$= 10 \times 2 + 2 \times 8$

$= 20 + 16 = 36$

WS-16 For 8th class

Task

① Given $\vec{F} = 4\hat{i} - 5\hat{j} + 3\hat{k}$

$\vec{r}_1 = \hat{i} + 2\hat{j} + 3\hat{k}$

$\vec{r}_2 = 3\hat{i} - 2\hat{j} + 3\hat{k}$

$\vec{r} = \vec{r}_1 - \vec{r}_2$

$= (\hat{i} + 2\hat{j} + 3\hat{k}) - (3\hat{i} - 2\hat{j} + 2\hat{k})$

$\vec{r} = -2\hat{i} + 4\hat{j} + 6\hat{k}$

$$\vec{\tau} = \vec{r} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -2 & 4 & 6 \\ 4 & -5 & 3 \end{vmatrix}$$

$\Rightarrow \hat{i}[4 \times 3 - 6 \times (-5)] - \hat{j}[-2 \times 3 - 6 \times 4]$

$+ \hat{k}(-2 \times -5 - 4 \times 4)$

$\Rightarrow 42\hat{i} + 30\hat{j} - 6\hat{k}$ Nm

$\theta = 60°$

used ab-bc

② Given $\vec{\omega} = \hat{i} + 2\hat{j} - 3\hat{k}$

$\vec{r} = 2\hat{i} - 3\hat{j}$

$$\vec{v} = \vec{r} \times \vec{\omega} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -3 & 0 \\ 1 & 2 & -3 \end{vmatrix}$$

$\Rightarrow \hat{i}(-2\times 3 - 2\times 0) - \hat{j}(2\times(-3) - 0\times 1) + \hat{k}[2\times 2 - (-3)\times 1]$

$\Rightarrow \hat{i}(-6-0) - \hat{j}(-6-0) + \hat{k}(4-(-3)]$

$\Rightarrow 6\hat{i} - 6\hat{j} - 7\hat{k}$

⑤ Given $\vec{A} = 2\hat{i} - 3\hat{j} + \hat{k}$

$\vec{B} = -\hat{i} + 3\hat{j} + \hat{k}$

$$\therefore \vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -3 & 1 \\ -1 & 3 & 1 \end{vmatrix}$$

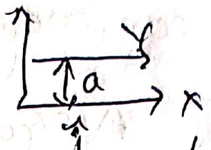
$\Rightarrow \hat{i}((-3\times 1 - 3\times 1) - \hat{j}(2\times 1 - 1\times(-1)] + \hat{k}(2\times 3 - (-3)(-1)]$

$\Rightarrow \hat{i}(-3-3) - \hat{j}(2+1) + \hat{k}(6-3)$

$= -6\hat{i} - 3\hat{j} + 3\hat{k}$

$\vec{r} = -2\hat{i} + 4\hat{j} + 6\hat{k}$

③



$\hat{j} \times \hat{i} = -\hat{k}$

Angular momentum $L = \vec{r} \times m\vec{v}$

$\wedge L = m(\vec{r} \times \vec{v})$

$= m(a\hat{j} \times v\hat{i})$

$= mav(\hat{j} \times \hat{i})$

$= -mav\,\hat{k}$

⑥ Given $\vec{F} = 2\hat{i} - \hat{j} - \hat{k}$

$\vec{r} = -5\hat{i} + 2\hat{j} + \hat{k}$

Torque $\tau = \vec{r} \times \vec{F}$

$$\tau = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -5 & 2 & 1 \\ 2 & -1 & -1 \end{vmatrix}$$

$\Rightarrow 42\hat{i} + 30\hat{j} - 6\hat{k}$ Nm

④ Given $\vec{p} = 2\hat{i} - 3\hat{j} + 2\hat{k}$

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

$$\vec{L} = \vec{r} \times \vec{p} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 4 & 2 \\ 2 & -3 & 2 \end{vmatrix}$$

$= \hat{i}(4\times 2 - (-2)(-3)] - \hat{j}[3\times 2 - 2\times 2) + \hat{k}(3(-3) - 4\times 2)$

$\vec{L} = 14\hat{i} - 2\hat{j} - 17\hat{k}$

$\tau = \hat{i}(2(-1) - (1)(-1)) - \hat{j}[-5\times -1 - 1\times 2] + \hat{k}[(-5)(-1) - 2\times 2]$

$\tau = \hat{i}(-2+1) - \hat{j}(5-2) + \hat{k}(5-4)$

$\tau = -\hat{i} - 3\hat{j} + \hat{k}$

$\quad\ \ x \quad\ \ y \quad\ z$

$|\tau| = \sqrt{x^2 + y^2 + z^2} = \sqrt{(-1)^2 + (-3)^2 + (1)^2}$

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

$= \sqrt{11}$ Nm

(7) Given $\vec{A} = 3\hat{i} + \hat{j} + 2\hat{k}$

$\vec{B} = 2\hat{i} - 2\hat{j} + 4\hat{k}$

The unit vector perpendicular to Both $\vec{A}$ and $\vec{B}$ A

$\vec{c} = \dfrac{\vec{A}\times\vec{B}}{|\vec{A}\times\vec{B}|} \Rightarrow \dfrac{8\hat{i} - 8\hat{j} - 8\hat{k}}{8\sqrt{3}}$

$\vec{c} \Rightarrow \dfrac{\hat{i} - \hat{j} - \hat{k}}{\sqrt{3}}$

Here $\vec{A}\times\vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 1 & 2 \\ 2 & -2 & 4 \end{vmatrix}$; $|\vec{A}\times\vec{B}| = \sqrt{x^2+y^2+z^2}$

$= \sqrt{8^2 + (-8)^2 + (-8)^2}$

$\Rightarrow 8\sqrt{3}$

$= \hat{i}(1\times4 - 2\times-2) - \hat{j}(3\times4 - 2\times2) + \hat{k}[3\times-2 - 2\times1]$

$= \hat{i}(4+4) - \hat{j}(12-4) + \hat{k}(-6-2)$

$\Rightarrow 8\hat{i} - 8\hat{j} - 8\hat{k}$

(8) Given $\vec{\omega} = \hat{i} - 2\hat{j} + 2\hat{k}$

$\vec{r} = 4\hat{j} - 3\hat{k}$

$\vec{v} = \vec{r}\times\vec{\omega} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4 & \cancel{0} & \cancel{0}3 \\ 1 & -2 & 2 \end{vmatrix}$

$= \hat{i}(2\times4 - (-3)(-2)] - \hat{j}(0\times2 - 1\times(-3))$
$+ \hat{k}(0\times(-2) - 4\times1)$

$= \hat{i}(8-6) - \hat{j}(0+3) + \hat{k}(0-4)$

$\Rightarrow 2\hat{i} - 3\hat{j} - 4\hat{k}$

$|\vec{v}| = \sqrt{x^2+y^2+z^2} = \sqrt{(-2)^2 + (-3)^2 + (-4)^2}$

$= \sqrt{4+9+16} = \sqrt{29}$

(9) Given $\vec{A}\cdot\vec{B} = \vec{A}\times\vec{B}$

$\Rightarrow \cancel{AB}\cos\theta = \cancel{AB}\sin\theta$

$\Rightarrow \cos\theta = \sin\theta$

$\Rightarrow \dfrac{\cos\theta}{\sin\theta} = 1$

$\Rightarrow \cot\theta = 1$

$\Rightarrow \theta = 45°$

(10) Given $\vec{A}\times\vec{B} = kAB$

$\Rightarrow \cancel{AB}\sin\theta = k\cancel{AB}$

$\Rightarrow \sin\theta = k$

$\Rightarrow \theta = \sin^{-1}(k)$

(16) we know $\vec{A}\times\vec{B} = AB\sin\theta$

(a) $\theta = 45°$, $\sin 45 = \frac{1}{\sqrt{2}}$

$\vec{A}\times\vec{B} = \dfrac{AB}{\sqrt{2}}$

(b) $\theta = 30$ $\sin 30 = \frac{1}{2}$

$\vec{A}\times\vec{B} = AB\sin 30$

$= \dfrac{AB}{2}$

(c) $\theta = 90$; $\sin 90° = 1$

$\vec{A}\times\vec{B} = AB\sin 90 = AB$

(D) $\theta = 60°$ $\sin 60 = \frac{\sqrt{3}}{2}$

$\vec{A}\times\vec{B} = AB\sin 60$

$= \dfrac{\sqrt{3}}{2}AB$

(17) Given $\vec{A} = -4\hat{i} + 3\hat{j}$

$\vec{B} = 2\hat{i}$

(i) $\vec{A}\times\vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -4 & 3 & 0 \\ 2 & 0 & 0 \end{vmatrix}$

$= \hat{i}(3\times0 - 0\times0) - \hat{j}(-4\times0 - 0\times0) + \hat{k}(-4\times0 - 2\times3)$

$\Rightarrow \hat{i}(0-0) - \hat{j}(0-0) + \hat{k}(0-6)$

$= -6\hat{k}$

$|\vec{A}\times\vec{B}| = |-6| = 6$

$\sin\theta = \dfrac{|\vec{A}\times\vec{B}|}{|A||B|}$

$\Rightarrow \sin\theta = \dfrac{6\,3}{5\times2}$

$\sin\theta = \dfrac{3}{5}$

$\Rightarrow \theta = 37°$

$|\vec{A}| = \sqrt{-4^2+3^2}$

$= \sqrt{16+9} = 25$

$|\vec{B}| = 2$

(18) Given $\vec{A} = 4\hat{i} - \hat{j} + 3\hat{k}$ & $\vec{B} = -2\hat{i} + \hat{j} - 2\hat{k}$

The unit vector perpendicular to Both $\vec{A}$ & $\vec{B}$

is $\vec{c} = \dfrac{\vec{A}\times\vec{B}}{|\vec{A}\times\vec{B}|}$; $\vec{A}\times\vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4 & -1 & 3 \\ -2 & 1 & -2 \end{vmatrix}$

$\Rightarrow \hat{i}(-1(-2) - 1\times3) - \hat{j}(4\times(-2) - 3(-2)] + \hat{k}(4\times1 - (-2)(-1))$

$\Rightarrow \hat{i}(2-3) - \hat{j}(-8+6) + \hat{k}(4-2)$

$\Rightarrow -\hat{i} + 2\hat{j} + 2\hat{k}$

$|\vec{A}\times\vec{B}| = \sqrt{(-1)^2 + 2^2 + 2^2} = 3$

$\therefore \vec{c} = \dfrac{-\hat{i} + 2\hat{j} + 2\hat{k}}{3}$

(19) Given $\vec{A}\cdot\vec{B}=12$; $|\vec{A}|=10$; $|\vec{B}|=2$

$\Rightarrow AB\cos\theta=12$

$\Rightarrow 10\times 2\cos\theta=12$

$\Rightarrow \cos\theta=\frac{12}{20}=\frac{3}{5}$

$\Rightarrow \sin\theta=\frac{4}{5}$

$\vec{A}\times\vec{B}=|\vec{A}||\vec{B}|\sin\theta$

$=\cancel{10}^{2}\times 2\times \frac{4}{\cancel{5}}$

$\Rightarrow 8\times 2=16$

(20) Given $\vec{A}=3\hat{i}-4\hat{j}+5\hat{k}$ & $\vec{B}=\hat{i}-\hat{j}+\hat{k}$

$$\vec{A}\times\vec{B}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 3 & -4 & 5\\ 1 & -1 & 1\end{vmatrix}$$

$\Rightarrow \hat{i}(-4\times1-5(-1))-\hat{j}(3-5)+\hat{k}(3(-1)-1\times(-4))$

$\Rightarrow \hat{i}+2\hat{j}+\hat{k}$

$|\vec{A}|=\sqrt{3^2+(-4)^2+5^2}=5\sqrt{2}$

$|\vec{B}|=\sqrt{1^2+(-1)^2+1^2}=\sqrt{3}$

$|\vec{A}\times\vec{B}|=\sqrt{1^2+2^2+1^2}=\sqrt{6}$

$\sin\theta=\frac{|\vec{A}\times\vec{B}|}{|\vec{A}||\vec{B}|}$

$\sin\theta=\frac{\sqrt{6}}{5\sqrt{2}\sqrt{3}}=\frac{1}{5}$

Task

(1) Given $\vec{\omega}=4\hat{i}+\hat{j}-2\hat{k}$

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

$$\vec{v}=\vec{r}\times\vec{\omega}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 2 & -3 & 1\\ 4 & 1 & -2\end{vmatrix}$$

$\Rightarrow \hat{i}(1-(-2)(-3))-\hat{j}(4\times1-(2)(-2))+\hat{k}(4(-3)-2\times1)$

$\Rightarrow \hat{i}(6-1)-\hat{j}(4+4)+k(12+2)$

$\Rightarrow 5\hat{i}+8\hat{j}+24\hat{k}$

(2) $\vec{A}\times\vec{B}=-\vec{B}\times\vec{A}$

i.e. $\vec{A}\times\vec{B}$ & $\vec{B}\times\vec{A}$ are antiparallel to each other $\theta=\pi$

(3) Given $\vec{A}=\hat{i}+4\hat{j}$ & $\vec{B}=2\hat{i}+3\hat{j}$

$$\text{Area}=\vec{A}\times\vec{B}=\begin{vmatrix}\hat{i} & \hat{j} & k\\ 1 & 4 & 0\\ 2 & 3 & 0\end{vmatrix}$$

$\Rightarrow \hat{i}(4\times0-3\times0)-\hat{j}(1\times0-2\times0)+\hat{k}(1\times3-2\times4)$

$\Rightarrow \hat{i}(0-0)-\hat{j}(0-0)+\hat{k}(3-8)$

$=-5\hat{k}$

$|\vec{A}\times\vec{B}|=|-5\hat{k}|=5$ sq cm

(5) Given $\vec{A}=2\hat{i}+\hat{j}+\hat{k}$

$\vec{B}=\hat{i}-\hat{j}+2\hat{k}$

$$\vec{A}\times\vec{B}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 2 & 1 & 1\\ 1 & -1 & 2\end{vmatrix}$$

$=\hat{i}(1\times2-1\times(-1))-\hat{j}(2\times2-1\times1)+\hat{k}(2(-1)-1\times1)$

$\Rightarrow \hat{i}(2+1)-\hat{j}(4-1)+\hat{k}(-2-1)=3\hat{i}-3\hat{j}-3\hat{k}$

$|\vec{A}\times\vec{B}|=\sqrt{3^2+(-3)^2+(-3)^2}=3\sqrt{3}$

unit vector perpendicular to both $\vec{A}\times\vec{B}$ is

$\hat{c}=\frac{\vec{A}\times\vec{B}}{|\vec{A}\times\vec{B}|}=\frac{3\hat{i}-3\hat{j}-3\hat{k}}{3\sqrt{3}}$

$\hat{c}=\frac{3(\hat{i}-\hat{j}-\hat{k})}{3\sqrt{3}}=\frac{\hat{i}-\hat{j}-\hat{k}}{\sqrt{3}}$

(4) Given $\vec{A}=3\hat{i}+4\hat{j}$; $\vec{B}=-3\hat{i}+7\hat{j}$

$$\text{Area}=|\vec{A}\times\vec{B}|=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 3 & 4 & 0\\ -3 & 7 & 0\end{vmatrix}$$

$\Rightarrow \hat{i}(4\times0-7\times0)-\hat{j}(3\times0-(-3)\times0)+\hat{k}(7\times3-(4)(-3))$

$\Rightarrow \hat{i}(0-0)-\hat{j}(0-0)+\hat{k}(21+12)$

$=33k$

$|\vec{A}\times\vec{B}|=33$ sq units

(7) $|\vec{A}|=2$; $|\vec{B}|=5$

$|\vec{A}\times\vec{B}|=8$

$\Rightarrow AB\sin\theta=8$

$\Rightarrow 2\times5\sin\theta=\cancel{8}\,4$

$\Rightarrow \sin\theta=\frac{4}{5}$

$\Rightarrow \cos\theta=\frac{3}{4}$

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

$=2\times5\times\frac{3}{5}$

$=2\times3=6$

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⑧ $\vec{A} = \hat{i} - \hat{j} - 3\hat{k}$ &

$\vec{B} = 4\hat{i} - 3\hat{j} + \hat{k}$

$\vec{C} = 3\hat{i} - \hat{j} + 2\hat{k}$

$\vec{AB} = \vec{B} - \vec{A} = 4\hat{i} - 3\hat{j} + \hat{k} - \hat{i} + \hat{j} + 3\hat{k}$

$= 3\hat{i} - 2\hat{j} + 4\hat{k}$

$\vec{BC} = \vec{C} - \vec{B} = 3\hat{i} - \hat{j} + 2\hat{k} - 4\hat{i} + 3\hat{j} - \hat{k}$

$\vec{BC} = -\hat{i} + 2\hat{j} + \hat{k}$

$\vec{AB} \times \vec{BC} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -2 & 4 \\ -1 & 2 & 1 \end{vmatrix}$

$\Rightarrow \hat{i}(-2-8) - \hat{j}(3+4) + \hat{k}(6-2)$

$= -10\hat{i} - 7\hat{j} + 4\hat{k}$

$\text{Area} = \frac{1}{2} |\underbrace{\vec{AB} \times \vec{BC}}|$

$= \frac{1}{2} |-10\hat{i} - 7\hat{j} + 4\hat{k}|$

$= \frac{1}{2} \sqrt{(-10)^2 + (-7)^2 + 4^2}$

$= \frac{1}{2} \sqrt{100 + 49 + 16}$

$= \frac{1}{2} \sqrt{165}$.

⑨ Given $\vec{d_1} = 3\hat{i} + \hat{j} + 2\hat{k}$

$\vec{d_2} = \hat{i} - 3\hat{j} + 4\hat{k}$.

$\vec{d_1} \times \vec{d_2} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 1 & 2 \\ 1 & -3 & 4 \end{vmatrix}$

$\text{Area} = \frac{1}{2} |\vec{d_1} \times \vec{d_2}|$

$\Rightarrow \hat{i}(4+6) - \hat{j}(3\times4 - 2\times1) - \hat{k}(3(-3) - 1\times1)$

$= 10\hat{i} - 10\hat{j} - 10\hat{k}$

$= 10(\hat{i} - \hat{j} - \hat{k})$

$|\vec{d_1} \times \vec{d_2}| = 10\sqrt{1^2 + (-1)^2 + (-1)^2}$

$= 10\sqrt{3}$

$= \frac{1}{2} 10\sqrt{3}$

$\Rightarrow \frac{1}{2} \sqrt{10^2 \times 3}$

$= \frac{1}{2} \sqrt{300}$

⑥ Given $\vec{A} = 3\hat{i} + \hat{j} + 2\hat{k}$

$\vec{B} = 2\hat{i} - 2\hat{j} + 4\hat{k}$

$|\vec{A}| = \sqrt{3^2 + 1^2 + 2^2}$

$= \sqrt{14}$

$|\vec{B}| = \sqrt{2^2 + (-2)^2 + 4^2}$

$= \sqrt{24}$

$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 1 & 2 \\ 2 & -2 & 4 \end{vmatrix}$

$= \hat{i}(1\times4 - 2\times(-2)) - \hat{j}(3\times4 - 2\times2)$
$+ \hat{k}(3(-2) - 2\times1)$

$\Rightarrow \hat{i}(4+4) - \hat{j}(12-4) + \hat{k}(-6-2)$

$\Rightarrow 8\hat{i} - 8\hat{j} - 8\hat{k}$

$= 8(\hat{i} - \hat{j} - \hat{k})$

$|\vec{A} \times \vec{B}| = 8\sqrt{1^2 + (-1)^2 + (-1)^2}$

$= 8\sqrt{3}$

$\sin\theta = \frac{|\vec{A} \times \vec{B}|}{|\vec{A}|\,|\vec{B}|}$

$\sin\theta = \frac{8\sqrt{3}}{\sqrt{14}\sqrt{24}} = \frac{\sqrt{8}\cdot 8\sqrt{3}}{\sqrt{2}\sqrt{7}\,\cancel{8}\cancel{\sqrt{3}}}$

$\sin\theta = \frac{\sqrt{8}}{\sqrt{2}\times\sqrt{7}} = \frac{2\sqrt{2}}{\cancel{2}\sqrt{7}}$

$\sin\theta = \frac{2}{\sqrt{7}} \Rightarrow \theta = \sin^{-1}\left(\frac{2}{\sqrt{7}}\right)$

⑰ Given $\vec{A} = 3\hat{i} + 2\hat{j} - 4\hat{k}$

$\vec{B} = 2\hat{i} - 3\hat{j} - 6\hat{k}$

$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 2 & -4 \\ 2 & -3 & -6 \end{vmatrix}$

$\Rightarrow \hat{i}(2\times-6 - (-3)(-4)) - \hat{j}(3(-6) + 2(-4))$
$+ \hat{k}(3(-3) - 2\times2)$

$\Rightarrow \hat{i}(-12-12) - \hat{j}(-18+8) + \hat{k}(-9-4)$

$\Rightarrow -24\hat{i} + 10\hat{j} - 13\hat{k}$

$|\vec{A} \times \vec{B}| = \sqrt{(-24)^2 + 10^2 + (-13)^2} = \sqrt{845}$

unit vector parallel to $\vec{A}$ and $\vec{B}$ $\Rightarrow \vec{C} = \frac{\vec{A} \times \vec{B}}{|\vec{A} \times \vec{B}|}$

$\vec{C} = \frac{-24\hat{i} + 10\hat{j} - 13\hat{k}}{\sqrt{845}}$

⑱ Given $\vec{A} = \hat{i} - 3\hat{j} + \hat{k}$

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

$\text{Area } \vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -3 & 1 \\ 1 & 1 & 1 \end{vmatrix}$

$= \hat{i}(-4) - \hat{j}(0) + \hat{k}(4)$

$\Rightarrow -4\hat{i} + 4\hat{k}$

$|\vec{A} \times \vec{B}| = \sqrt{4^2 + (-4)^2} =$

$= 4\sqrt{2}$ sq units

⑲ $A = (3, -1, 2)$; $B(1, -1, 3)$

$C = (4, -3, 1)$

$AB = B - A = (1-3, -1-(-1), 3-2)$

$= (-2, 0, -5)$

$\vec{AB} = -2\hat{i} + 5\hat{k}$

$BC = C - B = (4-1, -3-(-1), 1-(-3))$

$= (3, -2, 4)$

$\vec{BC} = 3\hat{i} - 2\hat{j} + 4\hat{k}$

$$\text{Area} = \frac{1}{2}\left|\vec{AB} \times \vec{BC}\right|$$

$$= \frac{1}{2}\begin{vmatrix} i & j & k \\ -2 & 0 & -5 \\ 3 & -2 & 4 \end{vmatrix}.$$

$$= \frac{1}{2}\left\{ i(4\times 0-(-2)(-5)) - j(-2\times 4-3(-5)) + \hat{k}(-2\times -2-3\times 0)\right]$$

$$\Rightarrow \frac{1}{2}\left[\hat{i}(-10) - \hat{j}(-8+15) + \hat{k}(-4-0)\right]$$

$$\Rightarrow \frac{1}{2}\{-10\hat{i} - 7\hat{j} - 4\hat{k}\}$$

$$= \frac{1}{2}\sqrt{(-10)^2+(-7)^2+(-4)^2}$$

$$= \frac{1}{2}\sqrt{100+49+16}$$

$$= \frac{1}{2}\sqrt{65} \text{ sq units}$$