

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

$$|\vec{F}_1| = 532 \text{ g}, |\vec{F}_2| = 628 \text{ g}, |\vec{F}_1 + \vec{F}_2| = 718 \text{ g}$$

Angle between \vec{F}_2 and $\vec{F}_1 + \vec{F}_2$ α , angle between \vec{F}_1 and $\vec{F}_1 + \vec{F}_2$ β .

Using cosine rule for triangles $(\vec{F}_1; \vec{F}_2; \vec{F}_1 + \vec{F}_2)$ and $(\vec{F}_2; \vec{F}_2 + \vec{F}_1; \vec{F}_1)$

$$\cos \alpha = \frac{|\vec{F}_1 + \vec{F}_2|^2 + |\vec{F}_2|^2 - |\vec{F}_1|^2}{2 \cdot |\vec{F}_1 + \vec{F}_2| \cdot |\vec{F}_2|}$$

$$\cos \beta = \frac{|\vec{F}_1 + \vec{F}_2|^2 + |\vec{F}_1|^2 - |\vec{F}_2|^2}{2 \cdot |\vec{F}_1 + \vec{F}_2| \cdot |\vec{F}_1|}$$

Derive final formula for angles:

$$\alpha = \arccos\left(\frac{|\vec{F}_1 + \vec{F}_2|^2 + |\vec{F}_2|^2 - |\vec{F}_1|^2}{2 \cdot |\vec{F}_1 + \vec{F}_2| \cdot |\vec{F}_2|}\right) = \arccos\left(\frac{718^2 + 628^2 - 532^2}{2 \cdot 718 \cdot 628}\right) = \arccos 0.6951 = 46^\circ$$

$$\beta = \arccos\left(\frac{|\vec{F}_1 + \vec{F}_2|^2 + |\vec{F}_1|^2 - |\vec{F}_2|^2}{2 \cdot |\vec{F}_1 + \vec{F}_2| \cdot |\vec{F}_1|}\right) = \arccos\left(\frac{718^2 + 532^2 - 628^2}{2 \cdot 718 \cdot 532}\right) = \arccos 0.529 = 58^\circ$$

Answer: Angle between \vec{F}_2 and $\vec{F}_1 + \vec{F}_2$ $\alpha = 46^\circ$, angle between \vec{F}_1 and $\vec{F}_1 + \vec{F}_2$ $\beta = 58^\circ$

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