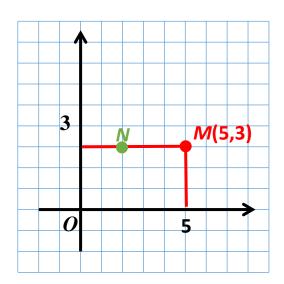# *Coordinates*

This week we discussed how one can introduce coordinates in a plane, so that every point is described by a pair of numbers. To do this, we need to choose:

- The origin (usually denoted O)
- Unit length
- Two perpendicular axes (usually called x and y)

For point $M(5,3)$, the x-coordinate is 5, the y-coordinate is 3. Order matters:

$$x_M = 5, \quad y_M = 3$$

Distance between two points

To find the distance along x between two points, at the same y, you need to subtract their x-coordinates and take the absolute value. The size of MN or distance is:

$$MN(x) = |x_M - x_N|$$

$$MN(x) = |5 - 2| = 3$$

In this case, similarly, the distance along y is:

$$MN(y) = |y_M - y_N|$$

$$MN(y) = |3 - 3| = 2$$

The distance (d) between any two points with coordinates (x_1, y_1) and (x_2, y_2) is:

$$d=\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Homework

1. A point *B* is 5 units above and 2 units to the left of *A*(7,5). What are the coordinates of point *B*?

2. Plot on the coordinate plane the following, and connect each dot to the next one. If you did everything correctly, you will get a picture...
   (0,2); (0,0); (1,3); (2,3); (3,2); (3,0); (1,-1); (2,-1); (1,-3); (0,-1);
   (-1,-3); (-2,-1); (-1,-1); (-3,0); (-3,2); (-2,3); (-1,3); (0,0).

3. Find the coordinates of the midpoint of the segment *AB*, where *A*=(3,11) and *B*=(7,5). Find the length of the segment AB.

4. Draw points *A*(4,1), *B*(3,5), *C*(-1,4). If you did everything correctly, you will have 3 vertices of a square. What are the coordinates of the fourth vertex? What is the area of the square?

5. Find the missing coordinates:
   (a) 3 points *A*(0,0), *B*(1,3), *D*(5,-2) are vertices of a parallelogram *ABCD*. What are the coordinates of *C*?
   (b) 3 points *A*(0,0), *B*(2,3), *D*(4,1) are vertices of a parallelogram *ABCD*. What are the coordinates of *C*?
   (c) 3 points *A*(0,0), *B*(1,5), *D*(3,-2) are vertices of a parallelogram *ABCD*. What are the coordinates of *C*?
   (d) Can you guess the general rule: if *A*(0,0), *B*(b_1,b_2), D(d_1,d_2) are vertices of a parallelogram *ABCD*. What are the coordinates of *C*?

6. Point M has coordinates (5,7)
   (a) Find the coordinates of the point M_1 obtained from *M* by reflection about the *x*-axis.
   (b) Find the coordinates of the point M_1 obtained from *M* by reflection about the *y*-axis.
   (c) Find the coordinates of the point M_1 obtained from *M* by reflection about the diagonal line *x=y*.