Answer on Question #63908, Physics / Mechanics | Relativity

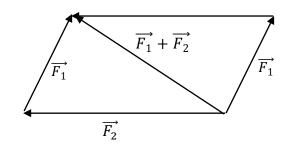
Problem: The resultant of two forces of 628 grams and 532 grams is a force of 718 grams. Find the angle which the resultant makes with the forces.

Solution: Let us denote

$$\left|\overrightarrow{F_1}\right|=532~g,\left|\overrightarrow{F_2}\right|=628~g$$
 , $\left|\overrightarrow{F_1}+\overrightarrow{F_2}\right|=718~g$

Angle between $\overrightarrow{F_2}$ and $\overrightarrow{F_1}$ + $\overrightarrow{F_2}$ α , angle between $\overrightarrow{F_1}$ and $\overrightarrow{F_1}$ + $\overrightarrow{F_2}$ β .

Using cosine rule for triangles $(\overrightarrow{F_1}; \overrightarrow{F_2}; \overrightarrow{F_1} + \overrightarrow{F_2})$ and $(\overrightarrow{F_2}; \overrightarrow{F_2} + \overrightarrow{F_1}; \overrightarrow{F_1})$



$$\cos \alpha = \frac{\left|\overrightarrow{F_1} + \overrightarrow{F_2}\right|^2 + \left|\overrightarrow{F_2}\right|^2 - \left|\overrightarrow{F_1}\right|^2}{2 \cdot \left|\overrightarrow{F_1} + \overrightarrow{F_2}\right| \cdot \left|\overrightarrow{F_2}\right|}$$

$$\cos \beta = \frac{\left|\overrightarrow{F_1} + \overrightarrow{F_2}\right|^2 + \left|\overrightarrow{F_1}\right|^2 - \left|\overrightarrow{F_2}\right|^2}{2 \cdot \left|\overrightarrow{F_1} + \overrightarrow{F_2}\right| \cdot \left|\overrightarrow{F_1}\right|}$$

Derive final formula for angles:

$$\alpha = \arccos\left(\frac{\left|\overrightarrow{F_{1}} + \overrightarrow{F_{2}}\right|^{2} + \left|\overrightarrow{F_{2}}\right|^{2} - \left|\overrightarrow{F_{1}}\right|^{2}}{2 \cdot \left|\overrightarrow{F_{1}} + \overrightarrow{F_{2}}\right| \cdot \left|\overrightarrow{F_{2}}\right|}\right) = \arccos\left(\frac{718^{2} + 628^{2} - 532^{2}}{2 \cdot 718 \cdot 628}\right) = \arccos 0.6951 = 46^{\circ}$$

$$\beta = \arccos\left(\frac{\left|\overrightarrow{F_{1}} + \overrightarrow{F_{2}}\right|^{2} + \left|\overrightarrow{F_{1}}\right|^{2} - \left|\overrightarrow{F_{2}}\right|^{2}}{2 \cdot \left|\overrightarrow{F_{1}} + \overrightarrow{F_{2}}\right| \cdot \left|\overrightarrow{F_{1}}\right|}\right) = \arccos\left(\frac{718^{2} + 532^{2} - 628^{2}}{2 \cdot 718 \cdot 532}\right) = \arccos 0.529 = 58^{\circ}$$

Answer: Angle between $\overrightarrow{F_1}$ and $\overrightarrow{F_1}$ + $\overrightarrow{F_2}$ $\alpha = 46^\circ$, angle between $\overrightarrow{F_1}$ and $\overrightarrow{F_1}$ + $\overrightarrow{F_2}$ $\beta = 58^\circ$

https://www.AssignmentExpert.com