4.4 Parallel and perpendicular lines

1 The movement of a robot football match have been mapped on a set of axes where (0,0) is the center of the pitch and the following equations represent the movement of the ball. Identify

i the parallel movements

ii the perpendicular movements

a $y = 2x + 5$

b $y = 5x + 2$

c $y - 5x = 2$

d $y - 7 = 2x$

e $y - 2x = 6$

f $y + 0.2x = 6$

g $y = 2x - 5$

h $y = 2$

i $y = 2x$

j $y = 5x$

k $y = 0.5x$

l $y = -0.5x$

m $2x = y$

n $x = \frac{1}{5}y$

2 **a** Show that a robot going in a straight line through the points (−4,3) and (11,6) will meet a robot going through the point (1,2) and (2,5)

b Find the equation representing their movements

c where they meet

3 The ball is moving in the direction $y = 4x + 3$. A robot is standing on (−1,3)

a find the equation of the shortest pass to the line representing the movement of the ball.

b find where the robot will catch the ball.

4 Two robots moving in perpendicular direction met at (4,−4) if one of the robots came from (3,6),

a find the equation of the second robot.

b find the two possible original positions of the second robot if he travels as much as the other robot to reach (4, −4)

5 A robot comes in the direction $y + \frac{1}{8}x = -3$. The goalkeeper who is standing on (−10,0) wants to send him the ball making the shortest distance.

a Find the equation of the ball making shortest pass between the goal keeper and the other robot.

b Find where the robot will catch the ball.

6 The goal keeper only moves on the line $x = 15$ two strikers are located at S1 (13,3) and S2 (12,−2). Find the best position to stand so that the combined distance from its position to both striker is shortest.

7 The referee only moves on the line $y = 4$ two furthest players are located at P1 (−8,2) and P2 (10,−2). Find the best position to stand so that the combined distance from the referee's position to both players is shortest.

8 The goal is located at G (−13,0), a striker is placed at S (−9,2), if the defense robot can only move on the line $y = \frac{1}{2}x + 5$, find the best position to take so that the combined distance from its position to the goal or the striker is shortest

9 A laser-cutter has been programmed to cut pieces of wood.

Find the resulting shape. The equations it has been programmed with are:

a $y = 2$, $y = 6.5$, $x = -1.2$, $x = 3.1$

b $y = 2$, $y = 6.5$, $y = 2x + 3$, $y = 2x - 3$

c $x = 2$, $x = -6.5$, $y = 2x + 3$, $y = 3x - 1$

Answers

1 **i** a,d,e,g,i and m or b,c,j and n

ii a and l, a and f

2 **a** as their gradient are different e.g $\frac{3}{15}=\frac{1}{5}\neq 3$ so they will meet

b $y=\frac{1}{5}x+\frac{19}{5}$ and $y=3x-1$

c $\left(\frac{12}{7},\frac{29}{7}\right)$

3 **a** $y=-\frac{1}{4}x+2.75$ **b** $\left(-\frac{2}{30},\frac{82}{30}\right)$

4 **a** $y=\frac{1}{10}x-4.4$ **b** (14,−3) or (−6, −5)

5 **a** $y=8x-10$ **b** $\left(\frac{56}{65},\frac{-202}{65}\right)$

6 The shortest point from S_1 to the line is (15,−2)

so the image of S_1 reflected in the line is S_1'(18,−2)

the equation of S_1' S_2 $y=-x+23$

S_1' S_2 cuts the x = 1 5 at (15,1)

So (15,1) is the best position

7 The shortest point from P_2 to the line is (10,4)

so the image of P_2 reflected in the line is P_2'(10,8)

the equation of P_2' P_1 $y=\frac{1}{3}x+\frac{14}{3}$

P_2' P_1 cuts the y = 4 at (−2,4)

So (−2,4) is the best position

8 The shortest point from G to the line is (−12,−1)

so the image of G reflected in the line is G'(−11,−2)

the equation of G' S $y=2x+20$

G'S cuts the $y=\frac{1}{2}x+5$ at (−10,0)

So (−10,0) is the best position

9 **a** 2 set of parallel lines (horizontal and vertical) with same length and a perpendicular angle make a square

b 2 sets of parallel lines (horizontal and diagonal e.g. y = 2x+..) parallelogram

c 1 set of parallel lines (vertical) the other sides are not parallel so it is a trapezium