Universal Law of Gravity

Universal gravitational constant:

\[ |\vec{F}_r| = \frac{GM_1M_2}{r^2}, \text{ towards each other} \]

Example: mass \((m_1)\) is located at \(r = \langle 0, 0 \rangle\), another mass \((m_2)\) is located at \(r = \langle 2, 3 \rangle\), and a third mass \((m_3)\) is located at \(r = \langle -1, 4 \rangle\).

What is the net gravitational force exerted on \(m_1\) by \(m_2\) and \(m_3\)?

\[ |\vec{F}_{21}| = \frac{GM_1M_2}{r_{21}^2} = \frac{GM_1M_2}{\sqrt{(2-0)^2 + (3-0)^2}} = \frac{GM_1M_2}{13} \]

\[ |\vec{F}_{31}| = \frac{GM_1M_3}{r_{31}^2} = \frac{GM_1M_3}{\sqrt{(-1-0)^2 + (4-0)^2}} = \frac{GM_1M_3}{17} \]

\[ \vec{F}_{21} = |\vec{F}_{21}| \langle \cos \theta, \sin \theta \rangle \]

\[ \vec{F}_{31} = |\vec{F}_{31}| \langle -\sin \phi, \cos \phi \rangle \]

Combine to find \(\Sigma \vec{F}\)

What up \(w\) little \(g\)?

Special case of universal gravity on surface of Earth

Circular Orbits
\[ F_{\text{total}} = \sum F_r \Rightarrow \frac{GMEm}{r^2} = \frac{V^2}{r} \Rightarrow V = \sqrt{\frac{GM_E}{r}} \]

if on surface:

\[ V = \sqrt{gr} \]

**Time for revolution?**

**Period (T) - time for 1 rev.**

\[
\text{use } \frac{V^2}{r} = \omega^2 r = \left(\frac{2\pi}{T}\right)^2 r \]\n
\[ T^2 = \left(\frac{4\pi^2}{GM_E}\right) r^3 \]