KATTAR NEET 2026

Physics By Saleem Sir

Vectors

Q1 If two vectors $\vec{A}$ and $\vec{B}$ having equal magnitude R are inclined at an angle θ, then

(A) $\left|\vec{A}-\vec{B}\right|=\sqrt{2}R\sin\frac{\theta}{2}$

(B) $\left|\vec{A}+\vec{B}\right|=2R\sin\frac{\theta}{2}$

(C) $\left|\vec{A}+\vec{B}\right|=2R\cos\frac{\theta}{2}$

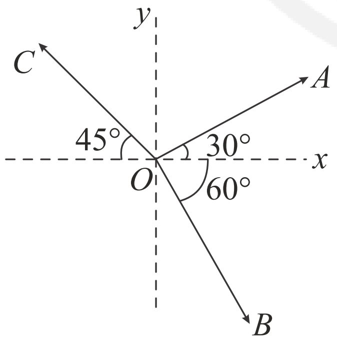
(D) $\left|\vec{A}-\vec{B}\right|=2R\cos\frac{\theta}{2}$

Q2 If $\vec{a}$ and $\vec{b}$ makes an angle $\cos^{-1}\left(\frac{5}{9}\right)$ with each other, then $\left|\vec{a}+\vec{b}\right|=\sqrt{2}\left|\vec{a}-\vec{b}\right|$ for $\left|\vec{a}\right|=n\left|\vec{b}\right|$. The integer value of n is

(A) 3 (B) 4

(C) 2 (D) 1

Q3 The magnitude of vectors $\overrightarrow{OA}$, $\overrightarrow{OB}$ and $\overrightarrow{OC}$ in the given figure are equal. The direction of $\overrightarrow{OA}+\overrightarrow{OB}-\overrightarrow{OC}$ with x-axis will be



(A) $\tan^{-1}\frac{(\sqrt{3}-1+\sqrt{2})}{(1-\sqrt{3}+\sqrt{2})}$

(B) $\tan^{-1}\frac{(1+\sqrt{3}-\sqrt{2})}{(1-\sqrt{3}-\sqrt{2})}$

(C) $\tan^{-1}\frac{(1-\sqrt{3}-\sqrt{2})}{(1+\sqrt{3}+\sqrt{2})}$

(D) $\tan^{-1}\frac{(\sqrt{3}-1+\sqrt{2})}{(1+\sqrt{3}-\sqrt{2})}$

Q4 **Statement-I:** If three forces $\vec{F}_1$, $\vec{F}_2$ and $\vec{F_3}$ are represented by three sides of a triangle and, $\vec{F}_1+\vec{F}_2=-\vec{F}_3$ then these satisfy the condition for equilibrium.

Statement-II: A triangle made up of three forces $\vec{F}_1$, $\vec{F}_2$ and $\vec{F}_3$ as its sides taken in the same order, the resultant force is zero.

In the light of the above statements, choose the most appropriate answer from the options given below:

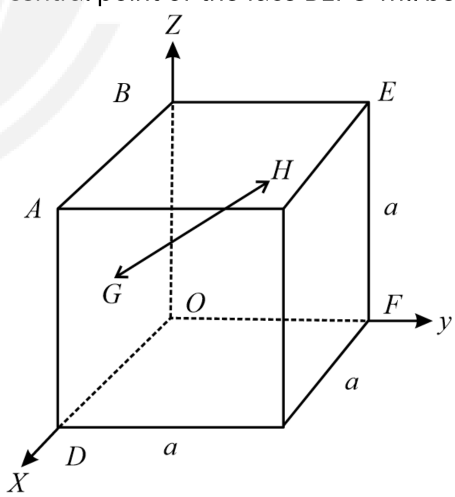
(A) Statement-I is false but Statement-II is true

(B) Both Statement-I and Statement-II are true

(C) Statement-I is true but Statement-II is false

(D) Both Statement-I and Statement-II are false

Q5 In the cube of side '*a*' shown in the figure, the vector from the central point of the face *ABOD* to the central point of the face *BEFO* will be:



(A) $\frac{1}{2}a\left(\hat{k}-\hat{i}\right)$ (B) $\frac{1}{2}a\left(\hat{i}-\hat{k}\right)$

(C) $\frac{1}{2}a\left(\hat{j}-\hat{i}\right)$ (D) $\frac{1}{2}a\left(\hat{j}-\hat{k}\right)$

Q6 Which of the following relations is true for two unit vectors $\hat{A}$ and $\hat{B}$ making an angle θ with each other?

(A) $\left|\widehat{A}+\widehat{B}\right|=\left|\widehat{A}-\widehat{B}\right|\tan\frac{\theta}{2}$
(B) $\left|\widehat{A}-\widehat{B}\right|=\left|\widehat{A}+\widehat{B}\right|\tan\frac{\theta}{2}$
(C) $\left|\widehat{A}+\widehat{B}\right|=\left|\widehat{A}-\widehat{B}\right|\cos\frac{\theta}{2}$
(D) $\left|\widehat{A}-\widehat{B}\right|=\left|\widehat{A}+\widehat{B}\right|\cos\frac{\theta}{2}$

Q7 Two vectors $\vec{A}$ and $\vec{B}$ have equal magnitudes. The magnitude of $\left(\vec{A}+\vec{B}\right)$ is 'n' times the magnitude of $\left(\vec{A}-\vec{B}\right)$. The angle between $\vec{A}$ and $\vec{B}$ is:

(A) $\cos^{-1}\left[\frac{n^2-1}{n^2+1}\right]$ (B) $\cos^{-1}\left[\frac{n-1}{n+1}\right]$
(C) $\sin^{-1}\left[\frac{n^2-1}{n^2+1}\right]$ (D) $\sin^{-1}\left[\frac{n-1}{n+1}\right]$

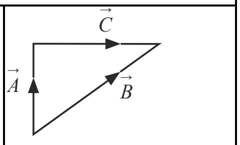
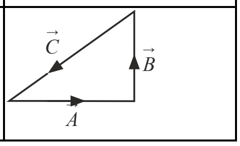
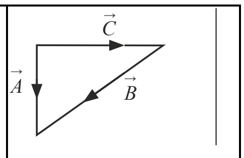
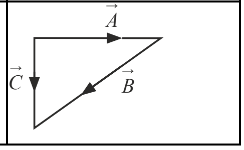
Q8 Let $\left|\vec{A}_1\right|=3,\left|\vec{A}_2\right|=5\ and\ \left|\vec{A}_1+\vec{A}_2\right|=5.$
The value of $\left(2\vec{A}_1+3\vec{A}_2\right).\left(3\vec{A}_1-2\vec{A}_2\right)$ is:

(A) –112.5 (B) –106.5
(C) –118.5 (D) –99.5

Q9 If $\vec{P}=3\hat{i}+\sqrt{3}\hat{j}+2\hat{k}$ and $\vec{Q}=4\hat{i}+\sqrt{3}\hat{j}+2.5\hat{k}$ then, the unit vector in the direction of $\vec{P}\times\vec{Q}$ is $\frac{1}{x}\left(\sqrt{3}\hat{i}+\hat{j}-2\sqrt{3}\hat{k}\right)$ the value of x is:

(A) 4 (B) 6
(C) 3 (D) 2

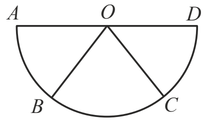
Q10 Match List-I with List-II.

	List-I		List-II
A.	$\vec{C}-\vec{A}-\vec{B}=0$	I.	
B.	$\vec{A}-\vec{C}-\vec{B}=0$	II.	
C.	$\vec{B}-\vec{A}-\vec{C}=0$	III.	
D.	$\vec{A}+\vec{B}=-\vec{C}$	IV.	

Choose the **correct** answer from the options given below:
(A) A-IV, B-I, C-III, D-II
(B) A-IV, B-III, C-I, D-II
(C) A-I, B-IV, C-II, D-III
(D) A-III, B-II, C-IV, D-I

Q11 **Assertion A:** If *A*, *B*, *C* and *D* are four points on a semicircular arc with centre at '*O*' such that $\left|\overrightarrow{AB}\right|=\left|\overrightarrow{BC}\right|=\left|\overrightarrow{CD}\right|$, then $\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}=4\overrightarrow{AO}+\overrightarrow{OB}+\overrightarrow{OC}$

Reason R: Polygon law of vector addition yields $\overrightarrow{AB}+\overrightarrow{BC}+\overrightarrow{CD}=2\overrightarrow{AO}$

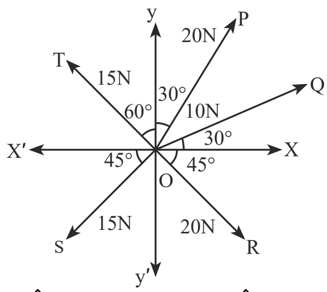


In the light of the above statements, choose the most appropriate answer from the options given below:
(A) A is not correct but R is correct.
(B) A is correct but R is not correct.
(C) Both A and R are correct and R is the correct explanation of A.
(D) Both A and R are correct but R is not the correct explanation of A.

Q12 The angle between vector $\vec{Q}$ and the resultant of $\left(2\vec{Q}+2\vec{P}\right)$ and $\left(2\vec{Q}-2\vec{P}\right)$ is:

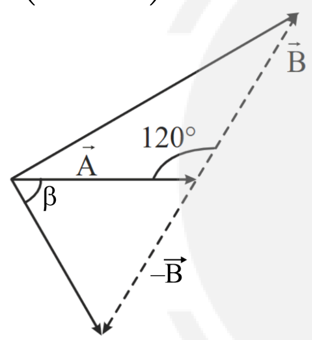
(A) 0°
(B) $\tan^{-1}\frac{\left(2\vec{Q}-2\vec{P}\right)}{2\vec{Q}+2\vec{P}}$
(C) $\tan^{-1}\left(\frac{P}{Q}\right)$
(D) $\tan^{-1}\left(\frac{2Q}{P}\right)$

Q13 The resultant of these forces $\overrightarrow{OP}, \overrightarrow{OQ}, \overrightarrow{OR}, \overrightarrow{OS}$ and $\overrightarrow{OT}$ in the given figure is approximately .... N.
Take $\sqrt{3} = 1.7$, $\sqrt{2} = 1.4$. Given $\hat{i}$ and $\hat{j}$ unit vectros along *x*, *y* axis]



(A) $9.25\hat{i} + 5\hat{j}$
(B) $2.5\hat{i} - 14.5\hat{j}$
(C) $-1.5\hat{i} - 15.5\hat{j}$
(D) $3\hat{i} + 15\hat{j}$

Q14 The angle between vector $\left(\vec{A}\right)$ and $\left(\vec{A} - \vec{B}\right)$ is:

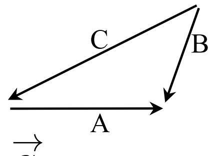


(A) $\tan^{-1}\left(\frac{\sqrt{3}B}{2A-B}\right)$
(B) $\tan^{-1}\left(\frac{B\cos\theta}{A-B\sin\theta}\right)$
(C) $\tan^{-1}\left(\frac{A}{0.7B}\right)$
(D) $\tan^{-1}\left(\frac{\frac{-B}{2}}{A-B\frac{\sqrt{3}}{2}}\right)$

Q15 **Statement-I:** Two forces $\left(\vec{P} + \vec{Q}\right)$ and $\left(\vec{P} - \vec{Q}\right)$ where $\vec{P} \perp \vec{Q}$, when act at an angle θ_1 with each other, the magnitude of their resultant is $\sqrt{3\left(P^2 + Q^2\right)}$ and when they act at an angle θ_2, the magnitude of their resultant becomes $\sqrt{2\left(P^2 + Q^2\right)}$. This is possible only when $\theta_1 < \theta_2$.
Statement-II: In the situation given above. $\theta_1 = 60°$ and $\theta_2 = 90°$.

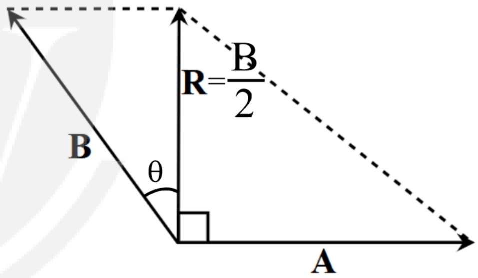
In the light of the above statements, choose the most appropriate answer from the options given below:
(A) Both Statement-I and Statement-II are true
(B) Both Statement-I and Statement-II are false
(C) Statement-I is true but Statement-II is false
(D) Statement-I is false but Statement-II is true

Q16 For the figure-



(A) $\vec{A} + \vec{B} = \vec{C}$
(B) $\vec{B} + \vec{C} = \vec{A}$
(C) $\vec{C} + \vec{A} = \vec{B}$
(D) $\vec{A} + \vec{B} + \vec{C} = 0$

Q17 The resultant of two vectors *A* and *B* is perpendicular to the vector *A* and its magnitude is equal to half the magnitude of vector *B*. The angle between *A* and *B* is:



(A) 120°
(B) 150°
(C) 135°
(D) None of these

Q18 Two forces, F_1 and F_2 are acting on a body. One force is double that of the other force and the magnitude of resultant is equal to that of the greater force. Then the angle between the two forces is –
(A) $\cos^{-1}(1/2)$
(B) $\cos^{-1}(-1/2)$
(C) $\cos^{-1}(-1/4)$
(D) $\cos^{-1}(1/4)$

Q19 If the magnitudes of the vectors $\vec{A}$, $\vec{B}$ and $\vec{C}$ are 6, 8, 10 units respectively and if

$\vec{A} + \vec{B} = \vec{C}$, then the angle between A and C is:

(A) $\pi/2$

(B) $\cos^{-1}(0.6)$

(C) $\tan^{-1}(0.75)$

(D) $\pi/4$

Q20 The linear velocity of a rotating body is given by $\vec{v} = \vec{\omega} \times \vec{r}$, where ω is the angular velocity and r is the radius vector. The angular velocity of a body $\omega = \hat{i} - 2\hat{j} + 2\hat{k}$ and their radius vector $r = 4\hat{j} - 3\hat{k}$, $|\vec{v}|$ is:

(A) $\sqrt{29}$ units (B) 31 units

(C) $\sqrt{37}$ units (D) $\sqrt{41}$ units

Q21 If $\vec{a}$ and $\vec{b}$ are two vectors with $|\vec{a}| = |\vec{b}|$ and $|\vec{a} + \vec{b}| + |\vec{a} - \vec{b}| = 2|\vec{a}|$, then angle between $\vec{a}$ and $\vec{b}$ -

(A) 0°

(B) 90°

(C) 60°

(D) Both (1) and (2)

Q22 If $\vec{P} = 5a\hat{i} + 6\hat{j}$ and $\vec{Q} = 3a\hat{i} + 10\hat{j}$. The vectors $\vec{P} + \vec{Q}$ makes an angle α with $\vec{P}$ and β with $\vec{Q}$. If $a = 2$,

(A) $\alpha = \beta$

(B) $\alpha > \beta$

(C) $\alpha < \beta$

(D) None of these

Q23 If $\vec{A} = 2\hat{i} + \hat{j} + \hat{k}$ then the unit vector:

(A) perpendicular to $\vec{A}$ is $\left(\frac{\hat{j}+\hat{k}}{\sqrt{2}}\right)$

(B) parallel to $\vec{A}$ is $\left(\frac{\hat{j}+\hat{k}}{\sqrt{2}}\right)$

(C) perpendicular to $\vec{A}$ is $\left(\frac{\hat{k}-\hat{j}}{\sqrt{2}}\right)$

(D) parallel to $\vec{A}$ $\left(\frac{\hat{k}-\hat{j}}{\sqrt{2}}\right)$

Q24 A vector is equally inclined to all of the coordinates axes then the angle made by it with x-axis is θ then–

(A) $\cos\theta = \frac{2}{\sqrt{3}}$ (B) $\cos\theta = \frac{1}{\sqrt{4}}$

(C) $\sin\theta = \sqrt{\frac{2}{3}}$ (D) $\sin\theta = \frac{1}{\sqrt{3}}$

Q25 A vector $\vec{P}_1$ is along the positive x-axis. If its vector product with another vector $\vec{P}_2$ is zero, then $\vec{P}_2$ could be-

(A) $4\hat{j}$ (B) $-4\hat{i}$

(C) $(\hat{j} + \hat{k})$ (D) $-(\hat{i} + \hat{j})$

Q26 The vector $5\hat{i} + 2\hat{j} - \ell\hat{k}$ is perpendicular to the vector $3\hat{i} + \hat{j} + 2\hat{k}$ for ℓ =

(A) 1 (B) 4.7

(C) 6.3 (D) 8.5

Q27 If $\vec{C} = \vec{A} + \vec{B}$, then:

(A) $|\vec{C}|$ is always greater than $|\vec{A}|$

(B) It is possible to have $|\vec{C}| < |\vec{A}|$ and $|\vec{C}| < |\vec{B}|$

(C) C is always equal to A + B

(D) C is never equal to A + B

Q28 Let the angle between two non zero vectors $\vec{A}$ an $\vec{B}$ be 120° and its resultant be $\vec{C}$. Then-

(A) C must be equal to |A – B|

(B) C must be less than |A – B|

(C) C must be greater than |A – B|

(D) C may be equal to |A – B|

Q29 The vector $\hat{i} + x\hat{j} + 3\hat{k}$ is rotated through an angle θ and doubled in magnitude, then it becomes $4\hat{i} + (4x - 2)\hat{j} + 2\hat{k}$. The values of x are

(A) $-\frac{2}{3}$

(B) 2

(C) $\frac{2}{3}$

(D) Both (1) and (2)

Q30 If a vector $2\hat{i}+3\hat{j}+8\hat{k}$ is perpendicular to the vector $2\hat{i}+4\hat{j}+\alpha\hat{k}$, then the value of α is:

(A) –2 (B) $\frac{1}{2}$

(C) $-\frac{1}{2}$ (D) 2

Q31 The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to $\vec{A}$ and its magnitude is half that of $\vec{B}$. The angle between vectors $\vec{A}$ and $\vec{B}$ is _____

(A) 120° (B) 150°

(C) 60° (D) 45°

Q32 When vector $\vec{A}=2\hat{i}+3\hat{j}+2\hat{k}$ is subtracted from vector $\vec{B}$, it gives a vector equal to $2\hat{j}$. Then the magnitude of vector $\vec{B}$ will be:

(A) $\sqrt{33}$ (B) 3

(C) $\sqrt{6}$ (D) $\sqrt{5}$

Q33 A vector in x-y plane makes an angle of 30° with y-axis. The magnitude of y-component of vector is $2\sqrt{3}$. The magnitude of x-component of the vector will be:

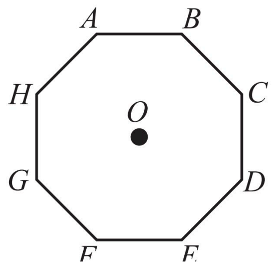
(A) $\frac{1}{\sqrt{3}}$ (B) 6

(C) $\sqrt{3}$ (D) 2

Q34 In an octagon ABCDEFGH of equal side, what is the sum of

$\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}+\overrightarrow{AE}+\overrightarrow{AF}+\overrightarrow{AG}+\overrightarrow{AH}$,

if, $\overrightarrow{AO}=2\hat{i}+3\hat{j}-4\hat{k}$



(A) $16\hat{i}+24\hat{j}-32\hat{k}$

(B) $16\hat{i}-24\hat{j}+32\hat{k}$

(C) $-16\hat{i}-24\hat{j}+32\hat{k}$

(D) $16\hat{i}+24\hat{j}+32\hat{k}$

Q35 Vectors $a\hat{i}+b\hat{j}+\hat{k}$ and $2\hat{i}-3\hat{j}+4\hat{k}$ are perpendicular to each other when 3 a+2 b=7, the ratio of a to b is $\frac{x}{2}$. The value of x is

(A) 1 (B) 2

(C) 1/2 (D) 3/2

Q36 If $\vec{A}$ and $\vec{B}$ are two vectors satisfying the relation $\vec{A}\cdot\vec{B}=\left|\vec{A}\times\vec{B}\right|$. Then the value of $\left|\vec{A}-\vec{B}\right|$ will be: (Given $\theta<90^{\circ}$)

(A) $\sqrt{A^2+B^2-\sqrt{2}AB}$

(B) $\sqrt{A^2+B^2}$ (C) $\sqrt{A^2+B^2+2AB}$

(D) $\sqrt{A^2+B^2+\sqrt{2}AB}$

Q37 Fwo vectors $\vec{A}$ and $\vec{B}$ have equal magnitudes. If magnitude of $\vec{A}+\vec{B}$ is equal to two times the magnitude of $\vec{A}-\vec{B}$, then the angle between $\vec{A}$ and $\vec{B}$ will be:

(A) $\sin^{-1}\left(\frac{3}{5}\right)$ (B) $\sin^{-1}\left(\frac{1}{3}\right)$

(C) $\cos^{-1}\left(\frac{3}{5}\right)$ (D) $\cos^{-1}\left(\frac{1}{3}\right)$

Q38 Two forces P and Q, of magnitude 2F and 3F, respectively, are at an angle θ with each other. If the force Q is doubled, then their resultant also gets doubled. Then, the angle θ is:

(A) 120° (B) 60°

(C) 90° (D) 30°

Q39 $\vec{A}$ is a vector quantity such that $\left|\vec{A}\right|$ = non-zero constant. Which of the following expression is true for $\vec{A}$?

(A) $\vec{A}\cdot\vec{A}=0$

(B) $\vec{A}\times\vec{A}<0$

(C) $\vec{A}\times\vec{A}=0$

(D) $\vec{A}\times\vec{A}>0$

Q40 Two vectors $\vec{X}$ and $\vec{Y}$ have equal magnitude. The magnitude of $\left(\vec{X}-\vec{Y}\right)$ is n times the magnitude of $\left(\vec{X}+\vec{Y}\right)$. The angle between $\vec{X}$ and $\vec{Y}$ is:

(A) $\cos^{-1}\left(\frac{n^2+1}{n^2-1}\right)$ (B) $\cos^{-1}\left(\frac{-n^2-1}{n^2-1}\right)$

(C) $\cos^{-1}\left(\frac{n^2-1}{-n^2-1}\right)$ (D) $\cos^{-1}\left(\frac{n^2+1}{-n^2-1}\right)$

Q41 What will be the projection of vector $\vec{A}=\hat{i}+\hat{j}+\hat{k}$ on vector $\vec{B}=\hat{i}+\hat{j}$?

(A) $2\left(\hat{i}+\hat{j}+\hat{k}\right)$ (B) $\sqrt{2}\left(\hat{i}+\hat{j}\right)$

(C) $\left(\hat{i}+\hat{j}\right)$ (D) $\sqrt{2}\left(\hat{i}+\hat{j}+\hat{k}\right)$

Q42 Two forces having magnitude A and $\frac{A}{2}$ are perpendicular to each other. The magnitude of their resultant is

(A) $\frac{\sqrt{5}A}{4}$ (B) $\frac{5A}{2}$

(C) $\frac{\sqrt{5}A^2}{2}$ (D) $\frac{\sqrt{5}A}{2}$

Q43 A vector may change if -

(A) frame of reference is translated

(B) vector is rotated

(C) frame of reference is rotated

(D) vector is translated parallel to itself

Q44 Let $\vec{A}=\frac{1}{\sqrt{2}}\cos\theta\hat{i}+\frac{1}{\sqrt{2}}\sin\theta\hat{j}$ be any vector. What will be the unit vector $\hat{n}$ in the direction of $\vec{A}$?

(A) $\cos\theta\hat{i}+\sin\theta\hat{j}$

(B) $-\cos\theta\hat{i}-\sin\theta\hat{j}$

(C) $1/\sqrt{2}\left(\cos\theta\hat{i}+\sin\theta\hat{j}\right)$

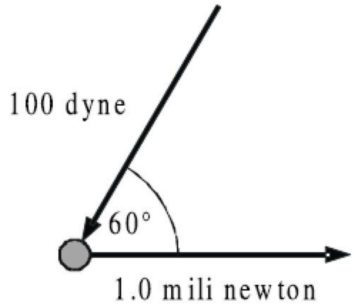
(D) $1/\sqrt{2}\left(\cos\theta\hat{i}-\sin\theta\hat{j}\right)$

Q45 If $\vec{A}$, $\vec{B}$ and $\vec{C}$ are vectors having a unit magnitude. If $\vec{A}+\vec{B}+\vec{C}=\vec{0}$ then $\vec{A}\cdot\vec{B}+\vec{B}\cdot\vec{C}+\vec{C}\cdot\vec{A}$ will be:-

(A) 1 (B) $-\frac{3}{2}$

(C) $-\frac{1}{2}$ (D) zero

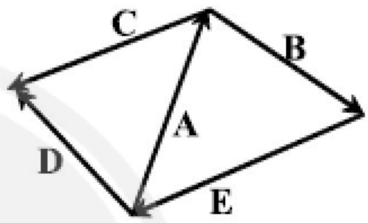
Q46 Two forces act on a particle simultaneously as shown in the figure. Find net force in milli newton on the particle. [Dyne is the CGS unit of force (1 dyne = 10^{-5} N)]



(A) $\sqrt{3}$ (B) $\sqrt{2}$

(C) 1 (D) 2

Q47 For figure the correct relation is :-



(A) $\vec{A}+\vec{B}+\vec{E}=\vec{0}$

(B) $\vec{C}-\vec{D}=\vec{A}$

(C) $\vec{B}+\vec{E}-\vec{C}=\vec{D}$

(D) all of the above

Q48 The dot product of two vectors of magnitudes 3 units and 5 units cannot be

(A) 2 (B) –2

(C) 20 (D) zero

Q49 The ratio of maximum and minimum magnitudes of the resultant of two vector $\vec{a}$ and $\vec{b}$ is 3 : 1. Now $|\vec{a}|$ is equal to :

(A) $|\vec{b}|$ (B) $2|\vec{b}|$

(C) $3|\vec{b}|$ (D) $4|\vec{b}|$

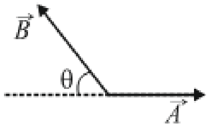
Q50 Vector $\vec{R}$ is the resultant of the vectors $\vec{A}$ and $\vec{B}$. Ratio of minimum value of $|\vec{R}|$ and maximum value of $|\vec{R}|$ is $\frac{1}{4}$. Then $\frac{|\vec{A}|}{|\vec{B}|}$ may be:-

(A) 4/1 (B) 2/1
(C) 3/5 (D) 1/4

Q51 Two vectors $\vec{A}$ and $\vec{B}$ have equal magnitude of 5 units each and are such that $\left|\vec{A}+\vec{B}\right| = 5\sqrt{3}$ units. What is the value of $\left|\vec{A}-\vec{B}\right|$?

(A) 5 units (B) $5\sqrt{2}$ units
(C) $\frac{5}{\sqrt{3}}$ units (D) $\frac{5}{\sqrt{2}}$ units

Q52 Two vectors $\vec{A}$ and $\vec{B}$ are as shown below. The dot product $\vec{A}\,.\,\vec{B}$ is given by;



(A) AB cos θ
(B) – AB cos θ
(C) AB sin θ
(D) – AB sin θ

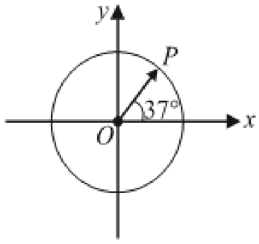
Q53 How many minimum number of vectors in different planes should be added to give zero resultant?

(A) 2 (B) 3
(C) 4 (D) 5

Q54 A vector $\vec{S}$ having magnitude of $5\sqrt{2}$ units is along +*x*-axis. Another vector $\vec{R}$ has magnitude of 5 units lies on the line *y* = *x*. The magnitude of resultant of $\vec{S}$ and $\vec{R}$ can be;

(A) $5\sqrt{5}$ units (B) $5\sqrt{2}$ units
(C) 10 units (D) $3\sqrt{2}$ units

Q55 A particle *P* is moving anticlockwise in a circle with uniform speed 5 m/s as shown. What is the velocity vector when the line joining the center and the particle *P* makes an angle of 37° with + *x*-axis?



(A) $\left(-4\hat{i}+3\hat{j}\right)\mathrm{m/s}$
(B) $\left(+3\hat{i}-4\hat{j}\right)\mathrm{m/s}$
(C) $\left(+4\hat{i}-3\hat{j}\right)\mathrm{m/s}$
(D) $\left(-3\hat{i}+4\hat{j}\right)\mathrm{m/s}$

Q56 If $\vec{a} = 2\hat{i}+\sqrt{5}\hat{j}$ & $\vec{b} = 5\hat{i}+\sqrt{5}\hat{j}+4\hat{k}$ then find a vector of same magnitude as $\vec{a}$ and parallel to vector $\vec{a}-\vec{b}$:-

(A) $\frac{7\hat{i}+2\sqrt{5}\hat{j}+4\hat{k}}{3}$ (B) $-3\hat{i}-4\hat{k}$
(C) $\frac{-9\hat{i}-12\hat{k}}{5}$ (D) $9\hat{i}+12\hat{k}$

Q57 For the given vector $\vec{A} = 3\hat{i}-4\hat{j}+10\hat{k}$, the ratio of magnitude of its component on the x-y plane and the component on z-axis is

(A) 2 (B) 1/2
(C) 1 (D) None of these

Q58 If $\vec{A}$ vector makes angle 90° & 30° with the x and y axis respectively then angle it makes with the z axis can be :

(A) 120° (B) 30°
(C) 45° (D) 90°

Q59 The angle between two vectors $\vec{R} = -\hat{i}+\frac{1}{3}\hat{j}+\hat{k}$ and $\vec{S} = x\hat{i}+3\hat{j}+\left(x-1\right)\hat{k}$

(A) Is obtuse angle
(B) Is acute angle
(C) Is right angle
(D) Depends on x

Q60 If the angle between $\hat{a}$ & $\hat{b}$ is 60°, then which of the following vector(s) have magnitude one:-

(A) $\frac{\hat{a}+\widehat{b}}{\sqrt{3}}$
(B) $\widehat{a}-\hat{b}$
(C) â
(D) $\hat{b}$

(A) Only C,D (B) Only B,C,D
(C) Only A,C,D (D) All

Answer Key

Q1	(C)
Q2	(A)
Q3	(C)
Q4	(B)
Q5	(C)
Q6	(B)
Q7	(A)
Q8	(C)
Q9	(A)
Q10	(B)
Q11	(D)
Q12	(A)
Q13	(A)
Q14	(A)
Q15	(A)
Q16	(C)
Q17	(B)
Q18	(C)
Q19	(B)
Q20	(A)
Q21	(D)
Q22	(A)
Q23	(C)
Q24	(C)
Q25	(B)
Q26	(D)
Q27	(B)
Q28	(B)
Q29	(D)
Q30	(A)
Q31	(B)
Q32	(A)
Q33	(D)
Q34	(A)
Q35	(A)
Q36	(A)
Q37	(C)
Q38	(A)
Q39	(C)
Q40	(C)
Q41	(C)
Q42	(D)
Q43	(B)
Q44	(A)
Q45	(B)
Q46	(C)
Q47	(A)
Q48	(C)
Q49	(B)
Q50	(C)
Q51	(A)
Q52	(B)
Q53	(C)
Q54	(A)
Q55	(D)
Q56	(C)
Q57	(B)
Q58	(A)
Q59	(C)
Q60	(D)

Hints & Solutions

Q1 Text Solution:

Resultant vector,

$\vec{R} = \sqrt{a^2 + b^2 + 2ab\cos\theta}$

According to question, $a = b = R$

$\vec{R} = \sqrt{R^2 + R^2 + 2R^2\cos\theta}$

$= R\sqrt{2}\sqrt{1+\cos\theta}$

$= \sqrt{2}R\sqrt{2\cos^2\frac{\theta}{2}} = 2R\cos\frac{\theta}{2}$

Q2 Text Solution:

Given: $\cos\theta = \frac{5}{9}$

$\Rightarrow \frac{\vec{a}\,.\,\vec{b}}{ab} = \frac{5}{9}$

$\Rightarrow \left|\vec{a} + \vec{b}\right| = \sqrt{2}\left|\vec{a} - \vec{b}\right|$

$\Rightarrow a^2 + b^2 + 2\,\vec{a}\,.\,\vec{b} = 2a^2 + 2b^2 - 4\,\vec{a}\,.\,\vec{b}$

$\Rightarrow 6\,\vec{a}\,.\,\vec{b} = a^2 + b^2$

$\Rightarrow 6 \times \frac{5}{9}ab = a^2 + b^2$

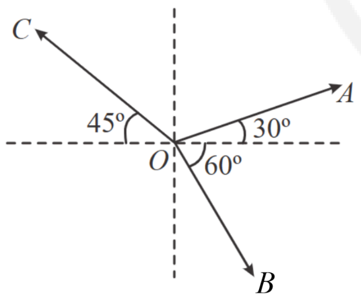
$\Rightarrow \frac{10}{3}ab = a^2 + b^2 \,\&\, a = nb$

$\Rightarrow 3n^2 - 10n + 3 = 0$

$\Rightarrow n = \frac{1}{3}$ and $n = 3$

Thus, $n = 3$

Q3 Text Solution:



According to diagram, let magnitude be equal to λ

$\overrightarrow{OA} = \lambda\left[\cos 30^\circ\,\hat{i} + \sin 30\hat{j}\right]$

$= \lambda\left[\frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j}\right]$

$\overrightarrow{OB} = \lambda\left[\cos 60^\circ\,\hat{i} - \sin 60\hat{j}\right]$

$= \lambda\left[\frac{1}{2}\hat{i} - \frac{\sqrt{3}}{2}\hat{j}\right]$

$\overrightarrow{OC} = \lambda\left[\cos 45^\circ\left(-\hat{i}\right) + \sin 45\hat{j}\right]$

$= \lambda\left[-\frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j}\right]$

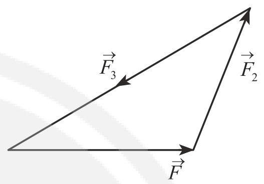
$\therefore \overrightarrow{OA} + \overrightarrow{OB} - \overrightarrow{OC}$

$= \lambda\left[\left(\frac{\sqrt{3}+1}{2} + \frac{1}{\sqrt{2}}\right)\hat{i} + \left(\frac{1}{2} - \frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}}\right)\hat{j}\right]$

$\tan^{-1}\left[\frac{\frac{1}{2} - \frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}}}{\frac{\sqrt{3}}{2} + \frac{1}{2} + \frac{1}{\sqrt{2}}}\right] = \tan^{-1}\left[\frac{\sqrt{2} - \sqrt{6} - 2}{\sqrt{6} + \sqrt{2} + 2}\right]$

$= \tan^{-1}\left[\frac{1 - \sqrt{3} - \sqrt{2}}{\sqrt{3} + 1 + \sqrt{2}}\right]$

Q4 Text Solution:



$\therefore$ For equilibrium $F_{net} = 0$

Q5 Text Solution:

$G \equiv \left(\frac{a}{2}, 0, \frac{a}{2}\right), \qquad H \equiv \left(0, \frac{a}{2}, \frac{a}{2}\right)$

$\overrightarrow{GH} = -\frac{a}{2}\hat{i} + \frac{a}{2}\hat{j} = \frac{a}{2}\left(\hat{j} - \hat{i}\right)$

Q6 Text Solution:

$\left|\vec{A} + \vec{B}\right|$

$= \sqrt{\left|\vec{A}\right|^2 + \left|\vec{B}\right|^2 + 2\left|\vec{A}\right|\left|\vec{B}\right|\cos\theta}$

$= \sqrt{1 + 1 + 2\cos\theta} = 2\cos\theta/2$

$\left|\vec{A} - \vec{B}\right|$

$= \sqrt{\left|\vec{A}\right|^2 + \left|\vec{B}\right|^2 - 2\left|\vec{A}\right|\left|\vec{B}\right|\cos\theta}$

$= \sqrt{1 - 2\cos\theta} = 2\sin\theta/2$

$\frac{\left|\vec{A} + \vec{B}\right|}{\left|\vec{A} - \vec{B}\right|} = \cot\theta/2$

$\left|\vec{A} - \vec{B}\right| = \left|\vec{A} + \vec{B}\right|\tan\frac{\theta}{2}$

Q7 Text Solution:

$$\left|\vec{A}+\vec{B}\right|=n\left|\vec{A}-\vec{B}\right|$$

$$\Rightarrow A^2+B^2+2AB\cos\theta$$

$$=n^2\left(A^2+B^2-2AB\cos\theta\right)$$

$$\text{As }\left|\vec{A}\right|=\left|\vec{B}\right|,$$

$$\Rightarrow \cos\theta\left(1+n^2\right)=\frac{2A^2\left(n^2-1\right)}{2A^2}$$

$$\cos\theta=\frac{n^2-1}{n^2+1}$$

Q8 Text Solution:

$$\left|\vec{A}_1\right|=3,\quad \left|\vec{A}_2\right|=5,\quad \left|\vec{A}_1+\vec{A}_2\right|=5$$

$$\left|\vec{A}_1+\vec{A}_2\right|$$

$$=\sqrt{\left|\vec{A}_1\right|^2+\left|\vec{A}_2\right|^2+2\left|\vec{A}_1\right|\left|\vec{A}_2\right|\cos\theta}$$

$$5=\sqrt{9+25+2\times3\times5\cos\theta}$$

$$\Rightarrow \cos\theta=-\frac{3}{10}$$

$$\left(2\vec{A}_1+3\vec{A}_2\right).\left(3\vec{A}_1-2\vec{A}_2\right)$$

$$=6\left|\vec{A}_1\right|^2+9\vec{A}_1.\vec{A}_2-4\vec{A}_1.\vec{A}_2$$

$$-6\left|\vec{A}_2\right|^2$$

$$=-118.5$$

Q9 Text Solution:

$$\vec{P}\times\vec{Q}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 3 & \sqrt{3} & 2\\ 4 & \sqrt{3} & 2.5\end{vmatrix}$$

$$=\sqrt{3}\frac{\hat{i}}{2}+\frac{\hat{j}}{2}-\sqrt{3}\hat{k}$$

and

$$\Rightarrow\left|\vec{P}\times\vec{Q}\right|=\frac{1}{2}$$

$$\Rightarrow\frac{\vec{P}\times\vec{Q}}{\left|\vec{P}\times\vec{Q}\right|}=\frac{1}{2}\left(\sqrt{3}\frac{i}{2}+\frac{\hat{j}}{2}-\sqrt{3}\hat{k}\right)$$

$$=\frac{1}{4}\left(\sqrt{3}\hat{i}+\hat{j}-2\sqrt{3}\hat{k}\right)\Rightarrow x=4$$

Q10 Text Solution:

Apply the triangle law of addition, to get answer.

Q11 Text Solution:

$$\overrightarrow{AB}=\overrightarrow{AO}+\overrightarrow{OB},\overrightarrow{AC}=\overrightarrow{AO}+\overrightarrow{OC},\overrightarrow{AD}$$

$$\overrightarrow{AO}+\overrightarrow{OD}=2\overrightarrow{AO}$$

$$\Rightarrow\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}=4\overrightarrow{AO}+\overrightarrow{OB}+\overrightarrow{OC}$$

Q12 Text Solution:

Let the resultant of both the vectors be $\vec{R}$, then

$$\vec{R}=\left(2\vec{Q}+2\vec{P}\right)+\left(2\vec{Q}-2\vec{P}\right)$$

$$\vec{R}=4\vec{Q}$$

Angle between $\vec{Q}$ and $\vec{R}$ is zero.

Q13 Text Solution:

The horizontal component of forces,

$$\vec{F}_x$$

$$=\left[10\times\frac{\sqrt{3}}{2}+20\times\frac{1}{2}+\frac{20}{\sqrt{2}}-\frac{15}{\sqrt{2}}-\frac{15\sqrt{3}}{\sqrt{2}}\right]$$

$$=9.25\hat{i}$$

$$\vec{F}_y$$

$$=$$

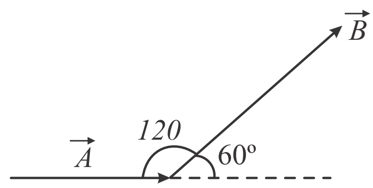
$$\left[15\times\frac{1}{2}+20\times\frac{\sqrt{3}}{2}+10\times\frac{1}{2}-\frac{15}{\sqrt{2}}-\frac{15}{\sqrt{2}}\right.$$

$$\left.-\frac{20}{\sqrt{2}}\right]$$

$$=5j$$

$$\therefore\vec{F}_R=\vec{F}_x+\hat{F}_y=9.25\hat{i}+5\hat{j}$$

Q14 Text Solution:



According to diagram,

Angle between $\vec{A}$ and $\vec{B}$, $\theta=60^{\circ}$

Angle between $\vec{A}$ and $-\vec{B}$, $\theta=120^{\circ}$

If angle between $\vec{A}$ and $\vec{A}-\vec{B}$ is α

$$\tan\alpha = \frac{\left|-\vec{B}\right|\sin\theta}{\left|\vec{A}\right|+\left|-\vec{B}\right|\cos\theta}$$

then

$$= \frac{B\sin g120^{\circ}}{A+B\cos 120^{\circ}} = \frac{B\frac{\sqrt{3}}{2}}{A-\frac{B}{2}}$$

$$\Rightarrow \tan\alpha = \frac{\sqrt{3}B}{2A-B}$$

Hence, the angle between vector $\vec{A}$ and $\left(\vec{A}-\vec{B}\right)$ is

$$\tan\alpha = \frac{\sqrt{3}B}{2A-B}$$

Q15 Text Solution:

According to question the given data is two forces $\left(\vec{P}+\vec{Q}\right)$ and $\left(\vec{P}-\vec{Q}\right)$

$$\vec{A} = \vec{P}+\vec{Q}\ \&\ \vec{B} = \vec{P}-\vec{Q}\ \&\ \vec{P}\perp\vec{Q}$$

$$\Rightarrow \left|\vec{A}\right|+\left|\vec{B}\right| = \sqrt{2\left(P^2+Q^2\right)\left(1+\cos\theta\right)}$$

$\Rightarrow$For $\theta_1 = 60^{\circ}$

$$\Rightarrow \left|\vec{A}+\vec{B}\right| = \sqrt{3\left(P^2+Q^2\right)}$$

$$\Rightarrow \text{For } \theta_2 = 90^{\circ}\ \left|\vec{A}+\vec{B}\right|$$

$$= \sqrt{2\left(P^2+Q^2\right)}$$

Q16 Text Solution:

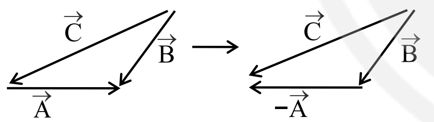


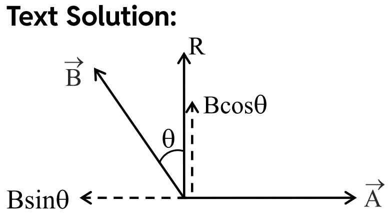
Fig.(a) Fig.(b)

From figure (b) we can say that

$$\vec{C} = \left(-\vec{A}\right)+\vec{B}$$

Hence $\vec{B} = \vec{C}+\vec{A}$

Q17 Text Solution:



Given

$$\left|\vec{R}\right| = \frac{1}{2}\left|\vec{B}\right|$$

$$B\cos\theta = R = \frac{B}{2}$$

$$\cos\theta = \frac{1}{2}$$

$$\theta = 60^{\circ}$$

Hence angle between $\vec{A}\ \&\ \vec{B}$ is (90+60)=150°

Q18 Text Solution:

Given that

$$\left|\vec{F}_1\right| = 2\left|\vec{F}_2\right|$$

$$\left|\vec{R}\right| = \left|\vec{F}_1\right|$$

$$\left|\vec{R}\right| = \left|\vec{F}_1+\vec{F}_2\right|$$

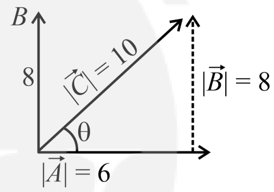
$$R = \sqrt{F_1^2+F_2^2+2F_1F_2\cos\theta}$$

$$F_1^2 = F_1^2+\frac{F_1^2}{4}+2\left(F_1\right)\left(\frac{F_1}{2}\right)\cos\theta$$

$$-\frac{F_1^2}{4} = F_1^2\cos\theta$$

$$\theta = \cos^{-1}\left(\frac{-1}{4}\right)$$

Q19 Text Solution:



$$\cos\theta = \frac{\text{Base}}{\text{Hypotaneous}}$$

$$\cos\theta = \frac{6}{10} = 0.6$$

$$\theta = \cos^{-1}(0.6)$$

Q20 Text Solution:

$$\vec{v} = \vec{w}\times\vec{r}$$

$$\Rightarrow \begin{bmatrix}\hat{i} & \hat{j} & \hat{k}\\ 1 & -2 & 2\\ 0 & 4 & -3\end{bmatrix}$$

$$\vec{w} = \vec{r} = \hat{i}\left(6-8\right)-j\left(-3-0\right)$$

$$+\hat{k}\left(4-0\right)$$

$$\vec{v} = -2\hat{i}+3\hat{j}+4\hat{k}$$

$$\left|\vec{v}\right| = \sqrt{4+9+16} = 9\ \text{units}$$

Q21 Text Solution:

$$\left|\vec{a}+\vec{b}\right|+\left|\vec{a}-\vec{b}\right| = 2\left|\vec{a}\right|$$

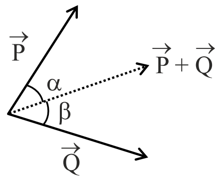
$$\sqrt{a^2+b^2+2ab\cos\theta}$$
$$+\sqrt{a^2+b^2-2ab\cos\theta}=2a$$

As, $\left|\vec{a}\right|=\left|\vec{b}\right|$

$$\sqrt{2}\left(\sqrt{1+\cos\theta}+\sqrt{1-\cos\theta}\right)=2$$
$$\left(\sqrt{1+\cos\theta}+\sqrt{1-\cos\theta}\right)=\sqrt{2}$$

Above equation is satisfy when θ = 0°, 90°

Q22 Text Solution:



Q23 Text Solution:

Vectors are perpendicular if their dot product is zero.

for option (3)

$$\vec{A}\cdot\left(\frac{\hat{k}-\hat{j}}{\sqrt{2}}\right)=\left(2\hat{i}+\hat{j}+\hat{k}\right)\cdot\left(\frac{\hat{k}-\hat{j}}{\sqrt{2}}\right)$$

= 0

Q24 Text Solution:

Given that vector is equally inclined to all of the coordinate

Let A vector $=a\hat{i}+a\hat{j}+a\hat{k}$

$\cos\theta=\frac{a}{\sqrt{a^2+a^2+a^2}}=\frac{1}{\sqrt{3}}$

If cosθ is $\frac{1}{\sqrt{3}}$ then

$\sin\theta=\sqrt{\frac{2}{3}}$

Q25 Text Solution:

$$\vec{A}\times\vec{B}=AB\sin\theta=0$$
$$\theta=0^\circ\ \ or\ 180^\circ$$

So $\vec{P}_2=-4\hat{i}$

Q26 Text Solution:

$$\vec{A}\,.\,B=15+2-2\ell=0$$
$$2\ell=17\Rightarrow\ell=\frac{17}{2}=8.5$$

Q27 Text Solution:

It is possible to have $\left|\vec{C}\right|<\left|\vec{A}\right|$ and $\left|\vec{C}\right|<\left|\vec{B}\right|$ when angle between $\vec{A}\,\&\,\vec{B}$ is greater than $\frac{\pi}{2}$

Q28 Text Solution:

$$\left|\vec{A}+\vec{B}\right|^2=\left|\vec{A}\right|^2+\left|\vec{B}\right|^2+2\vec{A}\,.\,\vec{B}\ \text{...(i)}$$
$$\left|\vec{A}-\vec{B}\right|^2=\left|\vec{A}\right|^2+\left|\vec{B}\right|^2-2\vec{A}\,.\,\vec{B}\ \text{...(ii)}$$
$$\left|\vec{A}+\vec{B}\right|^2-\left|\vec{A}-\vec{B}\right|^2=4\vec{A}\,.\,\vec{B}$$
$$\vec{C}=\left|\vec{A}-\vec{B}\right|^2+4AB\cos120^\circ$$
$$\vec{C}=\left|\vec{A}-\vec{B}\right|-2AB$$

So, C must be less then $|A-B|$.

Q29 Text Solution:

Since, the vector $i+xj+3k$ is doubled in magnitude, then it becomes

$4i+(4x-2)j+2k$

$2(i+xj+3k)=4i+(4x-2)j+2k$

$$2\sqrt{1+x^2+9}=\sqrt{16+(4x-2)^2+4}$$
$$40+4x^2=20+(4x-2)^2$$
$$3x^2-4x-4=0$$
$$(x-2)(3x+2)=0$$
$$x=2,-\frac{2}{3}$$

Q30 Text Solution:

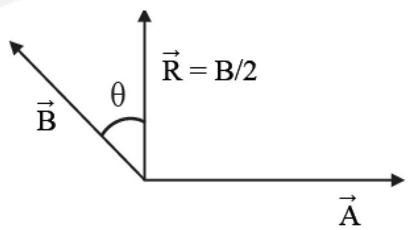
Dot product = 0

4 + 12 + 8α = 0

16 = – 8α

α = –2

Q31 Text Solution:



According to the question.

$B\cos\theta=\frac{B}{2}\Rightarrow\theta=60^\circ$

Hence, the angle between $\vec{A}$ & $\vec{B}$

90° + 60° = 150°

Q32 Text Solution:

Given,

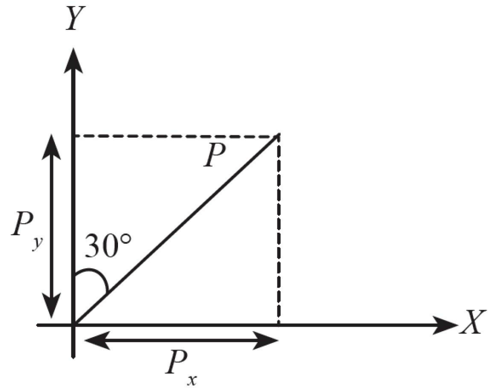
$$\vec{B}-\vec{A}=2\hat{j},\ \vec{B}=2\hat{j}+2\hat{i}+3\hat{j}+2\hat{k}$$

$\therefore \vec{B} = 2\hat{i} + 5\hat{j} + 2\hat{k}$

$\left|\vec{B}\right| = \sqrt{(2)^2 + (5)^2 + (2)^2} = \sqrt{33}$

Q33 Text Solution:

Let the vector be P.



$P_y = P\cos 30^\circ = 2\sqrt{3}$

$\Rightarrow P\frac{\sqrt{3}}{2} = 2\sqrt{3} \Rightarrow P = 4$

$\text{Now } P_x = P\sin 30^\circ = 4 \times \frac{1}{2} = 2$

Q34 Text Solution:

$\overrightarrow{AB} + \overrightarrow{AH} = \overrightarrow{AO} \Rightarrow \overrightarrow{AC} + \overrightarrow{AG} = 2\overrightarrow{AO}$

$\overrightarrow{AD} + \overrightarrow{AF} = 3\overrightarrow{AO} \Rightarrow \overrightarrow{AE} = 2\overrightarrow{AO}$

Adding all,

$\overrightarrow{AB} + \overrightarrow{AC} + \overrightarrow{AD} + \overrightarrow{AE} + \overrightarrow{AF} + \overrightarrow{AG}$

$+ \overrightarrow{AH} = 8\overrightarrow{AO}$

$= 16\hat{i} + 24\hat{j} - 32\hat{k}$

Q35 Text Solution:

For two perpendicular vectors

$\left(a\hat{i} + b\hat{j} + \hat{k}\right) \cdot \left(2\hat{i} - 3\hat{j} + 4\hat{k}\right) = 0$

2a – 3b + 4 = 0 ...(i)

On solving, 2a – 3b = –4

Also given 3a + 2b = 7 ...(ii)

Form (i) & (ii) We get a = 1, b = 2

$\frac{1}{2} = \frac{a}{b} = \frac{x}{2} \Rightarrow x = 1$

Q36 Text Solution:

Given that, $\vec{A} \cdot \vec{B} = \left|\vec{A} \times \vec{B}\right| \Rightarrow \text{AB cos}$

$\theta = \text{ABsin}\,\theta \Rightarrow \theta = 45^\circ$

$\left|\vec{A} - \vec{B}\right| = \sqrt{A^2 + B^2 - 2AB\cos\theta}$

$= \sqrt{A^2 + B^2 - 2AB \times \frac{1}{\sqrt{2}}}$

$= \sqrt{A^2 + B^2 - \sqrt{2}AB}$

Q37 Text Solution:

According to the question

$\left|\vec{A} + \vec{B}\right| = 2\left|\vec{A} - \vec{B}\right| ....(1)$

Squaing equation (i) both side. $[\because A = B]$

$\left|\vec{A} + \vec{B}\right|^2 = \left(2\left|\vec{A} - \vec{B}\right|\right)^2$

$\Rightarrow 2A^2 + 2A^2\cos\theta = 4\left(2A^2 - 2A^2\cos\theta\right)$

$\Rightarrow \cos\theta = \frac{3}{5}$

$\therefore \theta = \cos^{-1}(3/5)$

Q38 Text Solution:

$2\left|\vec{P} + \vec{Q}\right| = \left|\vec{P} + 2\vec{Q}\right|$

$\Rightarrow$ 13 +12 cos θ = 10 + 6 cos θ

$\cos = -\frac{1}{2} \Rightarrow \theta = 120^\circ$

Q39 Text Solution:

Given,

$\left|A\right| \neq 0\,\vec{A} \times \vec{A} = \left|A\right|\left|A\right|\sin\theta\hat{n}$

$= |A||A|\sin 0^\circ\hat{n}$

= 0 [Since Angle between the vectors are zero degree]

$\vec{A} \times \vec{A} = 0$

Q40 Text Solution:

Given, $\left|\vec{x}\right| = \left|\vec{y}\right|$ and

$\left|\vec{x} - \vec{y}\right| = n\left|\vec{x} + \vec{y}\right|$

$x^2 + y^2 - 2\vec{x} \cdot \vec{y}$

$= n^2\left(x^2 + y^2 + 2\vec{x} \cdot \vec{y}\right)$

$\left(1 - n^2\right)\left(x^2 + y^2\right) = \left(1 + n^2\right)2\vec{x} \cdot \vec{y}$

$\left(1 - n^2\right)\left(x^2 + y^2\right) = \left(1 + n^2\right)2xy\cos\theta$

$\cos\theta = \frac{1-n^2}{1+n^2} \quad \therefore 2xy = x^2 + y^2$

$\theta = \cos^{-1}\left(\frac{n^2-1}{-n^2-1}\right)$

Q41 Text Solution:

Projection of $\vec{A}$ on $\vec{B} = \left(\vec{A}\,.\,\widehat{B}\right)\widehat{B}$

$= \left[\left(\hat{i} + \hat{j} + \hat{k}\right) \cdot \frac{\left(\hat{i}+\hat{j}\right)}{\sqrt{2}}\right]\frac{\left(\hat{i}+\hat{j}\right)}{\sqrt{2}}$

$$= \frac{1}{2}\left(1+1\right)\left(\hat{i}+\hat{j}\right)$$
$$= \left(\frac{1}{\sqrt{2}}+\frac{1}{\sqrt{2}}\right)\frac{\left(\hat{i}+\hat{j}\right)}{\sqrt{2}}$$
$$= \hat{i}+\hat{j}$$

Q42 Text Solution:

$$\vec{F} = \left(\vec{F}_1+\vec{F}_2\right) \Rightarrow \left|\vec{F}_1\right| = A, \left|\vec{F}_2\right|$$
$$= \frac{A}{2}$$
$$\theta = 90^\circ$$
$$\therefore \left|\vec{F}\right| = \sqrt{F_1^2+F_2^2+2F_1F_2\cos\theta}$$
$$\left|\vec{F}\right| = \sqrt{A^2+\frac{A^2}{4}} = \frac{A\sqrt{5}}{2}$$

Q43 Text Solution:

Vector has both magnitude and direction, of rotation, direction change. Hence vector changes.

Q44 Text Solution:

$$\mathrm{A}=\sqrt{\frac{\cos^2\theta+\sin^2\theta}{2}}=\frac{1}{\sqrt{2}}$$

Hence the unit vector

$$\frac{\mathrm{A}}{|\mathrm{A}|}=\sqrt{2}\left(\frac{\cos\theta\hat{\mathrm{i}}}{\sqrt{2}}+\frac{\sin\theta\hat{\mathrm{j}}}{\sqrt{2}}\right)$$

Q45 Text Solution:

Since A+B+C=0

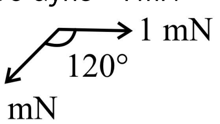
$0=|A+B+C|^2 = |A|^2 + |B|^2 + |C|^2 + 2(A\cdot B+B\cdot C+C\cdot A)$

With each |A|=|B|=|C|=1, this gives

$0=3+2(A\cdot B+B\cdot C+C\cdot A) \Longrightarrow A\cdot B+B\cdot C+C\cdot A=-3/2$.

Q46 Text Solution:

100 dyne = 1 mN

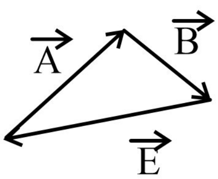


(Rearanging the forces)

$$F_{\text{net}} = \sqrt{1^2+1^2+2\left(1\right)\left(1\right)\cos 120^\circ}$$

= 1 mN

Q47 Text Solution:



$$\vec{A}+\vec{B} = -\vec{E}$$
$$\therefore \vec{A}+\vec{B}+\vec{E} = 0$$

Q48 Text Solution:

For vector of magnitudes 3 and 5, their dot product is

A.B = (3) (5) cos θ = 15 cosθ, and since – 1 ≤ cosθ ≤ 1, the product ranges from – 15 to + 15. Hence 20 is impossible.

Q49 Text Solution:

Let |a|=A and |b|=B. The maximum resultant is A+B and the minimum is |A - B|. Given

$\frac{A+B}{A-B} = 3 \Longrightarrow$ A + B = 3A - 3B $\Longrightarrow$ 4B = 2A $\Longrightarrow$ A = 2B.

Q50 Text Solution:

$$R_{\text{min}} = |A-B|$$
$$\mathrm{R}_{\text{max}}=\mathrm{A}+\mathrm{B}$$

Given

$$\frac{|A-B|}{A+B} = \frac{1}{4}$$
$$\Rightarrow \quad \frac{|A|B-1|}{A|B+1} = \frac{1}{4}$$

Let A/B = x

4 |(x – 1)| = x + 1

on solving, $x = \frac{3}{5}$ or $\frac{5}{3}$

Q51 Text Solution:

$$\left(5\sqrt{3}\right)^2 = 5^2+5^2+2\left(5\right)\left(5\right)\cos\theta$$
$$75 = 50+50\cos\theta$$
$$\cos\theta = \frac{1}{2} \text{ or } \theta = 60^\circ$$

Angle between $\vec{A} - \vec{B}$ is 120°

$$\left|\vec{A}-\vec{B}\right| = \sqrt{5^2+5^2+2\left(5\right)\left(5\right)\left(-\frac{1}{2}\right)}$$

= 5 units

Q52 Text Solution:

Angle between the vectors is (180° – θ)

$$\therefore \vec{A}\cdot\vec{B} = AB\cos\left(180^\circ-\theta\right)$$
$$\Rightarrow \vec{A}\cdot\vec{B} = -AB\cos\theta$$

Q53 Text Solution:

Minimum four vectors in different planes can give zero resultant.

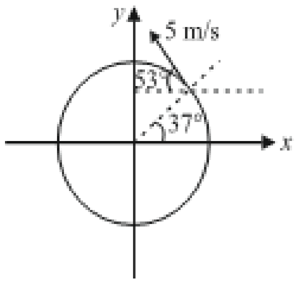
Q54 Text Solution:

Angle between the two vectors is 45°

Resultant $= \sqrt{25+50+2\times 5\times 5\sqrt{2}\times \frac{1}{\sqrt{2}}}$

$= \sqrt{75+50} = \sqrt{125} = 5\sqrt{5}$ units.

Q55 Text Solution:



$\overrightarrow{v} = -5\cos 53^{\circ}\hat{i} + 5\sin 53^{\circ}\hat{j}$

$= -3\hat{i} + 4\hat{j}$ m/s

Q56 Text Solution:

Difference vector

a-b $= \left(2-5\right)\hat{i} + \left(\sqrt{5}-\sqrt{5}\right)\hat{j}$

$+ \left(0-4\right)\hat{k} = -3\hat{i} - 4\hat{k}$

Its magnitude is |a – b|=

$= \sqrt{\left((-3)^2+(-4)^2\right)} = 5$

Magnitude of a is $|\mathrm{a}| = \sqrt{2^2+(\sqrt{5})^2} = 3.$

Unit vector parallel to a–b : $\frac{\left(-3\hat{i}-4\hat{k}\right)}{5}.$

Q57 Text Solution:

The x-y-plane component of

$\overrightarrow{A} = 3\hat{i} - 4\hat{j} + 10\hat{k}$

is $\overrightarrow{A}_{xy} = 3\hat{i} - 4\hat{j}$

Magnitude in the x-y plane

$\left|\overrightarrow{A}_{xy}\right| = \sqrt{3^2+(-4)^2} = 5$

Magnitude along the z-axis

$\left|\overrightarrow{A}_{z}\right| = \left|10\right| = 10$

Required ratio

$\frac{\left|\overrightarrow{A}_{xy}\right|}{\left|\overrightarrow{A}_{z}\right|} = \frac{5}{10} = \frac{1}{2}.$

Q58 Text Solution:

Using the direction-cosine relation

$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 11:$

α=90° ⇒ cosα = 0

β = 30° ⇒ cosβ = $\sqrt{\frac{3}{2}}$

$\cos^2\gamma = 1 - 0^2 - \left(\frac{\sqrt{3}}{2}\right)^2 = 1 - \frac{3}{4} = \frac{1}{4}$

$\Rightarrow \cos\gamma = -\frac{1}{2},\quad \gamma = 120^{\circ}$

Q59 Text Solution:

Dot product

R.S=(-1)(x)+$\frac{1}{3}$(3)+1(x-1)=-x+1+x-1=0

Since R·S=0, the cosine of the angle is zero, so the vectors are perpendicular. Therefore the angle is 90°

option (3) "right angle".

Q60 Text Solution:

(A) $\frac{\left|\hat{a}+\hat{b}\right|}{\sqrt{3}} = \frac{\sqrt{1+1+2\cos 60^{\circ}}}{\sqrt{3}} = 1$

(B) $\widehat{a} - \hat{b} = \sqrt{1+1-2\cos 60^{\circ}} = 1$

(C) $\left(\widehat{a}\right) = 1$

(D) $\left|\hat{b}\right| = 1$