Nishant Jindal

DPP – 01

SOLUTION

Vector

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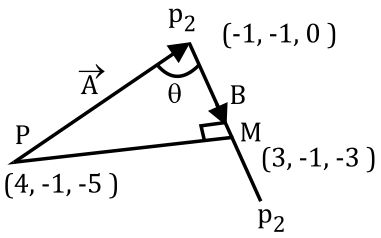
1. $\overrightarrow{PP_1} = \vec{A} = (-5\hat{i} + 5\hat{k})$

$\overrightarrow{P_1P_2} = \vec{B} = (4i - 3\hat{k})$

$\overrightarrow{AB} = AB\cos\theta$ $\quad |\bar{A}| = A = 5\sqrt{2}$

$|\bar{B}| = B = 5$



$-20 - 15 = 25\sqrt{2}\cos\theta$

$-35 = 25\sqrt{2}\cos\theta$

$\cos\theta = -\frac{7}{5\sqrt{2}}$

$\sin\theta = \frac{1}{5\sqrt{2}}$

$P = A\sin\theta = 5\sqrt{2} \times \frac{1}{5\sqrt{2}} = 1\text{km}$

$t = \frac{1\text{km}}{10\text{m/s}} = \frac{1000\text{m}}{10\text{m/s}} = 100\text{ sec}$

2. $F_2\sin\theta = F_1\sin 30$

$\frac{F_1}{2} = F_2\sin\theta$

$F_2\cos\theta + F_1\cos 30 = 80\sqrt{3}$

$F_2\cos\theta + 2F_2\sin\theta \times \frac{\sqrt{3}}{2} = 80\sqrt{3}$

$F_2(\sqrt{3}\sin\theta + \cos\theta) = 80\sqrt{3}$

$F_2\left[\frac{\sqrt{3}}{2}\sin\theta + \frac{1}{2}\cos\theta\right) = \frac{80\sqrt{3}}{2}$

$F_2[\sin(\theta + 30)] = 40\sqrt{3}$

F_2 is minimum

$F_2 = \frac{40\sqrt{3}}{\sin(\theta + 30)}$

$\theta + 30 = 90 \qquad \theta = 60°$

$F_2 = 40\sqrt{3}$

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$F_1 = 2F_2 \sin\theta = 2 \times 40\sqrt{3} \times \frac{\sqrt{3}}{2}$

$= 40 \times 3 = 120M$

3. $\vec{A} = 2\hat{i} + 2\hat{j} + 4\hat{k}$

$\vec{B} = 5I - 3J - K$

$\vec{P} = 10\hat{i} + 2\hat{j} - 11\hat{k}$

$\overrightarrow{AB} = 3\hat{i} - 5\hat{j} - 5\hat{k} = \vec{S}$

$\overrightarrow{AP} = 8\hat{i} + 0\hat{j} - 15\hat{k}$

$|\vec{F}| = 34$ N, Force acting along AP

(i) $\vec{F} = |\vec{F}|\hat{AP}$

$\vec{F} = 34 \cdot \frac{(8\hat{i} - 15\hat{k})}{\sqrt{64 + 225}} = \frac{34(8\hat{i} - 15\hat{k})}{\sqrt{289}}$

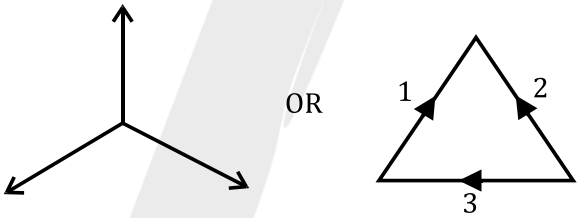
$\vec{F} = 16\hat{i} - 30\hat{j}$

(ii) $W = \vec{F} \cdot \vec{S}$

$= (6\hat{i} - 30\hat{j})(3\hat{i} - 5\hat{j} - 5\hat{k})$

$= 48 + 150 = 198$ J

4.



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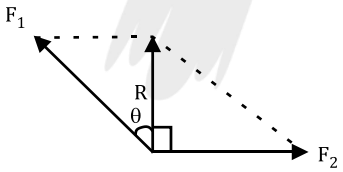

Let Forces are F_1 & F_2

$F_1 = 2F_2$

$F_1 \cos\theta = R$ $\quad$ $F_1 \sin\theta = F_2$

$2F_2 \sin\theta = F_2$

$\sin\theta = \frac{1}{2}$

$\theta = 30°$

Angle b/w $\vec{F}_1$ & $\vec{F}_2$ is 120°

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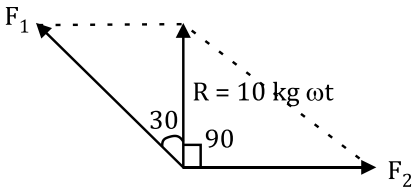
6. Let two forces are $\vec{F}_1$ & $\vec{F}_2$



$F_1 \cos 30 = 10 \text{ kgwt}$

$F_1 = \frac{20}{\sqrt{3}} \text{ kg} - \text{wt}$

$F_2 = F_1 \sin 30$

$= \frac{20}{\sqrt{3}} \times \frac{1}{2} = \frac{10}{\sqrt{3}} \text{ kg} - \text{wt}$

7. $P^2 + Q^2$

$R = \sqrt{P^2 + Q^2 + 2PQ\cos 60}$

$\sqrt{7Q} = \sqrt{P^2 + Q^2 + PQ}$

$7Q^2 = P^2 + Q^2 + PQ$

$6Q^2 = P^2 + PQ$

$P^2 + PQ - 6Q^2 = 0$

$P^2 + 3PQ + 2PQ - 6Q^2 = 0$

$P(P - 3Q)2Q(P - 3Q) = 0$

$(P - 3Q)(P + 2Q) = 0$

$P = 3Q \, , \; P = -2Q$

$\boxed{\frac{P}{Q} = 3}$ $\boxed{\frac{P}{Q} = -2}$

Ratio of Magnitude $= 2:1 = 2$

8. $\overrightarrow{F_1} = 36\text{N}$ North

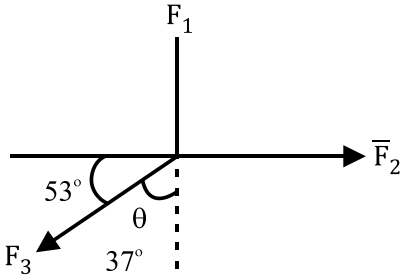
$\overrightarrow{F_2} = 27\text{N}$ Earth

$\overrightarrow{F_1} = 36\hat{j}$ $F_2 = 27i$

$F_{net} = 0$

$F_3 \cos\theta = 36$ ...(i)

$F_3 \sin\theta = 27$ ...(ii)



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$\frac{(ii)}{(i)} \Rightarrow \tan\theta = \frac{3}{4}$

$\theta = 37^{o}$

$F_3 \sin 37 = 27$

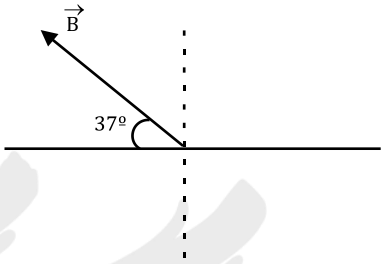
$F_3 \times \frac{3}{5} = 27$

$F_3 = 45N$

$F_3 = 45$ N due 53° South of west

9. $\vec{A} = 40$ east

$\vec{B} = 25$ 37^{o} north of west



$\vec{A} = 40i$

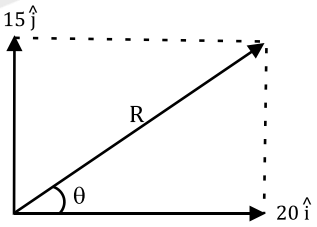
$\vec{B} = 25\cos 37(-i) + 25\sin 37\hat{j}$

$\vec{B} = -20i + 15\hat{j}$

$\vec{R} = \vec{A} + \vec{B}$

$\vec{R} = 40i - 20i + 15j$

$\vec{R} = 20i + 15\hat{j}$



$|\vec{R}| = \sqrt{400 + 225} = 25$

$\tan\theta = \frac{15}{20} = \frac{3}{4} = 37°$

$\vec{R} = 25$ unit 37° North of east.

10. $\vec{c} = \vec{a} + \vec{b}$

$\theta = 180^{0}$

$c = \sqrt{a^2 + b^2 + 2ab\cos 180}$

$c = a - b$

11. $(2\vec{A_1} + 3\vec{A_2}) \cdot (3\vec{A_1} - 2\vec{A_2})$

$= 6A_1^2 - 4A_1A_2\cos\theta + 9A_1A_2\cos\theta - 6A_2^2$

$= 6(A_1^2 - A_2^2) + 5A_1A_2\cos\theta$

Given $|\vec{A_1} + \vec{A_2}| = 5$

$A_1^2 + A_2^2 + 2A_1A_2\cos\theta = 25$

$9 + 25 + 2 \times 3 \times 5\cos\theta = 25$

$30\cos\theta = -9$

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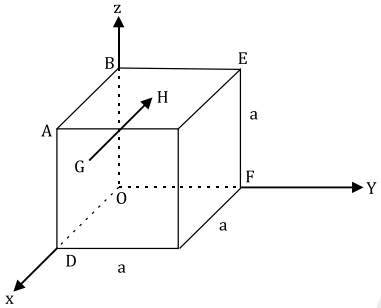
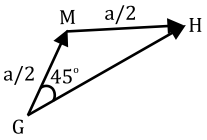
$$\cos\theta = \frac{-3}{10}$$

Put the value of $\cos\theta$ on cquation (i)

$$= -118.5$$

12.





$$\overrightarrow{GM} + \overrightarrow{MH} = \overrightarrow{GH}$$

$$GH\cos 45 = \frac{a}{2}$$

$$\overrightarrow{GH} = \frac{a}{2}(-\hat{i}) + \frac{a}{2}\hat{j}$$

$$= \frac{a}{2}(\hat{j} - \hat{i})$$

13. $|\vec{A}| = |\vec{B}| = x$

$$|\vec{A} + \vec{B}| = n|\vec{A} - \vec{B}|$$

$$A^2 + B^2 + 2AB\cos\theta = n^2[A^2 + B^2 - 2AB\cos\theta]$$

$$(2x^2 + 2n^2x^2)\cos\theta = (2n^2 - 2)x^2$$

$$2x^2(n^2 + 1)\cos\theta = 2x^2(n^2 - 1)$$

$$\cos\theta = \frac{n^2 - 1}{n^2 + 1}$$

$$\boxed{\theta = \cos^{-1}\left(\frac{n^2 - 1}{n^2 + 1}\right)}$$

14. (A) $\vec{a} + \vec{b} + \vec{c} = 0$ $\vec{a} + \vec{b} = -\vec{c}$

(A) $\rightarrow$ (r)

(B) $\vec{a} + \vec{b} - \vec{c} = 0$

$\vec{a} + \vec{b} = \vec{c}$ (B) $\rightarrow$ (S)

(C) $\vec{a} - \vec{b} - \vec{c} = 0$

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$\vec{a} - (\vec{b} + \vec{c}) = 0$ (C) → (P)

(D) $\vec{b} - \vec{a} - \vec{c} = 0$ (D) → (Q)

$\vec{b} - \vec{c} = \vec{a}$