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Class: XII
Subject: Math's
Topic: Vector Algebra
No. of Questions: 20
Duration: 60 Min
Maximum Marks: 60

1. The values of a, for which the A,B, C with position vectors 2i –j +k, i – 3j- 5k and ai – 3j + k respectively are vertices of a right with C =π/2, are
   A. -2 and 1
   B. 2 and 1
   C. 2 and 1
   D. -2and – 1

   Ans. C

   Sol :

   A (2,-1, 1) B (1,-3,-5) C (A,-3, +1)

   $\overrightarrow{AB} = (-1, -2, -6)$

   $\overrightarrow{BC} = (a-1, 0, 6)$

   $\overrightarrow{AB} = (2-a, 2, 0)$

   $\overrightarrow{BC}.\overrightarrow{CA} = 0$

   $\Rightarrow (a-1)(2-a) = 0$

   $a = 1 \; or \; a = 2$

2. If $\overrightarrow{AB}$=2i + j -3k and the coordinates of A are (1, 2, - 1), then the coordinate of B are
   A. (3, 3, 4)
   B. (3, 2, - 4)
   C. (3, -3, -4)
   D. (3, 3, -4)

   Ans. D

   Sol :

$A(1,2,-1)$
$\mathrm{B(x,y,z)}$
$\overrightarrow{AB} = (x-1, y-z+1) = (2,1,-3)$
$x = 3, y = 3, z = -4$

3. Let ABC be equilateral triangle whose orthocenter is at origin O
If $\vec{O}A = \vec{a}$ and $\vec{O}B = \vec{b}$ then $\vec{O}C$

A. $(\vec{a} + \vec{b})$
B. $-(\vec{a} + \vec{b})$
C. $2(\vec{a} + \vec{b})$
D. $-3(\vec{a} + \vec{b})$

Ans. B

Sol: $\vec{a} + \vec{b} + \vec{a} = 0$
$\vec{c} = -(\vec{a} + \vec{b})$

4. Which of the following is false?
A. $|\vec{a} \times \vec{b}| = |\vec{a}||\vec{b}| \Longrightarrow \vec{a} \perp \vec{b}$

B. $|\vec{a}+\vec{b}| = |\vec{a}-\vec{b}| \Longrightarrow \vec{a} \perp \vec{b}$
C. $|\vec{a} \times \vec{b}| = \vec{0} \Longrightarrow \vec{a} \,||\, \vec{b}$
D. none of there

Ans. D

Solution:

1,2,3, all are true

None of these is false

5. If $\left|\hat{a}+\hat{b}\right| = \sqrt{3}, then \left(\hat{a}+\hat{b}\right).\left(\hat{a}-2\hat{b}\right)$ is
A. $-\frac{1}{2}$
B. $-\frac{3}{2}$
C. 0

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D. None of these

Ans. B

Sol :

$$\left(\hat{a}+\hat{b}\right)\left(\hat{a}-2\hat{b}\right)$$
$$=|\hat{a}|^2-2\hat{a}\hat{b}+\hat{b}\hat{a}-2|\hat{b}|^2$$
$$=1-\hat{a}\hat{b}-2$$
$$=-1-\hat{a}\hat{b}$$
$$and\,|\hat{a}+\hat{b}|^2=(\sqrt{3})^2$$
$$|\hat{a}|^2+2\hat{a}\hat{b}+|\hat{b}|^2=3$$
$$2\hat{a}\hat{b}=3-2$$
$$\hat{a}\hat{b}=1/2$$
$$\therefore -1-\hat{a}\hat{b}=-1-1/2=-3/2$$

6. If the vectors (λ,3,4,),(0,-1,10) and (1, λ,3) are coplanar, then λ =
   A. -2 or 17
   B. 2 or 17
   C. 0 or -2
   D. None of these

   Ans. A

   Vectors are co- planar then

$$\begin{vmatrix} \lambda & 3 & 4 \\ 0 & -1 & 10 \\ 1 & \lambda & 3 \end{vmatrix} = 0$$
$$then$$
$$10\lambda^2+3\lambda-34=0$$
$$\lambda=-2,17$$

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7. The position vectors of three consecutive vertices of a parallelogram are $\hat{\imath} - \hat{\jmath} + 2\hat{k}, 2\hat{\jmath} + \hat{k}$ and $\hat{\jmath} + 3\hat{k}$. Then its area in square units is
   A. $\sqrt[2]{30}$
   B. $\sqrt{30}$
   C. $\frac{1}{2}\sqrt{30}$
   D. None of these

   Ans. B

   Solution:

   Three consecutive vertices of a parallelogram are

$$\hat{i} - \hat{j} + 2\hat{k}, 2\hat{j} + \hat{k} \; and \; \hat{j} + 3\hat{k}$$
$$\vec{a} = -i + 3j - k$$
$$\vec{b} = -j + 2k$$
$$area = \left|\vec{a} \times \vec{b}\right| = \sqrt{30}$$

8. The tangent of the angle between $\hat{\imath} + 3\hat{\jmath}$ *and* $3\hat{\imath} - \hat{k}$ is
   A. ∞
   B. $\frac{1}{3}$
   C. $\frac{3}{10}$
   D. None of these

   Ans. D

Sol: $\cos\theta = \frac{(\hat{i} + 3j)(3\hat{i} - \hat{k})}{|\hat{i} + 3j||3\hat{i} - \hat{k}|}$

$$\cos\theta = \frac{3}{10}$$
$$\tan\theta \neq 3/10$$

9. If $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}, \vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$ and $\vec{a} + t\vec{b}$ is orthogonal to $\vec{c}$, then t =
   A. 2
   B. 4
   C. 5
   D. 8

   Ans. D

   Solution:

   $\vec{a} + t\vec{b} = (2-t)i + (2+2t)j + (3+t)k$

   and $\vec{a} + t\vec{b}$ is orthogonal to $\vec{c}$

   Then their dot product =0

   We get 3(2-t)+2+2t=0

   Then t=8

10. Which of the following is true?
    A. $(\vec{b} \times \vec{c}) \times (\vec{c} \times \vec{a}) \times \lambda \vec{c}$ where $\lambda = [\vec{b}\,\vec{a}\,\vec{c}]$
    B. If $\vec{a}, \vec{b}, \vec{c}$ are mutually⊥ unit vectors, then $\left|\vec{a} + \vec{b} + \vec{c}\right| = 3$
    C. If $\vec{a}, \vec{b}, \vec{c}$ are the p.v.s of the vertices of a Δ then its area is $|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}|$
    D. If $\left|\vec{a}\right| = 3, \left|\vec{b}\right| = 4$ and $\left|\vec{c}\right| = 5$ then $\left|\vec{a} + \vec{b} + \vec{c}\right| = 5$

    Ans. D

11. If $\vec{a} = (2, -3, -1)$ and $\vec{b} = (1,4,2)$, then $\vec{a} \times \vec{b} =$
    A. $(-2, -5, 100)$
    B. $(2, 5, -11)$
    C. $(-2$,-5,11)
    D. None of these

    Ans. C

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$$\hat{a}x\hat{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -3 & -1 \\ 1 & 4 & 2 \end{vmatrix}$$

$$\text{Sol}: = \hat{i}(-6+4) - \hat{j}(4+1) + \hat{k}(8+3)$$

$$= -2\hat{i} - 5\hat{j} + 11\hat{k}$$

Sol :

12. Let $\vec{a} = 2i + j + k, \vec{b} = i + 2j - k$and a unit vector $\vec{c}$ be coplanar. If$\vec{c}$ is$\perp$ $\vec{a}$, then $\vec{a} =$
    A. $\frac{1}{\sqrt{2}}(k - j)$
    B. $\frac{1}{\sqrt{3}}(-i - j - k)$
    C. $\frac{1}{\sqrt{5}}(i - 2j)$
    D. $\frac{1}{\sqrt{3}}(i + j - k)$

    Ans. A

    Sol :

    $\vec{c} \perp \vec{a}$

    $let\ \vec{c} = (\text{l}, \text{m}, \text{n})$

    $\text{since}, \vec{c}\ is\ unit\ vector$

    $l^2 + m^2 + n^2 = 1 \quad \underline{\quad\quad} 1$

    $\vec{c} \perp \vec{a}$

    $\therefore 2l + m + n = 0 \underline{\quad\quad} 2$

    $ans, \vec{a} \times \vec{b} \perp \vec{c}\ \text{sin}\,ce\ a, b, c\ are\ coplanar$

    $now\ solve\ \ for\ (\text{l}, \text{m}, \text{n}) = ?$

13. If $\vec{a} = i - 2j + 3k, \vec{b} = -3i + j - k, \vec{r} \times \vec{a} = \vec{b} \times \vec{a}$ and $\vec{r} \times \vec{b} = \vec{a} \times \vec{b}$, then a unit vector in the direction of $\vec{r}$ is
    A. $\frac{1}{\sqrt{6}}(-2i + j - k)$
    B. $-\frac{1}{3}(2i + j + 2k)$
    C. $\frac{1}{3}(-2i - j + 2k)$
    D. None of these

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Ans. C

14. If $\vec{a}+\vec{b}+\vec{c}=\vec{0}$ then which of the following is true always?
    A. $|\vec{a}+\vec{b}|=|\vec{c}|$
    B. $|\vec{a}|+|\vec{b}|+|\vec{c}|$
    C. $\vec{a},\vec{b},\vec{c}$ from sides of the Δ
    D. None of these

    Ans. A

    Solution:

    $|\vec{a}+\vec{b}|=|\vec{c}|$ is true

15. Let $\vec{a}$ and $\vec{b}$ be two non-collinear unit vectors. If $\vec{u}=\vec{a}-(\vec{a}.\vec{b})\vec{b}$ and $\vec{v}=\vec{a}\times\vec{b}$ then $|\vec{v}|=$
    A. $|\vec{u}|$
    B. $|\vec{u}|+|\vec{u}.\vec{a}|$
    C. $|\vec{u}|+|\vec{u}.\vec{b}|$
    D. $|\vec{u}|+\vec{u}(\vec{a}+\overrightarrow{b})$

    Ans. C

16. Let $\vec{a}=2i+j-2k$ and $\vec{b}=i+j$ if $\vec{c}$ is a vector such that $\vec{a}.\vec{c}=|\vec{c}|, |\vec{c}-\vec{a}|=\sqrt[2]{2}$ and the angle between $(\vec{a}\times\vec{b})$ and $\vec{c}$ is 30º ,then $|(\vec{a}\times\vec{b})\times\vec{c}|$ is
    A. $\frac{2}{3}$
    B. $\frac{3}{2}$
    C. 2
    D. 3

    Ans. B

17. If $|\vec{a}|=1, |\vec{b}|=2, |\vec{c}|=3$ And $\vec{a}+\vec{b}+\vec{c}=\vec{0}$ then $\vec{a}.\vec{b}+\vec{b}.\vec{c}+\vec{c}\,\vec{a}=$
    A. -14
    B. -7
    C. 7
    D. None of these

    Ans. A

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Solution:

$$\vec{a} + \vec{b} + \vec{c} = \vec{0}$$

$$then(\vec{a} + \vec{b} + \vec{c})^2 = 0$$

$$2(a.b + b.c + c.a) = -14$$

$$\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}\,\vec{a} = -7$$

18. If $\vec{a} = 2\hat{i} + \hat{j}, \vec{b} = 2\hat{j} - \hat{k}\ and\ \vec{c} = \hat{i} + \hat{j}$ Then $\left(\vec{a} - 2\vec{b}\right).\vec{c} =$

A. -2
B. 1
C. 0
D. None of these

Ans. D

Solution:

$$\left(\vec{a} - 2\vec{b}\right).\vec{c} = (2i + j - 4j + 2k).(i + j) = -1$$

19. If $\vec{a} = 3\hat{i} - 2\hat{j} + \hat{k}, \vec{b} = 2\hat{i} - 4\hat{j} - 3\hat{k}\ and\ \vec{c} = -\hat{i} + 2\hat{j} + 2\hat{k}, then\ a \times \left(\vec{b} \times \vec{c}\right) =$

A. $11\vec{b} + 5\vec{c}$
B. $11\vec{c} - 5\vec{b}$
C. $3\vec{a} - 5\vec{b}$
D. None of these

Ans. D

Solution:

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$\vec{a} = 3\hat{i} - 2\hat{j} + \hat{k}, \vec{b} = 2\hat{i} - 4\hat{j} - 3\hat{k}$ *and* $\vec{c} = -\hat{i} + 2\hat{j} + 2\hat{k}$, *then* $a \times \left(\vec{b} \times \vec{c}\right) =$

$= (a.c)b - (a.b)c = i - 2j - 7k$

20. If $(\vec{a} \times \vec{b})(\vec{c} \times \vec{d}) = \alpha(\vec{b}.\vec{d}) - \beta(\vec{b}.\vec{c})$ then, $(\alpha, \beta) =$
    A. $(\vec{a}.\vec{c}, \vec{a}.\vec{b})$
    B. $(\vec{a}.\vec{b}, \vec{a}.\vec{d})$
    C. $(\vec{a}.\vec{c}, \vec{d}.\vec{d})$
    D. None of these

    Ans. C

    Solution:

$$\left(\vec{a} \times \vec{b}\right).\left(\vec{c} \times \vec{d}\right) = \left(\vec{a}.\vec{c}\right)\left(\vec{b}.\vec{d}\right) - \left(\vec{a}.\vec{d}\right)\left(\vec{b}.\vec{c}\right)$$