Coordinates

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Coordinates (1st Quadrant) Practice ~ 1

In each of the following exercises (I to IX) the coordinates given are to be plotted on a 9 by 9 grid and joined up in order by a series of straight lines.

I. Join (4, 1) to (4, 3) to (3, 2) to (2, 2) to (1, 2) to (1, 3) to (2, 5) to (3, 6) to (3, 7) to (4, 6) to (6, 5) to (8, 1)
Put in a dot at (3, 4)

II. Join (5, 9) to (6, 8) to (7, 8) to (6, 7) to (7, 1) to (8, 0) to (2, 0) to (3, 9) to (5, 9)
Join (5, 6) to (5, 2) to (3, 1) to (3, 2) to (4, 6)
Put in a dot at (5, 8)

III. Join (8, 8) to (8, 6) to (9, 2) to (8, 2) to (8, 1) to (2, 1) to (2, 2) to (1, 2) to (2, 6) to (2, 8) to (8, 8)
Join (3, 7) to (7, 7) to (7, 2) to (3, 2) to (3, 7)
Join (3, 5) to (7, 5)
Join (5, 5) to (5, 7)
Join (4, 5) to (5, 3) to (6, 5)
Put in dots at (4, 6) and (6, 6)

IV. Join (6, 8) to (7, 7) to (7, 6) to (8, 5) to (8, 4) to (7, 3) to (6, 1) to (3, 1) to (2, 3) to (1, 4) to (1, 5) to (2, 6) to (2, 7) to (3, 8) to (6, 8)
Join (3, 2) to (3, 3) to (6, 3) to (6, 2) to (3, 2)
Join (3, 5) to (3, 6) to (4, 6) to (4, 5) to (3, 5)
Join (5, 5) to (5, 6) to (6, 6) to (6, 5) to (5, 5)

V. Join (6, 5) to (4, 3) to (2, 3) to (0, 2) to (6, 2) to (9, 5) to (8, 6) to (7, 6) to (6, 5)
Join (4, 4) to (5, 5) to (4, 6) to (3, 6) to (2, 5) to (2, 4) to (3, 4) to (4, 5)
Join (6, 5) to (5, 7) to (2, 7) to (1, 5) to (2, 3)
Put in a dot at (8, 5)
Join (8, 6) to (8, 8)
Join (8, 6) to (7, 8)

VI. Join (1, 7) to (2, 7) to (2, 6) to (3, 6) to (3, 7) to (4, 7) to (4, 6) to (5, 6) to (5, 7) to (6, 7) to (6, 6) to (7, 6) to (7, 7) to (8, 7) to (8, 1) to (5, 1) to (5, 3) to (4, 4) to (3, 3) to (3, 1) to (1, 1) to (1, 7)
Join (6, 5) to (7, 5) to (7, 3) to (6, 3) to (6, 5)

VII. Join (6, 1) to (9, 2) to (1, 2) to (2, 1) to (6, 1)
Join (5, 2) to (5, 8) to (0, 3) to (5, 3)
Join (5, 8) to (5, 9) to (9, 2) to (6, 3) to (5, 9)

VIII. Join (1, 2) to (1, 4) to (6, 9) to (8, 9) to (8, 4) to (9, 4) to (9, 2) to (8, 2) to (8, 0) to (6, 0) to (6, 2) to (1, 2)
Join (6, 4) to (6, 7) to (3, 4) to (6, 4)

IX. Join (1, 0) to (1, 9) to (6, 9) to (9, 7) to (9, 5) to (7, 3) to (9, 0)
Join (3, 0) to (3, 3) to (5, 3) to (7, 0)
Join (3, 7) to (3, 5) to (6, 5) to (7, 6) to (6, 7) to (3, 7)

Write a title underneath each of the 'pictures' you have drawn.
Titles must be taken from this list, and no title may be used more than once.

snail penguin yacht ahr horse four castle owl face

Coordinates (1st Quadrant) Practice ~ 2

The following eight sets of coordinates (A to H) can all be plotted on the same 9 by 9 grid. Each set of points when joined up, in the order they are given, by straight lines will make a quadrilateral. As a guide, none of these quadrilaterals should touch or overlap.
Draw these shapes and print the correct identifying letter inside of each.

A. Join (0, 6) to (2, 6) to (2, 8) to (0, 8) to (0, 6)

B. Join (5, 5) to (4, 7) to (5, 8) to (6, 7) to (5, 5)

C. Join (7, 5) to (8, 5) to (8, 8) to (7, 8) to (7, 5)

D. Join (0, 5) to (1, 4) to (4, 5) to (3, 6) to (0, 5)

E. Join (0, 2) to (1, 3) to (0, 4) to (3, 3) to (0, 2)

F. Join (3, 4) to (5, 2) to (6, 5) to (5, 3) to (3, 4)

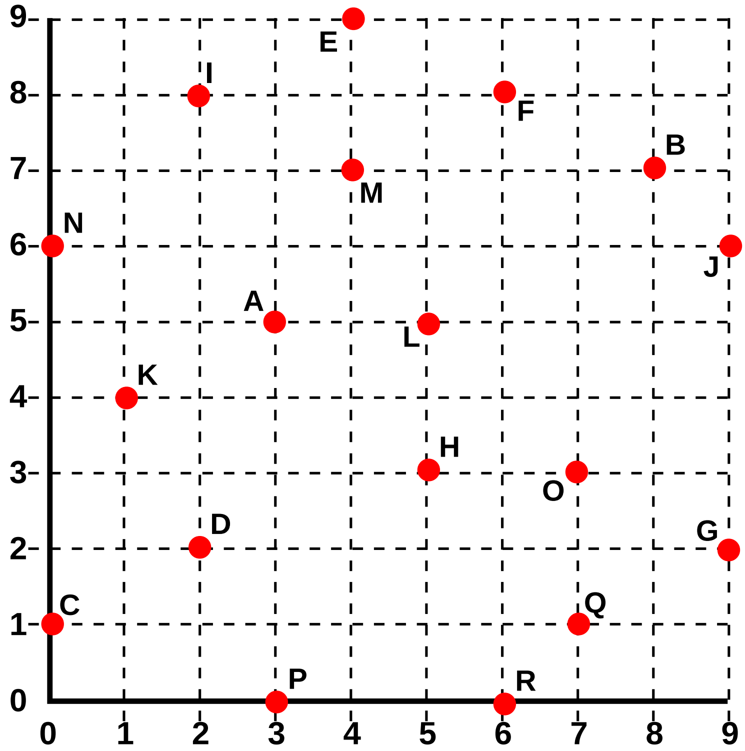
G. Join (7, 0) to (6, 2) to (7, 4) to (8, 2) to (7, 0)

H. Join (1, 0) to (2, 2) to (4, 2) to (5, 0) to (1, 0)

Write down the letters A to H in a list and then, beside each letter write down the correct name of the quadrilateral containing that letter
All the names you will need can be found in this list, and no name is needed more than once.

rhombus	square	parallelogram	kite	arrowhead
oblong	trapezium	irregular quadrilateral		

Write down the letters A to R and, beside each letter write the coordinates of each of the marked points on the grid shown on the right, which is next to that letter.
Do NOT mark the grid.



On a 9 by 9 grid, draw a 'picture' of your own design.
On a separate piece of paper write out the instructions for drawing your picture.
Give these instructions to someone else (with a blank grid) and see if they draw exactly the same picture.

Coordinates (All 4 Quadrants) Practice ~ 3

In each of the following exercises (1 to 6) the coordinates given are to be plotted on a grid which goes from $^-5$ to 5 on both axes, and the points joined up in order by a series of straight lines.

1. Join ($^-2$, 3) to (0, 5) to (2, 3) to ($^-2$, 3)
Join ($^-3$, 1) to ($^-1$, 3) to (1, 3) to (3, 1) to ($^-3$, 1)
Join ($^-4$, $^-2$) to ($^-1$, 1) to (1, 1) to (4, $^-2$) to ($^-4$, $^-2$)
Join ($^-2$, $^-3$) to (2, $^-3$) to (1, $^-5$) to ($^-1$, $^-5$) to ($^-2$, $^-3$)
Join ($^-1$, $^-2$) to ($^-1$, $^-3$) and (1, $^-3$) to (1, $^-2$)

2. Join ($^-5$, $^-1$) to ($^-3$, 4) to (1, 4) to (3, $^-1$) to ($^-5$, $^-1$)
Join ($^-2$, $^-1$) to ($^-2$, $^-2$) to ($^-3$, $^-3$) to ($^-3$, $^-4$) to ($^-2$, $^-5$) to (0, $^-5$) to (1, $^-4$) to (1, $^-3$) to (0, $^-2$) to (0, $^-1$)

3. Join ($^-5$, 2) to ($^-4$, 3) to ($^-2$, 4) to (2, 4) to (4, 3) to (5, 2)
Join ($^-5$, 2) to (1, $^-4$)
Join ($^-1$, $^-4$) to (5, 2)
Join ($^-4$, 3) to (0, $^-3$) to (4, 3)
Join ($^-2$, 4) to (0, $^-3$) to (2, 4)

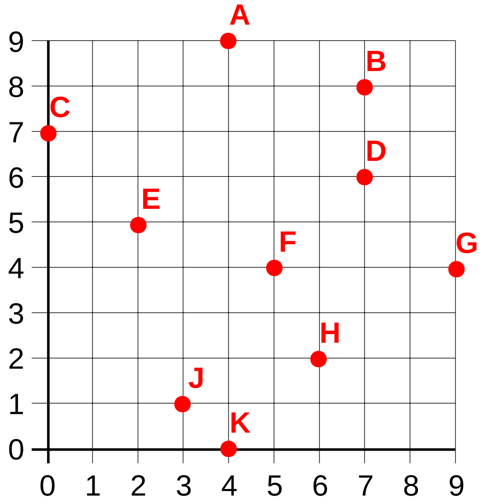
4. Join (0, 0) to (2, $^-2$) to (2, $^-4$) to (1, $^-5$) to ($^-3$, $^-5$) to ($^-4$, $^-4$) to ($^-4$, $^-2$) to ($^-2$, 0) to ($^-3$, 1) to ($^-3$, 5) to ($^-2$, 4) to (0, 4) to (1, 5) to (1, 1) to (0, 0)
Join ($^-4$, 3) to ($^-2$, 2) to ($^-4$, 1)
Join ($^-2$, 2) to ($^-4$, 2)
Join (2, 1) to (0, 2) to (2, 2)
Join (2, 3) to (0, 2)
Join ($^-2$, 1) to (0, 1)
Join (2, $^-4$) to (4, $^-4$) to (4, $^-2$) to (3, $^-2$) to (3, $^-1$) to (5, $^-1$) to (5, $^-4$) to (4, $^-5$) to (1, $^-5$)
Put in dots at ($^-2$, 3) and (0, 3)

5. Join (2, $^-1$) to (3, $^-1$) to (4, 0) to (4, 2) to (3, 3) to (2, 2) to (2, $^-1$)
Join ($^-5$, 2) to ($^-3$, 2) to ($^-3$, $^-1$) to ($^-5$, 2)
Join ($^-2$, 3) to ($^-1$, 4) to (0, 4) to (1, 3) to ($^-2$, 3)
Join ($^-3$, $^-1$) to ($^-2$, $^-2$) to (1, $^-2$) to (2, $^-1$)
Join ($^-3$, 2) to ($^-2$, 3)
Join (1, 3) to (2, 2)

6. Join ($^-3$, 0) to ($^-2$, 1) to ($^-1$, 1) to (0, 0) to (0, $^-1$) to ($^-1$, $^-2$) to ($^-2$, $^-2$) to ($^-3$, $^-1$) to ($^-3$, 0)
Join (2, 0) to (3, 1) to (4, 1) to (5, 0) to (5, $^-1$) to (4, $^-2$) to (3, $^-2$) to (2, $^-1$) to (2, 0)
Join ($^-3$, 0) to ($^-2$, 4) to ($^-1$, 3)
Join (3, 3) to (4, 4) to (5, 0)
Join (0, 0) to (2, 0) with a curve

On a similar size of grid, draw a 'picture' of your own design.
On a separate piece of paper write out the instruction for drawing your picture.
Give these instructions to someone else (with a blank grid) and see if they draw exactly the same picture.

Test A



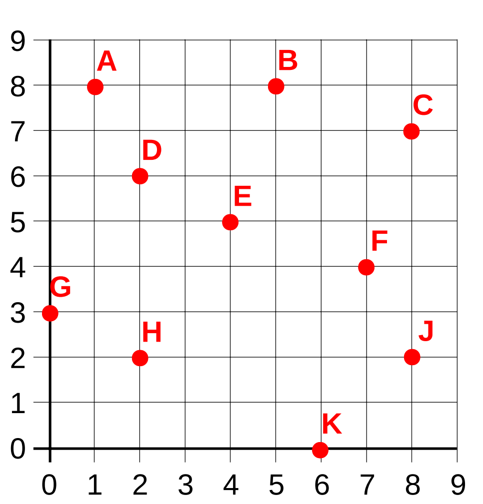
Write in the coordinates of the points marked -

A is (,) **B** is (,) **C** is (,)
D is (,) **E** is (,) **F** is (,)
G is (,) **H** is (,) **J** is (,)
K is (,)

Mark in these points and their letters -

P at (2, 7) **Q** at (9, 7) **R** at (3, 6) **S** at (5, 6)
T at (3, 3) **V** at (7, 3) **W** at (0, 2) **X** at (9, 2)
Y at (1, 1) **Z** at (8, 0)

Test B



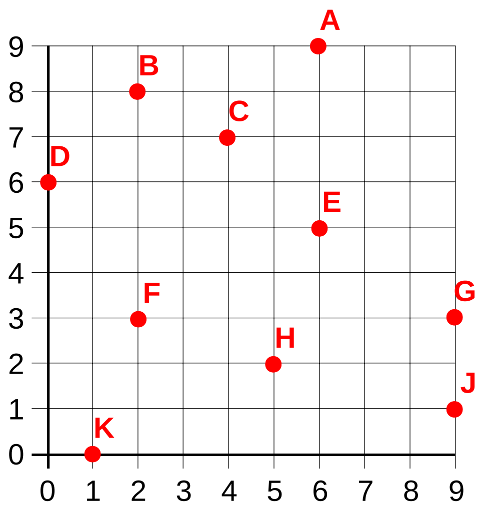
Write in the coordinates of the points marked -

A is (,) **B** is (,) **C** is (,)
D is (,) **E** is (,) **F** is (,)
G is (,) **H** is (,) **J** is (,)
K is (,)

Mark in these points and their letters -

P at (8, 9) **Q** at (3, 8) **R** at (3, 7) **S** at (6, 6)
T at (0, 5) **V** at (9, 5) **W** at (2, 4) **X** at (4, 3)
Y at (4, 1) **Z** at (2, 0)

Test C



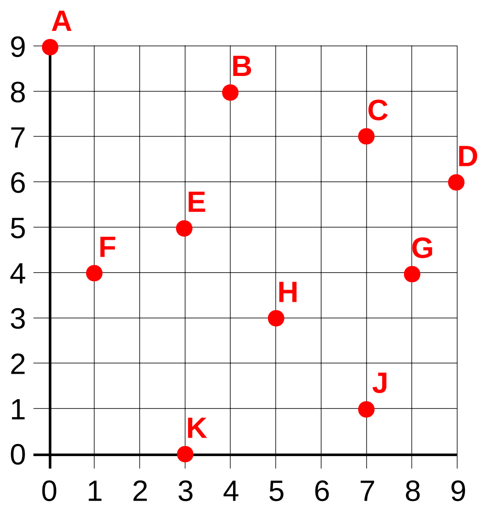
Write in the coordinates of the points marked -

A is (,) **B** is (,) **C** is (,)
D is (,) **E** is (,) **F** is (,)
G is (,) **H** is (,) **J** is (,)
K is (,)

Mark in these points and their letters -

P at (5, 9) **Q** at (9, 9) **R** at (0, 8) **S** at (8, 6)
T at (1, 5) **V** at (4, 4) **W** at (3, 2) **X** at (7, 2)
Y at (2, 1) **Z** at (9, 0)

Test D



Write in the coordinates of the points marked -

A is (,) **B** is (,) **C** is (,)
D is (,) **E** is (,) **F** is (,)
G is (,) **H** is (,) **J** is (,)
K is (,)

Mark in these points and their letters -

P at (2, 9) **Q** at (6, 9) **R** at (8, 8) **S** at (1, 7)
T at (5, 5) **V** at (3, 4) **W** at (4, 2) **X** at (0, 1)
Y at (9, 1) **Z** at (5, 0)

Test E

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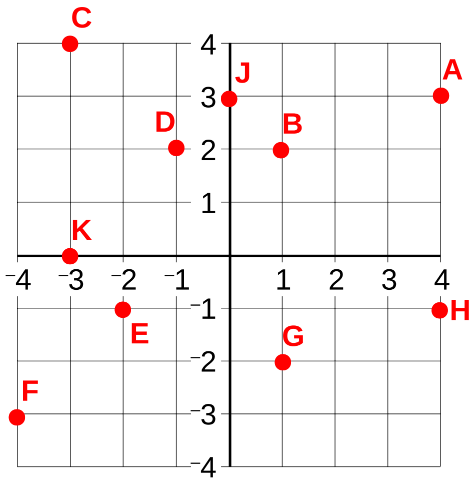

Write in the coordinates of the points marked -

A is (,) **B** is (,) **C** is (,)
D is (,) **E** is (,) **F** is (,)
G is (,) **H** is (,) **J** is (,)
K is (,)

Mark in these points and their letters -

P at (1, 4) **Q** at (3, 1) **R** at $(^{-}3, 2)$ **S** at $(1, ^{-}1)$
T at $(0, ^{-}3)$ **V** at (1, 0) **W** at $(^{-}4, 3)$ **X** at $(3, ^{-}3)$
Y at $(^{-}1, ^{-}2)$ **Z** at $(^{-}2, ^{-}4)$

Test F

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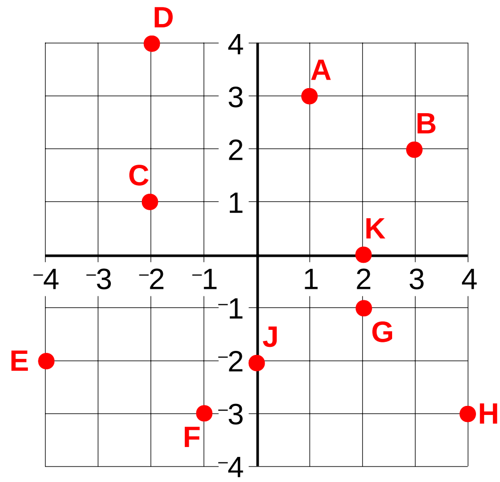

Write in the coordinates of the points marked -

A is (,) **B** is (,) **C** is (,)
D is (,) **E** is (,) **F** is (,)
G is (,) **H** is (,) **J** is (,)
K is (,)

Mark in these points and their letters -

P at (4, 1) **Q** at $(^{-}1, 3)$ **R** at (4, 4) **S** at (0, 4)
T at $(^{-}4, 1)$ **V** at $(2, ^{-}3)$ **W** at $(4, ^{-}2)$ **X** at $(^{-}2, 0)$
Y at $(^{-}1, ^{-}1)$ **Z** at $(^{-}3, ^{-}2)$

Test G

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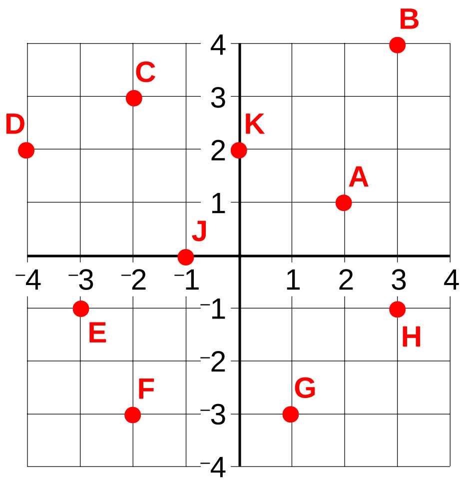

Write in the coordinates of the points marked -

A is (,) **B** is (,) **C** is (,)
D is (,) **E** is (,) **F** is (,)
G is (,) **H** is (,) **J** is (,)
K is (,)

Mark in these points and their letters -

P at (2, 3) **Q** at (4, 2) **R** at $(^{-}3, 1)$ **S** at $(1, ^{-}4)$
T at $(0, ^{-}1)$ **V** at (3, 0) **W** at $(2, ^{-}1)$ **X** at $(^{-}1, 4)$
Y at $(^{-}1, ^{-}4)$ **Z** at $(^{-}4, ^{-}4)$

Test H

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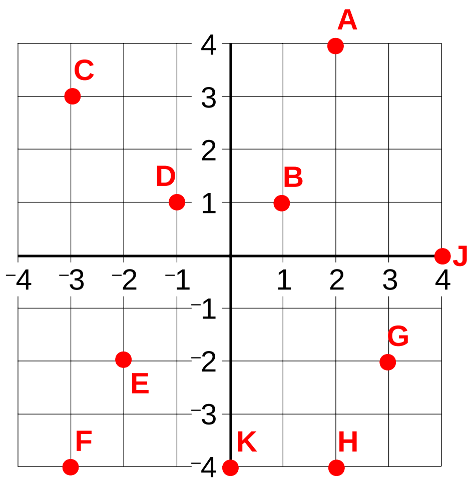
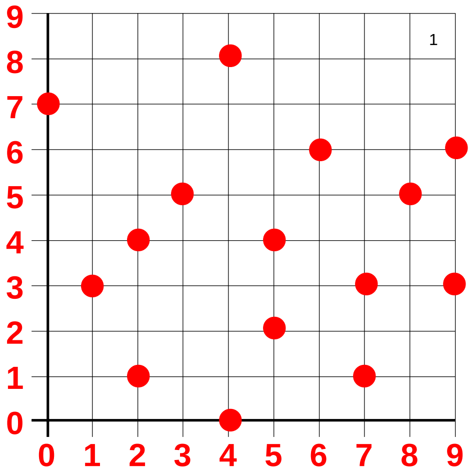


Write in the coordinates of the points marked -

A is (,) **B** is (,) **C** is (,)
D is (,) **E** is (,) **F** is (,)
G is (,) **H** is (,) **J** is (,)
K is (,)

Mark in these points and their letters -

P at (3, 3) **Q** at (4, 2) **R** at $(^{-}4, 2)$ **S** at (3, 0)
T at $(4, ^{-}3)$ **V** at $(0, ^{-}2)$ **W** at $(3, ^{-}4)$ **X** at $(^{-}1, 3)$
Y at $(^{-}3, ^{-}3)$ **Z** at $(^{-}4, ^{-}1)$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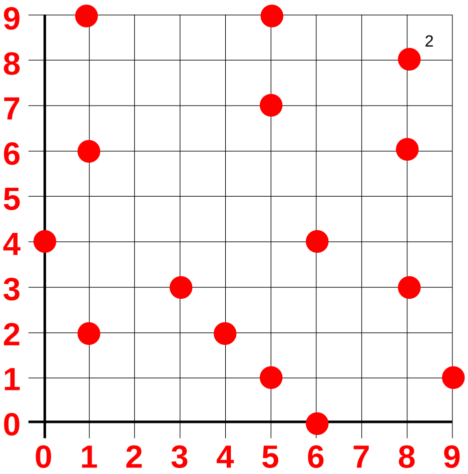
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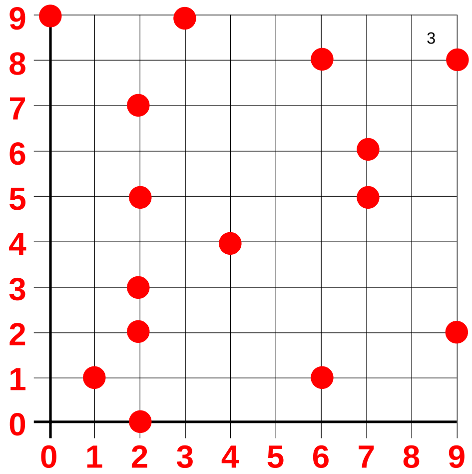
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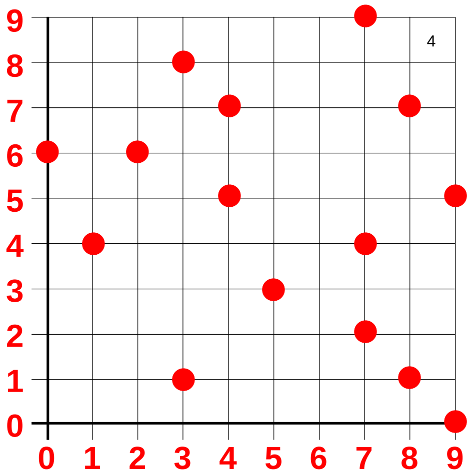
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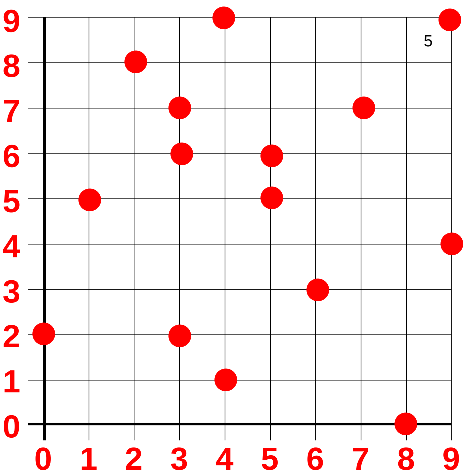
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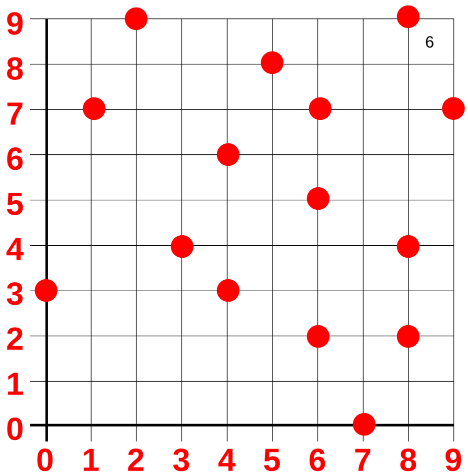
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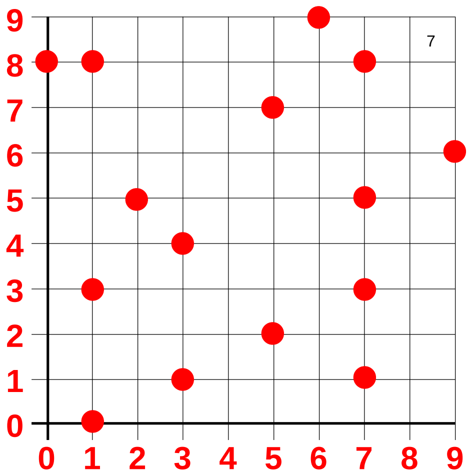
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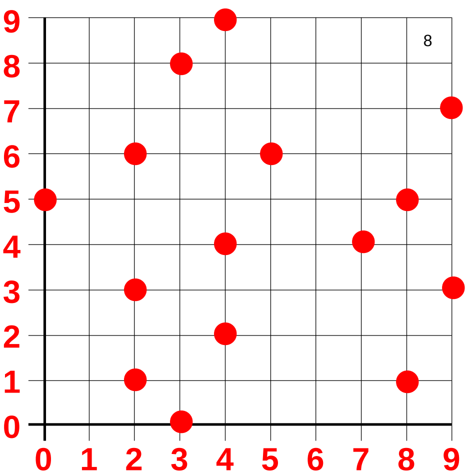
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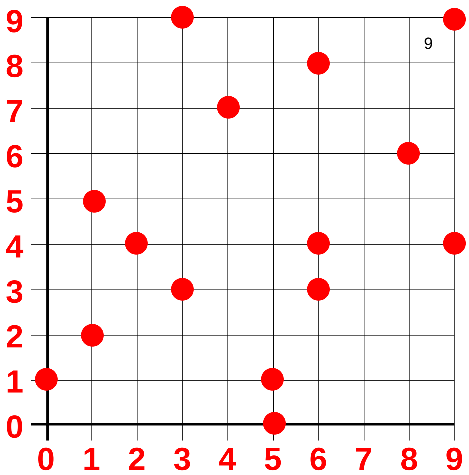
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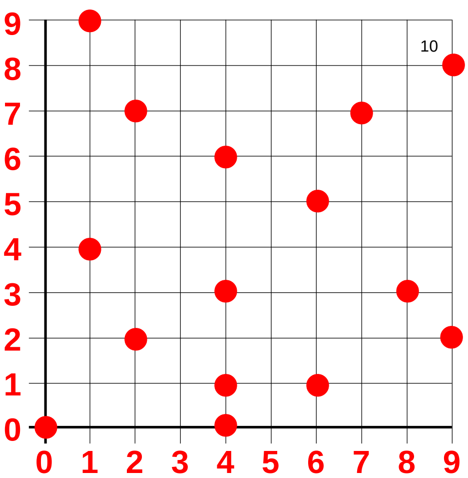
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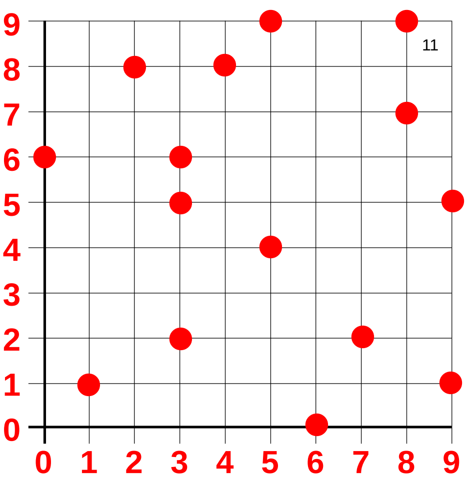
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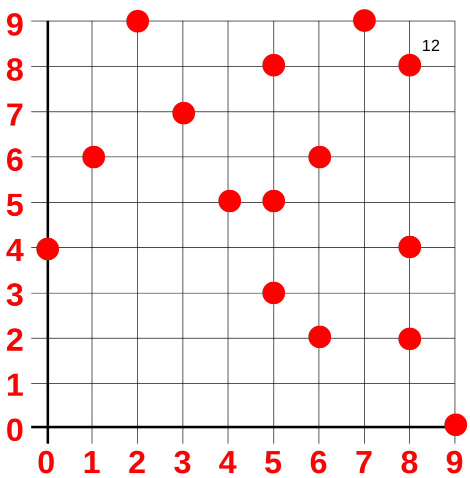
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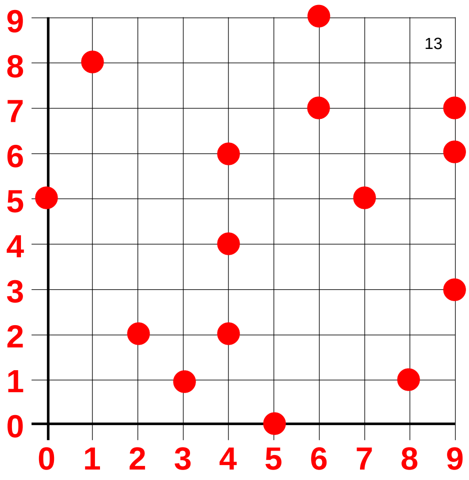
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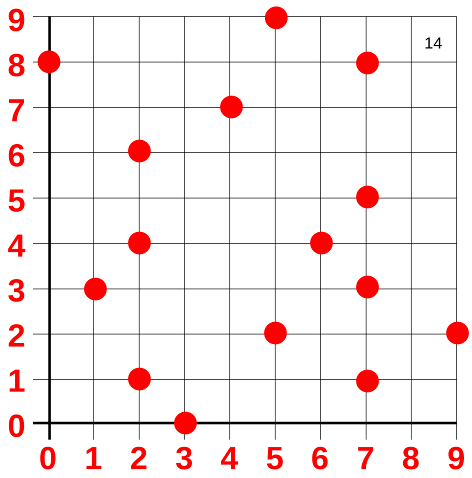
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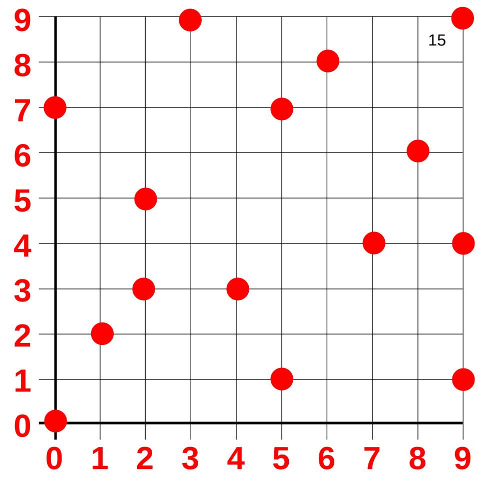
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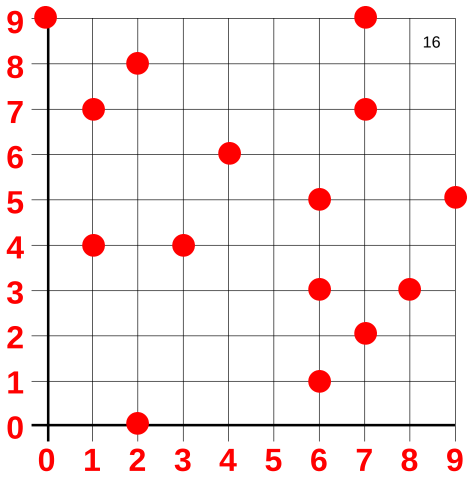
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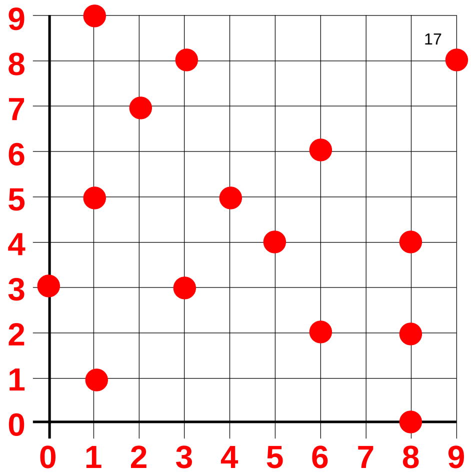
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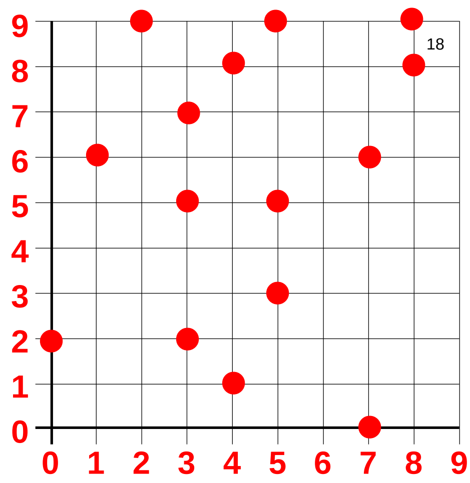
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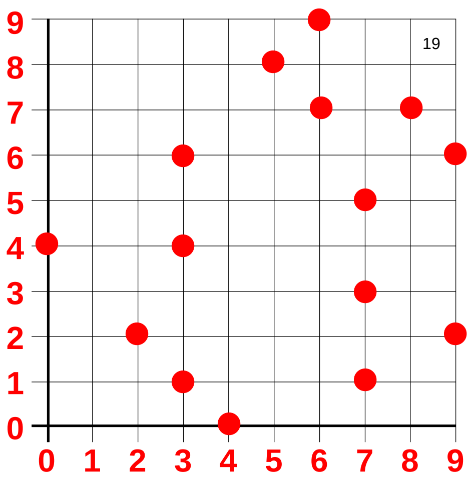
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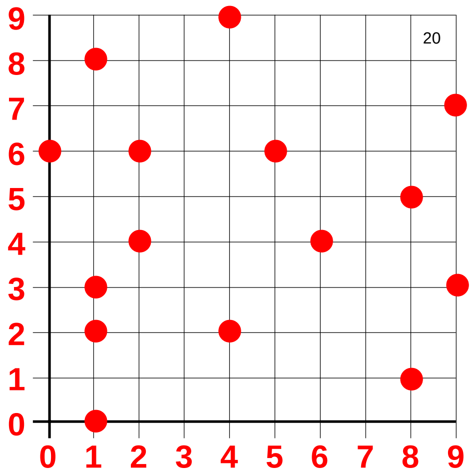
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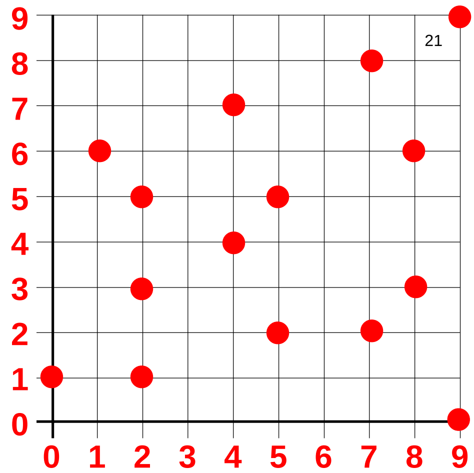
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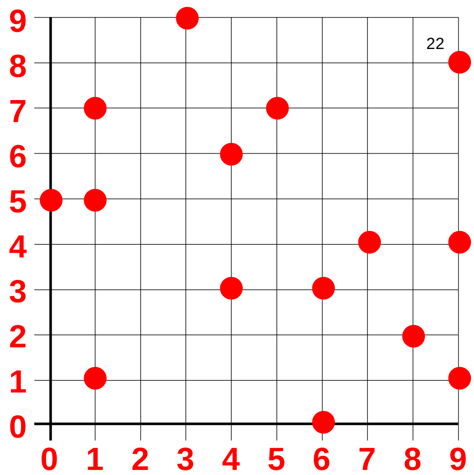
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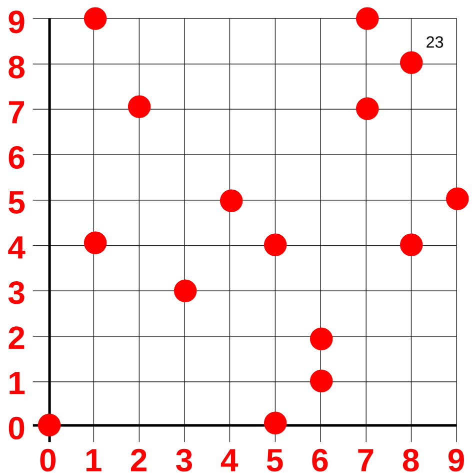
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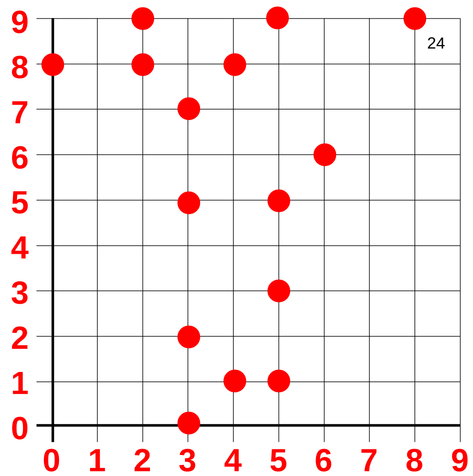
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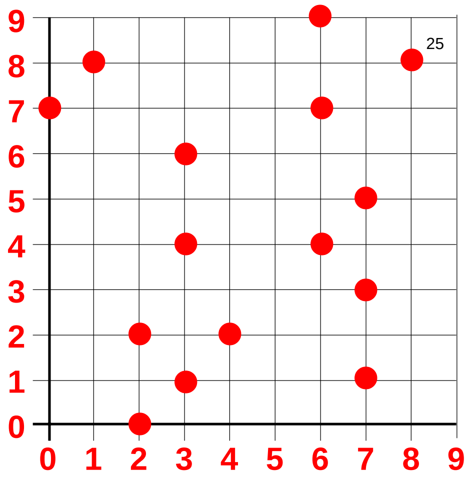
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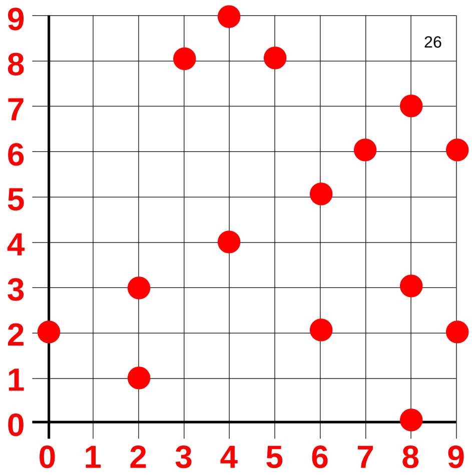
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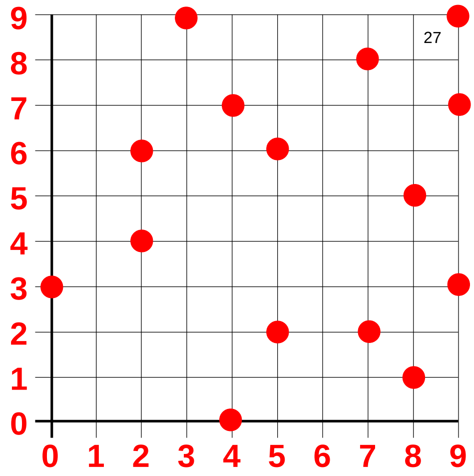
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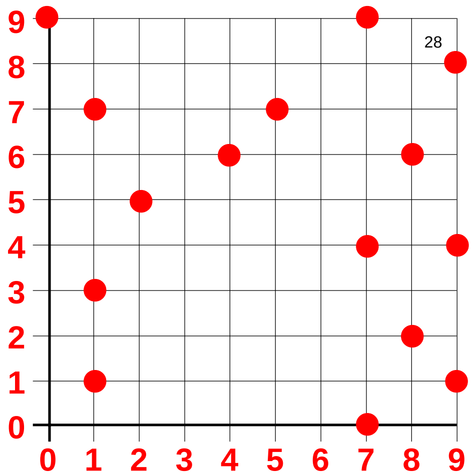
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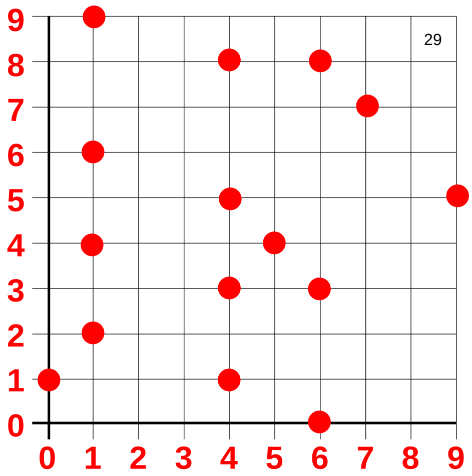
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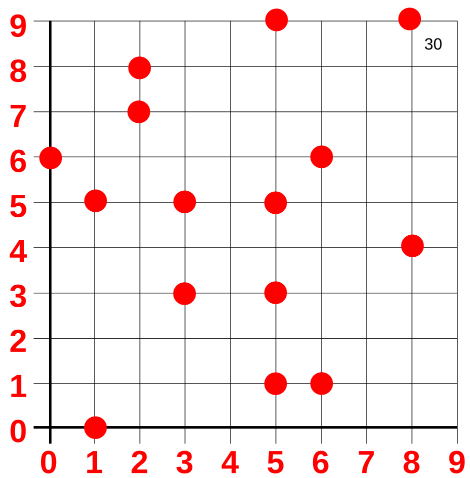
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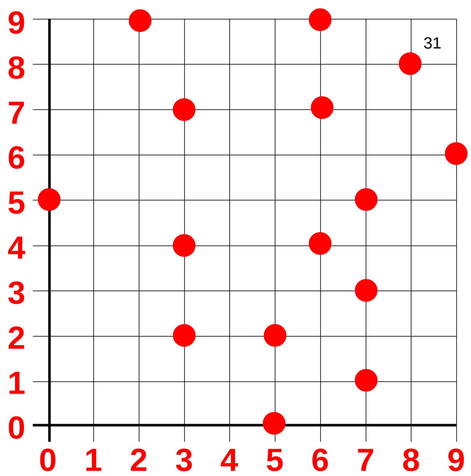
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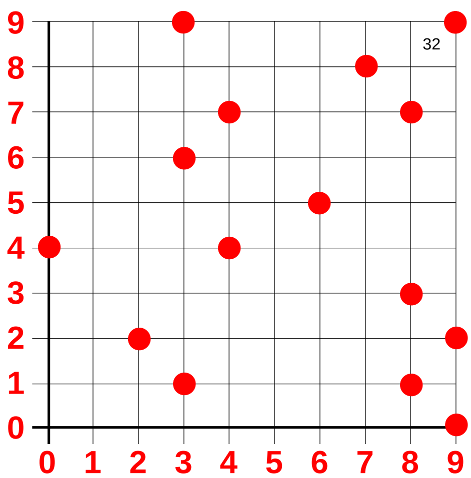
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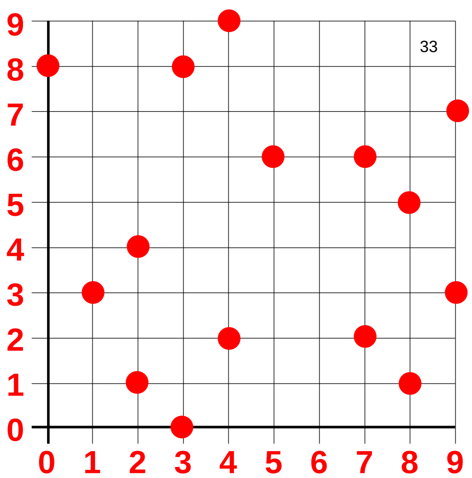
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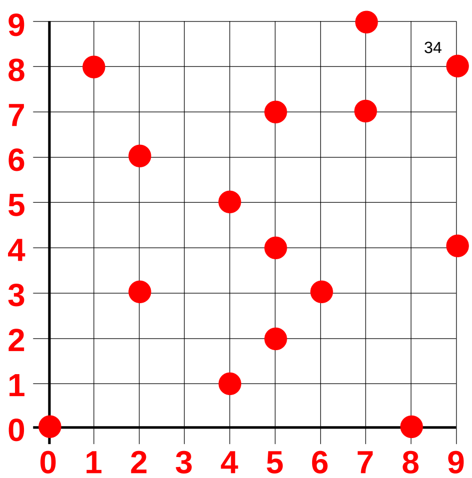
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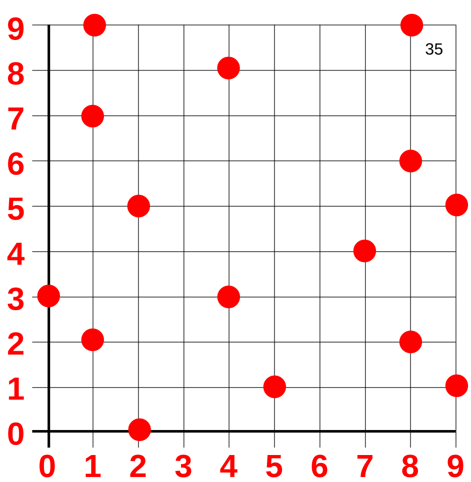
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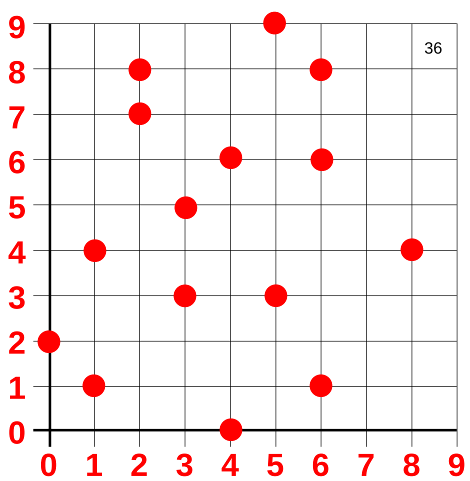
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(0, 0)	(0, 1)	(0, 2)	(0, 3)	(0, 4)	(0, 5)
(0, 6)	(0, 7)	(0, 8)	(0, 9)	(1, 0)	(1, 1)
(1, 2)	(1, 3)	(1, 4)	(1, 5)	(1, 6)	(1, 7)
(1, 8)	(1, 9)	(2, 0)	(2, 1)	(2, 2)	(2, 3)
(2, 4)	(2, 5)	(2, 6)	(2, 7)	(2, 8)	(2, 9)
(3, 0)	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)
(3, 6)	(3, 7)	(3, 8)	(3, 9)	(4, 0)	(4, 1)
(4, 2)	(4, 3)	(4, 4)	(4, 5)	(4, 6)	(4, 7)
(4, 8)	(4, 9)	(5, 0)	(5, 1)	(5, 2)	(5, 3)
(5, 4)	(5, 5)	(5, 6)	(5, 7)	(5, 8)	(5, 9)
(6, 0)	(6, 1)	(6, 2)	(6, 3)	(6, 4)	(6, 5)
(6, 6)	(6, 7)	(6, 8)	(6, 9)	(7, 0)	(7, 1)
(7, 2)	(7, 3)	(7, 4)	(7, 5)	(7, 6)	(7, 7)
(7, 8)	(7, 9)	(8, 0)	(8, 1)	(8, 2)	(8, 3)
(8, 4)	(8, 5)	(8, 6)	(8, 7)	(8, 8)	(8, 9)
(9, 0)	(9, 1)	(9, 2)	(9, 3)	(9, 4)	(9, 5)
		(9, 6)	(9, 7)	(9, 8)	(9, 9)

Teachers' Notes

In addition to the material supplied here, blank grids on which the work can be done are to be found under **Coordinate Grids** on the **trol** index page. The use of these pre-printed grids is recommended in early work in order to focus attention on their use and not waste time on their preparation.

The use of coordinates must appear somewhere in any mathematics syllabus, and the material provided here is intended to help in the introduction and practice of the necessary skills.

No matter how the topic is introduced, or what explanation is given for its need, it is important to make it clear that the order in which the numbers are stated to locate the point is of paramount importance. It is only a convention, but we must follow it if we all wish to get the same results!

There are essentially two distinct skills, one being the inverse of the other. They are

- Plotting a point from given coordinates
- Recording the coordinates of a given point

The second appears to be harder that the first, judging by the number of errors made. And both seem to be that little bit more difficult if one of the pair of coordinates is a zero, or the point lies on one of the axes.

A good introductory lesson can be woven around a large grid drawn on the overhead projector where the rationale for it can be explained, together with the need for order (and what happens when you don't have it). An early practice can consist of everyone having a grid and 'drawing a picture' as the points are dictated. For the first effort the picture can be drawn on the ohp at the same time as the points are called, so everyone can see what is happening one point at a time. This can then be repeated but with the ohp switched off until the picture is complete.

Practice Sheets 1, 2 and 3 provide further work, giving exercises in the reading and writing of coordinates.

Another form of practice is to play Coordinate Bingo as described on a later page.

Two sheets contain the basic tests for either the First or all Four quadrants. There are four tests on each sheet. To use them, make sufficient copies of the appropriate sheet, tear them into four, and stack them A, B, C, D, A, B, C, D, ... (or D, E, F, G). Then deal them out - face down - one to each pupil. That way, no adjacent pair of pupils will be doing the same test and 'helping' will be much more obvious. Turn the paper over, start . . . . . stop. Marking can be made a little easier if an overlay is made and marked with the points P to Z for each separate test.

Teachers' Notes

Transformation Grids

Among the sheets in the unit which contain the various Coordinate Grids are two which are identified as Transformation Grids 1 and 2. These are intended to demonstrate the usefulness of grids in changing shapes in some way.

Both sheets are identical in that each has 6 grids, with each grid having 10 lines in one direction with another set of 10 lines drawn in a direction (roughly) perpendicular to the first set. The lines forming the grids may be straight or curved, and the spacing between the lines varies. The left-hand middle grid is the same on both sheets and might be designated as the ‘original grid’ for purposes of standardisation. Any shape may be plotted and drawn on the original grid and then re-plotted and drawn on the surrounding grids.

Transformation Grids 1 provides, in addition to the original grid, other grids which give

- a one-way stretch in the vertical direction
- a one-way stretch in the horizontal direction
- a combination of the above, giving an enlargement
- a shear (but with some stretching involved)
- a one-way stretch, with one of the scales being logarithmic.

Transformation Grids 2 provides, in addition to the original grid, a lot more variety and could provide a starting point for more imaginative work.

Both sheets (though particularly the second) can provide even more variations by starting with the paper turned to a different positon. This can be investigated very efficiently by having four people, each starting with his or her paper in one of the four different orientations, and all working with the same ‘picture’ to be plotted and drawn on the original grid. For the most dramatic effect, it is best if the picture covers most of the grid and has no symmetry. A well-organised production by the whole class, with each group of four using a different original picture, makes for a very striking display.

Polar Coordinates

Also among the sheets provided under Coordinate Grids are two on Polar Coordinates. One is large for ohp work, the other gives two smaller grids for pupils' work. No exercises are provided here for these grids. Probably no more than a simple practice or two to show that the idea exists and how it works is appropriate at this level.

If reference should be made to the familiar grid used for displays in radar work, an important difference should be noted. In polar coordinates the angle is measured in an anti-clockwise direction starting from a 'horizontal' line. On the radar-display angles are measured in a clockwise direction starting from a 'vertical' line - this, of course, is the way directions are measured on the 360° compass, starting from North.

Teachers' Notes

Coordinate Bingo: A Popular Practice Activity

This is based on the game of 'Bingo', 'Lotto', 'Housey-Housey', or whatever it is, or has been, called in various countries and at various times.

In this version, the 'card' is a coordinate grid, representing the first quadrant only with the axes numbered from 1 to 9, and with 15 points already marked on the grid. These can be made by copying the sheets given on pages 7 to 9 and cutting them up into separate grids. Each grid is numbered in the top right hand corner cell, from 1 to 36. Stack them in numerical order and deal out one to each pupil. The cards are all different in some way and, using at least 8 cards in consecutive numerical order will ensure that nearly all of the 100 possible points on the card will be 'in play'.

Being all ready to play (does everyone have their own pencil or marker?) a 'random' set of coordinates now has to be generated. This can be done by copying (on card is best), and cutting up, the set of coordinates from (0, 0) to (9, 9) given on page 10; mix them up and draw them one at a time. Players mark off the dots on their card (with a distinctive cross) if and when it is called. Since a record has to be kept in some way for checking a winning claim, it could be done on an ohp - probably best switched off while play is actually in progress.

Usually, with a winner (or possibly more than one) established, there are pleas to continue playing in order to establish a 'second', 'third', and so on. (Some fine judgement called for here.) This game has always been well-received and enjoyed, generally with requests to play another game.

Variations

The players could make their own cards. Each player marks 15 dots on a grid - on the intersections of the lines of course. (You might wish to lay an additional condition on this: that *at least* one dot must be on the ***x***-axis, and one dot on the ***y***-axis, since these positions often provide difficulties for beginners.) Players then swop cards among themselves and check that each card does indeed have 15 dots marked on it, before returning the card to its originator. (Or players could be made to retain the card they have been given - not usually popular!).

A 'better' way of getting the necessary coordinates is to move from player to player in some regular and systematic manner. The controller points to one of the dots which that player has marked on his or her grid (and which has not already been crossed off) and the player calls out the coordinates (as an ordered pair) of that dot. To remove all doubt, the controller **repeats** the call and records it on the master grid. Supplementary rule here: it is the coordinates called by the player which matter - not the true coordinates of the dot being pointed at by the controller. If the player calls wrongly - say (5,7) for (7,5) - then the error is pointed out and the player cannot cross off that dot (but they might happen to have a dot at the other position of course. Another supplementary: if a player has only one dot not crossed off on their grid then no call is taken from that player - this builds up the tension considerably!

After about two rounds of the classroom have been done (or about 60 points called) it can be interesting to ask “How many are waiting on 1 dot … 2 dots … etc.” It also helps to keep the feeling of playing a game rather than doing a mathematical exercise.