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فصل ۲

$$\vec{F}, \vec{F}', \quad \vec{R} = \vec{F} + \vec{F}' \perp \vec{F}, \quad R = \sqrt{3} F \rightarrow \frac{F'}{F} = ?$$

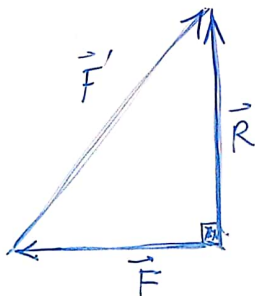
$$(\vec{F} + \vec{F}') \cdot \vec{F} = 0 \rightarrow \vec{F} \cdot \vec{F} + \vec{F} \cdot \vec{F}' = 0 \rightarrow F^2 + F F' \cos \theta = 0 \rightarrow F + F' \cos \theta = 0$$

$$F' \cos \theta = -F$$

$$R = \sqrt{3} F \rightarrow \sqrt{F^2 + F'^2 + 2FF' \cos \theta} = \sqrt{3} F \rightarrow F^2 + F'^2 + 2FF' \cos \theta = 3F^2$$

$$-2F^2 + F'^2 + 2FF' \cos \theta = 0 \rightarrow -2F^2 + F'^2 + 2F(-F) = 0 \rightarrow F'^2 = 4F^2 \rightarrow \frac{F'}{F} = 2$$

درش جمع شستی (کرش)



$$\text{مشتکات الزاویه} \rightarrow R^2 = F'^2 - F^2$$

$$R = \sqrt{3} F \rightarrow 3F^2 = F'^2 - F^2 \rightarrow 4F^2 = F'^2 \rightarrow \frac{F'}{F} = 2$$

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فصل ۲

$$A=B=C=1, \quad \vec{A}+\vec{B}+\vec{C}=\vec{0} \rightarrow |\vec{A} \times \vec{B}| + |\vec{B} \times \vec{C}| + |\vec{C} \times \vec{A}| = ?$$

$$\vec{A}+\vec{B}+\vec{C}=\vec{0} \rightarrow \vec{A} = -(\vec{B}+\vec{C}) \rightarrow |\vec{A}| = |\vec{B}+\vec{C}| \rightarrow 1 = \sqrt{1+1+2\cos\theta} \rightarrow \cos\theta = -\frac{1}{2} \rightarrow \theta = 120^\circ$$

بهین صورت زاویه بین هر دو بردار $\vec{A}, \vec{B}, \vec{C}$ برابر 120° خواهد بود

$$|\vec{A} \times \vec{B}| + |\vec{B} \times \vec{C}| + |\vec{C} \times \vec{A}| = AB\sin\theta + BC\sin\theta + CA\sin\theta = 3\sin\theta = 3\sin 120^\circ = 3\left(\frac{\sqrt{3}}{2}\right) = \frac{3\sqrt{3}}{2}$$

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$$A=B=C=1, \quad \vec{A}+\vec{B}+\vec{C}=\vec{0} \rightarrow \vec{C} \cdot \vec{A} + \vec{B} \cdot \vec{C} + \vec{A} \cdot \vec{B} = ?$$

$$\vec{A}+\vec{B}+\vec{C}=\vec{0} \rightarrow \vec{A} = -(\vec{B}+\vec{C}) \rightarrow |\vec{A}| = |\vec{B}+\vec{C}| \rightarrow 1 = \sqrt{1+1+2\cos\theta} \rightarrow \cos\theta = -\frac{1}{2} \rightarrow \theta = 120^\circ$$

به همین صورت زاویه بین هر دو بردار $\vec{A}$, $\vec{B}$, $\vec{C}$ برابر 120° خواهد بود.

$$\vec{C} \cdot \vec{A} + \vec{B} \cdot \vec{C} + \vec{A} \cdot \vec{B} = \overset{1}{C} \overset{1}{A} \cos\theta + \overset{1}{B} \overset{1}{C} \cos\theta + \overset{1}{A} \overset{1}{B} \cos\theta = 3\cos\theta = 3\cos 120^\circ = 3\left(-\frac{1}{2}\right) = -\frac{3}{2}$$

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فصل ٢

$$\vec{b}, \vec{a} \text{ متجهان؛ } \theta = 135^\circ, \quad a = 1, \quad \vec{c} = \vec{b} - \vec{a} \perp \vec{a}, \quad c = 4$$

$$b = ? \quad , \quad d = |\vec{b} + \vec{a}| = ?$$

$$\vec{c} \perp \vec{a} \rightarrow \vec{c} \cdot \vec{a} = 0 \rightarrow (\vec{b} - \vec{a}) \cdot \vec{a} = 0 \rightarrow \vec{b} \cdot \vec{a} - \vec{a} \cdot \vec{a} = 0 \rightarrow$$

$$b a \cos \theta - a^2 = 0 \rightarrow b(1)(\frac{1}{\sqrt{2}}) - 4 = 0 \rightarrow b = \frac{4\sqrt{2}}{\frac{1}{\sqrt{2}}} = 10$$

$$|\vec{b} + \vec{a}| = \sqrt{a^2 + b^2 + 2ab \cos \theta} = \sqrt{4 + 100 + 2(1)(10)(\frac{1}{\sqrt{2}})} = \sqrt{114} = 11$$

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٢. فضل

$$F_1 = 14 \text{ N} , \theta_1 = 45^\circ$$

$$F_2 = 2 \text{ N} , \theta_2 = 135^\circ$$

$$F_3 = ? , \theta_3 = ?$$

$$\vec{R} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 \rightarrow R = 12 \text{ N} \rightarrow R_x = 0$$

والى محورها $\theta = 90^\circ$

$$R_y = 12$$

$$\vec{R} = (\sum F_x) \hat{i} + (\sum F_y) \hat{j} \rightarrow \begin{cases} \sum F_x = 0 \rightarrow 0 = 14 \cos 45^\circ + 2 \cos 135^\circ + F_{3x} \rightarrow F_{3x} = 1.1 \\ \sum F_y = 12 \rightarrow 12 = 14 \sin 45^\circ + 2 \sin 135^\circ + F_{3y} \rightarrow F_{3y} = -13.4 \end{cases}$$

$$F_3 = \sqrt{(1.1)^2 + (13.4)^2} = 13.4$$

$$\vec{F}_3 = 1.1 \hat{i} - 13.4 \hat{j}$$

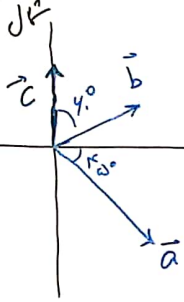
$$\theta = 34.2^\circ - 90^\circ = 55.8^\circ$$

$$\theta = \tan^{-1} \left(\frac{-13.4}{1.1} \right) = -88.1^\circ$$

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فصل ٢

$a = 10 \text{ m}$ جنوب شرقی ، $b = 4 \text{ m}$ ، $c = 5 \text{ m}$ زاویه 4° شرق شمال

$$\vec{R} = \vec{a} + \vec{b} + \vec{c} = ?$$



$$\vec{a} \text{ زاویه } \theta = 34^\circ - 4^\circ = 31^\circ \rightarrow \begin{cases} a_x = a \cos \theta = 10 \cos 31^\circ = 10 \left(\frac{\sqrt{r}}{r} \right) = 8.0 \sqrt{r} \\ a_y = a \sin \theta = 10 \sin 31^\circ = 10 \left(-\frac{\sqrt{r}}{r} \right) = -8.0 \sqrt{r} \end{cases}$$

$$\vec{b} \text{ زاویه } \theta = 9^\circ - 4^\circ = 5^\circ \rightarrow \begin{cases} b_x = b \cos \theta = 4 \cos 5^\circ = 4 \left(\frac{\sqrt{r}}{r} \right) = 2.0 \sqrt{r} \\ b_y = b \sin \theta = 4 \sin 5^\circ = 4 \left(\frac{1}{r} \right) = 2.0 \end{cases}$$

$$\vec{c} \text{ زاویه } \theta = 9^\circ \rightarrow c_x = c \cos \theta = 0, \quad c_y = c \sin \theta = 5.0$$

$$\vec{R} = (8.0 \sqrt{r} + 2.0 \sqrt{r} + 0) \hat{i} + (-8.0 \sqrt{r} + 2.0 + 5.0) \hat{j} = 10.0 \sqrt{r} \hat{i} + 1.0 \hat{j}$$

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فصل ٢

$$R = |F_1 + F_2| = 3\sqrt{a} \quad , \quad \vec{F}_1 \perp \vec{F}_2 \quad , \quad F_2 = 2F_1 \quad \rightarrow F_1 = ?$$

$$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos 90^\circ} = \sqrt{F_1^2 + (2F_1)^2 + 0} = \sqrt{F_1^2 + 4F_1^2} = F_1\sqrt{5}$$

$$R = 3\sqrt{a} \quad \left\{ \rightarrow F_1 = 3\sqrt{a} \right.$$

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فصل ۲

$$F_1 = F_2 = F$$

$$\theta = 90^\circ \rightarrow$$

$$R = |\vec{F}_1 + \vec{F}_2|$$

$$\theta = 120^\circ \rightarrow$$

$$R' = |\vec{F}_1 + \vec{F}_2|$$

$$\rightarrow \frac{R'}{R} = ?$$

$$R = |\vec{F}_1 + \vec{F}_2| = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos 90^\circ} = \sqrt{F^2 + F^2 + 0} = F\sqrt{2}$$

$$R' = |\vec{F}_1 + \vec{F}_2| = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos 120^\circ} = \sqrt{F^2 + F^2 - 2FF(\frac{1}{2})} = F$$

$$\rightarrow \frac{R'}{R} = \frac{F}{F\sqrt{2}} = \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$$

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فصل ٢

$$\vec{A} = 2\hat{i} - 3\hat{j} \quad , \quad \vec{B} = 3\hat{i} - 4\hat{j} \quad , \quad \vec{C} = 2\hat{i} - 3\hat{j} + \hat{k} \quad , \quad \vec{D} = \hat{i} - \hat{j} + \hat{k}$$

$$\vec{R} = (\vec{A} \cdot \vec{B}) + (\vec{C} \cdot \vec{D}) = ?$$

$$\vec{A} \cdot \vec{B} = (2\hat{i} - 3\hat{j}) \cdot (3\hat{i} - 4\hat{j}) = 4 + 12 = 16$$

$$\vec{C} \cdot \vec{D} = (2\hat{i} - 3\hat{j} + \hat{k}) \cdot (\hat{i} - \hat{j} + \hat{k}) = 2 + 3 + 1 = 6$$

$$\vec{R} = 16 + 6 = 22$$

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فصل ٢

$$\vec{A} = 2\hat{i} - 3\hat{j} \quad , \quad \vec{B} = 3\hat{i} - 4\hat{j} \quad , \quad \vec{C} = 2\hat{i} - 3\hat{j} + \hat{k} \quad , \quad \vec{D} = \hat{i} - \hat{j} + \hat{k}$$

$$\vec{R} = (\vec{A} \cdot \vec{B}) \vec{C}$$

$$\vec{A} \cdot \vec{B} = (2\hat{i} - 3\hat{j}) \cdot (3\hat{i} - 4\hat{j}) = 4 + 12 = 16$$

$$\vec{R} = (\vec{A} \cdot \vec{B}) \vec{C} = 16 \vec{C} = 32\hat{i} - 48\hat{j} + 16\hat{k}$$

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٢- فضل

$$\vec{A} = 2\hat{i} - 3\hat{j} \quad , \quad \vec{B} = 3\hat{i} - 4\hat{j} \quad , \quad \vec{C} = 2\hat{i} - 3\hat{j} + \hat{k} \quad , \quad \vec{D} = \hat{i} - \hat{j} + \hat{k}$$

$$\vec{R} = 3\vec{A} \times 2\vec{C} = ? \quad \quad 3\vec{A} = 4\hat{i} - 9\hat{j} \quad , \quad 2\vec{C} = 4\hat{i} - 6\hat{j} + 2\hat{k}$$

$$\vec{R} = 3\vec{A} \times 2\vec{C} = (4\hat{i} - 9\hat{j}) \times (4\hat{i} - 6\hat{j} + 2\hat{k}) = (-18 - 0)\hat{i} + (0 - 12)\hat{j} + \underbrace{(-24 + 36)}_0\hat{k}$$

$$\vec{R} = -18\hat{i} - 12\hat{j}$$