XI – REG - PHYSICS SOLUTIONS

1. **d)**

$\vec{A} = 2\hat{i} + 3\hat{j}$

$\hat{A} = \frac{2i+3j}{\sqrt{4+9}} = \frac{2i+3j}{\sqrt{13}}$

2. **b)**

$\vec{P} - \vec{Q} = (\hat{i} + \hat{j} - \hat{k}) - (\hat{i} - \hat{j} + \hat{k}) = 2\hat{j} - 2\hat{k}$

$\therefore$ unit vector along $\vec{P} - \vec{Q} = \frac{(\vec{P} - \vec{Q})}{|\vec{P} - \vec{Q}|} = \frac{2\hat{j} - 2\hat{k}}{\sqrt{(2)^2 + (-2)^2}}$

$= \frac{2\hat{j} - 2\hat{k}}{\sqrt{4+4}} = \frac{2\hat{j} - 2\hat{k}}{2\sqrt{2}} = \frac{\hat{j} - \hat{k}}{\sqrt{2}}$

3. **a)**

$\vec{A} + \vec{B} = 2\hat{i}$

$\vec{A} - \vec{B} = 2\hat{j}$

$(\vec{A} + \vec{B}) \times (\vec{A} - \vec{B}) = 4\hat{k}$

4. **c)**

$\overline{A}.\overline{B} = -2 + 3 - 1 = 0$

5. **b)**

$\vec{A} + \vec{B} = 2\hat{i}$

$\vec{A} - \vec{B} = 2\hat{j}$

$(\vec{A} + \vec{B}).\ (\vec{A} - \vec{B}).\ = 4\hat{i}\ .\ \hat{j} = 0$

6. **a)**

Component of $\vec{A}$ along $\vec{B}$ is

$\vec{B}$ के अनुदिश का $\vec{A}$ घटक है।

$= A\cos = \frac{\vec{A}.\vec{B}}{A+B} = \frac{\vec{A}.\vec{B}}{B}$

$= A\cos\theta = A\frac{\vec{A}.\vec{B}}{AB} = \frac{\vec{A}.\vec{B}}{B}$

$\frac{(3\hat{i} + 4\hat{j})(\hat{i} + \hat{j})}{(\hat{i} + \hat{j})} = \frac{3+4}{\sqrt{1^2 + 1^2}} = \frac{7}{\sqrt{2}}$

7. **b)**

Velocity = (speed)

$= 6\frac{(2\hat{i} + 2\hat{j} - \hat{k})}{\sqrt{4+4+1}} = (4\hat{i} + 4\hat{j} - 2\hat{k})$ units.

8. **a)**

Given figure represents a regular pentagan so magnitude of AE = 10 metre.

9. **d)**

$3\sqrt{2}\cos 45° - 10 = -7$

10. **b)**

$\vec{V} = 6\ \dfrac{2\hat{i} - \hat{j} - 2\hat{k}}{3}$

$\vec{r} = \vec{r}_0 + \vec{v}t = 3\hat{i} + 4\hat{j} - 7\hat{k} + 4 \times 2\,(2\hat{i} - \hat{j} - 2\hat{k}) \Rightarrow \vec{r} = 19\ \hat{i} - 4\ \hat{j} - 23\ \hat{k}$

11. **a)**

$\left(\vec{A} + \vec{B}\right) = 5\hat{i} + 8\hat{j} + 9\hat{k}$

x-component is 5

12. **c)**

$a_1 = a_2 = 1$ and

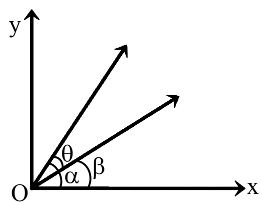
$a_1^2 + a_2^2 + 2a_1a_2\cos\theta = (\sqrt{3})^2 = 3$

Or $1 + 1 + 2\cos\theta = 3$ or $\cos\theta = \dfrac{1}{2}$

Now $(\vec{a}_1 - \vec{a}_2)\ (2\vec{a}_1 + \vec{a}_2) = 2a_1^2 - a_2^2 - a_1a_2\cos\theta$

$= 2 - 1 - \dfrac{1}{2} = \dfrac{1}{2}$

13. **a)**



$\tan\beta = \dfrac{1}{\sqrt{3}}$

$\Rightarrow \quad \beta = 30º$

$\therefore \quad \alpha = \theta + \beta = 53º$

$\therefore \quad \vec{b} = 10\cos 53\,\hat{i} + 10\sin 53\,\hat{j} = 6\,\hat{i} + 8\,\hat{j}$

$\therefore\ \vec{a} + \vec{b} = (6 + \sqrt{3})\,\hat{i} + 9\,\hat{j}$

14. **c)**

Sol. R = $\sqrt{P^2 + 2PQ\cos\theta + Q^2}$ ...(1)

tan 90º = $\frac{2Q\sin\theta}{P + 2Q\cos\theta}$ = $\frac{1}{0}$

P + 2Q cos θ = 0

from (1)

R = $\sqrt{P(P + 2Q\cos\theta) + Q^2}$

R = Q

15. **a)**

Sol. Vector in the direction of $\vec{A}$ and having same magnitude as B is = $B\hat{A}$

$= B\left(\frac{\vec{A}}{A}\right)$

$= \frac{7}{3}(\hat{i} + 2\hat{j} + 2\hat{k})$

16. **c)**

Sol. tan β = $\frac{B\sin\theta}{A + B\cos\theta}$

$= \frac{F\sqrt{3}\sin\theta}{F + F\sqrt{3}\cos\theta}$

$= \frac{\sqrt{3}\sin\theta}{1 + \sqrt{3}\cos\theta}$

tan β = $\frac{\sqrt{3}}{1}$ (θ = 90º)

β = 60º

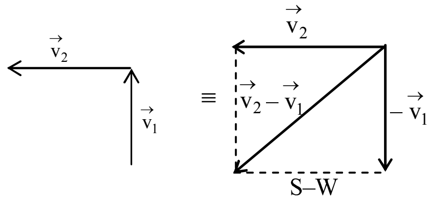
17. **a)**

Sol. $\vec{v}_1$ = 20 m/s due north

$\vec{v}_2$ = 20 m/s due west

$|\vec{v}_2 - \vec{v}_1|$ = $\sqrt{v_1^2 + v_2^2 - 2v_1v_2\cos\theta}$

= $\sqrt{20^2 + 20^2 - 0}$ [$\because \theta = 90°$] = $20\sqrt{2}$ m/s



Direction of $\vec{v}_2 - \vec{v}_1$ is due South –West

18. **a)**

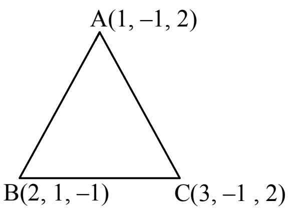
Sol. $\because \vec{A} = \frac{1}{\sqrt{2}}\cos\theta\,\hat{i} + \frac{1}{\sqrt{2}}\sin\theta\,\hat{j}$

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

$\Rightarrow \hat{n} = \frac{\vec{A}}{|\vec{A}|} = \cos\theta\,\hat{i} + \sin\theta\,\hat{j}$

19. **c)**

Sol.



$\overrightarrow{AB} = \hat{i} + 2\hat{j} - 3\hat{k}$

$\overrightarrow{BC} = \hat{i} - 2\hat{j} + 3\hat{k}$

$\overrightarrow{AB} \times \overrightarrow{BC} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & -3 \\ 1 & -2 & 3 \end{vmatrix} = -6\hat{j} - 4\hat{k}$

$|\overrightarrow{AB} \times \overrightarrow{BC}| = \sqrt{(-6)^2 + (-4)^2} = \sqrt{52}$ unit

$\therefore$ Area of $\Delta = \frac{1}{2}|\overrightarrow{AB} \times \overrightarrow{BC}| = \sqrt{13}$ unit

20. **d)**

Sol. $\because$ A + B = 17

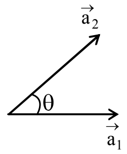
& A – B = 7 $\Rightarrow \boxed{\begin{matrix} A = 12 \\ B = 5 \end{matrix}}$

$\because$ θ = 90°

$\therefore\ R = \sqrt{A^2 + B^2} = \sqrt{12^2 + 5^2}$ = 13 unit

21. **a)**

Sol.



$|\vec{a}_1| = |\vec{a}_2| = a$

$|\Delta \vec{a}| = |\vec{a}_2 - \vec{a}_1|$

= $\sqrt{a_1^2 + a_2^2 - 2a_1a_2\cos\theta}$

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

= 2a sin θ/2

22. **d)**

Sol. $\because\ |\vec{F}_1 + \vec{F}_2| = P$

$\Rightarrow F_1^2 + F_2^2 + 2F_1F_2\ \cos\theta = P^2$ .....(1)

& $|\vec{F}_1 - \vec{F}_2| = Q$

$\Rightarrow\ F_1^2 + F_2^2 - 2F_1F_2\ \cos\theta = Q^2$ .....(2)

(1) + (2), $\boxed{2(F_1^2 + F_2^2) = P^2 + Q^2}$

23. **d)**

(D) Minimum number of non-coplanar vectors whose resultant can be zero is four.

24. **c)**

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

$$\Rightarrow \ \hat{c} = \frac{\vec{c}}{|\vec{c}|} = \frac{3}{\sqrt{26}}\,\hat{i} - \frac{4}{\sqrt{26}}\hat{j} - \frac{1}{\sqrt{26}}\hat{k}$$

24. **b)**

Sol. Component of $\vec{A}$ along $\vec{B}$ = $\left(\frac{\vec{A}.\vec{B}}{|\vec{B}|}\right)\hat{B}$

25. **c)**

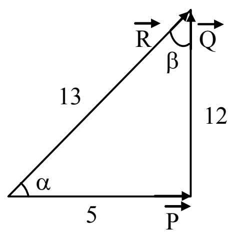
Sol. Here $R^2 = P^2 + Q^2 + 2PQ \cos\theta$

θ = angle between $\vec{P}$ and $\vec{Q}$ $\quad \therefore \theta = 90º$

From $\tan\alpha = \frac{Q\sin\theta}{P+Q\cos\theta}$

(α = angle between $\vec{P}$ and $\vec{R}$)

$= \frac{12.\sin 90^o}{5+12\cos 90^o} = \frac{12}{5}$



$\cos\beta = \frac{12}{13} \qquad \therefore \quad \beta = \cos^{-1}\left(\frac{12}{13}\right)$

26. **c)**

Sol. $\vec{a}\,.\,\vec{b} = 0 \qquad$ if $\vec{a} \perp \vec{b}$

$(2\hat{i}+3\hat{j}+8\hat{k})\ .\ (-4\hat{i}+4\hat{j}+\alpha\hat{k}) = 0$

$\Rightarrow \ -8 + 12 + 8\alpha = 0 \ \Rightarrow \alpha = \frac{-1}{2}$

27. **a)**

Sol. $\vec{C} = \vec{A} + \vec{B}$ = $(3\hat{i} + 6\hat{j} - 2\hat{k})$

$$\hat{C} = \frac{\vec{C}}{|C|} = \frac{3\hat{i} + 6\hat{j} - 2\hat{k}}{\sqrt{3^2 + 6^2 + (-2)^2}} = \frac{3\hat{i} + 6\hat{j} - 2\hat{k}}{7}$$

28. **d)**

Sol. Resultant can be zero if

$|F_1 - F_2| \le F_3 \le F_1 + F_2$

29. **d)**

Sol. $\vec{F_1}$ = $F_1\ \hat{i}$ and $F_1\ \hat{i} \times (-4\hat{i})$ = 0

30. **d)**

Sol. Component of $\vec{A}$ along $\vec{B}$

$$= \frac{\vec{A}.\vec{B}}{B} = \frac{3+4}{\sqrt{2}} = \frac{7}{\sqrt{2}}$$

In vector form $= \frac{7}{\sqrt{2}}\ \hat{B}$

$$= \frac{7}{\sqrt{2}}\left(\frac{\hat{i} + \hat{j}}{\sqrt{2}}\right) \qquad = \frac{7}{2}(\hat{i} + \hat{j})$$