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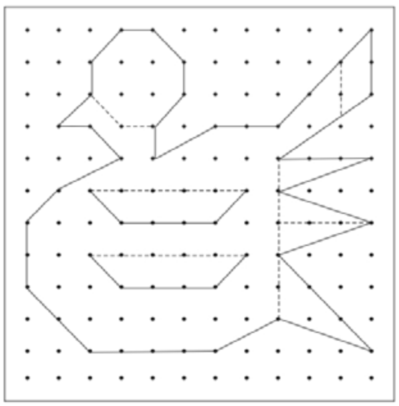
GEOBOARD

Given geoboard is made of 6 mm blue acrylic. It is of the size 12" x 12" with 120 pegs. These pegs are fixed with a gap of 22mm between them. Rubber bands, twines, ink pen, and scale are required to do the experiments with geoboard

LEARNING :

Shape : At primary level shape is basic concept in geometry. Stretch rubber bands around any number of pegs (or use twine - tie one end of twine to one peg and move it around any number of pegs), make your own shapes and enjoy. Here are few illustrations.

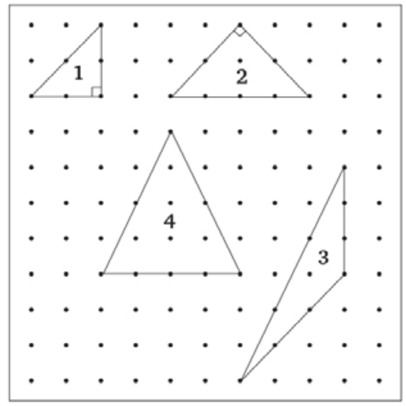


This pretty duck wants you to search for :

1. Octagon 2. Open Curve 3. Isosceles triangle
4. Trapezia 5. Parallel lines 6. Any other shapes !!

You can do many other drawings using geometrical shapes.

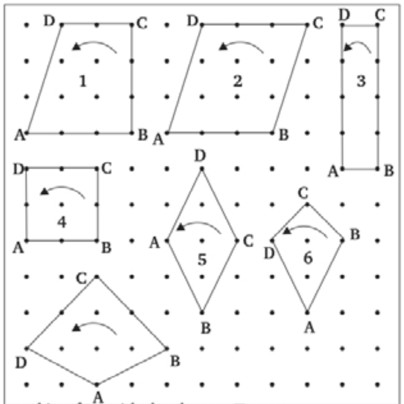
UNDERSTANDING TRIANGLES :



* Take a rubber band and stretch it around any three pegs (which are not in a straight line) this forms a triangle.

1. **Right angled triangle :** Take a rubber band and stretch along a row around a peg, then continue up or down along a column and release at a peg.
2. **Isosceles triangle :** Stretch the rubber band around two pegs which are at certain distance. Let the no. of pegs in between be odd nos. Now stretch one part of the rubber band and replace it around another peg up or down such that the third peg is at equidistant from the first two pegs or the third peg is exactly in the same column of the middle peg of the first two pegs.
3. Form an obtuse angled triangle, acute angled triangle as shown in fig. (3)
4. Form an equilateral triangle as shown in fig (4)

UNDERSTANDING QUADRILATERALS :



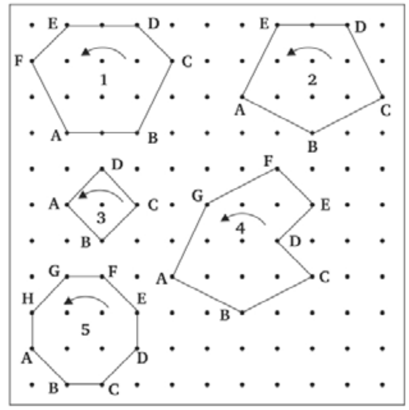
A quadrilateral is a four sided polygon. Types :

Trapezium (See Fig. 1)**:** Stretch the rubber band say from a point A to D crosswise, then rowwise to the point C, then either crosswise or columnwise (up or down) to B which is in the same row as that of A and bring back to A just by releasing. You can choose as many no. of pegs as you desire from A to D, D to C, C to B and B to A. This is a trapezium as AB and DC are parallel

Parallelogram (See the fig. 2)**:** Hang the rubber band say at point A and stretch straight to B, turning around B stretch it cross wise to C, again from and around C stretch to D which is in the same row as that of C, bring back to A cross wise. But the no. of the pegs between A and B must be equal to the no. of pegs between C to D and the no. of pegs between B and C is equal to No of pegs between D to A

Similarly you can form Rectangle (fig.3), Square (fig.4), Rhombus (fig.5), Kite (fig.6) etc.

UNDERSTANDING POLYNOMIALS :

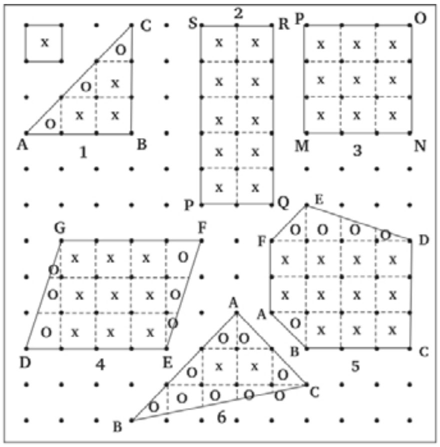


To construct a hexagon (see fig.1), starting from A stretch the rubber band to B rowwise from B to C crosswise (up) from C to D crosswise (up) from D to E rowwise, E to F crosswise (down) from F to A crosswise (down). The direction of stretch may be clockwise or anticlockwise for fig. but not both for a single fig.

Fig 1 has 6 sides and is a hexagon
Fig 2 has 5 sides and is a pentagon
Fig 3 has 4 sides and is a quadrilateral
Fig 4 has 7 sides and is a heptagon
Fig 5 has 8 sides and is a octagon
For a regular polygon let the no of pegs contained for each side be same.

FINDING AREAS FROM GEOBOARD :

Each smallest square in a geoboard can be treated as 1 sq. unit (may be mm, cm or m) as it is made up of equidistant pegs rowwise and columnwise consecutively. In the below fig. a square with mark X is one such square unit.



To find the area of any shape, count the no. of squares (marked as x) and the no. of triangles (marked as O). Then the total no. of squares is added with the half of total no. of triangles. This sum will give you the area of the shape. you can verify the results with the known formulae as follows :

1. Area of triangle ABC (See fig. 1)

   By formula Area Δ ABC = 1/2 base x height
   = 1/2 AB x BC
   = 1/2 3 x 3 = 9/2 sq.units

   By counting Method :

   No. of squares in the Δ ABC = 3
   No. of triangles in Δ ABC = 3
   Area of Δ ABC = 3 + 3/2 = (6+3)/2
   = 9/2 sq.units

2. Area of rectangle PQRS (See Fig.2)

   By formula Area of PQRS = base x height
   = PQ x RS
   = 5 x 2 = 10 sq.units

   By counting Method :

   No. of squares inside PQRS = 10 sq.units

3. Area of square (see fig.4) MNOP :

   by formula area of MNOP = side x side
   = MN x MN = 3x3
   = 9 sq.units

   by method of counting :
   the no. of squares inside MNOP = 9
   Area of square MNOP = 9 sq.units

4. Area of parallelogram DEFG (see fig.4)

   area of parallelogram = base x height
   = 4 x 3 = 12 sq.units

   By counting method :

   In this few are neither full triangles nor full squares. In such case, consider the shape (shape with dotted line inside the entire fig.4) which seems to be more than half of one square as full square and neglect that shape which seems to be less than half of one square.

   Under these consideration the total no. of such squares inside the parallelogram DEFG is 12.

   So, the area of parallelogram DEFG = 12 sq.units

5. Area of irregular shapes :

   For irregular shapes, count the no. of exact square units inside the shape, count the no. of exact triangles, count the no. of shapes which seems to be more than half of one square unit as one square unit otherwise neglect it.

   Then area of the shape = No. of square units + 1/2 no of triangles + no. of square units which are more than the 1/2 square unit

   e.g. Area of ABCDEF = 13+ 1/2 x 2
   13+1 = 14 sq.units

6. Area of triangle ABC (se fig.6)

   by formula Area of Δ ABC = 1/2 x AC x AB
   = 1/2 x 2 $(\sqrt{2})$ x 3 $(\sqrt{2})$
   = 6 x 2/2
   = 6 sq.units

   By counting :
   no. of squares = 2, no. of more than half the square = 2
   no. of complete triangles = 5

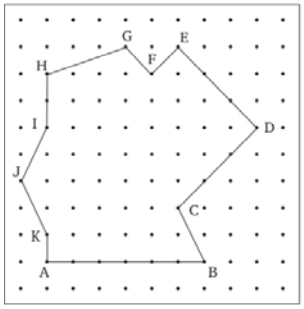
Area of D ABC $= 2 + 2/2 + 5/2 = 2 + 7/2$

$= 11/2 = 5.5$ sq.units

This is in close approximation with the area by formula.

Now can you find the area of the duck given on the page 1?

Alternate Method of finding the area of irregular shape using no. of pegs :



The area of the any irregular shape is given by

$A = i + (b/2) - 1$

Where i is the no. of pegs inside the polygon and b is the no. of pegs on the polygon.

For the above irregular shape given in the figure

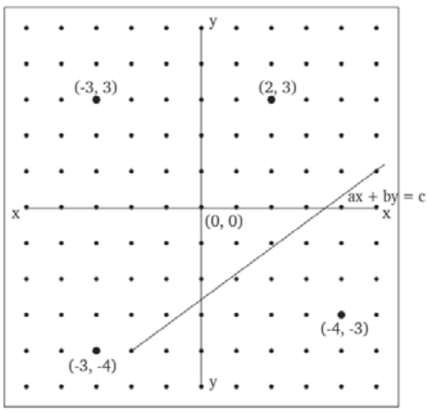
$i = 40$ and $b = 21$

so area $= 40 + (21/2) - 1$

$= 49.5$ sq.units

You can verify this by counting the unit squares and triangle methods.

UNDERSTANDING THE CARTESIAN PLANE :



Stretch the rubber band from the exact (or approximate) middle peg of the top row, straight down and release it at a peg in the last row but in the same column.

Similarly stretch a rubber band from the exact (or approximate) middle peg of the first column (to the left) straight to the right and release it at a peg (middle) of the last column but in the same row.

This divides the board into 4 parts. This can be considered as the 4 quadrants of the cartesian plane.

The rubber band stretched at the middle row is x-axis and stretched rubber band at the middle column is y-axis. To plot the co-ordinate P(2,3) (At the first quadrant) with fore fingers of both hands, starting from origin O(0,0), count 2 pegs along x axis with right hand and 3 pegs along y-axis with left hand.

Advance the left hand up to 2 pegs at the right and advance the right hand up to 3 pegs above the peg where the tip of the finger meet is the co-ordinate (2,3).

Similarly plot other co-ordinates of your choice. Confirm that (0,y) is along y-axis and (x,0) is along x-axis.

Using the twine observe that the curve plotted by an equation $ax + by = c$ a straight line (linear graph).

Extend the use of this method for finding the solution of simultaneous linear equations like

$a_1x + b_1y + c_1 = 0$

$a_2x + b_2y + c_2 = 0$