DPP – 3

Vector

Q.1 Consider the two vectors: $\vec{L} = 1\hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{l} = 4\hat{i} + 5\hat{j} + 6\hat{k}$. Find the value of the scalar α such that the vector $\vec{L} - \alpha\vec{l}$ is perpendicular to $\vec{L}$.

Q.2 Find components of vector $\vec{a} = \hat{i} + \hat{j} + 3\hat{k}$ in directions parallel to and perpendicular to vector $\vec{b} = \hat{i} + \hat{j}$.

Q.3 (a) Calculate $\vec{r} = \vec{a} - \vec{b} + \vec{c}$ where $\vec{a} = 5\hat{i} + 4\hat{j} - 6\hat{k}$, $\vec{b} = -2\hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{c} = 4\hat{i} + 3\hat{j} + 2\hat{k}$

(b) Calculate the angle between $\vec{r}$ and the z-axis.

(c) Find the angle between $\vec{a}$ and $\vec{b}$

Q.4 If the velocity of a particle is $(2\hat{i} + 3\hat{j} - 4\hat{k})$ and its acceleration is $(-\hat{i} + 2\hat{j} + \hat{k})$ and angle between them is $\frac{n\pi}{4}$. The value of n is.

Q.5 Consider three vectors $\vec{A} = \hat{i} + \hat{j} - 2\hat{k}, \vec{B} = \hat{i} - \hat{j} + \hat{k}$ and $\vec{C} = 2\hat{i} - 3\hat{j} + 4\hat{k}$. A vector $\vec{X}$ of the form $\alpha\vec{A} + \beta\vec{B}$ (α and β are numbers) is perpendicular to $\vec{C}$. The ratio of α and β is

(A) 1: 1 (B) 2: 1 (C) $-1: 1$ (D) 3: 1

Q.6 A string connected with bob is suspended by the point (O) such that it sweeps out conical surface in horizontal plane. Here $\vec{r}$ is the position vector of bob, $\vec{v}$ is its velocity and $\vec{z}$ is the axis of swept cone as shown. Select INCORRECT statement :-

(A) $\vec{r}.\vec{z}$ is always zero (B) $\vec{r}.\vec{v}$ is always zero

(C) $\vec{Z} \cdot \vec{v}$ is always constant (D) $\vec{r} \cdot \vec{z}$ is always non zero constant

Q.7 x-component of a vector $\vec{A}$ is twice of its y-component and $\sqrt{2}$ times of its z-component. Find out the angle made by the vector from y-axis.

(A) $\cos^{-1}\left(\frac{2}{\sqrt{7}}\right)$ (B) $\cos^{-1}\left(\frac{1}{\sqrt{7}}\right)$ (C) $\cos^{-1}\left(\frac{1}{\sqrt{6}}\right)$ (D) $\cos^{-1}\left(\frac{2}{\sqrt{6}}\right)$

Q.8 Given the vectors $\vec{A} = 2\hat{i} + 3\hat{j} - \hat{k}$; $\vec{B} = 3\hat{i} - 2\hat{j} - 2\hat{k}$ & $\vec{C} = p\hat{i} + p\hat{j} + 2p\hat{k}$. Find the angle between $(\vec{A} - \vec{B})$ & $\vec{C}$

(A) $\theta = \cos^{-1}\left(\frac{2}{\sqrt{3}}\right)$ (B) $\theta = \cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$

(C) $\theta = \cos^{-1}\left(\frac{\sqrt{2}}{3}\right)$ (D) none of these

Q.9 Find the component of $\vec{r}$ in the direction of $\vec{a}$: –

(A) $\frac{(\vec{r}\cdot\vec{a})\vec{a}}{a^2}$ (B) $\frac{(\vec{r}\cdot\vec{a})\vec{a}}{a}$ (C) $\frac{(\vec{r}\cdot\vec{a})\hat{r}}{r}$ (D) $\frac{(\vec{r}\cdot\vec{a})\hat{r}}{r^2}$

Q.10 Statement 1: Unit vector has a unit though its magnitude is one and

Statement 2: Unit vector is obtained by dividing a vector by its own magnitude.

(A) Statement-1 is true, statement-2 is true and statement- 2 is correct explanation for statement-1.

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

(C) Statement-1 is true, statement-2 is false.

(D) Statement-1 is false, statement- 2 is true.

Q.11 A vector of magnitude 10 m in the direction 37° south of west has its initial point at (5 m, 2 m). If positive x-axis represents the east and positive y-axis the north, the coordinates of its terminal point are

(A) $(-3m, -4m)$ (B) $(3\ m, 4\ m)$ (C) $(-4\ m, 6\ m)$ (D) $(-4m, -6m)$

Q.12 A plumber steps down 1 m out of his truck and walks 50 m east and then 25 m south, and then takes an elevator to the basement of the building 9 m below street level. If the east, the north and the upward direction are represented by the positive x, y and z − axes, which one of the following represents displacement (meters) of the plumber?

(A) $50\hat{i} - 25\hat{j} - 9\hat{k}$ (B) $50\hat{i} + 25\hat{j} - 9\hat{k}$

(C) $50\hat{i} - 25\hat{j} - 10\hat{k}$ (D) $50\hat{i} + 25\hat{j} - 10\hat{k}$

ANSWER KEY

1. 7/16 **2.** $\hat{i}+\hat{j}, 3\hat{k}$ **3.** (a) $11\hat{i}+5\hat{j}-7\hat{k}$, (b) $\cos^{-1}\left(\frac{-7}{\sqrt{195}}\right)$, (c) $\cos^{-1}\left(\frac{-20}{\sqrt{1309}}\right)$

4. (2) **5.** (A) **6.** (A) **7.** (B) **8.** (C) **9.** (A)

10. (D) **11.** (A) **12.** (C)