OCR C1 June 2013

8. A is the point $(-2,6)$ and B is the point $(3,-8)$. The line l is perpendicular to the line $x - 3y + 15 = 0$ and passes through the mid-point of AB. Find the equation of l, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers.

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(7)

8. The line l has gradient -2 and passes through the point $A(3,5)$. B is a point on the line l such that the distance AB is $6\sqrt{5}$. Find the coordinates of each of the possible points B.

(6)

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11. The line l_1 passes through the points $P(-1,2)$ and $Q(11,8)$.

(a) Find an equation for l_1 in the form $y = mx + c$, where m and c are constants.

(4)

The line l_2 passes through the point $R(10,0)$ and is perpendicular to l_1. The lines l_1 and l_2 intersect at the point S.

(b) Calculate the coordinates of S.

(5)

(c) Show that the length of RS is $3\sqrt{5}$.

(2)

(d) Hence, or otherwise, find the exact area of triangle PQR.

(4)

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$$x - 3y + 15 = 0$$
$$3y = x + 15$$
$$y = \tfrac{1}{3}x + 5$$

$$\therefore \quad m = \tfrac{1}{3}$$

$$m_\perp = -3$$

$A\,(-2, 6), \quad B\,(3, -8)$

Midpoint of $AB = \left(\dfrac{-2+3}{2}, \dfrac{6-8}{2} \right) = \left(\dfrac{1}{2}, -1 \right)$

Equation of ℓ:
$$y + 1 = -3 \left(x - \tfrac{1}{2} \right)$$
$$y + 1 = -3x + \tfrac{3}{2}$$

$$3x + y - \tfrac{1}{2} = 0$$
$$6x + 2y - 1 = 0 \;//$$

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Equation of ℓ:
$$y - 5 = -2(x-3)$$
$$y - 5 = -2x + 6$$
$$y = -2x + 11$$

Distance $AB = \sqrt{(x-3)^2 + (y-5)^2}$ (where B is (x,y))

$$\therefore \quad 6\sqrt{5} = \sqrt{(x-3)^2 + (y-5)^2}$$
$$180 = (x-3)^2 + (y-5)^2 \quad \text{(square both sides)}$$
$$180 = x^2 - 6x + 9 + y^2 - 10y + 25$$
$$146 = x^2 - 6x + y^2 - 10y$$

Using $y = -2x + 11$

$$146 = x^2 - 6x + (-2x+11)^2 - 10(-2x+11)$$
$$146 = x^2 - 6x + 4x^2 - 44x + 121 + 20x - 110$$
$$0 = 5x^2 - 30x - 135$$
$$0 = x^2 - 6x - 27$$
$$0 = (x-9)(x+3)$$

$$\therefore \quad x = -3, 9$$

When $x = -3$, $y = -2(-3) + 11 = 17$
When $x = 9$, $y = -2(9) + 11 = -7$

$x = -3$, $y = 17$
$x = 9$, $y = -7$

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$P(-1, 2)$ $Q(11, 8)$

(a) Equation of ℓ_1: $m = \dfrac{8-2}{11+1} = \dfrac{1}{2}$

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

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

(b) Equation of ℓ_2:

$$M_\perp = -2$$

$R(10, 0)$

$$\therefore y - 0 = -2(x-10)$$
$$y = 20 - 2x$$

Intersection: $\dfrac{1}{2}x + \dfrac{5}{2} = 20 - 2x$

$$\frac{5}{2}x = \frac{35}{2}$$

$$x = 7$$

When $x = 7$, $y = 20 - 2(7) = 6$

$$S(7, 6)$$

(c) $RS = \sqrt{(10-7)^2 + (6-0)^2}$

$\quad\quad = \sqrt{45}$

$\quad\quad = 3\sqrt{5}$

(d) $P(-1,2)$, $Q(11,8)$, $R(10,0)$

$\quad\quad\quad\quad$ Base $= PQ = \sqrt{(11+1)^2 + (8-2)^2}$

$\quad\quad\quad\quad\quad\quad\quad = 6\sqrt{5}$

$\quad\quad\quad\quad$ Height $= RS = 3\sqrt{5}$

Area $PQR = \frac{1}{2} \times 6\sqrt{5} \times 3\sqrt{5} = 45$