Sri Raghavendra Tuition Center

VECTOR ALGEBRA

11th Standard

Maths

Date : 18-09-24

Reg.No. :

Exam Time : 03:00 Hrs Total Marks : 90

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I. MULTIPLE CHOICE QUESTION. 20 x 1 = 20

1) The value of $\overrightarrow{AB}+\overrightarrow{BC}+\overrightarrow{DA}+\overrightarrow{CD}$ is

(a) $\overrightarrow{AD}$ (b) $\overrightarrow{CA}$ (c) $\vec{0}$ (d) $-\overrightarrow{AD}$

2) The unit vector parallel to the resultant of the vectors $\hat{i}+\hat{j}-\hat{k}$ and $\hat{i}-2\hat{j}+\hat{k}$ is

(a) $\frac{\hat{i}-\hat{j}+\hat{k}}{\sqrt{5}}$ (b) $\frac{2\hat{i}+\hat{j}}{\sqrt{5}}$ (c) $\frac{2\hat{i}-\hat{j}+\hat{k}}{\sqrt{5}}$ (d) $\frac{2\hat{i}-\hat{j}}{\sqrt{5}}$

3) A vector makes equal angle with the positive direction of the coordinate axes. Then each angle is equal to

(a) $cos^{-1}(\frac{1}{3})$ (b) $cos^{-1}(\frac{2}{3})$ (c) $cos^{-1}(\frac{1}{\sqrt{3}})$ (d) $cos^{-1}(\frac{2}{\sqrt{3}})$

4) If ABCD is a parallelogram, then $\overrightarrow{AB}+\overrightarrow{AD}+\overrightarrow{CB}+\overrightarrow{CD}$ is equal to

(a) $2(\overrightarrow{AB}+\overrightarrow{AD})$ (b) $4\overrightarrow{AC}$ (c) $4\overrightarrow{BD}$ (d) $\vec{0}$

5) One of the diagonals of parallelogram ABCD with $\vec{a}$ and $\vec{b}$ as adjacent sides is $\vec{a}+\vec{b}$ The other diagonal $\overrightarrow{BD}$ is

(a) $\vec{a}-\vec{b}$ (b) $\vec{b}-\vec{a}$ (c) $\vec{a}+\vec{b}$ (d) $\frac{\vec{a}+\vec{b}}{2}$

6) If $\vec{a},\vec{b}$ are the position vectors A and B, then which one of the following points whose position vector lies on AB, is

(a) $\vec{a}+\vec{b}$ (b) $\frac{2\vec{a}-\vec{b}}{2}$ (c) $\frac{2\vec{a}+\vec{b}}{3}$ (d) $\frac{\vec{a}-\vec{b}}{3}$

7) If $\vec{a},\vec{b},\vec{c}$ are the position vectors of three collinear points, then which of the following is true?

(a) $\vec{a}=\vec{b}+\vec{c}$ (b) $2\vec{a}=\vec{b}+\vec{c}$ (c) $\vec{b}=\vec{c}+\vec{a}$ (d) $4\vec{a}+\vec{b}+\vec{c}=0$

8) If $\vec{r}=\frac{9\vec{a}+7\vec{b}}{16}$, then the point P whose position vector $\vec{r}$ divides the line joining the points with position vectors $\vec{a}$ and $\vec{b}$ in the ratio

(a) 7: 9 internally (b) 9: 7 internally (c) 9: 7 externally (d) 7: 9 externally

9) If $\lambda\hat{i}+2\lambda\hat{j}+2\lambda\hat{k}$ is a unit vector, then the value of λ is

(a) $\frac{1}{3}$ (b) $\frac{1}{4}$ (c) $\frac{1}{9}$ (d) $\frac{1}{2}$

10) Two vertices of a triangle have position vectors $3\hat{i}+4\hat{j}-4\hat{k}$ and $2\hat{i}+3\hat{j}+4\hat{k}$. If the position vector of the centroid is $\hat{i}+2\hat{j}+3\hat{k}$, then the position vector of the third vertex is

(a) $-2\hat{i}-\hat{j}+9\hat{k}$ (b) $-2\hat{i}-\hat{j}-6\hat{k}$ (c) $2\hat{i}-\hat{j}+6\hat{k}$ (d) $-2\hat{i}+\hat{j}+6\hat{k}$

11) If $|\vec{a}+\vec{b}|=60, |\vec{a}-\vec{b}|=40$ and $|\vec{b}|=46$, then $|\vec{a}|$ is

(a) 42 (b) 12 (c) 22 (d) 32

12) If $\vec{a}$ and $\vec{b}$ having same magnitude and angle between them is 60° and their scalar product is $\frac{1}{2}$ then $|\vec{a}|$ is

(a) 2 (b) 3 (c) 7 (d) 1

13) If $|\vec{a}| = 13, |\vec{b}| = 5$ and $\vec{a}.\vec{b} = 60^o$ then $|\vec{a} \times \vec{b}|$ is

(a) 15 (b) 35 (c) 45 (d) 25

14) Vectors $\vec{a}$ and $\vec{b}$ are inclined at an angle $\theta = 120^o$. If $|\vec{a}| = 1, |\vec{b}| = 2$, then $[(\vec{a} + 3\vec{b}) \times (3\vec{a} - \vec{b})]^2$ is equal to

(a) 225 (b) 275 (c) 325 (d) 300

15) If $\vec{a}$ and $\vec{b}$ are two vectors of magnitude 2 and inclined at an angle 60°, then the angle between $\vec{a}$ and $\vec{a} + \vec{b}$ is

(a) 30° (b) 60° (c) 45° (d) 90°

16) If the projection of $5\hat{i} - \hat{j} - 3\hat{k}$ on the vector $\hat{i} + 3\hat{j} + \lambda\hat{k}$ is same as the projection of $\hat{i} + 3\hat{j} + \lambda\hat{k}$ on $5\hat{i} - \hat{j} - 3\hat{k}$, then λ is equal to

(a) ± 4 (b) ± 3 (c) ± 5 (d) ± 1

17) If (1, 2, 4) and (2, -3λ, -3) are the initial and terminal points of the vector $\hat{i} + 5\hat{j} - 7\hat{k}$, then the value of λ is equal to

(a) $\frac{7}{3}$ (b) -$\frac{7}{3}$ (c) -$\frac{5}{3}$ (d) $\frac{5}{3}$

18) If the points whose position vectors $10\hat{i} + 3\hat{j}, 12\hat{i} - 5\hat{j}$ and $a\hat{i} + 11\hat{j}$ are collinear then a is equal to

(a) 6 (b) 3 (c) 5 (d) 8

19) If $\vec{a} = \hat{i} + \hat{j} + \hat{k}, \vec{b} = 2\hat{i} + x\hat{j} + \hat{k}, \vec{c} = \hat{i} - \hat{j} + 4\hat{k}$ and $\vec{a}.(\vec{b} \times \vec{c}) = 70$, then x is equal to

(a) 5 (b) 7 (c) 26 (d) 10

20) If $\vec{a} = \hat{i} + 2\hat{j} + 2\hat{k}, |\vec{b}| = 5$ and the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{6}$, then the area of the triangle formed by these two vectors as two sides, is

(a) $\frac{7}{4}$ (b) $\frac{15}{4}$ (c) $\frac{3}{4}$ (d) $\frac{17}{4}$

II. ANSWER ANY SEVEN QUESTION. 7 x 2 = 14

21) Find a unit vector along the direction of the vector $5\hat{i} - 3\hat{j} + 4\hat{k}$.

22) Verify whether the following ratios are direction cosines of some vector or not $\frac{1}{5}, \frac{3}{5}, \frac{4}{5}$

23) Find the direction cosines of a vector whose direction ratios are 1, 2, 3

24) Find $\vec{a}.\vec{b}$ when $\vec{a}$= $\hat{i} - \hat{j} + 5\hat{k}$ and $\vec{b} = 3\hat{i} - 2\hat{k}$

25) Find $(\vec{a} + 3\vec{b}).(2\hat{a} - \hat{b})$ if $\vec{a} = \hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = 3\hat{i} + 2\hat{j} - \hat{k}$

26) Find the value λ for which the vectors $\vec{a}$ and $\vec{b}$ are perpendicular, where $\vec{a} = 2\hat{i} + \lambda\hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} + 3\hat{k}$

27) Find $|\vec{a} \times \vec{b}|$,where $\vec{a} = 3\hat{i} + 4\hat{j}$ and $\vec{b} = \hat{i} + \hat{j} + \hat{k}$.

28) For any two vectors $\vec{a}$ and $\vec{b}$, prove that $|\vec{a} \times \vec{b}|^2 + (\vec{a}.\vec{b})^2 = |\vec{a}|^2|\vec{b}|^2$

29) Find the magnitude of $\vec{a} \times \vec{b}$ if $\vec{a} = 2\hat{i} + \hat{j} + 3\hat{k}$ and $\vec{b} = 3\hat{i} + 5\hat{j} - 2\hat{k}$.

30) If $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}, \vec{b} = -3\hat{i} + 4\hat{j} - 5\hat{k}$ then find the value of $\vec{a}.\vec{b}$.

III. ANSWER ANY SEVEN QUESTION. 7 x 3 = 21

31) Find the direction cosines and direction ratios for the following vectors. $3\hat{i} + \hat{j} + \hat{k}$

32) Find the angle between the vectors $5\hat{i} + 3\hat{j} + 4\hat{k}$ and $6\hat{i} - 8\hat{j} - \hat{k}$.

33) If $\vec{a}$ and $\vec{b}$are two vectors such that | $\vec{a}$ | = 10, | $\vec{b}$ | = 15 and $\vec{a}.\vec{b}$ = 75 $\sqrt{2}$, find the angle between $\vec{a}$ and $\vec{b}$.

34) Find the angle between the vectors $2\hat{i} + 3\hat{j} - 6\hat{k}$ and $6\hat{i} - 3\hat{j} + 2\hat{k}$

35) If $\vec{a}, \vec{b}, \vec{c}$are three vectors such that $\vec{a} + 2\vec{b} + \vec{c} = \vec{0}$ and $|\vec{a}| = 3, |\vec{b}| = 4, |\vec{c}| = 7$, find the angle between $\vec{a}$ and $\vec{b}$.

36) Show that the vectors $\vec{a} = 2\hat{i} + 3\hat{j} + 6\hat{k}$, $\vec{b} = 6\hat{i} + 2\hat{j} - 3\hat{k}$, and $\vec{c} = 3\hat{i} - 6\hat{j} + 2\hat{k}$ are mutually orthogonal.

37) If $\vec{a}, \vec{b}$ are unit vectors and θ is the angle between them, show that $sin\frac{\theta}{2} = \frac{1}{2}|\vec{a} - \vec{b}|$

38) If $\vec{a} = -3\hat{i} + 4\hat{j} - 7\hat{k}$ and $\vec{b} = 6\hat{i} + 2\hat{j} - 3\hat{k}$, verify $\vec{b}$are $\vec{a} \times \vec{b}$ perpendicular to each other

39) Show that $\vec{a} \times (\vec{b} + \vec{c}) + \vec{b} \times (\vec{c} + \vec{a}) + \vec{c} \times (\vec{a} + \vec{b}) = \vec{0}$

40) Find the area of the parallelogram whose two adjacent sides are determined by the vectors $\hat{i}+2\hat{j}+3\hat{k}$ and $3\hat{i}-2\hat{j}+\hat{k}$

IV. ANSWER ALL QUESTION. 7 x 5 = 35

41) a) If D is the midpoint of the side BC of a triangle ABC, prove that $\overrightarrow{AB}$ + $\overrightarrow{AC}$ = 2$\overrightarrow{AD}$

(OR)

b) Let A, B and C be the vertices of a triangle. Let D, E, and F be the midpoints of the sides BC, CA, and AB respectively. Show that $\overrightarrow{AD}$ + $\overrightarrow{BE}$ +$\overrightarrow{CF}$ = $\vec{0}$.

42) a) Find the projection of the vector $\hat{i}+3\hat{j}+7\hat{k}$ on the vector$2\hat{i}+6\hat{j}+3\hat{k}$.

(OR)

b) If $\vec{a},\vec{b},\vec{c}$are position vectors of the vertices A, B, C of a triangle ABC, show that the area of the triangle ABC is $\frac{1}{2}|\vec{a}\times\vec{b}+\vec{b}+\vec{c}+\vec{c}\times\vec{a}|$. Also deduce the condition for collinearity of the points A, B, and C.

43) a) Show that the following vectors are coplanar $\hat{i}$ − 2$\hat{j}$ + 3$\hat{k}$, - 2$\hat{i}$ + 3$\hat{j}$ - 4$\hat{k}$,-$\hat{j}$ + 2$\hat{k}$.

(OR)

b) Show that the following vectors are coplanar 5$\hat{i}$ +6$\hat{j}$ +7$\hat{k}$,7 $\hat{i}$ -8$\hat{j}$ +9 $\hat{k}$,3$\hat{i}$+20$\hat{j}$ +5$\hat{k}$.

44) a) If ABCD is a quadrilateral and E and F are the midpoints of AC and BD respectively, then prove that $\overrightarrow{AB}$ + $\overrightarrow{AD}$ + $\overrightarrow{CB}$ +$\overrightarrow{CD}$ = 4 $\overrightarrow{EF}$.

(OR)

b) The medians of a triangle are concurrent.

45) a) Show that the points whose position vectors are 2$\hat{i}$ + 3$\hat{j}$ − 5$\hat{k}$, 3$\hat{i}$ + $\hat{j}$ − 2$\hat{k}$ and, 6$\hat{i}$ − 5$\hat{j}$ + 7$\hat{k}$ are collinear

(OR)

b) Prove that the points whose position vectors $2\hat{i}+4\hat{j}+3\hat{k},4\hat{i}+\hat{j}+9\hat{k}$ and $10\hat{i}-\hat{j}+6\hat{k}$ form a right angled triangle.

46) a) A triangle is formed by joining the points (1, 0, 0), (0, 1, 0) and (0, 0, 1). Find the direction cosines of the medians.

(OR)

b) For any vector $\vec{a}$ prove that $|\vec{a}\times\hat{i}|^2+|\vec{a}\times\hat{j}|^2+|\vec{a}\times\hat{k}|^2=2|\vec{a}|^2$.

47) a) Show that the vectors 2$\hat{i}$ − $\hat{j}$ + $\hat{k}$, 3 $\hat{i}$ − 4$\hat{j}$ - 4$\hat{k}$, $\hat{i}$ − 3$\hat{j}$ - 5 $\hat{k}$ form a right angled triangle.

(OR)

b) If $\vec{a}=2\hat{i}+3\hat{j}-4\hat{k},\vec{b}=3\hat{i}-4\hat{j}-5\hat{k}$, and $\vec{c}=-3\hat{i}+2\hat{j}+3\hat{k}$, find the magnitude and direction cosines of $(i)\ \vec{a}+\vec{b}+\vec{c}\ (ii)\ 3\vec{a}-2\vec{b}+5\vec{c}$.

...ALL THE BEST...

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