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PRACTICE PAPER 10 (2023-24)

CHAPTER 10 VECTOR ALGEBRA

SUBJECT: MATHEMATICS **MAX. MARKS : 40**

CLASS : XII **DURATION : 1½ hrs**

General Instructions:

(i). **All** questions are compulsory.

(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.

(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.

(iv). There is no overall choice.

(v). Use of Calculators is not permitted

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. The vector of the direction of the vector $\hat{i}-2\hat{j}+2\hat{k}$ that has magnitude 9 is

(a) $\hat{i}-2\hat{j}+2\hat{k}$ (b) $\frac{\hat{i}-2\hat{j}+2\hat{k}}{3}$ (c) $3(\hat{i}-2\hat{j}+2\hat{k})$ (d) $9(\hat{i}-2\hat{j}+2\hat{k})$

2. The magnitude of each of the two vectors $\vec{a}$ and $\vec{b}$, having the same magnitude such that the angle between them is 60° and their scalar product is 9/2, is

(a) 2 (b) 3 (c) 4 (d) 5

3. The projection of the vector $2\hat{i}+3\hat{j}+2\hat{k}$ *on the vector* $\hat{i}+2\hat{j}+\hat{k}$ is

(a) 10/√6 (b) 10/√3 (c) 5/√6 (d) 5/√3

4. Find the angle between the vectors $\vec{a}=\hat{i}-\hat{j}+\hat{k}$ and $\vec{b}=\hat{i}+\hat{j}-\hat{k}$

(a) $\cos^{-1}\left(-\frac{1}{2}\right)$ (b) 60° (c) $\cos^{-1}\left(-\frac{1}{3}\right)$ (d) $\cos^{-1}\left(-\frac{2}{3}\right)$

5. If $(\hat{i}+3\hat{j}+8\hat{k})\times(3\hat{i}-\lambda\hat{j}+\mu\hat{k})=0$, then λ and μ are respectively:

(a) 27, -9 (b) 9, 9 (c) -9, 18 (d) -1, 1

6. The value of λ such that the vector $\vec{a}=2\hat{i}+\lambda\hat{j}+\hat{k}$ and $\vec{b}=\hat{i}+2\hat{j}+3\hat{k}$ are orthogonal is:

(a) 3/2 (b) −5/2 (c) −1/2 (d) 1/2

7. For any vector $\vec{a}$, the value of $|\vec{a}\cdot\hat{i}|^2+|\vec{a}\cdot\hat{j}|^2+|\vec{a}\cdot\hat{k}|^2$ is:

(a) a (b) a^2 (c) 1 (d) 0

8. The area of a parallelogram whose one diagonal is $2\hat{i}+\hat{j}-2\hat{k}$ and one side is $3\hat{i}+\hat{j}-\hat{k}$ is

(a) $\hat{i}-4\hat{j}-\hat{k}$ (b) 3√2 sq units (c) 6√2 sq units (d) 6 sq units

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(a) Both Assertion (A) and Reason (R) are true and Reason(R) is the correct explanation of assertion (A).

(b) Both Assertion (A) and Reason (R) are true but Reason(R) is not the correct explanation of assertion (A).

(c) Assertion (A) is true but reason (R) is false.

(d) Assertion (A) is false but reason (R) is true.

9. **Assertion (A):** The value of $\hat{i}\cdot(\hat{j}\times\hat{k})+\hat{j}\cdot(\hat{i}+\hat{k})+\hat{k}\cdot(\hat{i}\times\hat{j})$ is 1.

Reason (R): Since, $\hat{i}\cdot\hat{i}=\hat{j}\cdot\hat{j}=\hat{k}\cdot\hat{k}=0$

Assertion (A): The direction of cosines of vector $\vec{a}=2\hat{i}+4\hat{j}-5\hat{k}$ are $\frac{2}{\sqrt{45}},\frac{4}{\sqrt{45}},-\frac{5}{\sqrt{45}}$

Reason (R): A vector having zero magnitude and arbitrary direction is called 'zero vector' or 'null vector'.

SECTION – B

Questions 11 to 14 carry 2 marks each.

10. If $|\vec{a}\times\vec{b}|^2+(\vec{a}.\vec{b})^2=144$ and $|\vec{a}|=4$, then find the value of $|\vec{b}|$.

11. Find the angle between the vectors $\vec{a}=\hat{i}-\hat{j}+\hat{k}$ and $\vec{b}=\hat{i}-\hat{j}+\hat{k}$.

12. Given, $\vec{p}=3\hat{i}+2\hat{j}+4\hat{k},\vec{a}=\hat{i}+\hat{j},\vec{b}=\hat{j}+\hat{k},\vec{c}=\hat{i}+\hat{k}$ and $\vec{p}=x\vec{a}+y\vec{b}+z\vec{c}$, then find the value of x, y, z.

13. Using vectors, find the area of the triangle with vertices A(1, 1, 2), B(2, 3, 5) and C(1, 5, 5).

SECTION – C

Questions 15 to 17 carry 3 marks each.

14. Show that the points A(1, 2, 7), B(2, 6, 3) and C(3, 10, –1) are collinear.

15. Find a unit vector perpendicular to each of the vectors $(\vec{a}+\vec{b})$ and $(\vec{a}-\vec{b})$, where $\vec{a}=\hat{i}+\hat{j}+\hat{k},\vec{b}=\hat{i}+2\hat{j}+3\hat{k}$.

16. The two adjacent sides of a parallelogram are $2\hat{i}-4\hat{j}+5\hat{k}$ and $\hat{i}-2\hat{j}-3\hat{k}$. Find the unit vector parallel to its diagonal. Also, find its area.

SECTION – D

Questions 18 carry 5 marks.

17. The magnitude of the vector product of the vector $\hat{i}+\hat{j}+\hat{k}$ with a unit vector along the sum of vectors $2\hat{i}+4\hat{j}-5\hat{k}$ and $\lambda\hat{i}+2\hat{j}+3\hat{k}$ is equal to $\sqrt{2}$. Find the value of λ.

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

18. Case-Study 1: Read the following passage and answer the questions given below.

Solar panels have to be installed carefully so that the tilt of the roof, and the direction to the sun, produce the largest possible electrical power in the solar panels. A surveyor uses his instrument to determine the coordinates of the four corners of a roof where solar panels are to be mounted. In the picture, suppose the points are labelled counter clockwise from the roof corner nearest to the camera in units of meters P_1 (6, 8, 4), P_2 (21, 8, 4), P_3 (21, 16, 10) and P_4 (6,16,10).

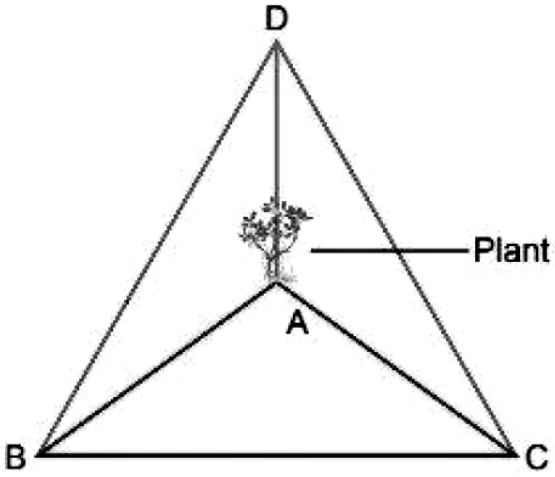
(i) Find the components to the two edge vectors defined by $\vec{A}$ = PV of P_2 – PV of P_1 and $\vec{B}$ = PV of P_4 – PV of P_1 where PV stands for position vector.

(ii) (a) Find the magnitudes of the vectors $\vec{A}$ and $\vec{B}$.

(b) Find the components to the vector $\vec{N}$, perpendicular to $\vec{A}$ and $\vec{B}$ and the surface of the roof.

19. Case-Study 2: Read the following passage and answer the questions given below.

Raghav purchased an air plant holder which is in shape of tetrahedron. Let A, B, C, D be the co-ordinates of the air plant holder where A = (1, 2, 3), B= (3, 2, 1), C = (2, 1, 2), D = (3, 4, 3).



(i) Find the vector $\overrightarrow{AB}$. (1)

(ii) Find the vector $\overrightarrow{CD}$. (1)

(iii) Find the unit vector along $\overrightarrow{BC}$ vector. (2)

OR

(iii) Find the area (ABCD). (2)