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Class: 11
Subject: Math's
Topic: Straight Lines
No. of Questions: 25

1. The point (2, 3) undergoes the following three transformation successively.

(i) reflection about the line y = x
(ii) translation through a distance 2 units along the positive direction of y-axis
(iii) rotation through an angle of 45° about the origin in the anticlockwise direction

The final co-ordinates of the point are

A. $\left(\frac{1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$
B. $\left(-\frac{1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$
C. $\left(\frac{1}{\sqrt{2}}, -\frac{7}{\sqrt{2}}\right)$
D. None of these

Sol. B

After the first transformation, we get
(2, 3) $\Rightarrow$ (3, 2) reflection about the line y = x.
After second transformation, we get
(3, 2) $\Rightarrow$ (3, 2 + 2) $\Rightarrow$ (3, 4)
After the last transformation, we get

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} 3 \\ 4 \end{bmatrix} = \begin{bmatrix} \frac{-1}{\sqrt{2}} \\ \frac{7}{\sqrt{2}} \end{bmatrix}$$

2. The lines px + qy + r = 0, qx + ry + p = 0, rx + py + q = 0 are concurrent if

A. p + q + r = 0
B. $p^2 + q^2 + r^2 + pq + qr + rp = 0$
C. $p^2 + q^2 + r^2 + 3pqr = 0$
D. all of the above

Sol. A
The given three lines will be concurrent if

$$\begin{bmatrix} p & q & r \\ q & r & p \\ r & p & q \end{bmatrix} = 0$$

, which gives, p + q + r = 0

3. The straight lines x + y = 0, 3x + y − 4 = 0 and x + 3y − 4 = 0 form which of the following triangles?

A. Isoscles
B. Equilateral
C. Right-angled
D. None of these

Sol. A
First two lines intersect at (2, - 2)….(A)
The second line and the third line intersect at (1, 1)… (B)
The first line and the last line intersect at (- 2, 2)…(C)
Distance of A and C from B is equal, whereas AC is not equal to them. Hence, it is an isosceles triangle.

4. The vertices of Δ are (0, 0), (3, 0) and (0, 4). Its orthocentre is at

A. (0, 0)
B. (1, 4/3)
C. (3/2, 2)
D. None of these

Sol. A
Given vertices are of a right angled triangle, and the orthocenter of a right angled triangle lies on the intersection of perpendiculars. i.e. (0, 0)

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5. One of the equations of lines passing through the point (3, − 2) and inclined at 60º to the line $\sqrt{3}$ x + y = 1 is

A. y + 2 = 0
B. x + 2 = 0
C. x + y = 2
D. x − y = $\sqrt{3}$

Sol. A

6. A straight line through the point (2, 2) intersects the lines $\sqrt{3x}$ + y = 0 and $\sqrt{3}$ x − y = 0 at the points A and B. The equation to the line AB so that the triangle OAB is equilateral, is

A. x − 2 = 0
B. y − 2 = 0
C. x + y − 4 = 0
D. none of these

Sol. B

Equation of the line passing from (2, 2), and slope m (say), is

(y - 2) = m (x - 2); m = $\frac{y-2}{x-2}$

The angle between the line and given lines should be 60^0, as they are required to form an equilateral triangle.

7. The incentre of a triangle with vertices (1, $\sqrt{3}$), (0, 0) and (2, 0) is

A. $\left(1, \frac{\sqrt{3}}{2}\right)$
B. $\left(\frac{2}{3}, \frac{1}{\sqrt{3}}\right)$
C. $\left(\frac{2}{3}, \frac{\sqrt{3}}{2}\right)$
D. None of these

Sol. D

Sides of the triangle are 2, 2 and 2

Incentre: $\left(\frac{ax_1 + bx_2 + cx_3}{a+b+c}, \frac{ay_1 + by_2 + cy_3}{a+b+c}\right) = (1, \frac{1}{\sqrt{3}})$

8. If the sum of the slopes of the lines given by $x^2 - 2cxy - 7y^2 = 0$ is four times their product then c has the value

A. 2
B. -1
C. 1
D. -2

Sol. A
$x^2 + 2hxy + by^2 = 0$
$m_1 + m_2 = -2h/b$ and
$m_1 m_2 = a/b$
where, m_1 m_2 are slopes of lines
$m_1 + m_2 = 4 m_1 m_2$
$-2c/7 = -4/7$

9. A line passes through point (4, 1) and is perpendicular to line 3x + y = 3, then its x − intercept is

A. $\frac{1}{3}$
B. $\frac{2}{3}$
C. 1
D. $\frac{4}{3}$

Sol. C
Slope of the line perpendicular to the given line 3x + y = 3 will be 1/3, and it passes through (4, 1), its equation will be
$(y - 1) = 1/3\,(x - 4)$
Or $x - 3y = 1$
To find out the x intercept, put y = 0, we get
x = 1

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10. The value of λ for which the equation x2 − λxy + $2y^2$ + 3x − 5y + 2 = 0 may represent a pair of straight lines is

A. 2
B. 3
C. 4
D. 1

Sol. B
Comparing the equation with the standard second degree equation, i.e. $ax^2 + bx^2 + 2fx + 2gy + 2hxy + c = 0$, we get
a = 1, b = 1, c = 2, h = - λ/2, g = - 5/2, f = 3/2
For straight lines:
$\Delta = 0$
$\Delta =$
$$\begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix} = 0$$
$$\begin{vmatrix} 1 & -\frac{\lambda}{2} & \frac{-5}{2} \\ -\frac{\lambda}{2} & 1 & \frac{3}{2} \\ \frac{-5}{2} & \frac{3}{2} & 2 \end{vmatrix} = 0$$
So, we get
$\lambda = 3$

11. The equation of base of an equilateral triangle is x + y = 2 and the vertex opposite to this base is (2, −1). Then the length of the side of triangle equals

A. $\sqrt{\frac{1}{3}}$
B. $\sqrt{3}$
C. $\sqrt{\frac{2}{3}}$
D. $\sqrt{\frac{3}{2}}$

Sol. C

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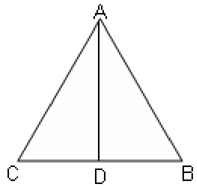
Let the length of side be 'a'.

Distance of the opposite vertex from the given line is AD = $\frac{1}{\sqrt{2}}$



In triangle ADB, $AB^2 = AD^2 + BD^2$

$a^2 = 1/2 + a^2/4$ (D is mid point on BC)

a = $\sqrt{\frac{2}{3}}$

12. If the distance between lines 5x + 12 y − 1 = 0 and 10x + 24y + k = 0 is 2, what is the value of k?

A. 54 only
B. 50 only
C. 54, 50
D. 53 only

Sol. C

On multiplying by 2 on both sides of the first equation, we get

10x + 24y – 2 = 0

Distance between the two lines:

$\frac{|c-d|}{\sqrt{a^2+b^2}} = 2$

$\frac{|-2+k|}{\sqrt{100+576}} = 2$

|k - 2| = 2 $\sqrt{676}$

Squaring both sides, we get:

k = - 54, 50

13. Foot of perpendicular drawn from (0, 5) in the line 3x − 4y − 5 = 0 is

A. (3, 2)
B. (3, 1)
C. (1, 3)
D. (2, 3)

Sol. B

Distance of the point (0, 5) from the line is 5 units.
We can check from the options which point is 5 units away from the given point.
And only option 2, i.e. (3, 1) satisfies the given condition.

14. Let P (− 1, 0), Q (0, 0) and R (3, $3\sqrt{3}$) be three points. Then the equation of the bisector of the angle PQR is

A. $\frac{\sqrt{3}}{2}x + y = 0$
B. $x + \sqrt{3}y = 0$
C. $\sqrt{3}x + y = 0$
D. $x + \frac{\sqrt{3}}{2}y = 0$

Sol. C
Line passing through PQ is y = 0
Line passing through QR is $y - \sqrt{3}x = 0$
Applying the formula of angle bisector between two lines, i.e.

$$\frac{a_1x + b_1y + c_1}{\sqrt{a_1^2 + b_1^2}} = \frac{a_2x + b_2y + c_2}{\sqrt{a_2^2 + b_2^2}}$$

We get
$\sqrt{3}x + y = 0$

15. If the lines x + 2ay + a = 0, x + 3by + b = 0 and x + 4cy + c = 0 are concurrent, then a, b, c are in

A. A.P
B. H.P
C. G.P
D. None of these

Sol. B
Given three lines are concurrent if

$$\begin{bmatrix} 1 & 2a & a \\ 1 & 3b & b \\ 1 & 4c & c \end{bmatrix} = 0$$

. On solving it gives

$b = \frac{2ac}{a + c}$, i.e a, b, c is in HP.

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16. The equation of line parallel to x-axis and bisecting the join of (1, 4) and (− 2, 6) is

A. y = 5
B. y = 3
C. y + 1 = 0
D. x = 5

Sol. A
The mid point of the line segment joining the given point is
(1 - 2/2, 4 + 6/2), i.e.
(- 1/2, 5). The line is bisecting the join of the points; it will pass through their mid point. Checking from options, we can say that option 1, i.e. y = 5, is the line.

17. The line formed by joining (− 1, 1) and (5, 7) is divided by a line x + y = 4 in the ratio

A. 1 : 2
B. 1 : 3
C. 3 : 4
D. 1 : 4

Sol. A
You maight have got confused between the point of intersection and the ratio (1, 3) is the point of intersection and 1 : 2 is the ratio

18. If the points (1, 2) and (3, 4) were to be on the same side of line 3x − 5y + a = 0, then

A. 7 < a < 11
B. a = 7
C. a = 11
D. a < 7 or a > 11

Sol. D

19. The extremities of diagonal of a parallelogram are the points (3, − 4) and (− 6, 5). If the third vertex is (− 2, 1), then the fourth vertex will be

A. (0, 1)
B. (1, 0)
C. (1, 1)
D. (− 1, 0)

Sol. D

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Let the fourth vertex be D (x, y) Given A(3, - 4), C(- 6, 5), B(- 2, 1)
Since diagonals of a parallelogram bisect each other, hence midpoints of AC and BD are the same.
(- 3/2, 1/2) = (- 2 + x /2, 1 + y /2)
- 3 = - 2 + x , 1 = 1+ y
x = - 1, y = 0

20. Orthocentre of the triangle formed by the lines x + y = 1 and xy = 0 is

A. (0, 0)
B. (0, 1)
C. (1, 0)
D. (− 1, 1)

Sol. A
The given equation xy = 0 represents a pair of perpendicular lines intersecting at (0, 0). So the triangle formed is a right angled triangle. Whose orthocenter is at intersection of perpendiculars (0, 0)

21. If three points (h, 0) (a, b) and (0, k) lie on a line, show that $\frac{a}{h}+\frac{b}{k}=1$

Sol:

Let $A(h,0)\,B(a,b)$ and $C(0,k)$

Slope of AB = slope of BC

$$\frac{b-0}{a-h}=\frac{k-b}{0-a}$$
$$\frac{b}{a-h}=\frac{h-b}{-a}$$

$$(a-h)(k-b)=-ab$$

$$ak - ab - hk + hb = -ab$$

$$ak + hb = hk$$

$$\frac{ak}{hk} + \frac{hb}{hk} = 1$$

$$\frac{a}{h} + \frac{b}{k} = 1$$

22. p (a, b) is the mid point of a line segment between axes. Show that equation of the line is $\frac{x}{a} + \frac{y}{b} = 2$

Sol:

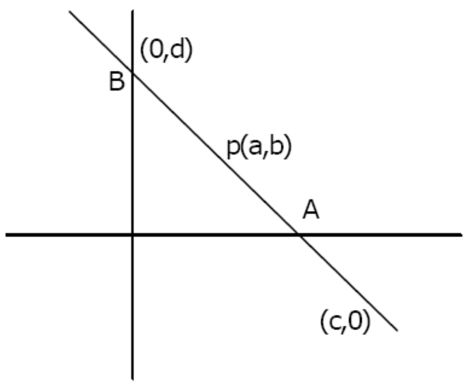
Req. eq. be

$$\frac{x}{c} + \frac{y}{d} = 1 \ldots\ldots (i)$$

P is the mid point

Coordinate of $p = \left(\frac{c}{2}, \frac{d}{2}\right)$

$$(a, b) = \left(\frac{c}{2}, \frac{d}{2}\right)$$



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$$\frac{a}{1} = \frac{c}{2}$$
$$c = 2a$$

$$\frac{b}{1} = \frac{d}{2}$$
$$d = 2b$$

Put the value of C and D in eq. (i)

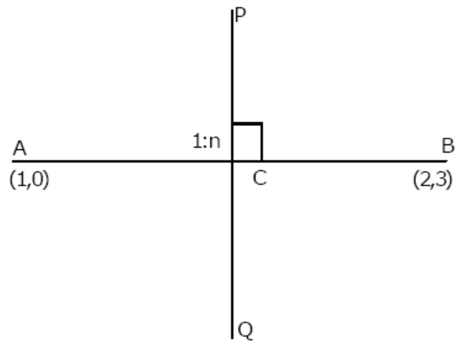
$$\frac{x}{2a} + \frac{y}{2b} = 1$$

$$\frac{x}{a} + \frac{y}{b} = 2$$

23. The line ⊥ to the line segment joining the points (1,0) and (2,3) divides it in the ratio 1 : n find the equation of line.

Sol:

Coordinate of $c\left(\frac{2+n}{1+n}, \frac{3}{1+n}\right)$



$$m_{AB} = 3$$
$$m_{PQ} = -\frac{1}{3}$$

Eq. of PQ is

$$\frac{y}{1} - \frac{3}{1+n} = -\frac{1}{3}\left(\frac{x}{1} - \frac{2+n}{1+n}\right)$$

$$(n+1)x + 3(n+1)y - (n+11) = 0$$

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24. A line is such that its segment between that lines 5x-y+4=0 and 3x+4y-4= 0 is bisected at the point (1,5) obtain its equation.

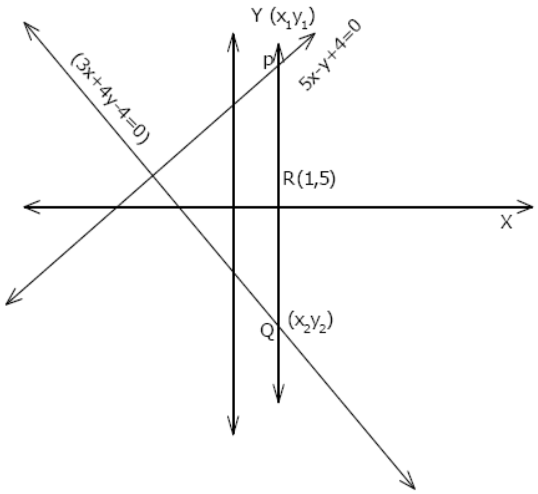
Sol:

$p(x_1 y_1)$ lies on $5x-y+4=0$

$\Rightarrow 5x_1 - y_1 + 4 = 0$

And $Q(x_2 y_2)$ lies on $3x+4y-4=0$

$3x_2 + 4y_2 - 4 = 0$



On solving

$y_1 = 5x_1 + 4$

$y_2 = \frac{4-3x_2}{4}$

Since R is the mid point of PQ

Since R is the mid point of PQ

$\frac{x_1+x_2}{2} = 1, \qquad \frac{y_1+y_2}{2} = 5$

$x_1 + x_2 = 2, \qquad y_1 + y_2 = 10$

On solving

$x_1 = \frac{26}{23}, \qquad x_2 = \frac{20}{23}$

And $y_1 = \frac{222}{23}, \qquad y_2 = \frac{8}{23}$

Eq. of PQ

$$y - \frac{222}{23} = \frac{\frac{8}{23} - \frac{222}{23}}{\frac{20}{23} - \frac{26}{23}}\left(x - \frac{26}{23}\right)$$

$107x - 3y - 92 = 0$

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25. Find the equation of the lines which pass through the point (4,5) and make equal angles with the lines 5x-12y+6 =0 and 3x-4y-7=0

Sol:

The slopes of the given lines are $\frac{5}{12}$ and $\frac{3}{4}$

Let m be the slope of a required line

ATQ $\left|\frac{m-\frac{5}{12}}{1+m.\frac{5}{12}}\right| = \left|\frac{m-\frac{3}{4}}{1+m.\frac{3}{4}}\right|$

$$\Rightarrow \left|\frac{12m-5}{12+5m}\right| = \left|\frac{4m-3}{4+3m}\right|$$

$$\frac{12m-5}{12+5m} = \frac{4m-3}{4+3m}$$

$$16m^2 = -16$$

$$m^2 = -1$$

Neglect

$$\frac{12m-5}{12+5m} = -\frac{4m-3}{4+3m}$$

$$m = \frac{4}{7}, \frac{-7}{4}$$

Req. eq. are

$$y-5 = \frac{4}{7}(x-4)$$

$$4x-7y+19=0$$

$$y-5 = \frac{-7}{4}(x-4)$$

$$7x+4y-48=0$$