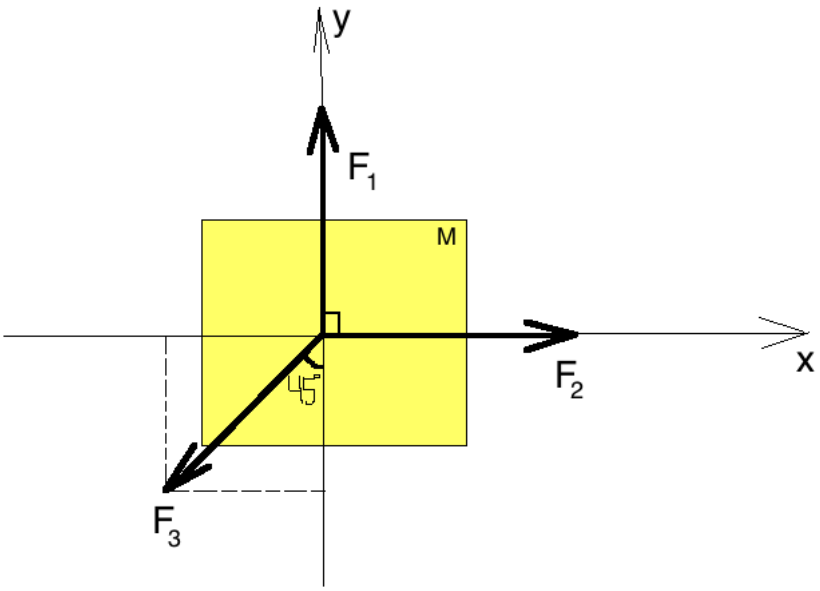
Answer on Question #40891 – Physics – Mechanics

WHEN A FORCE F ACTS ON A BODY OF MASS M , THE ACCELERATION PRODUCED IN THE BODY IS A . IF THREE EQUAL FORCES F1=F2=F3 ACT ON THE SAME BODY , ANGLE B/W F1 AND F2 IS 90 AND F2AND F3 IS 135. THE ACCELERATION PRODUCED IS- ??

Solution:



$$|\vec{F}_1| = |\vec{F}_2| = |\vec{F}_3| = F$$

Formula for the net force:

$$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$$

Resultant force along the X-axis:

$$F_{netX} = F_2 - F_3 \cdot \cos 45° = F - \frac{F}{\sqrt{2}} = F\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right) \quad (1)$$

Resultant force along the Y-axis:

$$F_{netY} = F_1 - F_3 \cdot \sin 45° = F - \frac{F}{\sqrt{2}} = F\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right) \quad (2)$$

Using the Pythagorean Theorem:

$$F_{net} = \sqrt{(F_{netX})^2 + (F_{netY})^2} \quad (3)$$

$$(1)\text{and}(2)\text{in}(3):$$

$$F_{net} = \sqrt{\left(F\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)\right)^2 + \left(F\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)\right)^2}$$

$$= \sqrt{2\left(\mathrm{F}\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)\right)^2} = \mathrm{F}\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)\cdot\sqrt{2} = \mathrm{F}\left(\sqrt{2}-1\right) \qquad (4)$$

Newton's second law for the body:

$$\mathrm{F}_{\mathrm{net}} = \mathrm{MA}_{\mathrm{result}} \qquad (5)$$

$$(4)\mathrm{in}(5):\ (\text{and using equation } \mathrm{F} = \mathrm{MA})$$

$$\begin{cases} \mathrm{F}\left(\sqrt{2}-1\right) = \mathrm{MA}_{\mathrm{result}} \\ \mathrm{F} = \mathrm{MA} \end{cases}$$

$$\frac{\mathrm{A}_{\mathrm{result}}}{\mathrm{A}} = \sqrt{2}-1$$

$$\mathrm{A}_{\mathrm{result}} = \mathrm{A}\left(\sqrt{2}-1\right)$$

Answer: the acceleration produced is equal to $\mathrm{A}\left(\sqrt{2}-1\right)$.