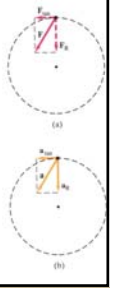
3 – Circular Motion and Gravitation

Non-Uniform Circular Motion

- WHAT IF: The net force applied to the object moving along a curved path is not directed toward the center?
- We resolve the force F into two components F_R and F_{tan}

Non-Uniform Circular Motion

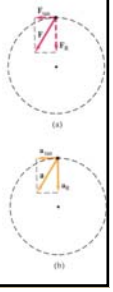
- F_R keeps the object moving in a circle and is solely responsible for a_R.
- $F_R = ma_R = m\frac{v^2}{r}$
- F_{tan} is responsible for a_{tan} which are changes in the v_{tan}.
- $F_{\tan} = ma_{\tan} = m\frac{\Delta v}{\Delta t}$



Non-Uniform Circular Motion

- a_R is always in the direction of the center of the circle (curve).
- a_{tan} is always tangent to the circle (curve).
  - a_{tan} is in the direction of the velo-city of speed is increasing and in the opposite direction if speed is decreas -ing
- a is the vector sum of a_{tan} and a_R

$$a = \sqrt{a_{\tan}^2 + a_R^2}$$



Newton's Law of Universal Gravitation

- Not called the 4th law.
- What force kept the Moon in its circular orbit?
- In the 1700's most forces were "contact" forces.
- The idea that gravity acted at a distance was radical and often rejected.

Newton's Law of Universal Gravitation

- Every particle in the universe attracts every other particle with a force that is proportional to the product of their masses and inversely proportional to the square of the distance between them. This force acts along the line joining the two particles.

$$F_g = G\frac{m_1 m_2}{d^2}$$

Newton's Law of Universal Gravitation

- Henry Cavendish measured G in 1798 about 75 after Newton died.
- $G = 6.67x10^{-11}\frac{Nm^2}{kg^2}$
- Known as the Universal Gravitational Constant