MATHS

BOOKS - MCGROW HILL EDUCATION MATHS (HINGLISH)

VECTOR ALGEBRA

Illustration

1. Find angle between the vectors $2i + j + k$ and $i - j + k$.

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2. Find $a \times b$ if $a = i - j + k$ and $b = i + j - 3k$.

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3. Find the sine of the angle between the vectors a and b, if $a = i - j + k$ and $b = -i + j + 2k$.

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4. Find vectors perpendicular to the plane of vectors $a = 2i - 6j + 3k$ and $b = 4i + 3j + k$.

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5. Find the area of a parallelogram whose adjacent sides are the vectors $a = 2i - 2j + k$ and $b = i - 3j + 3k$.

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6. Find the area of the triangle, the position vectors of whose vertices are $a = i - 2j + 3k, b = j - k$ and $c = 2i + j$

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7. If $a = 3i + 2j + k, b = 5i - j + 2k$ and $c = i + j + k$, find [a b c]

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8. Find the volume of the tetrahedron having coterminus edges represented by vectors $a = j + k, b = i + k$ and $c = i + j$.

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Solved Examples Concept Based Single Correct Answer Type Questions

1. In a triangle OAC, if B is the mid point of side AC and $\overrightarrow{O}A = \overrightarrow{a}$, $\overrightarrow{O}B = \overrightarrow{b}$, then what is $\overrightarrow{O}C$?

A. $OC = \frac{1}{2}(a + b)$

B. $OC = 2b - 2a$

C. $OC = 2b - a$

D. $OC = 3b - 2a$

Answer: C

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2. The angle between the vectors i-j+k and -i+j+2k is

A. 45°

B. 60°

C. 90°

D. 135°

Answer: C

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3. A unit vector c perpendicular to $a = i - j$ and coplanar with a and $b = i + k$ is

A. $\frac{1}{\sqrt{16}}(i + j + 2k)$

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

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

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

Answer: A

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4. If $\hat{a}$ and $\hat{b}$ are two unit vectors, then the vector $\left(\hat{a} + \hat{b}\right) \times \left(\hat{a} \times \hat{b}\right)$ is parallel to

A. a

B. a - b

C. a + b

D. b

Answer: B

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5. If $a = i + j + k$ and $b = i - j + 2k$ then the projection of a on b is given by

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

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

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

D. $\frac{1}{3}(i - j + 2k)$

Answer: D

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6. If a, b, c are unit vectors such that $a - b + c = 0$ then $c \cdot a$ is equal to

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

B. $-\frac{1}{2}$

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

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

Answer: B

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7. The non-zero vectors a, b and c are related as b = 5a and c = -2b. The angle between a and c is

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

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

C. π

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

Answer: C

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8. A vector b collinear with $a = 2\sqrt{2}i - j + 4k$ of length 10 is given by

A. $3\left(2\sqrt{2}i - j + 4k\right)$

B. $2\left(2\sqrt{2}i + j - 4k\right)$

C. $2\left(2\sqrt{2}i + j + 4k\right)$

D. $2\left(2\sqrt{2}i - j + 4k\right)$

Answer: D

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9. The vector $p = (a \cdot c)b - (a \cdot b)c$ is be perpendicular to

A. c

B. b

C. a

D. c + b

Answer: A

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10. The angle between $a + 2b$ and $a - 3b$ if $|a| = 1, |b| = 2$ and angle between a and b is 60° is

A. an acute angle

B. $\cos^{-1}\frac{-24}{\sqrt{21}\sqrt{31}}$

C. $\cos^{-1}\frac{24}{\sqrt{21}\sqrt{31}}$

D. $\cos^{-1} -\frac{1}{3}$

Answer: B

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Solved Examples Level 1 Single Correct Answer Type Questions

1. Let

$L_1 : r = (i + 5j + 5k) + t(4i - 4j + 5k)$ and $L_2 : r = (2i + 4j + 5k) + t($

be two lines then

A. L_1 is parallel to L_2

B. L_1 is parallel to L_2

C. L_1 is not parallel to L_2

D. none of these

Answer: C

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2. The angle between a diagonal of a cube and one of its edges is

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

B. $\pi/4$

C. $\pi/6$

D. $\pi/3$

Answer: A

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3. Let $u = 2i - j + 3k$ and $a = 4i - j + 2k$. The vector component of u orthogonal to a is

A. $-\frac{1}{7}(6i + 2j - 11k)$

B. $\frac{1}{7}(-6i + 2j - 11k)$

C. $-\frac{1}{7}(6i - 2j + 11k)$

D. $-\frac{1}{7}(-6i + 2j + 11k)$

Answer: A

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4. Volume of the tetrahedron with vertices P(-1, 2, 0), Q(2, 1, -3), R(1, 0, 1) and S(3, -2, 3) is

A. $1/3$

B. $2/3$

C. $1/4$

D. $3/4$

Answer: B

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5. The distance between a point P whose position vector is $5i + j + 3k$ and the line $r = (3i + 7j + k) + t(j + k)$ is

A. 3

B. 4

C. 5

D. 6

Answer: D

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6. Let a,b, c be the three vectors such that $a.(b+c)=b.(c+a)=c.(a+b)=0$ and $|a|=1, |b|=4, |c|=8$, then $|a+b+c|=$

A. 13

B. 81

C. 9

D. 5

Answer: C

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7. if $\vec{a} = 2i + 2j + 3k$, $\vec{b} = -i + 2j + k$ and $vcec = 3i + j$ are such that $\vec{a} + \lambda \vec{b}$ is perpendicular $\vec{c}$ then find the value of λ

A. 5

B. 4

C. 6

D. 2

Answer: A

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8. If $|a| = 2, |b| = 5$ and $|a \times b| = 8$ then $|a \cdot b|$ is equal to

A. 4

B. 6

C. 5

D. none of these

Answer: B

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9. If $a \cdot b = b \cdot c = c \cdot a = 0, then [abc]$ is equal to

A. 0

B. 1

C. -1

D. $|a||b||c|$

Answer: D

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10. Let $\vec{a}, \vec{b} and \vec{c}$ be three non-coplanar vectors and $\vec{p}, \vec{q} and \vec{r}$ the vectors defined by the relation $\vec{p} = \frac{\vec{b} \times \vec{c}}{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}, \vec{q} = \frac{\vec{c} \times \vec{a}}{\left[\vec{a}\ \vec{b}\ \vec{c}\right]} and \vec{r} = \frac{\vec{a} \times \vec{b}}{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}$. Then the value of the expression $\left(\vec{a} + \vec{b}\right)\dot{\vec{p}} + \left(\vec{b} + \vec{c}\right)\dot{\vec{q}} + \left(\vec{c} + \vec{a}\right)\dot{\vec{r}}$ is 0 b. 1 c. 2 d. 3

A. 0

B. 1

C. 2

D. 3

Answer: D

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11. The volume of the parallelopiped whose sides are given by $\overrightarrow{OA} = 2\hat{i} - 3\hat{j}, \overrightarrow{OB} + \hat{i} + \hat{j} - \hat{k}$

$\overrightarrow{OC} = 3\hat{i} - \hat{k},$ is

A. $4/13$

B. 4

C. $2/7$

D. none of these

Answer: B

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12. The points with position vectors $60i + 3j, 40i - 8j, ai - 52j$ are collinear if a. $a = -40$ b. $a = 40$ c. $a = 20$ d. none of these

A. a = -40

B. a = 40

C. a = 20

D. none of these

Answer: A

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13. If $|a| = 2, |b| = 3, |c| = 4$ and $a + b + c = 0$ then the value of $b \cdot c + c \cdot a + a \cdot b$ is equal to

A. $19/2$

B. $-19/2$

C. $29/2$

D. $-29/2$

Answer: D

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14. A,B,C,D are four points in space and $\left|\overline{AB} \times \overline{CD} + \overline{BC} \times \overline{AD} + \overline{CA} \times \overline{BD}\right| = \lambda$ (area ΔABC) then value of

λ is _____

A. 1

B. 2

C. 3

D. 4

Answer: D

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15. Given $a = i + j - k, b = -i + 2j + k$ and $c = -i + 2j - k$. A unit vector perpendicular to both a + b and b + c is

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

B. j

C. k

D. $\frac{i + j + k}{\sqrt{3}}$

Answer: C

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16. If $\vec{a}, \vec{b} and \vec{c}$ are unit coplanar vectors, then the scalar triple product $\left[2\vec{a} - \vec{b}\, 2\vec{b} - \vec{c}\, 2\vec{c} - \vec{a}\right]$ is 0 b. 1 c. $-\sqrt{3}$ d. $\sqrt{3}$

A. 0

B. 1

C. $-\sqrt{3}$

D. $\sqrt{3}$

Answer: A

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17. If the vectors $\vec{a}, \vec{b}, and \vec{c}$ form the sides $BC, CA and AB,$ respectively, of triangle $ABC, then$ $\vec{a}\cdot\vec{b} + \vec{b}\cdot\vec{c} + \vec{c}\cdot\vec{a} = 0$ b.

$\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$ c. $\vec{a}\,\vec{b} = \vec{b}\,\vec{c} = \vec{\cdot}\,\vec{a}$ d. $\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} = 0$

A. $a \cdot b + b \cdot c + c \cdot a = 0$

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

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

D. $a \times b = b \times c = c \times a = 0$

Answer: B

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

A. 45°

B. 60°

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

D. $\cos^{-1}(2/7)$

Answer: B

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19. Let $\overline{V} = 2i + j - k$ and $\overline{W} = i + 3k$

If $\overline{U}$ is a unit vector, then the max imum value of the scalar triple product $\left[\overline{U}\,\overline{V}\,\overline{W}\right]$ is

A. -1

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

C. $\sqrt{59}$

D. $\sqrt{60}$

Answer: C

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20. A vector c perpendicular to the vectors $2i + 3j - k$ and $i - 2j + 3k$ satisfying $c.\ (2i - j + k) = -6$ is

A. $-2i + j - k$

B. $2i - j - \frac{4}{3}k$

C. $-3i + 3j + 3k$

D. $3i - 3j + 3k$

Answer: C

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21. If a, b, c be three units vectors such that $a \times (b \times c) = \left(\frac{1}{2}\right)b$; b and c being non-parallel then

A. the angle between a and c is $\pi/3$

B. the angle between a and c is $\pi/2$

C. the angle between a and b is $\pi/3$

D. the angle between a and b is $\pi/6$

Answer: A

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22. If a vector ofmagnitude 50 is collinear with vector $\vec{b} = 6\hat{i} - 8\hat{j} - \frac{15}{2}\hat{k}$ and makes an acute anlewih positive z-axis then:

A. $24i - 32j - 30k$

B. $-24i + 32j + 30k$

C. $24i + 32j - 30k$

D. none of these

Answer: A

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23. IfA, B are two points on the curve $y = x^2$ in the xoy plane satisfying $\vec{OA} \cdot \vec{i} = 1$and $\vec{OB} \cdot \vec{i} = -2$ then the length of the vector $2\vec{0}A - 3\vec{O}B$ is

A. $\sqrt{14}$

B. $2\sqrt{51}$

C. $3\sqrt{41}$

D. none of these

Answer: D

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24. If A, B, C, D are four points in space satisfying $\overline{AB}.\overline{CD} = K\left[\left|\overline{AD}\right|^2 + \left|\overline{BC}\right|^2 - |AC|^2 - |BD|^2\right]$ then the value of K is

A. 2

B. $1/3$

C. $1/2$

D. 1

Answer: C

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25. The distance of the point B with position vector $i + 2j + 3k$ from the line passing through the point A with position vector $4i + 2j + 2k$ and parallel to the vector $2i + 3j + 6k$ is

A. $\sqrt{10}$

B. $\sqrt{5}$

C. $\sqrt{6}$

D. none of these

Answer: A

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26. If a, b and c are unit vectors then $|a-b|^2+|b-c|^2+|c-a|^2$ does not exceed.

A. 4

B. 9

C. 8

D. 6

Answer: B

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27. Find the value of a so that the volume of the parallelepiped formed by vectors $\hat{i}+a\hat{j}+k, \hat{j}+a\hat{k} and a\hat{i}+\hat{k}$ becomes minimum.

A. -3

B. 3

C. $1/\sqrt{3}$

D. $\sqrt{3}$

Answer: C

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28. If $a = i - j - k, a \cdot b = 1$ and $a \times b = -j + k$, then k is equal to

A. $i + j - k$

B. $-2j + k$

C. i

D. $2j + k$

Answer: C

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29. The unit vector which is orthogonal to the vector $5i + 2j + 6k$ and is coplanar with the vectors $2i + j + k$ and $i - j + k$ is

A. $\frac{1}{\sqrt{41}}(2i - 6j + k)$

B. $\frac{1}{\sqrt{29}}(2i - 5j)$

C. $\frac{1}{\sqrt{10}}(3j - k)$

D. $\frac{1}{\sqrt{69}}(2i - 8j + k)$

Answer: C

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30. Let $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} - \hat{j} + \hat{k} and \vec{c} = \hat{i} + \hat{j} - \hat{k}$. A vector in the plane of $\vec{a} and \vec{b}$ whose projectionof c is $1/\sqrt{3}$ is $4\hat{i} - \hat{j} + 4\hat{k}$ b. $3\hat{i} + \hat{j} + 3\hat{k}$ c. $2\hat{i} + \hat{j} - 2\hat{k}$ d. $4\hat{i} + \hat{j} - 4\hat{k}$

A. $4i - j + 4k$

B. $3i + j + 3k$

C. $2i + j + 2k$

D. $4i + j - 4k$

Answer: C

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31. If $|a| = 1, |b| = 2$ and $|a - 2b| = 4$ then $|a + 3b|$ is equal to

A. 8

B. $\sqrt{\frac{51}{2}}$

C. $\sqrt{\frac{19}{2}}$

D. $\sqrt{\frac{77}{2}}$

Answer: D

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32. If $|a|^2 = 8$ and $a \times (i + j + 2k) = 0$ then the value of $a \cdot (-i + j + 4k)$ is

A. $\frac{4}{\sqrt{3}}$

B. $\frac{16}{\sqrt{3}}$

C. $\frac{8}{\sqrt{3}}$

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

Answer: B

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33. If a, b, c are unit vectors, then the maximum value of $|a + 2b|^2 + |b + 3c|^2 + |c + 4a|^2$ is

A. 28

B. 21

C. 48

D. 58

Answer: B

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34. Let $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$, $\vec{b} = \hat{i} + \hat{j}$. If $\vec{c}$ is a vector such that $\vec{a} . \vec{c} = \left|\vec{c}\right|$ and angle between vectors $\vec{a} \times \vec{b}$ and $\vec{c}$ is 30°, then $\left|\left(\vec{a} \times \vec{b}\right) \times \vec{c}\right|$ is equal to

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

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

C. 2

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

Answer: A

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35. The non-zero vectors are $\vec{a}, \vec{b}$ and $\vec{c}$ are related by $\vec{a} = 8\vec{b}$ and $\vec{c} = -7\vec{b}$. Then the angle between $\vec{a}$ and $\vec{c}$ is

A. 0

B. $\pi/4$

C. $\pi/2$

D. π

Answer: D

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36. If $\vec{u}, \vec{v}, \vec{w}$ are non -coplanar vectors and $p, q,$ are real numbers then the equality

$\left[3\vec{u}\, p\vec{v}\, p\vec{w}\right] - \left[p\vec{v}\, \vec{w}\, q\vec{u}\right] - \left[2\vec{w} - q\vec{v}\, q\vec{u}\right] = 0$ holds for

A. more than two but not all values of (p, q)

B. all values of (p, q)

C. exactly one values of (p, q)

D. exactly two values of (p, q)

Answer: C

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37. vectors $\vec{a} = i - j + 2k$, $\vec{b} = 2i + 4j + k$ and $\vec{c} = \lambda i + j + \mu k$ are mutually orthogonal then (λ, μ) is

A. (-2, 3)

B. (3, -2)

C. (-3, 2)

D. (2, -3)

Answer: C

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38. Let $\vec{a} = \hat{j} - \hat{k}$ and $\vec{c} = \hat{i} - \hat{j} - \hat{k}$. Then the vector b satisfying $\vec{a} \times \vec{b} + \vec{c} = 0$ and $\vec{a} \cdot \vec{b} = 3$, is

A. $i - j - 2k$

B. $i + j - 2k$

C. $-i + j - 2k$

D. $2i - j + 2k$

Answer: C

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

A. 3

B. -5

C. -3

D. 5

Answer: B

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40. The vectors a and b are not perpendicular and c and d are two vectors satisfying $b \times c = b \times d$ and $a.\ d = 0$. The vectors d is equal to

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

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

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

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

Answer: A

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41. If the vectors pi + j + k, i + qj + k and i + j + rk, where $p \neq q \neq r \neq 1$ are coplanar, then : pqr- (p + q + r) =.....

A. 2

B. 0

C. -1

D. -2

Answer: D

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42. Let a,b and c be three non-zero vectors which are pairwise non-collinear. If a+3b is collinear with c and b+2c is collinear with a, then a+3b+6c is

A. a

B. b

C. 0

D. a + c

Answer: C

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43. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = \hat{i} - \hat{j} + \hat{k} and \vec{c} = \hat{i} - \hat{j} - \hat{k}$ be three vectors. A vector $\vec{v}$ in the plane of $\vec{a} and \vec{b}$, whose projection on $\vec{c}$ is $\frac{1}{\sqrt{3}}$ is given by $\hat{i} - 3\hat{j} + 3\hat{k}$ b. $-3\hat{i} - 3\hat{j} + 3\hat{k}$ c. $3\hat{i} - \hat{j} + 3\hat{k}$ d. $\hat{i} + 3\hat{j} - 3\hat{k}$

A. $i - 3k + 3k$

B. $-3i - 3j - k$

C. $3i - j + k$

D. $i + 3j - 3k$

Answer: C

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

A. $\pi/2$

B. $\pi/3$

C. $\pi/4$

D. $\pi/6$

Answer: B

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45. Let ABCD be a parallelogram such that $\vec{AB} = \vec{q}, \vec{AD} = \vec{p}$ and $\angle BAD$ be an acute angle. If $\vec{r}$ is the vector that coincides with the altitude directed from the vertex B to the side AD, then $\vec{r}$ is

A. $r = -q + \frac{(p \cdot q)}{p \cdot p} p$

B. $r = q - \frac{(p \cdot q)}{p \cdot p} p$

C. $r = -3q + \frac{3(p \cdot q)}{p \cdot p} p$

D. $r = 3q - \frac{3(p \cdot q)}{p \cdot p} p$

Answer: A

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Solved Examples Level 2 Single Correct Answer Type Questions

1. The vector $\vec{c}$, directed along the internal bisector of the angle between the vectors $\vec{c} = 7\hat{i} - 4\hat{j} - 4\hat{k}$ and $\vec{b} = -2\hat{i} - \hat{j} + 2\hat{k}$ with $\left|\vec{c}\right| = 5\sqrt{6}$, is

A. $\pm(5/3)(i - 7j + 2k)$

B. $(5/3)(5i + 5j + 2k)$

C. $\pm(5/3)(i + 7j + 2k)$

D. $(5/3)(-5i + 5j + 2k)$

Answer: A

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2. If $\bar{a}, \bar{b}$ and $\bar{c}$ be there non-zero vectors, no two of which are collinear. If the vectors $\bar{a} + 2\bar{b}$ is collinear with $\bar{c}$ and $\bar{b} + 3\bar{c}$ is collinear with a, then (λ being some non-zero scalar)$\bar{a} + 2\bar{b} + 6\bar{c}$ is equal to

A. λa

B. λb

C. λc

D. 0

Answer: D

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

A. 1

B. 2

C. 0

D. -1

Answer: D

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

A. the arithmetic mean of a and b

B. the geometric mean of a and b

C. the harmonic mean of a and b

D. equal to zero

Answer: B

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5. Let p, q, r be three mutually perpendicular vectors of the same magnitude. If a vector R satisfies th equation p x ((X-q) x p) q x ((x-r)xq)+rx ((x-p) x r) Then x is given by :

A. $(1/2)(p+q-2r)$

B. $(1/2)(p+q+r)$

C. $(1/3)(p+q+r)$

D. $(1/3)(2p+q-r)$

Answer: B

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6. If a, b, c and d are unit vectors, then $|a-b|^2+|b-c|^2+|c-d|^2+|d-a|^2+|c-a|^2+|b-d|^2$ does not exceed

A. 4

B. 12

C. 8

D. 16

Answer: B

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7. Let $\vec{a}=\vec{i}-\vec{k}, \vec{b}=x\vec{i}+\vec{j}+(1-x)\vec{k}$ and $\vec{c}=y\vec{i}+x\vec{j}+(1+x-y)\vec{k}$. Then $\left[\vec{a}\ \vec{b}\ \vec{c}\right]$ depends on only x (b) only y Neither xn or y (d) both $xandy$

A. only x

B. only y

C. neither x nor y

D. both x and y

Answer: C

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8. The vectors $a = 2\hat{i} + \hat{j} - 2\hat{k}, b = \hat{i} + \hat{j}$. If c is a vector such that $a.c = |c|$ and $|c - a| = 2\sqrt{2}$, angle between $a \times b$ and c is 45°, then $|(a \times b) \times c|$ is

A. $2/3$

B. $3/2$

C. 2

D. 3

Answer: B

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9. A tangent is drawn to the curve $y = \frac{8}{x^2}$ in XY-plane at the point $A(x_0, y_0)$, where $x_0 = 2$ and the tangent cuts the X-axis at a point B. Then $\overline{AB}.\overline{OB} =$

A. 2

B. 1

C. 0

D. 3

Answer: D

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10. The vectors $3i - 2j + k, i - 3j + 5k$ and $2i + j - 4k$ form the sides of a triangle. This triangle is

A. 2

B. 3

C. 1

D. $11/\sqrt{3}$

Answer: B

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11. For unit vectors b and c and any non zero vector a, the value of $\{\{(a+b)\times(a+c)\}\times(b\times c)\}\cdot(b+c)$ is

A. $|a|^2$

B. $2|a|^2$

C. $3|a|^2$

D. none of these

Answer: D

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12. Three non-coplanar vector a, b and c are drawn from a common initial point. The angle between the plane passing through the terminal points of these vectors and the vector $a \times b + b \times c + c \times a$ is

A. $\pi/4$

B. $\pi/2$

C. $\pi/3$

D. none of these

Answer: B

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13. A unit tengent vector at t = 2 on the curve $x = t^2 + 2, y = 4t^3 - 5, z = 2t^2 - 6t$ is

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

B. $\frac{1}{3}(2i + 2j + k)$

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

D. none of these

Answer: D

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14. A particle moves along a curve so that its coordinates at time t are x = t, $y = \frac{1}{2}t^2, z = \frac{1}{3}t^3$. The acceleration at t = 1 is

A. j + 2k

B. j + k

C. 2j + k

D. none of these

Answer: A

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

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

B. $\cos^{-1}(9/14)$

C. $\sin^{-1}(9/14)$

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

Answer: C

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16. A unit vector n perpendicular to the plane determined by the points A (0, -2, 1), B (1, -2, -2) and C (-1, 1, 0)

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

B. $1/4\sqrt{6}(8i+4j+4k)$

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

D. $\frac{1}{\sqrt{14}}(3i+j+2k)$

Answer: B

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17. The vector $\overline{AB}=3\hat{i}+4\hat{k}$ and $\overline{AC}=5\hat{i}-2\hat{j}+4\hat{k}$ are the sides of a triangle ABC. The length of the median through A is

A. $\sqrt{14}$

B. $\sqrt{18}$

C. $\sqrt{29}$

D. none of these

Answer: B

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18. If $a+b+c=0$ and $|a|=3, |b|=5$ and $|c|=7$ then the angle between a and b is

A. $\pi/6$

B. $2\pi/3$

C. $\pi/3$

D. $5\pi/3$

Answer: C

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19. The vector $((i-j)\times(j-k))\times(i+5k)$ is equal to

A. $5i-4j-k$

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

C. $4i-5j-k$

D. $5i + 4j - k$

Answer: A

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20. The position vector of a point P is $\overrightarrow{r} = x\hat{i} + y\hat{j} + z\hat{k}$ where $x, y, z \varepsilon N$ and $\overrightarrow{a} = \hat{i} + \hat{j} + \hat{k}$. If $\overrightarrow{r}.\overrightarrow{a} = 10$, then the number of possible position of P is

A. 72

B. 36

C. 60

D. 108

Answer: B

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21. If $\vec{a}$ and $\vec{b}$ are two unit vectors and θ be the angle between them, then $\sin\left(\frac{\theta}{2}\right) =$

A. $\frac{1}{2}|a-b|$

B. 1

C. $\frac{1}{2}|a+b|$

D. 0

Answer: A

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22. Vectors $i+j+(m+1)k, i+j+mk$ and $i-j+mk$ are coplaner for

A. 1

B. 4

C. 3

D. none of these

Answer: D

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23. If $\vec{a}, \vec{b} and \vec{c}$ are non-coplanar unit vectors such that $\vec{a} \times \left(\vec{b} \times \vec{c}\right) = \frac{\vec{b} + \vec{c}}{\sqrt{2}}$, then the angle between $\vec{a} and \vec{b}$ is $3\pi/4$ b. $\pi/4$ c. $\pi/2$ d. π

A. $3\pi/4$

B. $\pi/4$

C. $\pi/2$

D. π

Answer: A

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24. The vector $\vec{a} = \alpha\hat{i} + 2\hat{j} + \beta\hat{k}$ lies in the plane of the vectors $\vec{b} = \hat{i} + \hat{j}$ and $\vec{c} = \hat{j} + \hat{k}$ and bisects the angle between $\vec{b}$ and $\vec{c}$. Then which one of the following gives possible values of $\alpha \text{and} \beta$? (1) $\alpha = 2, \beta = 2$ (2) $\alpha = 1, \beta = 2$ (3) $\alpha = 2, \beta = 1$ (4) $\alpha = 1, \beta = 1$

A. $a \cdot i + 3 = 0$

B. $a \cdot k - 4 = 0$

C. $a \cdot i - 1 = 0$

D. $a \cdot k + 2 = 0$

Answer: B

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25. Let the volume of parallelopiped whose coteriminous edges are given by $u = i + j + \lambda k, v = i + j + 3k$ and $w = 2i + j + k$ be 1 $(\text{unit})^3$. If θ is angle between the edges u and w, then $\cos\theta$ can be

A. $\frac{7}{6\sqrt{3}}$

B. $\frac{5}{7}$

C. $\frac{5}{3\sqrt{3}}$

D. $\frac{7}{6\sqrt{6}}$

Answer: A

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Solved Examples Numerical Answer Type Questions

1. Suppose $AB = i + 2j + 4k$ and $AC = 5i + j + 2k$ are two sides of a triangle ABC whose centroid is G, then $|AG| =$ _____

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2. Let the position vectors of vertices of a ΔABC be $OA = 3i + j + 2k, OB = i + 2j + 3k$ and $OC = 2i + 3j + k.$ If length of altitude of ΔABC from A is p, then $2p^2 =$ _____

View Text Solution

3. Suppose $4i + 7j + 8k, 2i + 3j + 4k, 2i + 5j + 7k$ are respectively the position vectors of the vertices, A, B, C of ΔABC. If the bisector of $\angle BAC$ meet at point D in BC, position vector of D is $2i + (13/3)j + \lambda k,$ then $\lambda =$ _____

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4. Prove that the volume of the tetrahedron and that formed by the centroids of the faces are in the ratio of $27:1$.

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5. $\bar{a} = 2\bar{i} + \bar{j} - 2\bar{k}$ and $\bar{b} = \bar{i} + \bar{j}$ if $\bar{c}$ is a vector such that $\bar{a} \cdot \bar{c} = |\bar{c}|, |\bar{c} - \bar{a}| = 2\sqrt{2}$ and and the angle between$\bar{a} \times \bar{b}$ and $\bar{c}$ is 30°, then $\left|\left(\bar{a} \times \bar{b}\right) \times \bar{c}\right| =$

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6. Suppose a and b are two unit vectors and θ is acute angle between them. If $|a-b|^2 = 4\sin^2(\alpha\theta)$, then $8\alpha^2 =$ _____

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7. The vector a, b and c are such tha $|a| = |b| = 1$ and $|c| = 2$ (ii) $a \times (a \times c) + b = 0$ find the possible angles between a and c.

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8. Let $a = 2i - 3j + 4k, b = i + 2j - 2k$ and $c = 3i - j + k$. Let V be, the volume (in cubic unit) of the parallelopiped having $a + b + c, a - b + c$ and $a + b - c$ as coterminus edges, then V = _____

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9. If

$A(3i-2j-k), B(2i+3j-4k), C(-i+j+2k)$ and $D(4i+5j+\lambda k)$

are coplanar points, then $\lambda =$ _____

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10. Suppose $a+x^2b+y^2c=0$ and $a\times b+c\times a=16(b\times c)$, then (x, y) lies on a circle of radius _____ units

View Text Solution

11. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three vectors having magnitudes $1, 1$ and 2 respectively. If $\vec{a}\times\left(\vec{a}\times\vec{c}\right)+\vec{b}=\vec{0}$, the acute angle between $\vec{a}$ and $\vec{c}$ is

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12. Suppose ABC is a right angled triangle with $\angle C = \pi/2$. If $|AB| = 5$, then $AB \cdot AC + BC \cdot BA + CA \cdot CB =$ _____

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13. Let $a = 5i + 4j - k, b = -4i + j + 5k, c = i + 3j - k$. Let α be a vector perpendicular to both a and b such that $\alpha \cdot c = 63$, then $|\alpha|^2 / 21^2 =$ _____

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14. If the volume of parallelopiped whose coterminous edges are $a = i + j + 2k, b = 2i + \lambda j + k$ and $c = 2i + 2j + \lambda k$ is 35 $(\text{unit})^3$, then $a \cdot b + b \cdot c - c \cdot a =$ _____

View Text Solution

15. Suppose $P=(x+1)i+xj+xk, Q=xi+(x+1)j+xk, k=xi+xj+(x+1)$ are coplanar vectors and $3(P.\,Q)^2-\lambda|R\times Q|^2=0,$ then $\lambda=$ _____

View Text Solution

16. Let $|a|=\sqrt{3}, |b|=5, b\cdot c=10,$ angle between b and c is equal to $\pi/3.$ If a is perpendicular to $b\times c,$ then $|a\times(b\times c)|=$ _____

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17. Let a,b,c be three vectors such that $a\neq 0$ and $a\times b=2a\times c, |a|=|c|=1, |b|=4$ and $|b\times c|=\sqrt{15}.$ If $b-2c=\lambda a,$ then λ is equal ot

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18. Let $a = i - 2j + 3k$. If b is a vector such that $a \cdot b = |b|^2$ and $|a - b| = \sqrt{7}$, then $|b|^2 =$ _____

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19. Suppose the diagonals of a parallelogram are represented by vectors $i + 3j - 2k$ and $3i + j - 4k$. If A is the area of this parallelogram, then A =

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20. Let a be vector, such that $|a| = 5$. Then $|a \cdot i|^2 + |a \cdot j|^2 + |a \cdot k|^2 =$ _____

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21. If $\vec{r} = l\left(\vec{b} \times \vec{c}\right) + m\left(\vec{c} \times \vec{a}\right) + n\left(\vec{a} \times \vec{b}\right)$ and $\left[\vec{a}, \vec{b}, \vec{c}\right] = 2$, then $l + m + n$ is equal to

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22. Suppose $a = 5i - 3j + 2k, b = -i + 2j + 3k, c = 7i - 18j + 21k,$ then $[a - b$

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23. If $a = 2i - 3j + 5k, b = 3i - 4j + 5k$ and $c = 5i - 3j - 2k$ then volume of the parallelopiped with coterminus edges $a + b, b + c, c + a$ is

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24. Suppose a, b, c are three unit vectors such that

$$|a-b|^2+|b-c|^2+|c-a|^2=9,$$

then $|2a+7b+7c|=$ _____

Watch Video Solution

25. If $4x+3y+12z=26, x, y, z, \in R$, then minimum possible value of $x^2+y^2+z^2$ is _____

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Exercise Concept Based Single Correct Answer Type Questions

1. Which of the following statements are correct :- If M is the mid point of AB and O is any point, then

A. $OM=OA+MA$

B. $OM=OA-MA$

C. $OM = \frac{1}{2}(OA - OB)$

D. $OM = \frac{1}{2}(OB + OA)$

Answer: D

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2. The angle between $3i + 4j$ and $2j - 5k$ is

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

B. $\cos^{-1}\frac{8}{5\sqrt{29}}$

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

D. $\cos^{-1}\frac{1}{3}$

Answer: B

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3. A unit vector c perpendicular to a and coplanar with a and b, $a = i + j + k, b = i + 2j$ is given by

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

B. $\frac{1}{\sqrt{2}}(i - j)$

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

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

Answer: D

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4. A vector b, which is collinear with vector $a = 2i + j - k$ and satisfies $a \cdot b = 2$ is given by

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

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

C. $\frac{1}{4}(2i + j - k)$

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

Answer: B

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5. If $u=i+j-k, v=2i+j+k$ and $w=i+j+2k$ then the magnitude of projection of $u \times v$ on w is given by

A. $\sqrt{\frac{1}{2}}$

B. $\sqrt{\frac{1}{3}}$

C. $\sqrt{\frac{3}{4}}$

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

Answer: D

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6. If a and b are non-collinear vectors, then the value of λ for which

$u = (\lambda + 2)a + b$ and

$v = (1 + 4\lambda)a - 2b$ are collinear is

A. $\frac{1}{2}$

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

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

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

Answer: B

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7. The area of the triangle formed by A (1, 0, 0), B(0, 1, 0), C(1, 1, 1) is

A. $\frac{1}{2}$

B. $\frac{\sqrt{3}}{4}$

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

D. $\frac{1}{4}$

Answer: C

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

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

B. $\frac{1}{\sqrt{14}}(i - 2k + 3k)$

C. $\frac{1}{\sqrt{74}}(4i + 3j - 7k)$

D. $\frac{1}{\sqrt{74}}(4i - 3j - 7k)$

Answer: D

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9. The value of scalar triple product $i - 2j + 3k, 2i + j - k$ and $j + k$ is

A. 12

B. 10

C. 14

D. 16

Answer: A

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10. The vector $[(i - j + k) \times (2i - 3j - k)] \times [(-3i + j + k) \times (2j + k)]$ is given by

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

B. $-5(3i - 5j - 3k)$

C. $5(3i + 5j - 3k)$

D. $(15i - 25j + 15k)$

Answer: B

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Exercise Level 1 Single Correct Answer Type Questions

1. Let $|a| = 3$ and $|b| = 4$. The value of μ for which the vectors $a + \mu b$ and $a - \mu b$ will be perpendicular is

A. $3/4$

B. $2/3$

C. $-5/2$

D. $-2/3$

Answer: A

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2. The value of α for which the vectors $2i - j + k, i + 2j + \alpha k$ and $3i - 4j + 5k$ are coplanar is

A. 3

B. -3

C. 2

D. none of these

Answer: B

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3. The area of a parallelogram having diagonals $a = 3i + j - 2k$ and $b = i - 3j + 4k$ is

A. $5\sqrt{3}$

B. $2\sqrt{3}$

C. $4\sqrt{3}$

D. none of these

Answer: A

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4. If $\vec{r}$ satisfies $\vec{r} \times \left(\vec{i} + 2\vec{j} + \vec{k}\right) = \vec{i} - \vec{k}$ then for any scalar t, $\vec{r} =$

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

B. $j + t(i + 2j + k)$

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

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

Answer: B

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5. The vectors $\vec{a}, \vec{b}, \vec{c}$ are of the same length and pairwise form equal angles. If $\vec{a} = \hat{i} + \hat{j}$ and $\vec{b} = \hat{j} + \hat{k}$ then $\vec{c}$ may be :

A. $i + k$

B. $-i + 4j - k$

C. $-\frac{1}{3}i + \frac{4}{3}j - \frac{1}{3}k$

D. $\frac{1}{3}i + \frac{4}{3}j - \frac{1}{3}k$

Answer: C

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6. The vectors $\overrightarrow{AB} = 3\hat{i} + 2\hat{} 2\hat{k}$ and $\overrightarrow{BC} = -\hat{i} - 2\hat{k}$ are the adjacent sides of parallelogram. The angle between its diagonal is (A) $\frac{\pi}{3}$ (B) $\frac{\pi}{4}$ (C) $\frac{3\pi}{4}$ (D) (2pi)/3`

A. $\pi/4$

B. $\pi/3$

C. $\pi/2$

D. $2\pi/3$

Answer: A

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7. Let the unit vectors a and b be perpendicular and the unit vector c be inclined at an angle θ to both a and b. If $c = \alpha a + \beta b + \gamma(a \times b)$, then

A. $\alpha = 2\beta$

B. $\gamma^2 = 1 + 2\alpha^2$

C. $\gamma^2 = \cos 2\theta$

D. $\beta^2 = \dfrac{1 + \cos 2\theta}{2}$

Answer: D

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8. If unit vectors $\vec{a}$ and $\vec{b}$ are inclined at an angle 2θ such that $\left|\vec{a}-\vec{b}\right|<1$ and $0 \leq \theta \leq \pi$, then θ lies in the interval

A. $\left[0, \frac{\pi}{6}\right]$

B. $\left(\frac{5\pi}{6}, 2\pi\right]$

C. $\left[\frac{\pi}{6}, \frac{\pi}{2}\right]$

D. $\left[\frac{\pi}{2}, \frac{5\pi}{6}\right]$

Answer: A

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9. For non-coplanar vectors a, b and c, $|(a \times b) \cdot c| = |a||b||c|$ holds if and only if

A. $a \cdot b = b \cdot c = c \cdot a = 0$

B. $a \cdot b = 0 = b \cdot c$

C. $a \cdot b = 0 = c \cdot a$

D. $b \cdot c = 0 = c \cdot a$

Answer: A

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

A. -1

B. 1

C. -7

D. 5

Answer: B

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11. The vectors $(x, x+1, x+2), (x+3, x+3, x+5)$ and $(x+6, x+7, x+8)$ are coplanar for (A) all values of x (B) $x < 0$ (C) $x > 0$ (D) none of these

A. only finite number of values of x

B. $x < 0$

C. Only x = z

D. none of these

Answer: B

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12. A vector oflength $\sqrt{7}$ which is perpendicul to $2\bar{j} - \bar{k}$ and $-\bar{i} + 2\bar{j} - 3\bar{k}$ and makes obtus angle with y-aixs is

A. $\left(1/\sqrt{5}\right)\left(4i - j + \sqrt{18}k\right)$

B. $\left(1/\sqrt{3}\right)(4i - j - 2k)$

C. $(1/\sqrt{3})(-4i+j+2k)$

D. $(1/\sqrt{3})(-4i-j+2k)$

Answer: B

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13. Let $|a|=|b|=2$ and $p=a+b, q=a-b.$ If $|p\times q|=2\left(k-(a.\,b)^2\right)^{1/2}$ then

A. k = 16

B. k = 8

C. k = 4

D. k = 1

Answer: A

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14. IF r.a = 0, r. b = 0 and r. c= 0 for some non-zero vector r. Then, the value of [a b c] is

A. 0

B. $1/2$

C. 1

D. 2

Answer: A

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15. If the position vectors of three consecutive vertices of any parallelogram are respectively $\vec{i}+\vec{j}+\vec{k}, \vec{i}+3\vec{j}+5\vec{k}, 7\vec{i}+9\vec{j}+11\vec{k}$ then the position vector of its fourth vertex is:

A. $6(i+j+k)$

B. $7(i+j+k)$

C. $2j-4k$

D. $6i+8j+10k$

Answer: B

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16. The volume of the parallelopiped whose sides are given by $\overrightarrow{OA}=2\hat{i}-3\hat{j}$, $\overrightarrow{OB}+\hat{i}+\hat{j}-\hat{k}$

$\overrightarrow{OC}=3\hat{i}-\hat{k}$, is

A. $4/13$

B. 4

C. $2/7$

D. none of these

Answer: B

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17. The value of $|a \times i|^2 + |a \times j|^2 + |a \times k|^2$ is

A. a^2

B. $2a^2$

C. $3a^2$

D. none of these

Answer: B

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18. If a, b and c are any three vectors, then $a \times (b \times c) = (a \times b) \times c$ if and only if

A. b and c are collinear

B. a and c are collinear

C. a and b are collinera

D. none of these

Answer: B

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19. $i \times (a \times i) + j \times (a \times j) + k \times (a \times k)$ is always equal to

A. a

B. 2a

C. 0

D. 3a

Answer: B

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20. The value of $[a \times b, b \times c, c \times a]$ is

A. 2 [a b c]

B. [a b c]

C. $[abc]^2$

D. 0

Answer: C

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21. Given vectors a = (3, -1, 5) and b = (1, 2, -3). A vector c which is perpendicular to z-axis and satisfying $c \cdot a = 9 \text{ and } c \cdot b = -4$ is

A. (2, -2, 0)

B. (4, -2, 0)

C. (2, -3, 0)

D. (1, 2, 4)

Answer: C

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22. Area of the parallelogram on the vectors a + 3b and 3a + b if $|a| = |b| = 1$ and the angle between a and b is $\pi / 6$ is

A. 2

B. 4

C. 8

D. 16

Answer: B

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23. If $a = xi + 5j + 7k, b = i + j - k, c = i + 2j + 2k$ are coplanar then the value of x is

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24. If $a \cdot (b \times c) = 3$ then

A. $c \cdot (a \times b) = -3$

B. $a \cdot (c \times b) = -3$

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

D. $(a \times c) \cdot b = 3$

Answer: B

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25. Let $a = 2i + 2j + k$ and b be another vector such that $a \cdot b = 14$ and $a \times b = 3i + j - 8k$ then the vector b is equal to

A. $5i + j + 2k$

B. $5i - j - 2k$

C. $5i + j - 2k$

D. $3i + j + 4k$

Answer: A

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26. ABCDEF is a regular hexagon with centre a the origin such that $\overrightarrow{AB} + \overrightarrow{EB} + \overrightarrow{FC} = \lambda\overrightarrow{ED} then \lambda =$ (A) 2 (B) 4 (C) 6 (D) 3

A. 2

B. 4

C. 6

D. 3

Answer: B

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27. A non zero vector $\vec{a}$ is parallel to the kine of intersection of the plane determined by the vectors $veri$, $\vec{i} + \vec{j}$ and the plane determined by the vectors $\vec{i} - verj$, $\vec{i} + \vec{k}$ find the angle between $\vec{a}$ and the vector $\vec{i} - 2\vec{j} + 2\vec{k}$.

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

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

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

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

Answer: D

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28. Let P, Q, R and S be the points on the plane with position vectors $-2i - j, 4i, 3i + 3jand - 3j + 2j,$ respectively. The quadrilateral $PQRS$ must be a Parallelogram, which is neither a rhombus nor a rectangle Square Rectangle, but not a square Rhombus, but not a square

A. parallelogram, which is neither rhombus nor a rectangle

B. square

C. rectangle but not a square

D. rhombus, but not a square

Answer: A

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29. If $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ are unit vectors such that $\left(\vec{a} \times \vec{b}\right) \cdot \left(\vec{c} \times \vec{d}\right) = 1$ and $\vec{a} . \vec{c} = \frac{1}{2}$, then

A. a, b, c are non-coplanar

B. b, c, d are non-coplanar

C. b, d are non-parallel

D. a, d are parallel and b, c are parallel

Answer: C

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30. The edges of a parallelopiped are of unit length and are parallel to non-coplanar unit vectors $\hat{a}, \hat{b}, \hat{c}$ such that $\hat{a} \cdot \hat{b} = \hat{b} \cdot \hat{c} = \hat{c} \cdot \hat{a} = \frac{1}{2}$. Then, the volume of the parallelopiped is

A. $1/\sqrt{2}$

B. $1/2\sqrt{2}$

C. $\sqrt{3}/2$

D. $1/\sqrt{3}$

Answer: A

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31. If a is a non-zero real number, then prove that the vectors $\vec{\alpha} = a\hat{i} + 2a\hat{j} - 3a\hat{k}, \vec{\beta} = (2a+1)\hat{i} + (2a+3)\hat{j} + (a+1)\hat{k} and, \vec{\gamma} = ($ are never coplanar.

A. $\{0\}$

B. $(0, \infty)$

C. $(-\infty, 1)$

D. $(1, \infty)$

Answer: A

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32. If $\left(\vec{a} \times \vec{b}\right) \times \left(\vec{c} \times \vec{d}\right) = h\vec{a} + k\vec{b} = r\vec{c} + s\vec{d}$, where $\vec{a}, \vec{b}$ are non-collinear and $\vec{c}, \vec{d}$ are also non-collinear then :

A. p = [c b d]

B. p = [a c d]

C. p = [a b d]

D. p = [a b c]

Answer: A

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33. Let the unit vectors a and b be perpendicular and the unit vector c be inclined at an angle θ to both a and b. If $c = \alpha a + \beta b + \gamma(a \times b)$, then

A. $\alpha = \beta$

B. $\alpha = 2\beta$

C. $\alpha = \frac{\beta}{2}$

D. $\beta^2 - \frac{1+\beta}{2}$

Answer: A

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Exercise Level 2 Single Correct Answer Type Questions

1. A line makes angles $\alpha, \beta, \gamma and \delta$ with the diagonals of a cube. Show that $\cos^2\alpha + \cos^2\beta + \cos^2\gamma + \cos^2\delta = 4/3$.

A. 1

B. $1/3$

C. $8/3$

D. $4/3$

Answer: D

Watch Video Solution

2. If $(a \times b) \times (c \times d) = [abd]c + kd$ then the value of k is

A. [b a c]

B. [a b c]

C. [b c d]

D. [c b d]

Answer: A

Watch Video Solution

3. The one of the value of x for which the angle between $c = xi + j + k$ and $d = i + xj + k$ is $\pi/3$ is

A. $1 + \sqrt{2}$

B. $2 + \sqrt{2}$

C. $3 + \sqrt{2}$

D. none of these

Answer: D

Watch Video Solution

4. The line $x = -2, y = 4 + 2t, z = -3 + t$ intersect

A. the xy-plane

B. the xz-plane in (-2, 0, -4)

C. the yz-plane

D. none of these

Answer: A

View Text Solution

5. Let $u = 2i - j + 3k$ and $a = 4i - j + 2k$. The vector component of u orthogonal to a is

A. $(1/7)(20i - 5j + 10k)$

B. $(1/7)(4i + 24j + 4k)$

C. $(1/7)(11i + 2j + 6k)$

D. $(-1/7)(6i + 2j - 11k)$

Answer: D

Watch Video Solution

6. If a, b, c, d lie in the same plane then $(a \times b) \times (c \times d)$ is equal to

A. c + d

B. 0

C. [a, b, c] a + 2b

D. [b, c, d] c + d

Answer: B

Watch Video Solution

7. If $(a \times b) \cdot (c \times d) = (a \cdot c)(b \cdot d) + k(a.\, d)(b.\, c)$ then the value of k is

A. 1

B. 0

C. -2

D. -1

Answer: D

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8. The distance between (5, 1, 3) and the line x = 3, y = 7 + t, z = 1 + t is

A. 4

B. 2

C. 6

D. 8

Answer: C

Watch Video Solution

9. The distance between the lines

$x = 1 - 4t, y = 2 + t, z = 3 + 2t$ and $x = 1 + s, y = 4 - 2s, z = -1 +$

is

A. 8

B. $16/\sqrt{90}$

C. $8/\sqrt{5}$

D. $16/\sqrt{110}$

Answer: D

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10. The vertices of a triangle ABC are A (1,-2, 2), B (1, 4, 0) and C (-4, 1, 1) respectively. If M be the foot of perpendicular drawn from B on AC, then $\overrightarrow{BM}$ is

A. $-\frac{20}{3}i - 10j + \frac{10}{3}k$

B. $-\frac{10}{7}i - \frac{30}{7}j + \frac{10}{7}k$

C. $\frac{20}{7}i + 5j - \frac{10}{7}k$

D. $-\frac{20}{7}i - \frac{30}{7}j + \frac{10}{7}k$

Answer: D

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11. If a, b, c, are non-coplanar vectors such that $(2h+k)a+(3-4h+l)b+(1+h+k)c=ha+kb+lc$ then

A. $h=1, k=-4/3, l=4/3$

B. $h=4/3, k=-4/3, l=1$

C. $h=1/3, k=-1/3, l=2/3$

D. none of these

Answer: B

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12. Show that the angle between two diagonals of a cube is $\cos^{-1}\sqrt{\frac{1}{3}}$.

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

B. $\cos^{-1}\left(\frac{2}{\sqrt{3}}\right)$

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

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

Answer: C

Watch Video Solution

13. The point of intersection of the lines $r \times a = b \times a, r \times b = a \times b$ is

A. a

B. b - a

C. a - b

D. a + b

Answer: D

Watch Video Solution

14. If

$a = a_1 i + a_2 j + a_3 k, b = b_1 i + b_2 j + b_3 k, c = c_1 i + c_2 j + c_3 k, d = d_1 i + d$

and

$$k(a \times b) \times (c \times d) = \begin{vmatrix} -a & -b & c & d \\ a_1 & b_1 & c_1 & d_1 \\ a_2 & b_2 & c_2 & d_2 \\ a_3 & b_3 & c_3 & d_3 \end{vmatrix}$$

(formal expression) then

A. k = 16

B. k = 2

C. k = 4

D. none of these

Answer: B

View Text Solution

15. The value of $(b \times c) \cdot (a \times d) + (c \times a) \cdot (b \times d) + (a \times b) \cdot (c \times d)$ is

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

B. [a, b, c] + [b, c, d]

C. 0

D. none of these

Answer: C

View Text Solution

16. The lines $r = b - 2c + \lambda(a + b)$ and $r = 2b - c + \mu(b + c)$ intersect at the point.

A. $b - 2c$

B. $b + 2c$

C. $b + c$

D. $c - b$

Answer: A

View Text Solution

17. If $a = i + 2j - 3k, b = 2i + j - k$ then the vector v satisfying $a \times v = a \times b$ and $a \cdot v = 0$ is $b + ta, t$ being a scalar for

A. all values of t

B. for no value of t

C. finite number of values of t

D. $t = -1/4$

Answer: C

View Text Solution

18. The value of

$|a \times (i \times j)|^2 + |a \times (j \times k)|^2 + |a \times (k \times i)|^2$ is

A. $|a|^2$

B. $2|a|^2$

C. $3|a|^2$

D. none of these

Answer: B

Watch Video Solution

19. The locus of a point equidistant from two points with position vectors $\vec{a}$ and $\vec{b}$ is

A. $(r - (a + b)) \cdot b = 0$

B. $\left(r - \frac{1}{2}(a + b)\right) \cdot a = 0$

C. $\left(r - \frac{1}{2}(a + b)\right) \cdot (a - b) = 0$

D. $\left(r-\frac{1}{2}(a+b)\right)\cdot(a+b)=0$

Answer: C

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20. A vector $\vec{a}=(x,y,z)$ makes an obtuse angle with F-axis, and make equal angles with $\vec{b}=(y,-2z,3x)$ and $\vec{c}=(2z,3x,-y)$ and $\vec{a}$ is perpendicular to $\vec{d}=(1,-1,2)$ if $\left|\vec{a}\right|=2\sqrt{3}$ then vector $\vec{a}$ is:

A. (-2, 2, 2)

B. $\left(1,1,\sqrt{10}\right)$

C. (2, -2, -2)

D. none of these

Answer: C

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21. If $a \times b = c$ and $b \times c = a$, then

A. a, b, c are orthogonal in pairs but $|a| \neq |c|$

B. a, b, c are orthogonal in pairs but $|b| \neq 1$

C. a, b, c are not orthogonal to each other in pairs

D. a, b, c are orthogonal in pairs and $|a| = |c|, |b| = 1$

Answer: D

View Text Solution

22. Let OABC be a regular tetrahedron, then angle between edges OA and BC is:

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

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

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

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

Answer: B

View Text Solution

23. Let $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$, $\vec{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$ and $\vec{c} = c_1\hat{i} + c_2\hat{j} + c_3\hat{k}$ be three non zero vectors such that $\vec{c}$ is a unit vector perpendicular to both $\vec{a}$ and $\vec{b}$. If the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{6}$, then $\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}^2$ is equal to

A. 0

B. 1

C. $\left(\frac{1}{4}\right)\left(\sum_{i=1}^{3} a_i^2\right)\left(\sum_{i=1}^{3} b_i^2\right)$

D. none of these

Answer: C

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24. The vector $\vec{a}$ has the components $2p$ and 1 w.r.t. a rectangular Cartesian system. This system is rotated through a certain angel about the origin in the counterclockwise sense. If, with respect to a new system, $\vec{a}$ has components $(p+1) and 1$, then p is equal to a. -4 b. $-1/3$ c. 1 d. 2

A. p = 0

B. p = 1 or p = 1/3

C. p = 1 or p = 1/3

D. p = 1 or p = -1

Answer: C

Watch Video Solution

25. $a \cdot ((b \times c) \times (a + (b \times c))$ is equal to

A. 0

B. 2 [a b c]

C. [a b c]

D. none of these

Answer: A

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26. If $\vec{X}.\vec{A}=0, \vec{X}.\vec{B}=0, \vec{X}.\vec{C}=0$ for some non-zero vector $\vec{X}$ then $\left[\vec{A}\,\vec{B}\,\vec{C}\right]=0$

A. $|A||B||C|$

B. 0

C. $2|A||B||C|$

D. none of these

Answer: B

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27. Given the vectors $a = 3i - j + 5k$ and $b = i + 2j - 3k$. A vector c which is perpendicular to the z-axis and satisfies $c \cdot a = 9$ and $c \cdot b = -4$ is

A. $2i - 3j$

B. $-2i + 3j$

C. $-4i - 4j$

D. $i - j + k$

Answer: A

Watch Video Solution

28. The unit vector in XOZ plane and making angles 45° and 60° respectively with $\vec{a} = 2i + 2j - k$ and $\vec{b} = 0i + j - k$, is

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

B. $\frac{1}{\sqrt{2}}(i-k)$

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

D. none of these

Answer: B

Watch Video Solution

29. If vector $\vec{a}+\vec{b}$ bisects the angle between $\vec{a}$ and $\vec{b}$, then prove that $\left|\vec{a}\right| = \left|\vec{b}\right|$.

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

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

C. $|a| = |b|$

D. $|a| - |b| = |a-b|$

Answer: C

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30. The vector $\overline{AB} = 3\hat{i} + 4\hat{k}$ and $\overline{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle ABC. The length of the median through A is

A. $\sqrt{5}$

B. $\sqrt{14}$

C. $\sqrt{17}$

D. $\sqrt{18}$

Answer: D

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31. $ABCD$ is quadrilateral such that $\vec{A}B = \vec{b}, \vec{A}D = \vec{d}, \vec{A}C = m\vec{b} + p\vec{..}$ Show that he area of the quadrilateral $ABCDis\frac{1}{2}|m+p|\left|\vec{b} \times \vec{d}\right|$.

A. $\frac{1}{2}(m+p)|b \times d|$

B. $(m+p)|b \times d|$

C. $2(m+p)|b \times d|$

D. $\frac{1}{2}|m-p||b \times d|$

Answer: A

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32. If $\vec{u} = \vec{a} - \vec{b}, \vec{v} = \vec{a} + \vec{b}$ and $\left|\vec{a}\right| = \left|\vec{b}\right| = 2$, then $\left|\vec{u} \times \vec{v}\right|$ is equal to

A. $2\left(k^2 - (a.\, b)^2\right)$

B. $2\left(k^4 - (a.\, b)^2\right)^{1/2}$

C. $\left(k^4 + (a.\, b)^2\right)^{1/2}$

D. $\left(k^4 + (a.\, b)^2\right)^{1/2}$

Answer: B

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Exercise Numerical Answer Type Questions

1. Let ABCD be a parallelogram whose diagonals intersect at point P. Suppose S is any point in space. If $SA + SB + SC + SD = \lambda SP$ then $\lambda =$ _____

View Text Solution

2. If ABCDEF is a regular hexagon , then

$\overline{AB} + \overline{AC} + \overline{AE} + \overline{AF} =$

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3. Suppose a and b are two non-zero vectors and angle between a and b is θ, where $0 < \theta < \pi/2$. If $|a \times b| = |a \cdot b|$, then $\pi/\theta =$ _____

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4. Suppose a, b, c are three vectors such that $|a| = 7$. If a + b + c = 0, then $|a \cdot b + a \cdot c| =$ _____

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5. Suppose a, b, c are three vectors such that $a + b + c = 0, |a| = |b| = 1$ and $a \cdot b + b \cdot c - c \cdot a = -3/2$, then $|c$

_____

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6. Suppose a, b, c are three vectors such that $|a| = |b| = |c| = 1$ and $a + b + c = 0$, then $|a - b|^2 + |b - c|^2 + |c -$

_____

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7. Suppose $-i+j-k$ bisects the angle between the vector c and $3i+4j$. If $c=\alpha i+\beta j+\gamma k$ and $|c|=3$, then $|\gamma|=$

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8. Suppose $a, b, c>0$ and are respectively the pth, qth and rth terms of a G.P. Let

$x=(\log a)i+(\log b)j+(\log c)k$

$y=(q-r)i+(r-p)j+(p-q)k$

If angle between x and y is $k\pi$, then k = _____

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9. Let $a=2\lambda^2 i+4\lambda j+k$ and $b=7i-2j+\lambda k$. The number of values of λ for which angle between a and b is θ, where $\pi/2<\theta<\pi$ and angle between b and k is ϕ where $0<\varphi<\pi/6$, is _____

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10. Suppose a, b, c are three non-coplanar vectors. Suppose

$$\Delta = \begin{vmatrix} a \cdot a & a \cdot b & a \cdot c \\ b \cdot a & b \cdot b & b \cdot c \\ c \cdot a & c \cdot b & c \cdot c \end{vmatrix}$$

If $\Delta = [abc]^r$ then $r =$ _____

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11. Suppose a, b, c are three non-coplanar vectors, then

$$\frac{(a+b+c) \cdot ((a+c) \times (a+b))}{[abc]} = \_\_\_\_\_$$

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12. Suppose $A_1, A_2, \ldots, A_5$ are vertices of a regular pentagon with O as centre.

If $\sum_{i=1}^{4} (OA_i \times OA_{i+1}) = \lambda(OA_1 \times OA_2)$

then $\lambda =$ _____

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13. Suppose a, b, c are three non-zero vectors such that b and c are non-collinear. If $(c \cdot c)a = c$ and $a \times (b \times c) + (a \cdot b)b = \left(4 - 2\beta - \sin^2 \alpha\right)b + \left(\beta^2 - 1\right)c$

_____

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14. Let $\alpha = 3i + j$ and $\beta = 2i - j + 3k$. Suppose $\beta = \beta_1 - \beta_2$, where β_1 is parallel to α and β_2 is perpendicular to α. If $\beta_1 \times \beta_2 = -\frac{3}{2}i + aj + bk$, then a + b = _____

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15. Let $a = i - 2j + k$ and $b = i - j + \lambda k$, (where $\lambda \in Z$) be two vectors. If c is a vector such that $a \times b = c \times b, c \cdot a = 0$ and $2b \cdot c + 1 = 0$, then $\lambda =$ _____

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16. The vectors, $p = (a+1)i + aj + ak, q = ai + (a+1)j + ak$ and $r = ai + aj + (a+$. If $3(p.\ q)^2 - \lambda|r \times q|^2 = 0$, then the value of λ is _____

View Text Solution

17. Suppose $OA = 2i + 2j + k, OB = 3i + 4j + 12k.$ If $OC = \frac{1}{16}(45i + aj + bk)$ is internal angle bisector of ΔOAB, then b - a = _____

View Text Solution

18. Let $A = (2\alpha, 1, \alpha), B = (2, 1, 3), C = 3i - j + 4k.$ If $AB \times C = 5i - 9j -$ _____

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Questions From Previous Years Aieee Jee Main Papers

1. If $|\bar{a}| = 4, |\bar{b}| = 2$ and the angle between $\bar{a}$ and $\bar{b}$ is $\frac{\pi}{6}$, then $(\bar{a} \times \bar{b})^2$ is equal to

A. 48

B. 16

C. 9

D. none of these

Answer: B

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2. If a, b, c are vectors such that [a b c] = 4 then $[a \times b \quad b \times c \quad c \times a] =$

A. 16

B. 64

C. 4

D. 8

Answer: A

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3. If $a+b+c=0$ and $|a|=5$, $|b|=3$ and $|c|=7$, then angle between a and b is

A. 60°

B. 30°

C. 45°

D. 90°

Answer: A

Watch Video Solution

4. If $|a| = 5, |b| = 4, |c| = 3$ then the value of $(a \cdot b + b \cdot c + c \cdot a)$ given that $a + b + c = 0$

A. 25

B. 50

C. -25

D. -50

Answer: C

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5. If $\bar{a} = 3i - 5j$ and $\bar{b} = 6i + 3j$ are two vectors, and $\bar{c}$ is a vector such that $\bar{c} = \bar{a} \times \bar{b}$,

then : $|\bar{a}| : |\bar{b}| : |\bar{c}| =$

A. $\sqrt{34}:\sqrt{45}:\sqrt{39}$

B. $\sqrt{34}:\sqrt{45}:39$

C. $34:39:45$

D. $39:35:34$

Answer: B

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6. Let $\vec{u}=\hat{i}+\hat{j}, \vec{v}=\hat{i}-\hat{j}$ and $\vec{w}=\hat{i}+2\hat{j}+3\hat{k}$.If $\hat{n}$ is a unit vector such that $\vec{u}\cdot\hat{n}=0$ and $\vec{v}\cdot\hat{n}$ then $\left|\vec{w}\cdot\hat{n}\right|$ is equal to

A. 1

B. 2

C. 3

D. 0

Answer: C

Watch Video Solution

7. A particle acted by constant forces $4\hat{i}+\hat{j}-3\hat{k} and 3\hat{i}+\hat{9}-\hat{k}$ is displaced from point $\hat{i}+2\hat{j}+3\hat{k}$ to point $5\hat{i}+4\hat{j}+\hat{k}$. find the total work done by the forces in units.

A. 30 units

B. 40 units

C. 50 units

D. 20 units

Answer: B

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8. The vector $\overline{AB}=3\hat{i}+4\hat{k}$ and $\overline{AC}=5\hat{i}-2\hat{j}+4\hat{k}$ are the sides of a triangle ABC. The length of the median through A is

A. $\sqrt{72}$

B. $\sqrt{33}$

C. $\sqrt{288}$

D. $\sqrt{18}$

Answer: B

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9. If a,b,c are non coplanner vectors and λ is a real no.then the vector a+2b+3c , λ b + 4c and $(2\lambda - 1)$ c are non coplanner for:-

A. all except two values of λ

B. all except one value of λ

C. for all values of λ

D. no value of λ

Answer: A

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10. Let $\vec{u}, \vec{v} and \vec{w}$ be such that $\left|\vec{u}\right| = 1, \left|\vec{v}\right| = 2 and \left|\vec{w}\right| = 3.$ If the projection of $\vec{v}$ along $\vec{u}$ is equal to that of $\vec{w}$ along $\vec{u}$ and vectors $\vec{v} and \vec{w}$ are perpendicular to each other, then $\left|\vec{u} - \vec{v} + \vec{w}\right|$ equals 2 b. $\sqrt{7}$ c. $\sqrt{14}$ d. 14

A. $\sqrt{14}$

B. $\sqrt{7}$

C. 2

D. 14

Answer: A

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11. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be the non zero vectors such that $\left(\vec{a} \times \vec{b}\right) \times \vec{c} = \frac{1}{3}\left|\vec{b}\right|\left|\vec{c}\right|\vec{a}.$ if theta is the acute angle between

the vectors $\vec{b}$ and $\vec{a}$ then theta equals (A) $\frac{1}{3}$ (B) $\frac{\sqrt{2}}{3}$ (C) $\frac{2}{3}$ (D) $2\frac{\sqrt{2}}{3}$

A. $2/3$

B. $\sqrt{2}/3$

C. $1/3$

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

Answer: D

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12. If C is the mid-point of AB and P is any point outside AB, then

A. $PA + PB + 2PC = 0$

B. $PA + PB + PC = 0$

C. $PA + PB = 2PC$

D. $PA + PB = PC$

Answer: C

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13. For any vector x, the value of $\left(\vec{x} \times \hat{i}\right)^2 + \left(\vec{x} \times \hat{j}\right)^2 + \left(\vec{x} \times \hat{k}\right)^2$ is equal to

A. $2a^2$

B. $4a^2$

C. $3a^2$

D. a^2

Answer: A

Watch Video Solution

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

A. equal to zero

B. the harmonic mean of a and b

C. the geometric mean of a and b

D. the arithmetic mean of a and b

Answer: C

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15. If $\bar{a}, \bar{b}, \bar{c}$ are non-coplanar vectors and λ is a real numbers then $\left[\lambda\left(\bar{a}+\bar{b}\right)\lambda^2\bar{b} \quad \lambda\bar{c}\right] = \left[\bar{a}\bar{b}+\bar{c}\bar{b}\right]$ for

A. exactly three values of λ

B. exactly two values of λ

C. exactly one value of λ

D. no value of λ

Answer: D

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16. Let $\vec{a} = \vec{i} - \vec{k}, \vec{b} = x\vec{i} + \vec{j} + (1-x)\vec{k}$ and $\vec{c} = y\vec{i} + x\vec{j} + (1+x-y)\vec{k}$. Then $\left[\vec{a}\,\vec{b}\,\vec{c}\right]$ depends on only x (b) only y Neither xn or y (d) both $xandy$

A. both x and y

B. neither on x nor on y

C. only y

D. only x

Answer: B

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

A. parallel

B. inclined at an angle of $\pi/3$ between then

C. inclined at angle of $\pi/6$ between then

D. perpendicular

Answer: A

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18. Values of a for which the points A, B, C with position vectors 2i - j+k, i - 3j - 5k and ai - 3j +k, respectively, are the vertices of a right angled triangle with $C = \frac{\pi}{2}$ are

A. 2 and -1

B. 2 and 1

C. $-2 \text{ and } -1$

D. $-2 \text{ and } 1$

Answer: B

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19. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = \hat{i} - \hat{j} + 2\hat{k}$ and $\vec{c} = x\hat{i} + (x-2)\hat{j} - \hat{k}$. If the vector $\vec{c}$ lies in the plane of $\vec{a}$ and $\vec{b}$ then x equals

A. 0

B. 1

C. -4

D. -2

Answer: D

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20. If $\hat{u}$ and $\hat{v}$ are unit vectors and θ is the acute angle between them, then $2\hat{u} \times 3\hat{v}$ is a unit vector for (1) exactly two values of θ (2) more than

two values of θ (3) no value of θ (4) exactly one value of θ

A. exactly two values of θ

B. more than two value of θ

C. no value of θ

D. Exactly one value of θ

Answer: D

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21. The vector $\vec{a} = \alpha\hat{i} + 2\hat{j} + \beta\hat{k}$ lies in the plane of vectors $\vec{b} = \hat{i} + \hat{j}$ and $\vec{c} = \hat{j} + \hat{k}$ and bisects the angle between $\vec{b}$ and $\vec{c}$. Then which one of the following gives possible values o α and β? (A) alpha=2, beta=1(B)alpha=1, beta=1(C)alpha=2, beta=1(D)alpha=1, beta=2`

A. $\alpha = 2, \beta = 2$

B. $\alpha = 1, \beta = 2$

C. $\alpha = 2, \beta = 1$

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

Answer: D

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22. The non-zero vectors are $\vec{a}, \vec{b}$ and $\vec{c}$ are related by $\vec{a} = 8\vec{b}$ and $\vec{c} = -7\vec{b}$. Then the angle between $\vec{a}$ and $\vec{c}$ is

A. 0

B. $\pi/4$

C. $\pi/2$

D. π

Answer: D

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23. If $\vec{u}, \vec{v}, \vec{w}$ are non -coplanar vectors and $p, q,$ are real numbers then the equality

$\left[3\vec{u}\, p\vec{v}\, p\vec{w}\right] - \left[p\vec{v}\, \vec{w}\, q\vec{u}\right] - \left[2\vec{w} - q\vec{v}\, q\vec{u}\right] = 0$ holds for

A. more than two but not all values of (p, q)

B. all values of (p, q)

C. exactly one values of (p, q)

D. exactly two values of (p, q)

Answer: C

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24. vectors $\vec{a} = i - j + 2k$, $\vec{b} = 2i + 4j + k$ and $\vec{c} = \lambda i + j + \mu k$ are mutually orthogonal then (λ, μ) is

A. (-2, 3)

B. (3, -2)

C. (-3, 2)

D. (2, -3)

Answer: C

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25. Let $\vec{a} = \hat{j} - \hat{k}$ and $\vec{c} = \hat{i} - \hat{j} - \hat{k}$. Then the vector b satisfying $\vec{a} \times \vec{b} + \vec{c} = 0$ and $\vec{a} \cdot \vec{b} = 3$, is

A. $i - j - 2k$

B. $i + j - 2k$

C. $-i + j - 2k$

D. $2i - j + 2k$

Answer: C

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

A. 3

B. -5

C. -3

D. 5

Answer: B

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27. The vectors a and b are not perpendicular and c and d are two vectors satisfying $b \times c = b \times d$ and $a.\ d = 0$. The vectors d is equal to

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

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

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

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

Answer: A

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28. If the vectors pi + j + k, i + qj + k and i + j + rk, where $p \neq q \neq r \neq 1$ are coplanar, then : pqr- (p + q + r) =.....

A. 2

B. 0

C. -1

D. -2

Answer: D

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29. Let a,b and c be three non-zero vectors which are pairwise non-collinear. If a+3b is collinear with c and b+2c is collinear with a, then a+3b+6c is

A. a

B. c

C. 0

D. a + c

Answer: C

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30. Let $\hat{a}$ and $\hat{b}$ be two unit vectors. If the vectors $\vec{c} = \hat{a} + 2\hat{b}$ and $\vec{d} = 5\hat{a} - 4\hat{b}$ are perpendicular to each other then the angle between $\hat{a}$ and $\hat{b}$ is (A) $\frac{\pi}{2}$ (B) $\frac{\pi}{3}$ (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{6}$

A. $\pi/2$

B. $\pi/3$

C. $\pi/4$

D. $\pi/6$

Answer: B

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31. Let ABCD be a parallelogram such that $\vec{A}B = \vec{q}, \vec{A}D = \vec{p}$ and $\angle BAD$ be an acute angle. If $\vec{r}$ is the vector that coincides with the altitude directed from the vertex B to the side AD, then $\vec{r}$ is

A. $r = -q + \left(\frac{p.q}{p.p}\right)p$

B. $r = q - \left(\frac{p.q}{p.p}\right)p$

C. $r = -3q + 3\left(\frac{p.q}{p.p}\right)p$

D. $r = 3q - 3\left(\frac{p \cdot q}{p \cdot p}\right)p$

Answer: A

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32. The vector $\overline{AB} = 3\hat{i} + 4\hat{k}$ and $\overline{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle ABC. The length of the median through A is

A. $\sqrt{72}$

B. $\sqrt{33}$

C. $\sqrt{45}$

D. $\sqrt{18}$

Answer: B

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33. If $\vec{a}$ and $\vec{b}$ are non colinear vectors, then the value of α for which the vectors $\vec{u} = (\alpha - 2)\vec{a} + \vec{b}$ and $\vec{v} = (2 + 3\alpha)\vec{a} - 3\vec{b}$ are collinear is (A) $\frac{3}{2}$ (B) $\frac{2}{3}$ (C) $\frac{-3}{2}$ (D) $\frac{-2}{3}$

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

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

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

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

Answer: B

Watch Video Solution

34. Let $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{c} = \hat{i} + \hat{j} - 2\hat{k}$ be three vectors. A vectors of the type $\vec{b} + \lambda\vec{c}$ for some scalar λ, whose projection on $\vec{a}$ is of magnitude $\sqrt{\frac{2}{3}}$, is:

A. $2i + j + 5k$

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

C. $2i - j + 5k$

D. $2i + 3j + 5k$

Answer: B

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35. If $[a \times bb \times cc \times a] = \lambda[abc]^2$, then λ is euqual to

A. 2

B. 3

C. 0

D. 1

Answer: D

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36. If $|a| = 2, |b| = 3$ and $|2a - b| = 5$, then $|2a + b|$ equals

A. 17

B. 7

C. 5

D. 1

Answer: C

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37. If $|c|^2 = 60$ and $c \times (i + j + 5k) = 0$, then a value of $c \cdot (-7i + 2j + 3k)$ is:

A. $4\sqrt{2}$

B. 12

C. 24

D. $12\sqrt{2}$

Answer: D

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38. If x, y and z are three unit vectors in three dimensional space, then the minimum value of $|x+y|^2+|y+z|^2+|z+x|^2$=

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

B. 3

C. $3\sqrt{3}$

D. 6

Answer: B

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39. If $x=3i-6j-k, y=i+4j-3k$ and $z=3i-4j-12k$, then the magnitude of the projection of $x\times y$ on z is

A. 12

B. 15

C. 14

D. 13

Answer: C

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40. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three non-zero vectors such that no two of them are collinear and $\left(\vec{a} \times \vec{b}\right) \times \vec{c} = \frac{1}{3}\left|\vec{b}\right|\left|\vec{c}\right|\vec{a}$. If θ is the angle between vectors $\vec{b}$ and $\vec{c}$, then the value of $\sin\theta$ is:

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

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

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

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

Answer: A

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41. Given a parallelogram $ABCD$. If $\left|\overrightarrow{AB}\right| = a, \left|\overrightarrow{AD}\right| = b \& \left|\overrightarrow{AC}\right| = c$, then $\overrightarrow{DB}.\overrightarrow{AB}$ has the value

A. $\frac{1}{2}(3a^2 + b^2 - c^2)$

B. $\frac{1}{4}(a^2 + b^2 - c^2)$

C. $\frac{1}{3}(b^2 + c^2 - a^2)$

D. $\frac{1}{2}(a^2 + b^2 + c^2)$

Answer: A

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42. Let $\vec{a}$ and $\vec{b}$ be two unit vectors such that $\left|\vec{a} + \vec{b}\right| = \sqrt{3}$ if $\vec{c} = \vec{a} + 2\vec{b} + 3\left(\vec{a} X \vec{b}\right)$ then $2\left|\vec{c}\right|$ is equal to

A. $\sqrt{55}$

B. $\sqrt{51}$

C. $\sqrt{43}$

D. $\sqrt{37}$

Answer: A

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43. Let a, b and c be three unit vectors such that $a \times (b \times c) = \frac{\sqrt{3}}{2}(b + c)$. If b is not parallel to c , then the angle between a and b is

A. $\frac{3\pi}{4}$

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

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

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

Answer: D

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44. In a triangle ABC , right angled at the vertex A , if the position vectors of A , B and C are respectively $3\hat{i}+\hat{j}-\hat{k},\ -\hat{i}+3\hat{j}+p\hat{k}$ and $5\hat{i}+q\hat{j}-4\hat{k}$, then the point (p,q) lies on a line

A. making an obtuse angle with the positive direction of x-axis.

B. parallel to x-axis.

C. parallel to y-axis.

D. making an acute angle with the positive direction of x-axis.

Answer: D

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45. Let ABC be a triangle whose circumcenter is at P, if the positions vectors of A,B,C and P are $\vec{a}$, $\vec{b}$, $\vec{c}$ and $\frac{\vec{a}+\vec{b}+\vec{c}}{4}$ respectively, then the positions vector of the orthocenter of this triangle, is:

A. $-\frac{1}{2}(a+b+c)$

B. $a+b+c$

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

D. 0

Answer: C

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46. Let $a=2\hat{i}-2\hat{k}, b=\hat{i}+\hat{j}$ and c be a vectors such that $|c-a|=3, |(a\times b)\times c|=3$ and the angle between c and $a\times b$ is 30°. Then a. c is equal to

A. $1/8$

B. $25/8$

C. 2

D. 5

Answer: C

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47. The area (in sq units) of the parallelogram whose diagonals are along the vectors $8\hat{i} - 6\hat{j}$ and $3\hat{i} + 4\hat{j} - 12\hat{k}$ is:

A. 26

B. 65

C. 20

D. 52

Answer: B

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48. If $b = 3j + 4k$, is written as sum of a vector b_1 parallel to $a = i + j$ and a vector b_2 perpendicular to a, then $b_1 \times b_2$ is equal to

A. $-3i+3j-9k$

B. $6i-6j+\left(\frac{9}{2}\right)k$

C. $-6i+6j-9/2k$

D. $3i-3j+9k$

Answer: B

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49. Let $\vec{u}$ be a vector coplanar with the vectors $\vec{a}=2\hat{i}+3\hat{j}-\hat{k}$ and $\vec{b}=\hat{j}+\hat{k}$ If $\vec{u}$ is perpendicular to $\vec{a}$ and $\vec{u}.\vec{b}=24$ then $\left|\vec{u}\right|^2$ is equal to

A. 315

B. 256

C. 84

D. 336

Answer: D

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50. If a, b and c are unit vectors such that $a + 2b + 2c = 0, \quad \text{then} \quad |a \times c|$ is equal to

A. $\frac{1}{4}$

B. $\frac{\sqrt{15}}{16}$

C. $\frac{15}{16}$

D. $\frac{\sqrt{15}}{4}$

Answer: D

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51. If the position vectors of the vertices A,B and C of a $\triangle ABC$ are respectively $4\hat{i} + 7\hat{j} + 8\hat{k}$, $2\hat{i} + 4\hat{k}$ and $2\hat{i} + 5\hat{j} + 7\hat{k}$,then the positions

vector of the point, where the bisector of $\angle A$ meets BC is:

A. $\frac{1}{2}(4i + 8j + 11k)$

B. $\frac{1}{3}(6i + 13j + 18k)$

C. $\frac{1}{4}(8i + 14j + 19k)$

D. $\frac{1}{3}(6i + 11j + 15k)$

Answer: D

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52. Let $a = i + j + k, c = j - k$ and a vector b is such that $a \times b = c$ and $a \cdot b = 3$. Then $|b|$ equals:

A. $\sqrt{\frac{11}{3}}$

B. $\frac{11}{\sqrt{3}}$

C. $\frac{\sqrt{11}}{3}$

D. $\frac{11}{3}$

Answer: A

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53. Let $\alpha = (\lambda - 2)a \neq b$ and $\beta = (4\lambda - 2)a + 3b$ be two given vectors where vectors a and b are non-collinear. The value of λ for which vectors α and β are collinear, is.

A. -4

B. -3

C. 4

D. 3

Answer: A

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54. Let $\sqrt{3i}+\hat{j}, \hat{i}+\sqrt{3j}$ and $\beta\hat{i}+(1-\beta)\hat{j}$ respectively be the position vedors of the points A, B and C with respect the origin O. If the distance of C from the bisector of the acute angle between OA and OB is $\frac{3}{\sqrt{2}}$, then the sum all possible values of β is _____.

A. 4

B. 3

C. 2

D. 1

Answer: D

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55. Let $a=\hat{i}+2\hat{j}+4\hat{k} \quad b=\hat{i}=\lambda\hat{j}+4\hat{k}$ and $c=2\hat{i}+4\hat{j}+\left(\lambda^2+1\right)\hat{k}$ be coplanar vectors . Then the non-zero vectors $a\times c$ is

A. $-10i-5j$

B. $-14i-5j$

C. $-14i+5j$

D. $-10i+5j$

Answer: D

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56. Let $a=\hat{i}-\hat{j}, b=\hat{i}+\hat{j}+\hat{k}$ and c be a vector such that $a\times c+b=0$ and a.c =4, then $|c|^2$ is equal to .

A. $19/2$

B. 9

C. 8

D. $17/2$

Answer: A

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57. Let $\vec{a} = 2\hat{i} + (\lambda)_1\hat{j} + 3\hat{k}$, $\vec{b} = 4\hat{i} + \left(3 - (labda)_2\right)\hat{j} + 6\hat{k}$ and $\vec{c} = 3\hat{i} + 6\hat{j} + \left((\lambda)_3 - 1\right)\hat{k}$ be three vectors such that $\vec{b} = 2\vec{a}$ and $\vec{a}$ is perpendicular to $\vec{c}$ then a possible value of $\left((\lambda)_1, (\lambda)_2, (\lambda)_3\right)$ is:

(a) $(1, 3, 1)$ (b) $\left(\left(-\frac{1}{2}\right), 4, 0\right)$ (c) $(1, 5, 1)$ (d) $\left(\left(\frac{1}{2}\right), 4, -2\right)$

A. (1, 2, 3)

B. $(-1/2, 4, 0)$

C. $(1/2, 4, -2)$

D. (15, 1)

Answer: B

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58. Let $a = \hat{i} + \hat{j} + \sqrt{2}\hat{k}, b = b_1\hat{i} + b_2\hat{j} + \sqrt{2}\hat{k}$ and $c = 5\hat{i} + \hat{j} + \sqrt{2}\hat{k}$ be three vectors such that the projection vector of b on a is a. If $a + b$ is

perpendicular to c, then $|b|$ is equal to

A. $\sqrt{32}$

B. 6

C. $\sqrt{22}$

D. 4

Answer: B

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59. The sum of the distinct real values of mu for which the vectors, $\mu\hat{i}+\hat{j}+\hat{k}, \hat{i}+\mu\hat{j}+\hat{k}, \hat{i}+\hat{j}+\mu\hat{k}$ are co-planar is :

A. -1

B. 0

C. 1

D. 2

Answer: A

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60. Let a , b and c be three unit vectors out of which vectors b and c are non -parallel. If α and β are the angles which vector a makes with vectors b and c respectively and $a \times (b \times c) = \frac{1}{2}b$, Then $|\alpha - \beta|$ is equal to

A. 30°

B. 90°

C. 60°

D. 45°

Answer: A

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61. Let $\alpha = 3i + j$ and $\beta = 2i - j + 3k$. If $\beta = \beta_1 - \beta_2$, where β_1 is parallel to α and β_2 is perpendicular to α, then $\beta_1 \times \beta_2$ is equal to

A. $\frac{1}{2}(-3i + 9j + 5k)$

B. $\frac{1}{2}(3i - 9j + 5k)$

C. $3i - 9j - 5k$

D. $-3i + 9j + 5k$

Answer: A

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62. Let $a = 3\hat{i} + 2\hat{j} + x\hat{k}$ and $b = \hat{i} - \hat{j} + \hat{k}$ for some real x Then $|a \times b| = r$ is possible if

A. $0 < r \leq \sqrt{\frac{3}{2}}$

B. $\sqrt{\frac{3}{2}} < r \leq 3\sqrt{\frac{3}{2}}$

C. $3\sqrt{\frac{3}{2}} < r \leq 5\sqrt{\frac{3}{2}}$

D. $r \geq 5\sqrt{\frac{3}{2}}$

Answer: D

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63. If unit vector a makes angles $\frac{\pi}{3}$ with i, $\pi/4$ with j and $\theta \in (0, \pi)$ with k, then a value of θ is

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

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

C. $\frac{5\pi}{12}$

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

Answer: A

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64. if the volume of parallelopiped formed by the vectors $\hat{i}+\lambda\hat{j}+\hat{k}, \hat{j}+\lambda\hat{k}$ and $\lambda\hat{i}+\hat{k}$ is minimum then λ is equal to

A. $-\sqrt{3}$

B. $\sqrt{3}$

C. $\frac{1}{\sqrt{3}}$

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

Answer: C

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65. Let $a=3\hat{i}+2\hat{j}+2\hat{k}$ and $b=\hat{i}+2\hat{j}-2\hat{k}$ be two vectors. If a vector perpendicular to both the

$a+b$ and $a-b$ has the magnitude 112, then one such vector is:

A. $4(2i+2j+k)$

B. $4(-2i-2j+k)$

C. $4(2i + 2j - k)$

D. $4(2i - 2j - k$

Answer: D

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Questions From Previous Years B Architecture Entrance Examination Papers

1. Let $\vec{u}, \vec{v}$ and $\vec{w}$ be vector such $\vec{u} + \vec{v} + \vec{w} = \vec{0}$. If $\left|\vec{u}\right| = 3, \left|\vec{v}\right| = 4$ and $\left|\vec{w}\right| = 5,$ then find $\vec{u}\cdot\vec{v} + \vec{v}\cdot\vec{w} + \vec{w}\cdot\vec{u}$.

A. -25

B. 0

C. 25

D. 47

Answer: A

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2. If a and b are two non-parallel vectors having equal magnitude, then the vector $(a-b)\times(a\times b)$ is parallel to

A. b

B. a - b

C. a + b

D. a

Answer: C

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

A. geometric mean of a, b

B. harmonic mean of a, b

C. equal to zero

D. arithmetic mean of a, b

Answer: A

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4. Let x, y and z be unit vectors such that

$|x-y|^2+|y-z|^2+|z-x|^2=9$

Then $|x+y-z|^2-4x.\,y=$

A. 1

B. 4

C. 6

D. 8

Answer: C

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5. If a, b and c are three unit vectors satisfying $2a \times (a \times b) + c = 0$ then the acute angle between a and b is

A. $\frac{\pi}{5}$

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

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

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

Answer: D

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6. If $b = i - j + 3k, c = j + 2k$ and a is a unit vector, then the maximum value of the scalar triple product [a b c] is

A. $\sqrt{30}$

B. $\sqrt{29}$

C. $\sqrt{26}$

D. $\sqrt{60}$

Answer: A

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7. If a, b and c are non-zero vectors such that $a \times b = c, b \times c = a$ and $c \times a = b$ then

A. [a b c] = 0

B. a = b = c

C. $|a| = |b| = |c|$

D. $|a| + |b| - |c| = 0$

Answer: C

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8. Let $\overrightarrow{O}A = \overrightarrow{a}, \overrightarrow{O}B = 10\overrightarrow{a} + 2\overrightarrow{b}, and \overrightarrow{O}C = bwhereO$ is origin. Let p denote the area of th quadrilateral $OABCandq$ denote the area of teh parallelogram with $OAandOC$ as adjacent sides. Prove that $p = 6q$.

A. q^6

B. 6q

C. $q/6$

D. $6 - q$

Answer: B

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9. If a and b are two vectors such that $2a + b = e_1 \text{ and } a + 2b = e_2$, where $e_1 = (1, 1, 1) \text{ and } e_2 = (1, 1, -1)$, then the 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. $\cos^{-1}\left(-\frac{7}{9}\right)$

Answer: C

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10. If u, v, w are unit vectors satisfying $2u + 2v + 2w = 0, \quad \text{then} \quad |u - v|$ equals

A. $\frac{7}{4}$

B. $\sqrt{\frac{5}{2}}$

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

D. $\frac{5}{4}$

Answer: C

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11. Let $\overline{V} = 2i + j - k$ and $\overline{W} = i + 3k$

If $\overline{U}$ is a unit vector, then the max imum value of the scalar triple product $\left[\overline{U}\,\overline{V}\,\overline{W}\right]$ is

A. $\sqrt{6}$

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

C. $\sqrt{59}$

D. $\sqrt{60}$

Answer: C

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12. Unit vectors a, b, c are coplanar. A unit vector d is perpendicular to them. If

$(a \times b) \times (c \times d) = \frac{1}{6}i - \frac{1}{3}j + \frac{1}{3}k$

and the angle between a and b is 30°, then c is/are

A. $\pm\frac{1}{3}(-i-2j+2k)$

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

C. $\pm\frac{1}{3}(-i+2j-2k)$

D. $\frac{1}{3}(-2i-2j+k)$

Answer: C

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13. Let $x = 2i + j - 2k$ and $y = i + j$. If z is a vector such that $x.z = |z|, |z - x| = 2\sqrt{2}$ and the angle between $x \times y$ and z is 30°, then the magnitude of the vector $(x \times y) \times z$ is:

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

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

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

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

Answer: B

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14. From a point A with position vector $p(i+j+k)$, AB and AC are drawn perpendicular to the lines $r = k + \lambda(i+j)$ and $r = -k + \mu(i-j)$ respectively. A value of p is equal to

A. -1

B. $\sqrt{2}$

C. 2

D. -2

Answer: A::B::C::D

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15. Three vector a, b and c are such that $|a| = 1, |b| = 2, |c| = 4$ and $a + b + c = 0$. Then the value of $4a.\ b + 3b.\ c + 3c.\ a$ is equal to

A. 27

B. -68

C. -26

D. -34

Answer: C

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16. If a, b and c are non-collinear unit vectors also b, c are non-collinear and $2a \times (b \times c) = b + c$, then

A. $\pi / 6$

B. $2\pi / 3$

C. $\pi/4$

D. $3\pi 4$

Answer: B

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17. $\bar{a} = 2\bar{i} + \bar{j} - 2\bar{k}$ and $\bar{b} = \bar{i} + \bar{j}$ if $\bar{c}$ is a vector such that $\bar{a} \cdot \bar{c} = |\bar{c}|, |\bar{c} - \bar{a}| = 2\sqrt{2}$ and and the angle between$\bar{a} \times \bar{b}$ and $\bar{c}$ is 30°, then $\left|\left(\bar{a} \times \bar{b}\right) \times \bar{c}\right| =$

A. $1/2$

B. 3

C. $3/2$

D. 6

Answer: C

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18. Let an angle between a and b be $2\pi/3$. If $|b| = 2|a|$ and the vectors a + xb and a - b are at right angles, then the value of x is:

A. $2/3$

B. $2/5$

C. $1/3$

D. $1/5$

Answer: B

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19. If three vectors $V_1 = \alpha i + j + k, V_2 = i + \beta j - 2k$ and $V_3 = i + j$ are coplanar, and V_1 and V_3 are perpendicular, then the vector $V_1 \times V_2$ is:

A. $-i + j + 2k$

B. $i - j + 2k$

C. $-i + j$

D. $2i - 2j + k$

Answer: B

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20. Let $OA = a = \frac{1}{2}(i + j - 2k), OC = b = i - 2j + k$ and $OB = 10a + 2b$. Let p (in $(\text{unit})^2$) be the area of the quadrilateral OABC and q (in $(\text{unit})^2$) be the area of the parallelogram with OA and OC as adjacent sides, then p/q is equal to

A. 3

B. 4

C. 6

D. 8

Answer: C

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