EJERCICIO COMPLETO

Imagina que quiero calcular la fuerza gravitatoria que m_1 y m_2 ejercen sobre m_3.

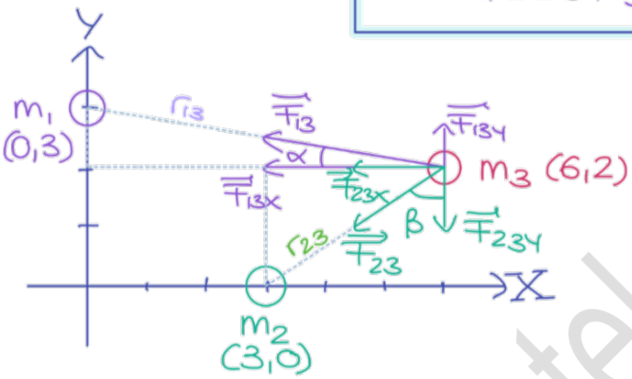
Primera forma:

Principio de superposición

$$\vec{F}_3 = \vec{F}_{13} + \vec{F}_{23}$$

$\vec{F}_{13}$: fuerza de m_1 sobre m_3

$\vec{F}_{23}$: fuerza de m_2 sobre m_3



$m_1 = 2kg$
$m_2 = 5kg$
$m_3 = 3kg$

$\boxed{F_{13}}$ Módulo

$$F_{13} = G\frac{m_1 \cdot m_3}{r_{13}^2} = 6'67 \cdot 10^{-11} \cdot \frac{2 \cdot 3}{(\sqrt{37})^2} = 1'08 \cdot 10^{-11} \text{ (N)}$$

$$r_{13} = \sqrt{1^2 + 6^2} = \sqrt{37}$$

Carácter vectorial

$$\alpha = \arctan\left(\frac{1}{6}\right) = 9'46^\circ$$

$$\cos\alpha = \frac{F_{13x}}{F_{13}} \longrightarrow F_{13x} = F_{13} \cdot \cos\alpha = 1'08 \cdot 10^{-11} \cdot \cos(9'46^\circ) = 1'07 \cdot 10^{-11}$$

$$\operatorname{sen}\alpha = \frac{F_{13y}}{F_{13}} \longrightarrow F_{13y} = F_{13} \cdot \operatorname{sen}\alpha = 1'08 \cdot 10^{-11} \cdot \operatorname{sen}(9'46^\circ) = 1'78 \cdot 10^{-12}$$

$$\Longrightarrow \vec{F}_{13} = (-1'07 \cdot 10^{-11}\,\vec{i} + 1'78 \cdot 10^{-12}\,\vec{j}) \text{ (N)}$$

$\boxed{F_{23}}$ Módulo

$$r_{23} = \sqrt{2^2 + 3^2} = \sqrt{13}$$

$$F_{23} = G\,\frac{m_2 \cdot m_3}{r_{23}^2} = 6'67\cdot10^{-11}\cdot\frac{5\cdot3}{(\sqrt{13})^2} = 7'7\cdot10^{-11}\ (N)$$

Carácter vectorial

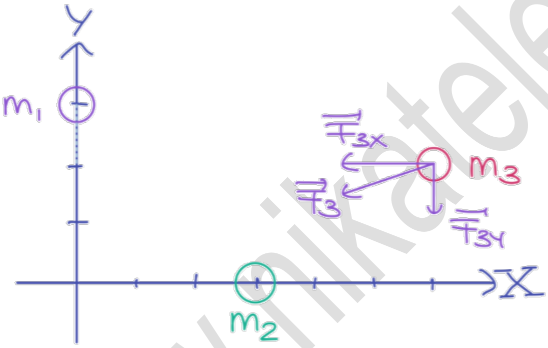
$$\beta = \arctan\left(\frac{3}{2}\right) = 56'31^\circ$$

$$\cos\alpha = \frac{F_{23y}}{F_{23}} \longrightarrow F_{23y} = F_{23}\cdot\cos\beta = 7'7\cdot10^{-11}\cdot\cos(56'31^\circ) = $$
$$= 4'27\cdot10^{-11}$$

$$\operatorname{sen}\alpha = \frac{F_{23x}}{F_{23}} \longrightarrow F_{23x} = F_{23}\cdot\operatorname{sen}\beta = 7'7\cdot10^{-11}\cdot\operatorname{sen}(56'31^\circ) =$$
$$= 6'41\cdot10^{-11}$$

$$\Longrightarrow \vec{F}_{23} = (-6'41\cdot10^{-11}\,\vec{i} - 4'27\cdot10^{-11}\,\vec{j})\ (N)$$

$$\Longrightarrow \vec{F}_3 = \vec{F}_{13} + \vec{F}_{23} = (\underbrace{-7'48\cdot10^{-11}\,\vec{i}}_{\vec{F}_{3x}} - \underbrace{4'09\cdot10^{-11}\,\vec{j}}_{\vec{F}_{3y}})\ (N)$$



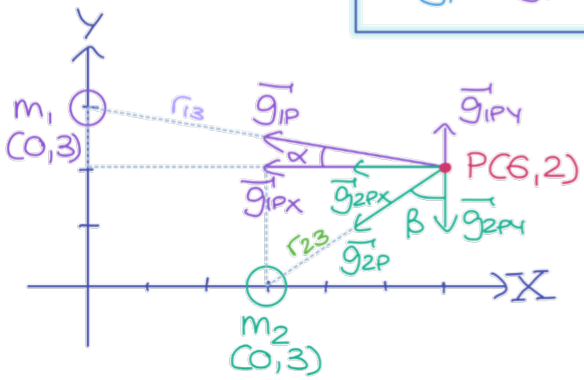
Segunda forma:

$$\vec{F}_3 = m_3\cdot\vec{g}_P$$

donde:

Principio de superposición

$$\vec{g}_P = \vec{g}_{1P} + \vec{g}_{2P}$$



$m_1 = 2kg$
$m_2 = 5kg$
$m_3 = 3kg$

$\boxed{g_{1P}}$ Módulo

$$g_{1P} = G\frac{m_1}{r_{1P}^2} = 6'67\cdot 10^{-11}\frac{2}{(\sqrt{37})^2} = 3'61\cdot 10^{-12}\ (N/kg)$$

$$r_{1P} = \sqrt{1^2+6^2} = \sqrt{37}$$

Carácter vectorial

$$\alpha = \arctan\left(\frac{1}{6}\right) = 9'46^\circ$$

$$\cos\alpha = \frac{g_{1Px}}{g_{1P}} \longrightarrow g_{1Px} = g_{1P}\cdot\cos\alpha = 3'61\cdot 10^{-12}\cdot\cos(9'46^\circ) = $$
$$= 3'56\cdot 10^{-12}$$

$$\operatorname{sen}\alpha = \frac{g_{1Py}}{g_{1P}} \longrightarrow g_{1Py} = g_{1P}\cdot\operatorname{sen}\alpha = 3'61\cdot 10^{-12}\cdot\operatorname{sen}(9'46^\circ) =$$
$$= 5'93\cdot 10^{-13}$$

$$\Longrightarrow \vec{g}_{1P} = (-3'56\cdot 10^{-12}\,\vec{i} + 5'93\cdot 10^{-13}\,\vec{j})\ (N/kg)$$

$\boxed{g_{2P}}$ Módulo

$$g_{2P} = G\cdot\frac{m_2}{r_{2P}^2} = 6'67\cdot 10^{-11}\cdot\frac{5}{(\sqrt{13})^2} = 2'57\cdot 10^{-11}\ (N/kg)$$

$$r_{2P} = \sqrt{2^2+3^2} = \sqrt{13}$$

Carácter vectorial

$$\beta = \arctan\left(\frac{3}{2}\right) = 56'31^\circ$$

$$\cos\alpha = \frac{g_{2Py}}{g_{2P}} \longrightarrow g_{2Py} = g_{2P}\cdot\cos\beta = 2'57\cdot 10^{-11}\cdot\cos(56'31^\circ) =$$
$$= 1'43\cdot 10^{-11}$$

$$\operatorname{sen}\alpha = \frac{g_{2Px}}{g_{2P}} \longrightarrow g_{2Px} = g_{2P}\cdot\operatorname{sen}\beta = 2'57\cdot 10^{-11}\cdot\operatorname{sen}(56'31^\circ) =$$
$$= 2'14\cdot 10^{-11}$$

$$\Longrightarrow \vec{g}_{2P} = (-2'14\cdot 10^{-11}\,\vec{i} - 1'43\cdot 10^{-11}\,\vec{j})\ (N/kg)$$

$$\Longrightarrow \vec{g}_P = \vec{g}_{1P} + \vec{g}_{2P} = (-2'5\cdot 10^{-11}\,\vec{i} - 1'37\cdot 10^{-11}\,\vec{j})\ (N/kg)$$

$$\Longrightarrow \vec{F}_3 = m_3\cdot\vec{g}_P = 3\cdot\vec{g}_P = (-7'5\cdot 10^{-11}\,\vec{i} - 4'11\cdot 10^{-11}\,\vec{j})\ (N)$$