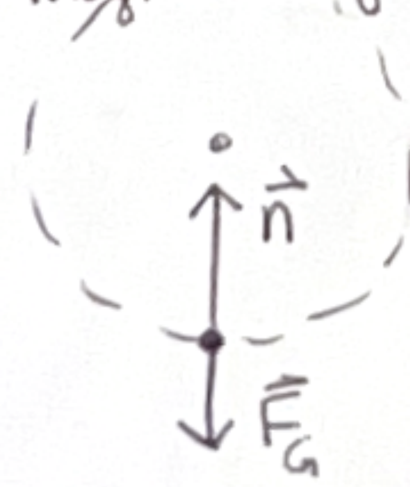
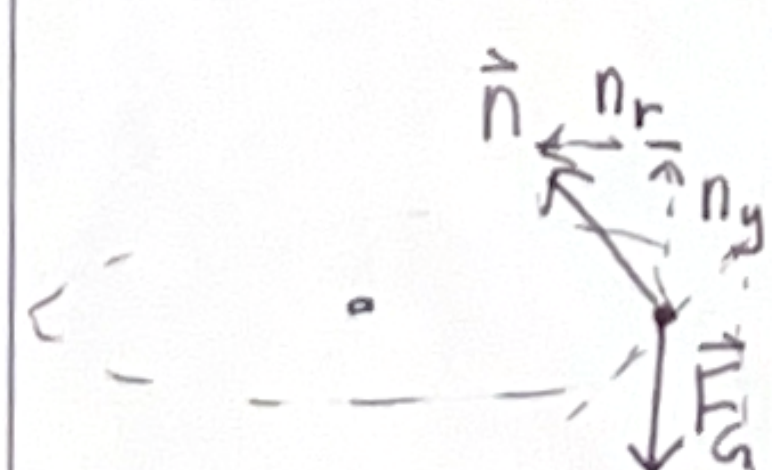
Remember that for the radial axis, r, the + direction is always toward the center of the circle!

Circular Motion Basic Concepts

Assume constant speed for all motions described.

Description of Situation	1. Draw a free-body diagram showing all the forces on the object at the moment shown:	2. Draw a labeled vector showing the net force on the object at the moment shown in one color 3. Draw a labeled vector showing the acceleration in another color.	4. Write the Fnet = ma equation for the center-axis for the moment shown: General principle is $(F_{net})_r = ma_r$ for all:
1. The **moon** revolving around the earth.			$(F_{net})_r = ma_r$ $F_G = ma_r$
2. A toy **car** is attached to a string and moving in a circle on the floor (side view)			$(F_{net})_r = ma_r$ $T = ma_r$
3. A **car** rounds a flat curve (side view)	side view:  Static friction is the force toward the center! Imagine if friction was zero...		$(F_{net})_r = ma_r$ $f_s = ma_r$
4. **Bucket** attached to a rope, whirled in vertical circle (side view) a. For a point at the top	 (unknown how the magnitudes compare)		$(F_{net})_r = ma_r$ $F_G + T = ma_r$
b. For a point at the bottom			$(F_{net})_r = ma_r$ $T - F_G = ma_r$

The $\vec{T}$ vector needs to be longer than the $\vec{F}_G$ vector in order to have $\vec{F}_{net}$ toward the center.

Description of Situation	1. Draw a free-body diagram showing all the forces on the object at the moment shown:	2. Draw a labeled vector showing the net force on the object at the moment shown in one color 3. Draw a labeled vector showing the acceleration in another color.	4. Write the Fnet = ma equation for the center-axis for the moment shown:
5. **Rollercoaster car** moving through vertical circular loop (side view) a) For a point at the top	 (Both are down, but we don't know how magnitudes compare.)		$(F_{net})_r = ma_r$ $n + F_G = ma_r$
b) For a point at the bottom	$\vec{n}$ has greater magnitude than $\vec{F}_G$ 		$(F_{net})_r = ma_r$ $n - F_G = ma_r$
6. **Car** driving on a hilly road. a) for a point at the top of a hill	 magnitude of $\vec{n}$ is less than magnitude of $\vec{F}_G$		$(F_{net})_r = ma_r$ $F_G - n = ma_r$
b) for a point at the bottom of a valley	magnitude of $\vec{n}$ is more than magnitude of $\vec{F}_G$ 		$(F_{net})_r = ma_r$ $n - F_G = ma_r$
7. A **car** is on a banked curve in the road, and is not relying on friction to make the turn (cross-section view).		 center of circle is left of the car	$(F_{net})_r = ma_r$ $n_r = ma_r$ In the vertical direction, $\Sigma F_y = ma_y$ $n_y - F_G = m(0)$ ☺

$\vec{n}$ is perpendicular to the road surface

The net force is the horizontal component of $\vec{n}$, so that is n_r toward the center!