DPP - 2

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1. $|\hat{a} - \hat{b}| = \sqrt{\hat{a}^2 + \hat{b}^2 - 2\hat{a}\hat{b}\cos 60}$

$= \sqrt{1 + 1 - 2 \times \frac{1}{2}} = 1$

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

Projection of $\vec{r}$ in x – y plane

$= 3\hat{i} + \hat{j}$

Magnitude $= \sqrt{9 + 1} = \sqrt{10}$

3. $\vec{r}_A = 1000\cos 37\hat{i} - 1000\sin 37\hat{j} + 800\hat{k}$

$\vec{r}_A = 800\hat{i} - 600\hat{j} + 800\hat{k}$

$\vec{r}_B = 2000\cos 53\hat{i} + 2000\sin 53\hat{j} + 1200\hat{k}$

$\vec{r}_B = 1200\hat{i} + 1600\hat{j} + 1200\hat{k}$

$\vec{S} = \vec{r}_B - \vec{r}_A$

$\vec{S} = 400\hat{i} + 2200\hat{j} + 400\hat{k}$

4. $F = 100N$

$\vec{F} = 100\cos 45\hat{i} + 100\sin 45(-\hat{j})$

$= 50\sqrt{2}\hat{i} - 50\sqrt{2}\hat{j}$

$= 50\sqrt{2}(\hat{i} - \hat{j})$

5. $\vec{A} = \hat{i} + \hat{j} + \hat{k}$

$\vec{B} = \hat{i} - \hat{j} - \hat{k}$

$\vec{A} \cdot \vec{B} = AB\cos\theta$

$(\hat{i} + \hat{j} + \hat{k}) \cdot (\hat{i} - \hat{j} - \hat{k}) = \sqrt{1^2 + 1^2 + 1^2}\sqrt{1^2 + (-1)^2 + (-1)^2}\cos\theta$

$1 - 1 - 1 = 3\cos\theta$

$-\frac{1}{3} = \cos\theta$

$\boxed{\theta = \cos^{-1}\left(\frac{1}{3}\right)}$

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6. $\vec{F} = (4\hat{i} + \hat{j} + 3\hat{k})N$

$\vec{s} = \vec{r}_f - \vec{r}_i = 11\hat{i} + 11\hat{j} + 15\hat{k}$

$W = \vec{F} \cdot \vec{S} = 44 + 11 + 45$

$= 55 + 45 = 100J$

7. $\hat{i} - \hat{j} - \hat{k}$

If two vector are perpendicular then its dot product equal to zero.

8. $|\vec{A} + \vec{B}| \leq A + B$

$|\vec{A} + \vec{B}| \geq |A - B|$

9. Paragraph (9 to 10)

$\vec{v} = 4\hat{i} + 3\hat{j}$

$\vec{a} = 10\hat{i} + 15\hat{j} + 20\hat{k}$

a_T = Projection $\vec{a}$ in direction of $\vec{v}$

$\vec{v} \cdot \vec{a} = va\cos\theta$

$$a\cos\theta = \frac{\vec{v} \cdot \vec{a}}{v}$$

$$a\cos\theta = \frac{40 + 45}{5} = 17$$

$$a_T = 17 \cdot \hat{v} = \frac{17}{5}(4\hat{i} + 3\hat{j})$$

10. For Normal acceleration.

$\vec{a} = \vec{a_T} + \vec{a}_N$

$$10\hat{i} + 15\hat{j} + 20\hat{k} = \frac{17}{5}(4\hat{i} + 3\hat{j}) + \vec{a_N}$$

$$\vec{a}_N = \left(10 - \frac{68}{5}\right)\hat{i} + \left(15 - \frac{51}{5}\hat{j}\right) + 20k$$

$$a_N = -\frac{18}{5}\hat{i} - \frac{24}{5}\hat{j} + 20k$$

$$a_N = \frac{-18\hat{i} - 24\hat{j} + 100\hat{k}}{5}$$