Assignment

Modulus and Direction cosines of Vector

Basic Level

1. The perimeter of a triangle with sides $3\mathbf{i}+4\mathbf{j}+5\mathbf{k}$, $4\mathbf{i}-3\mathbf{j}-5\mathbf{k}$ and $7\mathbf{i}+\mathbf{j}$ is **[MP PET 1991]**

(a) $\sqrt{450}$ (b) $\sqrt{150}$ (c) $\sqrt{50}$ (d) $\sqrt{200}$

2. The magnitudes of mutually perpendicular forces **a, b** and **c** are 2, 10 and 11 respectively. Then the magnitude of its resultant is **[IIT 1984]**

(a) 12 (b) 15 (c) 9 (d) None of these

3. If $\mathbf{a}=2\mathbf{i}+\mathbf{j}-8\mathbf{k}$ and $\mathbf{b}=\mathbf{i}+3\mathbf{j}-4\mathbf{k}$, then the magnitude of $\mathbf{a}+\mathbf{b}=$ **[MP PET 1996]**

(a) 13 (b) $\frac{13}{3}$ (c) $\frac{3}{13}$ (d) $\frac{4}{13}$

4. The position vectors of A and B are $2\mathbf{i}-9\mathbf{j}-4\mathbf{k}$, and $6\mathbf{i}-3\mathbf{j}+8\mathbf{k}$ respectively, then the magnitude of $\overrightarrow{AB}$ is **[MP PET 20**

(a) 11 (b) 12 (c) 13 (d) 14

5. If the position vectors of P and Q are $(\mathbf{i}+3\mathbf{j}-7\mathbf{k})$ and $(5\mathbf{i}-2\mathbf{j}+4\mathbf{k})$, then $|\overrightarrow{PQ}|$ is **[MP PET 2001]**

(a) $\sqrt{158}$ (b) $\sqrt{160}$ (c) $\sqrt{161}$ (d) $\sqrt{162}$

6. If **a, b, c** are mutually perpendicular unit vectors, then $|\mathbf{a}+\mathbf{b}+\mathbf{c}|=$ **[Karnataka CET 2002]**

(a) $\sqrt{3}$ (b) 3 (c) 1 (d) 0

7. Let $\mathbf{a}=\mathbf{i}+\mathbf{j}+p\mathbf{k}$ and $\mathbf{b}=\mathbf{i}+\mathbf{j}+\mathbf{k}$, then $|\mathbf{a}+\mathbf{b}|=|\mathbf{a}|+|\mathbf{b}|$, holds for

(a) All real p (b) No real p (c) $p=-1$ (d) $p=1$

8. For any two vectors **a** and **b**, which of the following is true

(a) $|\mathbf{a}+\mathbf{b}|\geq|\mathbf{a}|+|\mathbf{b}|$ (b) $|\mathbf{a}+\mathbf{b}|=|\mathbf{a}|+|\mathbf{b}|$ (c) $|\mathbf{a}+\mathbf{b}|<|\mathbf{a}|+|\mathbf{b}|$ (d) $|\mathbf{a}+\mathbf{b}|\leq|\mathbf{a}|+|\mathbf{b}|$

9. If **a** and **b** are the adjacent sides of a parallelogram, then $|\mathbf{a}+\mathbf{b}|=|\mathbf{a}-\mathbf{b}|$ is a necessary and sufficient condition for the parallelogram to be a

(a) Rhombus (b) Square (c) Rectangle (d) Trapezium

10. The direction cosines of vector $\mathbf{a}=3\mathbf{i}+4\mathbf{j}+5\mathbf{k}$ in the direction of positive axis of x, is **[MP PET 1991]**

(a) $\pm\frac{3}{\sqrt{50}}$ (b) $\frac{4}{\sqrt{50}}$ (c) $\frac{3}{\sqrt{50}}$ (d) $-\frac{4}{\sqrt{50}}$

11. A force is a

(a) Unit vector (b) Localised vector (c) Zero vector (d) Free vector

12. A zero vector has

(a) Any direction (b) No direction (c) Many directions (d) None of these

Advance Level

13. The perimeter of the triangle whose vertices have the position vectors $(\mathbf{i}+\mathbf{j}+\mathbf{k})$, $(5\mathbf{i}+3\mathbf{j}-3\mathbf{k})$ and $(2\mathbf{i}+5\mathbf{j}+9\mathbf{k})$ is given by

[MP PET 1993]

(a) $15+\sqrt{157}$ (b) $15-\sqrt{157}$ (c) $\sqrt{15}-\sqrt{157}$ (d) $\sqrt{15}+\sqrt{157}$

14. If the vectors $6\mathbf{i}-2\mathbf{j}+3\mathbf{k}$, $2\mathbf{i}+3\mathbf{j}-6\mathbf{k}$ and $3\mathbf{i}+6\mathbf{j}-2\mathbf{k}$ form a triangle, then it is **[Karnataka CET 1999]**

(a) Right angled (b) Obtuse angled (c) Equilateral (d) Isosceles

15. The vectors $\overrightarrow{AB}=3\mathbf{i}+4\mathbf{k}$ and $\overrightarrow{AC}=5\mathbf{i}-2\mathbf{j}+4\mathbf{k}$ are the sides of a triangle *ABC*. The length of the median through *A* is

[AIEEE 2003]

(a) $\sqrt{18}$ (b) $\sqrt{72}$ (c) $\sqrt{33}$ (d) $\sqrt{288}$

16. If **a** and **b** are two unit vectors inclined at an angle 2θ to each other, then $|\mathbf{a}+\mathbf{b}|<1$, if

(a) $\frac{\pi}{3}<\theta<\frac{2\pi}{3}$ (b) $\theta<\frac{\pi}{3}$ (c) $\theta>\frac{2\pi}{3}$ (d) $\theta=\frac{\pi}{2}$

17. If the position vectors of *A* and *B* are $\mathbf{i}+3\mathbf{j}-7\mathbf{k}$ and $5\mathbf{i}-2\mathbf{j}+4\mathbf{k}$, then the direction cosine of $\overrightarrow{AB}$ along *y*- axis is **[MNR 1**

(a) $\frac{4}{\sqrt{162}}$ (b) $-\frac{5}{\sqrt{162}}$ (c) –5 (d) 11

18. The position vectors of four points *A, B, C, D* lying in plane are **a, b, c, d** respectively. They satisfy the relation $|\mathbf{a}-\mathbf{d}|=|\mathbf{b}-\mathbf{d}|=|\mathbf{c}-\mathbf{d}|$, then the point *D* is

(a) Centroid of ΔABC (b) Circumcentre of ΔABC (c) Orthocentre of ΔABC (d) Incentre of ΔABC

19. In a parallelopiped the ratio of the sum of the squares on the four diagonals to the sum of the squares on the three coterminous edges is

(a) 2 (b) 3 (c) 4 (d) 1

Addition of Vectors

Basic Level

20. *P* is the point of intersection of the diagonals of the parallelogram *ABCD*. If *O* is any point, then $\overrightarrow{OA}+\overrightarrow{OB}+\overrightarrow{OC}+\overrightarrow{OD}=$

[Rajasthan PET 1989]

(a) $\overrightarrow{OP}$ (b) $2\overrightarrow{OP}$ (c) $3\overrightarrow{OP}$ (d) $4\overrightarrow{OP}$

21. If $\mathbf{p}=7\mathbf{i}-2\mathbf{j}+3\mathbf{k}$ and $\mathbf{q}=3\mathbf{i}+\mathbf{j}+5\mathbf{k}$, then the magnitude of **p** – 2**q** is **[MP PET 1987]**

(a) $\sqrt{29}$ (b) 4 (c) $\sqrt{62}-2\sqrt{35}$ (d) $\sqrt{66}$

22. If *C* is the middle point of *AB* and *P* is any point outside *AB,* then **[MNR 1991, UPSEAT 2000]**

(a) $\overrightarrow{PA}+\overrightarrow{PB}=\overrightarrow{PC}$ (b) $\overrightarrow{PA}+\overrightarrow{PB}=2\overrightarrow{PC}$ (c) $\overrightarrow{PA}+\overrightarrow{PB}+\overrightarrow{PC}=0$ (d) $\overrightarrow{PA}+\overrightarrow{PB}+2\overrightarrow{PC}=0$

23. If $\mathbf{a}=2\mathbf{i}+5\mathbf{j}$ and $\mathbf{b}=2\mathbf{i}-\mathbf{j}$, then the unit vector along **a** + **b** will be **[Rajasthan PET 1985, 1995]**

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

24. What should be added in vector $\mathbf{a}=3\mathbf{i}+4\mathbf{j}-2\mathbf{k}$ to get its resultant a unit vector **i** **[Roorkee 1977]**

(a) $-2\mathbf{i}-4\mathbf{j}+2\mathbf{k}$ (b) $-2\mathbf{i}+4\mathbf{j}-2\mathbf{k}$ (c) $2\mathbf{i}+4\mathbf{j}-2\mathbf{k}$ (d) None of these

25. If $\mathbf{a}=\mathbf{i}+2\mathbf{j}+3\mathbf{k}$, $\mathbf{b}=-\mathbf{i}+2\mathbf{j}+\mathbf{k}$ and $\mathbf{c}=3\mathbf{i}+\mathbf{j}$, then the unit vector along its resultant is **[Roorkee 1980]**

(a) $3\mathbf{i}+5\mathbf{j}+4\mathbf{k}$ (b) $\frac{3\mathbf{i}+5\mathbf{j}+4\mathbf{k}}{50}$ **(c)** $\frac{3\mathbf{i}+5\mathbf{j}+4\mathbf{k}}{5\sqrt{2}}$ (d) None of these

26. In the triangle *ABC*, $\overrightarrow{AB}=\mathbf{a}$, $\overrightarrow{AC}=\mathbf{c}$, $\overrightarrow{BC}=\mathbf{b}$, then **[Rajasthan PET 1984]**

(a) $\mathbf{a}+\mathbf{b}+\mathbf{c}=0$ (b) $\mathbf{a}+\mathbf{b}-\mathbf{c}=0$ (c) $\mathbf{a}-\mathbf{b}+\mathbf{c}=0$ (d) $-\mathbf{a}+\mathbf{b}+\mathbf{c}=0$

27. If **a** has magnitude 5 and points north-east and vector **b** has magnitude 5 and points north-west, then $|\mathbf{a}-\mathbf{b}|=$ **[MNR 1**

(a) 25 (b) 5 (c) $7\sqrt{3}$ (d) $5\sqrt{2}$

28. If $|\mathbf{a}|=3$, $|\mathbf{b}|=4$ and $|\mathbf{a}+\mathbf{b}|=5$, then $|\mathbf{a}-\mathbf{b}|=$ **[EAMCET 1994]**

(a) 6 (b) 5 (c) 4 (d) 3

29. If the sum of two unit vectors is a unit vector, then the angle between them is equal to **[MP PET 1999; UPSEAT 2000; Rajasthan PET 2002; Roorkee 1998]**

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) $\frac{\pi}{2}$ (d) $\frac{2\pi}{3}$

30. *A, B, C, D, E* are five coplanar points, then $\overrightarrow{DA}+\overrightarrow{DB}+\overrightarrow{DC}+\overrightarrow{AE}+\overrightarrow{BE}+\overrightarrow{CE}$ is equal to **[Rajasthan PET 1999]**

(a) $\overrightarrow{DE}$ (b) $3\overrightarrow{DE}$ (c) $2\overrightarrow{DE}$ (d) $4\overrightarrow{ED}$

31. If $\mathbf{a}\neq 0, \mathbf{b}\neq 0$ and $|\mathbf{a}+\mathbf{b}|=|\mathbf{a}-\mathbf{b}|$, then the vectors **a** and **b** are

[MNR 1988; IIT Screening 1989; MP PET 1990, 97; Rajasthan PET 1984, 90, 96, 99; Karnataka CET 1999; Roorkee 1986]

(a) Parallel to each other (b) Perpendicular to each other

(c) Inclined at an angle of 60° (d) Neither perpendicular nor parallel

32. If *ABCDEF* is a regular hexagon and $\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}+\overrightarrow{AE}+\overrightarrow{AF}=\lambda\overrightarrow{AD}$, then $\lambda=$ **[Rajasthan PET 1985]**

(a) 2 (b) 3 (c) 4 (d) 6

33. If *O* be the circumcentre and *O'* be the orthocentre of a triangle *ABC*, then $\overrightarrow{OA}+\overrightarrow{OB}+\overrightarrow{OC}=$ **[MNR 1987, EAMCET 1994]**

(a) $2\overrightarrow{OO'}$ (b) $2\overrightarrow{O'O}$ (c) $\overrightarrow{OO'}$ (d) $\overrightarrow{O'O}$

34. Let $\mathbf{a}=\mathbf{i}$ be a vector which makes an angle of 120° with a unit vector **b**. Then the unit vector (**a** + **b**) is **[MP PET 1991]**

(a) $-\frac{1}{2}\mathbf{i}+\frac{\sqrt{3}}{2}\mathbf{j}$ (b) $-\frac{\sqrt{3}}{2}\mathbf{i}+\frac{1}{2}\mathbf{j}$ (c) $\frac{1}{2}\mathbf{i}+\frac{\sqrt{3}}{2}\mathbf{j}$ (d) $\frac{\sqrt{3}}{2}\mathbf{i}-\frac{1}{2}\mathbf{j}$

35. If θ be the angle between the unit vectors **a** and **b**, then $\cos\frac{\theta}{2}=$ **[MP PET 1998]**

(a) $\frac{1}{2}|\mathbf{a}-\mathbf{b}|$ (b) $\frac{1}{2}|\mathbf{a}+\mathbf{b}|$ (c) $\frac{|\mathbf{a}-\mathbf{b}|}{|\mathbf{a}+\mathbf{b}|}$ (d) $\frac{|\mathbf{a}+\mathbf{b}|}{|\mathbf{a}-\mathbf{b}|}$

36. If $|\mathbf{a}|=3$, $|\mathbf{b}|=4$, $|\mathbf{c}|=5$ and $\mathbf{a}+\mathbf{b}+\mathbf{c}=0$, then the angle between **a** and **b** is **[MP PET 1989; Bihar CEE 1994]**

(a) 0 (b) $\frac{\pi}{6}$ (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

37. If *ABCD* is a parallelogram, $\overrightarrow{AB}=2\mathbf{i}+4\mathbf{j}-5\mathbf{k}$ and $\overrightarrow{AD}=\mathbf{i}+2\mathbf{j}+3\mathbf{k}$, then the unit vector in the direction of *BD* is **[Roorkee**

(a) $\frac{1}{\sqrt{69}}(\mathbf{i}+2\mathbf{j}-8\mathbf{k})$ (b) $\frac{1}{69}(\mathbf{i}+2\mathbf{j}-8\mathbf{k})$ (c) $\frac{1}{\sqrt{69}}(-\mathbf{i}-2\mathbf{j}+8\mathbf{k})$ (d) $\frac{1}{69}(-\mathbf{i}-2\mathbf{j}+8\mathbf{k})$

38. If **a** and **b** are unit vectors making an angle θ with each other then $|\mathbf{a}-\mathbf{b}|$ is **[BIT Ranchi 1991; Karnataka CET 2000, 01]**

(a) 1 (b) 0 (c) $\cos\frac{\theta}{2}$ (d) $2\sin\frac{\theta}{2}$

39. If the moduli of the vectors **a, b, c** are 3, 4, 5 respectively and **a** and **b** + **c**, **b** and **c** + **a**, **c** and **a** + **b** are mutually perpendicular, then the modulus of **a** + **b** + **c** is **[IIT 1981]**

(a) $\sqrt{12}$ (b) 12 (c) $5\sqrt{2}$ (d) 50

40. If **a** and **b** are unit vectors and **a** – **b** is also a unit vector, then the angle between **a** and **b** is **[Rajasthan PET 1991; MP PE**

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

41. If in a triangle $\overrightarrow{AB}=\mathbf{a}$, $\overrightarrow{AC}=\mathbf{b}$ and *D, E* are the mid-points of *AB* and *AC* respectively, then $\overrightarrow{DE}$ is equal to **[Rajasthan P**

(a) $\frac{\mathbf{a}}{4}-\frac{\mathbf{b}}{4}$ (b) $\frac{\mathbf{a}}{2}-\frac{\mathbf{b}}{2}$ (c) $\frac{\mathbf{b}}{4}-\frac{\mathbf{a}}{4}$ (d) $\frac{\mathbf{b}}{2}-\frac{\mathbf{a}}{2}$

42. *ABCDE* is a pentagon. Forces $\overrightarrow{AB}, \overrightarrow{AE}, \overrightarrow{DC}, \overrightarrow{ED}$ act at a point. Which force should be added to this system to make the resultant $2\overrightarrow{AC}$ **[MNR 1984]**

(a) $\overrightarrow{AC}$ (b) $\overrightarrow{AD}$ (c) $\overrightarrow{BC}$ (d) $\overrightarrow{BD}$

43. In a regular hexagon *ABCDEF*, $\overrightarrow{AE} =$ **[MNR 1984]**

(a) $\overrightarrow{AC}+\overrightarrow{AF}+\overrightarrow{AB}$ (b) $\overrightarrow{AC}+\overrightarrow{AF}-\overrightarrow{AB}$ (c) $\overrightarrow{AC}+\overrightarrow{AB}-\overrightarrow{AF}$ (d) None of these

44. $3\overrightarrow{OD}+\overrightarrow{DA}+\overrightarrow{DB}+\overrightarrow{DC}=$ **[IIT 1988]**

(a) $\overrightarrow{OA}+\overrightarrow{OB}-\overrightarrow{OC}$ (b) $\overrightarrow{OA}+\overrightarrow{OB}-\overrightarrow{BD}$ (c) $\overrightarrow{OA}+\overrightarrow{OB}+\overrightarrow{OC}$ (d) None of these

45. In a triangle *ABC*, if $2\overrightarrow{AC}=3\overrightarrow{CB}$, then $2\overrightarrow{OA}+3\overrightarrow{OB}$ equals **[IIT 1988]**

(a) $5\overrightarrow{OC}$ (b) $-\overrightarrow{OC}$ (c) $\overrightarrow{OC}$ (d) None of these

46. If $|\overrightarrow{AO}+\overrightarrow{OB}|=|\overrightarrow{BO}+\overrightarrow{OC}|$, then *A, B, C* form **[IIT 1983]**

(a) Equilateral triangle (b) Right angled triangle (c) Isosceles triangle (d) Line

47. Three forces of magnitudes 1, 2, 3 dynes meet in a point and act along diagonals of three adjacent faces of a cube. The resultant force is **[MNR 1987]**

(a) 114 dynes (b) 6 dynes (c) 5 dynes (d) None of these

48. If $\mathbf{p}+\mathbf{q}+\mathbf{r}=0, |\mathbf{p}|=3, |\mathbf{q}|=5, |\mathbf{r}|=7$. Then angle between **p** and **q** is

[UPSEAT 2001; Kurukshetra CEE 1998; AIEEE 2002, MP PET 2002]

(a) $\frac{\pi}{16}$ (b) $\frac{2\pi}{3}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{3}$

49. If *A, B, C* are the vertices of a triangle whose position vectors are **a, b, c** and **G** is the centroid of the ΔABC, then $\overrightarrow{GA}+\overrightarrow{GB}+\overrightarrow{GC}$ is

[Karnataka CET 2000; MP PET 1997]

(a) 0 (b) $\vec{A}+\vec{B}+\vec{C}$ (c) $\frac{\mathbf{a}+\mathbf{b}+\mathbf{c}}{3}$ (d) $\frac{\mathbf{a}-\mathbf{b}-\mathbf{c}}{3}$

50. If $\mathbf{a}=3\mathbf{i}-2\mathbf{j}+\mathbf{k}$, $\mathbf{b}=2\mathbf{i}-4\mathbf{j}-3\mathbf{k}$ and $\mathbf{c}=-\mathbf{i}+2\mathbf{j}+2\mathbf{k}$, then $\mathbf{a}+\mathbf{b}+\mathbf{c}$ is **[MP PET 2001]**

(a) $3\mathbf{i}-4\mathbf{j}$ (b) $3\mathbf{i}+4\mathbf{j}$ (c) $4\mathbf{i}-4\mathbf{j}$ (d) $4\mathbf{i}+4\mathbf{j}$

51. If **x** and **y** are two unit vectors and π is the angle between them, then $\frac{1}{2}|\mathbf{x}-\mathbf{y}|$ is equal to **[UPSEAT 2001]**

(a) 0 (b) $\pi/2$ (c) 1 (d) $\pi/4$

52. If *D, E, F* are respectively the mid points of *AB, AC* and *BC* in ΔABC, then $\overrightarrow{BE}+\overrightarrow{AF}=$ **[EAMCET 2003]**

(a) $\overrightarrow{DC}$ (b) $\frac{1}{2}\overrightarrow{BF}$ (c) $2\overrightarrow{BF}$ (d) $\frac{3}{2}\overrightarrow{BF}$

53. If *ABCD* is a rhombus whose diagonals cut at the origin *O*, then $\overrightarrow{OA}+\overrightarrow{OB}+\overrightarrow{OC}+\overrightarrow{OD}$ equals

(a) $\overrightarrow{AB}+\overrightarrow{AC}$ (b) $\vec{O}$ (c) $2(\overrightarrow{AB}+\overrightarrow{BC})$ (d) $\overrightarrow{AC}+\overrightarrow{BD}$

54. *ABCD* is a parallelogram with *AC* and *BD* as diagonals. Then $\overrightarrow{AC}-\overrightarrow{BD}=$ **[EAMCET 2001]**

(a) $4\overrightarrow{AB}$ (b) $3\overrightarrow{AB}$ (c) $2\overrightarrow{AB}$ (d) $\overrightarrow{AB}$

55. The vectors **b** and **c** are in the direction of north-east and north-west respectively and $|\mathbf{b}|=|\mathbf{c}|=4$. The magnitude and direction of the vector $\mathbf{d}=\mathbf{c}-\mathbf{b}$, are **[Roorkee 2000]**

(a) $4\sqrt{2}$, towards north (b) $4\sqrt{2}$, towards west (c) 4, towards east (d) 4, towards south

56. Let **a** and **b** be two unit vectors inclined at an angle θ, then $\sin(\theta/2)$ is equal to **[UPSEAT 2002]**

(a) $\frac{1}{2}|\mathbf{a}-\mathbf{b}|$ (b) $\frac{1}{2}|\mathbf{a}+\mathbf{b}|$ (c) $|\mathbf{a}-\mathbf{b}|$ (d) $|\mathbf{a}+\mathbf{b}|$

57. If **a, b, c** are three vectors such that $\mathbf{a}=\mathbf{b}+\mathbf{c}$ and the angle between **b** and **c** is $\pi/2$, then **[EAMCET 2003; Bihar CEE 198**

(a) $a^2=b^2+c^2$ (b) $b^2=c^2+a^2$ (c) $c^2=a^2+b^2$ (d) $2a^2-b^2=c^2$

(**Note :** Here $a=|\mathbf{a}|,\ b=|\mathbf{b}|,\ c=|\mathbf{c}|$)

Advance Level

58. If $\mathbf{a},\mathbf{b},\mathbf{c}$ are three vectors of equal magnitude and the angle between each pair of vectors is $\frac{\pi}{3}$ such that $|\mathbf{a}+\mathbf{b}+\mathbf{c}|=\sqrt{6}$ then $|\mathbf{a}|$ is equal to

(a) 2 (b) –1 (c) 1 (d) $\frac{1}{3}\sqrt{6}$

59. Let $\mathbf{a},\mathbf{b},\mathbf{c}$ be three unit vectors such that $|\mathbf{a}+\mathbf{b}+\mathbf{c}|=1$ and $\mathbf{a}\perp\mathbf{b}$. If **c** makes angles α,β with **a, b** respectively then $\cos\alpha+\cos\beta$ is equal to

(a) $\frac{3}{2}$ (b) 1 (c) –1 (d) None of these

60. A vector of magnitude 2 along a bisector of the angle between the two vectors $2\mathbf{i}-2\mathbf{j}+\mathbf{k}$ and $\mathbf{i}+2\mathbf{j}-2\mathbf{k}$ is

(a) $\frac{2}{\sqrt{10}}(3\mathbf{i}-\mathbf{k})$ (b) $\frac{1}{\sqrt{26}}(\mathbf{i}-4\mathbf{j}+3\mathbf{k})$ (c) $\frac{2}{\sqrt{26}}(\mathbf{i}-4\mathbf{j}+3\mathbf{k})$ (d) None of these

61. The vector $\mathbf{i}+x\mathbf{j}+3\mathbf{k}$ is rotated through an angle θ and doubled in magnitude, then it becomes $4\mathbf{i}+(4x-2)\mathbf{j}+2\mathbf{k}$. The value of x is

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

62. If I is the centre of a circle inscribed in a triangle ABC, then $|\vec{BC}|\vec{IA}+|\vec{CA}|\vec{IB}+|\vec{AB}|\vec{IC}$ is

(a) 0 (b) $\vec{IA}+\vec{IB}+\vec{IC}$ (c) $\frac{\vec{IA}+\vec{IB}+\vec{IC}}{3}$ (d) None of these

63. If the vector $-\mathbf{i}+\mathbf{j}-\mathbf{k}$ bisects the angle between the vector **e** and the vector $3\mathbf{i}+4\mathbf{j}$, then the unit vector in the direction of **e** is

(a) $\frac{1}{15}(11\mathbf{i}+10\mathbf{j}+2\mathbf{k})$ (b) $-\frac{1}{15}(11\mathbf{i}-10\mathbf{j}+2\mathbf{k})$ (c) $-\frac{1}{15}(11\mathbf{i}+10\mathbf{j}-2\mathbf{k})$ (d) $-\frac{1}{15}(11\mathbf{i}+10\mathbf{j}+2\mathbf{k})$

64. The sides of a parallelogram are $2\mathbf{i}+4\mathbf{j}-5\mathbf{k}$, $\mathbf{i}+2\mathbf{j}+3\mathbf{k}$, then the unit vector parallel to one of the diagonals

(a) $\frac{1}{7}(3\mathbf{i}+6\mathbf{j}-2\mathbf{k})$ (b) $\frac{1}{7}(3\mathbf{i}-6\mathbf{j}-2\mathbf{k})$ (c) $\frac{1}{7}(-3\mathbf{i}+6\mathbf{j}-2\mathbf{k})$ (d) $\frac{1}{7}(3\mathbf{i}+6\mathbf{j}+2\mathbf{k})$

65. A point O is the centre of a cricle circumscribed about a triangle ABC. Then $\vec{OA}\sin 2A+\vec{OB}\sin 2B+\vec{OC}\sin 2C$ is equal to

(a) $(\vec{OA}+\vec{OB}+\vec{OC})\sin 2A$ (b) $3.\vec{OG}$, where G is the centroid of triangle ABC

(c) $\vec{O}$ (d) None of these

66. If $\mathbf{a}+\mathbf{b}+\mathbf{c}=\alpha\mathbf{d}$, $\mathbf{b}+\mathbf{c}+\mathbf{d}=\beta\mathbf{a}$ and **a, b, c** are non-coplanar, then the sum of $\mathbf{a}+\mathbf{b}+\mathbf{c}+\mathbf{d}=$ **[DCE 1997]**

(a) 0 (b) $(\beta-1)\mathbf{d}+(\alpha-1)\mathbf{a}$ (c) $(\alpha-1)\mathbf{d}-(\beta-1)\mathbf{a}$ (d) $(\alpha-1)\mathbf{d}+(\beta-1)\mathbf{a}$

67. Let **a** and **b** be two non-parallel unit vectors in a plane. If the vectors $(\alpha\mathbf{a}+\mathbf{b})$ bisects the internal angle between **a** and **b**, then α is

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

68. The horizontal force and the force inclined at an angle 60° with the vertical, whose resultant is in vertical direction of *P kg*, are

[IIT 1983]

(a) $P, 2P$ (b) $P, P\sqrt{3}$ (c) $2P, P\sqrt{3}$ (d) None of these

69. If the resultant of two forces is of magnitude *P* and equal to one of them and perpendicular to it, then the other force is **[MNR 1986]**

(a) $P\sqrt{2}$ (b) P (c) $P\sqrt{3}$ (d) None of these

70. *ABC* is an isosceles triangle right angled at *A*. Forces of magnitude $2\sqrt{2}, 5$ and 6 act along $\overrightarrow{BC}, \overrightarrow{CA}$ and $\overrightarrow{AB}$ respectively. The magnitude of their resultant force is **[Roorkee 1999]**

(a) 4 (b) 5 (c) $11+2\sqrt{2}$ (d) 30

71. If the resultant of two forces of magnitudes *P* and *Q* acting at a point at an angle of 60° is $\sqrt{7}Q$, then P/Q is **[Roorkee 1999]**

(a) 1 (b) 3/2 (c) 2 (d) 4

72. Five points given by *A, B, C, D, E* are in a plane. Three forces $\overrightarrow{AC}, \overrightarrow{AD}$ and $\overrightarrow{AE}$ act at *A* and three forces $\overrightarrow{CB}, \overrightarrow{DB}, \overrightarrow{EB}$ act at *B*. Then their resultant is **[AMU 2001]**

(a) $2\overrightarrow{AC}$ (b) $3\overrightarrow{AB}$ (c) $3\overrightarrow{DB}$ (d) $2\overrightarrow{BC}$

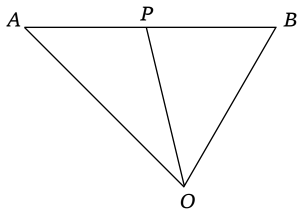
Position Vectors

Basic Level

73. If **a, b, c** are the position vectors of the vertices *A, B, C* of the triangle *ABC*, then the centroid of ΔABC is **[MP PET 1987**

(a) $\frac{\mathbf{a}+\mathbf{b}+\mathbf{c}}{3}$ (b) $\frac{1}{2}\left(\mathbf{a}+\frac{\mathbf{b}+\mathbf{c}}{2}\right)$ (c) $\mathbf{a}+\frac{\mathbf{b}+\mathbf{c}}{2}$ (d) $\frac{\mathbf{a}+\mathbf{b}+\mathbf{c}}{2}$

74. If in the given figure $\overrightarrow{OA}=\mathbf{a}$, $\overrightarrow{OB}=\mathbf{b}$ and $AP:PB=m:n$, then $\overrightarrow{OP}=$ **[Rajasthan PET 1981; MP PET 1988]**



(a) $\frac{m\mathbf{a}+n\mathbf{b}}{m+n}$ (b) $\frac{n\mathbf{a}+m\mathbf{b}}{m+n}$ (c) $m\mathbf{a}-n\mathbf{b}$ (d) $\frac{m\mathbf{a}-n\mathbf{b}}{m-n}$

75. The position vectors of *A* and *B* are $\mathbf{i}-\mathbf{j}+2\mathbf{k}$ and $3\mathbf{i}-\mathbf{j}+3\mathbf{k}$. The position vector of the middle point of the line *AB* is

[MP PET 1988]

(a) $\frac{1}{2}\mathbf{i}-\frac{1}{2}\mathbf{j}+\mathbf{k}$ (b) $2\mathbf{i}-\mathbf{j}+\frac{5}{2}\mathbf{k}$ (c) $\frac{3}{2}\mathbf{i}-\frac{1}{2}\mathbf{j}+\frac{3}{2}\mathbf{k}$ (d) None of these

76. If the position vectors of the points *A* and *B* are $\mathbf{i}+3\mathbf{j}-\mathbf{k}$ and $3\mathbf{i}-\mathbf{j}-3\mathbf{k}$, then what will be the position vector of the mid point of *AB* **[MP PET 1992]**

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

77. The position vectors of two points A and B are $\mathbf{i}+\mathbf{j}-\mathbf{k}$ and $2\mathbf{i}-\mathbf{j}+\mathbf{k}$ respectively. Then $|\overrightarrow{AB}|=$ **[Ranchi BIT 1992]**

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

78. The position vector of the points which divides internally in the ratio 2 : 3 the join of the points $2\mathbf{a}-3\mathbf{b}$ and $3\mathbf{a}-2\mathbf{b}$, is

[AI CBSE 1985]

(a) $\frac{12}{5}\mathbf{a}+\frac{13}{5}\mathbf{b}$ (b) $\frac{12}{5}\mathbf{a}-\frac{13}{5}\mathbf{b}$ (c) $\frac{3}{5}\mathbf{a}-\frac{2}{5}\mathbf{b}$ (d) None of these

79. If **a** and **b** are P.V. of two points A, B, and C divides AB in ratio 2 : 1, then P.V. of C is **[Rajasthan PET 1996]**

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

80. If three points A, B, C whose position vector are respectively $\mathbf{i}-2\mathbf{j}-8\mathbf{k}$, $5\mathbf{i}-2\mathbf{k}$ and $11\mathbf{i}+3\mathbf{j}+7\mathbf{k}$ are collinear, then the ratio in which B divides AC is **[Rajasthan PET 1999]**

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

81. If O is the origin and C is the mid point of A (2, –1) and B (–4, 3). Then value of $\overrightarrow{OC}$ is **[Rajasthan PET 2001]**

(a) $\mathbf{i}+\mathbf{j}$ (b) $\mathbf{i}-\mathbf{j}$ (c) $-\mathbf{i}+\mathbf{j}$ (d) $-\mathbf{i}-\mathbf{j}$

82. If the position vectors of P and Q are $\mathbf{i}+3\mathbf{j}-7\mathbf{k}$ and $5\mathbf{i}-2\mathbf{j}+4\mathbf{k}$ respectively, then $\overrightarrow{PQ}$ is equal to **[MP PET 2003]**

(a) $-4\mathbf{i}+5\mathbf{j}-11\mathbf{k}$ (b) $4\mathbf{i}-5\mathbf{j}+11\mathbf{k}$ (c) $\mathbf{i}+\mathbf{j}+\mathbf{k}$ (d) None of these

83. The position vectors of two vertices and the centroid of a triangle are $\mathbf{i}+\mathbf{j}$, $2\mathbf{i}-\mathbf{j}+\mathbf{k}$ and **k** respectively. The position vector of the third vertex of the triangle is

(a) $-3\mathbf{i}+2\mathbf{k}$ (b) $3\mathbf{i}-2\mathbf{k}$ (c) $\mathbf{i}+\frac{2}{3}\mathbf{k}$ (d) None of these

84. The position vector of three consecutive vertices of a parallelogram are $\mathbf{i}+\mathbf{j}+\mathbf{k}$, $\mathbf{i}+3\mathbf{j}+5\mathbf{k}$ and $7\mathbf{i}+9\mathbf{j}+11\mathbf{k}$ respectively. The position vector of the fourth vertex is

(a) $7(\mathbf{i}+\mathbf{j}+\mathbf{k})$ (b) $5(\mathbf{i}+\mathbf{j}+\mathbf{k})$ (c) $6\mathbf{i}+8\mathbf{j}+10\mathbf{k}$ (d) None of these

Advance Level

85. If **a** and **b** are the position vectors of A and B respectively, then the position vector of a point C on AB produced such that $\overrightarrow{AC}=3\overrightarrow{AB}$ is **[MNR 1980; MP PET 1995, 1999]**

(a) 3**a** – **b** (b) 3**b** – **a** (c) 3**a** – 2**b** (d) 3**b** – 2**a**

86. If the position vectors of the points A, B, C, D be $2\mathbf{i}+3\mathbf{j}+5\mathbf{k}$, $\mathbf{i}+2\mathbf{j}+3\mathbf{k}$, $-5\mathbf{i}+4\mathbf{j}-2\mathbf{k}$ and $\mathbf{i}+10\mathbf{j}+10\mathbf{k}$ respectively, then

[MNR 1982]

(a) $\overrightarrow{AB}=\overrightarrow{CD}$ (b) $\overrightarrow{AB}\parallel\overrightarrow{CD}$ (c) $\overrightarrow{AB}\perp\overrightarrow{CD}$ (d) None of these

87. The position vector of a point C with respect to B is $\mathbf{i}+\mathbf{j}$ and that of B with respect to A is $\mathbf{i}-\mathbf{j}$. The position vector of C with respect to A is **[MP PET 1989]**

(a) 2**i** (b) 2**j** (c) –2**j** (d) –2**i**

88. A and B are two points. The position vector of A is 6**b** – 2**a**. A point P divides the line AB in the ratio 1 : 2. If **a** – **b** is the position vector of P, then the position vector of B is given by **[MP PET 1993]**

(a) $7\mathbf{a}-15\mathbf{b}$ (b) $7\mathbf{a}+15\mathbf{b}$ (c) $15\mathbf{a}-7\mathbf{b}$ (d) $15\mathbf{a}+7\mathbf{b}$

89. The points D, E, F divide BC, CA and AB of the triangle ABC in the ratio 1 : 4, 3 : 2 and 3 : 7 respectively and the point K divides AB in the ratio 1 : 3, then $(\overrightarrow{AD}+\overrightarrow{BE}+\overrightarrow{CF}):\overrightarrow{CK}$ is equal to **[MNR 1987]**

(a) 1 : 1 (b) 2 : 5 (c) 5 : 2 (d) None of these

90. The point B divides the arc AC of a quadrant of a circle in the ratio 1 : 2. If O is the centre and $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$, then the vector $\overrightarrow{OC}$ is **[MNR 1988]**

(a) **b** – 2**a** (b) 2**a** – **b** (c) 3**b** – 2**a** (d) None of these

91. The point having position vectors $2\mathbf{i}+3\mathbf{j}+4\mathbf{k},\ 3\mathbf{i}+4\mathbf{j}+2\mathbf{k},\ 4\mathbf{i}+2\mathbf{j}+3\mathbf{k}$ are the vectices of **[EAMCET 1988]**

(a) Right angled triangle (b) Isosceles triangle (c) Equilateral triangle (d) Collinear

92. Let p and q be the position vectors of P and Q respectively with respect to O and $|\mathbf{p}| = p$, $|\mathbf{q}| = q$. The points R and S divide PQ internally and externally in the ratio 2 : 3 respectively. If $\overrightarrow{OR}$ and $\overrightarrow{OS}$ are perpendicular,then **[IIT Scr**

(a) $9p^2 = 4q^2$ (b) $4p^2 = 9q^2$ (c) $9p = 4q$ (d) $4p = 9q$

93. The position vectors of the points A, B, C are $(2\mathbf{i}+\mathbf{j}-\mathbf{k})$, $(3\mathbf{i}-2\mathbf{j}+\mathbf{k})$ and $(\mathbf{i}+4\mathbf{j}-3\mathbf{k})$ respectively. These points **[Haryana CET 2002]**

(a) Form an isosceles triangle (b) Form a right-angled triangle (c) Are collinear (d) Form a scalene triangle

94. $ABCDEF$ is a regular hexagon where centre O is the origin. If the position vectors of A and B are $\mathbf{i}-\mathbf{j}+2\mathbf{k}$ and $2\mathbf{i}+\mathbf{j}-\mathbf{k}$ respectively, then $\overrightarrow{BC}$ is equal to

(a) $\mathbf{i}-\mathbf{j}+2\mathbf{k}$ (b) $-\mathbf{i}+\mathbf{j}-2\mathbf{k}$ (c) $3\mathbf{i}+3\mathbf{j}-4\mathbf{k}$ (d) None of these

95. Let $\overrightarrow{AB} = 3\mathbf{i}+\mathbf{j}-\mathbf{k}$ and $\overrightarrow{AC} = \mathbf{i}-\mathbf{j}+3\mathbf{k}$. If the point P on the line segment BC is equidistant from AB and AC, then $\overrightarrow{AP}$ is

(a) $2\mathbf{i}-\mathbf{k}$ (b) $\mathbf{i}-2\mathbf{k}$ (c) $2\mathbf{i}+\mathbf{k}$ (d) None of these

96. If $4\mathbf{i}+7\mathbf{j}+8\mathbf{k},\ 2\mathbf{i}+3\mathbf{j}+4\mathbf{k}$, and $2\mathbf{i}+5\mathbf{j}+7\mathbf{k}$ are the position vectors of the vertices A, B and C respectively of triangle ABC. The position vector of the point where the bisector of angle A meets BC, is

(a) $\frac{2}{3}(-6\mathbf{i}-8\mathbf{j}-6\mathbf{k})$ (b) $\frac{2}{3}(6\mathbf{i}+8\mathbf{j}+6\mathbf{k})$ (c) $\frac{1}{3}(6\mathbf{i}+13\mathbf{j}+18\mathbf{k})$ (d) $\frac{1}{3}(5\mathbf{j}+12\mathbf{k})$

Collinear and Parallel Vectors

Basic Level

97. If $\mathbf{a} = \mathbf{i}-2\mathbf{j}$ and $\mathbf{b} = 2\mathbf{i}+\lambda\mathbf{j}$ are parallel, then λ is **[Rajasthan PET 1996]**

(a) 4 (b) 2 (c) –2 (d) – 4

98. The vectors $3\mathbf{i}+\mathbf{j}-5\mathbf{k}$ and $a\mathbf{i}+b\mathbf{j}-15\mathbf{k}$ are collinear, if **[Rajasthan PET 1986; MP PET 1988]**

(a) $a=3,\ b=1$ (b) $a=9,\ b=1$ (c) $a=3,\ b=3$ (d) $a=9,\ b=3$

99. If **a** = (1, –1) and **b** = (–2, m) are two collinear vectors, then m = **[MP PET 1998]**

(a) 4 (b) 3 (c) 2 (d) 0

100. If **a**, **b**, **c** are the position vectors of three collinear points, then the existence of x, y, z is such that

(a) $x\mathbf{a}+y\mathbf{b}+z\mathbf{c}=0,\ x+y+z\neq 0$ (b) $x\mathbf{a}+y\mathbf{b}+z\mathbf{c}\neq 0,\ x+y+z=0$

(c) $x\mathbf{a}+y\mathbf{b}+z\mathbf{c}\neq 0,\ x+y+z\neq 0$ (d) $x\mathbf{a}+y\mathbf{b}+z\mathbf{c}=0,\ x+y+z=0$

101. If **a** and **b** are two non-collinear vectors, then $x\mathbf{a}+y\mathbf{b}$ = 0 **[Rajasthan PET 2001]**

(a) x = 0, but y is not necessarily zero (b) y = 0, but x is not necessarily zero

(c) x = 0, y = 0 (d) None of these

102. If **a** and **b** are two non-collinear vectors, then $x\mathbf{a}+y\mathbf{b}$ (where x and y are scalars) represents a vector which is **[MP PET**

(a) Parallel to **b** (b) Parallel to **a** (c) Coplanar with **a** and **b** (d) None of these

103. If **a, b, c** are non-collinear vectors such that for some scalars x, y, z, $x\mathbf{a}+y\mathbf{b}+z\mathbf{c}=0$, then **[Rajasthan PET 2002]**

(a) $x = 0, y = 0, z = 0$ (b) $x \neq 0, y \neq 0, z = 0$ (c) $x = 0, y \neq 0, z \neq 0$ (d) $x \neq 0, y \neq 0, z \neq 0$

104. If the position vectors of the points *A, B, C* be **a**, **b**, 3**a** – 2**b** respectively, then the points *A, B, C* are **[MP PET 1989]**

(a) Collinear (b) Non-collinear

(c) Form a right angled triangle (d) None of these

105. If two vertices of a triangle are $\mathbf{i} - \mathbf{j}$ and $\mathbf{j} + \mathbf{k}$, then the third vertex can be **[Roorkee 1995]**

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

106. If the vectors $3\mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and $6\mathbf{i} - 4x\mathbf{j} + y\mathbf{k}$ are parallel, then the value of *x* and *y* will be **[Rajasthan PET 1985, 1986]**

(a) –1, –2 (b) 1, –2 (c) –1, 2 (d) 1, 2

107. The position vectors of four points *P, Q, R, S* are $2\mathbf{a} + 4\mathbf{c}$, $5\mathbf{a} + 3\sqrt{3}\mathbf{b} + 4\mathbf{c}$, $-2\sqrt{3}\mathbf{b} + \mathbf{c}$ and $2\mathbf{a} + c$ respectively, then **[MP PET 1997]**

(a) $\overrightarrow{PQ}$ is parallel to $\overrightarrow{RS}$ (b) $\overrightarrow{PQ}$ is not parallel to $\overrightarrow{RS}$

(c) $\overrightarrow{PQ}$ is equal to $\overrightarrow{RS}$ (d) $\overrightarrow{PQ}$ is parallel and equal to $\overrightarrow{RS}$

108. The vectors $2\mathbf{i} + 3\mathbf{j}$, $5\mathbf{i} + 6\mathbf{j}$ and $8\mathbf{i} + \lambda\mathbf{j}$ have their initial points at (1, 1). The value of λ so that the vectors terminate on one straight line, is

(a) 0 (b) 3 (c) 6 (d) 9

109. The points with position vectors $20\mathbf{i} + p\mathbf{j}$, $5\mathbf{i} - \mathbf{j}$ and $10\mathbf{i} - 13\mathbf{j}$ are collinear. The value of *p* is **[Pb. CET 1999]**

(a) 7 (b) – 37 (c) – 7 (d) 37

Advance Level

110. Three points whose position vectors are $\mathbf{a} + \mathbf{b}$, $\mathbf{a} - \mathbf{b}$ and $\mathbf{a} + k\mathbf{b}$ will be collinear, if the value of *k* is **[IIT 1984]**

(a) Zero (b) Only negative real number (c) Only positive real number (d) Every real number

111. The points with position vectors $10\mathbf{i} + 3\mathbf{j}$, $12\mathbf{i} - 5\mathbf{j}$ and $a\mathbf{i} + 11\mathbf{j}$ are collinear, If *a* = **[MNR 1992; Kurukshetra CEE 2002]**

(a) – 8 (b) 4 (c) 8 (d) 12

112. Let the value of $\mathbf{p} = (x + 4y)\mathbf{a} + (2x + y + 1)\mathbf{b}$ and $\mathbf{q} = (y - 2x + 2)\mathbf{a} + (2x - 3y - 1)\mathbf{b}$, where **a** and **b** are non-collinear vectors. If $3\mathbf{p} = 2\mathbf{q}$, then the value of *x* and *y* will be **[Rajasthan PET 1984; MNR 1984]**

(a) – 1, 2 (b) 2, –1 (c) 1, 2 (d) 2, 1

113. If $(x, y, z) \neq (0, 0, 0)$ and $(\mathbf{i} + \mathbf{j} + 3\mathbf{k})x + (3\mathbf{i} - 3\mathbf{j} + \mathbf{k})y + (-4\mathbf{i} + 5\mathbf{j})z = \lambda(x\mathbf{i} + y\mathbf{j} + z\mathbf{k})$, then the value of λ will be **[IIT 1982; Rajasthan PET 1984]**

(a) – 2, 0 (b) 0, – 2 (c) – 1, 0 (d) 0, – 1

114. The vectors $\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$, $\lambda\mathbf{i} + 4\mathbf{j} + 7\mathbf{k}$, $-3\mathbf{i} - 2\mathbf{j} - 5\mathbf{k}$ are collinear, if λ equals **[Kurukshetra CEE 1996]**

(a) 3 (b) 4 (c) 5 (d) 6

115. If three points *A, B* and *C* have position vectors (1, *x*, 3), (3, 4, 7) and (*y*, – 2, – 5) respectively and if they are collinear, then (*x*, *y*) = **[EAMCET 2002]**

(a) (2, – 3) (b) (– 2, 3) (c) (2, 3) (d) (– 2, – 3)

116. The position vectors of three points are $2\mathbf{a} - \mathbf{b} + 3\mathbf{c}$, $\mathbf{a} - 2\mathbf{b} + \lambda\mathbf{c}$ and $\mu\mathbf{a} - 5\mathbf{b}$ where **a**, **b**, **c** are non-coplanar vectors. The points are collinear when

(a) $\lambda = -2, \ \mu = \frac{9}{4}$ (b) $\lambda = -\frac{9}{4}, \ \mu = 2$ (c) $\lambda = \frac{9}{4}, \ \mu = -2$ (d) None of these

117. Three points whose position vectors are **a, b, c** will be collinear if

(a) $\lambda \mathbf{a} + \mu \mathbf{b} = (\lambda + \mu)\mathbf{c}$ (b) $\mathbf{a} \times \mathbf{b} + \mathbf{b} \times \mathbf{c} + \mathbf{c} \times \mathbf{a} = 0$ (c) $[\mathbf{a}\ \ \mathbf{b}\ \ \mathbf{c}] = 0$ (d) None of these

118. If $\mathbf{p} = \mathbf{i} - 2\mathbf{j} + 3\mathbf{k}$ and $\mathbf{q} = 3\mathbf{i} + \mathbf{j} + 2\mathbf{k}$, then a vector along **r** which is linear combination of **p** and **q** and also perpendicular to **q** is **[MNR 1986]**

(a) $\mathbf{i} + 5\mathbf{j} - 4\mathbf{k}$ (b) $\mathbf{i} - 5\mathbf{j} + 4\mathbf{k}$ (c) $-\frac{1}{2}(\mathbf{i} + 5\mathbf{j} - 4\mathbf{k})$ (d) None of these

119. If **a** and **b** are two non zero and non-collinear vectors, then **a** + **b** and **a** – **b** are **[MP PET 1997]**

(a) Linearly dependent vectors (b) Linearly independent vectors

(c) Linearly dependent and independent vectors (d) None of these

120. If **p, q** are two non-collinear and non-zero vectors such that $(\mathbf{b} - \mathbf{c})\mathbf{p} \times \mathbf{q} + (\mathbf{c} - \mathbf{a})\mathbf{p} + (\mathbf{a} - \mathbf{b})\mathbf{q} = 0$, where **a, b, c** are the lengths of the sides of a triangle, then the triangle is

(a) Right angled (b) Obtuse angled (c) Equilateral (d) Isosceles

121. If $\mathbf{r} = 3\mathbf{i} + 2\mathbf{j} - 5\mathbf{k}$, $\mathbf{a} = 2\mathbf{i} - \mathbf{j} + \mathbf{k}$, $\mathbf{b} = \mathbf{i} + 3\mathbf{j} - 2\mathbf{k}$ and $\mathbf{c} = -2\mathbf{i} + \mathbf{j} - 3\mathbf{k}$ such that $r = \lambda\,\mathbf{a} + \mu\,\mathbf{b} + \nu\,\mathbf{c}$ then

(a) $\mu, \frac{\lambda}{2}, \nu$ are in A.P. (b) λ, μ, ν are in A.P. (c) λ, μ, ν are in H.P. (d) μ, λ, ν are in G.P.

122. Let **a, b, c** are three non-coplanar vectors such that $\mathbf{r}_1 = \mathbf{a} - \mathbf{b} + \mathbf{c}$, $\mathbf{r}_2 = \mathbf{b} + \mathbf{c} - \mathbf{a}$, $\mathbf{r}_3 = \mathbf{c} + \mathbf{a} + \mathbf{b}$, $\mathbf{r} = 2\mathbf{a} - 3\mathbf{b} + 4\mathbf{c}$. If $\mathbf{r} = \lambda_1\mathbf{r}_1 + \lambda_2\mathbf{r}_2 + \lambda_3\mathbf{r}_3$, then

(a) $\lambda_1 = 7$ (b) $\lambda_1 + \lambda_3 = 3$ (c) $\lambda_1 + \lambda_2 + \lambda_3 = 4$ (d) $\lambda_3 + \lambda_2 = 2$

123. If $\mathbf{c} = 2\mathbf{a} - 3\mathbf{b}$ and $2\mathbf{c} = 3\mathbf{a} + 4\mathbf{b}$ then **c** and **a** are

(a) Like parallel vectors (b) Unlike parallel vectors (c) Are at right angles (d) None of these

124. The sides of a triangle are in A.P., then the line joining the centroid to the incentre is parallel to

(a) The largest side (b) The smaller side (c) The middle side (d) None of the sides

125. In a trapezoid the vector $\overrightarrow{BC} = \lambda\overrightarrow{AD}$. We will then find that $\mathbf{p} = \overrightarrow{AC} + \overrightarrow{BD}$ is collinear with *AD*. If $\mathbf{p} = \mu\overrightarrow{AD}$, then

(a) $\mu = \lambda + 1$ (b) $\lambda = \mu + 1$ (c) $\lambda + \mu = 1$ (d) $\mu = 2 + \lambda$

Scalar or Dot Product of Two Vectors

Basic Level

126. The angle between the vectors $2\mathbf{i} + 3\mathbf{j} + \mathbf{k}$ and $2\mathbf{i} - \mathbf{j} - \mathbf{k}$ is **[MNR 1990]**

(a) 0 (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{2}$

127. If $\mathbf{a} = 2\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$, $\mathbf{b} = -\mathbf{i} + 2\mathbf{j} + \mathbf{k}$ and $\mathbf{c} = 3\mathbf{i} + \mathbf{j}$, then $\mathbf{a} + t\mathbf{b}$ is perpendicular to **c** if $t =$ **[MNR 1979; MP PET 2002]**

(a) 2 (b) 4 (c) 6 (d) 8

128. The angle between the vectors $3\mathbf{i} + \mathbf{j} + 2\mathbf{k}$ and $2\mathbf{i} - 2\mathbf{j} + 4\mathbf{k}$ is **[MP PET 1990]**

(a) $\cos^{-1}\frac{2}{\sqrt{7}}$ (b) $\sin^{-1}\frac{2}{\sqrt{7}}$ (c) $\cos^{-1}\frac{2}{\sqrt{5}}$ (d) $\sin^{-1}\frac{2}{\sqrt{5}}$

129. If **a, b, c** are non zero-vectors such that **a . b = a . c,** then which statement is true **[Rajasthan PET 2001]**

(a) $\mathbf{b} = \mathbf{c}$ (b) $\mathbf{a} \perp (\mathbf{b} - \mathbf{c})$ (c) $\mathbf{b} = \mathbf{c}$ or $\mathbf{a} \perp (\mathbf{b} - \mathbf{c})$ (d) None of these

130. The vector $2\mathbf{i} + a\mathbf{j} + \mathbf{k}$ is perpendicular to the vector $2\mathbf{i} - \mathbf{j} - \mathbf{k}$, if $a =$ **[MP PET 1987]**

(a) 5 (b) – 5 (c) – 3 (d) 3

131. The vector $2\mathbf{i}+\mathbf{j}-\mathbf{k}$ is perpendicular to the vector $\mathbf{i}-4\mathbf{j}+\lambda\mathbf{k}$, if $\lambda =$ **[MNR 1983; MP PET 1988]**

(a) 0 (b) – 1 (c) – 2 (d) – 3

132. If the vectors $a\mathbf{i}-2\mathbf{j}+3\mathbf{k}$ and $3\mathbf{i}+6\mathbf{j}-5\mathbf{k}$ are perpendicular to each other, then *a* is given by **[MP PET 1993]**

(a) 9 (b) 16 (c) 25 (d) 36

133. The value of λ for which the vectors $2\lambda\mathbf{i}+\mathbf{j}-\mathbf{k}$ and $2\mathbf{j}+\mathbf{k}$ are perpendicular, is **[MP PET 1992]**

(a) None (b) – 1 (c) 1 (d) Any

134. The angle between the vectors $\mathbf{i}-\mathbf{j}+\mathbf{k}$ and $\mathbf{i}+2\mathbf{j}+\mathbf{k}$ is **[Ranchi BIT 1991]**

(a) $\cos^{-1}\left(\frac{1}{\sqrt{15}}\right)$ (b) $\cos^{-1}\left(\frac{4}{\sqrt{15}}\right)$ (c) $\cos^{-1}\left(\frac{4}{15}\right)$ (d) $\frac{\pi}{2}$

135. If λ is a unit vector perpendicular to plane of vector **a** and **b** and angle between them is θ, then **a . b** will be **[Rajastha**

(a) $|\mathbf{a}|\,|\mathbf{b}|\sin\theta\vec{\lambda}$ (b) $|\mathbf{a}|\,|\mathbf{b}|\cos\theta\vec{\lambda}$ (c) $|\mathbf{a}|\,|\mathbf{b}|\cos\theta$ (d) $|\mathbf{a}|\,|\mathbf{b}|\sin\theta$

136. If the vectors $a\mathbf{i}+b\mathbf{j}+c\mathbf{k}$ and $p\mathbf{i}+q\mathbf{j}+r\mathbf{k}$ are perpendicular, then **[Rajasthan PET 1989]**

(a) $(a+b+c)(p+q+r)=0$ (b) $(a+b+c)(p+q+r)=1$ (c) $ap+bq+cr=0$ (d) $ap+bq+cr=1$

137. If θ be the angle between two vectors **a** and **b**, then $\mathbf{a}\,.\,\mathbf{b}\ge 0$ if **[MP PET 1995]**

(a) $0\le\theta\le\pi$ (b) $\frac{\pi}{2}\le\theta\le\pi$ (c) $0\le\theta\le\frac{\pi}{2}$ (d) None of these

138. If $\mathbf{a}=2\mathbf{i}+4\mathbf{j}+2\mathbf{k}$ and $\mathbf{b}=8\mathbf{i}-3\mathbf{j}+\lambda\mathbf{k}$ and $\mathbf{a}\perp\mathbf{b}$, then value of λ will be **[Rajasthan PET 1995]**

(a) 2 (b) – 1 (c) – 2 (d) 1

139. If **a** and **b** are mutually perpendicular vectors, then $(\mathbf{a}+\mathbf{b})^2 =$ **[MP PET 1994]**

(a) $\mathbf{a}+\mathbf{b}$ (b) $\mathbf{a}-\mathbf{b}$ (c) $\mathbf{a}^2-\mathbf{b}^2$ (d) $(\mathbf{a}-\mathbf{b})^2$

140. If $\mathbf{a}=\mathbf{i}+2\mathbf{j}-3\mathbf{k}$ and $\mathbf{b}=3\mathbf{i}-\mathbf{j}+2\mathbf{k}$, then the angle between the vectors $\mathbf{a}+\mathbf{b}$ and $\mathbf{a}-\mathbf{b}$ is **[Karnataka CET 1994]**

(a) 30° (b) 60° (c) 90° (d) 0°

141. $\mathbf{a}\,.\,\mathbf{b}=0$, then **[Rajasthan PET 1995]**

(a) $\mathbf{a}\perp\mathbf{b}$ (b) $\mathbf{a}\parallel\mathbf{b}$

(c) Angle between **a** and **b** is 60° (d) None of these

142. The angle between the vectors $(2\mathbf{i}+6\mathbf{j}+3\mathbf{k})$ and $(12\mathbf{i}-4\mathbf{j}+3\mathbf{k})$ is **[MP PET 1996]**

(a) $\cos^{-1}\left(\frac{1}{10}\right)$ (b) $\cos^{-1}\left(\frac{9}{11}\right)$ (c) $\cos^{-1}\left(\frac{9}{91}\right)$ (d) $\cos^{-1}\left(\frac{1}{9}\right)$

143. If the vectors $a\mathbf{i}+2\mathbf{j}+3\mathbf{k}$ and $-\mathbf{i}+5\mathbf{j}+a\mathbf{k}$ are perpendicular to each other, then *a* = **[MP PET 1996]**

(a) 6 (b) – 6 (c) 5 (d) – 5

144. If the angle between two vectors $\mathbf{i}+\mathbf{k}$ and $\mathbf{i}-\mathbf{j}+a\mathbf{k}$ is $\pi/3$, then the value of *a* = **[MP PET 1997]**

(a) 2 (b) 4 (c) -2 (d) 0

145. (**a . b**) **c** and (**a . c**) **b** are **[Rajasthan PET 2000]**

(a) Two like vectors (b) Two equal vectors

(c) Two vectors in direction of **a** (d) None of these

146. The angle between the vector $2\mathbf{i}+3\mathbf{j}+\mathbf{k}$ and $2\mathbf{i}-\mathbf{j}-\mathbf{k}$ is **[UPSEAT 2000]**

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{3}$ (d) 0

147. If **a** = (1, –1, 2), **b** = (– 2, 3, 5), **c** = (2, – 2, 4) and **i** is the unit vector in the *x*-direction, then $(\mathbf{a}-2\mathbf{b}+3\mathbf{c}).\mathbf{i} =$

[Karnataka CET 2001]

(a) 11 (b) 15 (c) 18 (d) 36

148. If $a\mathbf{i}+6\mathbf{j}-\mathbf{k}$ and $7\mathbf{i}-3\mathbf{j}+17\mathbf{k}$ are perpendicular vectors, then the value of a is **[Karnataka CET 2001]**

(a) 5 (b) – 5 (c) 7 (d) $\frac{1}{7}$

149. If $\mathbf{a}+\mathbf{b}\perp\mathbf{a}$ and $|\mathbf{b}|=\sqrt{2}|\mathbf{a}|$ then

(a) $(2\mathbf{a}+\mathbf{b})\parallel\mathbf{b}$ (b) $(2\mathbf{a}+\mathbf{b})\perp\mathbf{b}$ (c) $(2\mathbf{a}-\mathbf{b})\perp\mathbf{b}$ (d) $(2\mathbf{a}+\mathbf{b})\perp\mathbf{a}$

150. If **a** and **b** are adjacent sides of a rhombus, then **[Rajasthan PET 2001]**

(a) $\mathbf{a}\,.\,\mathbf{b}=0$ (b) $\mathbf{a}\times\mathbf{b}=\mathbf{0}$ (c) $\mathbf{a}\,.\,\mathbf{a}=\mathbf{b}\,.\,\mathbf{b}$ (d) None of these

151. If $|\mathbf{a}|=|\mathbf{b}|$, then $(\mathbf{a}+\mathbf{b}).(\mathbf{a}-\mathbf{b})$ is **[MP PET 2002]**

(a) Positive (b) Negative (c) Zero (d) None of these

152. If $4\mathbf{i}+\mathbf{j}-\mathbf{k}$ and $3\mathbf{i}+m\mathbf{j}+2\mathbf{k}$ are at right angle, then m = **[Karnataka CET 2002]**

(a) – 6 (b) – 8 (c) – 10 (d) – 12

153. If the vectors $3\mathbf{i}+\lambda\mathbf{j}+\mathbf{k}$ and $2\mathbf{i}-\mathbf{j}+8\mathbf{k}$ are perpendicular, then λ is **[Kerala (Engg.) 2002]**

(a) – 14 (b) 7 (c) 14 (d) $\frac{1}{7}$

154. $(\mathbf{a}\,.\,\mathbf{i})^2+(\mathbf{a}\,.\,\mathbf{j})^2+(\mathbf{a}\,.\,\mathbf{k})^2$ is equal to

(a) $\mathbf{a}^2$ (b) 3 (c) $|\mathbf{a}.(\mathbf{i}+\mathbf{j}+\mathbf{k})|^2$ (d) None of these

155. If the vectors $\mathbf{i}-2x\mathbf{j}-3y\mathbf{k}$ and $\mathbf{i}+3x\mathbf{j}+2y\mathbf{k}$ are orthogonal to each other, then the locus of the point (x, y) is

(a) A circle (b) An ellipse (c) A parabola (d) A straight line

156. If $\vec{A}=\mathbf{i}+2\mathbf{j}+3\mathbf{k}$, $\vec{B}=-\mathbf{i}+2\mathbf{j}+\mathbf{k}$ and $\vec{C}=3\mathbf{i}+\mathbf{j}$, then the value of t such that $\vec{A}+t\vec{B}$ is at right angle to vector $\vec{C}$, is **[Rajasthan PET 2002]**

(a) 3 (b) 4 (c) 5 (d) 6

157. If **a** and **b** are two perpendicular vectors, then out of the following four statements

(i) $(\mathbf{a}+\mathbf{b})^2=(\mathbf{a})^2+(\mathbf{b})^2$ (ii) $(\mathbf{a}-\mathbf{b})^2=(\mathbf{a})^2+(\mathbf{b})^2$ (iii) $|\mathbf{a}+\mathbf{b}|^2=|\mathbf{a}|^2+|\mathbf{b}|^2$

(iv) $(\mathbf{a}+\mathbf{b})^2=(\mathbf{a}-\mathbf{b})^2$

(a) Only one is correct (b) Only two are correct (c) Only three are correct (d) All the four are correct

Advance Level

158. If **a, b, c** are unit vectors such that $\mathbf{a}+\mathbf{b}+\mathbf{c}=0$, then $\mathbf{a}\,.\,\mathbf{b}+\mathbf{b}\,.\,\mathbf{c}+\mathbf{c}\,.\,\mathbf{a}=$ **[MP PET 1988; Karnataka CET 2000; UPSEAT 2003]**

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

159. A unit vector in the xy-plane which is perpendicular to $4\mathbf{i}-3\mathbf{j}+\mathbf{k}$ is **[Rajasthan PET 1991]**

(a) $\frac{\mathbf{i}+\mathbf{j}}{\sqrt{2}}$ (b) $\frac{1}{5}(3\mathbf{i}+4\mathbf{j})$ (c) $\frac{1}{5}(3\mathbf{i}-4\mathbf{j})$ (d) None of these

160. The vectors $2\mathbf{i}+3\mathbf{j}-4\mathbf{k}$ and $a\mathbf{i}+b\mathbf{j}+c\mathbf{k}$ are perpendicular, when **[MNR 1982; MP PET 1988, 2002]**

(a) $a=2, b=3, c=-4$ (b) $a=4, b=4, c=5$ (c) $a=4, b=4, c=-5$ (d) None of these

161. The unit normal vector to the line joining $\mathbf{i}-\mathbf{j}$ and $2\mathbf{i}+3\mathbf{j}$ and pointing towards the origin is **[MP PET 1989]**

(a) $\frac{4\mathbf{i}-\mathbf{j}}{\sqrt{17}}$ (b) $\frac{-4\mathbf{i}+\mathbf{j}}{\sqrt{17}}$ (c) $\frac{2\mathbf{i}-3\mathbf{j}}{\sqrt{13}}$ (d) $\frac{-2\mathbf{i}+3\mathbf{j}}{\sqrt{13}}$

162. The position vector of coplanar points A, B, C, D are **a, b, c** and **d** respectively, in such a way that $(\mathbf{a}-\mathbf{d}).(\mathbf{b}-\mathbf{c})=(\mathbf{b}-\mathbf{d}).(\mathbf{c}-\mathbf{a})=0$, then the point D of the triangle ABC is **[IIT 1984]**

(a) Incentre (b) Circumcentre (c) Orthocentre (d) None of these

163. If $\vec{F_1}=\mathbf{i}-\mathbf{j}+\mathbf{k}$, $\vec{F_2}=-\mathbf{i}+2\mathbf{j}-\mathbf{k}$, $\vec{F_3}=\mathbf{j}-\mathbf{k}$, $\vec{A}=4\mathbf{i}-3\mathbf{j}-2\mathbf{k}$ and $\vec{B}=6\mathbf{i}+\mathbf{j}-3\mathbf{k}$, then the scalar product of $\vec{F_1}+\vec{F_2}+\vec{F_3}$ and $\overrightarrow{AB}$ will be **[Roorkee 1980]**

(a) 3 (b) 6 (c) 9 (d) 12

164. If the moduli of **a** and **b** are equal and angle between them is 120° and **a . b** = – 8, then $|\mathbf{a}|$ is equal to **[Rajasthan PET 1**

(a) – 5 (b) – 4 (c) 4 (d) 5

165. The position vector of vertices of a triangle ABC are $4\mathbf{i}-2\mathbf{j}$, $\mathbf{i}+4\mathbf{j}-3\mathbf{k}$ and $-\mathbf{i}+5\mathbf{j}+\mathbf{k}$ respectively, then $\angle ABC=$ **[Rajasthan PET 1988, 1997]**

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

166. A, B, C, D are any four points, then $\overrightarrow{AB}.\overrightarrow{CD}+\overrightarrow{BC}.\overrightarrow{AD}+\overrightarrow{CA}.\overrightarrow{BD}=$ **[MNR 1986]**

(a) $2\overrightarrow{AB}.\overrightarrow{BC}.\overrightarrow{CD}$ (b) $\overrightarrow{AB}+\overrightarrow{BC}+\overrightarrow{CD}$ (c) $5\sqrt{3}$ (d) 0

167. If $|\mathbf{a}|=3, |\mathbf{b}|=1, |\mathbf{c}|=4$ and $\mathbf{a}+\mathbf{b}+\mathbf{c}=0$, then $\mathbf{a}.\mathbf{b}+\mathbf{b}.\mathbf{c}+\mathbf{c}.\mathbf{a}=$ **[MP PET 1995; Rajasthan PET 2000]**

(a) – 13 (b) – 10 (c) 13 (d) 10

168. The value of c so that for all real x, the vectors $cx\mathbf{i}-6\mathbf{j}+3\mathbf{k}$, $x\mathbf{i}+2\mathbf{j}+2cx\mathbf{k}$ make an obtuse angle are **[EAMCET 1994]**

(a) $c<0$ (b) $0<c<\frac{4}{3}$ (c) $-\frac{4}{3}<c<0$ (d) $c>0$

169. The vector $\frac{1}{3}(2\mathbf{i}-2\mathbf{j}+\mathbf{k})$ is **[IIT Screening 1994]**

(a) A unit vector

(b) Makes an angle $\frac{\pi}{3}$ with the vector $2\mathbf{i}-4\mathbf{j}+3\mathbf{k}$

(c) Parallel to the vector $-\mathbf{i}+\mathbf{j}-\frac{1}{2}\mathbf{k}$

(d) Perpendicular to the vector $3\mathbf{i}+2\mathbf{j}-2\mathbf{k}$

170. The value of x for which the angle between the vectors $\mathbf{a}=-3\mathbf{i}+x\mathbf{j}+\mathbf{k}$ and $\mathbf{b}=x\mathbf{i}+2x\mathbf{j}+\mathbf{k}$ is acute and the angle between **b** and x-axis lies between $\frac{\pi}{2}$ and π satisfy **[Kurukshetra CEE 1996]**

(a) $x>0$ (b) $x<0$ (c) $x>1$ only (d) $x<-1$ only

171. If the scalar product of the vector $\mathbf{i}+\mathbf{j}+\mathbf{k}$ with a unit vector parallel to the sum of the vectors $2\mathbf{i}+4\mathbf{j}-5\mathbf{k}$ and $\lambda\mathbf{i}+2\mathbf{j}+3\mathbf{k}$ be 1, then $\lambda=$ **[Roorkee 1985, 95; Kurukshetra CEE 1998; UPSEAT 1992, 2000]**

(a) 1 (b) – 1 (c) 2 (d) – 2

172. If **a** is any vector in space, then **[MP PET 1997]**

(a) $\mathbf{a}=(\mathbf{a}.\mathbf{i})\mathbf{i}+(\mathbf{a}.\mathbf{j})\mathbf{j}+(\mathbf{a}.\mathbf{k})\mathbf{k}$

(b) $\mathbf{a}=(\mathbf{a}\times\mathbf{i})+(\mathbf{a}\times\mathbf{j})+(\mathbf{a}\times\mathbf{k})$

(c) $\mathbf{a}=\mathbf{j}(\mathbf{a}.\mathbf{i})+\mathbf{k}(\mathbf{a}.\mathbf{j})+\mathbf{i}(\mathbf{a}.\mathbf{k})$

(d) $\mathbf{a}=(\mathbf{a}\times\mathbf{i})\times\mathbf{i}+(\mathbf{a}\times\mathbf{j})\times\mathbf{j}+(\mathbf{a}\times\mathbf{k})\times\mathbf{k}$

173. If **a, b** and **c** are unit vectors, then $|\mathbf{a}-\mathbf{b}|^2+|\mathbf{b}-\mathbf{c}|^2+|\mathbf{c}-\mathbf{a}|^2$ does not exceed **[IIT 1995, 2001]**

(a) 4 (b) 9 (c) 8 (d) 6

174. If **a** and **b** are two unit vectors, such that $\mathbf{a}+2\mathbf{b}$ and $5\mathbf{a}-4\mathbf{b}$ are perpendicular to each other then the angle between **a** and **b** is

[IIT Screening 2002]

(a) 45° (b) 60° (c) $\cos^{-1}\left(\frac{1}{3}\right)$ (d) $\cos^{-1}\left(\frac{2}{7}\right)$

175. **a, b, c** are three vectors, such that $\mathbf{a}+\mathbf{b}+\mathbf{c}=0$, $|\mathbf{a}|=1, |\mathbf{b}|=2, |\mathbf{c}|=3$, then $\mathbf{a}.\mathbf{b}+\mathbf{b}.\mathbf{c}+\mathbf{c}.\mathbf{a}$ is equal to **[AIEEE 2003]**

(a) 0 (b) – 7 (c) 7 (d) 1

176. A unit vector in xy-plane that makes an angle 45° with the vectors $(\mathbf{i}+\mathbf{j})$ and an angle of 60° with the vector $(3\mathbf{i}-4\mathbf{j})$ is

[Kurukshetra CEE 2002]

(a) $\mathbf{i}$ (b) $\frac{1}{\sqrt{2}}(\mathbf{i}-\mathbf{j})$ (c) $\frac{1}{\sqrt{2}}(\mathbf{i}+\mathbf{j})$ (d) None of these

177. The angle between the vectors $\mathbf{a}+\mathbf{b}$ and $\mathbf{a}-\mathbf{b}$, when **a** = (1, 1, 4) and **b** = (1, – 1, 4) is **[Karnataka CET 2003]**

(a) 90° (b) 45° (c) 30° (d) 15°

178. Let $\mathbf{u}=\mathbf{i}+\mathbf{j}$, $\mathbf{v}=\mathbf{i}-\mathbf{j}$ and $\mathbf{w}=\mathbf{i}+2\mathbf{j}+3\mathbf{k}$. If **n** is a unit vector such that **u . n** = 0 and **v . n** = 0, then $|\mathbf{w}.\mathbf{n}|$ is equal to

[AIEEE 2003]

(a) 0 (b) 1 (c) 2 (d) 3

179. If a, b, c are the p^{th}, q^{th}, r^{th} terms of an HP and $\mathbf{u}=(q-r)\mathbf{i}+(r-p)\mathbf{j}+(p-q)\mathbf{k}$, $\mathbf{v}=\frac{\mathbf{i}}{a}+\frac{\mathbf{j}}{b}+\frac{\mathbf{k}}{c}$, then

(a) **u, v** are parallel vectors (b) **u, v** are orthogonal vectors (c) **u . v** = 1 (d) $\mathbf{u}\times\mathbf{v}=\mathbf{i}+\mathbf{j}+\mathbf{k}$

180. ABC is an equilateral triangle of side a. The value of $\overrightarrow{AB}.\overrightarrow{BC}+\overrightarrow{BC}.\overrightarrow{CA}+\overrightarrow{CA}.\overrightarrow{AB}$ is equal to

(a) $\frac{3a^2}{2}$ (b) $3a^2$ (c) $-\frac{3a^2}{2}$ (d) None of these

181. If $\mathbf{e}_1=(1,1,1)$ and $\mathbf{e}_2=(1,1,-1)$ and **a** and **b** are two vectors such that $\mathbf{e}_1=2\mathbf{a}+\mathbf{b}$ and $\mathbf{e}_2=\mathbf{a}+2\mathbf{b}$ then angle between **a** and **b** is

(a) $\cos^{-1}\left(\frac{7}{9}\right)$ (b) $\cos^{-1}\left(\frac{7}{11}\right)$ (c) $\cos^{-1}\left(-\frac{7}{11}\right)$ (d) $\cos^{-1}\left(\frac{6\sqrt{2}}{11}\right)$

182. A vector whose modulus is $\sqrt{51}$ and makes the same angle with $\mathbf{a}=\frac{\mathbf{i}-2\mathbf{j}+2\mathbf{k}}{3}$, $\mathbf{b}=\frac{-4\mathbf{i}-3\mathbf{k}}{5}$ and $\mathbf{c}=\mathbf{j}$, will be **[Roorkee**

(a) $5\mathbf{i}+5\mathbf{j}+\mathbf{k}$ (b) $5\mathbf{i}+\mathbf{j}-5\mathbf{k}$ (c) $5\mathbf{i}+\mathbf{j}+5\mathbf{k}$ (d) $\pm(5\mathbf{i}-\mathbf{j}-5\mathbf{k})$

183. In a right angled triangle ABC, the hypotenues $AB = p$, then $\overrightarrow{AB}.\overrightarrow{AC}+\overrightarrow{BC}.\overrightarrow{BA}+\overrightarrow{CA}.\overrightarrow{CB}$ is equal to

(a) $2p^2$ (b) $\frac{p^2}{2}$ (c) p^2 (d) None of these

184. If the vectors $\mathbf{b}=\left(\tan\alpha, -1, 2\sqrt{\sin\frac{\alpha}{2}}\right)$ and $\mathbf{c}=\left(\tan\alpha, \tan\alpha, -\frac{3}{\sqrt{\sin\frac{\alpha}{2}}}\right)$ are orthogonal and a vector $\mathbf{a}=(1, 3, \sin 2\alpha)$ makes an obtuse angle with the z-axis, then the value of α is

(a) $\alpha=(4n+1)\pi-\tan^{-1}2$ (b) $\alpha=(4n+2)\pi-\tan^{-1}2$ (c) $\alpha=(4n+1)\pi+\tan^{-1}2$ (d) $\alpha=(4n+2)\pi+\tan^{-1}2$

185. If the vectors $\mathbf{a}=(2, \log_3 x, a)$ and $\mathbf{b}=(-3, a\log_3 x, \log_3 x)$ are inclined at an acute angle, then

(a) $a=0$ (b) $a<0$ (c) $a>0$ (d) None of these

186. The value of x for which the angle between the vectors $\mathbf{a} = x\mathbf{i} - 3\mathbf{j} - \mathbf{k}$ and $\mathbf{b} = 2x\mathbf{i} + x\mathbf{j} - \mathbf{k}$ is acute and the angle between the vector **b** and y-axis lies between $\frac{\pi}{2}$ and π are **[DCE 2001]**

(a) < 0 (b) > 0 (c) – 2, – 3 (d) 1, 2

187. If **a, b, c** are linearly independent vectors and $\Delta = \begin{vmatrix} \mathbf{a} & \mathbf{b} & \mathbf{c} \\ \mathbf{a}.\mathbf{a} & \mathbf{a}.\mathbf{b} & \mathbf{a}.\mathbf{c} \\ \mathbf{a}.\mathbf{c} & \mathbf{b}.\mathbf{c} & \mathbf{c}.\mathbf{c} \end{vmatrix}$, then

(a) $\Delta = 0$ (b) $\Delta = 1$ (c) $\Delta =$ any non-zero value (d) None of these

188. The position vectors of the points A, B and C are $\mathbf{i} + \mathbf{j} + \mathbf{k}$, $\mathbf{i} + 5\mathbf{j} - \mathbf{k}$ and $2\mathbf{i} + 3\mathbf{j} + 5\mathbf{k}$ respectively.The greatest angle of the triangle ABC is

(a) 135^o (b) 90° (c) $\cos^{-1}\left(\frac{2}{3}\right)$ (d) $\cos^{-1}\left(\frac{5}{7}\right)$

Component of Vector

Basic Level

189. If **a** and **b** are two non-zero vectors, then the component of **b** along **a** is **[MP PET 1991]**

(a) $\frac{(\mathbf{a}.\mathbf{b})\mathbf{a}}{\mathbf{b}.\mathbf{b}}$ (b) $\frac{(\mathbf{a}.\mathbf{b})\mathbf{b}}{\mathbf{a}.\mathbf{a}}$ (c) $\frac{(\mathbf{a}.\mathbf{b})\mathbf{b}}{\mathbf{a}.\mathbf{b}}$ (d) $\frac{(\mathbf{a}.\mathbf{b})\mathbf{a}}{\mathbf{a}.\mathbf{a}}$

190. Projection of the vector $\mathbf{i} - 2\mathbf{j} + \mathbf{k}$ in the direction of the vector $4\mathbf{i} - 4\mathbf{j} + 7\mathbf{k}$ will be

[Rajasthan PET 1990; MNR 1980; MP PET 2002; UPSEAT 2002]

(a) $\frac{5\sqrt{6}}{10}$ (b) $\frac{9}{19}$ (c) $\frac{19}{9}$ (d) $\frac{\sqrt{6}}{19}$

191. If $\mathbf{a} = 4\mathbf{i} + 6\mathbf{j}$ and $b = 3\mathbf{j} + 4\mathbf{k}$, then the component of **a** along **b** is **[IIT Screening 1989; MNR 1983, 87; UPSEAT 2000]**

(a) $\frac{18}{10\sqrt{3}}(3\mathbf{j} + 4\mathbf{k})$ (b) $\frac{18}{25}(3\mathbf{j} + 4\mathbf{k})$ (c) $\frac{18}{\sqrt{3}}(3\mathbf{j} + 4\mathbf{k})$ (d) $(3\mathbf{j} + 4\mathbf{k})$

192. The projection of vector $2\mathbf{i} + 3\mathbf{j} - 2\mathbf{k}$ on the vector $\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$ will be **[Rajasthan PET 1984, 90, 97, 99]**

(a) $\frac{1}{\sqrt{14}}$ (b) $\frac{2}{\sqrt{14}}$ (c) $\frac{3}{\sqrt{14}}$ (d) $\sqrt{14}$

193. If vector $\mathbf{a} = 2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$ and vector $\mathbf{b} = -2\mathbf{i} + 2\mathbf{j} - \mathbf{k}$, then $\frac{\text{Projection of vector } \mathbf{a} \text{ on vector } \mathbf{b}}{\text{Projection of vector } \mathbf{b} \text{ on vector } \mathbf{a}} =$ **[MP PET 1994, 1999]**

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

194. The projection of **a** along **b** is **[Rajasthan PET 1995]**

(a) $\frac{\mathbf{a}.\mathbf{b}}{|\mathbf{a}|}$ (b) $\frac{\mathbf{a} \times \mathbf{b}}{|\mathbf{a}|}$ (c) $\frac{\mathbf{a}.\mathbf{b}}{|\mathbf{b}|}$ (d) $\frac{\mathbf{a} \times \mathbf{b}}{|\mathbf{b}|}$

195. If $\mathbf{a} = 2\mathbf{i} + \mathbf{j} + 2\mathbf{k}$ and $\mathbf{b} = 5\mathbf{i} - 3\mathbf{j} + \mathbf{k}$, then the projection of **b** on **a** is **[Karnataka CET 2002]**

(a) 3 (b) 4 (c) 5 (d) 6

196. The projection of the vector $\mathbf{i} + \mathbf{j} + \mathbf{k}$ along the vector **j** is **[Kerala (Engg.) 2002]**

(a) 1 (b) 0 (c) 2 (d) – 1

197. If $\hat{\mathbf{a}}$ is a unit vector and **b**, a non-zero vector not parallel to $\hat{\mathbf{a}}$, then the vector $\mathbf{b} - (\hat{\mathbf{a}}.\mathbf{b})\hat{\mathbf{a}}$ is

(a) Parallel to **b** (b) At right angles to $\hat{\mathbf{a}}$ (c) Parallel to $\hat{\mathbf{a}}$ (d) At right angles to **b**

Advance Level

198. If $\mathbf{a} = \mathbf{i} + 2\mathbf{j} + 2\mathbf{k}$ and $\mathbf{b} = 3\mathbf{i} + 6\mathbf{j} + 2\mathbf{k}$, then a vector in the direction of **a** and having magnitude as $|\mathbf{b}|$ is **[IIT 1983]**

(a) $7(\mathbf{i} + \mathbf{j} + \mathbf{k})$ (b) $\frac{7}{3}(\mathbf{i} + 2\mathbf{j} + 2\mathbf{k})$ (c) $\frac{7}{9}(\mathbf{i} + 2\mathbf{j} + 2\mathbf{k})$ (d) None of these

199. The vector $\mathbf{b} = 3\mathbf{j} + 4\mathbf{k}$ is to be written as the sum of a vector $\mathbf{b}_1$ parallel to $\mathbf{a} = \mathbf{i} + \mathbf{j}$ and a vector $\mathbf{b}_2$ perpendicular to **a**. Then $\mathbf{b}_1 =$ **[MNR 1993; UPSEAT 2000]**

(a) $\frac{3}{2}(\mathbf{i} + \mathbf{j})$ (b) $\frac{2}{3}(\mathbf{i} + \mathbf{j})$ (c) $\frac{1}{2}(\mathbf{i} + \mathbf{j})$ (d) $\frac{1}{3}(\mathbf{i} + \mathbf{j})$

200. The components of a vector **a** along and perpendicular to the non-zero vector **b** are respectively **[IIT 1988]**

(a) $\frac{\mathbf{a}.\mathbf{b}}{|\mathbf{a}|}, \frac{|\mathbf{a} \times \mathbf{b}|}{|\mathbf{a}|}$ (b) $\frac{\mathbf{a}.\mathbf{b}}{|\mathbf{b}|}, \frac{|\mathbf{a} \times \mathbf{b}|}{|\mathbf{b}|}$ (c) $\frac{\mathbf{a}.\mathbf{b}}{|\mathbf{a}|}, \frac{\mathbf{a}.\mathbf{b}}{|\mathbf{a}|}$ (d) $\frac{|\mathbf{a} \times \mathbf{b}|}{|\mathbf{a}|}, \frac{|\mathbf{a} \times \mathbf{b}|}{|\mathbf{b}|}$

201. Let $\mathbf{b} = 4\mathbf{i} + 3\mathbf{j}$ and **c** be two vectors perpendicular to each other in the *xy*-plane. All vectors in the same plane having projections 1 and 2 along **b** and **c** respectively, are given by **[IIT 1987]**

(a) $2\mathbf{i} - \mathbf{j}, \frac{2}{5}\mathbf{i} + \frac{11}{5}\mathbf{j}$ (b) $2\mathbf{i} + \mathbf{j}, -\frac{2}{5}\mathbf{i} + \frac{11}{5}\mathbf{j}$ (c) $2\mathbf{i} + \mathbf{j}, -\frac{2}{5}\mathbf{i} - \frac{11}{5}\mathbf{j}$ (d) $2\mathbf{i} - \mathbf{j}, -\frac{2}{5}\mathbf{i} + \frac{11}{5}\mathbf{j}$

202. Let $\mathbf{a} = 2\mathbf{i} - \mathbf{j} + \mathbf{k}, \mathbf{b} = \mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and $\mathbf{c} = \mathbf{i} + \mathbf{j} - 2\mathbf{k}$ be three vectors. A vector in the plane of **b** and **c** whose projection on **a** is of magnitude $\sqrt{2/3}$ is **[IIT 1993]**

(a) $2\mathbf{i} + 3\mathbf{j} - 3\mathbf{k}$ (b) $2\mathbf{i} + 3\mathbf{j} + 3\mathbf{k}$ (c) $-2\mathbf{i} - \mathbf{j} + 5\mathbf{k}$ (d) $2\mathbf{i} + \mathbf{j} + 5\mathbf{k}$

Work done by a Force

Basic Level

203. If the position vectors of *A* and *B* be $6\mathbf{i} + \mathbf{j} - 3\mathbf{k}$ and $4\mathbf{i} - 3\mathbf{j} - 2\mathbf{k}$, then the work done by the force $\vec{F} = \mathbf{i} - 3\mathbf{j} + 5\mathbf{k}$ in displacing a particle from *A* to *B* is **[MP PET 1987]**

(a) 15 units (b) 17 units (c) – 15 units (d) None of these

204. If the force $\vec{F} = \mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$ moves from $\mathbf{i} + \mathbf{j} - \mathbf{k}$ to $2\mathbf{i} - \mathbf{j} + \mathbf{k}$, then work done will be represented by **[Ranchi BIT 1992]**

(a) 3 (b) 4 (c) 5 (d) 6

205. The work done by the force $\vec{F} = 2\mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$ in displacing a particle from the point (3, 4, 5) to the point (1, 2, 3) is

[MP PET 1994; Kurukshetra CEE 2002]

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

206. The work done in moving an object along the vector $3\mathbf{i} + 2\mathbf{j} - 5\mathbf{k}$, if the applied force is $\vec{F} = 2\mathbf{i} - \mathbf{j} - \mathbf{k}$, is **[MP PET 1997, 2**

(a) 7 (b) 8 (c) 9 (d) 10

207. A force $\vec{F} = 2\mathbf{i} + \mathbf{j} - \mathbf{k}$ acts at a point *A* whose position vector is $2\mathbf{i} - \mathbf{j}$. If point of application of $\vec{F}$ moves from *A* to the point *B* with position vector $2\mathbf{i} + \mathbf{j}$, then work done by $\vec{F}$ is **[Pb. CET 2000]**

(a) 4 (b) 20 (c) 2 (d) None of these

Advance Level

208. Force $3\mathbf{i} + 2\mathbf{j} + 5\mathbf{k}$ and $2\mathbf{i} + \mathbf{j} - 3\mathbf{k}$ are acting on a particle and displace it from the point $2\mathbf{i} - \mathbf{j} - 3\mathbf{k}$ to the point $4\mathbf{i} - 3\mathbf{j} + 7\mathbf{k}$, then work done by the force is **[MP PET 1995]**

(a) 30 units (b) 36 units (c) 24 units (d) 18 units

209. A force of magnitude 5 units acting along the vector $2\mathbf{i}-2\mathbf{j}+\mathbf{k}$ displaces the point of application from (1, 2, 3) to (5, 3, 7), then the work done is **[Kerala (Engg.) 2002]**

(a) 50/7 (b) 50/3 (c) 25/3 (d) 25/4

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

(a) 4 units (b) – 4 units (c) 7 units (d) – 7 units

Vector or Cross Product of Two Vectors

Basic Level

211. If $\mathbf{u}=2\mathbf{i}+2\mathbf{j}-\mathbf{k}$ and $\mathbf{v}=6\mathbf{i}-3\mathbf{j}+2\mathbf{k}$, then a unit vector perpendicular to both **u** and **v** is **[MP PET 1987]**

(a) $\mathbf{i}-10\mathbf{j}-18\mathbf{k}$ (b) $\frac{1}{\sqrt{17}}\left(\frac{1}{5}\mathbf{i}-2\mathbf{j}-\frac{18}{5}\mathbf{k}\right)$ (c) $\frac{1}{\sqrt{473}}(7\mathbf{i}-10\mathbf{j}-18\mathbf{k})$ (d) None of these

212. $(\mathbf{a}-\mathbf{b})\times(\mathbf{a}+\mathbf{b})=$ **[MP PET 1987]**

(a) $2\mathbf{a}\times\mathbf{b}$ (b) $\mathbf{a}\times\mathbf{b}$ (c) $\mathbf{a}^2-\mathbf{b}^2$ (d) None of these

213. If $\mathbf{a}+\mathbf{b}+\mathbf{c}=0$, then which relation is correct **[Rajasthan PET 1985; Roorkee 1981; AIEEE 2002]**

(a) $\mathbf{a}=\mathbf{b}=\mathbf{c}=0$ (b) $\mathbf{a}.\mathbf{b}=\mathbf{b}.\mathbf{c}=\mathbf{c}.\mathbf{a}$ (c) $\mathbf{a}\times\mathbf{b}=\mathbf{b}\times\mathbf{c}=\mathbf{c}\times\mathbf{a}$ (d) None of these

214. If θ be the angle between the vectors **a** and **b** and $|\mathbf{a}\times\mathbf{b}|=\mathbf{a}.\mathbf{b}$, then $\theta=$ **[Rajasthan PET 1990; MP PET 1990; UPSEAT 200**

(a) π (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{4}$ (d) 0

215. If **a** and **b** are two vectors such that **a** . **b** = 0 and $\mathbf{a}\times\mathbf{b}=0$, then **[MNR 1988; IIT 1989; UPSEAT 2000, 01]**

(a) **a** is parallel to **b** (b) **a** is perpendicular to **b**

(c) Either **a** or **b** is a null vector (d) None of these

216. $(2\hat{\mathbf{a}}+3\hat{\mathbf{b}})\times(5\hat{\mathbf{a}}+7\hat{\mathbf{b}})=$ **[MP PET 1988]**

(a) $\hat{\mathbf{a}}\times\hat{\mathbf{b}}$ (b) $\hat{\mathbf{b}}\times\hat{\mathbf{a}}$ (c) $\hat{\mathbf{a}}+\hat{\mathbf{b}}$ (d) $7\hat{\mathbf{a}}+10\hat{\mathbf{b}}$

217. Which of the following is not a property of vectors **[MP PET 1987]**

(a) $\mathbf{u}\times\mathbf{v}=\mathbf{v}\times\mathbf{u}$ (b) $\mathbf{u}.\mathbf{v}=\mathbf{v}.\mathbf{u}$ (c) $(\mathbf{u}\times\mathbf{v})^2=\mathbf{u}^2.\mathbf{v}^2-(\mathbf{u}.\mathbf{v})^2$ (d) $\mathbf{u}^2=|\mathbf{u}|^2$

218. The number of vectors of unit length perpendicular to vectors **a** = (1, 1, 0) and **b** = (0, 1, 1) is **[Ranchi BIT 1991; IIT 1987; Kurukshetra CEE 1998; DCE 2000; MP PET 2002]**

(a) Three (b) One (c) Two (d) Infinite

219. If $\mathbf{a}\neq 0, \mathbf{b}\neq 0, \mathbf{c}\neq 0$, then true statement is **[MP PET 1991]**

(a) $\mathbf{a}\times(\mathbf{b}+\mathbf{c})=(\mathbf{c}+\mathbf{b})\times\mathbf{a}$ (b) $\mathbf{a}.(\mathbf{b}+\mathbf{c})=-(\mathbf{b}+\mathbf{c}).\mathbf{a}$ (c) $\mathbf{a}\times(\mathbf{b}-\mathbf{c})=(\mathbf{c}-\mathbf{b})\times\mathbf{a}$ (d) $\mathbf{a}.(\mathbf{b}-\mathbf{c})=(\mathbf{c}-\mathbf{b}).\mathbf{a}$

220. A unit vector which is perpendicular to $\mathbf{i}+2\mathbf{j}-2\mathbf{k}$ and to $-\mathbf{i}+2\mathbf{j}+2\mathbf{k}$ is **[MP PET 1992]**

(a) $\frac{1}{\sqrt{5}}(2\mathbf{i}-\mathbf{k})$ (b) $\frac{1}{\sqrt{5}}(-2\mathbf{i}+\mathbf{k})$ (c) $\frac{1}{\sqrt{5}}(2\mathbf{i}+\mathbf{j}+\mathbf{k})$ (d) $\frac{1}{\sqrt{5}}(2\mathbf{i}+\mathbf{k})$

221. The unit vector perpendicular to the $3\mathbf{i}+2\mathbf{j}-\mathbf{k}$ and $12\mathbf{i}+5\mathbf{j}-5\mathbf{k}$, is **[Roorkee 1979; Rajasthan PET 1989, 1991]**

(a) $\frac{5\mathbf{i}-3\mathbf{j}+9\mathbf{k}}{\sqrt{115}}$ (b) $\frac{5\mathbf{i}+3\mathbf{j}-9\mathbf{k}}{\sqrt{115}}$ (c) $\frac{-5\mathbf{i}+3\mathbf{j}-9\mathbf{k}}{\sqrt{115}}$ (d) $\frac{5\mathbf{i}+3\mathbf{j}+9\mathbf{k}}{\sqrt{115}}$

222. The sine of the angle between the two vectors $3\mathbf{i}+2\mathbf{j}-\mathbf{k}$ and $12\mathbf{i}+5\mathbf{j}-5\mathbf{k}$ will be **[Roorkee 1978]**

(a) $\frac{\sqrt{115}}{\sqrt{14}\sqrt{194}}$ (b) $\frac{51}{\sqrt{14}\sqrt{144}}$ (c) $\frac{\sqrt{64}}{\sqrt{14}\sqrt{194}}$ (d) None of these

223. For any two vectors **a** and **b**, if $\mathbf{a}\times\mathbf{b}=\mathbf{0}$, then **[Roorkee 1984]**

(a) **a** = **0** (b) **b** = **0** (c) Not parallel (d) None of these

224. For any vectors **a, b, c.** $\mathbf{a}\times(\mathbf{b}+\mathbf{c})+\mathbf{b}\times(\mathbf{c}+\mathbf{a})+\mathbf{c}\times(\mathbf{a}+\mathbf{b})=$ **[Roorkee 1981; Kerala (Engg.) 2002]**

(a) **0** (b) $\mathbf{a}+\mathbf{b}+\mathbf{c}$ (c) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (d) $\mathbf{a}\times\mathbf{b}\times\mathbf{c}$

225. If $|\mathbf{a}|=2, |\mathbf{b}|=5$ and $|\mathbf{a}\times\mathbf{b}|=8$, then $\mathbf{a}\,.\,\mathbf{b}$ is equal to **[Rajasthan PET 1991; AI CBSE 1984]**

(a) 0 (b) 2 (c) 4 (d) 6

226. If $\mathbf{a}=2\mathbf{i}+2\mathbf{j}-\mathbf{k}$ and $\mathbf{b}=6\mathbf{i}-3\mathbf{j}+2\mathbf{k}$,then the value of $\mathbf{a}\times\mathbf{b}$ is **[MNR 1978; Rajasthan PET 2001]**

(a) $2\mathbf{i}+2\mathbf{j}-\mathbf{k}$ (b) $6\mathbf{i}-3\mathbf{j}+2\mathbf{k}$ (c) $\mathbf{i}-10\mathbf{j}-18\mathbf{k}$ (d) $\mathbf{i}+\mathbf{j}+\mathbf{k}$

227. A unit vector perpendicular to the vector $4\mathbf{i}-\mathbf{j}+3\mathbf{k}$ and $-2\mathbf{i}+\mathbf{j}-2\mathbf{k}$ is **[MNR 1995]**

(a) $\frac{1}{3}(\mathbf{i}-2\mathbf{j}+2\mathbf{k})$ (b) $\frac{1}{3}(-\mathbf{i}+2\mathbf{j}+2\mathbf{k})$ (c) $\frac{1}{3}(2\mathbf{i}+\mathbf{j}+2\mathbf{k})$ (d) $\frac{1}{3}(2\mathbf{i}-2\mathbf{j}+2\mathbf{k})$

228. A unit vector perpendicular to each of the vector $2\mathbf{i}-\mathbf{j}+\mathbf{k}$ and $3\mathbf{i}+4\mathbf{j}-\mathbf{k}$ is equal to **[MP PET 2003]**

(a) $\frac{(-3\mathbf{i}+5\mathbf{j}+11\mathbf{k})}{\sqrt{155}}$ (b) $\frac{(3\mathbf{i}-5\mathbf{j}+11\mathbf{k})}{\sqrt{155}}$ (c) $\frac{(6\mathbf{i}-4\mathbf{j}-\mathbf{k})}{\sqrt{53}}$ (d) $\frac{(5\mathbf{i}+3\mathbf{j})}{\sqrt{34}}$

229. If $\mathbf{a}=\mathbf{i}-2\mathbf{j}+3\mathbf{k}$ and $\mathbf{b}=3\mathbf{i}+\mathbf{j}+2\mathbf{k}$, then the unit vector perpendicular to **a** and **b** is **[MP PET 1996]**

(a) $\frac{\mathbf{i}+\mathbf{j}+\mathbf{k}}{\sqrt{3}}$ (b) $\frac{\mathbf{i}-\mathbf{j}+\mathbf{k}}{\sqrt{3}}$ (c) $\frac{-\mathbf{i}+\mathbf{j}+\mathbf{k}}{\sqrt{3}}$ (d) $\frac{\mathbf{i}-\mathbf{j}-\mathbf{k}}{\sqrt{3}}$

230. If θ is the angle between the vectors **a** and **b**, then $\frac{|\mathbf{a}\times\mathbf{b}|}{|\mathbf{a}\,.\,\mathbf{b}|}$ equal to **[Karnataka CET 1999]**

(a) $\tan\theta$ (b) $-\tan\theta$ (c) $\cot\theta$ (d) $-\cot\theta$

231. A vector perpendicular to both of the vectors $\mathbf{i}+\mathbf{j}+\mathbf{k}$ and $\mathbf{i}+\mathbf{j}$ is **[Rajasthan PET 2000]**

(a) $\mathbf{i}+\mathbf{j}$ (b) $\mathbf{i}-\mathbf{j}$ (c) $c(\mathbf{i}-\mathbf{j}), c$ is a scalar (d) None of these

232. A unit vector perpendicular to the plane of $\mathbf{a}=2\mathbf{i}-6\mathbf{j}-3\mathbf{k}$, $\mathbf{b}=4\mathbf{i}+3\mathbf{j}-\mathbf{k}$ is **[MP PET 2000]**

(a) $\frac{4\mathbf{i}+3\mathbf{j}-\mathbf{k}}{\sqrt{26}}$ (b) $\frac{2\mathbf{i}-6\mathbf{j}-3\mathbf{k}}{7}$ (c) $\frac{3\mathbf{i}-2\mathbf{j}+6\mathbf{k}}{7}$ (d) $\frac{2\mathbf{i}-3\mathbf{j}-6\mathbf{k}}{7}$

233. The unit vector perpendicular to the both the vectors $\mathbf{i}-2\mathbf{j}+3\mathbf{k}$ and $\mathbf{i}+2\mathbf{j}-\mathbf{k}$ is **[DCE 2001]**

(a) $\frac{1}{\sqrt{3}}(-\mathbf{i}+\mathbf{j}+\mathbf{k})$ (b) $(-\mathbf{i}+\mathbf{j}+\mathbf{k})$ (c) $\frac{(\mathbf{i}+\mathbf{j}-\mathbf{k})}{\sqrt{3}}$ (d) None of these

234. The unit vector perpendicular to the vectors $\mathbf{i}-\mathbf{j}+\mathbf{k}$ and $2\mathbf{i}+3\mathbf{j}-\mathbf{k}$ is **[Karnataka CET 2001]**

(a) $\frac{-2\mathbf{i}+3\mathbf{j}+5\mathbf{k}}{\sqrt{30}}$ (b) $\frac{-2\mathbf{i}+5\mathbf{j}+6\mathbf{k}}{\sqrt{38}}$ (c) $\frac{-2\mathbf{i}+3\mathbf{j}+5\mathbf{k}}{\sqrt{38}}$ (d) $\frac{-2\mathbf{i}+4\mathbf{j}+5\mathbf{k}}{\sqrt{38}}$

235. If $\mathbf{a}=2\mathbf{i}-3\mathbf{j}-\mathbf{k}$ and $\mathbf{b}=\mathbf{i}+4\mathbf{j}-2\mathbf{k}$, then $\mathbf{a}\times\mathbf{b}$ is **[MP PET 2001]**

(a) $10\mathbf{i}+2\mathbf{j}+11\mathbf{k}$ (b) $10\mathbf{i}+3\mathbf{j}+11\mathbf{k}$ (c) $10\mathbf{i}-3\mathbf{j}+11\mathbf{k}$ (d) $10\mathbf{i}-3\mathbf{j}-10\mathbf{k}$

236. If $|\mathbf{a}|=4, |\mathbf{b}|=2$ and the angle between **a** and **b** is $\frac{\pi}{6}$, then $(\mathbf{a}\times\mathbf{b})^2$ is equal to **[AIEEE 2002]**

(a) 48 (b) 16 (c) **a** (d) None of these

237. $\mathbf{a}=3\mathbf{i}-5\mathbf{j}$ and $\mathbf{b}=6\mathbf{i}+3\mathbf{j}$ are two vectors and **c** is a vector such that $\mathbf{c}=\mathbf{a}\times\mathbf{b}$, then $|\mathbf{a}|:|\mathbf{b}|:|\mathbf{c}|$ is **[AIEEE 2002]**

(a) $\sqrt{34}:\sqrt{45}:\sqrt{39}$ (b) $\sqrt{34}:\sqrt{45}:39$ (c) 34 : 39 : 45 (d) 39 : 35 : 34

238. $3\lambda\mathbf{c}+2\mu(\mathbf{a}\times\mathbf{b})=0$, then **[AIEEE 2002]**

(a) $3\lambda+2\mu=0$ (b) $3\lambda=2\mu$ (c) $\lambda=\mu$ (d) $\lambda+\mu=0$

239. If $\mathbf{a}=2\mathbf{i}+4\mathbf{j}-5\mathbf{k}$ and $\mathbf{b}=\mathbf{i}+2\mathbf{j}+3\mathbf{k}$, then $|\mathbf{a}\times\mathbf{b}|$ is **[UPSEAT 2002]**

(a) $11\sqrt{5}$ (b) $11\sqrt{3}$ (c) $11\sqrt{7}$ (d) $11\sqrt{2}$

240. The unit vector perpendicular to both **i** + **j** and **j** + **k** is **[Kerala (Engg.) 2002]**

(a) $\mathbf{i}-\mathbf{j}+\mathbf{k}$ (b) $\mathbf{i}+\mathbf{j}+\mathbf{k}$ (c) $\frac{\mathbf{i}+\mathbf{j}-\mathbf{k}}{\sqrt{3}}$ (d) $\frac{\mathbf{i}-\mathbf{j}+\mathbf{k}}{\sqrt{3}}$

241. If $|\mathbf{a}\times\mathbf{b}|=4$ and $|\mathbf{a}.\mathbf{b}|=2$, then $|\mathbf{a}|^2|\mathbf{b}|^2=$ **[Karnataka CET 2003]**

(a) 2 (b) 6 (c) 8 (d) 20

242. If $(\mathbf{a}\times\mathbf{b})^2+(\mathbf{a}.\mathbf{b})^2=144$ and $|\mathbf{a}|=4$, then $|\mathbf{b}|=$ **[EAMCET 1994]**

(a) 16 (b) 8 (c) 3 (d) 12

243. The unit vector perpendicular to both the vectors $\mathbf{a}=\mathbf{i}+\mathbf{j}+\mathbf{k}$ and $\mathbf{b}=2\mathbf{i}-\mathbf{j}+3\mathbf{k}$ and making an acute angle with the vector $\mathbf{k}$ is

(a) $-\frac{1}{\sqrt{26}}(4\mathbf{i}-\mathbf{j}-3\mathbf{k})$ (b) $\frac{1}{\sqrt{26}}(4\mathbf{i}-\mathbf{j}-3\mathbf{k})$ (c) $\frac{1}{\sqrt{26}}(4\mathbf{i}-\mathbf{j}+3\mathbf{k})$ (d) None of these

244. The angle between $3(\mathbf{a}\times\mathbf{b})$ and $\frac{1}{2}(\mathbf{b}-(\mathbf{a}.\mathbf{b})\hat{\mathbf{a}})$ is **[Pb. CET 1996]**

(a) 30° (b) 60° (c) 90° (d) $\cos^{-1}\left(\frac{3}{4}\right)$

Advance Level

245. If the vectors **a, b** and **c** are represented by, the sides *BC, CA* and *AB* respectively of the ΔABC, then **[IIT Screening 2000**

(a) $\mathbf{a}.\mathbf{b}+\mathbf{b}.\mathbf{c}+\mathbf{c}.\mathbf{a}=0$ (b) $\mathbf{a}\times\mathbf{b}=\mathbf{b}\times\mathbf{c}=\mathbf{c}\times\mathbf{a}$ (c) $\mathbf{a}.\mathbf{b}=\mathbf{b}.\mathbf{c}=\mathbf{c}.\mathbf{a}$ (d) $\mathbf{a}\times\mathbf{b}=\mathbf{b}\times\mathbf{c}=\mathbf{c}\times\mathbf{a}=0$

246. $\mathbf{a}\times\mathbf{b}=\mathbf{b}\times\mathbf{c}\neq 0$, where **a, b** and **c** are coplanar vectors, then for some scalar **k** **[Roorkee 1985; Rajasthan PET 1997]**

(a) $\mathbf{a}+\mathbf{c}=k\mathbf{b}$ (b) $\mathbf{a}+\mathbf{b}=k\mathbf{c}$ (c) $\mathbf{b}+\mathbf{c}=k\mathbf{a}$ (d) None of these

247. If $\mathbf{a}\times\mathbf{b}=\mathbf{b}\times\mathbf{c}\neq\mathbf{0}$ and $\mathbf{a}+\mathbf{c}\neq\mathbf{0}$, then **[Rajasthan PET 1999]**

(a) $(\mathbf{a}+\mathbf{c})\perp\mathbf{b}$ (b) $(\mathbf{a}+\mathbf{c})\parallel\mathbf{b}$ (c) $(\mathbf{a}+\mathbf{c})=\mathbf{b}$ (d) None of these

248. If **a** and **b** are two vectors, then $(\mathbf{a}\times\mathbf{b})^2$ equals **[Roorkee 1975, 1979, 1981, 1985]**

(a) $\begin{vmatrix}\mathbf{a}.\mathbf{b} & \mathbf{a}.\mathbf{a}\\ \mathbf{b}.\mathbf{b} & \mathbf{b}.\mathbf{a}\end{vmatrix}$ (b) $\begin{vmatrix}\mathbf{a}.\mathbf{a} & \mathbf{a}.\mathbf{b}\\ \mathbf{b}.\mathbf{a} & \mathbf{b}.\mathbf{b}\end{vmatrix}$ (c) $\begin{vmatrix}\mathbf{a}.\mathbf{b}\\ \mathbf{b}.\mathbf{a}\end{vmatrix}$ (d) None of these

249. Given $\mathbf{a}=\mathbf{i}+\mathbf{j}-\mathbf{k}, \mathbf{b}=-\mathbf{i}+2\mathbf{j}+\mathbf{k}$ and $\mathbf{c}=-\mathbf{i}+2\mathbf{j}-\mathbf{k}$. A unit vector perpendicular to both $\mathbf{a}+\mathbf{b}$ and $\mathbf{b}+\mathbf{c}$ is **[Karnataka CET 1993]**

(a) **i** (b) **j** (c) **k** (d) $\frac{\mathbf{i}+\mathbf{j}+\mathbf{k}}{\sqrt{3}}$

250. For any two vectors **a** and **b**, $(\mathbf{a}\times\mathbf{b})^2$ is equal to **[Roorkee 1975, 1979, 1981, 1985]**

(a) a^2-b^2 (b) a^2+b^2 (c) $a^2b^2-(\mathbf{a}.\mathbf{b})^2$ (d) None of these

251. If vectors $\vec{A}=2\mathbf{i}+3\mathbf{j}+4\mathbf{k}$, $\vec{B}=\mathbf{i}+\mathbf{j}+5\mathbf{k}$ and $\vec{C}$ form a left handed system, then $\vec{C}$ is **[Roorkee 1999]**

(a) $11\mathbf{i}-6\mathbf{j}-\mathbf{k}$ (b) $-11\mathbf{i}+6\mathbf{j}+\mathbf{k}$ (c) $11\mathbf{i}-6\mathbf{j}+\mathbf{k}$ (d) $-11\mathbf{i}+6\mathbf{j}-\mathbf{k}$

252. $(\mathbf{r}.\mathbf{i})(\mathbf{r}\times\mathbf{i})+(\mathbf{r}.\mathbf{j})(\mathbf{r}\times\mathbf{j})+(\mathbf{r}.\mathbf{k})(\mathbf{r}\times\mathbf{k})$ is equal to

(a) 3**r** (b) **r** (c) **o** (d) None of these

253. If **a, b, c** are noncoplanar vectors such that $\mathbf{b}\times\mathbf{c}=\mathbf{a}$, $\mathbf{a}\times\mathbf{b}=\mathbf{c}$ and $\mathbf{c}\times\mathbf{a}=\mathbf{b}$, then

(a) $|\mathbf{a}|=1$ (b) $|\mathbf{b}|=1$ (c) $|\mathbf{a}|+|\mathbf{b}|+|\mathbf{c}|=3$ (d) None of these

254. If $\overrightarrow{AB}=\mathbf{b}$ and $\overrightarrow{AC}=\mathbf{c}$,then the length of the perpendicular from *A* to the line *BC* is

(a) $\frac{|\mathbf{b}\times\mathbf{c}|}{|\mathbf{b}+\mathbf{c}|}$ (b) $\frac{|\mathbf{b}\times\mathbf{c}|}{|\mathbf{b}-\mathbf{c}|}$ (c) $\frac{1}{2}\frac{|\mathbf{b}\times\mathbf{c}|}{|\mathbf{b}-\mathbf{c}|}$ (d) None of these

Area of parallelogram and Triangle

Basic Level

255. The area of a parallelogram whose two adjacent sides are represented by the vector $3\mathbf{i}-\mathbf{k}$ and $\mathbf{i}+2\mathbf{j}$ is **[MNR 1981]**

(a) $\frac{1}{2}\sqrt{17}$ (b) $\frac{1}{2}\sqrt{14}$ (c) $\sqrt{41}$ (d) $\frac{1}{2}\sqrt{7}$

256. The area of the parallelogram whose diagonals are $\mathbf{a}=3\mathbf{i}+\mathbf{j}-2\mathbf{k}$ and $\mathbf{b}=\mathbf{i}-3\mathbf{j}+4\mathbf{k}$ is

[MNR 1985; MP PET 1988,93; Tamilnadu Engg. 2002]

(a) $10\sqrt{3}$ (b) $5\sqrt{3}$ (c) 8 (d) 4

257. The area of a parallelogram whose diagonals coincide with the following pair of vectors is $5\sqrt{3}$. The vectors are

[Kurukshetra CEE 1993]

(a) $3\mathbf{i}+2\mathbf{j}-\mathbf{k},\ 3\mathbf{i}-\mathbf{j}+4\mathbf{k}$ (b) $\frac{3}{2}\mathbf{i}+\frac{1}{2}\mathbf{j}-\mathbf{k},\ 2\mathbf{i}-6\mathbf{j}+8\mathbf{k}$ (c) $3\mathbf{i}+\mathbf{j}-2\mathbf{k},\ \mathbf{i}-3\mathbf{j}+8\mathbf{k}$ (d) None of these

258. If $\mathbf{i}+2\mathbf{j}+3\mathbf{k}$ and $3\mathbf{i}-2\mathbf{j}+\mathbf{k}$ represents the adjacent sides of a parallelogram, then the area of this parallelogram is

[Roorkee 1978, 1979; MP PET 1990; Rajasthan PET 1988, 1989, 1991]

(a) $4\sqrt{3}$ (b) $6\sqrt{3}$ (c) $8\sqrt{3}$ (d) $16\sqrt{3}$

259. If the vectors $\mathbf{i}-3\mathbf{j}+2\mathbf{k},\ -\mathbf{i}+2\mathbf{j}$ represents the diagonals of a parallelogram, then its area will be **[Roorkee 1976]**

(a) $\sqrt{21}$ (b) $\frac{\sqrt{21}}{2}$ (c) $2\sqrt{21}$ (d) $\frac{\sqrt{21}}{4}$

260. The area of a parallelogram whose adjacent sides are $\mathbf{i}-2\mathbf{j}+3\mathbf{k}$ and $2\mathbf{i}+\mathbf{j}-4\mathbf{k}$, is **[MP PET 1996, 2000]**

(a) $5\sqrt{3}$ (b) $10\sqrt{3}$ (c) $5\sqrt{6}$ (d) $10\sqrt{6}$

261. If the diagonals of a parallelogram are represented by the vectors $3\mathbf{i}+\mathbf{j}-2\mathbf{k}$ and $\mathbf{i}+3\mathbf{j}-4\mathbf{k}$, then its area in square units is

[MP PET 1998]

(a) $5\sqrt{3}$ (b) $6\sqrt{3}$ (c) $\sqrt{26}$ (d) $\sqrt{42}$

262. The area of a parallelogram whose adjacent sides are given by the vectors $\mathbf{i}+2\mathbf{j}+3\mathbf{k}$ and $-3\mathbf{i}-2\mathbf{j}+\mathbf{k}$ (in square units) is

[Karnataka CET 2001]

(a) $\sqrt{180}$ (b) $\sqrt{140}$ (c) $\sqrt{80}$ (d) $\sqrt{40}$

263. The area of the parallelogram whose diagonals are $\frac{3}{2}\mathbf{i}+\frac{1}{2}\mathbf{j}-\mathbf{k}$ and $2\mathbf{i}-6\mathbf{j}+8\mathbf{k}$ is **[UPSEAT 2002]**

(a) $5\sqrt{3}$ (b) $5\sqrt{2}$ (c) $25\sqrt{3}$ (d) $25\sqrt{2}$

264. The area of the triangle whose two sides are given by $2\mathbf{i}-7\mathbf{j}+\mathbf{k}$ and $4\mathbf{j}-3\mathbf{k}$ is **[EAMCET 1990]**

(a) 17 (b) $\frac{17}{2}$ (c) $\frac{17}{4}$ (d) $\frac{1}{2}\sqrt{389}$

265. If $3\mathbf{i}+4\mathbf{j}$ and $-5\mathbf{i}+7\mathbf{j}$ are the vector sides of any triangle, then its area is given by **[Rajasthan PET 1987, 1990]**

(a) 41 (b) 47 (c) $\frac{41}{2}$ (d) $\frac{47}{2}$

Advance Level

266. Let **a, b, c** be the position vectors of the vertices of a triangle *ABC*. The vector area of triangle *ABC* is **[MP PET 1990; EAMCET 2003]**

(a) $\mathbf{a}\times\mathbf{b}+\mathbf{b}\times\mathbf{c}+\mathbf{c}\times\mathbf{a}$ (b) $\frac{1}{4}(\mathbf{a}\times\mathbf{b}+\mathbf{b}\times\mathbf{c}+\mathbf{c}\times\mathbf{a})$ (c) $\frac{1}{2}(\mathbf{a}\times\mathbf{b}+\mathbf{b}\times\mathbf{c}+\mathbf{c}\times\mathbf{a})$ (d) $\mathbf{b}\times\mathbf{a}+\mathbf{c}\times\mathbf{b}+\mathbf{a}\times\mathbf{c}$

267. Consider a tetrahedron with faces F_1, F_2, F_3, F_4. Let $\vec{V_1}, \vec{V_2}, \vec{V_3}, \vec{V_4}$ be the vectors whose magnitudes are respectively equal to areas of F_1, F_2, F_3, F_4 and whose directions are perpendicular to these faces in outward direction. Then $|\vec{V_1}+\vec{V_2}+\vec{V_3}+\vec{V_4}|$ equals

(a) 1 (b) 4 (c) 0 (d) None of these

268. A unit vector perpendicular to the plane determined by the points (1, –1, 2), (2, 0, –1) and (0, 2, 1) is **[IIT 1983; MNR 19**

(a) $\pm\frac{1}{\sqrt{6}}(2\mathbf{i}+\mathbf{j}+\mathbf{k})$ (b) $\frac{1}{\sqrt{6}}(\mathbf{i}+2\mathbf{j}+\mathbf{k})$ (c) $\frac{1}{\sqrt{6}}(\mathbf{i}+\mathbf{j}+\mathbf{k})$ (d) $\frac{1}{\sqrt{6}}(2\mathbf{i}-\mathbf{j}-\mathbf{k})$

269. The position vectors of the points *A, B* and *C* are $\mathbf{i}+\mathbf{j}$, $\mathbf{j}+\mathbf{k}$ and $\mathbf{k}+\mathbf{i}$ respectively. The vector area of the $\Delta ABC = \pm\frac{1}{2}\boldsymbol{\alpha}$, where $\vec{\alpha}=$ **[MP PET 1989]**

(a) $-\mathbf{i}+\mathbf{j}+\mathbf{k}$ (b) $\mathbf{i}-\mathbf{j}+\mathbf{k}$ (c) $\mathbf{i}+\mathbf{j}-\mathbf{k}$ (d) $\mathbf{i}+\mathbf{j}+\mathbf{k}$

270. The area of the triangle having vertices as $\mathbf{i}-2\mathbf{j}+3\mathbf{k}, -2\mathbf{i}+3\mathbf{j}+\mathbf{k}, 4\mathbf{i}-7\mathbf{j}+5\mathbf{k}$ is **[MP PET 2004]**

(a) 26 (b) 11 (c) 36 (d) 0

271. Let $\vec{OA}=\mathbf{a}, \vec{OB}=10\mathbf{a}+2\mathbf{b}$ and $\vec{OC}=\mathbf{b}$, where *O, A* and *C* are noncollinear points. Let *p* denote the area of the quadrilateral *OABC,* and *q* denote the area of the parallelogram with *OA* and *OC* as adjacent sides. Then $\frac{p}{q}$ is equal to

(a) 4 (b) 6 (c) $\frac{1}{2}\frac{|\mathbf{a}-\mathbf{b}|}{|\mathbf{a}|}$ (d) None of these

272. The adjacent sides of a parallelogram are along $\mathbf{a}=\mathbf{i}+2\mathbf{j}$ and $\mathbf{b}=2\mathbf{i}+\mathbf{j}$. The angles between the diagonals are

(a) 30° and 150° (b) 45° and 135° (c) 90° and 90° (d) None of these

273. Four points with position vectors $7\mathbf{i}-4\mathbf{j}+7\mathbf{k}, \mathbf{i}-6\mathbf{j}+10\mathbf{k}, -\mathbf{i}-3\mathbf{j}+4\mathbf{k}$ and $5\mathbf{i}-\mathbf{j}+\mathbf{k}$ form a

(a) Rhombus (b) Parallelogram but not rhombus

(c) Rectangle (d) Square

274. In a ΔABC, $\vec{AB}=r\mathbf{i}+\mathbf{j}$, $\vec{AC}=s\mathbf{i}-\mathbf{j}$. If the area of triangle is of unit magnitude, then **[DCE 1996]**

(a) $|r-s|=2$ (b) $|r+s|=1$ (c) $|r+s|=2$ (d) $|r-s|=1$

Moment of a Force

Basic Level

275. The moment of the force $\vec{F}$ acting at a point *P*, about the point *C* is **[MP PET 1987]**

(a) $\vec{F}\times\vec{CP}$ (b) $\vec{CP}.\vec{F}$

(c) A vectors having the same direction as $\vec{F}$ (d) $\overrightarrow{CP} \times \vec{F}$

276. A force $\vec{F} = 2\mathbf{i} + \mathbf{j} - \mathbf{k}$ acts at a point A, whose position vector is $2\mathbf{i} - \mathbf{j}$. The moment of $\vec{F}$ about the origin is **[Karnataka C**

(a) $\mathbf{i} + 2\mathbf{j} - 4\mathbf{k}$ (b) $\mathbf{i} - 2\mathbf{j} - 4\mathbf{k}$ (c) $\mathbf{i} + 2\mathbf{j} + 4\mathbf{k}$ (d) $\mathbf{i} - 2\mathbf{j} + 4\mathbf{k}$

Advance Level

277. Let the point *A, B,* and *P* be (–2, 2, 4), (2, 6, 3) and (1, 2, 1) respectively. The magnitude of the moment of the force represented by $\overrightarrow{AB}$ and acting at *A* about *P* is **[MP PET 1987]**

(a) 15 (b) $3\sqrt{41}$ (c) $3\sqrt{57}$ (d) None of these

278. The moment about the point *M*(–2, 4, –6) of the force represented in magnitude and position by $\overrightarrow{AB}$ where the points *A* and *B* have the coordinates (1, 2, –3) and (3, –4, 2) respectively, is **[MP PET 2000]**

(a) $8\mathbf{i} - 9\mathbf{j} - 14\mathbf{k}$ (b) $2\mathbf{i} - 6\mathbf{j} + 5\mathbf{k}$ (c) $-3\mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$ (d) $-5\mathbf{i} + 8\mathbf{j} - 8\mathbf{k}$

279. A force of 39 *kg. wt* is acting at a point *P* (–4, 2, 5) in the direction of $12\mathbf{i} - 4\mathbf{j} - 3\mathbf{k}$. The moment of this force about a line through the origin having the direction of $2\mathbf{i} - 2\mathbf{j} + \mathbf{k}$ is

(a) 76 units (b) –76 units (c) $42\mathbf{i} + 144\mathbf{j} - 24\mathbf{k}$ (d) None of these

280. If the magnitude of moment about the point $\mathbf{j} + \mathbf{k}$ of a force $\mathbf{i} + \alpha\mathbf{j} - \mathbf{k}$ acting through the point $\mathbf{i} + \mathbf{j}$ is $\sqrt{8}$, then the value of α is

[Tamilnadu (Engg.) 2002]

(a) 1 (b) 2 (c) 3 (d) 4

Scalar Triple Product

Basic Level

281. $\mathbf{a}.[(\mathbf{b} + \mathbf{c}) \times (\mathbf{a} + \mathbf{b} + \mathbf{c})]$ is equal to **[Rajasthan PET 1988, 2002; IIT 1981; UPSEAT 2003; MP PET 2004]**

(a) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (b) $2[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (c) $3[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (d) 0

282. If **a, b, c** are three non-coplanar vector, then $\frac{\mathbf{a}.\mathbf{b} \times \mathbf{c}}{\mathbf{c} \times \mathbf{a}.\mathbf{b}} + \frac{\mathbf{b}.\mathbf{a} \times \mathbf{c}}{\mathbf{c}.\mathbf{a} \times \mathbf{b}} =$ **[IIT 1985, 86; UPSEAT 2003]**

(a) 0 (b) 2 (c) –2 (d) None of these

283. If **i, j, k** are the unit vectors and mutually perpendicular, then $[\mathbf{i}\ \mathbf{k}\ \mathbf{j}]$ is equal to **[Rajasthan PET 1986]**

(a) 0 (b) –1 (c) 1 (d) None of these

284. If $\mathbf{a} = 2\mathbf{i} + \mathbf{j} - \mathbf{k}$, $\mathbf{b} = \mathbf{i} + 2\mathbf{j} + \mathbf{k}$ and $\mathbf{c} = \mathbf{i} - \mathbf{j} + 2\mathbf{k}$, then $\mathbf{a}.(\mathbf{b} \times \mathbf{c}) =$ **[Rajasthan PET 1989, 2001]**

(a) 6 (b) 10 (c) 12 (d) 24

285. If $\mathbf{a}.\mathbf{b} = \mathbf{b}.\mathbf{c} = \mathbf{c}.\mathbf{a} = 0$ or **a, b, c** are a right handed triad of mutually perpendicular vectors, then [**a b c**] =

[MP PET 1994; Tamilnadu Engg. 2001]

(a) $|\mathbf{a}|\ |\mathbf{b}|\ |\mathbf{c}|$ (b) 1 (c) –1 (d) A non-zero vector

286. $\mathbf{i}.(\mathbf{j} \times \mathbf{k}) + \mathbf{j}.(\mathbf{k} \times \mathbf{i}) + \mathbf{k}.(\mathbf{i} \times \mathbf{j}) =$ **[Karnataka CET 1994]**

(a) 1 (b) 3 (c) –3 (d) 0

287. If $\mathbf{a} = 3\mathbf{i} - \mathbf{j} + 2\mathbf{k}$, $\mathbf{b} = 2\mathbf{i} + \mathbf{j} - \mathbf{k}$, then $\mathbf{a} \times (\mathbf{a}.\mathbf{b}) =$ **[Karnataka CET 1994]**

(a) 3**a** (b) $3\sqrt{14}$ (c) 0 (d) None of these

288. If $\mathbf{a}.\mathbf{i} = 4$, then $(\mathbf{a} \times \mathbf{j}).(2\mathbf{j} - 3\mathbf{k}) =$ **[EAMCET 1994]**

(a) 12 (b) 2 (c) 0 (d) – 12

289. $\mathbf{a}.(\mathbf{a}\times\mathbf{b})=$ **[MP PET 1996]**

(a) **b . b** (b) a^2b (c) 0 (d) a^2+ab

290. For three vectors **u, v, w** which of the following expressions is not equal to any of the remaining three **[IIT 1998; Orissa**

(a) $\mathbf{u}.(\mathbf{v}\times\mathbf{w})$ (b) $(\mathbf{v}\times\mathbf{w}).\mathbf{u}$ (c) $\mathbf{v}.(\mathbf{u}\times\mathbf{w})$ (d) $(\mathbf{u}\times\mathbf{v}).\mathbf{w}$

291. Which of the following expressions are meaningful **[IIT 1998; Rajasthan PET 2001]**

(a) $\mathbf{u}.(\mathbf{v}\times\mathbf{w})$ (b) $(\mathbf{u}.\mathbf{v}).\mathbf{w}$ (c) $(\mathbf{u}.\mathbf{v})\mathbf{w}$ (d) $\mathbf{u}\times(\mathbf{v}.\mathbf{w})$

292. Given vectors **a, b, c** such that $\mathbf{a}.(\mathbf{b}\times\mathbf{c})=\lambda\neq 0$, the value of $(\mathbf{b}\times\mathbf{c}).(\mathbf{a}+\mathbf{b}+\mathbf{c})/\lambda$ is **[AMU 1999]**

(a) 3 (b) 1 (c) -3λ (d) $\frac{3}{\lambda}$

293. If $\mathbf{a}=3\mathbf{i}-2\mathbf{j}+2\mathbf{k}, \mathbf{b}=6\mathbf{i}+4\mathbf{j}-2\mathbf{k}$ and $\mathbf{c}=3\mathbf{i}-2\mathbf{j}-4\mathbf{k}$, then $\mathbf{a}.(\mathbf{b}\times\mathbf{c})$ is **[Karnataka CET 2001]**

(a) 122 (b) – 144 (c) 120 (d) – 120

294. $\mathbf{a}.(\mathbf{b}\times\mathbf{c})$ is equal to **[Rajasthan PET 2001]**

(a) $\mathbf{b}.(\mathbf{a}\times\mathbf{c})$ (b) $\mathbf{c}.(\mathbf{b}\times\mathbf{a})$ (c) $\mathbf{b}.(\mathbf{c}\times\mathbf{a})$ (d) None of these

295. $[\mathbf{i}\ \mathbf{k}\ \mathbf{j}]+[\mathbf{k}\ \mathbf{j}\ \mathbf{i}]+[\mathbf{j}\ \mathbf{k}\ \mathbf{i}]$ **[UPSEAT 2002]**

(a) 1 (b) 3 (c) – 3 (d) – 1

296. If $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]=1$, then $\frac{\mathbf{a}.\mathbf{b}\times\mathbf{c}}{\mathbf{c}\times\mathbf{a}.\mathbf{b}}+\frac{\mathbf{b}.\mathbf{c}\times\mathbf{a}}{\mathbf{a}\times\mathbf{b}.\mathbf{c}}+\frac{\mathbf{c}.\mathbf{a}\times\mathbf{b}}{\mathbf{b}\times\mathbf{c}.\mathbf{a}}$ is equal to

(a) 3 (b) 1 (c) – 1 (d) None of these

297. If the vectors $2\mathbf{i}-3\mathbf{j}$, $\mathbf{i}+\mathbf{j}-\mathbf{k}$ and $3\mathbf{i}-\mathbf{k}$ form three concurrent edges of a parallelopiped, then the volume of the parallelopiped is

[IIT 1983; Rajasthan PET 1995; DCE 2001; Kurukshetra CEE 1998; MP PET 2001]

(a) 8 (b) 10 (c) 4 (d) 14

298. If three vectors $\mathbf{a}=12\mathbf{i}+4\mathbf{j}+3\mathbf{k}$, $\mathbf{b}=8\mathbf{i}-12\mathbf{j}-9\mathbf{k}$ and $\mathbf{c}=33\mathbf{i}-4\mathbf{j}-24\mathbf{k}$ represents a cube, then its volume will be

[Roorkee 1988]

(a) 616 (b) 308 (c) 154 (d) None of these

299. Volume of the parallelopiped whose coterminous edges are $2\mathbf{i}-3\mathbf{j}+4\mathbf{k}$, $\mathbf{i}+2\mathbf{j}-2\mathbf{k}$, $3\mathbf{i}-\mathbf{j}+\mathbf{k}$, is **[EAMCET 1993]**

(a) 5 cubic units (b) 6 cubic units (c) 7 cubic units (d) 8 cubic units

300. If $\mathbf{a}=-3\mathbf{i}+7\mathbf{j}+5\mathbf{k}$, $\mathbf{b}=-3\mathbf{i}+7\mathbf{j}-3\mathbf{k}$ and $\mathbf{c}=7\mathbf{i}-5\mathbf{j}-3\mathbf{k}$ are the three coterminous edges of a parallelopiped, then its volume is

[MP PET 1996]

(a) 108 (b) 210 (c) 272 (d) 308

301. Three concurrent edges *OA, OB, OC* of a parallelopiped are represented by three vectors $2\mathbf{i}+\mathbf{j}-\mathbf{k}$, $\mathbf{i}+2\mathbf{j}+3\mathbf{k}$ and $-3\mathbf{i}-\mathbf{j}+\mathbf{k}$, the volume of the solid so formed in cubic units is **[Kurukshetra CEE 1998]**

(a) 5 (b) 6 (c) 7 (d) 8

302. What will be the volume of that parallelopiped whose sides are $\mathbf{a}=\mathbf{i}-\mathbf{j}+\mathbf{k}$, $\mathbf{b}=\mathbf{i}-3\mathbf{j}+4\mathbf{k}$ and $\mathbf{c}=2\mathbf{i}-5\mathbf{j}+3\mathbf{k}$ **[UPSEAT 1**

(a) 5 unit (b) 6 unit (c) 7 unit (d) 8 unit

303. The volume of the parallelopiped whose coterminous edges are $\mathbf{i}-\mathbf{j}+\mathbf{k}$, $2\mathbf{i}-4\mathbf{j}+5\mathbf{k}$ and $3\mathbf{i}-5j+2\mathbf{k}$ is **[Kerala (Engg.) 2**

(a) 4 (b) 3 (c) 2 (d) 8

304. The volume of the parallelopiped whose edges are represented by $-12\mathbf{i}+\alpha\mathbf{k}$, $3\mathbf{j}-\mathbf{k}$ and $2\mathbf{i}+\mathbf{j}-15\mathbf{k}$ is 546, then $\alpha=$

[IIT Screening 1989; MNR 1987]

(a) 3 (b) 2 (c) – 3 (d) – 2

Advance Level

305. $|(\mathbf{a}\times\mathbf{b}).\mathbf{c}| = |\mathbf{a}||\mathbf{b}||\mathbf{c}|$, if **[Ranchi BIT 1990; IIT 1982; AMU 2002]**

(a) $\mathbf{a}.\mathbf{b}=\mathbf{b}.\mathbf{c}=0$ (b) $\mathbf{b}.\mathbf{c}=\mathbf{c}.\mathbf{a}=0$ (c) $\mathbf{c}.\mathbf{a}=\mathbf{a}.\mathbf{b}=0$ (d) $\mathbf{a}.\mathbf{b}=\mathbf{b}.\mathbf{c}=\mathbf{c}.\mathbf{a}=0$

306. If **a, b, c** be any three non-coplanar vectors, then $[\mathbf{a}+\mathbf{b}, \mathbf{b}+\mathbf{c}, \mathbf{c}+\mathbf{a}]=$

[Rajasthan PET 1988; MP PET 1990, 2002; Kerala (Engg.) 2002]

(a) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (b) $2[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (c) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]^2$ (d) $2[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]^2$

307. If **a, b, c** are three non-coplanar vectors and **p, q, r** are defined by the relations $\mathbf{p}=\frac{\mathbf{b}\times\mathbf{c}}{[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]}$, $\mathbf{q}=\frac{\mathbf{c}\times\mathbf{a}}{[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]}$, $\mathbf{r}=\frac{\mathbf{a}\times\mathbf{b}}{[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]}$, then $(\mathbf{a}+\mathbf{b}).\mathbf{p}+(\mathbf{b}+\mathbf{c}).\mathbf{q}+(\mathbf{c}+\mathbf{a}).\mathbf{r}=$ **[IIT 1988; BIT Ranchi 1996; AMU 2002]**

(a) 0 (b) 1 (c) 2 (d) 3

308. If $\mathbf{p}=\frac{\mathbf{b}\times\mathbf{c}}{[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]}$, $\mathbf{q}=\frac{\mathbf{c}\times\mathbf{a}}{[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]}$, $\mathbf{r}=\frac{\mathbf{a}\times\mathbf{b}}{[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]}$, where **a, b, c** are three non-coplanar vectors, then the value of $(\mathbf{a}+\mathbf{b}+\mathbf{c}).(\mathbf{p}+\mathbf{q}+\mathbf{r})$ is given by **[MNR 1992; UPSEAT 2000]**

(a) 3 (b) 2 (c) 1 (d) 0

309. The value of $[\mathbf{a}-\mathbf{b}\ \ \mathbf{b}-\mathbf{c}\ \ \mathbf{c}-\mathbf{a}]$, where $|\mathbf{a}|=1$, $|\mathbf{b}|=5$ and $|\mathbf{c}|=3$ is **[Rajasthan PET 1988, 2000; IIT 1989]**

(a) 0 (b) 1 (c) 2 (d) 4

310. If **a, b** and **c** are three non-coplanar vectors, then $(\mathbf{a}+\mathbf{b}+\mathbf{c}).[(\mathbf{a}+\mathbf{b})\times(\mathbf{a}+\mathbf{c})]$ is equal to **[IIT 1995]**

(a) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (b) $2[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (c) $-[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (d) 0

311. If **a, b, c** are three coplanar vectors, then $[\mathbf{a}+\mathbf{b}\ \ \mathbf{b}+\mathbf{c}\ \ \mathbf{c}+\mathbf{a}]=$ **[MP PET 1995]**

(a) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (b) $2[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (c) $3[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (d) 0

312. If **b** and **c** are any two non-collinear unit vectors and **a** is any vector, then $(\mathbf{a}.\mathbf{b})\mathbf{b}+(\mathbf{a}.\mathbf{c})\mathbf{c}+\frac{\mathbf{a}.(\mathbf{b}\times\mathbf{c})}{|\mathbf{b}\times\mathbf{c}|}(\mathbf{b}\times\mathbf{c})=$ **[IIT 1996]**

(a) **a** (b) **b** (c) **c** (d) 0

313. If three coterminous edges of a parallelopiped are represented by $\mathbf{a}-\mathbf{b}$, $\mathbf{b}-\mathbf{c}$ and $\mathbf{c}-\mathbf{a}$, then its volume is **[MP PET 19**

(a) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (b) $2[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (c) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]^2$ (d) 0

314. If **a, b** and **c** are unit coplanar vectors then the scalar triple product $[2\mathbf{a}-\mathbf{b}\ \ 2\mathbf{b}-\mathbf{c}\ \ 2\mathbf{c}-\mathbf{a}]$ is equal to **[IIT Screening 2000**

(a) 0 (b) 1 (c) $-\sqrt{3}$ (d) $\sqrt{3}$

315. Let $\mathbf{a}=\mathbf{i}-\mathbf{k}$, $\mathbf{b}=x\mathbf{i}+\mathbf{j}+(1-x)\mathbf{k}$ and $\mathbf{c}=y\mathbf{i}+x\mathbf{j}+(1+x-y)\mathbf{k}$, then $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ depends on **[IIT Screening 2001]**

(a) Only x (b) Only y (c) Neither x nor y (d) Both x and y

316. $(\mathbf{a}+\mathbf{b}).(\mathbf{b}+\mathbf{c})\times(\mathbf{a}+\mathbf{b}+\mathbf{c})=$ **[EAMCET 2002]**

(a) $-[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (b) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (c) 0 (d) $2[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$

317. Let $\mathbf{V}=2\mathbf{i}+\mathbf{j}-\mathbf{k}$ and $\mathbf{W}=\mathbf{i}+3\mathbf{k}$ if **U** is a unit vector, then the maximum value of the scalar triple product [**U V W**] is

[IIT Screening 2002]

(a) – 1 (b) $\sqrt{10}+\sqrt{6}$ (c) $\sqrt{59}$ (d) $\sqrt{60}$

318. If **a, b** are non-zero and non-collinear vectors then $[\mathbf{a}\ \mathbf{b}\ \mathbf{i}]\mathbf{i}+[\mathbf{a}\ \mathbf{b}\ \mathbf{j}]\mathbf{j}+[\mathbf{a}\ \mathbf{b}\ \mathbf{k}]\mathbf{k}$ is equal to

(a) $\mathbf{a}+\mathbf{b}$ (b) $\mathbf{a}\times\mathbf{b}$ (c) $\mathbf{a}-\mathbf{b}$ (d) $\mathbf{b}\times\mathbf{a}$

319. If **a, b, c** are three non-coplanar nonzero vectors then $(\mathbf{a}.\mathbf{a})\mathbf{b}\times\mathbf{c}+(\mathbf{a}.\mathbf{b})\mathbf{c}\times\mathbf{a}+(\mathbf{a}.\mathbf{c})\mathbf{a}\times\mathbf{b}$ is equal to

(a) $[\mathbf{b}\ \mathbf{c}\ \mathbf{a}]\mathbf{a}$ (b) $[\mathbf{c}\ \mathbf{a}\ \mathbf{b}]\mathbf{b}$ (c) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]\mathbf{c}$ (d) None of these

320. Let **a, b, c** be three unit vectors and $\mathbf{a}.\mathbf{b} = \mathbf{a}.\mathbf{c} = 0$. If the angle between **b** and **c** is $\frac{\pi}{3}$, then $|[\mathbf{a}\ \ \mathbf{b}\ \ \mathbf{c}]|$ is equal to

(a) $\frac{\sqrt{3}}{2}$ (b) $\frac{1}{2}$ (c) 1 (d) None of these

321. If **a, b, c** are three non-coplanar vectors represented by concurrent edges of a parallelopiped of volume 4, then $(\mathbf{a}+\mathbf{b}).(\mathbf{b}\times\mathbf{c})+(\mathbf{b}+\mathbf{c}).(\mathbf{c}\times\mathbf{a})+(\mathbf{c}+\mathbf{a}).(\mathbf{a}\times\mathbf{b})$ is equal to

(a) 12 (b) 4 (c) ± 12 (d) 0

322. The three concurrent edges of a parallelopiped represent the vectors **a, b, c** such that $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}] = \lambda$. Then the volume of the parallelopiped whose three concurrent edges are the three concurrent diagonals of three faces of the given parallelopiped is

(a) 2λ (b) 3λ (c) λ (d) None of these

323. If **a, b, c** are non-coplanar non-zero vectors and **r** is any vector in space then $[\mathbf{b}\ \mathbf{c}\ \mathbf{r}]\mathbf{a}+[\mathbf{c}\ \mathbf{a}\ \mathbf{r}]\mathbf{b}+[\mathbf{a}\ \mathbf{b}\ \mathbf{r}]\mathbf{c}$ is equal to

(a) $3[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]\mathbf{r}$ (b) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]\mathbf{r}$ (c) $[\mathbf{b}\ \mathbf{c}\ \mathbf{a}]\mathbf{r}$ (d) None of these

324. If the vertices of a tetrahedron have the position vectors **0**, **i** + **j**, 2**j** – **k** and $\mathbf{i}+\mathbf{k}$ then the volume of the tetrahedron is

(a) $\frac{1}{6}$ (b) 1 (c) 2 (d) None of these

325. The three vectors $\mathbf{i}+\mathbf{j}, \mathbf{j}+\mathbf{k}, \mathbf{k}+\mathbf{i}$ taken two at a time form three planes. The three unit vectors drawn perpendicular to three planes form a parallelopiped of volume

(a) $\frac{1}{3}$ cubic units (b) 4 cubic units (c) $\frac{3\sqrt{3}}{4}$ cubic units (d) $\frac{4}{3\sqrt{3}}$ cubic units

326. The volume of the tetrahedron whose vertices are the points with position vectors $\mathbf{i}-6\mathbf{j}+10\mathbf{k}, -\mathbf{i}-3\mathbf{j}+7\mathbf{k}, 5\mathbf{i}-\mathbf{j}+\lambda\mathbf{k}$ and $7\mathbf{i}-4\mathbf{j}+7\mathbf{k}$ is 11 cubic units if the value of λ is

(a) – 1 (b) 1 (c) – 7 (d) 7

327. Let **a**, **b** and **c** be three non-zero and non-coplanar vectors and **p**, **q** and **r** be three vectors given by $\mathbf{p}=\mathbf{a}+\mathbf{b}-2\mathbf{c}$, $\mathbf{q}=3\mathbf{a}-2\mathbf{b}+\mathbf{c}$ and $\mathbf{r}=\mathbf{a}-4\mathbf{b}+2\mathbf{c}$. If the volume of the parallelopiped determined by **a**, **b**, and **c** is V_1 and that of the parallelopiped determined by **p, q,** and **r** is V_2, then $V_2 : V_1 =$

(a) 2 : 3 (b) 5 : 7 (c) 15 : 1 (d) 1 : 1

328. If **a, b, c** are any three vectors and their inverse are $\mathbf{a}^{-1}, \mathbf{b}^{-1}, \mathbf{c}^{-1}$ and $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}] \neq 0$, then $[\mathbf{a}^{-1}\ \mathbf{b}^{-1}\ \mathbf{c}^{-1}]$ will be **[Roorkee 1989**

(a) Zero (b) One (c) Non-zero (d) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$

329. **a, b, c** are three non-zero, non-coplanar vectors and **p, q, r** are three other vectors such that $\mathbf{p}=\frac{\mathbf{b}\times\mathbf{c}}{\mathbf{a}.\mathbf{b}\times\mathbf{c}}$, $\mathbf{q}=\frac{\mathbf{c}\times\mathbf{a}}{\mathbf{a}.\mathbf{b}\times\mathbf{c}}$, $\mathbf{r}=\frac{\mathbf{a}\times\mathbf{b}}{\mathbf{a}.\mathbf{b}\times\mathbf{c}}$. Then $[\mathbf{p}\ \mathbf{q}\ \mathbf{r}]$ equals **[Kurukshetra CEE 1993]**

(a) $\mathbf{a}.\mathbf{b}\times\mathbf{c}$ (b) $\frac{1}{\mathbf{a}.\mathbf{b}\times\mathbf{c}}$ (c) 0 (d) None of these

Coplanarity of Vectors

Basic Level

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

[Roorkee 1986; Rajasthan PET 1999, 2002; Kurukshetra CEE 2002]

(a) – 1 (b) – 2 (c) – 3 (d) – 4

331. If $\mathbf{a}=\mathbf{i}-\mathbf{j}+\mathbf{k},\ \mathbf{b}=\mathbf{i}+2\mathbf{j}-\mathbf{k}$ and $\mathbf{c}=3\mathbf{i}+p\mathbf{j}+5\mathbf{k}$ are coplanar then the value of p will be **[Rajasthan PET 1985, 86, 88, 91]**

(a) – 6 (b) – 2 (c) 2 (d) 6

332. A unit vector which is coplanar to vector $\mathbf{i}+\mathbf{j}+2\mathbf{k}$ and $\mathbf{i}+2\mathbf{j}+\mathbf{k}$ and perpendicular to $\mathbf{i}+\mathbf{j}+\mathbf{k}$, is **[IIT 1992; Kurukshetra CEE 2002]**

(a) $\frac{\mathbf{i}-\mathbf{j}}{\sqrt{2}}$ (b) $\pm\left(\frac{\mathbf{j}-\mathbf{k}}{\sqrt{2}}\right)$ (c) $\frac{\mathbf{k}-\mathbf{i}}{\sqrt{2}}$ (d) $\frac{\mathbf{i}+\mathbf{j}+\mathbf{k}}{\sqrt{3}}$

333. 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 = **[EAMCET 1994]**

(a) $\frac{8}{5}$ (b) $\frac{5}{8}$ (c) 0 (d) 1

334. If the vectors $\mathbf{i}+3\mathbf{j}-2\mathbf{k},\ 2\mathbf{i}-\mathbf{j}+4\mathbf{k}$ and $3\mathbf{i}+2\mathbf{j}+x\mathbf{k}$ are coplanar ,then the value of x is **[Karnataka CET 2000]**

(a) – 2 (b) 2 (c) 1 (d) 3

335. $\mathbf{a}=\mathbf{i}+\mathbf{j}+\mathbf{k},\ \mathbf{b}=2\mathbf{i}-4\mathbf{k},\ \mathbf{c}=\mathbf{i}+\lambda\mathbf{j}+3\mathbf{k}$ are coplanar, then the value of λ is **[MP PET 2000]**

(a) $\frac{5}{2}$ (b) $\frac{3}{5}$ (c) $\frac{7}{3}$ (d) None of these

336. $\vec{A}=\mathbf{i}+\mathbf{j}+\mathbf{k},\ \vec{B}=\mathbf{i},\ \vec{C}=C_1\mathbf{i}+C_2\mathbf{j}+C_2\mathbf{k}$. If $C_2=-1$ and $C_3=1$, then to make three vectors coplanar **[AMU 2000]**

(a) $C_1=0$ (b) $C_1=1$

(c) $C_1=2$ (d) No value of C_1 can be found

337. The vector **a** lies in the plane of vectors **b** and **c,** which of the following is correct **[Roorkee 1990]**

(a) $\mathbf{a}.(\mathbf{b}\times\mathbf{c})=0$ (b) $\mathbf{a}.\mathbf{b}\times\mathbf{c}=1$ (c) $\mathbf{a}.\mathbf{b}\times\mathbf{c}=-1$ (d) $\mathbf{a}.\mathbf{b}\times\mathbf{c}=3$

Advance Level

338. If the vectors $\mathbf{r}_1=\sec^2 A, 1, 1;\ \mathbf{r}_2=1, \sec^2 B, 1\ ;\ \mathbf{r}_3=1, 1, \sec^2 C$ are coplanar, then $\cot^2 A+\cot^2 B+\cot^2 C$ is equal to

(a) 0 (b) 1 (c) 2 (d) Not defined

339. If $\begin{vmatrix} a & a^2 & 1+a^3 \\ b & b^2 & 1+b^3 \\ c & c^2 & 1+c^3 \end{vmatrix}=0$ and $\mathbf{a}=(1, a, a^2),\ \mathbf{b}=(1, b, b^2)$ and $\mathbf{c}=(1, c, c^2)$ are non-coplanar vectors, then abc is equal to **[IIT 1985; AIEEE 2003]**

(a) – 1 (b) 0 (c) 1 (d) 4

340. Let a, b, c be distinct non-negative numbers. If the vectors $a\mathbf{i}+a\mathbf{j}+c\mathbf{k},\ \mathbf{i}+\mathbf{k}$ and $c\mathbf{i}+c\mathbf{j}+b\mathbf{k}$ lie in a plane, then **c** is **[IIT 19**

(a) The airthmetic 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

341. If the vectors $a\mathbf{i}+\mathbf{j}+\mathbf{k},\ \mathbf{i}+b\mathbf{j}+\mathbf{k}$ and $\mathbf{i}+\mathbf{j}+c\mathbf{k}$ $(a\neq b\neq c\neq 1)$ are coplanar, then the value of $\frac{1}{1-a}+\frac{1}{1-b}+\frac{1}{1-c}=$ **[BIT Ranchi 1988; Rajasthan PET 1987; IIT 1987; DCE 2001]**

(a) – 1 (b) $-\frac{1}{2}$ (c) $\frac{1}{2}$ (d) 1

342. If **a, b, c** are position vector of vertices of a triangle ABC, then unit vector perpendicular to its plane is **[Rajasthan PET**

(a) $\mathbf{a}\times\mathbf{b}+\mathbf{b}\times\mathbf{c}+\mathbf{c}\times\mathbf{a}$ (b) $\frac{\mathbf{a}\times\mathbf{b}+\mathbf{b}\times\mathbf{c}+\mathbf{c}\times\mathbf{a}}{|\mathbf{a}\times\mathbf{b}+\mathbf{b}\times\mathbf{c}+\mathbf{c}\times\mathbf{a}|}$ (c) $\frac{\mathbf{a}\times\mathbf{b}}{|\mathbf{a}\times\mathbf{b}|}$ (d) None of these

343. If **a, b, c** are non-coplanar vectors and $\mathbf{d}=\lambda\mathbf{a}+\mu\mathbf{b}+\nu\mathbf{c}$, then λ is equal to **[Roorkee 1999]**

(a) $\frac{[\mathbf{d\ b\ c}]}{[\mathbf{b\ a\ c}]}$ (b) $\frac{[\mathbf{b\ c\ d}]}{[\mathbf{b\ c\ a}]}$ (c) $\frac{[\mathbf{b\ d\ c}]}{[\mathbf{a\ b\ c}]}$ (d) $\frac{[\mathbf{c\ b\ d}]}{[\mathbf{a\ b\ c}]}$

344. If the points whose position vectors are $3\mathbf{i}-2\mathbf{j}-\mathbf{k}$, $2\mathbf{i}+3\mathbf{j}-4\mathbf{k}$, $-\mathbf{i}+\mathbf{j}+2\mathbf{k}$ and $4\mathbf{i}+5\mathbf{j}+\lambda\mathbf{k}$ lie on a plane, then $\lambda=$ **[IIT 1986]**

(a) $-\frac{146}{17}$ (b) $\frac{146}{17}$ (c) $-\frac{17}{146}$ (d) $\frac{17}{146}$

345. Vector coplanar with vectors **i+j** and **j+k** and parallel to the vector $2\mathbf{i}-2\mathbf{j}-4\mathbf{k}$, is **[Roorkee 2000]**

(a) $\mathbf{i}-\mathbf{k}$ (b) $\mathbf{i}-\mathbf{j}-2\mathbf{k}$ (c) $\mathbf{i}+\mathbf{j}-\mathbf{k}$ (d) $3\mathbf{i}+3\mathbf{j}-6\mathbf{k}$

346. Let $\boldsymbol{\lambda}=\mathbf{a}\times(\mathbf{b}+\mathbf{c})$, $\boldsymbol{\mu}=\mathbf{b}\times(\mathbf{c}+\mathbf{a})$ and $\mathbf{v}=\mathbf{c}\times(\mathbf{a}+\mathbf{b})$. Then

(a) $\boldsymbol{\lambda}+\boldsymbol{\mu}=\mathbf{v}$ (b) $\boldsymbol{\lambda}, \boldsymbol{\mu}, \mathbf{v}$ are coplanar (c) $\boldsymbol{\lambda}+\mathbf{v}=2\boldsymbol{\mu}$ (d) None of these

347. Let $\mathbf{a}=\mathbf{i}-2\mathbf{j}+3\mathbf{k}$, $\mathbf{b}=2\mathbf{i}+3\mathbf{j}-\mathbf{k}$ and $\mathbf{c}=\lambda\mathbf{i}+\mathbf{j}+(2\lambda-1)\mathbf{k}$. If **c** is parallel to the plane of the vectors **a** and **b** then λ is

(a) 1 (b) 0 (c) – 1 (d) 2

348. The vectors $\mathbf{a}=x\mathbf{i}+(x+1)\mathbf{j}+(x+2)\mathbf{k}$, $\mathbf{b}=(x+3)\mathbf{i}+(x+4)\mathbf{j}+(x+5)\mathbf{k}$ and $\mathbf{c}=(x+6)\mathbf{i}+(x+7)\mathbf{j}+(x+8)\mathbf{k}$ are coplanar for

(a) All values of x (b) $x<0$ (c) $x>0$ (d) None of these

349. Given a cube $ABCD\,A_1B_1C_1D_1$ with lower base $ABCD$, upper base $A_1B_1C_1D_1$ and the lateral edges AA_1, BB_1, CC_1 and DD_1; M and M_1 are the centres of the faces $ABCD$ and $A_1B_1C_1D_1$ respectively. O is a point on line MM_1, such that $\overrightarrow{OA}+\overrightarrow{OB}+\overrightarrow{OC}+\overrightarrow{OD}=\overrightarrow{OM_1}$, then $\overrightarrow{OM}=\lambda.\overrightarrow{OM_1}$, if $\lambda=$

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) $\frac{1}{6}$ (d) $\frac{1}{8}$

Vector Triple Product

Basic Level

350. $\mathbf{i}\times(\mathbf{j}\times\mathbf{k})$ is equal to **[Rajasthan PET 1988; MP PET 1997]**

(a) **0** (b) **i** (c) **j** (d) **k**

351. If $\mathbf{a}=\mathbf{i}+2\mathbf{j}-2\mathbf{k}$, $\mathbf{b}=2\mathbf{i}-\mathbf{j}+\mathbf{k}$ and $\mathbf{c}=\mathbf{i}+3\mathbf{j}-\mathbf{k}$, then $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})$ is equal to **[Rajasthan PET 1989]**

(a) $20\mathbf{i}-3\mathbf{j}+7\mathbf{k}$ (b) $20\mathbf{i}-3\mathbf{j}-7\mathbf{k}$ (c) $20\mathbf{i}+3\mathbf{j}-7\mathbf{k}$ (d) None of these

352. If $\mathbf{a}=\mathbf{i}+\mathbf{j}-\mathbf{k}$, $\mathbf{b}=\mathbf{i}-\mathbf{j}+\mathbf{k}$, $\mathbf{c}=\mathbf{i}-\mathbf{j}-\mathbf{k}$, then $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})$ is **[MP PET 2000]**

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

353. If **a, b, c** are any three vectors then $(\mathbf{a}\times\mathbf{b})\times\mathbf{c}$ is a vector

(a) Perpendicular to $\mathbf{a}\times\mathbf{b}$ (b) Coplanar with **a** and **b** (c) Parallel to **c** (d) Parallel to either **a** or **b**

354. If **a** and **b** are two unit vectors, then the vector $(\mathbf{a}+\mathbf{b})\times(\mathbf{a}\times\mathbf{b})$ is parallel to the vector **[DCE 2001]**

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

355. If $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})=0$, then **[Rajasthan PET 1995]**

(a) $|\mathbf{a}|=|\mathbf{b}|.|\mathbf{c}|=1$ (b) $\mathbf{b}\parallel\mathbf{c}$ (c) $\mathbf{a}\parallel\mathbf{b}$ (d) $\mathbf{b}\perp\mathbf{c}$

356. Which of the following is a true statement **[Kurukshetra CEE 1996]**

(a) $(\mathbf{a}\times\mathbf{b})\times\mathbf{c}$ is coplanar with **c** (b) $(\mathbf{a}\times\mathbf{b})\times\mathbf{c}$ is perpendicular to **a**

(c) $(\mathbf{a}\times\mathbf{b})\times\mathbf{c}$ is perpendicular to **b** (d) $(\mathbf{a}\times\mathbf{b})\times\mathbf{c}$ is perpendicular to **c**

357. If $\mathbf{u}=\mathbf{i}\times(\mathbf{a}\times\mathbf{i})+\mathbf{j}\times(\mathbf{a}\times\mathbf{j})+\mathbf{k}\times(\mathbf{a}\times\mathbf{k})$, then **[Rajasthan PET 1989, 97; MNR 1986, 93; MP PET 1987, 98, 99, 2004; UPSEAT 2000, 2002; Kerala (Engg.) 2002]**

(a) $\mathbf{u}=0$ (b) $\mathbf{u}=\mathbf{i}+\mathbf{j}+\mathbf{k}$ (c) $\mathbf{u}=2\mathbf{a}$ (d) $\mathbf{u}=\mathbf{a}$

358. A unit vector perpendicular to vector **c** and coplanar with vectors **a** and **b** is **[MP PET 1999]**

(a) $\dfrac{\mathbf{a}\times(\mathbf{b}\times\mathbf{c})}{|\mathbf{a}\times(\mathbf{b}\times\mathbf{c})|}$ (b) $\dfrac{\mathbf{b}\times(\mathbf{c}\times\mathbf{a})}{|\mathbf{b}\times(\mathbf{c}\times\mathbf{a})|}$ (c) $\dfrac{\mathbf{c}\times(\mathbf{a}\times\mathbf{b})}{|\mathbf{c}\times(\mathbf{a}\times\mathbf{b})|}$ (d) None of these

359. $\mathbf{i}\times(\mathbf{j}\times\mathbf{k})+\mathbf{j}\times(\mathbf{k}\times\mathbf{i})+\mathbf{k}\times(\mathbf{i}\times\mathbf{j})$ equals **[Rajasthan PET 1999]**

(a) **i** (b) **j** (c) **k** (d) **0**

360. Given three unit vectors **a, b, c** such that $\mathbf{a}\perp\mathbf{b}$ and $\mathbf{a}\parallel\mathbf{c}$, then $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})$ is **[AMU 1999]**

(a) **a** (b) **b** (c) **c** (d) **0**

361. $\vec{A}=\mathbf{i}-2\mathbf{j}-3\mathbf{k}$, $\vec{B}=2\mathbf{i}+\mathbf{j}-\mathbf{k}$, $\vec{C}=\mathbf{i}+3\mathbf{j}-2\mathbf{k}$, then $(\vec{A}\times\vec{B})\times\vec{C}$ is **[MP PET 2001]**

(a) $5(-\mathbf{i}+3\mathbf{j}+4\mathbf{k})$ (b) $4(-\mathbf{i}+3\mathbf{j}+4\mathbf{k})$ (c) $5(-\mathbf{i}-3\mathbf{j}-4\mathbf{k})$ (d) $4(\mathbf{i}+3\mathbf{j}+4\mathbf{k})$

362. If **i, j, k** are unit vectors, then **[MP PET 2001]**

(a) $\mathbf{i}.\mathbf{j}=1$ (b) $\mathbf{i}.\mathbf{i}=1$ (c) $\mathbf{i}\times\mathbf{j}=1$ (d) $\mathbf{i}\times(\mathbf{j}\times\mathbf{k})=1$

363. If **a, b, c** are any vectors, then the true statement is **[Rajasthan PET 1988]**

(a) $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})=(\mathbf{a}\times\mathbf{b})\times\mathbf{c}$ (b) $\mathbf{a}\times\mathbf{b}=\mathbf{b}\times\mathbf{a}$ (c) $\mathbf{a}.(\mathbf{b}\times\mathbf{c})=\mathbf{a}.\mathbf{b}\times\mathbf{a}.\mathbf{c}$ (d) $\mathbf{a}.(\mathbf{b}-\mathbf{c})=\mathbf{a}.\mathbf{b}-\mathbf{a}.\mathbf{c}$

364. $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})$ is equal to **[Rajasthan PET 1995; Kurukshetra CEE 1998; MP PET 2003]**

(a) $(\mathbf{a}.\mathbf{c})\mathbf{b}-(\mathbf{a}.\mathbf{a})\mathbf{b}$ (b) $(\mathbf{a}.\mathbf{c})\mathbf{a}-(\mathbf{b}.\mathbf{c})\mathbf{a}$ (c) $(\mathbf{a}.\mathbf{c})\mathbf{b}-(\mathbf{a}.\mathbf{b})\mathbf{c}$ (d) $(\mathbf{a}.\mathbf{b})\mathbf{c}-(\mathbf{a}.\mathbf{c})\mathbf{b}$

365. $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})+\mathbf{b}\times(\mathbf{c}\times\mathbf{a})+\mathbf{c}\times(\mathbf{a}\times\mathbf{b})=$ **[Rajasthan PET 2003]**

(a) **0** (b) $2[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ (c) $\mathbf{a}+\mathbf{b}+\mathbf{c}$ (d) $3[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$

Advance Level

366. If **a, b, c** are non-coplanar unit vectors such that $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})=\dfrac{\mathbf{b}+\mathbf{c}}{\sqrt{2}}$, then the angle between **a** and **b** is **[IIT 1995]**

(a) $\dfrac{\pi}{4}$ (b) $\dfrac{\pi}{2}$ (c) $\dfrac{3\pi}{4}$ (d) π

367. Let **a, b, c** be three vectors from $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})=(\mathbf{a}\times\mathbf{b})\times\mathbf{c}$, if **[Orissa JEE 2003]**

(a) $\mathbf{b}\times(\mathbf{a}\times\mathbf{c})=\mathbf{0}$ (b) $\mathbf{a}.(\mathbf{b}\times\mathbf{c})=0$ (c) $\mathbf{c}\times\mathbf{a}=\mathbf{a}\times\mathbf{b}$ (d) $\mathbf{c}\times\mathbf{b}=\mathbf{b}\times\mathbf{a}$

368. If **a, b, c** are any three vectors such that $(\mathbf{a}+\mathbf{b}).\mathbf{c}=(\mathbf{a}-\mathbf{b}).\mathbf{c}=0$, then $(\mathbf{a}\times\mathbf{b})\times\mathbf{c}$ is

(a) **0** (b) **a** (c) **b** (d) None of these

369. If three unit vectors **a, b, c** are such that $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})=\dfrac{\mathbf{b}}{2}$, then the vector **a** makes with **b** and **c** respectively the angles **[MP PET 1998]**

(a) $40^\circ, 80^\circ$ (b) $45^\circ, 45^\circ$ (c) $30^\circ, 60^\circ$ (d) $90^\circ, 60^\circ$

370. $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})$, $\mathbf{b}\times(\mathbf{c}\times\mathbf{a})$ and $\mathbf{c}\times(\mathbf{a}\times\mathbf{b})$ are

(a) Linearly dependent (b) Equal vectors (c) Parallel vectors (d) None of these

371. **a** and **b** are two given vectors. On these vectors as adjacent sides a parallelogram is constructed. The vector which is the altitude of the parallelogram and which is perpendicular to **a** is

(a) $\frac{(\mathbf{a}.\mathbf{b})}{|\mathbf{a}|^2}\mathbf{a}-\mathbf{b}$ (b) $\frac{1}{|\mathbf{a}|^2}\{|\mathbf{a}|^2\mathbf{b}-(\mathbf{a}.\mathbf{b})\mathbf{a}\}$ (c) $\frac{\mathbf{a}\times(\mathbf{a}\times\mathbf{b})}{|\mathbf{a}|^2}$ (d) $\frac{\mathbf{a}\times(\mathbf{b}\times\mathbf{a})}{|\mathbf{b}|^2}$

Scalar and Vector Product of Four or more Vectors

Basic Level

372. If $\alpha = 2\mathbf{i}+3\mathbf{j}-\mathbf{k},\ \beta = -\mathbf{i}+2\mathbf{j}-4\mathbf{k}$ and $\gamma = \mathbf{i}+\mathbf{j}+\mathbf{k}$, then $(\alpha\times\beta).(\alpha\times\gamma)$ is equal to **[MNR 1984; UPSEAT 2000]**

(a) 60 (b) 64 (c) 74 (d) – 74

373. $(\mathbf{b}\times\mathbf{c})\times(\mathbf{c}\times\mathbf{a}) =$ **[MP PET 1997]**

(a) [**b c a**]**a** (b) [**c a b**]**b** (c) [**a b c**]**c** (d) [**a c b**]**b**

374. If **a, b, c, d** are coplanar vectors, then $(\mathbf{a}\times\mathbf{b})\times(\mathbf{c}\times\mathbf{d}) =$ **[MP PET 1998]**

(a) $|\mathbf{a}\times\mathbf{c}|^2$ (b) $|\mathbf{a}\times\mathbf{d}|^2$ (c) $|\mathbf{b}\times\mathbf{c}|^2$ (d) 0

375. If **.** and × represent dot product and cross product respectively then which of the following is meaningless

(a) $(\mathbf{a}\times\mathbf{b}).(\mathbf{c}\times\mathbf{d})$ (b) $(\mathbf{a}\times\mathbf{b})\times(\mathbf{c}\times\mathbf{d})$ (c) $(\mathbf{a}.\mathbf{b})\,(\mathbf{c}\times\mathbf{d})$ (d) $(\mathbf{a}.\mathbf{b})\times(\mathbf{c}\times\mathbf{d})$

376. Two planes are perpendicular to one another. One of them contains vectors **a** and **b** and the other contains vectors **c** and **d**, then $(\mathbf{a}\times\mathbf{b}).(\mathbf{c}\times\mathbf{d})$ equals

(a) 1 (b) 0 (c) [**a b c**] (d) [**b c d**]

Advance Level

377. **a, b, c, d** are any four vectors then $(\mathbf{a}\times\mathbf{b})\times(\mathbf{c}\times\mathbf{d})$ is a vector

(a) Perpendicular to **a, b, c, d**

(b) Along the line of intersection of two planes, one containing **a, b** and the other containing **c, d**

(c) Equally inclined to both $\mathbf{a}\times\mathbf{b}$ and $\mathbf{c}\times\mathbf{d}$

(d) None of these

378. If **a, b, c** are non-coplanar non-zero vectors then $(\mathbf{a}\times\mathbf{b})\times(\mathbf{a}\times\mathbf{c})+(\mathbf{b}\times\mathbf{c})\times(\mathbf{b}\times\mathbf{a})+(\mathbf{c}\times\mathbf{a})\times(\mathbf{c}\times\mathbf{b})$ is equal to

(a) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]^2\ (\mathbf{a}+\mathbf{b}+\mathbf{c})$ (b) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}](\mathbf{a}+\mathbf{b}+\mathbf{c})$ (c) **0** (d) None of these

379. If **a, b, c** are three non-coplanar non-zero vectors and **r** is any vector is space then $(\mathbf{a}\times\mathbf{b})\times(\mathbf{r}\times\mathbf{c})+(\mathbf{b}\times\mathbf{c})\times(\mathbf{r}\times\mathbf{a})+(\mathbf{c}\times\mathbf{a})\times(\mathbf{r}\times\mathbf{b})$ is equal to

(a) 2[**a b c**]**r** (b) 3[**a b c**]**r** (c) [**a b c**]**r** (d) None of these

380. If $\mathbf{a}\parallel\ \mathbf{b}\times\mathbf{c}$ then $(\mathbf{a}\times\mathbf{b}).(\mathbf{a}\times\mathbf{c})$ is equal to

(a) $\mathbf{a}^2(\mathbf{b}.\mathbf{c})$ (b) $\mathbf{b}^2(\mathbf{a}.\mathbf{c})$ (c) $\mathbf{c}^2(\mathbf{a}.\mathbf{b})$ (d) None of these

381. $(\mathbf{a}\times\mathbf{b}).(\mathbf{c}\times\mathbf{d})$ is equal to

(a) $\mathbf{a}.\{\mathbf{b}\times(\mathbf{c}\times\mathbf{d})\}$ (b) $(\mathbf{a}.\mathbf{c})(\mathbf{b}.\mathbf{d})-(\mathbf{a}.\mathbf{d})(\mathbf{b}.\mathbf{c})$ (c) $\{(\mathbf{a}\times\mathbf{b})\times\mathbf{c}\}.\mathbf{d}$ (d) $(\mathbf{d}\times\mathbf{c}).(\mathbf{b}\times\mathbf{a})$

382. $(\mathbf{a}\times\mathbf{b})\times(\mathbf{a}\times\mathbf{c}).\mathbf{d}$ equals

(a) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}](\mathbf{b}.\mathbf{d})$ (b) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}](\mathbf{a}.\mathbf{d})$ (c) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}](\mathbf{c}.\mathbf{d})$ (d) None of these

383. $[(\mathbf{a}\times\mathbf{b})\times(\mathbf{b}\times\mathbf{c})\ (\mathbf{b}\times\mathbf{c})\times(\mathbf{c}\times\mathbf{a})\ (\mathbf{c}\times\mathbf{a})\times(\mathbf{a}\times\mathbf{b})]$ is equal to

(a) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]^2$ (b) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]^3$ (c) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]^4$ (d) None of these

384. If **a, b, c** are coplanar vectors, then **[IIT 1989]**

(a) $\begin{vmatrix}\mathbf{a} & \mathbf{b} & \mathbf{c}\\ \mathbf{b} & \mathbf{c} & \mathbf{a}\\ \mathbf{c} & \mathbf{a} & \mathbf{b}\end{vmatrix}=0$ (b) $\begin{vmatrix}\mathbf{a} & \mathbf{b} & \mathbf{c}\\ \mathbf{a}.\mathbf{a} & \mathbf{a}.\mathbf{b} & \mathbf{a}.\mathbf{c}\\ \mathbf{b}.\mathbf{a} & \mathbf{b}.\mathbf{b} & \mathbf{b}.\mathbf{c}\end{vmatrix}=0$ (c) $\begin{vmatrix}\mathbf{a} & \mathbf{b} & \mathbf{c}\\ \mathbf{c}.\mathbf{a} & \mathbf{c}.\mathbf{b} & \mathbf{c}.\mathbf{c}\\ \mathbf{b}.\mathbf{a} & \mathbf{b}.\mathbf{c} & \mathbf{b}.\mathbf{b}\end{vmatrix}=0$ (d) $\begin{vmatrix}\mathbf{a} & \mathbf{b} & \mathbf{c}\\ \mathbf{a}.\mathbf{b} & \mathbf{a}.\mathbf{a} & \mathbf{a}.\mathbf{c}\\ \mathbf{c}.\mathbf{a} & \mathbf{c}.\mathbf{c} & \mathbf{c}.\mathbf{b}\end{vmatrix}=0$

385. For any three non-zero vectors $\mathbf{r}_1$, $\mathbf{r}_2$ and $\mathbf{r}_3$, $\begin{vmatrix}\mathbf{r}_1.\mathbf{r}_1 & \mathbf{r}_1.\mathbf{r}_2 & \mathbf{r}_1.\mathbf{r}_3\\ \mathbf{r}_2.\mathbf{r}_1 & \mathbf{r}_2.\mathbf{r}_2 & \mathbf{r}_2.\mathbf{r}_3\\ \mathbf{r}_3.\mathbf{r}_1 & \mathbf{r}_3.\mathbf{r}_2 & \mathbf{r}_3.\mathbf{r}_3\end{vmatrix}=0$. Then which of the following is false **[AMU 2000]**

(a) All the three vectors are parallel to one and the same plane (b) All the three vectors are linearly dependent

(c) This system of equation has a non-trivial solution (d) All the three vectors are perpendicular to each other

386. $[\mathbf{b}\ \ \mathbf{c}\ \ \mathbf{b}\times\mathbf{c}]+(\mathbf{b}.\mathbf{c})^2$ is equal to

(a) $|\mathbf{b}|^2|\mathbf{c}|^2$ (b) $(\mathbf{b}+\mathbf{c})^2$ (c) $|\mathbf{b}|^2+|\mathbf{c}|^2$ (d) None of these

387. If **a, b, c** are vectors such that [**a b c**] = 4, then $[\mathbf{a}\times\mathbf{b}\ \ \mathbf{b}\times\mathbf{c}\ \ \mathbf{c}\times\mathbf{a}]=$ **[AIEEE 2002]**

(a) 16 (b) 64 (c) 4 (d) 8

Vector Equations

Basic Level

388. If position vector of points *A, B, C* are respectively **i, j, k** and *AB* = *CX*, then position vector of point *X* is **[MP PET 1994]**

(a) $-\mathbf{i}+\mathbf{j}+\mathbf{k}$ (b) $\mathbf{i}-\mathbf{j}+\mathbf{k}$ (c) $\mathbf{i}+\mathbf{j}-\mathbf{k}$ (d) $\mathbf{i}+\mathbf{j}+\mathbf{k}$

389. If $\mathbf{a}.\mathbf{i}=\mathbf{a}.(\mathbf{i}+\mathbf{j})=\mathbf{a}.(\mathbf{i}+\mathbf{j}+\mathbf{k})$, then **a** = **[EAMCET 2002]**

(a) **i** (b) **k** (c) **j** (d) $\mathbf{i}+\mathbf{j}+\mathbf{k}$

390. If $\mathbf{a}=\mathbf{i}+\mathbf{j}$, $\mathbf{b}=2\mathbf{j}-\mathbf{k}$ and $\mathbf{r}\times\mathbf{a}=\mathbf{b}\times\mathbf{a}$, $\mathbf{r}\times\mathbf{b}=\mathbf{a}\times\mathbf{b}$, then $\frac{\mathbf{r}}{|\mathbf{r}|}$ is equal to

(a) $\frac{1}{\sqrt{11}}(\mathbf{i}+3\mathbf{j}-\mathbf{k})$ (b) $\frac{1}{\sqrt{11}}(\mathbf{i}-3\mathbf{j}+\mathbf{k})$ (c) $\frac{1}{\sqrt{3}}(\mathbf{i}-\mathbf{j}+\mathbf{k})$ (d) None of these

391. Given that the vectors **a** and **b** are non-collinear, the values of x and y for which the vector equality $2\mathbf{u}-\mathbf{v}=\mathbf{w}$ holds true if $\mathbf{u}=x\mathbf{a}+2y\mathbf{b}$, $\mathbf{v}=-2y\mathbf{a}+3x\mathbf{b}$, $\mathbf{w}=4\mathbf{a}-2\mathbf{b}$ are

(a) $x=\frac{4}{7}, y=\frac{6}{7}$ (b) $x=\frac{10}{7}, y=\frac{4}{7}$ (c) $x=\frac{8}{7}, y=\frac{2}{7}$ (d) $x=2, y=3$

392. If $\mathbf{a}\times\mathbf{b}=\mathbf{c}\times\mathbf{d}$ and $\mathbf{a}\times\mathbf{c}=\mathbf{b}\times\mathbf{d}$, then

(a) $(\mathbf{a}-\mathbf{d})=\lambda(\mathbf{b}-\mathbf{c})$ (b) $\mathbf{a}+\mathbf{d}=\lambda(\mathbf{b}+\mathbf{c})$ (c) $(\mathbf{a}-\mathbf{b})=\lambda(\mathbf{c}+\mathbf{d})$ (d) None of these

393. If $\mathbf{r}.\mathbf{a}=\mathbf{r}.\mathbf{b}=\mathbf{r}.\mathbf{c}=0$ where **a, b, c** are non-coplanar, then

(a) $\mathbf{r}\perp\mathbf{c}\times\mathbf{a}$ (b) $\mathbf{r}\perp\mathbf{a}\times\mathbf{b}$ (c) $\mathbf{r}\perp\mathbf{b}\times\mathbf{c}$ (d) $\mathbf{r}=0$

394. If **i, j, k** are unit orthonormal vectors and **a** is a vector, if $\mathbf{a}\times\mathbf{r}=\mathbf{j}$, then $\mathbf{a}.\mathbf{r}$ is **[EAMCET 1990]**

(a) 0 (b) 1 (c) – 1 (d) Arbitrary scalar

395. $\mathbf{a}\times\mathbf{b}=\mathbf{a}\times\mathbf{c}$ where $(\mathbf{a}\neq 0)$ implies that **[Kurukshetra CEE 1996]**

(a) **b** = **c**
(b) **a** and **b** are parallel
(c) **a, b, c** are mutually perpendicular
(d) **a, b, c** are coplanar

396. The scalars l and m such that $l\mathbf{a}+m\mathbf{b}=\mathbf{c}$, where **a, b** and **c** are given vectors, are equal to

(a) $l=\frac{(\mathbf{c}\times\mathbf{b}).(\mathbf{a}\times\mathbf{b})}{(\mathbf{a}\times\mathbf{b})^2}, m=\frac{(\mathbf{c}\times\mathbf{a}).(\mathbf{b}\times\mathbf{a})}{(\mathbf{b}\times\mathbf{a})^2}$
(b) $l=\frac{(\mathbf{c}\times\mathbf{b}).(\mathbf{a}\times\mathbf{b})}{(\mathbf{a}\times\mathbf{b})}, m=\frac{(\mathbf{c}\times\mathbf{a}).(\mathbf{b}\times\mathbf{a})}{(\mathbf{b}\times\mathbf{a})}$
(c) $l=\frac{(\mathbf{c}\times\mathbf{b})\times(\mathbf{a}\times\mathbf{b})}{(\mathbf{a}\times\mathbf{b})^2}, m=\frac{(\mathbf{c}\times\mathbf{a})\times(\mathbf{b}\times\mathbf{a})}{(\mathbf{b}\times\mathbf{a})}$
(d) None of these

397. If **a** is a vector perpendicular to the vectors $\mathbf{b}=\mathbf{i}+2\mathbf{j}+3\mathbf{k}$ and $\mathbf{c}=-2\mathbf{i}+4\mathbf{j}+\mathbf{k}$ and satisfies the condition $\mathbf{a}.(\mathbf{i}-2\mathbf{j}+\mathbf{k})=-6$, then **a** =

(a) $5\mathbf{i}+\frac{7}{2}\mathbf{j}-4\mathbf{k}$ (b) $10\mathbf{i}+7\mathbf{j}-8\mathbf{k}$ (c) $5\mathbf{i}-\frac{7}{2}\mathbf{j}+4\mathbf{k}$ (d) None of these

398. If **a** = (1, – 1, 1) and **c** = (– 1, – 1, 0), then the vector **b** satisfying $\mathbf{a}\times\mathbf{b}=\mathbf{c}$ and $\mathbf{a}.\mathbf{b}=1$ is **[MP PET 1989]**

(a) (1, 0, 0) (b) (0, 0, 1) (c) (0, – 1, 0) (d) None of these

399. If **a** = (1, 1, 1), **c** = (0, 1, – 1) are two vectors and **b** is a vector such that $\mathbf{a}\times\mathbf{b}=\mathbf{c}$ and $\mathbf{a}.\mathbf{b}=3$, then **b** is equal to **[IIT 1985, 1991]**

(a) $\left(\frac{2}{3},\frac{2}{3},\frac{5}{3}\right)$ (b) $\left(\frac{2}{3},\frac{5}{3},\frac{2}{3}\right)$ (c) (5, 2, 2) (d) $\left(\frac{5}{3},\frac{2}{3},\frac{2}{3}\right)$

400. If $\mathbf{a}=2\mathbf{i}+\mathbf{k}, \mathbf{b}=\mathbf{i}+\mathbf{j}+\mathbf{k}$ and $\mathbf{c}=4\mathbf{i}-3\mathbf{j}+7\mathbf{k}$. If $\mathbf{d}\times\mathbf{b}=\mathbf{c}\times\mathbf{b}$ and $\mathbf{d}.\mathbf{a}=0$, then **d** will be **[IIT 1990]**

(a) $\mathbf{i}+8\mathbf{j}+2\mathbf{k}$ (b) $\mathbf{i}-8\mathbf{j}+2\mathbf{k}$ (c) $-\mathbf{i}+8\mathbf{j}-\mathbf{k}$ (d) $-\mathbf{i}-8\mathbf{j}+2\mathbf{k}$

401. If $\mathbf{a}.\mathbf{b}=\mathbf{a}.\mathbf{c}$, $\mathbf{a}\times\mathbf{b}=\mathbf{a}\times\mathbf{c}$ and $\mathbf{a}\neq 0$, then **[Rajasthan PET 1990]**

(a) **b** = **0** (b) $\mathbf{b}\neq\mathbf{c}$ (c) $\mathbf{b}=\mathbf{c}$ (d) None of these

402. If $\mathbf{x}.\mathbf{a}=0$, $\mathbf{x}.\mathbf{b}=0$ and $\mathbf{x}.\mathbf{c}=0$ for some non-zero vector **x**, then the true statement is **[IIT 1983; Karnataka CET 2002]**

(a) [**a b c**] = 0 (b) $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]\neq 0$ (c) [**a b c**] = 1 (d) None of these

403. A unit vector **a** makes an angle $\frac{\pi}{4}$ with z-axis. If $\mathbf{a}+\mathbf{i}+\mathbf{j}$ is a unit vector, then **a** is equal to **[IIT 1988]**

(a) $\frac{\mathbf{i}}{2}+\frac{\mathbf{j}}{2}+\frac{\mathbf{k}}{\sqrt{2}}$ (b) $\frac{\mathbf{i}}{2}+\frac{\mathbf{j}}{2}-\frac{\mathbf{k}}{\sqrt{2}}$ (c) $-\frac{\mathbf{i}}{2}-\frac{\mathbf{j}}{2}+\frac{\mathbf{k}}{\sqrt{2}}$ (d) None of these

404. If $[3\mathbf{a}+5\mathbf{b}\ \mathbf{c}\ \mathbf{d}]=p[\mathbf{a}\ \mathbf{c}\ \mathbf{d}]+q[\mathbf{b}\ \mathbf{c}\ \mathbf{d}]$, then $p+q=0$

(a) 8 (b) – 8 (c) 2 (d) 0

Advance Level

405. Given the following simultaneous equations for vectors **x** and **y**

$\mathbf{x}+\mathbf{y}=\mathbf{a}$ ....(i) $\mathbf{x}\times\mathbf{y}=\mathbf{b}$ ....(ii) $\mathbf{x}.\mathbf{a}=1$ ....(iii). Then **x** =............., **y** = ... **[Roorkee 1994]**

(a) **a**, **a** – **x** (b) **a** – **b**, **b** (c) **b**, **a** – **b** (d) None of these

406. $\mathbf{r}\times\mathbf{a}=\mathbf{b}\times\mathbf{a}$; $\mathbf{r}\times\mathbf{b}=\mathbf{a}\times\mathbf{b}$; $\mathbf{a}\neq 0$; $\mathbf{b}\neq 0$; $\mathbf{a}\neq\lambda\mathbf{b}$, **a** is not perpendicular to **b**, then **r** = **[EAMCET 1993]**

(a) **a** – **b** (b) **a** +**b** (c) $\mathbf{a}\times\mathbf{b}+\mathbf{a}$ (d) $\mathbf{a}\times\mathbf{b}+\mathbf{b}$

407. Let $\mathbf{a}=2\mathbf{i}+\mathbf{j}-2\mathbf{k}$ and $\mathbf{b}=\mathbf{i}+\mathbf{j}$. If **c** is a vector such that $\mathbf{a}.\mathbf{c}=|\mathbf{c}|$, $|\mathbf{c}-\mathbf{a}|=2\sqrt{2}$ and the angle between $(\mathbf{a}\times\mathbf{b})$ and **c** is 30^o, then $|(\mathbf{a}\times\mathbf{b})\times\mathbf{c}|=$ **[IIT 1999]**

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

408. Let $\mathbf{a}=2\mathbf{i}+\mathbf{j}+\mathbf{k}$, $\mathbf{b}=\mathbf{i}+2\mathbf{j}-\mathbf{k}$ and a unit vector **c** be coplanar. If **c** is perpendicular to **a**, then **c** = **[IIT 1999]**

(a) $\frac{1}{\sqrt{2}}(-\mathbf{j}+\mathbf{k})$ (b) $\frac{1}{\sqrt{3}}(-\mathbf{i}-\mathbf{j}-\mathbf{k})$ (c) $\frac{1}{\sqrt{5}}(\mathbf{i}-2\mathbf{j})$ (d) $\frac{1}{\sqrt{3}}(\mathbf{i}-\mathbf{j}-\mathbf{k})$

409. Let **a** and **b** be two non-collinear unit vectors. If $\mathbf{u}=\mathbf{a}-(\mathbf{a}.\mathbf{b})\mathbf{b}$ and $\mathbf{v}=\mathbf{a}\times\mathbf{b}$, then $|\mathbf{v}|$ is **[IIT 1999]**

(a) $|\mathbf{u}|$ (b) $|\mathbf{u}|+|\mathbf{u}.\mathbf{a}|$ (c) $|\mathbf{u}|+|\mathbf{u}.\mathbf{b}|$ (d) $|\mathbf{u}|+\mathbf{u}.(\mathbf{a}+\mathbf{b})$

410. Let **a, b, c** be three vectors such that $\mathbf{a}\neq\mathbf{0}$ and $\mathbf{a}\times\mathbf{b}=2\mathbf{a}\times\mathbf{c}$, $|\mathbf{a}|=|\mathbf{c}|=1, |\mathbf{b}|=4$ and $|\mathbf{b}\times\mathbf{c}|=\sqrt{15}$. If $\mathbf{b}-2\mathbf{c}=\lambda\mathbf{a}$, then λ equal to **[Orissa JEE 2004]**

(a) 1 (b) – 4 (c) 4 (d) – 2

411. Unit vectors **a**, **b** and **c** are coplanar. A unit vector **d** is perpendicular to them. If $(\mathbf{a}\times\mathbf{b})\times(\mathbf{c}\times\mathbf{d})=\frac{1}{6}\mathbf{i}-\frac{1}{3}\mathbf{j}+\frac{1}{3}\mathbf{k}$ and the angle between **a** and **b** is 30^o, then **c** is **[Roorkee Qualifying 1998]**

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

412. If vectors **a, b, c** satisfy the condition $|\mathbf{a}-\mathbf{c}|=|\mathbf{b}-\mathbf{c}|$, then $(\mathbf{b}-\mathbf{a}).\left(\mathbf{c}-\frac{\mathbf{a}+\mathbf{b}}{2}\right)$ is equal to **[AMU 1999]**

(a) 0 (b) – 1 (c) 1 (d) 2

413. Let **r** be a vector perpendicular to $\mathbf{a}+\mathbf{b}+\mathbf{c}$, where $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]=2$. If $\mathbf{r}=l(\mathbf{b}\times\mathbf{c})+m(\mathbf{c}\times\mathbf{a})+n(\mathbf{a}\times\mathbf{b})$, then $l+m+n$ is

(a) 2 (b) 1 (c) 0 (d) None of these

414. Let **a**, **b** and **c** be three vectors having magnitudes 1, 1 and 2 respectively. If $\mathbf{a}\times(\mathbf{a}\times\mathbf{c})+\mathbf{b}=\mathbf{0}$, the acute angle between **a** and **c** is

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{6}$ (d) None of these

415. If $\mathbf{a}=\mathbf{i}+\mathbf{j}-\mathbf{k}, \mathbf{b}=\mathbf{i}-\mathbf{j}+\mathbf{k}$ and **c** is a unit vector perpendicular to the vector **a** and coplanar with **a** and **b**, then a unit vector **d** perpendicular to both **a** and **c** is

(a) $\frac{1}{\sqrt{6}}(2\mathbf{i}-\mathbf{j}+\mathbf{k})$ (b) $\frac{1}{\sqrt{2}}(\mathbf{j}+\mathbf{k})$ (c) $\frac{1}{\sqrt{2}}(\mathbf{i}+\mathbf{j})$ (d) $\frac{1}{\sqrt{2}}(\mathbf{i}+\mathbf{k})$

416. If **a** is perpendicular to **b** and **r** is a non-zero vector such that $p\mathbf{r}+(\mathbf{r}.\mathbf{b})\mathbf{a}=\mathbf{c}$, then $\mathbf{r}=$

(a) $\frac{\mathbf{c}}{p}-\frac{(\mathbf{b}.\mathbf{c})\mathbf{a}}{p^2}$ (b) $\frac{\mathbf{a}}{p}-\frac{(\mathbf{c}.\mathbf{a})\mathbf{b}}{p^2}$ (c) $\frac{\mathbf{b}}{p}-\frac{(\mathbf{a}.\mathbf{b})\mathbf{c}}{p^2}$ (d) $\frac{\mathbf{c}}{p^2}-\frac{(\mathbf{b}.\mathbf{c})\mathbf{a}}{p}$

417. Given three vectors **a, b, c** such that $\mathbf{b}.\mathbf{c}=3,\ \mathbf{a}.\mathbf{c}=\frac{1}{3}$. The vector **r** which satisfies $\mathbf{r}\times\mathbf{a}=\mathbf{b}\times\mathbf{a}$ and $\mathbf{r}.\mathbf{c}=0$ is

(a) $\mathbf{b}+9\mathbf{a}$ (b) $\mathbf{a}+9\mathbf{b}$ (c) $\mathbf{b}-9\mathbf{a}$ (d) None of these

418. If $\mathbf{a}=\mathbf{i}+\mathbf{j}$ and $\mathbf{b}=2\mathbf{i}-\mathbf{k}$ are two vectors ,then the point of intersection of two lines $\mathbf{r}\times\mathbf{a}=\mathbf{b}\times\mathbf{a}$ and $\mathbf{r}\times\mathbf{b}=\mathbf{a}\times\mathbf{b}$ is

[IIT 1992; Rajasthan PET 2000]

(a) $\mathbf{i}+\mathbf{j}-\mathbf{k}$ (b) $\mathbf{i}-\mathbf{j}+\mathbf{k}$ (c) $3\mathbf{i}+\mathbf{j}-\mathbf{k}$ (d) $3\mathbf{i}-\mathbf{j}+\mathbf{k}$

419. A line passes through the points whose position vectors are $\mathbf{i}+\mathbf{j}-2\mathbf{k}$ and $\mathbf{i}-3\mathbf{j}+\mathbf{k}$. The position vector of a point on it at a unit distance from the first point is

(a) $\frac{1}{5}(5\mathbf{i}+\mathbf{j}-7\mathbf{k})$ (b) $\frac{1}{5}(5\mathbf{i}+9\mathbf{j}-13\mathbf{k})$ (c) $\mathbf{i}-4\mathbf{j}+3\mathbf{k}$ (d) None of these

420. The projection of the vector $\mathbf{i}+\mathbf{j}+\mathbf{k}$ on the line whose vector equation is $\mathbf{r}=(3+t)\mathbf{i}+(2t-1)\mathbf{j}+3t\mathbf{k}$, t being the scalar parameter, is

(a) $\frac{1}{\sqrt{14}}$ (b) 6 (c) $\frac{6}{\sqrt{14}}$ (d) None of these

421. If $\mathbf{a}\times(\mathbf{a}\times\mathbf{b})=\mathbf{b}\times(\mathbf{b}\times\mathbf{c})$ and $\mathbf{a}.\mathbf{b}\neq 0$, then $[\mathbf{a}\ \ \mathbf{b}\ \ \mathbf{c}]$ is equal to

(a) 0 (b) 1 (c) 2 (d) None of these

422. If $\mathbf{c}=\mathbf{a}\times\mathbf{b}$ and $\mathbf{b}=\mathbf{c}\times\mathbf{a}$ then

(a) $\mathbf{a}.\mathbf{b}=\mathbf{c}^2$ (b) $\mathbf{c}.\mathbf{a}=\mathbf{b}^2$ (c) $\mathbf{a}\perp\mathbf{b}$ (d) $\mathbf{a}\parallel\mathbf{b}\times\mathbf{c}$

423. If **r** satisfies the equation $\mathbf{r}\times(\mathbf{i}+2\mathbf{j}+\mathbf{k})=\mathbf{i}-\mathbf{k}$, then for any scalar *m*, **r** is equal to

(a) $\mathbf{i}+m(\mathbf{i}+2\mathbf{j}+\mathbf{k})$ (b) $\mathbf{j}+m(\mathbf{i}+2\mathbf{j}+\mathbf{k})$

(c) $\mathbf{k}+m(\mathbf{i}+2\mathbf{j}+\mathbf{k})$ (d) $\mathbf{i}-\mathbf{k}+m(\mathbf{i}+2\mathbf{j}+\mathbf{k})$

424. If $\mathbf{a}=(-1,1,1)$ and $\mathbf{b}\equiv(2,0,1)$, then the vector $\vec{X}$ satisfying the conditions

(i) That it is coplanar with **a** and **b** (ii) That it is perpendicular to **b** (iii) That $\mathbf{a}.\vec{X}=7$ is

(a) $-3\mathbf{i}+4\mathbf{j}+6\mathbf{k}$ (b) $-\frac{3}{2}\mathbf{i}+\frac{5}{2}\mathbf{j}+3\mathbf{k}$ (c) $3\mathbf{i}+16\mathbf{j}-6\mathbf{k}$ (d) None of these

425. If the non-zero vectors $\mathbf{a}$ and $\mathbf{b}$ are perpendicular to each other, then the solution of the equation, $\mathbf{r}\times\mathbf{a}=\mathbf{b}$ is given by

(a) $\mathbf{r}=x\mathbf{a}+\frac{\mathbf{a}\times\mathbf{b}}{|\mathbf{a}|^2}$ (b) $\mathbf{r}=x\mathbf{b}-\frac{\mathbf{a}\times\mathbf{b}}{|\mathbf{b}|^2}$

(c) $\mathbf{r}=x(\mathbf{a}\times\mathbf{b})$ (d) $\mathbf{r}=x(\mathbf{b}\times\mathbf{a})$

***

Answer Sheet

Vector Algebra — *Assignment (Basic and Advance level)*

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
a	b	a	d	d	a	d	d	c	c	b	a	a	b	c	a	b	b	c	d
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
d	b	d	a	c	b	d	b	d	b	b	b	c	c	b	d	c	d	c	b
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
d	c	c	c	a	c	c	d	a	c	c	a	c	c	b	a	a	c	c	a,c
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
a,d	a	d	a	c	a	b	c	a	b	c	b	a	b	b	b	b	b	a	b
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
c	b	a	a	d	b	a	a	b	c	c	a	c	b	c	c	d	d	c	d
101	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**
c	c	a	a	a,b,c,d	a	a	d	b	d	c	b	d	a	a	c	b	a	b	c
121	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**
a	b	a	c	a	d	d	b	c	d	c	a	a	d	c	c	c	c	d	c
141	**142**	**143**	**144**	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**	**153**	**154**	**155**	**156**	**157**	**158**	**159**	**160**
a	c	d	d	d	a	a	a	b	c	c	c	c	a	a	c	d	c	b	b
161	**162**	**163**	**164**	**165**	**166**	**167**	**168**	**169**	**170**	**171**	**172**	**173**	**174**	**175**	**176**	**177**	**178**	**179**	**180**
b	c	c	c	d	d	a	c	a,c,d	b	a	a	b	b	b	d	a	d	b	c
181	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**	**190**	**191**	**192**	**193**	**194**	**195**	**196**	**197**	**198**	**199**	**200**
c	d	c	b	d	a	c	b	d	c	b	b	b	c	a	a	b	b	a	b
201	**202**	**203**	**204**	**205**	**206**	**207**	**208**	**209**	**210**	**211**	**212**	**213**	**214**	**215**	**216**	**217**	**218**	**219**	**220**
d	c	a	a	a	c	c	c	b	a	b	a	c	c	c	b	a	c	c	d
221	**222**	**223**	**224**	**225**	**226**	**227**	**228**	**229**	**230**	**231**	**232**	**233**	**234**	**235**	**236**	**237**	**238**	**239**	**240**
c	a	d	a	d	c	b	a	c	a	c	c	a	c	b	b	b	b	a	d

241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
d	c	a	c	b	a	b	b	c	c	b	c	a,b,c	b	c	b	b	c	b	c
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
d	a	a	d	c	c	c	a	d	d	b	c	a	c	d	c	b	a	b	b
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
d	a	b	c	a	b	d	d	c	c	c	b	b	c	d	a	c	d	c	c
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
a	c	d	c	d	b	d	a	a	c	d	a	d	a	c	b	c	b	a	a
321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
c	a	b,c	a	d	b,d	c	c	b	d	a	b	a	b	d	d	a	d	a	b
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
d	b	b	a	b	b	b	b	a	a	a	b	a,b	b	b	d	c	c	d	b
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380
a	b	d	c	a	c	a	a	d	a	a,b,c	d	c	d	d	b	b,c	b	a	a
381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
a,b,c,d	b	c	b	a	a	a	a	a	a	b	b	d	d	a	a	a	b	d	d
401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
c	a	c	a	d	b	b	a	a,c	b,c	a,c	a	c	c	a	a	c	c	a,b	c
421	422	423	424	425															
a	c,d	b	b	a															