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# Brac University

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## Assignment

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| Course Code | : | PHY111 |
| Course Title | : | Fundamentals of Physics |
| Assignment No | : | 01 |

## Submited By


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| Session: | Fall '22 |
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The unit vector in the direction of vector B is,

$$\hat{b} = \frac{\vec{B}}{|\vec{B}|}$$

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

$$= \frac{\sqrt{3}\hat{i} - 2\hat{j} - 3\hat{k}}{\sqrt{3+4+9}}$$

$$= \frac{1}{4}\left[\sqrt{3}\hat{i} - 2\hat{j} - 3\hat{k}\right]$$

Given that,

$$|\vec{A}| = 4$$

Now,

$$\vec{A} = \hat{b} \times 4$$

$$= \frac{1}{4}\left[\sqrt{3}\hat{i} - 2\hat{j} - 3\hat{k}\right] \times 4$$

$$= \sqrt{3}\hat{i} - 2\hat{j} - 3\hat{k}$$ (Ans.)

Unit vector of $\hat{A}$ would be therefore,

$$\hat{a} = \frac{\sqrt{3}\hat{i} - 2\hat{j} - 3\hat{k}}{\sqrt{(\sqrt{3})^2 + (-2)^2 + (-3)^2}}$$

$$= \frac{\sqrt{3}}{4}\hat{i} - \frac{1}{2}\hat{j} - \frac{3}{4}\hat{k}$$

(Ans.)

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Given that,

$\vec{A} = -\sqrt{6}\hat{i} + \lambda\hat{k}$

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

Given,

$A = \sqrt{2} B$

$\Rightarrow |\vec{A}| = \sqrt{2}\,|\vec{B}|$

$\Rightarrow \sqrt{(-\sqrt{6})^2 + \lambda^2} = \sqrt{2} \cdot \sqrt{1^2 + 3^2 + 1^2}$

$\Rightarrow \sqrt{6 + \lambda^2} = \sqrt{2} \cdot \sqrt{11}$

$\Rightarrow 6 + \lambda^2 = 22$ [squaring both hand sides]

$\Rightarrow \lambda^2 = 22 - 6 = 16$

$\therefore \lambda = \pm 4$

for, $\lambda = +4$,

Projection of $\vec{A}$ on $\vec{B}$ would be,

$$\frac{\vec{A} \cdot \vec{B}}{|\vec{B}|} = \frac{(-\sqrt{6}\hat{i} + 4\hat{k}) \cdot (\hat{i} + 3\hat{j} + \hat{k})}{\sqrt{11}}$$

$$= \frac{-\sqrt{6} + 4}{\sqrt{11}} = \frac{4 - \sqrt{6}}{\sqrt{11}}$$ (Ans.)

For $\lambda = -4$

projection of $\vec{A}$ on $\vec{B}$ would be,

$$\frac{\vec{A} \cdot \vec{B}}{|\vec{B}|} = \frac{(-\sqrt{6}\,\hat{i} - 4\hat{k}) \cdot (\hat{i} + 3\hat{j} + \hat{k})}{\sqrt{11}}$$

$$= \frac{-\sqrt{6} - 4}{\sqrt{11}} = \frac{(\sqrt{6}+4)}{\sqrt{11}}$$ (Ans.)

Cylindrical polar co-ordinates of $\vec{B}$,

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

Here,

$x = 1, \quad y = 3, \quad z = 1$

We know,

$$\rho = \sqrt{x^2+y^2} = \sqrt{(1)^2+(3)^2} = \sqrt{1+9} = \sqrt{10}.$$

$$\theta = \tan^{-1}\left|\frac{3}{1}\right| = 71.56^\circ$$

and, $Z = z = 1$

$$\vec{B}(1, 3, 1) = (\sqrt{10}, 71.56^\circ, 1)$$

(Ans.)

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Given,

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

We know,

Area, $\vec{C} = \vec{A} \times \vec{B}$

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

$$= \hat{i}(-2-0) - \hat{j}(-3-8) + \hat{k}(0-4)$$

$$= -2\hat{i} + 11\hat{j} - 4\hat{k}$$

$\therefore |\vec{C}| = \sqrt{(-2)^2 + (11)^2 + (-4)^2} = \sqrt{141}$ sq. unit

(Ans.)

Now,

Angle of Area $\vec{C}$ with x-axis ;

$$\vec{C} \cdot \hat{i} = C \cdot i \cos\theta_x$$

$$\Rightarrow (-2\hat{i} + 11\hat{j} - 4\hat{k}) \cdot \hat{i} = \sqrt{141} \cdot 1 \cos\theta_x$$

$$\Rightarrow -2 = \sqrt{141} \cos\theta_x$$

$$\Rightarrow \theta_x = \cos^{-1}\left(\frac{-2}{\sqrt{141}}\right)$$

$$\therefore \theta_x = 99.69^\circ$$ (Ans.)

Angle of area $\vec{c}$ with y-axis ;

$$\vec{c} \cdot \hat{j} = c \cdot \hat{j} \cos \theta_y$$

$$\Rightarrow (-2\hat{i} + 11\hat{j} - 4\hat{k}) \cdot \hat{j} = \sqrt{141} \cdot 1 \cdot \cos \theta_y$$

$$\Rightarrow 11 = \sqrt{141} \cdot \cos \theta_y$$

$$\Rightarrow \theta_y = \cos^{-1} \frac{11}{\sqrt{141}}$$

$$\therefore \theta_y = 22.12^\circ \text{ (Ans:)}$$

Angle of area $\vec{c}$ with z-axis ;

$$\vec{c} \cdot \hat{k} = c \cdot k \cos \theta_z$$

$$\Rightarrow (-2\hat{i} + 11\hat{j} - 4\hat{k}) \cdot \hat{k} = \sqrt{141} \cdot 1 \cos \theta_z$$

$$\Rightarrow -4 = \sqrt{141} \cos \theta_z$$

$$\Rightarrow \theta_z = \cos^{-1} \frac{-4}{\sqrt{141}}$$

$$\therefore \theta_z = 109.64^\circ \text{ (Ans.)}$$