CBSE

MOTION IN A PLANE WS 8

Class 11 - Physics

Section A

1. The angle between the two vectors $\vec{A} = 5\hat{i} + 5\hat{j}$ and $\vec{B} = 5\hat{i} - 5\hat{j}$ will be **[1]**

   a) 90^o b) 45^o

   c) zero d) 0^o

2. The value of p so that the vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} + 2\hat{j} - 3\hat{k}$ and $3\hat{i} + p\hat{j} + 5\hat{k}$, are coplanar should be **[1]**

   a) -4 b) 16

   c) -8 d) 4

3. The magnitudes of vectors $\vec{A}$, $\vec{B}$ and $\vec{C}$ are 3, 4 and 5 units respectively. If $\vec{A} + \vec{B} = \vec{C}$, the angle between $\vec{A}$ and $\vec{B}$ is **[1]**

   a) $\cos^{-1}0.6$ b) $\frac{tan^{-1}7}{5}$

   c) $\frac{\pi}{4}$ d) $\frac{\pi}{2}$

4. If $|\vec{A} \times \vec{B}| = |\vec{A} \cdot \vec{B}|$, then angle between $\vec{A}$ and $\vec{B}$ will be **[1]**

   a) 30^o b) 90^o

   c) 60^o d) 45^o

5. $\vec{A}$ and $\vec{B}$ are two vectors and θ is the angle between them, if $|\vec{A} \times \vec{B}| = \sqrt{3}(\vec{A} \cdot \vec{B})$, the value of θ is **[1]**

   a) 30° b) 60°

   c) 90° d) 45°

6. **Assertion (A):** If $\overrightarrow{\mathbf{A}} \times \overrightarrow{\mathbf{B}} = \overrightarrow{\mathbf{A}} \times \overrightarrow{\mathbf{C}}$, then $\overrightarrow{\mathbf{C}}$ need not be equal to $\overrightarrow{\mathbf{B}}$. **[1]**

   Reason (R): The cross product of two vectors depend upon the angle between them.

   a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true but R is not the correct explanation of A.

   c) A is true but R is false. d) A is false but R is true.

7. **Assertion (A):** Angle between two vectors $\hat{\mathbf{j}} + \hat{\mathbf{k}}$ and $\hat{\mathbf{j}}$ is 45°. **[1]**

   Reason (R): Vector $\hat{\mathbf{j}} + \hat{\mathbf{k}}$ is equally inclined to both Y and Z axes and angle between $\hat{\mathbf{j}}$ and $\hat{\mathbf{k}}$ is 90°.

   a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true but R is not the correct explanation of A.

   c) A is true but R is false. d) A is false but R is true.

8. **Assertion (A):** The cross product of a vector with itself is a null vector. **[1]**

   Reason (R): The cross-product of two vectors results in a vector quantity.

a) Both A and R are true and R is the correct explanation of A.

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

c) A is true but R is false.

d) A is false but R is true.

9. **Assertion (A):** The angle between vectors $\overrightarrow{\mathbf{A}} \times \overrightarrow{\mathbf{B}}$ and $\overrightarrow{\mathbf{B}} \times \overrightarrow{\mathbf{A}}$ is n radian. **[1]**

Reason (R): $\overrightarrow{\mathbf{B}} \times \overrightarrow{\mathbf{A}} = -\overrightarrow{\mathbf{A}} \times \overrightarrow{\mathbf{B}}$.

a) Both A and R are true and R is the correct explanation of A.

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

c) A is true but R is false.

d) A is false but R is true.

10. **Assertion (A):** The perpendicular vector of $(\hat{i} + \hat{j} + \hat{k})$ is $(\hat{i} - 2\hat{j} + \hat{k})$. **[1]**

Reason (R): Two vectors are perpendicular if their dot product is equal to zero.

a) Both A and R are true and R is the correct explanation of A.

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

c) A is true but R is false.

d) A is false but R is true.

11. **Assertion (A):** The scalar product of two vectors will be zero if angle between them is 180^o. **[1]**

Reason (R): The scalar product of two vectors $\vec{A}$ and $\vec{B}$ is given by $\vec{A} \cdot \vec{B}$ = AB cos θ.

a) Both A and R are true and R is the correct explanation of A.

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

c) A is true but R is false.

d) A is false but R is true.

12. **Assertion (A):** If $\vec{A} \times \vec{B}$ = 0 and $\vec{A} \cdot \vec{B}$ = 0, then either $\vec{A}$ or $\vec{B}$ is a null vector. **[1]**

Reason (R): Magnitude of null vector is 0.

a) Both A and R are true and R is the correct explanation of A.

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

c) A is true but R is false.

d) A is false but R is true.

13. **Assertion (A):** If $\vec{P} \cdot \vec{Q} = |\vec{P} \times \vec{Q}|$, then angle between $\vec{P}$ and $\vec{Q}$ is $\frac{\pi}{2}$. **[1]**

Reason (R): If angle between $\vec{P}$ and $\vec{Q}$ is $\frac{\pi}{2}$, then dot product is zero.

a) Both A and R are true and R is the correct explanation of A.

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

c) A is true but R is false.

d) A is false but R is true.

14. **Assertion (A):** Two vectors are equal when their magnitude and direction both are equal. **[1]**

Reason (R): For any two vectors $\overrightarrow{\mathbf{A}}$ and $\overrightarrow{\mathbf{B}}$, if angle between them is $\frac{\pi}{4}$ rad, then $\overrightarrow{\mathbf{A}} \times \overrightarrow{\mathbf{B}} = \overrightarrow{\mathbf{A}} \cdot \overrightarrow{\mathbf{B}}$.

a) Both A and R are true and R is the correct explanation of A.

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

c) A is true but R is false.

d) A is false but R is true.

15. **Assertion (A):** If $\vec{A} \times \vec{B} = \vec{C} \times \vec{B}$, then $\vec{C}$ must be equal to $\vec{A}$. **[1]**

Reason (R): The cross product of two vectors depends upon the angle between them.

a) Both A and R are true and R is the correct

b) Both A and R are true but R is not the

explanation of A.

correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

16. **Assertion (A):** If $\vec{A} + \vec{B} + \vec{C}$ = 0 then $\vec{A} \times \vec{B} = \vec{B} \times \vec{C} = \vec{C} \times \vec{A}$. **[1]**

Reason (R): The vector sum of three vectors can never be zero.

a) Both A and R are true and R is the correct explanation of A.

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

c) A is true but R is false.

d) A is false but R is true.

17. **Assertion (A):** If $\vec{A} \cdot \vec{B} = \vec{B} \cdot \vec{C}$, then $\vec{A}$ may not always be equal to $\vec{C}$. **[1]**

Reason (R): The dot product of two vectors involves cosine of the angle between the two vectors.

a) Both A and R are true and R is the correct explanation of A.

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

c) A is true but R is false.

d) A is false but R is true.

18. **Assertion (A):** If dot product and cross product of $\vec{A}$ and $\vec{B}$ are zero, it implies that one of the vector $\vec{A}$ and $\vec{B}$ must be a null vector. **[1]**

Reason (R): Null vector is a vector with zero magnitudes.

a) Both A and R are true and R is the correct explanation of A.

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

c) A is true but R is false.

d) A is false but R is true.

19. Which of the following is correct relation between an arbitrary vector $\vec{A}$ and null vector $\vec{Q}$? **[1]**

a) $\vec{A} + \vec{O} + \vec{A} \times \vec{O} = \vec{A}$

b) $\vec{A} + \vec{O} + \vec{A} \times \vec{O} = \vec{O}$

c) $\vec{A} + \vec{O} + \vec{A} \times \vec{O} \neq \vec{A}$

d) $\vec{A} - \vec{O} - \vec{A} \times \vec{O} = \vec{O}$

20. The position vector of a point is $\vec{R} = x\hat{i} + y\hat{j} + z\hat{k}$ and another vector is $\vec{A} = 3\hat{i} + 2\hat{j} + 5\hat{k}$. Which of the mathematical relations is correct? **[1]**

a) $\nabla(\vec{A} \cdot \vec{R}) = \vec{R}$

b) $\nabla(\vec{A} \cdot \vec{R}) = \vec{A}$

c) $\nabla(\vec{A} \cdot \vec{R}) = 0$

d) $\nabla(\vec{A} \cdot \vec{R}) = 1$

21. Two vectors of magnitude A and $\sqrt{3}A$ are perpendicular to each other. What is the angle which their resultant makes with $\vec{A}$? **[1]**

22. If $\vec{A}, \vec{B}$ and $\vec{C}$ are non-zero vectors and $\vec{A} \cdot \vec{B} = 0$ and $\vec{B} \cdot \vec{C} = 0$, then find out the value of $\vec{A} \cdot \vec{C}$. **[1]**

23. If $\vec{a} = \hat{i} - 2\hat{j} - 3\hat{k}, \vec{b} = 2\hat{i} - \hat{j} - \hat{k}$ and $\vec{c} = \hat{i} + 3\hat{j} - 2\hat{k}$, find $(\vec{a} \times \vec{b}) \times \vec{c}$. **[1]**

24. When vectors are added or substrated, their resultant is a vector. Is it also true in the case of multiplication of two vectors? **[1]**

25. If $\vec{A}, \vec{B}$ and $\vec{C}$ are mutually perpendicular vectors, then what is the value of $\vec{A} \cdot (\vec{B} + \vec{C})$? **[1]**

26. What is the dot product of two similar unit vectors? **[1]**

27. What is the condition for two vectors to be collinear? **[1]**

28. Two vectors, both equal in magnitude, have their resultant equal in the magnitude of the either. Find the angle between the two vectors. **[1]**

29. A Body constrained to move along the z-axis of a co-ordinate system is subjected to a constant force $\vec{F}$ given by $\vec{F} = -\hat{i} + 2\hat{j} + 3\hat{k}$ newton where $\hat{i}, \hat{j}$ and $\hat{k}$ represent unit vectors along x-, y- and z-axis of the system **[1]**

respectively. Calculate the work done by the force in displacing the body through a distance of 4 m along the z-axis.

30. Find the area of the triangle formed by points O, A and B such that $\overrightarrow{OA} = \hat{i} + 2\hat{j} + 3\hat{k}$ and $\overrightarrow{OB} = -3\hat{i} - 2\hat{j} + \hat{k}$. **[1]**

31. Two vectors $\vec{A}$ and $\vec{B}$ are in the same plane and angle between them is θ. What is the magnitude and direction of $\vec{A} \times \vec{B}$? **[1]**

32. Evaluate $\hat{k} \cdot \hat{k}$ **[1]**

33. Prove that the vectors $\vec{A} = \hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{B} = 2\hat{i} - \hat{j}$ are perpendicular to each other. **[1]**

34. What is the angle between two vectors if the ratio of their dot product and the magnitude of cross product is $\sqrt{3}$? **[1]**

35. Two vectors of magnitudes 3 and 4 give a resultant of magnitude 2. What must be the dot product of these two vectors? **[1]**

36. If $\vec{A} \times \vec{B} = \vec{0}$, what can be said about the non-zero vectors $\vec{A}$ and $\vec{B}$? **[1]**

37. If $|\mathbf{A} \times \mathbf{B}| = \mathbf{A} \cdot \mathbf{B}$, what is the angle between A and B? **[1]**

38. Two vectors $\vec{A} = 5\hat{i} + 7\hat{j} - 3\hat{k}$ and $\vec{B} = 2\hat{i} + 2\hat{j} - \alpha\hat{k}$ are mutually perpendicular to each other. What is the value of α? **[1]**

39. Find the value of $\hat{i} \times \hat{j}$. **[1]**

40. Give one example of the dot product of vectors. Also, give its unit. **[1]**

41. What is the angle between $(\hat{i} + \hat{j})$ and $(\hat{i} - \hat{j})$? **[1]**

42. What is $\hat{i} \cdot (\hat{j} \times \hat{k})$? **[1]**

43. Calculate the area of the triangle determined by the two vectors: $\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = -3\hat{i} + 7\hat{j}$. **[1]**

Section B

44. Find the moment about the point $\hat{i} + 2\hat{j} - \hat{k}$ of a force represented by $3\hat{i} + \hat{k}$ acting through the point $2\hat{i} - \hat{j} + 3\hat{k}$. **[2]**

45. Find a vector whose length is 7 and which is perpendicular to each of the vectors: $\vec{A} = 2\hat{i} - 3\hat{j} + 6\hat{k}$ and $\vec{B} = \hat{i} + \hat{j} - \hat{k}$ **[2]**

46. Determine a unit vector perpendicular to both $\vec{A} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{B} = \hat{i} - \hat{j} + 2\hat{k}$. **[2]**

47. Find the value of a for which the vectors $3\hat{i} + 3\hat{j} + 9\hat{k}$ and $\hat{i} + a\hat{j} + 3\hat{k}$ are parallel. **[2]**

48. If $\vec{A}$ and $\vec{B}$ are two such vectors that $|\vec{A}| = 2$, $|\vec{B}| = 7$ and $\vec{A} \times \vec{B} = 3\hat{i} + 2\hat{j} + 6\hat{k}$, find the angle between $\vec{A}$ and $\vec{B}$. **[2]**

49. Find a unit vector perpendicular to the vectors $\vec{A} = 4\hat{i} - \hat{j} + 3\hat{k}$ and $\vec{B} = -2\hat{i} + \hat{j} - 2\hat{k}$ **[2]**

50. The resultant of two vectors $\vec{P}$ and $\vec{Q}$ is perpendicular to $\vec{P}$ and its magnitude is half that of $\vec{Q}$. What is the angle between $\vec{P}$ and $\vec{Q}$? **[2]**

51. The sum and difference of two vectors $\vec{A}$ and $\vec{B}$ are $\vec{A} + \vec{B} = 2\hat{i} + 6\hat{j} + \hat{k}$ and $\vec{A} - \vec{B} = 4\hat{i} + 2\hat{j} - 11\hat{k}$. Find the magnitude of each vector and their scalar product $\vec{A} \cdot \vec{B}$. **[2]**

52. If vectors $\vec{P}, \vec{Q}$ and $\vec{R}$ have magnetic 5, 12 and 13 units and $\vec{P} + \vec{Q} = \vec{R}$, find the angle between $\vec{Q}$ and $\vec{R}$. **[2]**

53. Prove that the vectors $\vec{A} = 4\hat{i} + 3\hat{j} + \hat{k}$ and $\vec{B} = 12\hat{i} + 9\hat{j} + 3\hat{k}$ are parallel to each other. **[2]**

54. If $\vec{a} = \hat{i} - 2\hat{j} - 3\hat{k}$, $\vec{b} = 2\hat{i} + \hat{j} - \hat{k}$ and $\vec{c} = \hat{i} + 3\hat{j} - 2\hat{k}$, then find $\vec{a} \times (\vec{b} \times \vec{c})$. **[2]**

55. The diagonals of a parallelogram are given by the vectors $3\hat{i} + \hat{j} + 2\hat{k}$ and $\hat{i} - 3\hat{j} + 4\hat{k}$. Find the area of the parallelogram. **[2]**

56. Three vectors $\vec{A}, \vec{B}$ and $\vec{C}$ are such that $\vec{A} = \vec{B} + \vec{C}$ and their magnitudes are 5, 4 and 3 respectively. Find the angle between $\vec{A}$ and $\vec{C}$. **[2]**

57. For two vectors $\vec{A}$ and $\vec{B}$ if $\vec{A} + \vec{B} = \vec{C}$ and A + B = C, then prove that $\vec{A}$ and $\vec{B}$ are parallel to each other. **[2]**

58. Find the conditions for two vectors to be (i) parallel and (ii) perpendicular to each other. **[2]**

59. Find the area of the triangle formed by the tips of the vectors $\vec{a} = \hat{i} - \hat{j} - 3\hat{k}$, $\vec{b} = 4\hat{i} - 3\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} - \hat{j} + 2\hat{k}$. **[2]**

60. Find the scalar and vector product of two vectors, $\vec{a} = (3\hat{i} - 4\hat{j} + 5\hat{k})$ and $\vec{b} = (-2\hat{i} + \hat{j} + 3\hat{k})$ **[2]**

Section C

61. Find the angle between the vectors A = $\hat{\mathbf{i}} - 2\hat{\mathbf{j}} - \hat{\mathbf{k}}$ and B = $-\hat{\mathbf{i}} + \hat{\mathbf{j}} - 2\hat{\mathbf{k}}$. **[3]**

62. A point P lies in the x-y plane. Its position can be specified by its x, y coordinates or by a radially directed vector $\vec{r} = (x\hat{i} + y\hat{j})$, making an angle θ with the x-axis. Find a vector $\hat{i}_r$ of unit magnitude in the direction of A vector $\vec{r}$ and a vector $\hat{i}_\theta$ of unit magnitude normal to the vector $\hat{i}_r$ and lying in the x-y plane. **[3]**

63. Two billiard balls are rolling on a flat table. One has the velocity components v_x = 1ms^{-1}, $v_y = \sqrt{3}$ ms^{-1} and the other has components v'_x = 2 ms^{-1} and v'_y = 2 ms^{-1}. If both the balls start moving from the same point, what is the angle between their paths? **[3]**

Section D

64. **State True or False:** **[4]**

(a) If the dot product of two vectors is zero, then the vectors are orthogonal. **[1]**

(b) Scalar products obey the commutatitve and distributive law's. **[1]**

(c) If $\vec{A} \cdot \vec{B} = \vec{A} \cdot \vec{C}$, then $\vec{B} = \vec{C}$ **[1]**

(d) The scalar product of two vectors is positive. **[1]**

Section E

65. **Fill in the blanks:** **[8]**

(a) The scalar product two similar base vectors is _____ and that of two different base vectors is _____. **[1]**

(b) If the vectors $3\hat{i} + 3\hat{j} + 9\hat{k}$ and $\hat{i} + a\hat{j} + 3\hat{k}$ are parallel, then a = _____. **[1]**

(c) If $\vec{A}$ and $\vec{B}$ denote the sides of a parallelogram of area $\frac{AB}{2}$, then the angle between $\vec{A}$ and $\vec{B}$ is _____ degree. **[1]**

(d) $\vec{A} \cdot \vec{B}$ is a _____ quantity while $(\vec{A} \times \vec{B})$ is _____. **[1]**

(e) Two vectors of magnitude A and $\sqrt{3}A$ are perpendicular to each other. The angle which their resultant makes with $\vec{A}$ is _____ degree. **[1]**

(f) If $|\vec{A}| = 10, |\vec{B}| = 2$, and $\vec{A} \cdot \vec{B}$ = 12, then $|\vec{A} \times \vec{B}|$ = _____ **[1]**

(g) Two vectors, equal in magnitude, have their resultant equal in magnitude of the either. The angle between the two vectors is _____ degree. **[1]**

(h) If the ratio of $\vec{A} \cdot \vec{B}$, $(\vec{A} \times \vec{B})$ is $\sqrt{3}$, then the angle between the vectors $\vec{A}$ and $\vec{B}$ is _____ degree. **[1]**