



## MATHS

### BOOKS - DEEPTI MATHS (TELUGU ENGLISH)

#### PRODUCTS OF VECTORS

##### Solved Examples

1. Let  $a = 2i - j + k$ ,  $b = i + 2j - k$  and  $c = i + j - 2k$  be three vectors. A vector in the plane of  $b$  and  $c$  whose projection on  $a$  is of magnitude  $\sqrt{2/3}$  is

A.  $2i + 3j - 3k$

B.  $2i + 2j + 3k$

C.  $-2i - j + 5k$

D.  $2i + j + 5k$

**Answer: A**



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2. If a vector  $a$  is expressed as the sum of two vectors  $\vec{\alpha}$  and  $\vec{\beta}$  along and perpendicular to a given vector  $b$ , then  $\vec{\beta} =$

A.  $\frac{(a \times b) \times b}{|b|^2}$

B.  $\frac{b \times (a \times b)}{|b|^2}$

C.  $\frac{b \times (a \times b)}{|b|}$

D.  $((a \cdot b) / (|b|^2))b$

Answer: B



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3. Let  $a, b, c$  be the distinct non-negative numbers. If the vectors  $ai + aj + ck$ ,  $i + k$  and  $ci + cj + bk$  lie in a plane, then  $c$  is

A. the arithmetic mean of  $a$  and  $b$

B. the geometric mean of a and b

C. the harmonic of a and b

D. equal to zero

**Answer: B**



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4. Let  $a = i - k$ ,  $b = xi + j + (1 - x)k$  and  $c = yi + xj + (1 + x - y)k$ . Then  $[a,b,c]$  depends on

A. only x

B. only y

C. neither x nor y

D. both x and y

**Answer: C**



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5. Let  $a = 2i + j - 2k$  and  $b = i + j$ . If  $c$  is vector such that  $ac = |c|$ ,  $|c - a| = 2\sqrt{2}$  and the angle between  $a \times b$  and  $c$  is  $30^\circ$ , then  $|(a \times b) \times c| =$

A.  $2/3$

B.  $3/2$

C. 2

D. 3

**Answer: B**



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6. Let  $v = 2i + j - k$  and  $w = i + 3k$ . If  $u$  is unit vector. Then the maximum value of the scalar triple product  $[u \ v \ w]$  is

A.  $-1$

B.  $\sqrt{10} + \sqrt{16}$

C.  $\sqrt{59}$

D.  $\sqrt{6}$

**Answer: C**



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7. Let P, Q, R be points with position vectors  $r_1 = 3i - 2j - k$ ,  $r_2 = I + 3j + 4k$  and  $r_3 = 2i + j - 2k$  relative to an origin. The distance of P from the plane OQR is

A. 2

B. 3

C. 1

D.  $11/\sqrt{3}$

**Answer: B**



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8. Consider the parallelopiped wide sides  $a = 3i + 2j + k$ ,  $b = i + j + 2k$  and  $c = i + 3j + 3k$  then the angle between  $a$  and the plane containing the face determined by  $b$  and  $c$  is

A.  $\sin^{-1}\left(\frac{1}{3}\right)$

B.  $\cos^{-1}\left(\frac{9}{14}\right)$

C.  $\sin^{-1}\left(\frac{9}{14}\right)$

D.  $\sin^{-1}\left(\frac{2}{3}\right)$

**Answer: C**



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### Exercise 1 A

1. If  $|a| = 3$ ,  $|b| = 4$  and  $|a + b| = 1$ , then  $|a - b| =$

A. 5

B. 6

C. 7

D. 8

**Answer: C**



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2. if  $\theta$  is the angle between the unit vectors  $a, b$  then  $|a - b| =$

A.  $\sin (\theta / 2)$

B.  $2 \sin (\theta / 2)$

C.  $\cos (\theta / 2)$

D.  $2 \cos (\theta / 2)$

**Answer: B**



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3. If  $\theta$  is the angle between the unit vectors  $a, b$  then  $|a + b| =$

A.  $\sin (\theta / 2)$

B.  $2 \sin (\theta / 2)$

C.  $\cos (\theta / 2)$

D.  $2 \cos (\theta / 2)$

**Answer: D**



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4. If  $a$  and  $b$  are unit vectors and  $\alpha$  is the angle between them then  $a - b$  will be a unit vector if  $\alpha =$

A.  $\pi / 4$

B.  $\pi / 3$

C.  $2\pi / 3$

D.  $\pi / 2$



**Answer: B**



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5. If the unit vector  $a$  and  $b$  are inclined at an angle  $2\theta$  such that  $|a - b| < 1$  then  $\theta$  lies in the interval

A.  $[0, \pi/6]$

B.  $[5\pi/6, \pi]$

C.  $[\pi/6, \pi/2]$

D.  $[\pi/2, 5\pi/6]$

**Answer: A**



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6. If  $a, b, c$  are three vectors such that  $a = b + c$  and the angle between  $b$  and  $c$  is  $\pi/2$ , then (here  $a = |a|, b = |b|, c = |c|$ )

A.  $a^2 = b^2 + c^2$

B.  $b^2 = c^2 + a^2$

C.  $c^2 = a^2 + b^2$

D.  $2a^2 - b^2 = c^2$

**Answer: A**



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7. If  $a + b + c = 0$  and  $|a| = 3$ ,  $|b| = 4$  and  $|c| = \sqrt{37}$  the angle between  $a$  and  $b$  is

A.  $\pi/4$

B.  $\pi/2$

C.  $\pi/6$

D.  $\pi/3$

**Answer: D**

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8. If  $a$  and  $b$  are noncollinear unit vectors and  $|a + b| = \sqrt{3}$ , then  $(2a + 5b) \cdot (3a - b) =$

A.  $15/4$

B.  $15/2$

C. 15

D. none

**Answer: B**

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9. If  $a, b$ , are two vectors of lengths 2,1 respectively and  $|a - b| = \sqrt{3}$  then  $(a, b) =$

A.  $\pi/4$

B.  $\pi / 6$

C.  $\pi / 3$

D.  $\pi / 2$

**Answer: C**



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**10.** If, in a right angled triangle ABC, the hypotenuse,  $AB = p$ , then  $AB.AC + BC . BA + CA. CB =$

A.  $2p^2$

B.  $p^2 / 2$

C.  $p^2$

D. none

**Answer: C**



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11. If  $a, b, c$  are unit vectors such that  $a + b + c = 0$  then  $a \cdot b + b \cdot c + c \cdot a =$

A. 2

B.  $3/2$

C.  $-2$

D.  $-3/2$

**Answer: D**



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12. If two out of the three vectors  $a, b, c$  are unit vectors,  $a + b + c = 0$  and  $2(a \cdot b + b \cdot c + c \cdot a) + 3 = 0$ , then the third vector is of length

A. 3

B. 2

C. 1

D. 0

**Answer: C**



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13. If  $a, b, c$  are three vectors such that  $a + b + c = 0$ ,  $|a| = 1$ ,  $|b| = 2$ ,  $|c| = 3$  then  $a \cdot b + b \cdot c + c \cdot a =$

A. 0

B.  $-7$

C. 7

D. 1

**Answer: B**



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14. If  $a, b, c$  are mutually perpendicular unit vectors, then  $|a + b + c| =$

A.  $\sqrt{2}$

B. 1

C.  $\sqrt{3}$

D. 0

**Answer: C**



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15. If  $A \cdot (B + C) = B \cdot (C + A) = C \cdot (A + B) = 0$ ,  $|A| = 3$ ,  $|B| = 4$ ,  $|C| = 5$  then  $|A + B + C| =$

A. 5

B.  $5\sqrt{2}$

C.  $5/\sqrt{2}$

D.  $\sqrt{2}$

**Answer: B**



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16. If  $a, b, c$  are vector of length 4,4,5 respectively and  $a, b, c$  are perpendicular to  $b + c, c + a, a + b$  respectively, then  $|a + b + c| =$

A.  $\sqrt{57}$

B.  $\sqrt{75}$

C.  $\sqrt{47}$

D. 7

**Answer: A**



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17. Let  $u, v, w$  be such that  $|u| = 1, |v| = 2, |w| = 3$ . If the projection  $v$  along  $u$  is equal to that  $w$  along  $u$  and  $v, w$  are perpendicular to each other then  $|u -$



$$|v + w| =$$

A. 1

B. 14

C.  $\sqrt{14}$

D.  $\sqrt{7}$

**Answer: C**



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**18.** If  $a, b$  and  $c$  are vectors with magnitudes 2, 3 and 4 respectively then the least upper bound of  $|a - b|^2 + |b - c|^2 + |c - a|^2$  among the given values is

A. 97

B. 87

C. 90

**Answer: B****Watch Video Solution**

19. If  $p^{\text{th}}, q^{\text{th}}, r^{\text{th}}$  terms of a geometric progression are the positive numbers  $a, b, c$  respectively, then the angle between the vectors  $(\log a^2)I + (\log b^2)j + (\log c^2)k$  and  $(q - r)I + (r - p)j + (p - q)k$  is

A.  $\frac{\pi}{3}$

B.  $\frac{\pi}{2}$

C.  $\sin^{-1} \frac{1}{\sqrt{a^2 + b^2 + c^2}}$

D.  $\frac{\pi}{4}$

**Answer: B****Watch Video Solution**

20. The vectors  $AB = 3i - 2j + 2k$  and  $BC = -i - 2k$  are the adjacent sides of a parallelogram. The angle between its diagonals is

A.  $\frac{\pi}{2}$

B.  $\frac{\pi}{3}$  or  $\frac{2\pi}{3}$

C.  $\frac{3\pi}{4}$  or  $\frac{\pi}{4}$

D.  $\frac{5\pi}{6}$  or  $\frac{\pi}{6}$

**Answer: C**



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21. Let  $a$  and  $b$  be two unit vectors. If the vectors  $c = a + 2b$  and  $d = 5a - 4b$  are perpendicular to each other, then the angle between  $a$  and  $b$  is

A.  $\frac{\pi}{3}$

B.  $\frac{\pi}{4}$

C.  $\frac{\pi}{6}$

D.  $\frac{\pi}{2}$

**Answer: A**



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22. If  $a, b$  are vectors of lengths  $a, b$  respectively then  $\left(\frac{a}{a^2} - \frac{b}{b^2}\right)^2 =$

A.  $\left(\frac{a + b}{ab}\right)^2$

B.  $\left(\frac{a - b}{ab}\right)^2$

C.  $\left(\frac{a + b}{ab}\right)$

D.  $\left(\frac{a - b}{ab}\right)$

**Answer: B**



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23. If  $a \cdot b = 0$  and  $a + b$  makes an angle of  $30^\circ$  with  $a$ , then

A.  $|b| = 2|a|$

B.  $|a| = 2|b|$

C.  $|a| = \sqrt{3}|b|$

D. none

**Answer: C**



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**24.** If  $a, b, c$  are three mutually perpendicular vectors such that  $|a| = |b| = |c|$  then find the angle between vector  $a$  and  $(a + b + c) =$

A.  $\pi/3$

B.  $\cos^{-1}(1/3)$

C.  $\cos^{-1}(1/\sqrt{3})$

D.  $\cos^{-1}(2/3)$

**Answer: C**

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25. If three unit vectors  $a, b, c$  satisfy  $a + b + c = 0$  then the angle between  $a$  and  $b$  is :

A.  $\frac{2\pi}{3}$

B.  $\frac{5\pi}{6}$

C.  $\frac{\pi}{3}$

D.  $\frac{\pi}{6}$

**Answer: A**

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26. In the parallelogram ABCD,  $\overline{AC}^2 - \overline{BD}^2 =$

A.  $4\overline{AB}$ . (orthogonal projection of  $\overline{AD}$  on  $\overline{AB}$ )

B.  $2\overline{AB}$ . (orthogonal projection of  $\overline{AD}$  on  $\overline{AB}$ )

C.  $\overline{AC}$ . (orthogonal projection of  $\overline{BD}$  on  $\overline{AC}$ )

D.  $2\overline{AC}$ . (orthogonal projection of  $\overline{BD}$  on  $\overline{AC}$ )

**Answer: A**



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27. In the parallelogram ABCD,  $\overline{AD}^2 - \overline{AB}^2 =$

A.  $4\overline{AB}$ . (orthogonal projection of  $\overline{AD}$  on  $\overline{AB}$ )

B.  $2\overline{AB}$ . (orthogonal projection of  $\overline{AD}$  on  $\overline{AB}$ )

C.  $\overline{AC}$ . (orthogonal projection of  $\overline{BD}$  on  $\overline{AC}$ )

D.  $2\overline{AC}$ . (orthogonal projection of  $\overline{BD}$  on  $\overline{AC}$ )

**Answer: C**



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28. If  $a, b$  are unit vectors such that the vector  $a + 3b$  is perpendicular to  $7a - 5b$  then the angle between  $a$  and  $b$  is

A.  $\pi/2$

B.  $\pi/3$

C.  $\pi/4$

D.  $\pi/6$

**Answer: B**



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29. P.T the smaller angle  $\theta$  between any two diagonals of a cube is given by  $\cos \theta = 1/3$

A.  $\cos^{-1}(1/\sqrt{3})$

B.  $\cos^{-1}(1/3)$

C.  $\cos^{-1}(2/3)$



D.  $\cos^{-1}(\sqrt{2}/3)$

**Answer: B**



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**30.** The angle between a diagonal of a cube and the diagonal of a face of the cube is

A.  $\cos^{-1}(1/\sqrt{3})$

B.  $\cos^{-1}(1/3)$

C.  $\cos^{-1}(2/3)$

D.  $\cos^{-1}(\sqrt{2}/3)$

**Answer: D**



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31. The cartesian equation of the plane passing through A and perpendicular to  $\overrightarrow{AB}$  where  $3i + j + 2k$ ,  $i - 2j + 4k$  are the position vectors of A, B respectively

A.  $[r - (3i + j - 2k)] \cdot (2i + 3j + 6k) = 0$

B.  $[r - (3i + j + 2k)] \cdot (2i + 3j + 6k) = 0$

C.  $[r - (3i - j + 2k)] \cdot (2i + 3j + 6k) = 0$

D.  $[r - (3i - j + 2k)] \cdot (2i + 3j - 6k) = 0$

**Answer: B**



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32. The cartesian equation of the plane passing through A and perpendicular to  $\overrightarrow{AB}$  where  $3i + j + 2k$ ,  $i - 2j + 4k$  are the position vectors of A, B respectively

A.  $2x + 3y - 2z - 5 = 0$

B.  $2x - 3y + 6z - 21 = 0$

C.  $2x + 3y + 6z + 21 = 0$

D.  $2x + 3y - 6z - 21 = 0$

**Answer: A**



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**33.** If  $A = (1, 3, -5)$  and  $B = (3, 5, -3)$  then the vector equation of the plane passing through the midpoint of  $AB$  and perpendicular to  $AB$  is

A.  $r \cdot (i + j + k) = 2$

B.  $r \cdot (i + j - k) = 2$

C.  $r \cdot (i - j + 4k)$

D. none

**Answer: A**



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34. The distance between the line  $\vec{r} = 2\hat{i} - 2\hat{j} + 3\hat{k} + \lambda(\hat{i} - \hat{j} + 4\hat{k})$  and the plane  $\vec{r} \cdot (\hat{i} + 5\hat{j} + \hat{k}) = 5$  is

A.  $\frac{10}{9}$

B.  $\frac{10}{3\sqrt{3}}$

C.  $\frac{3}{10}$

D.  $\frac{10}{3}$

**Answer: B**



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35. The angle between the planes  $r \cdot (2i - j + 2k) = 3$  and  $r \cdot (3i - 6j + 2k) = 4$

A.  $\cos^{-1}\left(\frac{16}{21}\right)$

B.  $\sin^{-1}\left(\frac{4}{21}\right)$

C.  $\cos^{-1}\left(\frac{1}{4}\right)$

D.  $\cos^{-1}\left(\frac{3}{4}\right)$

**Answer: A**



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**36.** The angle between the lines  $r = (2i - 3j + k) + \lambda (i + 4j + 3k)$  and  $r = (i - j + 2k) + \mu (i + 2j - 3k)$  is

A.  $\cos^{-1}\left(\frac{9}{\sqrt{91}}\right)$

B.  $\cos^{-1}\left(\frac{7}{\sqrt{84}}\right)$

C.  $\frac{\pi}{3}$

D.  $\frac{\pi}{2}$

**Answer: D**



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37. The distance from the origin to the plane passing through A and perpendicular to  $\overrightarrow{AB}$  where  $3i + j + 2k$ ,  $5i - j + 3k$  are the position vectors of A, B respectively is

A. 1

B. 2

C. 3

D. 4

**Answer: B**



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38. The vector equation of the sphere with centre  $3i + 2j - 5k$  and radius 7 is

A.  $[r - (3i + 2j - 5k)]^2 = 49$

B.  $[r + (3i - 2j - 5k)]^2 = 49$

$$C. r^2 = (3i + 2j - 5k)^2 + 49$$

$$D. r^2 = (3i + 2j - 5k)^2 + 7$$

**Answer: A**



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**39.** The centre and radius of the sphere  $r^2 - 2r \cdot (3i + 4j - 5k) + 1 = 0$

are

A.  $3i + 4j + 5k, 7$

B.  $3i + 4j - 5k, 1$

C.  $-3i - 4j + 5k, 7$

D.  $3i + 4j - 5k, 7$

**Answer: D**



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40. The centre and radius of the sphere

$$3x^2 + 3y^2 + 3z^2 - 2x - 12y + 6z + 7 = 0$$
 are

- A.  $(1, 2, -1), 5$
- B.  $(1/3, 2, -1), 5/3$
- C.  $(2/3, 4, -2), 10/3$
- D.  $2/3, 4, -5/2$

**Answer: B**



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41. The equation of the sphere on the join of  $(3, 4, -2), (-2, -1, 0)$  as diameter is

- A.  $r^2 - r \cdot (I + 3j - 2k) = 10$
- B.  $r^2 - 2r \cdot (I + 2j - 2k) + 10 = 0$
- C.  $r^2 - 2r \cdot (I + 2j - 2k) = 10$



$$D. r^2 - 2r \cdot (5i + 5j - 2k) + 20 = 0$$

**Answer: A**



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**42.** The centre of the sphere  $(r - 3i - 4j + 5k) \cdot (r - 2i + 3j - 4k) = 0$  is

A.  $5i + j - k$

B.  $\frac{1}{2}(5i + j - k)$

C.  $i + 7j - 9k$

D.  $\frac{1}{2}(i + 7j - 9k)$

**Answer: B**



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**43.** The radius of the sphere  $(r - 2i + 3j - k) \cdot (r + 3i - j + 2k) = 0$  is

A. 5

B.  $5\sqrt{2}$

C.  $5/\sqrt{2}$

D.  $2\sqrt{5}$

**Answer: C**



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**44.** The work done by the force  $F = 2i - 3j + 2k$  in moving a particle from  $(3,4,5)$  to  $(1,2,3)$  is

A. 0

B.  $3/2$

C.  $-4$

D.  $-2$

**Answer: D**

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45. The force  $f = 2i + 2j - k$  acting at  $a = i - 2j + k$  is displaced to a unit distance on z-axis ( $Oz = 1$ ) direction. The magnitude of the work done is

A. 1

B. 2

C. 3

D. 4

**Answer: B**

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46. Constant force  $P = 2i - 5j + 6k$  and  $Q = -i + 2j - k$  act on a particle. When the particle is displaced from A (4, -3, -2) to B (6, 1, -3) then the work done is

A. 14 unit

B.  $-14$  unit

C. 15 units

D.  $-15$  unit

**Answer: D**



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**47.** A particle acted on by constant forces  $4i + j - 3k$  and  $3i + j - k$  is displaced from the point  $i + 2j + 3k$  to the point  $5i + 4j + k$ . The total work done by the forces is

A. 20 unit

B. 30 unit

C. 40 unit

D. 50 unit

**Answer: C**



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**48.** If forces of magnitudes 6 and 7 units acting in the direction  $i - 2j + 2k$  and  $2i - 2j - k$ ,  $i + 2j + 2k$  and  $-2i + j - 2k$  respectively act on a particle which is displaced from P (2, -1, -3) to Q (5, -1, 1) then the work done by the forces is

A. 4

B. -4

C. 7

D. -7

**Answer: A**



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49. Three forces having magnitude 5, 4 and 3 units act on a particle in the directions  $2i - 2j + k$ ,  $i + 2j + 2k$  and  $-2i + j - 2k$  respectively and the particle gets displaced from the point A whose vector is  $6i - 2j + 3k$  to the point whose position vector is  $9i + 7j + 5k$ . Then the work done by these forces is

- A. 9 unit
- B. 43 unit
- C. 38 unit
- D.  $38/3$  unit

**Answer: A**



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50. The work done by force  $F = ai + j + k$  in moving a particle from  $(1,1,1)$  to  $(2,2,2)$  along a straight line is 5 unit. Then  $a =$

A. 1

B. 2

C. 3

D. 4

**Answer: C**



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## Exercise 1 B Cross Product Of Vectors

1. If  $a = i + j + k$ ,  $b = 2i - 3j + k$  then  $a \times b$  is

A.  $4i + j - 5k$

B.  $4i - j + 5k$

C.  $4i + j + 5k$

D.  $4i - j - 5k$

**Answer: A**



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2. If  $a = 2i - j + k$ ,  $b = 3i + 4j - k$  then  $|a \times b| =$

A. 9

B.  $3\sqrt{10}$

C.  $\sqrt{155}$

D.  $5\sqrt{5}$

**Answer: C**



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3. If  $|\vec{p}| = 2$ ,  $|\vec{q}| = 3$  and  $(\vec{p}, \vec{q}) = \frac{\pi}{6}$ , then find  $|\vec{p} \times \vec{q}|^2$

A. 7



B. 9

C. 8

D. 12

**Answer: B**



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4. If  $(a \times b)^2 + (a \cdot b)^2 = 144$  and  $|a| = 4$  then  $|b| =$

A. 16

B. 8

C. 3

D. 12

**Answer: C**



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5. If  $|a| = 5$ ,  $|b| = 6$ ,  $|a \cdot b| = 24$  then  $|a \times b| =$

A.  $\sqrt{224}$

B. 18

C.  $\sqrt{300}$

D.  $\sqrt{254}$

**Answer: B**



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6.  $u = a - b$ ,  $v = a + b$ ,  $|a| = |b| \Rightarrow |u \times v| =$

A.  $2\sqrt{16 - (a \cdot b)^2}$

B.  $2\sqrt{16 - (a \cdot b)^2}$

C.  $2\sqrt{4 - (a \cdot b)^2}$

D.  $\sqrt{4 - (a \cdot b)^2}$

**Answer: A**



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7. The unit vector perpendicular to each of the vectors  $2i - j + k$  and  $3i + 4j - k$  is

A.  $-3i + 5j + 11k$

B.  $\frac{-3i + 5j + 11k}{\sqrt{155}}$

C.  $\frac{-3i + 5j + 11k}{155}$

D.  $\frac{3i - 5j + 11k}{\sqrt{155}}$

**Answer: B**



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8. A unit vector perpendicular to  $2i + 3j + 4k$  and  $4i - 3j + 2k$  is

A.  $\frac{3i + 2j - 3k}{\sqrt{22}}$

B.  $\frac{3i - 2j - 3k}{\sqrt{22}}$

C.  $\frac{3i - 2j + 3k}{\sqrt{22}}$

D. none

**Answer: A**



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9. The unit vector normal to the plane containing  $a = i - j - k$  and  $b = i + j + k$  is

A.  $j - k$

B.  $k - j$

C.  $\frac{k - j}{\sqrt{2}}$

D.  $\frac{k - i}{\sqrt{2}}$

**Answer: C**

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10. A unit vector perpendicular to the plane of  $a = 2i - 6j - 3k$ ,  $b = 4i + 3j - k$  is

A.  $\frac{4i + 3j - k}{\sqrt{26}}$

B.  $\frac{2i - 6j - 3k}{7}$

C.  $\frac{3i - 2j + 6k}{7}$

D.  $\frac{2i - 3j - 6k}{7}$

**Answer: C**

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11. The number of vectors of unit length perpendicular to the vectors  $a = (1, 1, 0)$  and  $b = (0, 1, 1)$  is

A. one

B. two

C. three

D. infinite

**Answer: B**



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12. A unit vector perpendicular to the plane determined by the points P(1, -1, 2) Q (2, 0, -1) and R (0, 2, 1) is

A.  $\frac{2i + j + k}{\sqrt{6}}$

B.  $\frac{2i + j + k}{3}$

C.  $\frac{2i - j - k}{\sqrt{3}}$

D.  $\frac{2i - j - k}{3}$

**Answer: A**



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13. A unit vector normal to the plane through the point  $1, 2j, 3k$  is

A.  $6i + 3j + 2k$

B.  $1 + 2j + 3k$

C.  $\frac{6i + 3j + 2k}{7}$

D.  $\left| \frac{6i + 3j + 2k}{7} \right|$

**Answer: C**



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14. The unit vector orthogonal to  $a = 2i + 2j + k$ ,  $b = 3i + 4j - 12k$  and forming a right handed system with  $a$  and  $b$  is

A.  $28i - 27j - 2k$

B.  $-28i + 27j + 2k$

C.  $\frac{28i - 27j - 2k}{\sqrt{1517}}$

D.  $\frac{-28i + 27j + 2k}{\sqrt{1517}}$

**Answer: D**



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15. If  $a = 2i + j - 3k$ ,  $b = 1 - 2j + k$  then the vector of length  $2\sqrt{3}$  and perpendicular to both  $a$  and  $b$  is

A.  $i + j + k$

B.  $i - j - k$

C.  $2i - 2j + 2k$

D.  $2i - 2j - 2k$

**Answer: C**



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16. The sine of the angle between the vectors  $i + 3j - 2k$ ,  $2i - 4j - k$  is

A.  $3/4$

B.  $3/5$

C.  $5/6$

D.  $5/7$

**Answer: D**



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17. If  $\theta$  is the angle between the vector  $2i - 2j + 4k$  and  $3i + j + 2k$ , then  $\sin \theta$

=

A.  $2/7$

B.  $2/\sqrt{7}$

C.  $\sqrt{2}/7$

D.  $\sqrt{2/7}$

**Answer: B**



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**18.** If  $a = 2i + 3j + 6k$ ,  $b = 3i - 6j + 2k$ ,  $c = 6i + 2j - 3k$  then  $a \times b =$

A.  $3c$

B.  $5c$

C.  $7c$

D.  $11c$

**Answer: C**



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**19.** If  $13a = 3i + 4j + 12k$ ,  $13b = 4i - 12j + 3k$ ,  $13c = 12i + 3j - 4k$  then  $a \times b =$

A.  $c$

B. 5c

C. 13c

D. 169 c

**Answer: A**



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20. If  $(2i + 4j + 2k) \times (2i - xj + 5k) = 16i - 6j + 2xk$ , then the value of x is

A. 2

B. - 2

C. 0

D. none

**Answer: B**



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21. If  $a = 2i - 3j - k$ ,  $b = i + 4j - 2k$  then  $(a + b) \times (a - b) =$

A.  $20i - 6j - 22k$

B.  $-20i + 6j - 22k$

C.  $-20i - 6j - 22k$

D.  $20i + 6j - 22k$

**Answer: C**



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22. If  $a = 3i - j - 2k$ ,  $b = 2i + 3j + k$  then  $(a + 2b) \times (2a - b) =$

A.  $25i + 35j - 55k$

B.  $25i - 35j - 55k$

C.  $-25i - 35j - 55k$

D.  $-25i + 35j - 55k$

**Answer: D**



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**23.** If  $a = i + 2j - 3k$ ,  $b = 2i + j + k$ ,  $c = i + 3j - 2k$  then  $(a \times b) \times (b \times c) =$

A.  $5(2i + j + k)$

B.  $-5(2i + j + k)$

C.  $10(2i + j + k)$

D.  $-10(2i + j + k)$

**Answer: D**



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**24.**  $2i \times (3i - 4k) + (i + 2j) \times k =$



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25. If  $r = xi + yj + zk$  then  $(r \times i) \cdot (r \times j) + xy =$

A. 0

B. 1

C.  $xy$

D.  $I \times j$

**Answer: A**



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26. If  $|a| = 1$ ,  $|b| = 2$  and the angle between  $a$  and  $b$  is  $120^\circ$ , then

$$\{(a + 3b) \times (3a - b)\}^2 =$$

A. 425

B. 375

C. 325

D. 300

**Answer: D**



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**27.**  $(a + b) \times c + (b + c) \times a + (c + a) \times b =$

A. 0

B.  $a + b$

C.  $a - b$

D.  $a \times b$

**Answer: A**



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**28.** If  $|a \times b| = |a \cdot b|$  then  $(a,b) =$

A. 0

B.  $\pi$

C.  $\pi/2$

D.  $\pi/4$

**Answer: D**

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29. If  $a$  and  $b$  are unit vectors and  $a \times b = 1$ , then the angle between  $a$  and  $b$  is

A.  $\pi/4$

B.  $\pi/2$

C.  $\pi/3$

D.  $\pi$

**Answer: B**

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30. If  $a$  and  $b$  are unit vectors such that  $|a \times b| = a \cdot b$ , then  $|a + b|^2 =$

A. 2

B.  $2 + \sqrt{2}$

C.  $2 - \sqrt{2}$

D.  $\sqrt{2}$

**Answer: B**



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31. If  $a + b + c = 0$  then

A.  $a \cdot b = b \cdot c = c \cdot a$

B.  $a \times b = b \times c = c \times a$

C.  $a \times b = b \cdot c$

D.  $a + b = (a \times c) + (b \times c)$

**Answer: B**



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**32.** Let  $a, b, c$  represent respectively  $BC, CA$  and  $AB$  where  $ABC$  is a triangle.

Then

A.  $a + b = c$

B.  $b + c = a$

C.  $a \times b = b \times c = c \times a$

D. none

**Answer: C**



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**33.** If  $a \cdot b = a \cdot c, a \times b = a \times c$  then

A.  $a = 0$

B.  $b = c$

C.  $a = 0$  or  $b = c$

D.  $a = 0$  and  $b = c$

**Answer: C**



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**34.** If  $a \cdot b = a \cdot c$ ,  $a \times b = a \times c$  then

A.  $a - b$  is parallel to  $c$

B.  $a - b$  is perpendicular to  $c$

C.  $a + b$  is parallel to  $c$

D.  $a - b$  is perpendicular to  $c$

**Answer: A**



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35.  $a \neq 0, b \neq 0, C \neq 0, a \times b = 0, b \times c \Rightarrow a \times c =$

A. b

B. a

C. 0

D.  $i + j + k$

**Answer: C**



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36. If  $a \times b = b \times c \neq 0$ , then  $a + c =$

A.  $pa$  where  $p$  is scalar

B.  $pb$  where  $p$  is a scalar

C.  $pc$  where  $p$  is a scalar

D. none

**Answer: B**



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**37.** If  $a \times b = c \times d$ ,  $a \times c = b \times d$  then

A.  $a - d$  is parallel to  $b - c$

B.  $a - b$  is parallel to  $c - d$

C.  $a - c$  is parallel to  $b - d$

D.  $a + b$  is parallel to  $c + d$

**Answer: A**



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38. If  $a, b, c$  be unit vectors such that  $a \cdot b = a \cdot c = 0$  and the angle between  $b$  and  $c$  is  $\pi/6$  then  $a =$

A.  $\pm(a \times c)$

B.  $\pm 2(a \times c)$

C.  $\pm(b \times c)$

D.  $\pm 2(b \times c)$

**Answer: D**



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39. Let  $u = i + j, v = i - j, w = i + 2j + 3k$ . If  $n$  a unit vector such that  $u \cdot n = 0$   $v \cdot n = 0$  then  $|w \cdot n| =$

A. 0

B. 1

C. 2

D. 3

**Answer: D**



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**40.** If  $u$  and  $v$  are unit vectors and  $\theta$  is the acute angle between them, then  $2u \times 3v$  is a unit vector for

- A. Exactly two values of  $\theta$
- B. More than two values of  $\theta$
- C. No value of  $\theta$
- D. Eaxctly value of  $\theta$

**Answer: D**



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41. If  $r \cdot a = r \cdot b = r \cdot c = 0$  where  $a, b, c$  are noncoplanar, then

A.  $r \perp c \times a$

B.  $r \perp a \times b$

C.  $r \perp b \times c$

D.  $r = 0$

**Answer: D**



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42. If  $a$  is any vector then  $(a \times i)^2 + (a \times j)^2 + (a \times k)^2 =$

A.  $a^2$

B.  $2a^2$

C.  $3a^2$

D.  $4a^2$



**Answer: B**



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**43.** If  $a \times I + 2a - 5j = 0$  then  $a =$

A.  $2i + k$

B.  $i + 2k$

C.  $2j + k$

D.  $j + 2k$

**Answer: C**



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**44.** If  $\vec{a}$  is a unit vector and  $\vec{a} \times \vec{i} = \vec{j}$ , then  $\vec{a} \cdot \vec{i} =$

A. 0

B. 1

C. 2

D. 3

**Answer: A**



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45. If three vectors  $a, b, c$  are such that  $a \neq 0$  and  $a \times b = 2(a \times c)$ ,  $|a| = |c| = 1$ ,  $|b| = 4$  and the angle between  $b$  and  $c$  is  $\cos^{-1}(1/4)$ , then  $b - 2c = \lambda a$  where  $\lambda =$

A. 4

B. 3

C. 2

D. 1

**Answer: A**



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46. The vector area of the parallelogram whose adjacent sides are  $i + j + k$ ,  $2i - j + 2k$  is

A.  $3(i + k)$

B.  $3(i - k)$

C.  $(2i + j - 2k)$

D.  $-2i - j - 2k$

Answer: B



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47. The area of the parallelogram whose adjacent sides are  $3i + 2j + k$  and  $3i + k$  is

A.  $\sqrt{10}$

B.  $10\sqrt{2}$

C.  $2\sqrt{10}$

D. 20

**Answer: C**



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**48.** The vector area of the parallelogram whose diagonals are  $I + j - k$ ,  $2i - j + 2k$  is

A.  $\frac{1}{2}(I + 4j + 3k)$

B.  $\frac{1}{2}(I - 4j + 3k)$

C.  $\frac{1}{2}(I + 4j + 3k)$

D.  $\frac{1}{2}(I - 4j - 3k)$

**Answer: D**



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49. The area of the parallelogram whose diagonals are  $i - 3j + 2k$ ,  $-i + 2j$  is

A.  $4\sqrt{29}$  sq. unit

B.  $\frac{1}{2}\sqrt{21}$  sq. unit

C.  $10\sqrt{3}$  sq. unit

D.  $\frac{1}{2}\sqrt{270}$  sq. unit

**Answer: B**



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50. The vector area of the rectangle whose adjacent sides are  $2i + 3j$ ,  $4k$  is

A.  $12i + 8j$

B.  $12i - 8j$

C.  $-12i - 8j$

D.  $-12i + 8j$

**Answer: B**



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**51.** The vector area of the triangle whose adjacent sides are  $i - 2j + 2k$ ,  $3i + 2j - 5k$  is

A.  $\frac{1}{2}(6i + 11j - 8k)$

B.  $\frac{1}{2}(6i - 11j + 8k)$

C.  $\frac{1}{2}(6i + 11j + 8k)$

D.  $\frac{1}{2}(6i - 11j - 8k)$

**Answer: C**



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**52.** The area of the triangle whose sides are given by  $2i - 7j + k$  and  $4j - 3k$  is

A. 17

B.  $17/2$

C.  $17/4$

D.  $\frac{1}{2}\sqrt{389}$

**Answer: D**



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**53.** The vector area of the triangle with vertices  $i + j + k$ ,  $i + j + 2k$ ,  $i + 2j + k$  is

A.  $i + j + k$

B.  $-i$

C.  $\frac{1}{2}i$

D.  $-\frac{1}{2}i$

**Answer: D**

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54. The area of the triangle formed by the points whose position vectors are  $3\mathbf{i} + \mathbf{j} + 5\mathbf{k}$ ,  $5\mathbf{i} + 2\mathbf{j} + \mathbf{k}$ ,  $\mathbf{i} - 2\mathbf{j} + 3\mathbf{k}$  is

A.  $\sqrt{23}$  sq. unit

B.  $\sqrt{21}$  sq. unit

C.  $\sqrt{29}$  sq. unit

D.  $\sqrt{33}$  unit

**Answer: C**

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55. The area of the triangle with vertices  $(1,2,3)$ ,  $(2,5,-1)$ ,  $(-1,1,2)$  is

A. 6 sq. unit

B.  $\sqrt{3/2}$  sq. unit



C.  $\sqrt{29}$  sq. unit

D.  $\frac{1}{2}\sqrt{155}$  sq. unit

**Answer: D**



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56. The vector area of the  $\Delta ABC$  whose vertices are  $a, b, c$  is

A.  $\{(a \times b) + (b \times c) + (c \times a)\}$

B.  $\frac{1}{2}\{(a \times b) + (b \times c) + (c \times a)\}$

C.  $2\{(a \times b) - (b \times c) + (c \times a)\}$

D. none of these

**Answer: B**



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57. If  $a, b, c$  are the position vectors of  $A, B, C$  of  $\Delta ABC$  then  $(a \times b) + (b \times c) + (c \times a) =$

A.  $(1/2)$  (Area  $\Delta ABC$ )

B.  $2$  (Area  $\Delta ABC$ )

C.  $3$  (Area  $\Delta ABC$ )

D. none

**Answer: B**

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58. If  $|\vec{a}| = \sqrt{3}$ ,  $|\vec{b}| = 2$ ,  $(\vec{a}, \vec{b}) = \frac{\pi}{3}$ , then the area of the triangle with adjacent sides  $\vec{a} + 2\vec{b}$  and  $2\vec{a} + \vec{b}$  (in sq.u) is

A.  $3\sqrt{3}$  sq. unit

B.  $9\sqrt{3}$  sq. unit

C.  $\frac{9\sqrt{3}}{2}$  sq. unit

D.  $\frac{9}{2}$  unit

**Answer: C**



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59. If the area of the parallelogram whose adjacent sides are  $3\vec{i} - 4\vec{j} + \lambda\vec{k}$ ,  $2\vec{j} - 4\vec{k}$  is  $\sqrt{436}$  sq. units ( $\lambda \geq 0$ ), then  $\lambda =$

A. 0

B. 4

C. 1

D. 3

**Answer: A**



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60. If  $a = 2i + 2j + k$ ,  $a \cdot b = 14$ ,  $a \times b = 3i + j - 8k$  then  $b =$

A.  $5i + j + 2k$

B.  $5i - 5j + 2k$

C.  $5i + 5j - 2k$

D.  $5i - 5j - 2k$

**Answer: A**



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61. If  $a = (1,1,1)$   $c = (0,1,-1)$  are given vectors then a vector  $b$  satisfying the equations  $a \times b = c$  and  $a \cdot b = 3$  is

A.  $5i + 2j + 2k$

B.  $\frac{5}{2}i + j + k$

C.  $\frac{5}{3}i + \frac{2}{3}j + \frac{2}{3}k$

D.  $i + \frac{2}{5}j + \frac{2}{5}k$

**Answer: C**



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**62.** If  $a = 2i + k$ ,  $b = i + j + k$ ,  $c = 4i - 3j + 7k$ . The vector  $r$  satisfying

$r \times b = c \times b$  and  $r \cdot a = 0$  is

A.  $i + 8j + 2k$

B.  $i - 8j + 2k$

C.  $-i - 8j + 2k$

D.  $i - 8j - 2k$

**Answer: C**



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**63.** The vector  $c$  is perpendicular to both  $a = (1, -2, -1)$ ,  $b = (2, 1, -1)$  and  $c$  also

satisfies  $|c \times (i - j + k)| = 2\sqrt{6}$  then  $c =$

A.  $\pm(3i - j + 5k)$

B.  $\pm(-4i + 5j + k)$

C.  $\pm(I + j + k)$

D. none

**Answer: A**

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**64.** If  $a, b$  are two unit perpendicular vectors and  $c$  is a unit vector which is inclined an angle  $\theta$  with  $a$  and  $b$ . if  $c = \alpha a + \beta b + \gamma(a \times b)$  and  $\gamma^2 =$

A.  $\cos 2\theta$

B.  $-\cos 2\theta$

C.  $\sin 2\theta$

D.  $-\sin 2\theta$

**Answer: B**

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65. If  $a = i + 2j + 3k$ ,  $b = -i + 2j + k$ ,  $c = 3i + j$  and  $d$  is normal to both  $a$  and  $b$ , then  $(c, d) =$

A.  $\cos^{-1}\left(\frac{4}{\sqrt{30}}\right)$

B.  $\sin^{-1}\left(\frac{4}{\sqrt{30}}\right)$

C.  $\cos^{-1}\left(\frac{2}{\sqrt{30}}\right)$

D.  $\sin^{-1}\left(\frac{2}{\sqrt{30}}\right)$

**Answer: A**

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66. If  $x \cdot a = 0$ ,  $x \times b = c \times b$  then  $x =$

A.  $c - \frac{c \cdot a}{b \cdot a} b$

B.  $c - \frac{c \cdot a}{c \cdot b} a$

$$C. a - \frac{c \cdot a}{c \cdot b} b$$

$$D. b - \frac{c \cdot a}{c \cdot b} b$$

**Answer: A**



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67.  $r \times a = b \times a, r \times b = a \times b, r \times b = a \times b, \neq 0, b \neq 0, a \neq \lambda b, a$

is not perpendicular to  $b \Rightarrow r =$

A.  $a - b$

B.  $a + b$

C.  $a \times b + a$

D.  $a \times b + b$

**Answer: B**



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68. Let  $a = i + j$ ,  $b = 2i - k$ . Then the point of intersection of the lines

$r \times a = b \times a$  and  $r \times b = a \times b$  is

A.  $-i + j + k$

B.  $3i - j + k$

C.  $3i + j - k$

D.  $i - j - k$

**Answer: C**



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69. The perpendicular distance from A (1, 4, -2) to the line BC, where B = (2,

1, -2) and C = (0, -5, 1) is

A.  $\frac{\sqrt{26}}{7}$

B.  $\sqrt{\frac{26}{7}}$

C.  $\frac{2\sqrt{26}}{7}$

D.  $\frac{3\sqrt{26}}{7}$

**Answer: D**



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70. The perpendicular distance from the point  $3i - 2j + k$  to the line joining the points  $i - 3j + 5k, 2i + j - 4k$  is

A. 7

B.  $\sqrt{3}$

C.  $2\sqrt{3}$

D.  $7\sqrt{3}$

**Answer: B**



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71. If A (1,2,3), B (2,3,1), C (3,1,2) then the length of the altitude through C is

A. 3

B.  $3\sqrt{3}$

C.  $3\sqrt{2}$

D.  $3/\sqrt{2}$

**Answer: D**



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72. The torque about the point  $2i + j - k$  of a force represented by  $4i + k$  acting through the point  $(i - j + 2k)$  is

A.  $2i + 13j + 8k$

B.  $2i + 13j - 8k$

C.  $2i - 13j + 8k$

D.  $-2i + 13j + 8k$

**Answer: D**



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**73.** A force  $F = 2i - \lambda j + 5k$  is applied at the point A (1,2,5). If its moment about the point (-1, -2, 3) is  $16i - 6j + 2\lambda k$ , then  $\lambda =$

A. - 2

B. - 1

C. 0

D. 2

**Answer: A**



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1.  $[i - j j - k k - i] =$

A. 0

B. 1

C.  $-1$

D. 2

**Answer: A**



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2. If  $a = i + j - k, b = i - j + k, c = i - j - k$  then  $a \times (b \times c) =$

A. 0

B. 1

C.  $-1$

D. 2

**Answer: A**



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3. The vectors  $2i - 3j + k$ ,  $I - 2j + 3k$ ,  $3i + j - 2k$

A.  $-12$

B.  $14$

C.  $10$

D.  $15$

**Answer: A**



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4.  $(a + 2b - c) \cdot (a - b) \times (a - b - c) =$

A.  $-[abc]$

B.  $2 [a b c]$

C.  $-2 [a b c]$

D. 0

**Answer: C**



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5. If  $a$  is perpendicular to  $b$  and  $c$ ,  $|a| = 2$ ,  $|b| = 3$ ,  $|c| = 4$  and the angle between  $b$  and  $c$  is  $2\pi/3$  then  $[a b c] =$

A. 24

B. 12

C.  $12\sqrt{3}$

D.  $24\sqrt{3}$

**Answer: C**



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6. If  $u, v, w$  are non-coplanar vectors and  $p, q$  are real numbers, then the equality  $[3u \ p \ v] - [p \ v \ w] - [2w \ q \ v] = 0$  holds for

- A. exactly two values of  $(p, q)$
- B. more than two but not all value of  $(p, q)$
- C. all values of  $(p, q)$
- D. exactly one value of  $(p, q)$

**Answer: D**



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7. If  $x, y, z$  are non-zero real numbers,  $a = xi + 2j$ ,  $b = yi + 3k$  and  $c = xi + yi + zk$  are such that  $a \times b = zi - 3j + k$  then  $[a \ b \ c] =$

- A. 10
- B. 9



C. 6

D. 3

**Answer: B**



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8. If  $\bar{a}$ ,  $\bar{b}$ ,  $\bar{c}$  are mutually perpendicular unit vectors, then find  $[\bar{a}\bar{b}\bar{c}]^2$ .

A. 1

B. 0

C. 2

D. 3

**Answer: A**



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9. The volume of parallelopiped with edges  $i, i + j, i + j + k$  is

A. 0

B. 1

C. 2

D. 3

**Answer: B**



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10. The volume of the parallelopiped whose coterminal edges are  $2i - 3j +$

$4k, i + 2j - 2k, 3i - j + k$  is

A. 5

B. 6

C. 7

D. 8

**Answer: C**



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11. The volume of the parallelepiped whose edges are represented by  $2i - 3j$ ,  $i + j - k$ ,  $3i - k$  is

A.  $-1$

B.  $2$

C.  $3$

D.  $4$

**Answer: D**



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12. The volume of the parallelepiped with edges  $(2, -3, 0)$ ,  $(1, 1, -1)$ ,  $(3, 0, -1)$  is

A. 1

B. 4

C. 2

D. 8

**Answer: B**



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13. If  $[a \ b \ c] = 3$ , then the volume (in cube units) of the parallelepiped with  $2a + b$ ,  $2b + c$  and  $2c + a$  as coterminous edges is

A. 15

B. 22

C. 25

D. 27

**Answer: D**

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14. The volume of the parallelopiped whose sides are  $OA = (\lambda + 1)i + \lambda(\lambda + 1)j + k$ ,  $OB = (\lambda + 2)i + (\lambda + 1)(\lambda + 2)j + k$ ,  $OC =$  is

A. 2

B.  $4\lambda$

C.  $\lambda + 3$

D. none

**Answer: A**

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15. The volume of the parallelopiped whose sides are  $OA = (\lambda + 2)i + (\lambda + 2)(\lambda + 1)j + k$ ,  $OB = (\lambda + 3)i + (\lambda + 2)(\lambda + 3)j + k$  and  $OC = (\lambda + 4)i + (\lambda + 3)(\lambda + 4)j + k$  is

A.  $2\lambda$

B.  $3\lambda$

C.  $4\lambda$

D. 2

**Answer: D**



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**16.** Let  $Oa, Ob, OC$  be the co-terminal edges of a rectangular parallelepiped of volume  $V$  and let  $P$  be the vertex opposite to  $O$ . Then  $[APBPCP] =$

A.  $2V$

B.  $12V$

C.  $3\sqrt{3}V$

D. 0

**Answer: A**

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17. The volume of the tetrahedron with vertices at  $(0,0,0)$ ,  $(1,0,0)$ ,  $(0,1,0)$ ,  $(0,0,1)$  is

A. 1

B.  $1/2$

C.  $1/3$

D.  $1/6$

**Answer: D**

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18. The volume of the tetrahedron formed by  $(1,2,3)$ ,  $(4,3,2)$ ,  $(5,2,7)$ ,  $(6,4,8)$  is

A.  $22/3$

B.  $11/3$

C.  $1/3$

D.  $16/3$

**Answer: D**



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19. The volume of the tetrahedron formed by  $4i + 5j + k$ ,  $-j + k$ ,  $3i + 9j + 4k$ ,  $4(-i + j + k)$  is

A. 7

B. 9

C. 11

D. 13

**Answer: C**



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20. The volume of (in cubic units) of the tetrahedron with edges  $l + j + k$ ,  $l - j + k$  and  $l + 2j - k$  is

A. 4

B.  $\frac{2}{3}$

C.  $\frac{1}{6}$

D.  $\frac{1}{3}$

Answer: B



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21. If  $a, b, c$  are noncoplanar vectors then  $\frac{a \cdot (b \times c)}{(c \times a) \cdot B} + \frac{b \cdot (a \times c)}{c \cdot (a \times b)} =$

A. 0

B. 1

C. 2

D. -1

**Answer: A**



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22.  $[2+6 -2+7 8-10] =$



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23. If  $(a - \lambda b) \cdot (b - 2c) \times (c + 3a) = 0$  then  $\lambda =$

A. -1

B. -3

C. 6

D.  $-1/6$

**Answer: D**



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24. If  $a \cdot i = 4$  then  $(a \cdot j) \times (2j - 3k) =$

A. 12

B. 2

C. 0

D. -12

**Answer: D**



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25.  $\{a \cdot (b \times i)\} + \{a \cdot (b \times j)\}j + \{a \cdot (b \times k)\}k =$

A.  $2(a \times b)$

B.  $3(a \times b)$

C.  $(a \times b)$

D. none

**Answer: C**



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26.  $(a + b) \times c + (b + c) \times a + (c + a) \times b =$

A. 0

B.  $-[abc]$

C.  $2[a b c]$

D.  $[a b c]$

**Answer: D**



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27.  $(a - b) \cdot (b - c) \times (c - a) =$

A.  $(b \times c)$

B.  $2a \cdot (b \times c)$

C.  $3a(b \times c)$

D. 0

**Answer: D**



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28. C.  $(b + c) \times (a + b + c) =$

A.  $c \cdot b \times a$

B. 0

C.  $c \cdot a \times b$

D.  $-ac \times b$

**Answer: A**



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29. If  $u, v, w$  are three noncoplanar vectors then  $(u + v - w) \cdot (u - v) \times (v - w) =$

A. 0

B.  $u \cdot v \times w$

C.  $u \cdot w \times v$

D.  $3u \cdot v \times w$

**Answer: D**



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30. If  $a, b, c$  are three vectors such that  $[abc]=5$ , then the value of  $[a \times b \times c \times a]$  is

A. 15

B. 20

C. 25

D. 54

**Answer: C**



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31. If  $a, b, c$  are linearly independent, then  $\frac{[2a + b, 2b + c, 2c + a]}{[abc]} =$

A. 9

B. 8

C. 7

D. none

**Answer: A**



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32. If  $a, b, c$  are linearly independent,  $\frac{(a + 2b) \cdot (2b + c) \times (5c + a)}{a \cdot (b \times c)} = k$

then  $k$  is

A. 10

B. 14

C. 18

D. 12

**Answer: D**



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33. Let  $a, b$  and  $C$  be three non - coplanar vectors and let  $p, q$  and  $r$  be the vectors defined by  $p = \frac{b \times c}{[abc]}$ ,  $Q = \frac{c \times a}{[abc]}$ ,  $R = \frac{a \times b}{[abc]}$ . Then  $(a + b) \cdot P + (b + c) \cdot q + (C + a) \cdot R =$

A. 0

B. 1



C. 2

D. 3

**Answer: D**



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**34.** If the vectors  $2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$ ,  $\mathbf{i} + 2\mathbf{j} - \mathbf{k}$  and  $x\mathbf{i} - \mathbf{j} + 2\mathbf{k}$  are coplanar then  $x =$

A.  $8/5$

B.  $5/8$

C. 0

D. 1

**Answer: A**



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35. If the vectors  $2\mathbf{i} - \mathbf{j} + \mathbf{k}$ ,  $\mathbf{i} + m\mathbf{j}$ ,  $\mathbf{i} + \mathbf{j} + \mathbf{k}$  are coplanar then the value of  $m$  is

A. 1

B.  $-1$

C.  $-2$

D. 2

**Answer: C**



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36. If the three vectors  $2\mathbf{i} - \mathbf{j} + \mathbf{k}$ ,  $\mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$  and  $3\mathbf{i} + \lambda\mathbf{j} + 5\mathbf{k}$  are coplanar then  $\lambda =$

A. 4

B.  $-4$

C. 2

D. 3

**Answer: B**



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37. If  $i - 2j, 3j + k$  and  $\lambda i + 3j$  are coplanar. Then  $\lambda =$

A.  $-1$

B.  $1/2$

C.  $-3/2$

D. 2

**Answer: C**



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38. If  $i + j + k, i - j, i + 2j + ak$  are coplanar then a is

A.  $3/2$

B. 3

C.  $-3$

D. 0

**Answer: A**

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39. If  $3i + 3j + \sqrt{3}k$ ,  $i + k$ ,  $\sqrt{3}i + \sqrt{3}\lambda k$  are coplanar, then  $\lambda =$

A. 1

B. 2

C. 3

D. 4

**Answer: A**

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40. If  $a, b, c$  are non-coplanar vectors and  $\lambda$  is a real number, then the vectors  $a + 2b + 3c$ ,  $\lambda b + 4c$  and  $(2\lambda - 1)c$  are non coplanar for

- A. all values of  $\lambda$
- B. no value of  $\lambda$
- C. except two values of  $\lambda$
- D. except one value of  $\lambda$

**Answer: C**



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41. Let  $a = i + j + k$ ,  $b = i - j + 2k$  and  $c = xi + (x - 2)j - k$ . If the vector  $c$  lies in the plane of  $a$  and  $b$ . then  $x$  equals

- A. 0
- B. 1

C.  $-4$

D.  $-2$

**Answer: D**



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**42.** Let  $a = i - 2j + 3k$ ,  $b = 2i + 3j - k$  and  $c = \lambda i + j + (2\lambda - 1)k$ . If  $c$  is parallel to the plane containing  $a, b$  then  $\lambda =$

A.  $0$

B.  $1$

C.  $-1$

D.  $2$

**Answer: A**



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43. If the vectors  $a\mathbf{i} + \mathbf{j} + \mathbf{k}$ ,  $\mathbf{l} + b\mathbf{j} + \mathbf{k}$ ,  $\mathbf{l} + \mathbf{j} + c\mathbf{k}$  ( $a \neq b, c \neq 1$ ) are coplanar, then the value of  $\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c} =$

A. 0

B. 3

C. 2

D. 1

Answer: D



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44. Let  $a, b, c$  be distinct non-negative numbers. If the vectors  $a\mathbf{i} + a\mathbf{j} + c\mathbf{k}$ ,  $\mathbf{l} + \mathbf{k}$  and  $c\mathbf{i} + c\mathbf{j} + b\mathbf{k}$  lie in a plane, then  $c$  is

A. the arithmetic mean of  $a$  and  $b$

B. the geometric mean of  $a$  and  $b$

C. the harmonic mean of  $a$  and  $b$

D. equal to zero

**Answer: B**



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45. If  $a = i + j + k$ ,  $b = 4i + 3j + 4k$ ,  $c = i + \alpha j + \beta k$  are linearly dependent and  $|c| = \sqrt{3}$  then

A.  $\alpha = 1, \beta = -1$

B.  $\alpha = 1, \beta = \pm 1$

C.  $\alpha = -1, \beta = \pm 1$

D.  $\alpha = \pm 1, \beta = 1$

**Answer: D**



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46. If the volume of the parallelepiped whose edges are represented by  $12i + \lambda k$ ,  $3j = k$ ,  $2i + j - 15k$  is 546 then  $\lambda =$

- A. 1
- B. 2
- C. 3
- D. 4

**Answer: C**



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47. If  $a = 2i + 3j$ ,  $b = i + j + k$ ,  $c = \lambda i + 4j + 2k$  are the edges of a parallelepiped of volume 2 cubic units, then a value of  $\lambda$  is

- A. 1
- B. 2
- C. 3

D. 4

**Answer: D**



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**48.** If the volume of the parallelepiped with co-terminus edges  $4i + 5j + k$ ,  $-j + k$  and  $3i + 9j + pk$  is 34 cubic units, then the negative value of  $p =$

A. 4

B.  $-13$

C. 13

D. 6

**Answer: B**



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49. The value of  $k$  for which the points  $A (1,0,3)$ ,  $B (-1,3,4)$ ,  $C (1,2,1)$  and  $D(k,2,5)$  are coplanar is

A. 1

B. 2

C. 0

D.  $-1$

**Answer: D**



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50. If the points  $3i - 2j - k$ ,  $2i + 3j - 4k$ ,  $i + j + 2k$ ,  $4i + 5j + \lambda k$  are coplanar then  $\lambda =$

A. 12

B.  $-94/7$

C.  $3/2$

D. 5

**Answer: B**



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51. If the volume of the tetrahedron with edges  $2i + j - k$ ,  $i + aj + k$  and  $i + 2j - k$  is one cubic unit then  $a =$

A. 1

B.  $-1$

C. 2

D.  $-2$

**Answer: C**



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52. The volume of the tetrahedron having the edges  $l + 2j + k$ ,  $l + j + k$ ,  $l - j + \lambda k$  as coterminous is  $\frac{2}{3}$  cubic units. Then  $\lambda =$

- A. 1
- B. 2
- C. 3
- D. 4

**Answer: A**



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53. If  $a, b, c, d$  are the position vectors of  $A, B, C, D$  respectively then the volume of the tetrahedron  $ABCD$  is

- A.  $\pm \frac{1}{6} \{ [abc] - [abd] + [acd] - [bcd] \}$
- B.  $\{ [a b c] - [a b d] + [a c d] - [b c d] \}$
- C.  $\pm \frac{1}{6} \{ [bca] - [cba] + [acd] - [bcd] \}$

$$D. \pm \frac{1}{8} \{ [bac] - [acd] + [abd] - [bcd] \}$$

**Answer: A**



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54. If  $d = x(a \times b) + y(b \times c) + z(c \times a)$  and  $[a \ b \ c] = 1/8$ , then  $x + y + z =$

A.  $8d(a + b + c)$

B.  $d(a + b + c)$

C.  $4d(a + b + c)$

D. none

**Answer: A**



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55. If  $a, b, c$  are non-coplanar vector and  $\lambda$  is a real number then

$$[\lambda(a + b)\lambda^2b\lambda c] - [ab + cb] \text{ for}$$

- A. exactly one value of  $\lambda$
- B. no value of  $\lambda$
- C. exactly three values of  $\lambda$
- D. exactly two value of  $\lambda$

**Answer: B**



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56. Let  $a = i - k, b = xi + j + (1 - x)k$  and  $c = yi + xj + (1 + x - y)k$ . Then  $[a b c]$

depends on

- A. only  $y$
- B. only  $x$
- C. both  $x$  and  $y$

D. neither x or y

**Answer: D**



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57. let a be unit vector,  $b = 2i + j - k$  and  $c = i + 3k$ . The maximum value of  $[a \ b \ c]$  is



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58. The vectors  $a + 2b + 3c$ ,  $2a + b - 2c$ ,  $3a - 7c$  are

A. coplanar

B. collinear

C. noncoplanar

D. none



**Answer: A**



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**59.** The points  $2a + 3b - c$ ,  $a - 2b + 3c$ ,  $3a + 4b - 2c$ ,  $a - 6b + 6c$  are

- A. collinear
- B. coplanar
- C. noncoplanar
- D. none

**Answer: B**



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**60.** The vectors  $5i + 6j + 7k$ ,  $7i - 8j + 9k$ ,  $3i + 20j + 5k$  are

- A. coplanar

B. collinear

C. neocoplanar

D. none

**Answer: A**



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**61.** The points  $(2,1, -1)$ ,  $(1,1,1)$ ,  $(2,2,1)$ ,  $(0,2,5)$  are

A. coplanar

B. collinear

C. noncoplanar

D. none

**Answer: A**



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62. Let  $a = 2i + j + k$ ,  $b = i + 2j - k$  and a unit vector  $c$  be coplanar. If  $c$  is perpendicular to  $a$ , then  $c =$

A.  $\frac{1}{\sqrt{2}}(-j + k)$

B.  $\frac{1}{\sqrt{3}}(-j - j - k)$

C.  $\frac{1}{\sqrt{5}}(j - 2j)$

D.  $\frac{1}{\sqrt{3}}(i - j - k)$

**Answer: A**



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63. A unit vector coplanar with  $i + j + 3k$  and  $i + 3j + k$  and perpendicular to  $i + j + k$  is

A.  $\frac{1}{\sqrt{2}}(j + k)$

B.  $\frac{1}{\sqrt{3}}(i - j + k)$

C.  $\frac{1}{\sqrt{2}}(j - k)$

D.  $\frac{1}{3}(I + j - k)$

**Answer: C**



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**64.** The shortest distance between the straight line passing through the point  $A = (6, 2, 2)$  and parallel to the vector  $(1, -2, 2)$  and the straight line passing through  $A^1 = (-4, 0, -1)$  and parallel to the vector  $(3, -2, -2)$  is

A. 9

B. 8

C. 5

D. 2

**Answer: A**



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65. The shortest distance between the line  $r = (1 + 2j + 3k) + t(1 + 3j + 2k)$  and  $r = (4i + 5j + 6k) + t(2i + 3j + k)$  is

- A. 3
- B.  $2\sqrt{3}$
- C.  $\sqrt{3}$
- D.  $\sqrt{6}$

**Answer: C**



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66. The shortest distance between the line  $r = 3i + 5j + 7k + \lambda(1 + 2j + k)$  and  $r = i - j - k + \mu(7i - 6j + k)$  is

- A.  $\frac{16}{5\sqrt{5}}$
- B.  $\frac{26}{5\sqrt{5}}$
- C.  $\frac{36}{5\sqrt{5}}$

D.  $\frac{46}{5\sqrt{5}}$

**Answer: D**



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67. If  $A = (1, -2, -1)$ ,  $B = (4, 0, -3)$ ,  $C = (1, 2, -1)$  and  $D = (2, -4, -5)$  then the distance between AB and CD is

A.  $\frac{2}{3}$

B.  $\frac{4}{2}$

C.  $\frac{3}{2}$

D.  $\frac{5}{3}$

**Answer: B**



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68.  $(I \times j) \times k + (j \times k) \times I + (k \times i) \times j =$

A.  $I + k$

B.  $i$

C.  $j$

D.  $0$

Answer: D



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69.  $(a \times b) \times c + (b \times c) \times a + (C \times a) \times b =$

A.  $0$

B.  $a$

C.  $b$

D.  $c$

**Answer: A**



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**70.**  $a \times (b \times c) =$

A.  $(a.b) c = (a.c) b$

B.  $(a.c) b - (a.b) c$

C.  $(c.a) b - (c.b) a$

D.  $(c.b)a - (c.a) t$

**Answer: B**



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**71.**  $a \times (b \times c), b \times (c \times a), c \times (a \times b)$  are

A. coplanar



B. collinear

C. non-coplanar

D. none

**Answer: A**



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72. If  $a = 2i + 3j + 5k$ ,  $b = -i + j + k$ ,  $c = 4i + 2j + 3k$  then  $(a \times b) \times c =$

A.  $8i - 19j - k$

B.  $-i - 4j + 4k$

C.  $7i + 3j - k$

D.  $-i - 5j - 5k$

**Answer: B**



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73. If  $a = i + j - k$ ,  $b = i - j + k$ ,  $c = i - j - k$  then  $a \times (b \times c) =$

A.  $i - j + k$

B.  $2i - 2j$

C.  $3i - j + k$

D.  $2i + 2j - k$

**Answer: B**



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74. If  $a = i - 2j + k$ ,  $b = 2i + j - k$ ,  $c = 4i + 4j + 3k$  then  $|(a \times b) \times c| =$

A.  $\sqrt{474}$

B.  $\sqrt{33}$

C.  $\sqrt{74}$

D.  $\sqrt{130}$

**Answer: A**



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**75.** If  $a = 2i + 3j - 4k$ ,  $b = i + j + k$  and  $c = 4i + 2j + 3k$ , then  $|a \times (b \times c)| =$

A.  $\sqrt{10}$

B. 1

C. 2

D.  $\sqrt{5}$

**Answer: D**



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**76.** If  $a = i + j + k$ ,  $b = i + j$ ,  $c = i$  and  $(a \times b) \times c = \lambda a + \mu b$ , then  $\lambda + \mu =$

A. 0

B. 1

C. 2

D. 3

**Answer: A**



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77. If  $\bar{a} = \frac{1}{\sqrt{10}}(3\bar{i} + \bar{k})$  and  $\bar{b} = \frac{1}{7}(2\bar{i} + 3\bar{j} - 6\bar{k})$ , then the value of  $(2\bar{a} - \bar{b}) \cdot [(\bar{a} \times \bar{b}) \times (\bar{a} + 2\bar{b})]$

A. 5

B. 3

C. -5

D. -3

**Answer: C**



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78.  $I \times (a \times i) + j \times (a \times j) + k \times (a \times k) =$

A.  $3a$

B.  $2a$

C.  $a$

D.  $0$

**Answer: B**



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79.  $a = I + j - 2k \Rightarrow \sum \{(a \times i) \times j\}^2$

A.  $\sqrt{6}$

B.  $6$

C.  $36$

D.  $6\sqrt{6}$

**Answer: B**



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80.  $[b \times cc \times aa \times b] =$

A.  $[a b c]$

B.  $2 [a b c]$

C.  $[abc]^2$

D. 0

**Answer: C**



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81.  $(A \times B) \cdot \{(B \times C) \times (C \times A)\} =$

A.  $(B + C) \cdot \{(C + A) \times (A + B)\}$

B.  $\{A. (B \times C)\}^2$

C.  $2A. (B \times C)$

D. none

**Answer: B**



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82. If  $[a \times bb \times cc \times a]\lambda[abc]^2$  then  $\lambda$  is equal to

A. 0

B. 1

C. 2

D. 3

**Answer: B**



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83.  $a \times [a \times (a \times b)] =$

A.  $a^2(a \times b)$

B.  $a^2(b \times a)$

C.  $-a^2(b \times a)$

D.  $a. (b \times a)$

**Answer: B**



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84.  $(b \times c) \times (c \times a) =$

A.  $[a b c] c$

B.  $[a b c] b$

C.  $[a b c] a$

D.  $a \times (b \times c)$



**Answer: A**



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85. If  $a = i + 2j - 3k$ ,  $b = 2i + j + k$ ,  $c = i + 3j - 2k$  then  $(a \times b) \times (b \times c) =$

A.  $[a \ b \ c] a$

B.  $[a \ b \ c] b$

C.  $[a \ b \ c] c$

D.  $[a \ b \ c]$

**Answer: B**



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86.  $[(a \times b) \times (a \times c)] \cdot D =$

A. (a.d)  $[a \ b \ c]$

B. (b.d) [a b c]

C. (c.d) [a b c]

D. 0

**Answer: A**



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87.  $a \times \{b \times (C \times a) + (p \times q)\} =$

A. (a.q) P - (a.p) q + (b.a)  $(a \times c) - (b \times c)$

B. (a.q) p - (a.p) q + (b.a)  $(a \times c)$

C.  $a \times (p \times q) + [abc]c$

D. none of these

**Answer: B**



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88. If  $a$  is a unit vector,  $a \times r = b$ ,  $a \cdot r = c$ ,  $a \cdot b = 0$  then  $r$  is

A.  $ca - a \times b$

B.  $b - a \times b$

C.  $ca + a \times b$

D.  $cb + a \times b$

**Answer: A**



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89.  $a, b$  are non-zero vectors,  $c$  is given non-zero scalar such that  $a$  is perpendicular to  $b$ . Then the vector  $x$  satisfying the equations  $a \cdot x = c$  and  $a \times x = b$  is

A.  $ca - (a \times b)$

B.  $ca - \frac{a \times b}{|a|^2}$

C.  $\frac{ca - (a \times b)}{|a|^2}$

$$D. \frac{ca}{|a|^2} - (a \times b)$$

**Answer: C**



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**90.** If  $a$  and  $b$  are two non-zero perpendicular vectors, then a vector  $y$  satisfying equations  $a \cdot y = c$  ( $c$  scalar) and  $a \times y = b$  is

A.  $|a|^2(ca - (a \times b))$

B.  $|a|^2(ca + (a \times b))$

C.  $\frac{1}{|a|^2}(ca - (a \times b))$

D.  $\frac{1}{|a|^2}(ca + (a \times b))$

**Answer: C**



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91. The vectors  $\vec{a}$  and  $\vec{b}$  are not perpendicular and  $\vec{c}$  and  $\vec{d}$  are two vectors satisfying  $\vec{b} \times \vec{c} = \vec{b} \times \vec{d}$  and  $\vec{a} \cdot \vec{d} = 0$ . Then the vector  $\vec{d}$  is equal to

A.  $b + \left(\frac{b \cdot c}{a \cdot b}\right)c$

B.  $c - \left(\frac{a \cdot c}{a \cdot b}\right)b$

C.  $b - \left(\frac{b \cdot c}{a \cdot b}\right)c$

D.  $c + \left(\frac{a \cdot c}{a \cdot b}\right)b$

**Answer: B**



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92. If  $a, b, c$  are nonzero vectors, then  $(a \times b) \times c = a(b \times c)$  iff  $(a \times c) \times b =$

A.  $a + b$

B.  $0$

C. a

D. b

**Answer: B**



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93. If  $a, b, c$  are three unit vectors such that  $a \times (b \times c) = \frac{1}{2}b$  then the angles between  $a, b$  and  $a, c$  are

A.  $90^\circ . 90^\circ$

B.  $90^\circ . 60^\circ$

C.  $60^\circ . 90^\circ$

D.  $60^\circ . 30^\circ$

**Answer: B**



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94. Let  $a, b$  and  $c$  be non-zero vectors such that  $(a \times b) \times c = \frac{1}{3}|b||c|a$ . If

$\theta$  is the acute angle between the vectors  $b$  and  $c$  then  $\sin \theta =$

A.  $\frac{1}{3}$

B.  $\frac{2\sqrt{2}}{3}$

C.  $\frac{2}{3}$

D.  $\frac{\sqrt{2}}{3}$

**Answer: B**



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95. If  $(a \times b) \times c = a \times (b \times c)$ . Where  $a, b$  and  $c$  are any three vectors such that  $a \cdot b \neq 0, b \cdot c \neq 0$  then  $a$  and  $c$  are

A. perpendicular

B. parallel

C. inclined at an angle of  $\pi/3$  between them

D. inclined at an angle of  $\pi/6$  between them

**Answer: B**

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96. If  $\vec{a}$  and  $\vec{b}$  are unit vectors, then the vectors  $(\vec{a} + \vec{b}) \times (\vec{a} \times \vec{b})$  is parallel to the vector.

A.  $\vec{a} \cdot \vec{b}$

B.  $\vec{a} \vec{b}$

C.  $\vec{a} - \vec{b}$

D.  $2\vec{a} + \vec{b}$

**Answer: C**

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97.  $(a \times b) \cdot (a \times c) =$

A.  $(a.c) (b.c) - (a.b) (b.c)$

B.  $(a.b) (b.c) - (a.b) (a.b)$

C.  $(a.a) (b.c) - (a.b) \cdot (a.c)$

D.  $(a.a) (b.b) - (a.b) (a.c)$

**Answer: C**



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98. If  $a \times b = c \times d$ ,  $a \times c = b \times d$  then

A. 0

B.  $|a + b + c|$

C.  $[a b c]$

D.  $(a.b) (c.d)$

**Answer: A**



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99.  $[d \ b \ c] \ a + [a \ d \ c] \ b + [a \ b \ c] \ c =$

A.  $[a \ b \ c]$

B.  $[a \ b \ c] \ d$

C.  $d$

D.  $0$

**Answer: B**



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100. If the four vectors  $a, b, c, d$  are coplanar, then  $(a \times b) \times (c \times d) =$

A.  $1$

B. a

C. b

D. 0

**Answer: D**



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**101.** If  $a = i + j + k$ ,  $b = i + j - k$ ,  $c = i - j + k$ ,  $d = i - j - k$  then  $(a \times b) \cdot (c \times d) =$

A. 0

B. 1

C. 2

D. 3

**Answer: A**



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102. If  $a = 2i + j - 3k$ ,  $b = i - 2j + k$ ,  $c = -i + j - 4k$ ,  $d = i + j + k$  then  $(a \times b) \times (c \times d) =$

A.  $5\sqrt{114}$

B.  $\sqrt{114}$

C.  $5\sqrt{134}$

D.  $\sqrt{134}$

**Answer: A**



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103. The vector equation of a straight line passing through  $\bar{a}$  and perpendicular to  $\bar{b}$  and  $\bar{c}$  is

A.  $r - a = (b \times c)$

B.  $r = a \times (b \times c)$

C.  $r - b = t(a \times c)$

$$D. r = b \times (a \times c)$$

**Answer: A**



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**104.** The perpendicular distance of the point  $c$  from the line joining  $a$  and  $b$  is

A.  $\frac{|b \times c + c \times a + a \times b|}{|b - a|}$

B.  $\frac{|b \times c - c \times a + a \times b|}{|b - a|}$

C.  $\frac{|b \times c + c \times a - a \times b|}{|b - a|}$

D.  $\frac{|b \times c - c \times a - a \times b|}{|b - a|}$

**Answer: A**



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105. If  $a, b, c, d$  are four vectors then  $(A \times b) \times (C \times d) =$

A.  $[a d c] a - [b c a] a$

B.  $[a c d] b - [b c d] a$

C.  $[a c b] c - [b c d] c$

D.  $[a c d] b - [b a d] c$

**Answer: B**



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106. If the vectors  $b, c, d$  are not coplanar, then the vector

$(a \times b) \times (c \times d) + (a \times c) \times (d \times b) + (a \times d) \times (b \times c)$  is

A.  $[b c d]a$

B.  $2 [b c d] a$

C.  $- [bcd]a$

D.  $- 2[bcd]a$

**Answer: D**



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**107.**  $a.a' + b.b' + c.c' =$

A. 0

B. 1

C. 2

D. 3

**Answer: D**



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**108.**  $a.b' + b.c' + c.a' =$

A. 0

B. 1

C. 2

D. 3

**Answer: A**



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**109.**  $[a\ b\ c] [a'\ b'\ c'] =$

A. 0

B. 1

C. 2

D. 3

**Answer: B**



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110.  $(a + b) \cdot A' + (b + c) \cdot B' + (c + a) \cdot C' =$

A. 0

B. 1

C. 2

D. 3

**Answer: D**



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111. If  $a, b, c$  are three non-coplanar vectors and if  $r$  is any vector then  $r =$

A.  $(r \cdot a') a + (r \cdot b') b + (r \cdot c') c$

B.  $(r \cdot c') a + (r \cdot b') b + (r \cdot a') c$

C.  $(r \cdot a') a - (r \cdot b') b - (r \cdot c') c$

D.  $(a \cdot a') a + (b \cdot b') b + (c \cdot c') c$

**Answer: A**



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112.  $a' \times b' + b' \times c' + c' \times a' =$

A.  $\frac{a + b + c}{[abc]}$

B.  $\frac{a - b - c}{[abc]}$

C.  $\frac{a + b + c}{[bac]}$

D.  $\frac{a + b + c}{2[abc]}$

**Answer: A**



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**Exercise 2 Special Type Questions Set A**

1. I : The vector  $6i + 2j + k$ ,  $2i - 9j + 6k$  are mutually perpendicular.

II : The vectors  $i + 2j - k$ ,  $2i + j + k$  are mutually perpendicular

A. only I is true

B. Only II is true

C. both I and II are true

D. Neither I nor II are true

**Answer: A**



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2. I : If the vectors  $a = (1, x, -2)$ ,  $b = (x, 3, -4)$  are mutually perpendicular, then

$x = 2$

II : If  $a = i + 2j + 3k$ ,  $b = -i + k$ ,  $c = 3i + j$  and  $a + b$  is perpendicular to  $c$  then

$t = 5$ .

A. only I is true

B. Only II is true

C. both I and II are true

D. Neither I nor II are true

**Answer: B**



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3. I : If  $|a + b| = |a - b|$  then  $(a,b) = \pi/2$

II : If  $a, b, a + b$  are unit vectors then  $(a,b) = 2\pi/3$

A. only I is true

B. Only II is true

C. both I and II are true

D. Neither I nor II are true

**Answer: C**



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4. If  $|a \cdot b| = |a \times b|$  then  $(a, b) = \pi/4$



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5. I : If  $|a + b| = |a - b|$  then  $|a \times b| = 0$

II :  $(a \times b)^2 + (a \cdot b)^2 = |a|^2|b|^2$

A. only I is true

B. Only II is true

C. both I and II are true

D. Neither I nor II are true

**Answer: B**



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6. I : If  $(a + b) \cdot c = (a - b) \cdot c = 0$  then  $(a \times b) \times c = 0$

II : If  $a \times (b \times c)$  is a vector perpendicular to  $a, b, c$

- A. only I is true
- B. Only II is true
- C. both I and II are true
- D. Neither I nor II are true

**Answer: A**



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7. I : For any vector  $a$ ,  $(a \times i)^2 + (a \times j)^2 + (a \times k)^2 = 2a^2$  and  $(a \cdot i)^2 + (a \cdot j)^2 + (a \cdot k)^2 = a^2$

II : If  $(2i + 4j + 2k) \times (2i - xj + 5k) = 16i - 6j + 2xk$  then  $x = 2$

- A. only I is true
- B. Only II is true

C. both I and II are true

D. Neither I nor II are true

**Answer: A**



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8. Statement I : If  $a$  and  $b$  are any two vectors, then

$$|a \times b|^2 + |a \cdot b|^2 = |a|^2 |b|^2$$

Statement II : If  $a$  and  $b$  any two vectors then  $|a \times b|^2 = \begin{matrix} a \cdot a & a \cdot b \\ b \cdot a & b \cdot b \end{matrix}$ . Then

A. Both statement are true and II is a correct explanation of I

B. Both statements are true, but II is not a correct explanation of I

C. I is true and II is false

D. I is false and II is true

**Answer: A**



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9. I : If  $a = i + j - k$ ,  $b = 2i - 3j + 2k$ ,  $c = 13i - 7j + 3k$  then  $[a \ b \ c] = 0$

II : If  $a, b, c$  are mutually perpendicular unit vector then  $[abc]^2 = 1$

- A. only I is true
- B. Only II is true
- C. both I and II are true
- D. Neither I nor II are true

**Answer: C**



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10. The volume of the parallelepiped with edges  $2i - 4j + 5k$ ,  $i - j + k$ ,  $3i - 5j + 2k$  is -8



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11. If the vectors  $2i - 3j + 4k$ ,  $i + 2j - k$ ,  $xi - j + 2k$  are coplanar then  $x = 8/5$



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12. I :  $I \times (a \times i) + j \times (a \times j) + k \times (a \times k) = 2a$

II :  $I \times [(a \times b) \times i] + j \times [(a \times b) \times j] + k \times [(a \times b) \times k] = 0$

- A. only I is true
- B. Only II is true
- C. both I and II are true
- D. Neither I nor II are true

**Answer: A**



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13. I : If  $a, b, c, d$  are four vectors then  $[b \ c \ d] a + [c \ a \ d] b + [a \ b \ c] c = [a \ b \ c] d$

II : The points with position vectors  $a, b, c, d$  are coplanar then

$$[a \ b \ d] + [b \ c \ d] + [c \ a \ d] = [a \ b \ c]$$

- A. only I is true
- B. Only II is true
- C. both I and II are true
- D. Neither I nor II are true

**Answer: C**



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## Exercise 2 Special Type Questions Set B

1. The value of  $a \cdot b$  where  $a = 2i - 3j - k$ ,  $b = 3i + 2j - 2k$



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2. Arrange the value of  $|a + b + c|$  in ascending order

(A) If  $a, b, c$  are mutually perpendicular unit vectors

(b) If  $a, b, c$  are vectors of lengths 2, 3, 4 respectively and if  $a, b, c$  are perpendicular to  $b + c, c + a, a + b$  respectively.

If  $a, b, c$  are vector of length 4, 4, 5 respectively and  $a, b, c$  are perpendicular to  $b + c, c + a, a + b$  respectively.

A. A, B, C

B. C, B, A

C. B, C, A

D. B, A, C

**Answer: A**



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3. Arrange the following angles in ascending order

(A) Angle between the vectors  $i + 3j + 4k$  and  $i - 3j + 2k$

(B) Angle between the planes  $r \cdot (2i - j + k) = 7$  and  $r \cdot (i + j + 2k) = 11$

(C) Angle between the lines  $r = x(i + 2j + 2k)$  and  $r = t(3i + 2j + 6k)$

A. A,B,C

B. C,B,A

C. B,C,A

D. B,A,C

**Answer: B**



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4. Arrange the magnitudes of following vectors in ascending order

(A)  $i \times j + j \times k + k \times i$

(B) If  $|a| = 2$ ,  $|b| = 3$ ,  $(A,b) = 45^\circ$  then  $a \times b$

(C)  $(2i - 3j + 2k) \times (3i - j + 4k)$

A. A,B,C

B. C,B,A

C. B,C,A

D. B,A,C

**Answer: A**



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5. Arrange the following in ascending order of magnitude

(A) Area of parallelogram with adjacent sides  $i + 2j + 3k, 3i + 2j + k$

(B) Area of parallelogram with diagonals  $i + 2j + 3k, 3i - 2j + k$

(C) Area of parallelogram with diagonals are  $3i + j - 2k, i - 3j + 4k$

(D) Area of parallelogram whose sides are  $3i + j - 2k, i - 3j + 4k$

A. B,A,C,D

B. D,A,C,B

C. D,C,A,B

D. B,C,A,D

**Answer: D**



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6. find Area of the triangle with sides  $3i - 7j + k$ ,  $4j - 3k$



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7. The ascending order of the following

(A) volume of the tetrahedron formed by  $4i + 5j + k$ ,  $-j + k$ ,  $3i + 9j + 4k$ ,  $-4i + 4j + 4k$

(B) Volume of the parallelepiped with edges  $2i + 3j + 4k$ ,  $i + 2j - 2k$ ,  $3i - j + k$

(C)  $|a \times (b \times c)|$  where  $a = 2i + 3j - 4k$ ,  $b = i + j + k$ ,  $c = 4i + 2j + 3k$

(D)  $|(a \times b) \times c|$  where  $a = i - 2j + k$ ,  $b = 2i + j - k$ ,  $c = 4i + 2j + 3k$

A. A,B,C,D

B. A,D,B,C

C. A,C,B,D

D. C,B,A,D

**Answer: D**



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**8.** Set the following vectors in the increasing order of their magnitudes. a)

$3i+4j$  b)  $2i+4j+6k$  c)  $2i+2j+2k$

A. b,a,c

B. c,a,b

C. a,c,b

D. a,b,c

**Answer: A**



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**9.** Arrange the following in the descending order of magnitude (A)

$[I \times jj \times kk \times i]$

(B)  $[i + jj + k k + i]$

(C)  $(I \times j)(j \times k)$

(D)  $(K \times j)(k \times j)$

A. B,A,C,D

B. B,A,D,C

C. D,C,B,A

D. B,C,A,D

**Answer: A**



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## Exercise 2 Special Type Questions Set C

1.

*I.* The angle between the vectors  $2i + j - k$  and  $4j - 2k$

*II.* The angle between the vectors  $i + 2j - k$  and  $2i + j + k$

*III.* The angle between  $a$  and  $b$  if  $a$  and  $b$  are unit vectors and  $a + b$  is a unit vector

*IV.* The angle between  $\vec{AC}$  and  $\vec{BD}$  if  $A = (1, 1, 0)$ ,  $B = (1, -1, 0)$ ,  $C = (-1, 1, 0)$ ,  $D = (1, 1, 0)$



A. a,c,c,b

B. d,c,c,b

C. c,a,b,d

D. d,c,c,a

**Answer: B**



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2. I. Projection of  $I - 2j + k$  on  $4i - 4j + 7k$       a. 9  
II. Projection of  $2i - 3j + k$  on  $4i - 4j + 7k$       b. 3  
III. projection of  $9I - 7j + k$  on x-axis      c.  $19/9$   
IV. Projection of  $2i - 3j + 6k$  on  $I + 2j + 2k$       d.  $8/3$

A. b,d,c,a

B. c,b,a,c

C. a,d,c,b

D. c,b,a,d

**Answer: D**



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sphere

$$I. r^2 - 2r(3i + 4j - 5k) + 1 = 0$$

$$3. II. (r - 3i + 2j - 5k) \cdot (r + i + j + 3k) = 0$$

$$III. i^1 + y^2 + z^2 - 6x + 2y - 4x - 1 = 0$$

$$IV. (r - 3i - 2j + 5k)^2 = 49$$

centre

$$a. i + j + k$$

$$b. 3i + 4j - 5k$$

$$c. 3i + 2j - 5k$$

$$d. 3i - j + 2k$$

A. b,a,d,c

B. d,b,c,a

C. c,a,d,b

D. a,d,b,c

Answer: A



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4.

I. Unit vector perpendicular to the plane of  $2i - 6j - 3k$ .  $4i + 3j - k$

II. Unit vector perpendicular to the plane determined by the points  $(1, -$

III. Vector perpendicular to the plane of  $i - j - k$ .  $i + j + k$

IV. Vector of length 5 and perpendicular to both  $a = 2i + j - 3k$

A. a,c,d,b

B. b,a,d,c

C. a,d,c,b

D. d,c,b,a

Answer: D



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5.

I. If  $a = 2i - 3j - k$ .  $b = i + 4j - 2k$  then  $(a + b) \times (a - b)$  a.  $42i + 1$

II. If  $a = 3i - j - 2k$ .  $b = 2i + 3j + k$  then  $(a + 2b) \times (2a - b)$  b.  $-5i +$

III. If  $a = i + 2j - 3k$ .  $b = 2i + j + k$  then  $a \times b$  c.  $-25i +$

IV. If  $a = 2i + 3j + 6k$ .  $b = 3i - 6j + 2k$  then  $a \times b$  d.  $-20i -$

A. a,c,d,b

B. b,a,d,c

C. a,d,c,b

D. d,c,b,a

**Answer: D**



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**6.**

*I.*  $|a \times b + b \times c + c \times a|$

*II.*  $|AB \times cd + BC \times AD + CA \times BD|$

*III.*  $|(a - c) \times (b - d)|$

*IV.*  $\frac{1}{2}|(a - b) \times (b - c)|$

*a.* Area of  $\Delta ABC$

*b.*  $2 \times$  Area of  $\Delta ABC$

*c.*  $4 \times$  Area of  $\Delta ABC$

*d.*  $2 \times$  Area of quadrilateral  $A$

*e.* none

A. a,c,c,b

B. b,a,c,c

C. a,d,c,b

D. b,c,c,a

**Answer: D**



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7.  $\left\{ \begin{array}{l} \text{(I. "Area of the parallelogram with diagonals" } 3i + j - 2k, i - 3j + 4k, a, \\ (\sqrt{569})/4, \text{ (II. "Area of the triangle whose adjacent sides are" } 3i + 4j \\ \text{"and" } i - 3j + 4k, b, (2)/(\sqrt{14})), \text{ (III. "Volume of parallelepiped whose} \\ \text{edges are" } 2i - 3j, i + j - k, 3i - k, c, 5\sqrt{3}), \text{ (IV. "Projection of" } 2i + 3j - 2k \text{ "in} \\ \text{the direction of" } i + 2j + 3k, d, 4), \text{ (e. } 2/3) \end{array} \right\}$

A. c,a,d,b,

B. c,a,c,b

C. a,c,d,b

D. d,a,c,b

**Answer: A**



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8.

I. The points  $i + j + k$ ,  $4i + 3j$  and  $10i + 7j - 2k$  are

a.  $a \times b = 7$

II. The vectors  $5i + 5j + 7k$ ,  $7i - 8j + k$  and  $i - 20j - 5k$  are

b. collinear

III.  $a = 2i + 3j + 6k$ ,  $b = 3i - 6j + 2k$

c. non-coplanar

IV. The Points  $2i - j + k$ ,  $i - 3j = 5k$  and  $3i - 4j - 4k$  are

d. vertices of a triangle

e. vertices of a parallelogram

A. b,c,a,e

B. a,c,d,e

C. a,c,b,e

D. e,d,c,a

Answer: A



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I.  $[a \times b, b \times c, c \times a]$  a. 5

II.  $[a + b, b + c, c + a]$  b. 1

9. III.  $[abc, a'b', c']$  c.  $[abc]^2$

IV.  $[a - b, b - c, c - a]$  d. 0

e.  $2[abc]$

A. a,c,b,d

B. c,c,d,b

C. b,c,d,a

D. b,a,c,d

**Answer: A**



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**10. Observe the following list**

List-I

A.  $\left[ \vec{a} \ \vec{b} \ \vec{c} \right]$

B.  $(\vec{c} \times \vec{a}) \times \vec{b}$

C.  $\vec{a} \times (\vec{b} \times \vec{c})$

D.  $\vec{a} \cdot \vec{b}$

List-II

1.  $|\vec{a}| |\vec{b}| \cos(\vec{a} \cdot \vec{b})$

2.  $(\vec{a} \cdot \vec{c}) \vec{b} - (\vec{a} \cdot \vec{b}) \vec{c}$

3.  $\vec{a} \cdot \vec{b} \times \vec{c}$

4.  $|\vec{a}| |\vec{b}|$

5.  $(\vec{b} - \vec{c}) \vec{a} - (\vec{a} \cdot \vec{b}) \vec{c}$

Then the correct match for List-I from list II is

A. 1,2,3,4

B. 3,5,2,1

C. 3,2,5,1

D. 2,3,4,1

**Answer: B**



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11. If  $a = l + j + k$ ,  $b = l - j + k$ ,  $c = l + j - k$ ,  $d = l - j - k$ , then observe the following list.

List-I      List-II

i.  $a \cdot b$       A.  $-1$

ii.  $b \cdot c$       B.  $4$

iii.  $[abc]$       C.  $1$

iv.  $b \times c$       D.  $2j - 2k$

E.  $2j + 2k$

The correct match of List-I to List-II:

A. C,A,B,E

B. C,A,B,E

C. A,C,B,E



D. A,C,E,D

**Answer: B**



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**12.**  $a = 2i - 3j$ ,  $b = i + j - k$ ,  $c = 3i - k$ , Match the following

List-I

*i.*  $[abc]$  equals

*ii.*  $[b + cc + aa + b]$

*iii.*  $[b \times cc \times aa \times b]$  equals

*iv.* volume of the tetrahedron for which a.b.c are coterminus edges is

List-II

*a.*  $\frac{2}{3}$

*b.* 16

*c.* 8

*d.* 4

A.  $i \rightarrow d$ ,  $ii \rightarrow c$ ,  $iii \rightarrow b$ ,  $iv \rightarrow a$

B.  $i \rightarrow b$ ,  $ii \rightarrow c$ ,  $iii \rightarrow a$ ,  $iv \rightarrow d$

C.  $i \rightarrow c$ ,  $ii \rightarrow d$ ,  $iii \rightarrow a$ ,  $iv \rightarrow b$

D.  $i \rightarrow d$ ,  $ii \rightarrow b$ ,  $iii \rightarrow c$ ,  $iv \rightarrow a$

**Answer: A**



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## Exercise 2 Special Type Questions Set D

1. A : Angle between the vectors  $i - 2j + k, 2i - j - k$  is  $\frac{\pi}{3}$ .

R : If  $\theta$  is the angle between  $a, b$  then  $\cos \theta = \frac{a \cdot b}{|a||b|}$

- A. both A and R are true and R is the correct explanation of A
- B. Both A and R are true but R is not correct explanation of A
- C. A is true but R is false
- D. A is false but R is true

**Answer: A**



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2. A : Length of projection of  $2i - 3j + k$  along  $4i - 4j + 7k$  is 3

R : Length of projection of  $b$  on  $a$  is  $\frac{a \cdot b}{|b|}$

- A. both A and R are true and R is the correct explanation of A

B. Both A and R are true but R is not correct explanation of A

C. A is true but R is false

D. A is false but R is true

**Answer: A**



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3. A : If  $|a| = 13$ ,  $|b| = 19$ ,  $|a + b| = 24$  then  $|a - b| = 20$

R: for any vectors  $a, b$ ,  $|a + b|^2 + |a - b|^2 = 2(|a|^2 + |b|^2)$

A. both A and R are true and R is the correct explanation of A

B. Both A and R are true but R is not correct explanation of A

C. A is true but R is false

D. A is false but R is true

**Answer: C**



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4. A : The vector equation of the plane which is at a distance of 5 unit from origin and perpendicular to  $2i - j + 2k$  is  $r \cdot (2i - j + 2k) = 15$

R : The vector equation of the plane which is at distance of  $p$  from origin and perpendicular to the unit vector  $n$  is  $r \cdot n = p$

A. both A and R are true and R is the correct explanation of A

B. Both A and R are true but R is not correct explanation of A

C. A is true but R is false

D. A is false but R is true

**Answer: A**



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5. A : The vector equation of the plane passing through the point  $(2, -1, -4)$  and perpendicular to the vector  $4i - 12j - 3k$  is  $[r - (2i - j - 4k)] \cdot (4i - 12j - 3k) =$

0

R : the vector equation of the plane passing through the point a and perpendicular to the vector m is  $(r - a) \cdot m = 0$

- A. both A and R are true and R is the correct explanation of A
- B. Both A and R are true but R is not correct explanation of A
- C. A is true but R is false
- D. A is false but R is true

**Answer: A**



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6. Let  $a = a_1I + a_2j + a_3k$ .

Assertion (A) : The identity  $|a \times i|^2 + |a \times j|^2 + |a \times k|^2 = 2|a|^2$  hold for a,

Reason (R) :

$$a \times I = a_3j - a_2k, a \times j = a_1k - a_3I, a \times k = a_2I - a_1j$$

Which of the following is correct?

A. both A and R are true and R is the correct explanation of A

B. Both A and R are true but R is not correct explanation of A

C. A is true but R is false

D. A is false but R is true

**Answer: A**

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7. A : A vector perpendicular to both  $i + j + k$  and  $2i + j + 3k$  is  $2i - j - k$

R : Every vector perpendicular to plane containing  $a, b$  is equal to  $a \times b$

A. both A and R are true and R is the correct explanation of A

B. Both A and R are true but R is not correct explanation of A

C. A is true but R is false

D. A is false but R is true

**Answer: C**

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8. A : Area of the parallelogram whose adjacent sides are  $3i + 2j + k$ ,  $3i + k$  is  $\sqrt{10}$

R : Area of quadrilateral ABCD is  $\frac{1}{2}|AC \times BD|$

- A. both A and R are true and R is the correct explanation of A
- B. Both A and R are true but R is not correct explanation of A
- C. A is true but R is false
- D. A is false but R is true

**Answer: D**

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9. A : The perpendicular distance from  $(1, 4, -2)$  to the line joining  $(2, 1, -2)$   $(0, -5, 1)$  is  $3\sqrt{26}/7$

R : The perpendicular distance from a point P to the line joining the point

$$A, B \text{ is } \frac{|\vec{AP} \times \vec{AB}|}{|\vec{AB}|}$$

- A. both A and R are true and R is the correct explanation of A
- B. Both A and R are true but R is not correct explanation of A
- C. A is true but R is false
- D. A is false but R is true

**Answer: A**



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10. A : If  $a, b, c$  are vectors such that  $[a \ b \ c] = 4$  then  $[a \times bb \times cc \times a] = 64$

R :  $[a \times bb \times cc \times a] = [abc]^2$

- A. A, R are true, R is correct explanation of A
- B. A, R are true, R is not correct explanation of A



C. A is correct R is false

D. A is false R is true

**Answer: D**

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11. A: If  $a = i - j + k$ ,  $b = i - 2j - k$  and  $c = 2i + pj + 5k$  are coplanar then  $p = -1/2$

R: vectors  $a, b, c$  are coplanar if  $[a \ b \ c] = 0$

A. A, R are true, R is correct explanation of A

B. A, R are true, R is not correct explanation of A

C. A is correct R is false

D. A is false R is true

**Answer: A**

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12. A : The vector equation of the plane passing through  $i + j + k$  and parallel to the vectors  $2i + 3j - k, i + 2j + 3k$  is  $[r - (i + j + k) \cdot (2i + 3j - k) \cdot (i + 2j + 3k)] = 0$

R : The vector equation of the plane passing through the point  $a$  and parallel to the vectors  $b, c$  is  $[r - a \cdot b \cdot c] = 0$

- A. A, R are true, R is correct explanation of A
- B. A, R are true, R is not correct explanation of A
- C. A is correct R is false
- D. A is false R is true

**Answer: A**



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13. A : The vector equation of the plane passing through the point  $(1, -2, 5), (0, -5, -1), (-1, 5, 0)$  is  $[r - (i - 2j + 5k) \cdot (-i - 3j - 6k) \cdot (-i + 7j - 6k)] = 0$

R : The vector equation of the plane passing through the points a,b,c is [r

$$- ab - a c - a] = 0$$

- A. A,R are true, R is correct explanation of A
- B. A, R are true, R is not correct explanation of A
- C. A is correct R is false
- D. A is false R is true

**Answer: A**



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14. A : If A = (1, -2, -1) B = (4, 0, -3), C = (1,2 - 1), d = (2, -4,-5) then the distance between AB and CD is 4/3

R : The shortest distance between the skew lines  $r = a + sb$ ,  $r = c + td$  is

$$\frac{[a - cbd]}{|b \times d|}$$

- A. A,R are true, R is correct explanation of A
- B. A, R are true, R is not correct explanation of A

C. A is correct R is false

D. A is false R is true

**Answer: A**



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