JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- MATHEMATICS
CLASS :- 12th **PAPER CODE :- CWT-11**
CHAPTER :- VECTOR & 3D

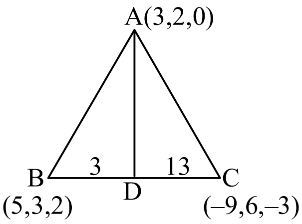
ANSWER KEY

1.	(B)	**2.**	(B)	**3.**	(B)	**4.**	(B)	**5.**	(A)	**6.**	(D)	**7.**	(A)
8.	(D)	**9.**	(D)	**10.**	(A)	**11.**	(C)	**12.**	(C)	**13.**	(D)	**14.**	(C)
15.	(D)	**16.**	(B)	**17.**	(B)	**18.**	(B)	**19.**	(B)	**20.**	(C)	**21.**	7
22.	17	**23.**	2	**24.**	1	**25.**	4	**26.**	58	**27.**	1	**28.**	3
29.	5	**30.**	3										

SOLUTIONS

1. (B)

Sol.



AB = $\sqrt{4+1+4}$ = 3

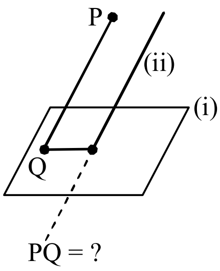
AC = $\sqrt{144+16+9}$ = 13

$D\left(\frac{-27+65}{3+13},\frac{18+39}{3+13},\frac{-9+26}{3+13}\right)$

$=\left(\frac{19}{8},\frac{57}{16},\frac{17}{16}\right)$

2. (B)

Sol.



2x + 5y – 6z = 16 ..... (i)

$\frac{x}{2}=\frac{y}{1}=\frac{z}{-2}$ ..... (ii)

P(3, – 4, 5)

DR's of line (ii) = DR's of line PQ

Eq. of line PQ $\Rightarrow \frac{x-3}{2}=\frac{y+4}{1}=\frac{z-5}{-2}$ = λ

∴ Coordinate of the point Q (3 + 2λ, – 4 + λ, 5 – 2λ)

Put the coordinates of Q in eqn. (i) ⇒λ= ?

distance between P & Q

2(3 + 2λ) + 5 (–4 + λ) – 6 (5 – 2λ) = 16

6 + 4λ – 20 + 5λ – 30 + 12λ = 16

$\lambda = \frac{20}{7}$

Q = $\left(\left(3+\frac{40}{7}\right),\left(-4+\frac{20}{7}\right),\left(5-\frac{40}{7}\right)\right)$

Q = $\left(\frac{61}{7},\frac{-8}{7},\frac{-5}{7}\right)$

PQ = $\sqrt{\left(\frac{61}{7}-3\right)^2+\left(\frac{-8}{7}+4\right)^2+\left(\frac{-5}{7}+5\right)^2}$

PQ = $\frac{\sqrt{(40)^2+(20)^2+(40)^2}}{7}$

PQ = $\frac{60}{7}$

3. (B)

Sol. $\vec{x}+\vec{y}+\vec{z}=0$

$\Rightarrow \vec{y}+\vec{z}=-\vec{x} \Rightarrow |\vec{y}+\vec{z}|^2=|\vec{x}|^2$

$\Rightarrow |\vec{y}|^2+|\vec{z}|^2+2\vec{y}.\vec{z} = |\vec{x}|^2$

⇒ 4 + 4 + 2 (2) (2) cos θ = 4

⇒ cos θ = $\frac{-1}{2}$ ⇒ θ = 120°

⇒ $\text{cosec}^2\theta + \cot^2\theta = \frac{4}{3}+\frac{1}{3}=\frac{5}{3}$

4. (B)

Sol. $\left(\sqrt{x^2+y^2}\right)^2 + \left(\sqrt{y^2+z^2}\right)^2 + \left(\sqrt{z^2+x^2}\right)^2$ = 36

⇒ $2(x^2 + y^2 + z^2) = 36$

⇒ $x^2 + y^2 + z^2 = 18$

⇒ $\sqrt{x^2+y^2+z^2} = \sqrt{18}$ ⇒ OP = $3\sqrt{2}$

5. (A)

Sol. We have sin α = $\frac{3}{5}$, cos β = $\frac{2+2}{\sqrt{5}\sqrt{5}}=\frac{4}{5}$s

So, $(\cos^2\alpha + \sin^2\beta) = \frac{16}{25}+\frac{9}{25}$ = 1. s

Ans.

6. (D)

Sol. Direction ratio's of normal of the plane are < 2, 3, 4 >.

(A) $\frac{x-0}{-6}=\frac{y-1}{9}=\frac{z-0}{-3}=t$; Now, – 6 (2) + 9 (3) – 3 (4) ≠ 0.

(B) $\frac{x+1}{1}=\frac{y-4}{1}=\frac{z-1}{3}=t$; Now, 1 (2) + 1 (3) + 3 (4) ≠ 0.

(C) $\frac{x-1}{2}=\frac{y-0}{3}=\frac{z-2}{-1}=t$; Now, 2 (2) + 3 (3) – 1(4) ≠ 0.

(D) $\frac{x-1}{2}=\frac{y-4}{-4}=\frac{z-0}{2}=t$ Now, 2 (2) – 4 (3) + 2 (4) = 0.

7. (A)

Sol. Direction ratios of joining (–1,2,4) and (1, 0, 5) are

1 + 1, 0 – 2, 5 – 4 = (2, – 2, 1)

∴ D.C. of this line are

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

m = $\frac{-2}{\sqrt{4+4+1}}$ = – 2/3

n = $\frac{1}{\sqrt{4+4+1}}$ = 1/3

∴ required projection

= $\left|(4-3)\frac{2}{3}+(6-4)(-2/3)+(3-5)\frac{1}{3}\right|$

= $\left|\frac{2}{3}-\frac{4}{3}-\frac{2}{3}\right|$ = 4/3

$\left\{\begin{array}{l}\because \text{projection of line joining } (x_1,y_1,z_1) \text{ and} \\ (x_2,y_2,z_2) \text{ to the line whose d.c's are } \ell, m, n \text{ is} \\ |(x_2-x_1)\ell+(y_2-y_1)m+(z_2-z_1)n|\end{array}\right\}$

8. (D)

Sol. Here L_1 is parallel to $2\hat{i}+\hat{j}+4\hat{k}$ and L_2 is parallel to $4\hat{i}-3\hat{j}+\hat{k}$ ⇒ $L_1 \neq L_2$.

We have (Lines in parametric form) as

L_1 : x = 1+ 2s, y = –1 + s, z = 2 + 4s

and L_1 : x = –2 + 4t, y = –3t, z = –1 + t

∴ The lines intersect if there are s and t for which

2s – 4t = –3 .....(1)

s + 3t = 1 .....(2)

4s – t = –3 .....(3)

Any solution of this system must coorespond to a point of intersection of L_1 and L_2 and if no solution exists, then L_1 and L_2 are skew.

∴ From (1) and (2), we get

s = $\frac{-1}{2}$, t = $\frac{1}{2}$s, which does not satisfy (3)

⇒ L_1 and L_2 are skew line.

9. (D)

Sol. ∵DR's of the normal of the plane ⇒ 2, –3, 6

&DR's of x-axis is 1, 0, 0

& If 'θ' is the angle between the plane & x-axis, then sin θ = $\frac{2(1)+(-3)(0)+(6)(0)}{\sqrt{2^2+(-3)^2+6^2}\sqrt{1}}$ = $\frac{2}{7}$

⇒θ = $\sin^{-1}\left(\frac{2}{7}\right)$

∴ a = $\frac{2}{7}$

10. (A)

Sol. Given line is

⇒ $\vec{r}$ = $(2\hat{i} - 2\hat{j} + 3\hat{k}) + \lambda(\hat{i} - \hat{j} + 4\hat{k})$ .....(i)

& $\vec{r}.(\hat{i} + 5\hat{j} + \hat{k}) = 5$ ....(ii)

By (i) ⇒ $\begin{cases}\vec{a}=(2\hat{i}-2\hat{j}+3\hat{k}) \\ \vec{b}=(\hat{i}-\hat{j}+4\hat{k})\end{cases}$

By (ii) ⇒ $\vec{n} = (\hat{i} + 5\hat{j} + \hat{k})$

∵ $\vec{b}.\vec{n} = 0$

Therefore, the line is parallel to the plane. Thus, the distance between the line & the plane is equal to the length of the perpendicular from a point $\vec{a} = (2\hat{i} - 2\hat{j} + 3\hat{k})$ on the line to the given plane.

Hence, the required distance

= $\left|\frac{(2\hat{i}-2\hat{j}+3\hat{k}).(\hat{i}+5\hat{j}+\hat{k})-5}{\sqrt{1+5^2+1}}\right|$

= $\frac{10}{3\sqrt{3}}$

11. (C)

Sol. Line of shortest distance will be along

$\begin{vmatrix}\hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & 4 \\ 3 & 4 & 5\end{vmatrix} = -\hat{i}+2\hat{j}-\hat{k}$

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

⇒ $\cos^{-1}(\cos\sqrt{6}\,x) = \cos^{-1}(\cos 1) = 1$

12. (C)

Sol. Equation of line passing through given point P and normal to given plane is

$\vec{r} = (\hat{i}+3\hat{j}+4\hat{k}) + \lambda(2\hat{i}-\hat{j}+\hat{k})$

$\Rightarrow$ Image point Q

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

Now mid point of

PQ $\equiv[(\lambda+1)\hat{i}+(3-\lambda/2)\hat{j}+(4+\lambda/2)\hat{k}]$

satisfies given plane that gives $\lambda = -2$

So position vector of image is $-3\hat{i}+5\hat{j}+2\hat{k}$

13. (D)

Sol. Let $|\vec{a}| = |\vec{b}| = |\vec{c}| = t$

from given equation, we have

$(\vec{a}.\vec{a})(\vec{m}-\vec{b}) - \{\vec{a}.(\vec{m}-\vec{b})\}\vec{a} + (\vec{b}.\vec{b})(\vec{m}-\vec{c}) - \{\vec{b}.(\vec{m}-\vec{c})\}\vec{b} + (\vec{c}.\vec{c})(\vec{m}-\vec{a}) - \{\vec{c}.(\vec{m}-\vec{a})\}.\vec{c} = 0$

$\Rightarrow |\vec{a}|^2(\vec{m}-\vec{b}) + |\vec{b}|^2(\vec{m}-\vec{c}) + |\vec{c}|^2(\vec{m}-\vec{a}) - [(\vec{a}.\vec{m})\vec{a} + (\vec{b}.\vec{m})\vec{b} + (\vec{c}.\vec{m})\vec{c}] + (\vec{a}.\vec{b})\vec{a} + (\vec{b}.\vec{c})\vec{b} + (\vec{c}.\vec{a})\vec{c} = 0$

also $\vec{a}.\vec{b} = \vec{b}.\vec{c} = \vec{c}.\vec{a} = 0$

$\Rightarrow t(3\vec{m} - \vec{a}-\vec{b}-\vec{c}) - t^2\vec{m} = 0$

$\Rightarrow 2\vec{m} = \vec{a}+\vec{b}+\vec{c} \Rightarrow \vec{m} = \dfrac{\vec{a}+\vec{b}+\vec{c}}{2}$

14. (C)

Sol. $\vec{a} + \vec{b} + \vec{c} + \vec{d} = (\alpha+1)\vec{d} = (\beta+1)\vec{a}$

$\Rightarrow \vec{d} = \dfrac{\beta+1}{\alpha+1}\vec{a}$

So $\vec{a} + \vec{b} + \vec{c} = \alpha\vec{d} = \alpha\left(\dfrac{\beta+1}{\alpha+1}\right)\vec{a}$

$\Rightarrow \vec{a}\left\{1-\dfrac{\beta+1}{\alpha+1}\alpha\right\} + \vec{b} + \vec{c} = 0$

$\Rightarrow [\vec{a}\ \vec{b}\ \vec{c}] \neq 0 \Rightarrow \alpha = -1$

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

15. (D)

Sol. $\vec{x} \times \vec{a} + (\vec{x}.\vec{b})\vec{c} = \vec{d}$

$\therefore \{\vec{x} \times \vec{a} + (\vec{x}.\vec{b})\vec{c}\} \times \vec{c} = \vec{d} \times \vec{c}$

or $(\vec{x} \times \vec{a}) \times \vec{c} + (\vec{x}.\vec{b})(\vec{c} \times \vec{c}) = \vec{d} \times \vec{c}$

$= (\vec{x}.\vec{c})\vec{a} - (\vec{a}.\vec{c})\vec{x} = (\vec{d} \times \vec{c})$

$\vec{a} \times \{(\vec{x}.\vec{c})\vec{a} - (\vec{a}.\vec{c})\vec{x}\} = \vec{a} \times (\vec{d} \times \vec{c})$

$= -(\vec{a}.\vec{c})(\vec{a} \times \vec{x}) = \vec{a} \times (\vec{d} \times \vec{c})$

$\because \vec{a} \times \vec{a} = 0$

$\vec{x} \times \vec{a} = \dfrac{\vec{a} \times (\vec{d} \times \vec{c})}{\vec{a}.\vec{c}}$

$\vec{a} \times (\vec{x} \times \vec{a}) = \vec{a} \times \dfrac{\vec{a} \times (\vec{d} \times \vec{c})}{\vec{a}.\vec{c}}$

$(\vec{a}.\vec{a})\vec{x} - (\vec{a}.\vec{x})\vec{a} = \vec{a} \times \dfrac{\vec{a} \times (\vec{d} \times \vec{c})}{\vec{a}.\vec{c}}$

$\vec{a}^2\vec{x} = (\vec{a}.\vec{x})\vec{a} + \vec{a}\dfrac{\vec{a} \times (\vec{d} \times \vec{c})}{\vec{a}.\vec{c}}$

$\vec{x} = \dfrac{(\vec{a}.\vec{x})\vec{a}}{\vec{a}^2} + \vec{a} \times \dfrac{\vec{a} \times (\vec{d} \times \vec{c})}{(\vec{a}.\vec{c})\vec{a}^2}$

$\vec{x} = \lambda\vec{a} + \vec{a} \times \dfrac{\vec{a} \times (\vec{d} \times \vec{c})}{(\vec{a}.\vec{c})\vec{a}^2} \Rightarrow \lambda = \dfrac{\vec{a}.\vec{x}}{\vec{a}^2}$

16. (B)

Sol. $\vec{d} \times \vec{b} = \vec{c} \times \vec{b}$

$\Rightarrow (\vec{d}-\vec{c}) \times \vec{b} = 0$

$\Rightarrow \vec{d} = \vec{c} + \lambda\vec{b}$

$\Rightarrow \vec{d} = (7+\lambda)\hat{i} + (-3+\lambda)\hat{j} + (4+\lambda)\hat{k}$

$\Rightarrow \vec{a}.\vec{d} = 0$

$\Rightarrow 7 + \lambda + 2(4+\lambda) = 0 \Rightarrow \lambda = -5$

So $\vec{d} = 2\hat{i} - 8\hat{j} - \hat{k}$

17. (B)

Sol. $\vec{b}$ perpendicular $\vec{c} \Rightarrow \vec{b}.\vec{c} = 0$

$\Rightarrow \tan^2\alpha - \tan\alpha - 6 = 0$

$\Rightarrow \tan\alpha = 3, -2$

also $\vec{a}$ make an obtuse angle with z- axis

therefore $\vec{a}.\hat{k} < 0 \Rightarrow \sin 2\alpha < 0$

if $\tan\alpha = 3$ then $\sin 2\alpha = \dfrac{2\tan\alpha}{1+\tan^2\alpha} = \dfrac{4}{3} > 0$

Now $\tan 2\alpha > 0$, $\sin 2\alpha < 0$ $\Rightarrow \alpha \in$ third quadrant and $\tan\alpha = -2$

$\Rightarrow \tan(\pi - \alpha) = 2 \Rightarrow \alpha = (2n+1)\pi - \tan^{-1} 2$, $n \in I$

18. (B)

Sol. $\vec{c} = \lambda(\vec{a} \times \vec{b})$

$1 = (\vec{a} \times \vec{b}).\vec{c} = \dfrac{\vec{c}.\vec{c}}{\lambda} = \dfrac{|\vec{c}|^2}{\lambda} = \dfrac{1}{3\lambda} \Rightarrow \lambda = \dfrac{1}{3}$

$\vec{c}^2 = \lambda^2(\vec{a} \times \vec{b})^2$

$\dfrac{1}{3} = \dfrac{1}{9} = (a^2 b^2 \sin^2\theta) = \dfrac{1}{9} \times 2 \times 3 \sin^2\theta$

$\Rightarrow \sin^2\theta = \dfrac{1}{2} \therefore \theta = \dfrac{\pi}{4}$

19. (B)

Sol. Let $\vec{a} = \lambda\vec{b} + \mu\vec{c}$

then $\frac{\vec{a}.\vec{b}}{ab} = \frac{\vec{a}.\vec{d}}{ad}$

i.e. $\frac{(\lambda\vec{b}+\mu\vec{c}).\vec{b}}{b} = \frac{(\lambda\vec{b}+\mu\vec{c}).\vec{d}}{d}$

i.e. $\frac{[\lambda(2\hat{i}+\hat{j})+\mu(\hat{i}-\hat{j}+\hat{k})].(2\hat{i}+\hat{j})}{\sqrt{5}}$

$= \frac{[\lambda(2\hat{i}+\hat{j})+\mu(\hat{i}-\hat{j}+\hat{k})].(\hat{j}+2\hat{k})}{\sqrt{5}}$

i.e.λ (4 + 1) + μ(2 – 1) = λ(1) + μ(–1 + 2)

i.e. $4\lambda = 0$ i.e. $\lambda = 0$

$\therefore \vec{a} = \frac{\hat{i}-\hat{j}+\hat{k}}{\sqrt{3}}$

20. (C)

Sol. We have $\left| \begin{vmatrix} 2 & 3 & 4 \\ 1 & \alpha & 2 \\ 1 & 2 & \alpha \end{vmatrix} \right| = 15$

$\Rightarrow |\, 2(\alpha^2 - 4) + 3(2 - \alpha) + 4(2 - \alpha)\, | = 15$

$\Rightarrow |2\alpha^2 - 7\alpha + 6| = 15$

$\Rightarrow$ Either $(2\alpha^2 - 7\alpha + 6) = 15$ or $(2\alpha^2 - 7\alpha + 6) = -15$

So, either $(2\alpha^2 - 7\alpha - 9) = 0 = (\alpha + 1)(2\alpha - 9)$

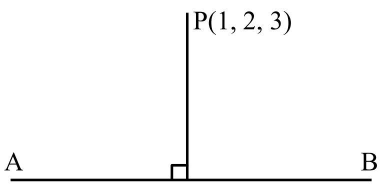
$\therefore \alpha = -1, \frac{9}{2}$ or $2\alpha^2 - 7\alpha + 21 = 0$

has non-real roots as discriminant is negative.

Hence $\alpha = \frac{9}{2}$. **Ans.**

21. 7

Sol. $\frac{x-6}{3} = \frac{y-7}{2} = \frac{z-7}{-2} = \lambda$



M $(3\lambda + 6, 2\lambda + 7, -2\lambda + 7)$

$\therefore$ M $(3\lambda + 6, 2\lambda + 7, -2\lambda + 7)$

As lines PM and AB are perpendicular, therefore

$3(3\lambda + 6 - 1) + 2(2\lambda + 7 - 2) - 2(-2\lambda + 7 - 3) = 0$

$17\lambda = -17$

$\lambda = -1$

$\therefore$ M $\equiv$ (3, 5, 9)

$\therefore$ PM = $\sqrt{(3-1)^2+(5-2)^2+(9-3)^2}$

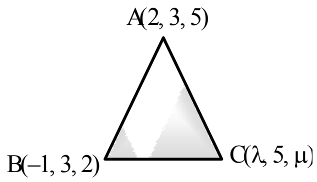
PM = $\sqrt{4+9+36}$

PM = 7

22. 17

Sol. Mid point of BC is $\left(\frac{\lambda-1}{2}, 4, \frac{2+\mu}{2}\right)$

DR's of median through A are -



$\frac{\lambda-1}{2} - 2,\ 4 - 3,\ \frac{2+\mu}{2} - 5$

i.e. $\frac{\lambda-5}{2}$, 1, $\frac{\mu+8}{2}$

The medium is equally inclined to axes,

$\therefore$ D.R's must be

equal $\frac{\lambda-5}{2} = 1 = \frac{\mu+8}{2} \Rightarrow \lambda = 7$ and $\mu = 10$

23. 2

Sol. Here $d_1 = d\cos(90° - \alpha)$, $d_2 = d\cos(90° - \beta)$ and $d_3 = d\cos(90° - \gamma)$

$d_1 = d\sin\alpha$, $d_2 = d\sin\beta$, $d_3 = d\sin\gamma$

$\Rightarrow d_1^2 + d_2^2 + d_3^2 = kd^2$

$\Rightarrow d^2(\sin^2\alpha + \sin^2\beta + \sin^2\gamma) = kd^2$

$\therefore$ k = 2.

24. 1

Sol. Let the vertices A, B, C, D quadrilateral be

(x_1, y_1, z_1), (x_2, y_2, z_2), (x_3, y_3, z_3) & (x_4, y_4, z_4) and the equation of plane PQRS be

$u \equiv ax + by + cz + d = 0$

let $u_r = a_r x + b_r y + c_r z + d$ where r = 1, 2, 3, 4

Then $\frac{AP}{PB}.\frac{BQ}{QC}.\frac{CR}{RD}.\frac{DS}{SA}$

$= \left(-\frac{u_1}{u_2}\right)\left(-\frac{u_2}{u_3}\right)\left(-\frac{u_3}{u_4}\right)\left(-\frac{u_4}{u_1}\right) = 1.$

25. 4

Sol. Point (3, 2, 1) & (2, –3, –1)

lies on 11x + my + nz = 28

i.e., 33 + 2m + n = 28

$\Rightarrow$ 2m + n = –5 … (1)

and 22 – 3m – n = 28

$\Rightarrow$ –3m – n = 6 … (2)

From (1) and (2)

m = –1 & n = –3.

|m + n| = |–1–3| = 4

26. 58

Sol. Since, both the planes are parallel

$P_1 : 4x - 6y + 12z + 10 = 0$

$P_2 : 4x - 6y + 12z + d = 0$

$b = -6,\ c = 12$

Now, $\left|\dfrac{d-10}{2\sqrt{4+9+36}}\right| = 3$

$|d - 10| = 42 \Rightarrow d = 52$ or -32

$\therefore P_2$ is $4x - 6y + 12z + 52 = 0$

or $4x - 6y + 12z - 32 = 0$

$\because$ Point $(-3, 0, -1)$ is lying between planes P_1 and P_2

$\therefore$ On substituting the point in the equation of the planes both expressions must be of opposite sign.

From P_1: $4 \times (-3) - 6 \times 0 + 12(-1) + 10 = -ve$

From P_2: $4 \times (-3) - 6 \times 0 + 12(-1) + 52 = +ve$

$\therefore$ d must be 52

Hence, $(b + c + d) = -6 + 12 + 52 = 58$ **Ans.**

27. 1

Sol. The vectors are coplanar if we can find two scalars λ, μ such that

$x\vec{i} + \vec{j} + \vec{k} = \lambda(\vec{i} + y\vec{j} + \vec{k}) + \mu(\vec{i} + \vec{j} + z\vec{k})$

$\Rightarrow x = \lambda + \mu,\ 1 = \lambda y + \mu,\ 1 = \lambda + \mu z$

$\therefore 1 - x = 1 - \lambda - \mu,\ y = \dfrac{1-\mu}{\lambda},\ z = \dfrac{1-\lambda}{\mu}$

$\therefore 1 - y = \dfrac{\lambda - 1 + \mu}{\lambda}$ and $1 - z = \dfrac{\mu - 1 + \lambda}{\mu}$

$\therefore \dfrac{1}{1-x} + \dfrac{1}{1-y} + \dfrac{1}{1-z}$

$= \dfrac{1}{1-\lambda-\mu} + \dfrac{\lambda}{\lambda+\mu-1} + \dfrac{\mu}{\lambda+\mu-1}$

$= \dfrac{1-\lambda-\mu}{1-\lambda-\mu} = 1.$

28. 3

Sol. If two vectors are perpendicular then $\cos\theta = 0$

$\therefore a_1 b_1 + a_2 b_2 + a_3 b_3 = 0$

$2(4) + P(-2) + 2(-1) = 0$

$8 - 2P - 2 = 0$

$-2P = -6$

$P = 3$

29. 5

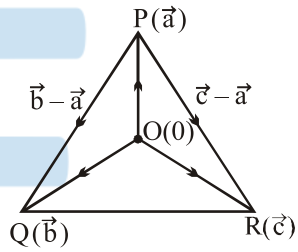
Sol. The line contained by the planes is along the vector $(2\hat{i} + \hat{j}) \times (\hat{i} - \hat{j} + \hat{k}) = \hat{i} - 2\hat{j} - 3\hat{k}$

Since it is parallel to the plane $kx + y + z + 2 = 0$, so

$k(1) + 1(-2) + 1(-3) = 0 \Rightarrow k = 5$. **Ans.**

30. 3

Sol. Given that $\vec{a} + k_1\vec{b} + k_2\vec{c} = \vec{0}$



Now, $\dfrac{\text{Area}(\Delta PQR)}{\text{Area}(\Delta OQR)}$

$= \dfrac{\frac{1}{2}\left|(\vec{b}-\vec{a}) \times (\vec{c}-\vec{a})\right|}{\frac{1}{2}\left|(\vec{b} \times \vec{c})\right|} = 4$

$\Rightarrow \dfrac{\left|\{(1+k_1)\vec{b} + k_2\vec{c}\} \times \{k_1\vec{b} + (1+k_2)\vec{c}\}\right|}{|\vec{b} \times \vec{c}|} = 4$

$\Rightarrow (1 + k_1)(1 + k_2) - k_1 k_2 = 4$

Hence, $k_1 + k_2 = 3$. **Ans.**