## SECTION - A

**1.** The expression $\left(\frac{1}{\sqrt{2}}\hat{i}+\frac{1}{\sqrt{2}}\hat{j}\right)$ is a

(1) Unit vector
(2) Null vector
(3) Vector of magnitude $\sqrt{2}$
(4) Scalar

**2.** The angle made by the vector $A=\hat{i}+\hat{j}$ with $x$-axis is

(1) 90° (2) 45°
(3) 22.5° (4) 30°

**3.** If a unit vector is represented by $0.5\hat{i}+0.8\hat{j}+c\hat{k}$, then the value of '$c$' is

(1) 1 (2) $\sqrt{0.11}$
(3) $\sqrt{0.01}$ (4) $\sqrt{0.39}$

**4.** Find the value of sin 105°

(1) $\frac{\sqrt{6}+\sqrt{2}}{4}$ (2) $\frac{1+\sqrt{3}}{2\sqrt{2}}$
(3) (1) & (2) (4) None

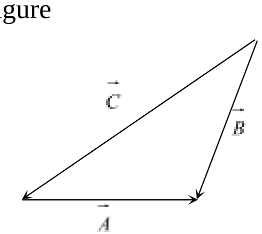
**5.** The angle between the two vectors $\vec{A}=3\hat{i}+4\hat{j}+5\hat{k}$ and $\vec{B}=3\hat{i}+4\hat{j}+5\hat{k}$ is

(1) 60° (2) Zero
(3) 90° (4) None of these

**6.** Find maximum value of '$y$' where $y = 2\sin\theta + \sqrt{5}\cos\theta$.

(1) 3 (2) $2+\sqrt{5}$
(3) $2\sqrt{5}$ (4) $\sqrt{5}$

**7.** For the figure




(1) $\vec{A}+\vec{B}=\vec{C}$ (2) $\vec{B}+\vec{C}=\vec{A}$
(3) $\vec{C}+\vec{A}=\vec{B}$ (4) $\vec{A}+\vec{B}+\vec{C}=0$

**8.** Let $\vec{C}=\vec{A}+\vec{B}$ then

(1) $|\vec{C}|$ is always greater then $|\vec{A}|$
(2) It is possible to have $|\vec{C}|<|\vec{A}|$ and $|\vec{C}|<|\vec{B}|$
(3) $C$ is always equal to $A + B$
(4) $C$ is never equal to $A + B$

**9.** If a vector $2\hat{i}+3\hat{j}+8\hat{k}$ is perpendicular to the vector $4\hat{j}-4\hat{i}+\alpha\hat{k}$. Then the value of $\alpha$ is

(1) –1 (2) $\frac{1}{2}$
(3) $-\frac{1}{2}$ (4) 1

**10.** If $\vec{A}=3\hat{i}+\hat{j}+2\hat{k}$ and $\vec{B}=2\hat{i}-2\hat{j}+4\hat{k}$ then value of $|\vec{A}\times\vec{B}|$ will be

(1) $8\sqrt{2}$ (2) $8\sqrt{3}$
(3) $8\sqrt{5}$ (4) $5\sqrt{8}$

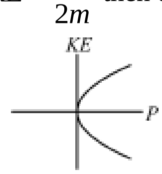
**11.** If $\vec{P}.\vec{Q}=PQ$, then angle between $\vec{P}$ and $\vec{Q}$ is

(1) 0° (2) 30°
(3) 45° (4) 60°

**12.** Correct value of cos (2°)

(1) 2° (2) $\frac{\pi}{50}$
(3) 1 (4) 0

**13.** If $KE=\frac{P^2}{2m}$ then draw graph between $KE$ and $P$.

(1)
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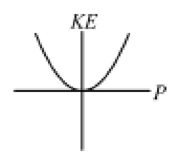


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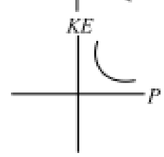


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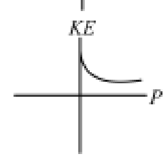
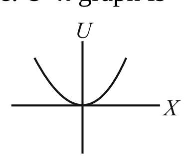



**14.** A body is attached to a spring whose other end is fixed. If the spring is elongated by $x$, its potential energy is $U = 20x^2$, where $x$ is in metre and $U$ is in joule. $U$–$x$ graph is

(1)
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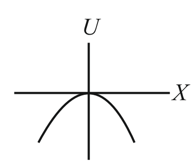


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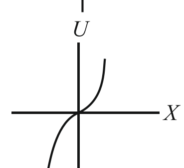


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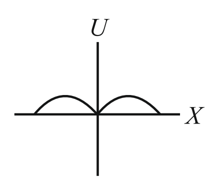



**15.** The angles which a vector $\hat{i}+\hat{j}+\sqrt{2}\hat{k}$ makes with $X$, $Y$ and $Z$ axes respectively are

(1) 60°, 60°, 60° (2) 45°, 45°, 45°
(3) 60°, 60°, 45° (4) 45°, 45°, 60°

**16.** If $\vec{A}=2\hat{i}+3\hat{j}-\hat{k}$ and $\vec{B}=-\hat{i}+3\hat{j}+4\hat{k}$ then projection of $\vec{A}$ on $\vec{B}$ will be

(1) $\frac{3}{\sqrt{13}}$ (2) $\frac{3}{\sqrt{26}}$

(3) $\sqrt{\frac{3}{26}}$ (4) $\sqrt{\frac{3}{13}}$

**17.** Which of the following is the unit vector perpendicular to $\vec{A}$ and $\vec{B}$

(1) $\frac{\hat{A}\times\hat{B}}{AB\sin\theta}$ (2) $\frac{\hat{A}\times\hat{B}}{AB\cos\theta}$

(3) $\frac{\vec{A}\times\vec{B}}{AB\sin\theta}$ (4) $\frac{\vec{A}\times\vec{B}}{AB\cos\theta}$

**18.** Two vectors $P=2\hat{i}+b\hat{j}+2\hat{k}$ and $Q=\hat{i}+\hat{j}+\hat{k}$ will be parallel if

(1) $b = 0$ (2) $b = 1$

(3) $b = 2$ (4) $b = -4$

**19.** $\frac{d}{dx}\left(\sqrt{x}+x^2+10\right)$

(1) $\frac{1}{2x}+2x$ (2) $\frac{1}{2\sqrt{x}}+2x$

(3) $\frac{1}{2\sqrt{x}}+2x+1$ (4) $\frac{1}{\sqrt{x}}+2x$

**20.** If $y = x^2 + 4x^3 - 8x + 4$, then find $\frac{dy}{dx}$

(1) $2x + 4x^2 - x$ (2) $2x + 12x^2 - 8$

(3) $2x + 4x^3 - 8$ (4) $2x + 12x^2 - x$

**21.** The minimum value of $y = 5x^2 - 2x + 1$ is

(1) 1/5 (2) 2/5

(3) 4/5 (4) 3/5

**22.** $\int(x^3+x+2)dx=?$

(1) $\frac{x^4}{4}+\frac{x^2}{2}+2x+c$ (2) $\frac{x^2}{2}+\frac{x}{2}+2x+c$

(3) $\frac{x^3}{3}+\frac{x^2}{2}+2+c$ (4) None

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

(1) 90° (2) 60°

(3) 45° (4) 30°

**24.** If $\sin\theta=\frac{4}{5}$ then tan θ will be

(1) $\frac{4}{9}$ (2) $\frac{3}{4}$

(3) $\frac{4}{5}$ (4) $\frac{4}{3}$

**25.** $\int\left(\cos\frac{x}{2}-\sin\frac{x}{2}\right)^2 dx=$

(1) $x+\cos x+c$ (2) $2\cos^2\frac{x}{2}+c$

(3) $\frac{1}{3}\left(\cos\frac{x}{2}-\frac{x}{2}\right)^3+c$ (4) $x-\cos x+c$

**26.** $\frac{d}{dx}\left(\sqrt{x}+\frac{1}{\sqrt{x}}\right)^2=$

(1) $1-\frac{1}{x^2}$ (2) $1+\frac{1}{x^2}$

(3) $1-\frac{1}{2x}$ (4) None of these

**27.** If $y=x^2$, then $\int_0^1 ydx$ will be:

(1) $\frac{x^3}{3}+C$ (2) 1/3

(3) 2/3 (4) 0

**28.** Value of $\int_0^{\pi/2}\cos 3t\,dt$ is

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

(3) $-\frac{2}{3}$ (4) $\frac{1}{3}$

**29.** Can the resultant of 2 vectors be zero

(1) Yes, when the 2 vectors are same in magnitude and direction

(2) No

(3) Yes, when the 2 vectors are same in magnitude but opposite in sense

(4) Yes, when the 2 vectors are same in magnitude making an angle of $\frac{2\pi}{3}$ with each other

**30.** Two equals forces are acting at a point with an angle of 60° between them. If the resultant force is equal to $40\sqrt{3}$ N, the magnitude of each force is

(1) 40 N (2) 20 N

(3) 80 N (4) 30 N

**31.** sin(90° – θ) is equal to:

(1) sin θ (2) – sin θ

(3) cos θ (4) – cos θ

**32.** Given $x^2 + 7x + 12 = 0$, find the root of $x$

(1) $x=\frac{3}{2},-4$ (2) $x = -3, -4$

(3) $x=\frac{3}{2},4$ (4) $x=\frac{3}{2},-2$

**33.** If $y = e^{-\alpha x}$, then find double differentiation of $y$.

(1) $\alpha e^{-\alpha x}$ (2) $-\alpha\, e^{-\alpha x}$

(3) $e^{-\alpha x}$ (4) $\alpha^2\, e^{-\alpha x}$

**34.** $\int e^{6x} dx$

(1) $e^{5x} + C$ (2) $e^{5x} \cdot \frac{5x^2}{2} + C$

(3) $\frac{e^{6x}}{6} + C$ (4) $e^{x} + C$

**35.** The sum of the series 1 + 1/4 + 1/16 + 1/64 + ⋯ ∞ is

(1) 8/7 (2) 6/5

(3) 5/4 (4) 4/3

## SECTION-B

**36.** Find the value of sin 15°.

(1) $\frac{\sqrt{3}-1}{\sqrt{2}}$ (2) $\frac{\sqrt{3}-\sqrt{2}}{2\sqrt{2}}$

(3) $\frac{\sqrt{3}-1}{2\sqrt{2}}$ (4) $\frac{1}{2}$

**37.** Convert angle from radian to degree $\frac{\pi}{3}$ rad:

(1) 60° (2) 30°

(3) 45° (4) 0°

**38.** Find the value of $\log_{10} 10^{35}$

(1) 28 (2) 32

(3) 36 (4) 35

**39.** What is the value of $\log_2 16$?

(1) 8 (2) 4

(3) 1/8 (4) 16

**40.** The slope of straight line $\sqrt{3}y = 3x + 4$ is

(1) 3 (2) $\sqrt{3}$

(3) $\frac{1}{\sqrt{3}}$ (4) $\frac{1}{3}$

**41.** Which of the following is correct for $(64)^{2/3}$

(1) 16 (2) 32

(3) 4 (4) 8

**42.** The angle made by the vector $\bar{A} = \hat{i} + \hat{j}$ with $x$-axis is

(1) 90° (2) 45°

(3) 22.5° (4) 30°

**43.** Angular momentum is

(1) A scalar (2) A polar vector

(3) An axial vector (4) None of these

**44.** If $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$, then the angle between $\vec{A}$ and $B$ is

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{3}$

(3) $\pi$ (4) $\frac{\pi}{4}$

**45.** If a vector $\vec{P}$ making angles $\alpha, \beta$ and $\gamma$ respectively with $X$, $Y$ and $Z$ axes respectively. Then $\sin^2\alpha + \sin^2\beta + \sin^2\gamma =$

(1) 0 (2) 1

(3) 2 (4) 3

**46.** Forces 7 N, 24 N, 25 N act at a point in mutually perpendicular directions. The magnitude of the resultant force is :

(1) 19 N (2) 13 N

(3) 26 N (4) $25\sqrt{2}\,N$

**47.** The angle between the vectors $\vec{A}$ and $\vec{B}$ is $\theta$. The value of the triple product $\vec{A} \cdot (\vec{B} \times \vec{A})$ is

(1) $A^2B$ (2) Zero

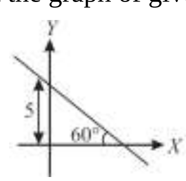
(3) $A^2B \sin\theta$ (4) $A^2B \cos\theta$

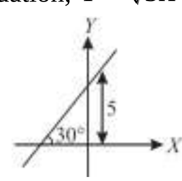
**48.** Given that, $\sin A = \frac{1}{2}$ and $\cos B = \frac{1}{\sqrt{2}}$ then value of $(A+B)$ will be:

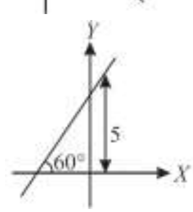
(1) 30° (2) 45°

(3) 75° (4) 15°

**49.** Plot the graph of given equation, $Y = \sqrt{3}X + 5$

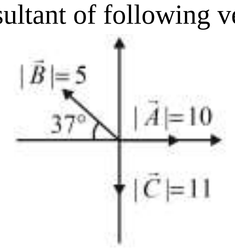
(1) 


(2) 


(3) 


(4) None of the above

**50.** Find the resultant of following vectors




(1) 8 (2) 6

(3) 10 (4) 20

# Solution

**1. (1)**

$\vec{P}=\frac{1}{\sqrt{2}}\hat{i}+\frac{1}{\sqrt{2}}\hat{j}\ \therefore |\vec{P}|=\sqrt{\left(\frac{1}{\sqrt{2}}\right)^2+\left(\frac{1}{\sqrt{2}}\right)^2}=1$

$\therefore$ It is a unit vector.

**2. (2)**

$\vec{A}=\hat{i}+\hat{j}\Rightarrow |A|=\sqrt{1^2+1^2}=\sqrt{2}$

$\cos\alpha=\frac{A_x}{|A|}=\frac{1}{\sqrt{2}}=\cos 45^\circ\ \therefore$

**3. (2)**

Magnitude of unit vector = 1

$\Rightarrow \sqrt{(0.5)^2+(0.8)^2+c^2}=1$

By solving we get $c=\sqrt{0.11}$

**4. (3)**

$\sin(105)=\sin(60+45^\circ)$

$=\sin 60\cos 45+\cos 60\sin 45^\circ$

$=\frac{\sqrt{6}+\sqrt{2}}{4}=\frac{1+\sqrt{3}}{2\sqrt{2}}$

**5. (2)**

$\cos\theta=\frac{\vec{A}.\vec{B}}{|A||B|}=\frac{9+16+25}{\sqrt{9+16+25}\sqrt{9+16+25}}$

$=\frac{50}{50}=1$

$\Rightarrow \cos\theta=1\ \therefore\ \theta=\cos^{-1}(1)$ = zero

**6. (1)**

$-\sqrt{(2)^2+(\sqrt{5})^2}<2\sin\theta+\sqrt{5}\cos\theta<\sqrt{(2)^2+(\sqrt{5})^2}$

$-3<2\sin\theta+\sqrt{5}\cos\theta<3$

then maximum value = 3

**7. (3)**

By law of triangle (graphical method)

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

**8. (2)**

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

The value of $C$ lies between $A-B$ and $A+B$

$\therefore |\vec{C}|<|\vec{A}|$ or $|\vec{C}|<|\vec{B}|$

**9. (3)**

Given vectors can be rewritten as $\vec{A}=2\hat{i}+3\hat{j}+8\hat{k}$ and $\vec{B}=-4\hat{i}+4\hat{j}+\alpha\hat{k}$

Dot product of these vectors should be equal to zero because they are perpendicular.

$\therefore\ \vec{A}.\vec{B}=-8+12+8\alpha=0\ \Rightarrow\ 8\alpha=-4$

$\Rightarrow\ \alpha=-1/2$

**10. (2)**

$$\vec{A}\times\vec{B}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 3 & 1 & 2\\ 2 & -2 & 4\end{vmatrix}$$

$=(1\times 4-2\times -2)\hat{i}+(2\times 2-4\times 3)\hat{j}+(3\times -2-1\times 2)\hat{k}$

$=8\hat{i}-8\hat{j}-8\hat{k}$

$\therefore$ Magnitude of $\vec{A}\times\vec{B}=|\vec{A}\times\vec{B}|$

$=\sqrt{(8)^2+(-8)^2+(-8)^2}=8\sqrt{3}$

**11. (1)**

$\cos\theta=\frac{\vec{P}.\vec{Q}}{PQ}=1\ \therefore\ \theta=0^\circ$

**12. (3)**

$\cos 2^\circ=1$

Because angle is very small.

**13. (2)**

$KE\propto P^2$ (Parabolic graph)

**14. (1)**

$U\propto x^2$ (Parabolic graph)

**15. (3)**

$\vec{R}=\hat{i}+\hat{j}+\sqrt{2}\hat{k}$

Comparing the given vector with

$R=R_x\hat{i}+R_y\hat{j}+R_z\hat{k}$

$R_x=1, R_y=1, R_z=\sqrt{2}$ and

$|\vec{R}|=\sqrt{R_x^2+R_y^2+R_z^2}=2$

$\cos\alpha=\frac{R_x}{R}=\frac{1}{2}\Rightarrow\alpha=60^\circ$

$\cos\beta=\frac{R_y}{R}=\frac{1}{2}\Rightarrow\beta=60^\circ$

$\cos\gamma=\frac{R_z}{R}=\frac{1}{\sqrt{2}}\Rightarrow\gamma=45^\circ$

**16. (2)**

$|\vec{A}|=\sqrt{2^2+3^2+(-1)^2}=\sqrt{4+9+1}=\sqrt{14}$

$|\vec{B}|=\sqrt{(-1)^2+3^2+4^2}=\sqrt{1+9+16}=\sqrt{26}$

$\vec{A}.\vec{B}=2(-1)+3\times 3+(-1)(4)=3$

The projection of $\vec{A}$ on $\vec{B}=\frac{\vec{A}.\vec{B}}{|\vec{B}|}=\frac{3}{\sqrt{26}}$

**17.** **(3)**

Vector perpendicular to *A* and *B*,

$\vec{A}\times\vec{B} = AB\sin\theta\,\hat{n}$

$\therefore$ Unit vector perpendicular to *A* and *B*

$\hat{n} = \dfrac{\vec{A}\times\vec{B}}{|\vec{A}|\times|\vec{B}|\sin\theta}$

**18.** **(3)**

*P* and *Q* will be parallel if $\dfrac{2}{1} = \dfrac{b}{1} = \dfrac{2}{1}$ $\therefore b = 2$

**19.** **(2)**

$\dfrac{d}{dx}(x^{1/2} + x^2 + 10)$

$= \dfrac{1}{2}x^{-1/2} + 2x + 0$

$= \dfrac{1}{2\sqrt{x}} + 2x$

**20.** **(2)**

$\dfrac{dy}{dx} = \dfrac{d}{dx}(x^2 + 4x^3 - 8x + 4)$

$= 2x + 12x^2 - 8$

**21.** **(3)**

$y = 5x^2 - 2x + 1$

$\dfrac{dy}{dx} = 10x - 2$

For min$^m$. $\dfrac{dy}{dx} = 0$

$\dfrac{dy}{dx} = 10x - 2 = 0$

$\boxed{x = \dfrac{1}{5}}$

And

$\dfrac{d^2y}{dx^2} = 10 > 0$

then

$y_{\min} = 5\left(\dfrac{1}{5}\right)^2 - 2\times\dfrac{1}{5} + 1 = \dfrac{4}{5}$

**22.** **(1)**

$\int (x^3 + x + 2)dx$

$= \dfrac{x^4}{4} + \dfrac{x^2}{2} + 2x + C$

**23.** **(2)**

$|\vec{A}\times\vec{B}| = \sqrt{3}\vec{A}\vec{B}$

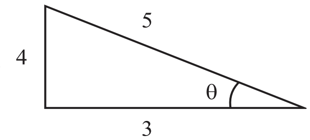
$AB\sin\theta = \sqrt{3}AB\cos\theta$

$\tan\theta = \sqrt{3}$

$\theta = 60°$

**24.** **(4)**

$\sin\theta = \dfrac{4}{5}$




$\boxed{\tan\theta = \dfrac{4}{3}}$

**25.** **(1)**

$\int\left(\cos\dfrac{x}{2} - \sin\dfrac{x}{2}\right)^2 dx$

$= \int\left\{\cos^2\dfrac{x}{2} + \sin^2\dfrac{x}{2} - 2\sin\dfrac{x}{2}\cos\dfrac{x}{2}\right\}dx$

$= \int(1 - \sin x)dx = x + \cos x + c$

**26.** **(1)**

$\dfrac{d}{dx}\left(\sqrt{x} + \dfrac{1}{\sqrt{x}}\right)^2 = \dfrac{d}{dx}\left[x + \dfrac{1}{x} + 2\right] = 1 - \dfrac{1}{x^2}$

**27.** **(2)**

$\int_0^1 y\,dx = \int_0^1 x^2 dx = \left[\dfrac{x^3}{3}\right]_0^1 = \dfrac{1}{3}$

**28.** **(2)**

$\int_0^{\pi/2} \cos 3t\,dt = \left[\dfrac{\sin 3t}{3}\right]_0^{\pi/2}$

$= \dfrac{1}{3}[-1 - 0] = \dfrac{-1}{3}$

**29.** **(3)**

**30.** **(1)**

$2F\cos\left(\dfrac{60°}{2}\right) = 40\sqrt{3}$

$\Rightarrow 2F\dfrac{\sqrt{3}}{2} = 40\sqrt{3}$

$\Rightarrow \boxed{F = 40\,N}$

**31.** **(3)**

sin (90 – θ) = + cos θ

**32.** **(2)**

$x^2 + 7x + 12 = 0$

$(x + 3)(x + 4) = 0$

$x = -3, -4$

**33. (4)**

$y = e^{-\alpha x}$

$$\frac{dy}{dx} = -\alpha e^{-\alpha x}$$

$$\boxed{\frac{d^2y}{dx^2} = +\alpha^2 e^{-\alpha x}}$$

$$= \alpha^2 e^{-\alpha x}$$

**34. (3)**

**35. (4)**

$$S_\infty = \frac{a}{1-r} = \frac{1}{1-1/4} = \frac{4}{3}$$

**36. (3)**

$\sin 15° = \sin(45-30)$

$\sin(A-B) = \sin A\cos B - \cos A\sin B$

$= \sin 45°\cos 30° - \cos 45°\sin 30°$

$$= \frac{1}{\sqrt{2}}\times\frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}}\times\frac{1}{2} = \frac{\sqrt{3}-1}{2\sqrt{2}}$$

**37. (1)**

$$\frac{\pi}{3}\times\frac{180}{\pi} = 60°$$

**38. (4)**

$\log^{a^b} = {}^b\log_a$

$\log_{10}^{10} = 1$

**39. (2)**

$\log_2 16 = \log_2 2^4 = 4\log_2 2 = 4$

**40. (2)**

$\sqrt{3}y = 3x + 4$

$$y = \sqrt{3}x + \frac{4}{\sqrt{3}}$$

slope = $\sqrt{3}$

**41. (1)**

Fact

**42. (2)**

$\vec{A} = \hat{i} + \hat{j} \Rightarrow |A| = \sqrt{1^2+1^2} = \sqrt{2}$

$$\cos\alpha = \frac{A_x}{|A|} = \frac{1}{\sqrt{2}} = \cos 45° \quad \therefore\ \alpha = 45°$$

**43. (3)**

Fact

**44. (3)**

But if the angle between $\vec{A}$ and $\vec{B}$ is 0 or $\pi$. Then $\vec{A}\times\vec{B} = \vec{B}\times\vec{A} = \vec{0}$.

**45. (3)**

$\sin^2\alpha + \sin^2\beta + \sin\gamma$

$= 1-\cos^2\alpha + 1-\cos^2\beta + 1-\cos^2\gamma$

$= 3-\left(\cos^2\alpha + \cos^2\beta + \cos^2\gamma\right) = 3-1 = 2$

**46. (4)**

**47. (2)**

**48. (3)**

$$\sin A = \frac{1}{2}$$

$A = 30°$

and

$$\cos B = \frac{1}{\sqrt{2}}$$

$B = 45°$

then

$A + B = 30 + 45 = 75°$

**49. (3)**

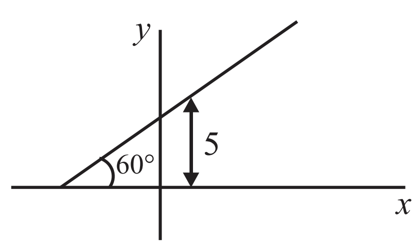
$y = \sqrt{3}x + 5$

$y = mx + C$

$m = \tan\theta = \sqrt{3}$

$\boxed{\theta = 60°}$

and $C = 5$




**50. (3)**