10. LOCUS AND VARIOUS FORMS OF LINES

Class: IX, MATHEMATICS FOUNDATION + SOLUTIONS

2025|26

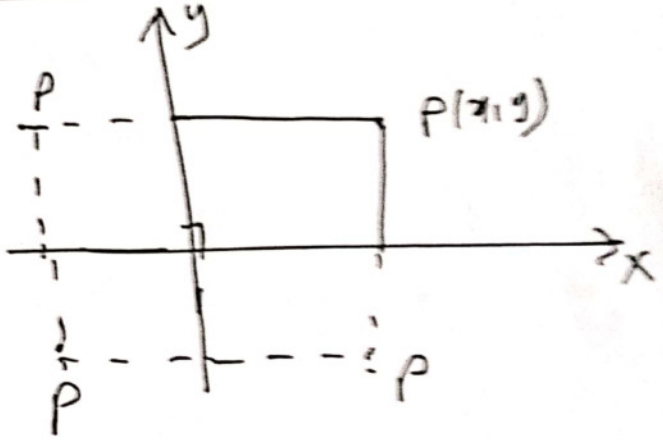
TEACHING TASK
JEE MAINS LEVEL

01. $|x|^2 + |y|^2 = 25$

$\pm x \pm y = 25$

$x + y = 25$

$x^2 + y^2 = 25$



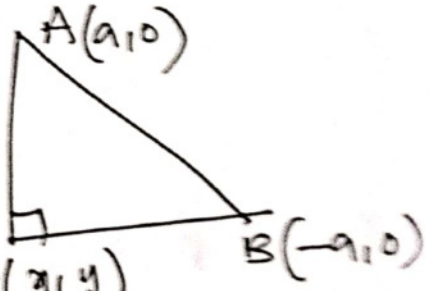
Ans - A

02 Let $P(x,y)$ be a point in the locus

$PA^2 + PB^2 = AB^2$

$(x-a)^2 + y^2 + (x+a)^2 + y^2 = (a+a)^2 + (0-0)^2$

$\Rightarrow x^2 + y^2 = a^2$



Ans: B

03 Let $P(x,y)$ $A(0,4)$, $B(0,-4)$

$|PA - PB| = 6 \Rightarrow PA - PB = \pm 6$

$\Rightarrow PA = \pm 6 + PB$

S.O.B.S

$\Rightarrow PA^2 = 36 + PB^2 \pm 12\,PB$

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$\Rightarrow (x-0)^2+(y-4)^2 = 36+(x-0)^2+(y+4)^2 \pm 12PB$

$\Rightarrow x^2+y^2-8y+16 = 36+x^2+y^2+8y+16 \pm 12PB$

$\Rightarrow \pm 12PB = 36+16y$

$\Rightarrow \pm 3PB = 9+4y$

Again S.G.B.S

$\Rightarrow 9PB^2 = (9+4y)^2$

$\Rightarrow 9[(x-0)^2+(y+4)^2] = (9+4y)^2$

upon simplification

$\Rightarrow 9x^2-7y^2+63=0$

Ans. A

04

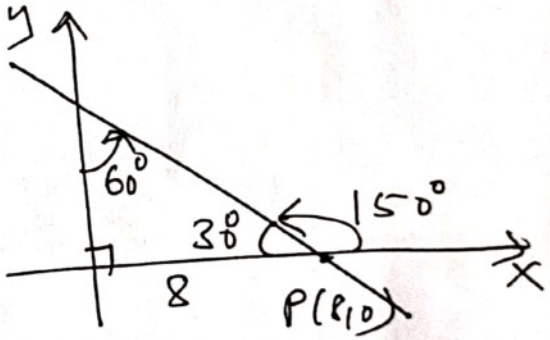
$\theta = 150^\circ$

Slope $= m = \tan 150^\circ$

$= \tan(180^\circ-30^\circ)$

$= -\tan 30^\circ$

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



$\therefore P(8,0),\ m = \frac{-1}{\sqrt{3}} \Rightarrow y-y_1 = m(x-x_1)$

Eqn of the line $x+\sqrt{3}y = 8$

Ans: B

05

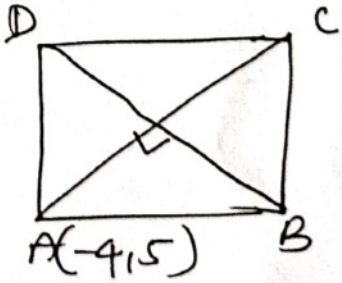
Eqn of BD $\Rightarrow 7x-y+k=0$

Eqn of AC $\Rightarrow x+7y+k=0$

$(-4,5) \Rightarrow -4+7(5)+k=0$

$\therefore k=-31$

Eqn of AC $\Rightarrow x+7y-31=0$.



Ans: ____

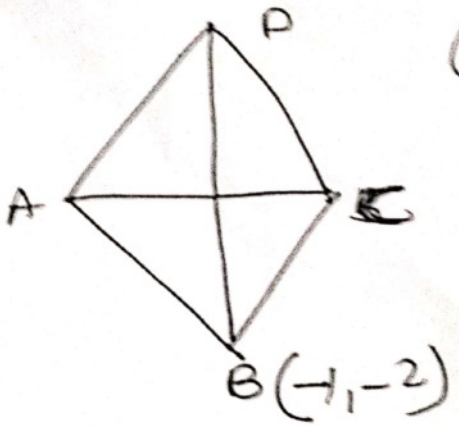
06 Eqn AC → $3x+4y-7=0$

Eqn BD → $4x-3y+k=0$

$(-1,-2) \Rightarrow 4(-1)-3(-2)+k=0$

$\Rightarrow k=-2$

∴ Eqn BD → $4x-3y-2=0$



Ans: C

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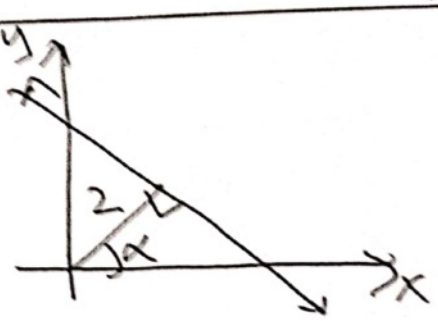
07 $p=2$

$\therefore x\cos\alpha+y\sin\alpha=2$



Ans: C

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08 Note: Here Angle is 135°

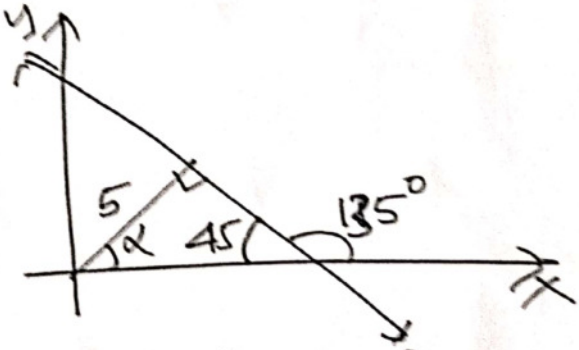
$\therefore \alpha=45^\circ$

$x\cos\alpha+y\sin\alpha=p$

$x\cos45^\circ+y\sin45^\circ=5$

$x+y=5\sqrt{2}$

$\Rightarrow \frac{x}{5\sqrt{2}}+\frac{y}{5\sqrt{2}}=1$

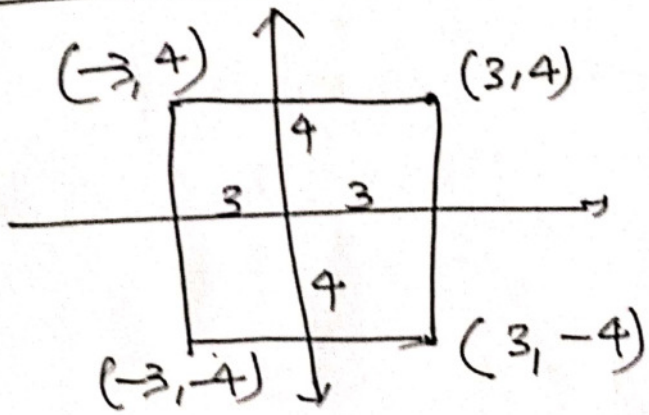


$\therefore \alpha=90-45^\circ$

$=45^\circ$

Ans: C

09



option: A

(A) (-3,4), (-3,-4), (3,-4)

Ans: A

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10 Option verification ~~method~~ technique (4)

$a+b=5, \quad ab=\frac{21}{4}$

Opt: C: $14x+6y=21$

$\Rightarrow \frac{x}{\left(\frac{3}{2}\right)}+\frac{y}{\left(\frac{7}{2}\right)}$

$a+b=\frac{3}{2}+\frac{7}{2}=5$

$ab=\frac{3}{2}\cdot\frac{7}{2}=\frac{21}{4}$

~~Ans:~~ C

JEE ~~ADVANCED~~ LEVEL

(11.) NOTE: The equation of the straight line whose intercepts on x-axis and y-axis are respectively twice and thrice of those by the line $3x+4y=12$ is $ax+by+c=0$, then

Given $3x+4y=12$

$\frac{x}{4}+\frac{y}{3}=1$

x-intercept $=4$; y-intercept $=b=3$

New → x-intercept $=2\times 4=8$

y-intercept $=3\times 3=9$

New eqn → $\frac{x}{8}+\frac{y}{9}=1$

$\Rightarrow 9x+8y-72=0$

$ax+by+c=0$

$a=9, \quad b=8, \quad c=-72$

Ans. A, B, C

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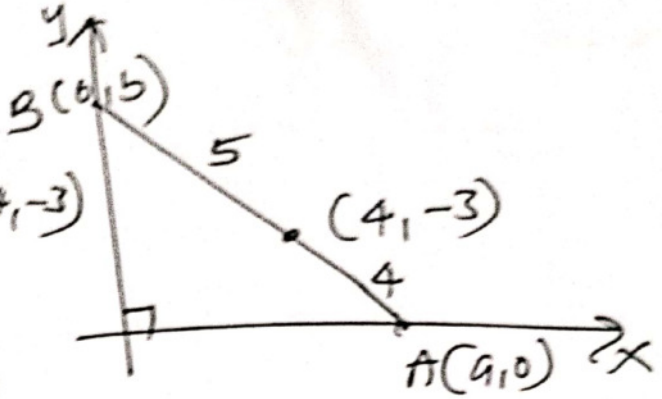
12. Section formula (5)



$\left(\frac{5a+0}{9}, \frac{0+4b}{9}\right) = (4,-3)$

$\Rightarrow a = \frac{36}{5}, \quad b = \frac{-27}{4}$

$\therefore \frac{x}{\left(\frac{36}{5}\right)} + \frac{y}{\left(\frac{-27}{4}\right)} = 1 \Rightarrow 15x - 16y - 108 = 0$

$ax + by + c = 0$

Ans: A, B, C, D

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13 Statement I: Eqn of the line ⊥r to $x - 7y + 5 = 0$ is $7x + y + k = 0$

x-intercept $= 3 \Rightarrow (3,0) \rightarrow 7x + y + k = 0$

$7(3) + 0 + k = 0$

$\Rightarrow k = -21$

$\therefore 7x + y - 21 = 0$ (True)

Statement II: Conceptual (True) Ans: A

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14 Statement: $4x + 3y = 12$

(-3, 8) $\rightarrow 4(-3) + 3(8) = -12 + 24 = 12$ ✓

$\frac{x}{3} + \frac{y}{4} = 1 \rightarrow$ Sum $= 3 + 4 = 7$ ✓

(True)

Statement: II: Conceptual (True)

Ans: A

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Q-nos 6 are not given for Assertion & Reason portion (6)

* **Assertion:** $2x-3y=7$ and $3x+2y=7$ are perpendicular lines (True)

Since $m_1 \times m_2 = \frac{2}{3} \times -\frac{3}{2} = -1$

Reason: Conceptual (True) Ans: A

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* **Assertion:** $(x_1, y_1) = (-1, 2)$, $m = 3$

$y-2 = 3(x+1)$ (True)

Reason: Conceptual (True) Ans: A

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15 $x+y+1=0$

$\Rightarrow x+y = -1$

$\Rightarrow -x-y = 1$

Dividing with $\sqrt{(-1)^2+(-1)^2} = \sqrt{2}$

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

$x\cos\alpha + y\sin\alpha = p$

$\therefore \cos\alpha = \frac{-1}{\sqrt{2}}, \sin\alpha = \frac{-1}{\sqrt{2}}$

$\therefore \alpha \in Q_3$

$\therefore \alpha = \pi + \frac{\pi}{4} = \frac{5\pi}{4}$

$\therefore$ Normal form $x\cos\frac{5\pi}{4} + y\sin\frac{5\pi}{4} = \frac{1}{\sqrt{2}}$ Ans: D

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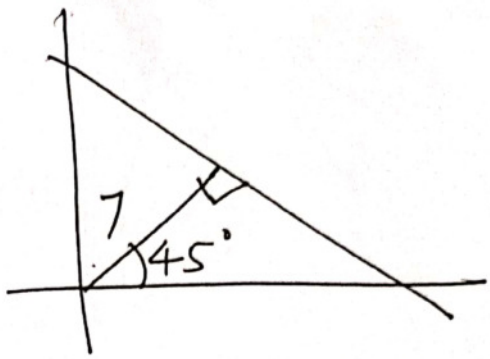
16 $p=7,\ \alpha=45^\circ$

$x\cos\alpha + y\sin\alpha = p$

$x\cos 45^\circ + y\sin 45^\circ = 7$

$x+y = 7\sqrt{2}$

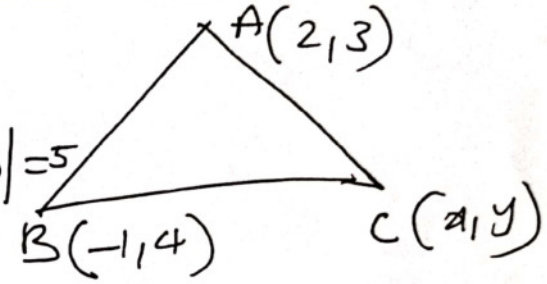


(7)

Ans: B

17 Ar $\triangle ABC = 5$

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



$\Rightarrow |-x-3y+11| = 10$

$\Rightarrow -x-3y+11 = \pm 10$

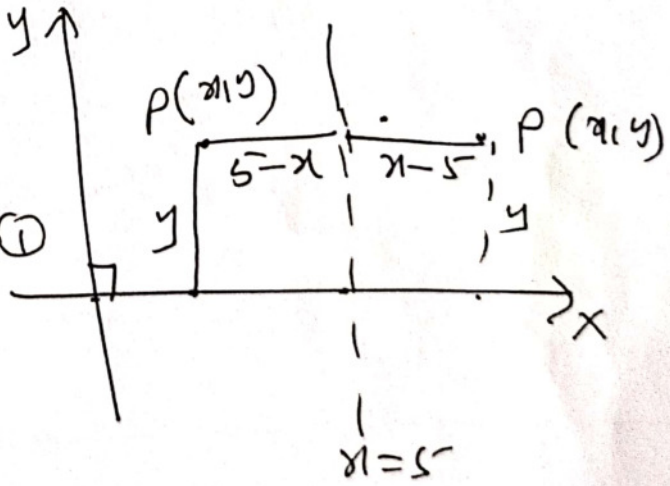
$\Rightarrow x+3y-1=0$ or $x+3y-21=0$

Ans: D

18 Given $y = 3(5-x)$

$\Rightarrow y = 15-3x$

$\Rightarrow 3x+y-15=0 \rightarrow (1)$



Given $y = 3(x-5)$

$y = 3x-15$

$\Rightarrow 3x-y-15=0 \rightarrow (2)$

Three one two possibilites

Ans: B

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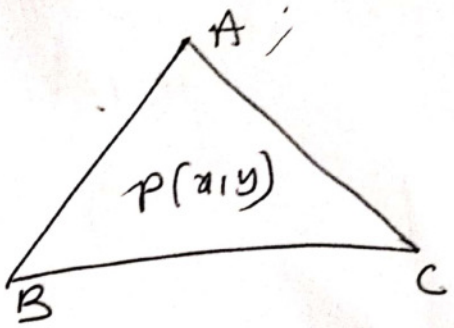
19 A(1,1), B(−1,−3)

Let C(a,b)

Let P(x,y) be the centroid



$\therefore \left(\frac{1-1+a}{3}, \frac{1-3+b}{3}\right) = (x,y)$

$a = 3x, \quad b = 3y+2$

$\therefore C(3x, 3y+2)$

Area $\triangle ABC = 6$

$\frac{1}{2}\left|1(-3-3y-2) - 1(3y+2-1) + 3x(1+3)\right| = 6$

$\Rightarrow |2x-y-1| = 2$

$\Rightarrow 2x-y-1 = \pm 2$

$2x-y-3=0$ or $2x-y+1=0$

∴ The locus of the point is

$(2x-y-3)(2x-y+1)=0$

$(2x-y+k_1)(2x-y+k_2)=0$

here $k_1 = -3, k_2 = 1 \Rightarrow k_1 + k_2 = -2$

Ans: −2

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20 P(x,y) A(0,−7)

Given $PA = 8$

$\Rightarrow PA^2 = 64$

$\Rightarrow (x-0)^2 + (y+7)^2 = 64$

$\Rightarrow x^2 + y^2 + 14y - 15 = 0$

$k = -15$

Ans: −15

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2) (i) Eqn of the line passing through $(2,-1)$ and $(5,-3)$
(x_1, y_1) (x_2, y_2)

$$y+1 = \frac{-3+1}{5-2}(x-2)$$

$$\Rightarrow 3y+3 = -2x+4$$

$$\Rightarrow 2x+3y-1=0$$

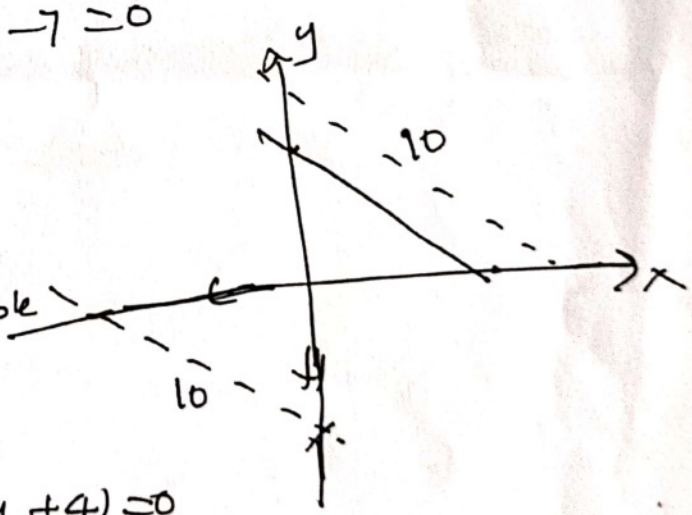
$(a,4) \Rightarrow 2a+3(4)-1=0 \Rightarrow a = \frac{-11}{2}$

$(-2,b) \Rightarrow 2(-2)+3b-1=0 \Rightarrow b = \frac{5}{3}$

b) $2x+6y+1=0 \Rightarrow 2\left(\frac{-11}{2}\right)+6\left(\frac{5}{3}\right)+1=0$

(ii) Given line $2x+6y-7=0$

$$\Rightarrow \frac{x}{\frac{7}{2}} + \frac{y}{\left(\frac{7}{6}\right)} = 1$$



There are two possible lines (p)

(iii) $(x-y+1)+k(y-2x+4)=0$

x-intercept $\Rightarrow y=0 \Rightarrow (x+1)+k(-2x+4)=0$

$$\Rightarrow x = \frac{4k+1}{2k-1}$$

y-intercept $\Rightarrow x=0 \Rightarrow (-y+1)+k(y+4)=0$

$$\Rightarrow y = \frac{4k+1}{1-k}$$

Given intercept are equal

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(10)

(i) $\frac{4k+1}{2k-1} = \frac{4k+1}{1-k}$

$4k+1=0$ or $\frac{1}{2k-1} - \frac{1}{1-k} = 0$

$\Rightarrow \boxed{k = -\frac{1}{4}}$ $\quad 1-k-2k+1=0 \Rightarrow \boxed{k=\frac{2}{3}}$ (t)

(iv) $x\cos\alpha + y\sin\beta = 2$ (s)

Ans.: q, p, t, s

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22 Please, discard this question as it is repeated (Q.no.: 21 above)

LEARNER'S TASK (CUES)

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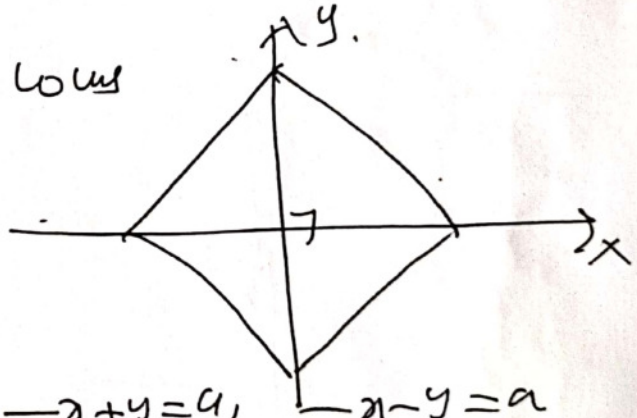
01. Without loss of generality, let us Consider the perpendicular lines as co-ordinate axes.



$P(x,y)$ be a point in the locus

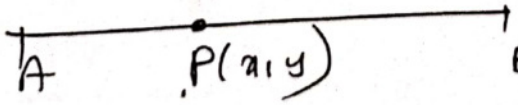
Given $|x|+|y|=a$

$\Rightarrow \pm x \pm y = a$

$\Rightarrow x+y=a$, $x-y=a$, $-x+y=a$, $-x-y=a$

$\therefore$ These Four lines form a square Ans: A

02



Ans.: A

Conceptual

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03 Circle

Ans.: A

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04 $ax+by+c=0$

parallel to X-axis $\Rightarrow$ slope $= 0$

$\Rightarrow -\frac{a}{b} = 0$

$\Rightarrow a = 0$

Clearly options : B, C, D are not defined as they have 'a' in the denominator

Ans: A

05 $\frac{1}{a} + \frac{1}{b} = \frac{1}{c}$

$\Rightarrow \frac{c}{a} + \frac{c}{b} = 1$

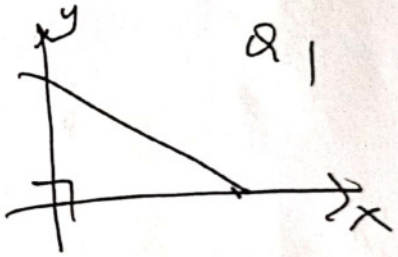
$\Rightarrow \frac{x}{a} + \frac{y}{b} = 1$

$(x,y) = (c,c)$

Ans: B

06 $ax+by+c=0$

$\Rightarrow \frac{x}{\left(\frac{-c}{a}\right)} + \frac{y}{\left(\frac{-c}{b}\right)} = 1$



Q 1

Ist quadrant $\Rightarrow \frac{-c}{a} > 0$, $\frac{-c}{b} > 0$

$\Rightarrow -ac > 0$, $-bc > 0$

$\Rightarrow ac < 0$ $bc < 0$

Ans. D

07 Conceptual

Ans: B

08 Conceptual

Ans: B

09 Conceptual

Ans: A

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10 $\theta = \frac{\pi}{4} \Rightarrow m = \tan\frac{\pi}{4} = 1$

$(-1, 2)$, $m = 1$

$y - 2 = 1(x + 1) \Rightarrow x - y + 3 = 0$. Ans.

JEE MAINS LEVEL

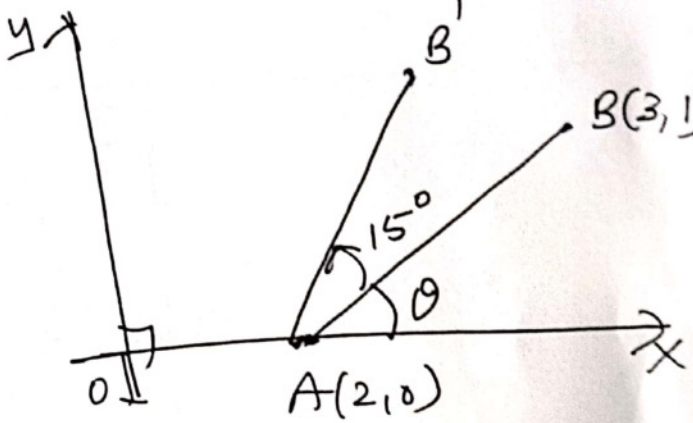
01. $A(2,0)$, $B(3,1)$

Slope of $AB = \frac{1-0}{3-2}$

$= 1$

$\therefore m = \tan\theta = 1$

$\theta = 45^\circ$



$\therefore$ Total Angle made by $AB' = 45^\circ + 15^\circ = 60^\circ$

$m = \tan 60^\circ = \sqrt{3}$

$\therefore$ Eqn of AB' $y - 0 = \sqrt{3}(x - 2)$

$\Rightarrow$ ~~$\sqrt{3}x - y + 2 = 0$~~

$\Rightarrow y = \sqrt{3}(x - 2)$ Ans: B

02 $2x + 3y = 6 \rightarrow$ meets X-axis at $A(3,0)$

$2x + 3y = 8 \rightarrow$ meet X-axis at $B(4,0)$

Let L meets X-axis at $C(c,0)$

Given 3, 4, C are in AP $\Rightarrow c = 5$

$\therefore C(5,0)$, $P(2,2) \Rightarrow$ Eqn of the line

$2x + 3y = 10$ Ans: A

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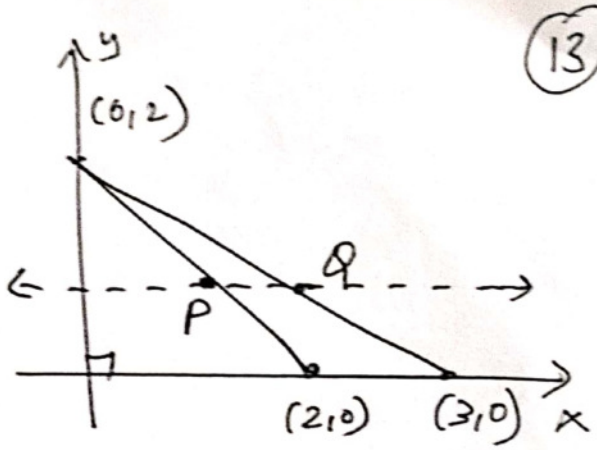
03 $x+y=2 \Rightarrow \frac{x}{2}+\frac{y}{2}=1$

$2x+3y=6 \Rightarrow \frac{x}{3}+\frac{y}{2}=1$

$P(1,1),\ Q\left(\frac{3}{2},1\right)$

Eqn of the line $y=1$



Ans. B

04 $\theta=30$

$\Rightarrow m=\tan 30^\circ=\frac{1}{\sqrt{3}}$

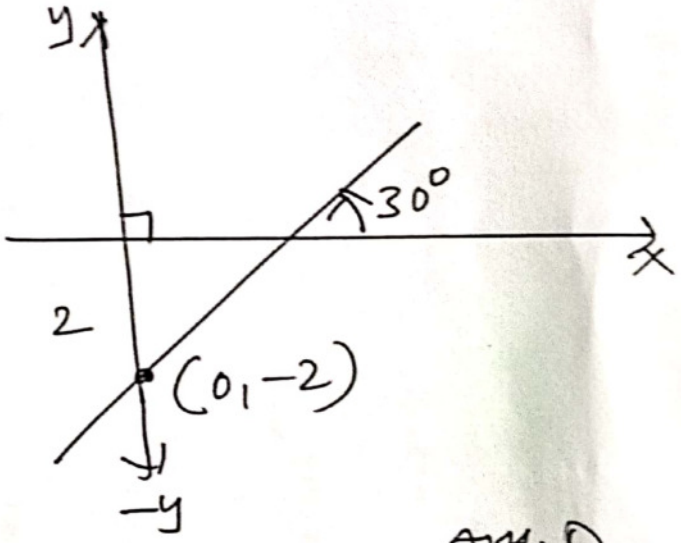
point $(0,-2)$

Eqn of the line

$y+2=\frac{1}{\sqrt{3}}(x-0)$

$x-\sqrt{3}y-2\sqrt{3}=0$ (or)

$\sqrt{3}y-x+2\sqrt{3}=0$



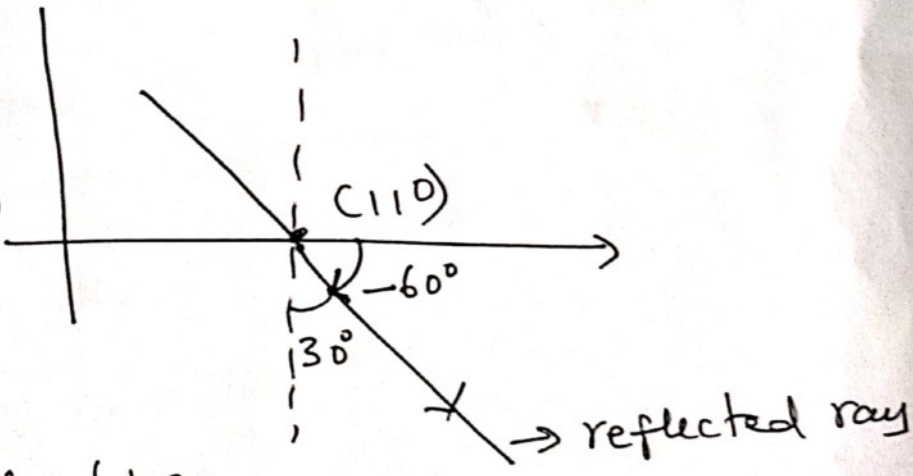
Ans: D

05 $\theta=-60^\circ$

$m=\tan(-60^\circ)$

$=-\sqrt{3}$

$P(1,0)$



Eqn of the line

$y-0=-\sqrt{3}(x-1)$

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

$\Rightarrow \sqrt{3}x+y-\sqrt{3}=0$

Ans: C

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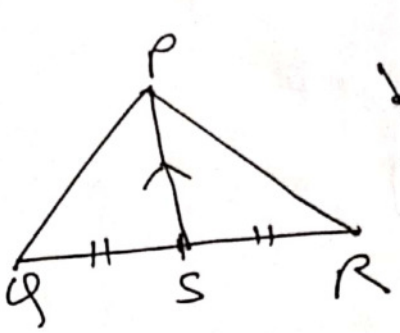
06 Q $P(2,2)$, $Q(6,-1)$ and $R(7,3)$



$S = \left(\frac{6+7}{2}, \frac{-1+3}{2}\right)$

$= \left(\frac{13}{2}, 1\right)$

Slope of $PS = \frac{\frac{13}{2} - 2}{1-2} = \frac{-2}{9}$

Option: B: $2x+9y+7=0 \Rightarrow$ slope $= m = -\frac{2}{9}$ Ans: B

07 $\sqrt{3}x + y - 1 = 0$

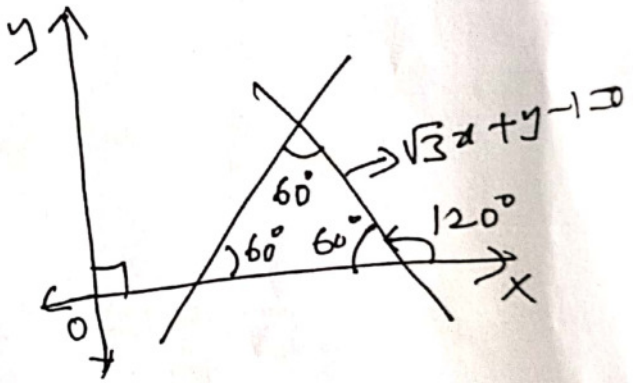
slope $= m = -\sqrt{3}$

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

$\tan(180 - 60^\circ) = -\tan 60^\circ$

$= -\sqrt{3}$

$\therefore \theta = 180 - 60^\circ = 120^\circ$



∴ Our required line makes 60° with x-axis and also passes through $(3,-2)$

slope $= m = \tan 60^\circ = \sqrt{3}$

Eqy. $y + 2 = \sqrt{3}(x-3)$

$\Rightarrow y - \sqrt{3}x + 2 + 3\sqrt{3} = 0$ Ans. B

08 $x+\sqrt{3}y=\sqrt{3}$

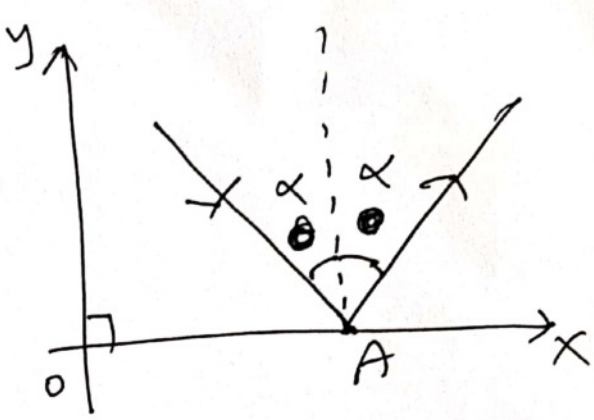
$\therefore A(\sqrt{3},0)$

$m_1=-\frac{1}{\sqrt{3}}$

$\tan\theta=\tan\left(\pi-\frac{\pi}{6}\right)$

$=\tan\frac{5\pi}{6}$

$\therefore \theta=150^\circ$ (Angle made by incident ray with x-axis)



From diagram $\alpha+90^\circ=150^\circ$

$\Rightarrow \alpha=60^\circ$

i.e. Reflected ray makes an angle of 30° with the x-axis.

$\therefore A(\sqrt{3},0)$, slope $=m=\tan 30^\circ=\frac{1}{\sqrt{3}}$

Eqn $y-0=\frac{1}{\sqrt{3}}(x-\sqrt{3})$

$\Rightarrow \sqrt{3}y=x-\sqrt{3}$

Ans. B

---

09 $(2,-3)\Rightarrow \frac{x}{a}+\frac{y}{b}=1 \Rightarrow \frac{2}{a}-\frac{3}{b}=1 \rightarrow (1)$

$(4,-5)\Rightarrow \frac{4}{a}-\frac{5}{b}=1 \rightarrow (2)$

option D $(-1,-1)$ satisfies these two equations

Ans: D

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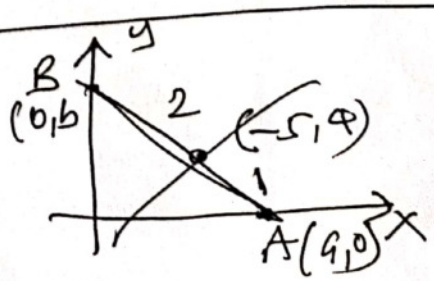
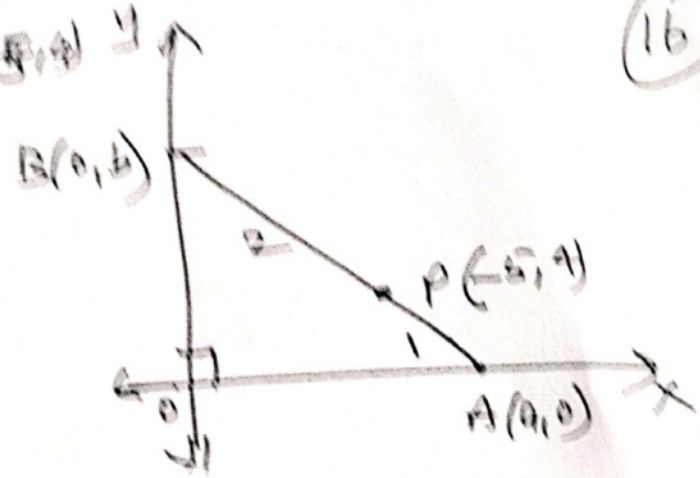
10 (



10 $\left(\frac{1\cdot 0+2\cdot a}{3}, \frac{1\cdot b+2\cdot 0}{3}\right) = (-5, 4)$



$\Rightarrow \frac{2a}{3} = -5$ | $\frac{b}{3} = 4$

$\Rightarrow a = -\frac{15}{2}$ | $b = 12$

Eqn of the line

$$\frac{x}{\left(-\frac{15}{2}\right)} + \frac{y}{12} = 1 \Rightarrow 8x - 5y + 60 = 0$$

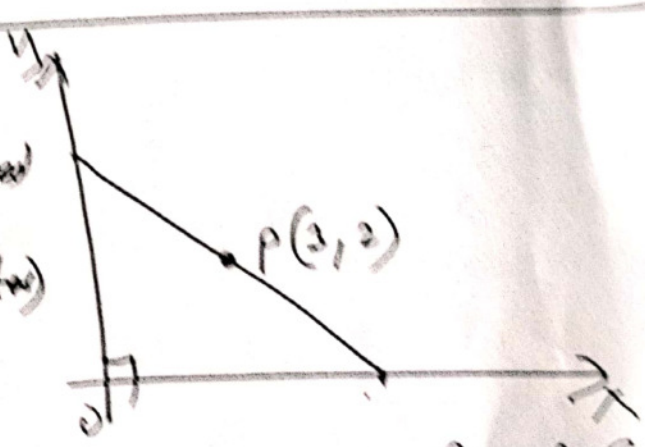
Ans: A

JEE ADVANCED LEVEL

11 Given point $(3, 2)$

opt: A: $2x + 3y = 12$ (Satisfies)

opt: B: $4x + 6y = 24$ (Satisfies)



Ans: A, B

12 $ax + by + c = 0$

$(1, -2) \Rightarrow a - 2b + c = 0$

$\Rightarrow 2b = a + c \Rightarrow a, b, c \rightarrow$ A.P

Ans: A

13 Statement: $x + 3y = 4$ and $6x - 2y = 7$

$m_1 \times m_2 = -\frac{1}{3} \times \frac{6}{2} = -1$ ∴ The diagonals are perpendicular → Rhombus (True)

Statement II: Conceptual (True)

Ans: A

14. Statement I: $x - \sqrt{3}y + 8 = 0$

$\Rightarrow x - \sqrt{3}y = -8$

$\Rightarrow -x + \sqrt{3}y = 8$

Dividing with $\sqrt{(-1)^2 + (\sqrt{3})^2} = \sqrt{1+3} = 2$

$\therefore x\left(-\frac{1}{2}\right) + y\left(\frac{\sqrt{3}}{2}\right) = \frac{8}{2}$

$x\cos\alpha + y\sin\alpha = p$

$\therefore \cos\alpha = \frac{-1}{2}, \quad \sin\alpha = \frac{\sqrt{3}}{2}$

$\therefore \alpha \in Q_2$

$\therefore \alpha = \pi - \frac{\pi}{6} = 120^\circ$

$\therefore x\cos 120^\circ + y\sin 120^\circ = 4$ (True) A

Statement II: Conceptual (True)

Ans. A

NOTE: For Assertion and Reason questions, Q no are not given

Assertion: $\frac{x}{2} + \frac{y}{3} = 1$

x-intercept $= 2 \Rightarrow (2, 0)$

y-intercept $= 3 \Rightarrow (0, 3)$ (True)

Reason: Conceptual (True)

Ans. A

Assertion: $m = 4, \quad P(2, 3)$

$y - 3 = 4(x - 2) \Rightarrow$ (True)

Reason: Conceptual (True)

Ans. A

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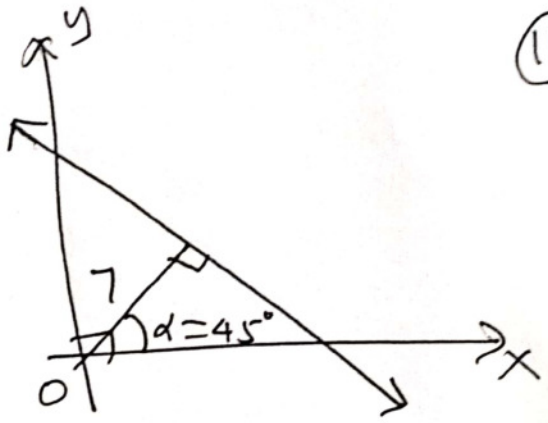
15 $p = 7, \quad \alpha = 45^\circ$

$x\cos\alpha + y\sin\alpha = p$

$x\cos 45^\circ + y\sin 45^\circ = 7$

$x + y = 7\sqrt{2}$



Ans: B

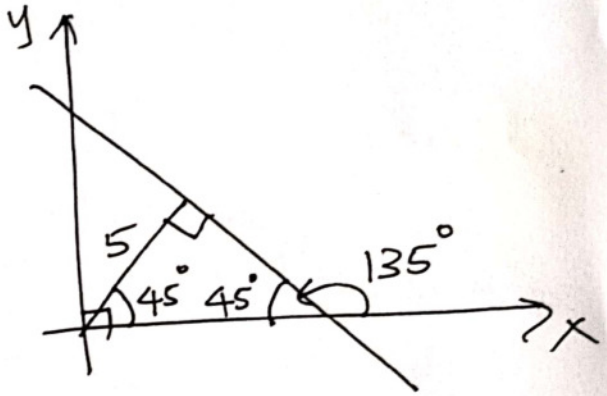
16 $p = 5, \quad \alpha = 45^\circ$

$x\cos\alpha + y\sin\alpha = p$

$x\cos 45^\circ + y\sin 45^\circ = 5$

$\Rightarrow x + y = 5\sqrt{2}$

$\Rightarrow \frac{x}{5\sqrt{2}} + \frac{y}{5\sqrt{2}} = 1$



Ans: C

17 $P(\alpha, \beta) \Rightarrow y = 6x - 1 \Rightarrow \beta = 6\alpha - 1 \rightarrow (1)$

$Q(\beta, \alpha) \Rightarrow 2x - 5y = 5 \Rightarrow 2\beta - 5\alpha = 5 \rightarrow (2)$

Solving (1) & (2) $\Rightarrow \alpha = 1, \beta = 5$

$\therefore P(1, 5), Q(5, 1) \rightarrow$ Eqn of the line $x + y = 6$

Ans: C

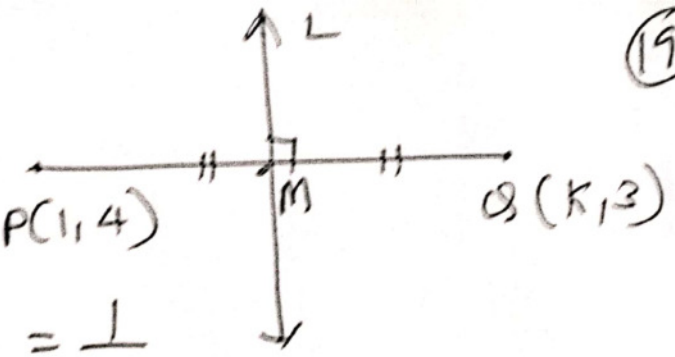
18 $(2, K) \Rightarrow 3x - 2y + 3 = 0$

$3(2) - 2(K) + 3 = 0$

$\Rightarrow K = \frac{9}{2}$

Ans. A

19



(19)

$M\left(\frac{1+K}{2}, \frac{4+3}{2}\right)$

$M\left(\frac{1+K}{2}, \frac{7}{2}\right)$

slope of $PQ = \frac{4-3}{1-K} = \frac{1}{1-K}$

slope of $L = K-1$

Eqn of $L \Rightarrow y - \frac{7}{2} = (K-1)\left[x - \left(\frac{1+K}{2}\right)\right]$

Y-intercept $\Rightarrow$ put $x = 0$

$$y - \frac{7}{2} = -(K-1)\left(\frac{1+K}{2}\right)$$

$$\left(\frac{1-K^2}{2}\right) + \frac{7}{2} = -4.$$

$\therefore$ Y-intercept =

Solving $K = -4$

Ans: -4

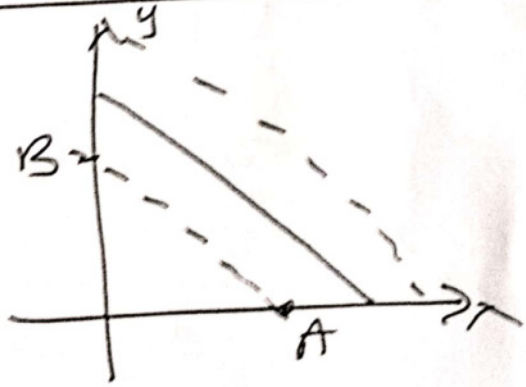
20

Eqn of the line parallel to $2x + 6y - 7 = 0$ is

$2x + 6y + K = 0.$

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

$A\left(\frac{-K}{2}, 0\right)$, $B\left(0, \frac{-K}{2}\right)$



Given $AB = 10$

$\Rightarrow AB^2 = 100$

$\Rightarrow \left(\frac{K}{2}\right)^2 + \left(\frac{K}{2}\right)^2 = 100$

$\Rightarrow K^2 = 200$

$= K = \pm 10\sqrt{2}$

i.e. K has two values

$\therefore$ There are two lines

Ans: 2

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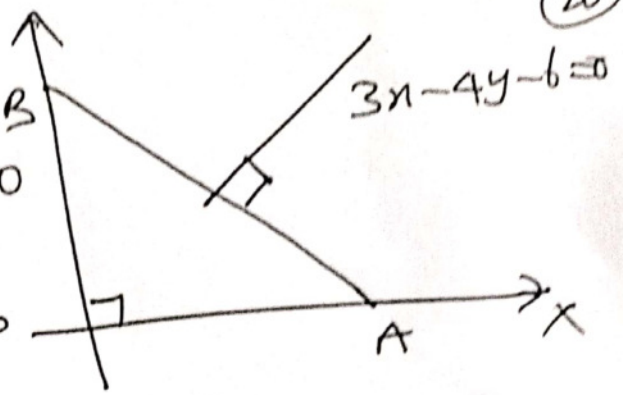
21 (i) Given line $3x-4y-6=0$



Eqy of $AB \Rightarrow 4x+3y+k=0$

Area of $\triangle AOB = \frac{k^2}{2|4\times3|} = 6$

$\Rightarrow k = \pm 12$

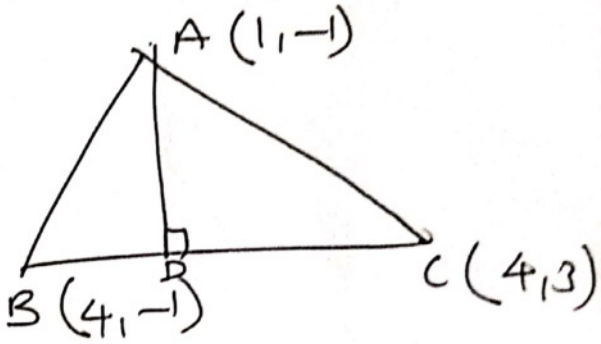
∴ Required lines are $4x+3y \pm 12 = 0$ (t)

(ii) Slope of $BC = m = \frac{3+1}{4-4}$

$= \frac{4}{0}$

$=$ Not defined

$=$ parallel to y-axis



∴ AD should be parallel to X-axis

∴ $y+1=0$ is the required line (p)

iii) Eqy of line perpendicular to $5x-2y-7=0$ is $2x+5y+17=0$ (q)

(iv) $(x-y+1)+k(y-2x+4)=0$

X-intercept $\Rightarrow$ put $y=0 \Rightarrow (x+1)+k(-2x+4)=0$

$x(1-2k) = -1-4k \Rightarrow x = \frac{4k+1}{2k-1}$

Y-intercept $\Rightarrow$ put $x=0 \Rightarrow (-y+1)+k(y+4)=0$

$\Rightarrow y(k-1) = -1-4k \Rightarrow y = \frac{4k+1}{1-k}$

Given $\frac{4k+1}{2k-1} = \frac{4k+1}{1-k} \Rightarrow k = \frac{2}{3} = 0.66$ (r)

Ans: t, p, q, r

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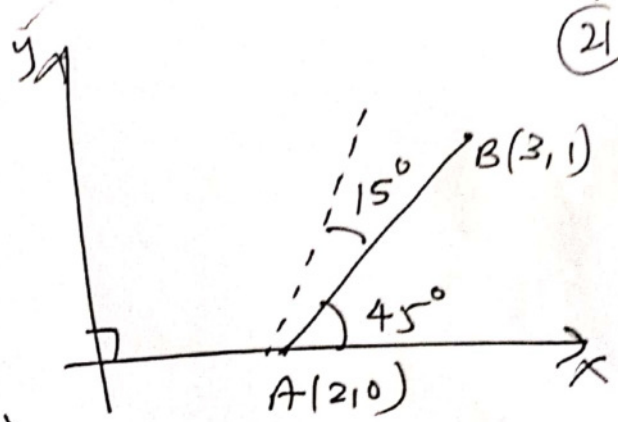
i) A(2,0), B(3,1)

slope of $AB = \frac{1-0}{3-2} = 1$

$\therefore \theta = 45°$



∴ Angle made by our required line $= (15° + 45°)$

$= 60° \rightarrow$ slope $= \sqrt{3}$

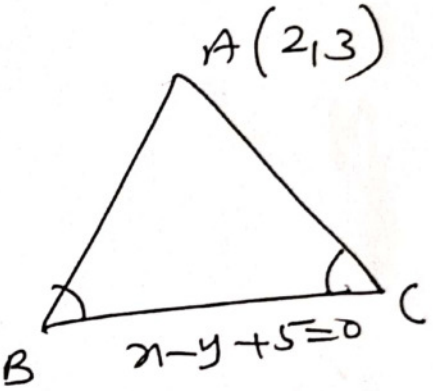
∴ A(2,0) $m = \sqrt{3}$

$y = \sqrt{3}(x-2)$ (q)

ii) option verification

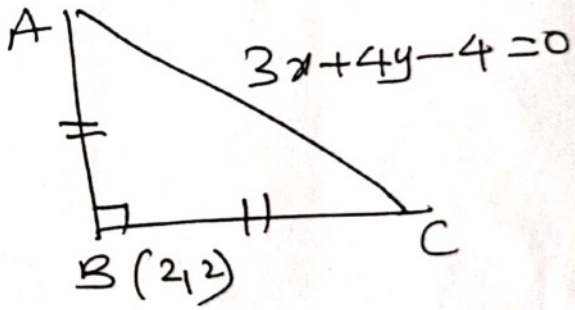
$y - 3 = -(2 \pm \sqrt{3})(x-2)$

is satisfied by (2,3) (p)



(iii) The sides posses through (2,2)

∴ $7x + y = 16$ satisfies (2,2) (t)

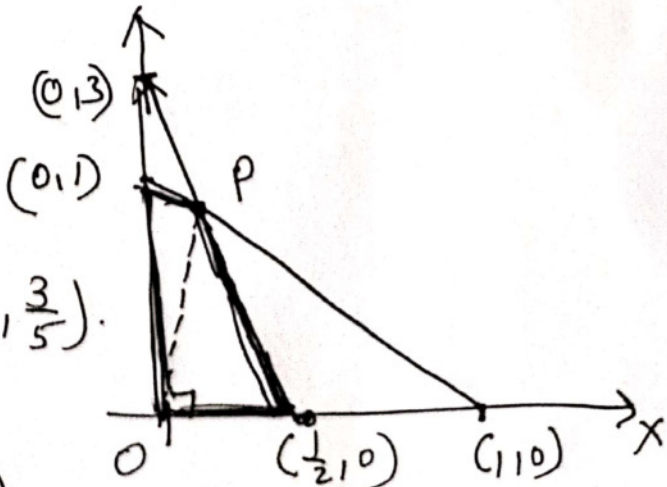


(iv) Diagonal op:

Solving $x + y = 1$ and $6x + y = 3$ we get $P\left(\frac{2}{5}, \frac{3}{5}\right)$.

∴ Eqn of op

$3x - 2y = 0$ (r)



Ans: q, p, t, r

⇒ THE END ⇐

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