

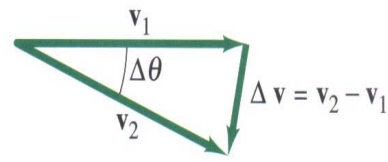
Circular Motion and Gravitation Exam Review

Uniform Circular Motion

Kinematics

Uniform circular motion – The *magnitude* of the velocity remains constant, but the *direction* of the velocity is continuously changing .

$$a_R = \frac{\Delta v}{\Delta t} = \frac{v\Delta\ell}{r\Delta t} = \frac{v^2}{r}$$



(b)

Frequency – f , the number of revolutions per second.

Period – T , time required for one complete revolution. Equal to $1/f$

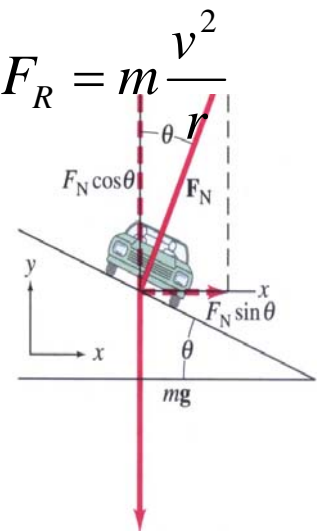
$$v = \frac{2\pi r}{T}$$

Dynamics

$$\Sigma F_R = ma_R \text{ and } a_R = \frac{v^2}{r} \text{ therefore } \Sigma F_R = m \frac{v^2}{r}$$

Banking

For a given banking angle θ , there will be a speed where NO Friction at all is required.

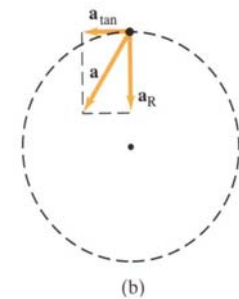
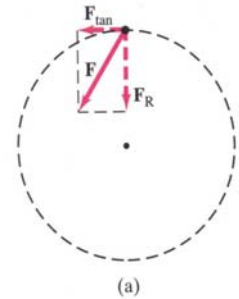


$$F_N \sin \theta = \frac{mv^2}{r}$$

Non-Uniform Circular Motion

$$F_R = ma_R = m \frac{v^2}{r}$$

$$F_{\text{tan}} = ma_{\text{tan}} = m \frac{\Delta v}{\Delta t}$$



Gravitation

Universal Gravitation

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

$$G = 6.67 \times 10^{-11} \frac{\text{Nm}^2}{\text{kg}^2}$$

Weight

For circular orbits

$$g = G \frac{m_E}{r_E^2} \quad \sum F_R = m \frac{v^2}{r} = G \frac{mm_E}{r^2}$$

$$W = mg + ma$$