

Q1. JEE Main 2026 (21 January Shift 2)

Let the line L pass through the point $(-3, 5, 2)$ and make equal angles with the positive coordinate axes. If the distance of L from the point $(-2, r, 1)$ is $\sqrt{\frac{14}{3}}$, then the sum of all possible values of r is :

- (1) 10 (2) 6 (3) 12 (4) 16

Q2. JEE Main 2026 (21 January Shift 2)

Let the line L_1 be parallel to the vector $-3\hat{i} + 2\hat{j} + 4\hat{k}$ and pass through the point $(2, 6, 7)$, and the line L_2 be parallel to the vector $2\hat{i} + \hat{j} + 3\hat{k}$ and pass through the point $(4, 3, 5)$. If the line L_3 is parallel to the vector $-3\hat{i} + 5\hat{j} + 16\hat{k}$

and intersects the lines L_1 and L_2 at the points C and D , respectively, then $|\overrightarrow{CD}|^2$ is equal to :

- (1) 89 (2) 312 (3) 171 (4) 290

Q3. JEE Main 2026 (23 January Shift 1)

Let the direction cosines of two lines satisfy the equations : $4l + m - n = 0$ and $2mn + 10nl + 3lm = 0$. Then the cosine of the acute angle between these lines is :

- (1) $\frac{20}{3\sqrt{38}}$ (2) $\frac{10}{3\sqrt{38}}$ (3) $\frac{10}{7\sqrt{38}}$ (4) $\frac{10}{\sqrt{38}}$

Q4. JEE Main 2026 (23 January Shift 1)

The vertices B and C of a triangle ABC lie on the line $\frac{x}{1} = \frac{1-y}{-2} = \frac{z-2}{3}$. The coordinates of A and B are $(1, 6, 3)$ and $(4, 9, \alpha)$ respectively and C is at a distance of 10 units from B . The area (in sq. units) of $\triangle ABC$ is :

- (1) $20\sqrt{13}$ (2) $5\sqrt{13}$ (3) $15\sqrt{13}$ (4) $10\sqrt{13}$

Q5. JEE Main 2026 (28 January Shift 2)

Let $Q(a, b, c)$ be the image of the point $P(3, 2, 1)$ in the line $\frac{x-1}{1} = \frac{y}{2} = \frac{z-1}{1}$. Then the distance of Q from the line $\frac{x-9}{3} = \frac{y-9}{2} = \frac{z-5}{-2}$ is

- (1) 8 (2) 5 (3) 7 (4) 6

Q6. JEE Main 2026 (28 January Shift 2)

If the distance of the point $P(43, \alpha, \beta)$, $\beta < 0$, from the line $\vec{r} = 4\hat{i} - \hat{k} + \mu(2\hat{i} + 3\hat{k})$, $\mu \in \mathbf{R}$ along a line with direction ratios $3, -1, 0$ is $13\sqrt{10}$, then $\alpha^2 + \beta^2$ is equal to _____

Q7. JEE Main 2026 (24 January Shift 2)

The sum of all values of α , for which the shortest distance between the lines $\frac{x+1}{\alpha} = \frac{y-2}{-1} = \frac{z-4}{-\alpha}$ and

$\frac{x}{\alpha} = \frac{y-1}{2} = \frac{z-1}{2\alpha}$ is $\sqrt{2}$, is

- (1) 6 (2) 8 (3) -8 (4) -6

Q8. JEE Main 2026 (22 January Shift 2)

Let L be the line $\frac{x+1}{2} = \frac{y+1}{3} = \frac{z+3}{6}$ and let S be the set of all points (a, b, c) on L , whose distance from the line $\frac{x+1}{2} = \frac{y+1}{3} = \frac{z-9}{0}$ along the line L is 7. Then $\sum_{(a,b,c) \in S} (a + b + c)$ is equal to :

- (1) 6 (2) 34 (3) 40 (4) 28

Q9. JEE Main 2026 (22 January Shift 1)

If the image of the point $P(1, 2, a)$ in the line $\frac{x-6}{3} = \frac{y-7}{2} = \frac{z-2}{2}$ is $Q(5, b, c)$, then $a^2 + b^2 + c^2$ is equal to

- (1) 298 (2) 293 (3) 264 (4) 283

Q10. JEE Main 2026 (22 January Shift 1)

Let $P(\alpha, \beta, \gamma)$ be the point on the line $\frac{x-1}{2} = \frac{y+1}{-3} = z$ at a distance $4\sqrt{14}$ from the point $(1, -1, 0)$ and nearer to the origin. Then the shortest distance, between the lines $\frac{x-\alpha}{1} = \frac{y-\beta}{2} = \frac{z-\gamma}{3}$ and $\frac{x+5}{2} = \frac{y-10}{1} = \frac{z-3}{1}$, is equal to

- (1) $4\sqrt{\frac{7}{5}}$ (2) $2\sqrt{\frac{7}{4}}$ (3) $7\sqrt{\frac{5}{4}}$ (4) $4\sqrt{\frac{5}{7}}$

Q11. JEE Main 2026 (23 January Shift 2)

If the image of the point $P(a, 2, a)$ in the line $\frac{x}{2} = \frac{y+a}{1} = \frac{z}{1}$ is Q and the image of Q in the line $\frac{x-2b}{2} = \frac{y-a}{1} = \frac{z+2b}{-5}$ is P , then $a + b$ is equal to _____.

Q12. JEE Main 2026 (21 January Shift 1)

Let (α, β, γ) be the co-ordinates of the foot of the perpendicular drawn from the point $(5, 4, 2)$ on the line $\vec{r} = (-\hat{i} + 3\hat{j} + \hat{k}) + \lambda(2\hat{i} + 3\hat{j} - \hat{k})$.

Then the length of the projection of the vector $\alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}$ on the vector $6\hat{i} + 2\hat{j} + 3\hat{k}$ is :

- (1) $\frac{15}{7}$ (2) 4 (3) $\frac{18}{7}$ (4) 3

Q13. JEE Main 2026 (28 January Shift 1)

If the distances of the point $(1, 2, a)$ from the line $\frac{x-1}{1} = \frac{y}{2} = \frac{z-1}{1}$ along the lines $L_1 : \frac{x-1}{3} = \frac{y-2}{4} = \frac{z-a}{b}$ and $L_2 : \frac{x-1}{1} = \frac{y-2}{4} = \frac{z-a}{c}$ are equal, then $a + b + c$ is equal to

- (1) 5 (2) 7 (3) 4 (4) 6

Q14. JEE Main 2026 (24 January Shift 1)

Let the lines $L_1 : \vec{r} = \hat{i} + 2\hat{j} + 3\hat{k} + \lambda(2\hat{i} + 3\hat{j} + 4\hat{k})$, $\lambda \in \mathbb{R}$ and $L_2 : \vec{r} = (4\hat{i} + \hat{j}) + \mu(5\hat{i} + 2\hat{j} + \hat{k})$, $\mu \in \mathbb{R}$, intersect at the point R . Let P and Q be the points lying on lines L_1 and L_2 , respectively, such that $|\vec{PR}| = \sqrt{29}$ and

$|\vec{PQ}| = \sqrt{\frac{47}{3}}$. If the point P lies in the first octant, then $27(QR)^2$ is equal to

- (1) 348 (2) 340 (3) 320 (4) 360

Q15. JEE Main 2026 (24 January Shift 1)

Let a line L passing through the point $P(1, 1, 1)$ be perpendicular to the lines $\frac{x-4}{4} = \frac{y-1}{1} = \frac{z-1}{1}$ and

$\frac{x-17}{1} = \frac{y-71}{1} = \frac{z}{0}$. Let the line L intersect the yz -plane at the point Q . Another line parallel to L and passing

through the point $S(1, 0, -1)$ intersects the yz -plane at the point R . Then the square of the area of the parallelogram

$PQRS$ is equal to _____.

ANSWERS AND SOLUTIONS

1. (1) 2. (4) 3. (2) 4. (2) 5. (3) 6. 170 7. (4) 8. (2)

9. (1) 10. (1) 11. 3 12. (3) 13. (2) 14. (4) 15. 6

1. (1) Line L through $(-3, 5, 2)$ making equal angles with axes has direction $(1, 1, 1)$.

Point $Q = (-2, r, 1)$, $\vec{PQ} = (1, r - 5, -1)$.

$$\vec{PQ} \times \vec{d} = (r - 4, -2, 6 - r).$$

$$|\vec{PQ} \times \vec{d}|^2 = (r - 4)^2 + 4 + (6 - r)^2 = 2r^2 - 20r + 56.$$

$$\text{Distance} = \sqrt{\frac{2r^2 - 20r + 56}{3}} = \sqrt{\frac{14}{3}}.$$

$$2r^2 - 20r + 56 = 14 \Rightarrow r^2 - 10r + 21 = 0 \Rightarrow r = 3 \text{ or } r = 7.$$

$$\text{Sum} = 3 + 7 = 10.$$

2. (4) $L_1 : \frac{x-2}{-3} = \frac{y-6}{2} = \frac{z-7}{4}$

Point C on $L_1 : (-3\lambda_1 + 2, 2\lambda_1 + 6, 4\lambda_1 + 7)$

$$L_2 : \frac{x-4}{2} = \frac{y-3}{1} = \frac{z-5}{3}$$

Point D on $L_2 : (2\lambda_2 + 4, \lambda_2 + 3, 3\lambda_2 + 5)$

Dir's of line $L_3 :$

$$L_3 : \frac{2\lambda_2 + 3\lambda_1 + 2}{-3} = \frac{\lambda_2 - 2\lambda_1 - 3}{5} = \frac{3\lambda_2 - 4\lambda_1 - 2}{16}$$

$$\lambda_1 = -3, \lambda_2 = 2$$

$$C(11, 0, -5)$$

$$D(8, 5, 11)$$

$$|\vec{CD}|^2 = 3^2 + 5^2 + 16^2 = 290$$

3. (2) From $n = 4l + m$, substitute in $2mn + 10nl + 3lm = 0$:

$$40l^2 + 21lm + 2m^2 = 0. \text{ Let } t = l/m: 40t^2 + 21t + 2 = 0.$$

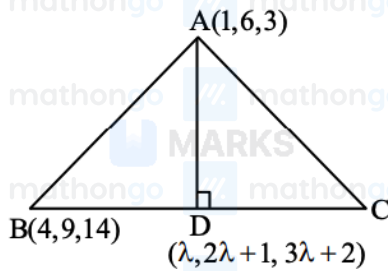
$$t = \frac{-21 \pm 11}{80}, \text{ giving } t = -1/8 \text{ or } t = -2/5.$$

$$l/m = -1/8: \text{ direction } (l, m, n) = (-1, 8, 4).$$

$$l/m = -2/5: \text{ direction } (l, m, n) = (-2, 5, -3).$$

$$\cos \theta = \frac{|2+40-12|}{\sqrt{81}\sqrt{38}} = \frac{30}{9\sqrt{38}} = \frac{10}{3\sqrt{38}}.$$

4. (2) $\frac{4}{1} = \frac{9-1}{2} = \frac{\alpha-2}{3} \Rightarrow \alpha = 14$



$$\vec{AD} \cdot (\hat{i} + 2\hat{j} + 3\hat{k}) = 0$$

$$(\lambda - 1)\hat{i} + (2\lambda - 5)\hat{j} + (3\lambda - 1)\hat{k} = \vec{AD}$$

$$\Rightarrow \lambda - 1 + 4\lambda - 10 + 9\lambda - 3 = 0$$

$$\Rightarrow 14\lambda = 14 \Rightarrow \lambda = 1$$

$$D = (1, 3, 5)$$

$$AD = \sqrt{3^2 + 2^2} = \sqrt{13}$$

$$Ar(\triangle ABC) = \frac{1}{2} \times \sqrt{13} \times 10 = 5\sqrt{13}$$

5. (3) Line 1 passes through (1, 0, 1) with direction (1, 2, 1). Point on line: $(1 + t, 2t, 1 + t)$.

For projection Q of P(3, 2, 1): $(t - 2, 2t - 2, t) \cdot (1, 2, 1) = 0$ gives $6t = 6$, so $t = 1$.

Thus Q = (2, 2, 2).

Distance from Q to line 2 (passing through (9, 9, 5) with direction (3, 2, -2)):

$$\vec{QR} = (7, 7, 3).$$

$$\vec{QR} \times \vec{d} = -20\vec{i} + 23\vec{j} - 7\vec{k}.$$

$$|\vec{QR} \times \vec{d}| = \sqrt{400 + 529 + 49} = \sqrt{978}.$$

$$|\vec{d}| = \sqrt{17}.$$

$$\text{Distance} = \frac{\sqrt{978}}{\sqrt{17}} = \sqrt{57.53} \approx 7.59 \approx 7.$$

6. (170) Point P(43, α , β) has distance $13\sqrt{10}$ from line $\vec{r} = 4\vec{i} - \vec{k} + \mu(2\vec{i} + 3\vec{k})$.

The line passes through A(4, 0, -1) with direction $\vec{d} = (2, 0, 3)$.

$$\text{Using distance formula: } d = \frac{|\vec{AP} \times \vec{d}|}{|\vec{d}|}.$$

With $\vec{AP} = (39, \alpha, \beta + 1)$, the cross product gives $\vec{AP} \times \vec{d} = (3\alpha, 2\beta - 115, -2\alpha)$.

Thus $|\vec{AP} \times \vec{d}| = \sqrt{13\alpha^2 + (2\beta - 115)^2}$ and $|\vec{d}| = \sqrt{13}$.

$$\text{Setting } \frac{\sqrt{13\alpha^2 + (2\beta - 115)^2}}{\sqrt{13}} = 13\sqrt{10} \text{ gives } \alpha^2 + \frac{(2\beta - 115)^2}{13} = 1690.$$

Solving with the constraint $\beta < 0$: $\alpha = 5$, $\beta = -13$, hence $\alpha^2 + \beta^2 = 25 + 169 = 170$.

7. (4) The given lines are $L_1 : \frac{x+1}{\alpha} = \frac{y-2}{-1} = \frac{z-4}{-\alpha}$ and $L_2 : \frac{x}{\alpha} = \frac{y-1}{2} = \frac{z-1}{2\alpha}$.

For L_1 , point $\vec{a}_1 = (-1, 2, 4)$ and direction $\vec{b}_1 = (\alpha, -1, -\alpha)$.

For L_2 , point $\vec{a}_2 = (0, 1, 1)$ and direction $\vec{b}_2 = (\alpha, 2, 2\alpha)$.

The shortest distance d is given by $d = \frac{|(\vec{a}_2 - \vec{a}_1) \cdot (\vec{b}_1 \times \vec{b}_2)|}{|\vec{b}_1 \times \vec{b}_2|}$.

$$\vec{a}_2 - \vec{a}_1 = (1, -1, -3).$$

$$\vec{b}_1 \times \vec{b}_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \alpha & -1 & -\alpha \\ \alpha & 2 & 2\alpha \end{vmatrix} = \hat{i}(-2\alpha + 2\alpha) - \hat{j}(2\alpha^2 + \alpha^2) + \hat{k}(2\alpha + \alpha) = (0, -3\alpha^2, 3\alpha).$$

$$|\vec{b}_1 \times \vec{b}_2| = \sqrt{0 + 9\alpha^4 + 9\alpha^2} = 3|\alpha|\sqrt{\alpha^2 + 1}.$$

$$(\vec{a}_2 - \vec{a}_1) \cdot (\vec{b}_1 \times \vec{b}_2) = (1)(0) + (-1)(-3\alpha^2) + (-3)(3\alpha) = 3\alpha^2 - 9\alpha.$$

$$\text{Given } d = \sqrt{2}, \text{ so } \frac{|3\alpha^2 - 9\alpha|}{3|\alpha|\sqrt{\alpha^2 + 1}} = \sqrt{2} \Rightarrow \frac{|\alpha - 3|}{\sqrt{\alpha^2 + 1}} = \sqrt{2}.$$

$$\text{Squaring both sides: } (\alpha - 3)^2 = 2(\alpha^2 + 1) \Rightarrow \alpha^2 - 6\alpha + 9 = 2\alpha^2 + 2.$$

$$\alpha^2 + 6\alpha - 7 = 0.$$

The values of α are the roots of this quadratic equation.

$$\text{Sum of values of } \alpha = -\frac{6}{1} = -6.$$

8. (2) M is the point of intersection of L_1 & L_2

$$\Rightarrow 2\lambda - 1 = 2\mu - 1, 3\lambda - 1 = 3\mu - 1, 6\lambda - 3 = 9$$

$$\Rightarrow \lambda = 2 = \mu$$

$$\Rightarrow M(3, 5, 9)$$

Now let point P be $(2K - 1, 3K - 1, 6K - 3)$ on L_2 such that $PM = 7$

$$\Rightarrow \sqrt{(2K - 4)^2 + (3K - 6)^2 + (6K - 12)^2} = 7$$

$$\Rightarrow 49K^2 + 196 - 196K = 49$$

$$\Rightarrow K^2 + 4 - 4K = 1$$

$$\Rightarrow K^2 - 4K + 3 = 0$$

$$\Rightarrow K = 1, 3$$

So points P & Q are $(1, 2, 3)$ & $(5, 8, 15)$

So sum of all co-ordinates of P & Q = 34

9. (1) Line: point $(6, 7, 7)$, direction $(3, 2, -2)$.

General point on line: $(6 + 3t, 7 + 2t, 7 - 2t)$.

Foot of perpendicular from $P(1, 2, a)$: $\vec{PM} \cdot (3, 2, -2) = 0$.

$$3(5 + 3t) + 2(5 + 2t) - 2(7 - 2t - a) = 0$$

$$\Rightarrow 17t + 11 + 2a = 0.$$

$$\text{Image } Q = 2M - P = (11 + 6t, 12 + 4t, 14 - 4t - a).$$

$$\text{Given } Q_x = 5: 11 + 6t = 5 \Rightarrow t = -1.$$

$$\text{From } 17(-1) + 11 + 2a = 0 \Rightarrow a = 3.$$

$$b = 12 + 4(-1) = 8, c = 14 - 4(-1) - 3 = 15.$$

$$a^2 + b^2 + c^2 = 9 + 64 + 225 = 298.$$

10. (1) Let $P(2\lambda + 1, -3\lambda - 1, \lambda)$

$$\text{Then } 4\lambda^2 + 9\lambda^2 + \lambda^2 = 16 \cdot 14 \Rightarrow \lambda = \pm 4 \Rightarrow -4$$

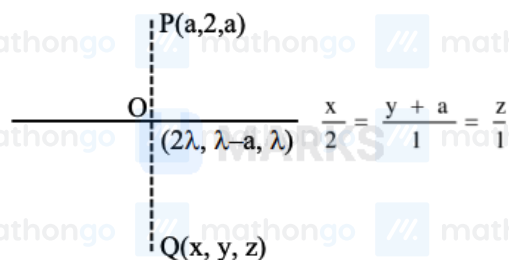
(nearer to origin)

$$\therefore P(-7, 11, -4)$$

$$\therefore \text{Shortest distance} = \frac{\begin{vmatrix} 2 & -1 & 7 \\ 1 & 2 & 3 \\ 2 & 1 & 1 \end{vmatrix}}{\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & 3 \\ 2 & 1 & 1 \end{vmatrix}}$$

$$= \frac{28}{\sqrt{1+25+9}} = \frac{4\sqrt{7}}{\sqrt{5}}$$

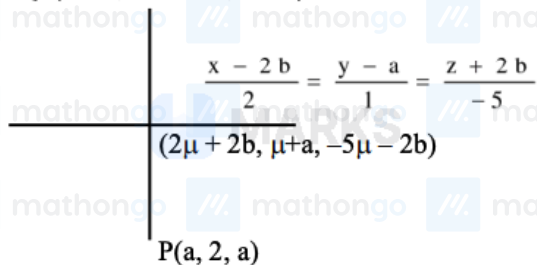
11.



(3)

Now,

$$Q. (4\lambda - a, 2\lambda - 2a - 2, 2\lambda - a)$$



$$\frac{2\lambda - a + a}{2} = -5\mu - 2b$$

$$\text{and } \frac{a + 4\lambda - a}{2} = 2\mu + 2b$$

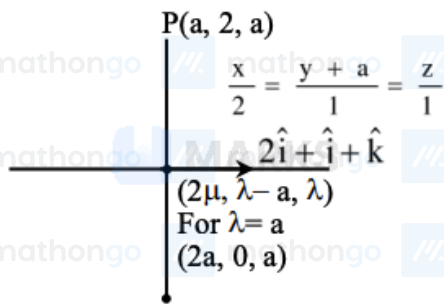
$$\text{and } \frac{2\lambda - 2a - 2 + 2}{2} = \mu + a$$

$$\Rightarrow \lambda - \mu = b$$

$$\lambda - \mu = 2a$$

$$\lambda + 5\mu = -2b$$

$$\Rightarrow b = 2a \text{ and } \lambda = a, \mu = -a$$



$$(a\hat{i} - 2\hat{j} + 0\hat{k}) \cdot (2\hat{i} + \hat{j} + \hat{k}) = 0$$

$$2a - 2 = 0$$

$$a = 1$$

$$b = 2a = 2 \times 1 = 2$$

$$a + b = 1 + 2 = 3$$

12. (3) Line: $\vec{r} = (-1, 3, 1) + \lambda(2, 3, -1)$, Point $P = (5, 4, 2)$.

Any point on line: $Q = (-1 + 2\lambda, 3 + 3\lambda, 1 - \lambda)$.

$$\vec{PQ} = (-6 + 2\lambda, -1 + 3\lambda, -1 - \lambda).$$

For perpendicular: $\vec{PQ} \cdot (2, 3, -1) = 0$ gives $14\lambda - 14 = 0$, so $\lambda = 1$.

Foot $(\alpha, \beta, \gamma) = (1, 6, 0)$.

$$\text{Projection of } (1, 6, 0) \text{ on } (6, 2, 3): \frac{|6+12+0|}{\sqrt{49}} = \frac{18}{7}.$$

13. (2) Line $L: \frac{x-1}{1} = \frac{y}{2} = \frac{z-1}{1}$

$$L_1: \frac{x-1}{3} = \frac{y-2}{4} = \frac{z-a}{b} = \lambda$$

$$L_2: \frac{x-1}{1} = \frac{y-2}{4} = \frac{z-a}{c} = \mu$$

Point $A(3\lambda + 1, 4\lambda + 2, b\lambda + a)$ lies on L :

$$\frac{3\lambda}{1} = \frac{4\lambda+2}{2} = \frac{b\lambda+a-1}{1}$$

$$\lambda = 1, a + b - 1 = 3 \Rightarrow a + b = 4 \dots (1), A = (4, 6, 4)$$

Point $B(\mu + 1, 4\mu + 2, c\mu + a)$ lies on L :

$$2\mu = 4\mu + 2 \Rightarrow \mu = -1, a - c - 1 = -1 \Rightarrow a = c \dots (2), B = (0, -2, 0)$$

Since $PA = PB$ where $P = (1, 2, a)$:

$$9 + 16 + (a - 4)^2 = 1 + 16 + a^2$$

$$\Rightarrow a = 3, \text{ so } c = 3, b = 1$$

$$a + b + c = 7$$

14. (4) Find R by solving $L_1 = L_2$:

From $1 + 2\lambda = 4 + 5\mu$, $2 + 3\lambda = 1 + 2\mu$, $3 + 4\lambda = \mu$ we get $\lambda = -1$, $\mu = -1$, so $R = (-1, -1, -1)$

Point P on L_1 : $P = (1 + 2\lambda_P, 2 + 3\lambda_P, 3 + 4\lambda_P)$ with $|\overrightarrow{PR}|^2 = 29$

$$4(1 + \lambda_P)^2 + 9(1 + \lambda_P)^2 + 16(1 + \lambda_P)^2 = 29 \rightarrow 29(1 + \lambda_P)^2 = 29 \rightarrow \lambda_P = 0 \text{ (first octant)}$$

Thus $P = (1, 2, 3)$

Point Q on L_2 : $Q = (4 + 5\mu_Q, 1 + 2\mu_Q, \mu_Q)$ with $|\overrightarrow{PQ}|^2 = \frac{47}{3}$

$$(3 + 5\mu_Q)^2 + (-1 + 2\mu_Q)^2 + (\mu_Q - 3)^2 = \frac{47}{3}$$

$$30\mu_Q^2 + 20\mu_Q + 19 = \frac{47}{3} \rightarrow 9\mu_Q^2 + 6\mu_Q + 1 = 0 \rightarrow \mu_Q = -\frac{1}{3}$$

So $Q = (\frac{7}{3}, \frac{1}{3}, -\frac{1}{3})$

$$|QR|^2 = \frac{100+16+4}{9} = \frac{120}{9} = \frac{40}{3}$$

$$27(QR)^2 = 360$$

15. (6) Line L passes through P(1,1,1) perpendicular to two lines with directions (4, 1, 1) and (1, 1, 0).

Direction of L: $(4, 1, 1) \times (1, 1, 0) = (-1, 1, 3)$

Line L: $(x, y, z) = (1, 1, 1) + t(-1, 1, 3)$

Q is intersection with yz-plane ($x=0$): Setting $1 - t = 0$ gives $t = 1$, so $Q = (0, 2, 4)$

Line through S(1,0,-1) parallel to L: $(x, y, z) = (1, 0, -1) + s(-1, 1, 3)$

R is intersection with yz-plane: Setting $1 - s = 0$ gives $s = 1$, so $R = (0, 1, 2)$

For parallelogram PQRS: $\overrightarrow{PQ} = (-1, 1, 3)$ and $\overrightarrow{PS} = (0, -1, -2)$

$$\text{Area} = |\overrightarrow{PQ} \times \overrightarrow{PS}| = |(1, -2, 1)| = \sqrt{1+4+1} = \sqrt{6}$$

Square of area = 6