

# VECTOR ALGEBRA

### SECTION – A

Questions 1 to 10 carry 1 mark each.

- The position vector of the point which divides the join of points with position vectors  $2\vec{a} - 3\vec{b}$  and  $\vec{a} + \vec{b}$  in the ratio 3 : 1 is  
 (a)  $\frac{3\vec{a} - 2\vec{b}}{2}$                       (b)  $\frac{7\vec{a} - 8\vec{b}}{4}$                       (c)  $\frac{3\vec{a}}{4}$                       (d)  $\frac{5\vec{a}}{4}$
- The angle between two vectors  $\vec{a}$  and  $\vec{b}$  with magnitudes  $\sqrt{3}$  and 4, respectively, and  $\vec{a} \cdot \vec{b} = 2\sqrt{3}$  is  
 (a)  $\frac{\pi}{3}$                       (b)  $\frac{\pi}{2}$                       (c)  $\frac{5\pi}{2}$                       (d)  $\frac{\pi}{6}$
- The vectors from origin to the points A and B are  $\vec{a} = 2\hat{i} - 3\hat{j} + 2\hat{k}$  and  $\vec{b} = 2\hat{i} + 3\hat{j} + \hat{k}$ , respectively, then the area of triangle OAB is  
 (a) 340                      (b)  $\sqrt{25}$                       (c)  $\frac{1}{2}\sqrt{229}$                       (d)  $\sqrt{229}$
- If  $|\vec{a}| = 10, |\vec{b}| = 2$  and  $\vec{a} \cdot \vec{b} = 12$ , then value of  $|\vec{a} \times \vec{b}|$  is  
 (a) 5                      (b) 10                      (c) 14                      (d) 16
- The value of  $\lambda$  for which the two vectors  $3\hat{i} - 6\hat{j} + \hat{k}$  and  $2\hat{i} - 4\hat{j} + \lambda\hat{k}$  are parallel is  
 (a)  $\frac{3}{2}$                       (b)  $\frac{2}{3}$                       (c)  $\frac{5}{2}$                       (d)  $\frac{2}{5}$
- If  $\vec{a}, \vec{b}, \vec{c}$  are three vectors such that  $\vec{a} + \vec{b} + \vec{c} = \vec{0}$  and  $|\vec{a}| = 2, |\vec{b}| = 3, |\vec{c}| = 5$  then value of  $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$  is  
 (a) 0                      (b) 1                      (c) -19                      (d) 38
- The area of the parallelogram whose adjacent sides are determined by the vectors  $\vec{a} = \hat{i} - \hat{j} + 3\hat{k}$  and  $\vec{b} = 2\hat{i} - 7\hat{j} + \hat{k}$  is  
 (a) 15                      (b)  $15\sqrt{3}$                       (c)  $15\sqrt{2}$                       (d) None of these
- Area of a rectangle having vertices A, B, C and D with position vectors  $-\hat{i} + \frac{1}{2}\hat{j} + 4\hat{k}, \hat{i} + \frac{1}{2}\hat{j} + 4\hat{k}, \hat{i} - \frac{1}{2}\hat{j} + 4\hat{k}$  and  $-\hat{i} - \frac{1}{2}\hat{j} + 4\hat{k}$ , respectively is  
 (a) 1/2                      (b) 1                      (c) 2                      (d) 4

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).

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- (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):** If means  $\vec{a} = 3\hat{i} - 4\hat{j} + 2\hat{k}$  and  $\vec{b} = 2\hat{i} - 3\hat{j} + p\hat{k}$  are mutually perpendicular then p is -9.

**Reason (R):** For perpendicular vectors,  $\vec{a} \cdot \vec{b} = 0$

10. **Assertion (A):** If two vectors are inclined at an angle, so that their resultant is also a unit vector, then  $\sin \theta$  is  $\frac{\sqrt{3}}{2}$ .

**Reason (R):** If two vectors are inclined at an angle, so that their resultant is also a unit vector, then  $\sin \theta$  is  $1/2$ .

## SECTION – B

Questions 11 to 14 carry 2 marks each.

11. If  $\vec{a}$  and  $\vec{b}$  are perpendicular vectors,  $|\vec{a} + \vec{b}| = 13$  and  $|\vec{a}| = 5$  find the value of  $|\vec{b}|$ .
12. If  $\vec{a}$  and  $\vec{b}$  are two unit vectors such that  $\vec{a} + \vec{b}$  is also a unit vector, then find the angle between  $\vec{a}$  and  $\vec{b}$ .
13. Find the area of the parallelogram whose adjacent sides are determined by the vectors  $\vec{a} = \hat{i} - \hat{j} + 3\hat{k}$  and  $\vec{b} = 2\hat{i} - 7\hat{j} + \hat{k}$ .
14. Find the area of a triangle having the points A(1, 1, 1), B(1, 2, 3) and C(2, 3, 1) as its vertices.

## SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Find a unit vector perpendicular to each of the vectors  $\vec{a} + 2\vec{b}$  and  $2\vec{a} + \vec{b}$ , where  $\vec{a} = 3\hat{i} + 2\hat{j} + 2\hat{k}$  and  $\vec{b} = \hat{i} + 2\hat{j} - 2\hat{k}$ .
16. If  $\vec{a} = \hat{i} - \hat{j} + 7\hat{k}$  and  $\vec{b} = 5\hat{i} - \hat{j} + \lambda\hat{k}$ , then find the value of  $\lambda$ , so that  $\vec{a} + \vec{b}$  and  $\vec{a} - \vec{b}$  are perpendicular vectors.
17. Show that the vectors  $2\hat{i} - \hat{j} + \hat{k}$ ,  $\hat{i} - 3\hat{j} - 5\hat{k}$  and  $3\hat{i} - 4\hat{j} - 4\hat{k}$  form the vertices of a right angled triangle.

## SECTION – D

Questions 18 carry 5 marks.

18. If  $\vec{a}$ ,  $\vec{b}$  and  $\vec{c}$  are mutually perpendicular vectors of equal magnitudes, show that the vector  $\vec{a} + \vec{b} + \vec{c}$  is equally inclined to  $\vec{a}$ ,  $\vec{b}$  and  $\vec{c}$ .

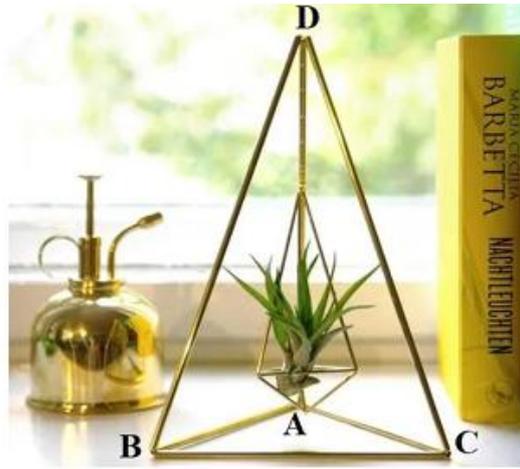
## SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

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

Aditi purchased an air plant holder which is in the shape of a tetrahedron. Let A, B, C and D are the coordinates of the air plant holder where A = (1, 1, 1), B = (2, 1, 3), C = (3, 2, 2) and D = (3, 3, 4).

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Based on the above information, answer the following questions.

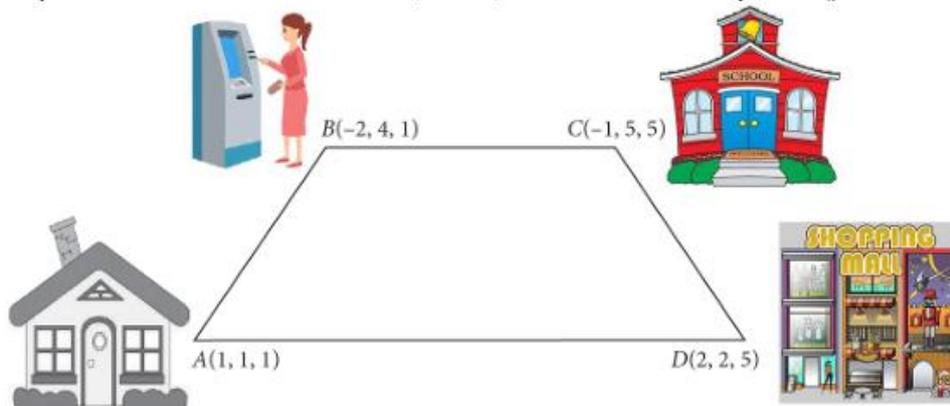
- (i) Find the position vector  $\overrightarrow{AB}$ . (1)
- (ii) Find the position vector  $\overrightarrow{AC}$ . (1)
- (iii) Find the unit vector along  $\overrightarrow{AD}$  vector. (2)

OR

- (iii) Find the area of  $\triangle ABC$ . (2)

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

Ritika starts walking from his house to shopping mall. Instead of going to the mall directly, she first goes to a ATM, from there to her daughter's school and then reaches the mall. In the diagram, A, B, C and D represent the coordinates of House, ATM, School and Mall respectively.



- (i) Find the position vector  $\overrightarrow{AB}$ . (1)
- (ii) Find the position vector  $\overrightarrow{BC}$ . (1)
- (iii) Find the unit vector along  $\overrightarrow{AD}$  vector. (2)