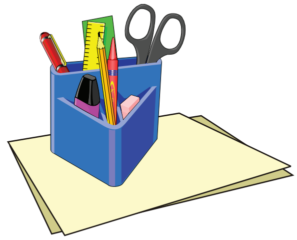
Activity 1



Objective

To verify that addition of whole numbers is commutative

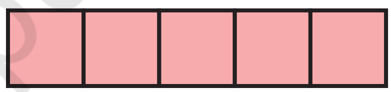
Material Required

Cardboard, white paper, graph strips, scissors, glue.

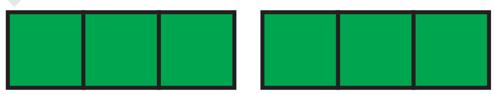
Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.

2. Take a graph paper and make two strips containing 'a' squares, say, 5 squares each and colour them pink.



3. Similarly, make two strips each containing 'b' squares, say, 3 squares and colour them green.



4. Draw two straight lines on the cardboard as shown in Fig. 1.

Fig. 1

Demonstration

1. Now paste the pink and green strips side by side on lines l_1 and l_2 as shown in Fig. 2.

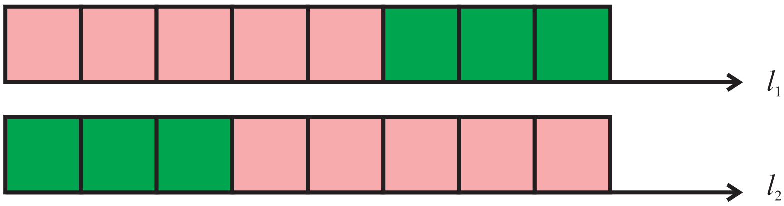


Fig. 2

Observation

From Fig. 2,

The length of the combined strips on line l_1 = 5 + 3.

The length of the combined strips on line l_2 = 3 + 5.

From Fig. 2, one can see that the length of combined strips on l_1 is the same as the length of combined strips on l_2.

So, 5 + 3 = 3 + 5.

That is, addition of 5 and 3 is commutative.

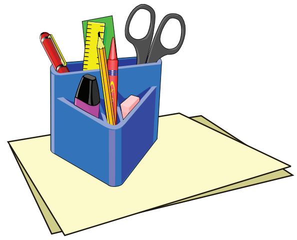
Repeat this activity by taking different pairs of numbers like 4, 5; 7, 2; 6, 7 and strips corresponding to these pairs.

Addition of whole numbers is _______.

Application

This activity can also be used to verify associative property for addition of whole numbers.

Activity 2



Objective

To verify that multiplication of whole numbers is commutative

Material Required

Cardboard, white sheet, graph paper/grid paper, colours, glue, scissors.

Method of Construction

1. Take a cardboard of a convenient size and cover it neatly with white sheet and graph paper.

2. To show 4 × 3 on a graph paper/grid paper, colour four columns of 3 squares each, with pink colour as shown in Fig. 1.

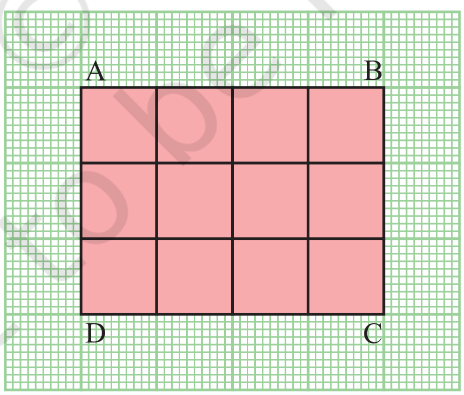


Fig. 1

3. To show 3 × 4 on a graph paper, colour 3 columns of 4 squares each with blue colour as shown in Fig. 2.

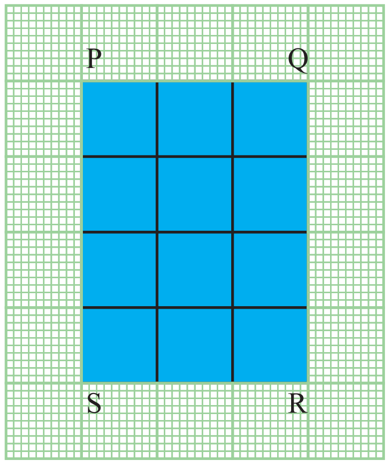


Fig. 2

4. Cut the coloured portion from both the graph papers and paste one coloured (say, pink) graph sheet on the cardboard.

Demonstration

1. Try to place the other coloured sheet over the pasted one in such a way that it exactly covers the pasted sheet.
2. PQ or SR of blue colour sheet covers exactly AD or BC of pink colour sheet.
3. PS or QR of blue colour covers exactly AB or CD of pink colour sheet.

Observation

On actual counting:

1. Number of squares of pink colour = _______ = 3 × _____.
2. Number of squares of blue colour = _______ = _____ × 3

   So, 3 × _____ = 4 × _____.

   Thus multiplication of 3 and 4 is commutative.

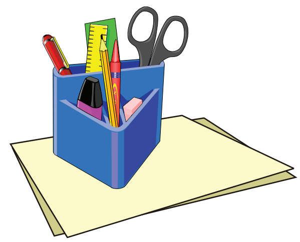
   Repeat this activity by taking some more pairs of strips.

   Multiplication of whole numbers is commutative.

Application

This activity can be used to explain the commutativity of multiplication of any two whole numbers. It can also be used to find the area of a rectangle.

Activity 3



Objective

To verify distributive property of whole numbers

Material Required

Chart paper, pencil, geometry box, eraser, sketch pens of blue and red colours.

Method of Construction

1. Draw three different line-segments of lengths a = 5 cm, b = 2 cm and c = 1 cm, respectively as shown in Fig. 1.

Fig. 1

2. Construct a rectangle ABCD with sides 'a' and $(b + c)$ (Fig. 2).

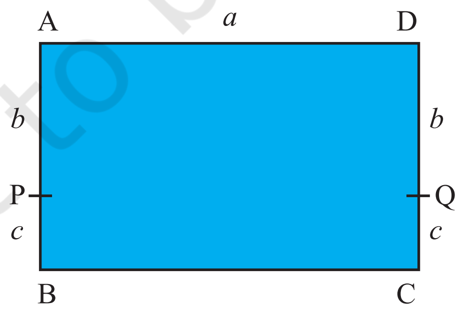


Fig. 2

3. Mark points P and Q on sides BA and CD respectively such that BP = CQ = c. Join PQ (Fig. 3).

4. Shade the part APQD with blue colour and the part BCQP with red colour.

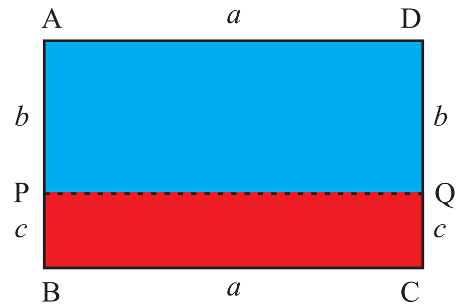


Fig. 3

DEMONSTRATION

1. From Fig. 2, area of the rectangle ABCD = $a \times (b + c)$.
2. From Fig. 3, area of the rectangle APQD = $a \times b$.
3. From Fig. 3, area of the rectangle PBCQ = $a \times c$.

   Also area of rectangle ABCD = area of APQD + area of PBCQ.

   So, $a \times (b + c) = a \times b + a \times c$.

OBSERVATION

Repeat the activity by taking different values of a, b and c.

On actual measurement:

a = ______.

b = ______.

c = ______.

Area of rectangle ABCD = _______.

Area of rectangle APQD = _______.

Area of rectangle PBCQ = _______.

Area of rectangle ABCD = Area of rectangle _____ + Area of rectangle _____.

So, $a \times (b + c) = (a \times$ ____) + ($a \times$___).

APPLICATION

1. This activity can be useful in explaining distributive property of whole numbers. This property is also useful in simplifying different expressions.

2. The above activity may be extended to explain the identity

   $(a + b)(c + d) = ac + ad + bc + bd$

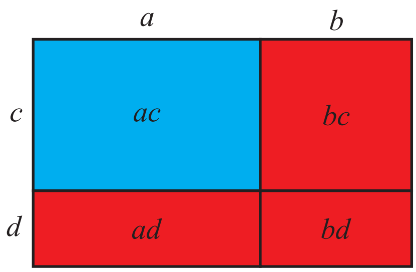
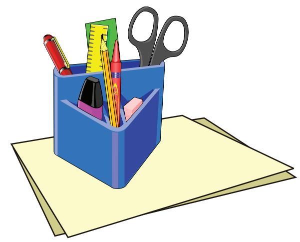


Fig. 4

Activity 4



Objective

To verify distributive property of multiplication over addition of whole numbers

Material Required

Cardboard, white sheet, grids of different dimensions, colours, scissors, glue, pen/pencil.

Method of Construction

1. Take a cardboard of a convenient size and cover it with a white sheet.
2. On a grid, colour 10 columns of 5 squares each with the same colour (say red) as in Fig. 1.

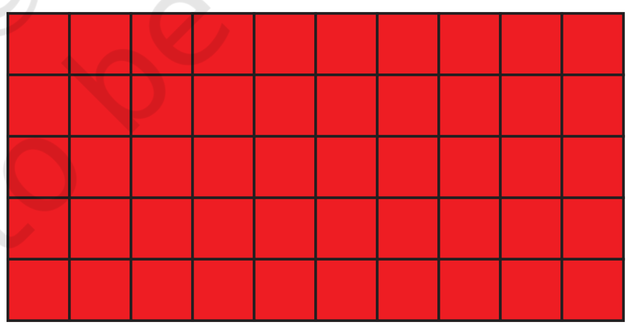


Fig. 1

3. Paste it neatly on the cardboard.
4. Now take three sets of grid papers and colour them as indicated below (Fig. 2). Make their cutouts also.

Set A :	5 columns of 5 squares	Pink colour
	5 columns of 5 squares	Pink colour
Set B :	3 columns of 5 squares	Blue colour
	7 columns of 5 squares	Blue colour
Set C :	4 columns of 5 squares	Yellow colour
	6 columns of 5 squares	Yellow colour

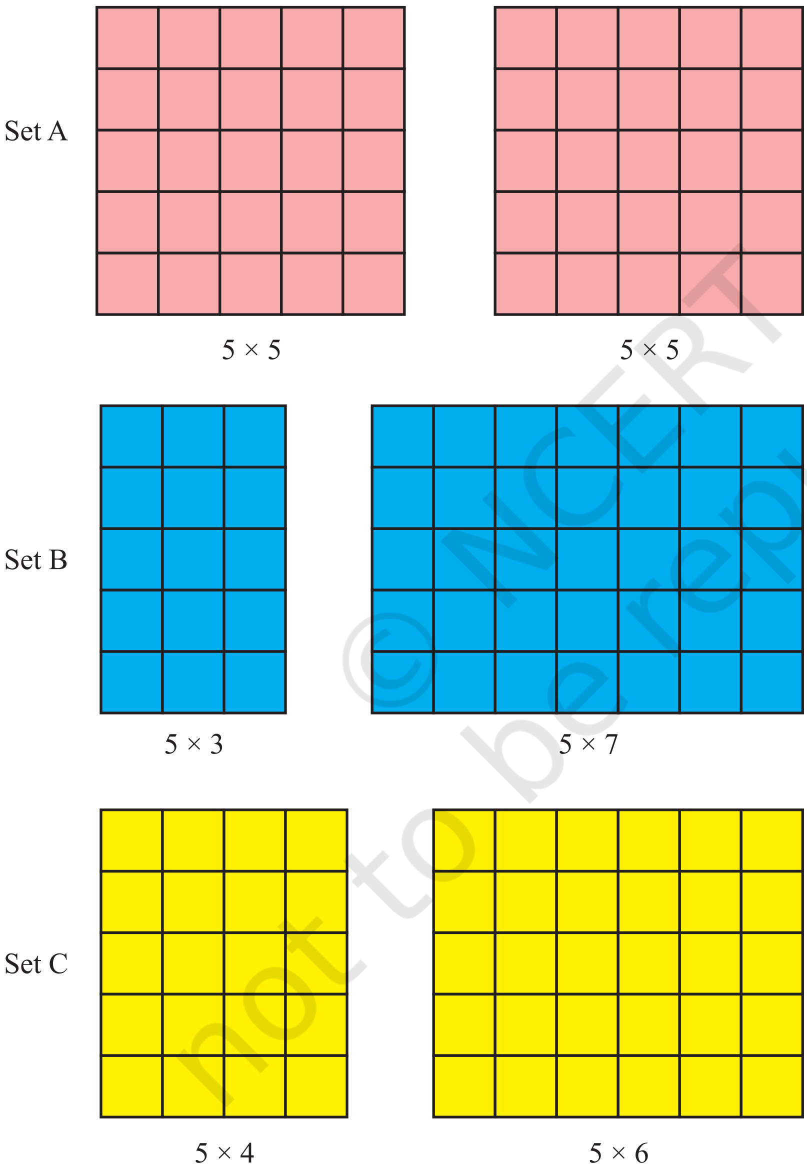


Fig. 2

Demonstration

1. Place the sets one above the other on the coloured grid in Fig. 1.
2. Both the sheets of set A when arranged side by side leaving no space between them will cover the pasted sheet exactly.

   So, $5 \times 10 = 5 \times 5 + 5 \times 5$.

   i.e. $5 \times (5 + 5) = 5 \times 5 + 5 \times 5$.
3. Both the sheets of set B when arranged side by side leaving no space between them will cover the pasted sheet exactly.

   So, $5 \times 10 = 5 \times 3 + 5 \times 7$.

   i.e., $5 \times (3 + 7) = 5 \times 3 + 5 \times 7$.
4. Both the sheets of set C when arranged side by side leaving no space between them will cover the pasted sheet exactly.

   So, $5 \times 10 = 5 \times 4 + 5 \times 6$.

   or, $5 \times (4 + 6) = 5 \times 4 + 5 \times 6$.

Observation

On actual counting of the squares:

$5 \times 10 =$ _______, $5 \times 5 =$ _______, $5 \times 5 =$ _______,

$5 \times 3 =$ _______, $5 \times 7 =$ _______,

$5 \times 4 =$ _______, $5 \times 6 =$ _______.

$5 \times 10 = 5 \times 5 + 5 \times$ _______.

$5 \times 10 = 5 \times 3 + 5 \times$ _______.

$5 \times 10 = 5 \times$ ___ $+ 5 \times 6$.

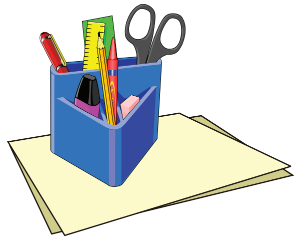
Repeat this activity for different such sets.

In general, $a \times (b + c) = a \times b + a \times c$.

Application

1. This activity may be used to explain distributive property of multiplication over addition of whole numbers which can be further used to simplify different expressions.
2. The activity can also be used to verify the distributive property of multiplication over subtraction of whole numbers.

Activity 5



Objective

To find HCF of two numbers

Material Required

Coloured strips, scissors, glue, ruler, pen/pencil.

Method of Construction

1. Take a cut out of one strip of length '*a*' (say 16 cm) and another strip of length '*b*' (say 6 cm) (Fig. 1).

Fig. 1

2. Place strip '*b*' over strip '*a*' as many times as possible (Fig. 2).

Fig. 2

3. Cut the part of strip '*a*' left out in the above step.

4. Place this cut out part of strip '*a*' as obtained from Step 3 on strip '*b*' as shown in Fig. 3.

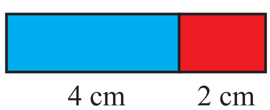


Fig. 3

5. Again cut the left out part of strip '*b*' as obtained in the above step.

6. Place the cutout part of above strip as many times as possible on the other part of strip '*b*' obtained in Step 4 as shown in Fig. 4.

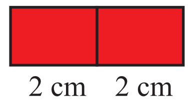


Fig. 4

Demonstration

Since the left out part of strip *b* in Step 5 covers the other part of strip '*b*' at Step 6 completely, HCF of 16 and 6 is 2 (length of the last cut out part).

It can be seen that a strip of length 2 cm can cover both the strips of length 16 cm and 6 cm complete number of times.

Similarly, HCF of other two numbers may be found out by taking strips of suitable lengths.

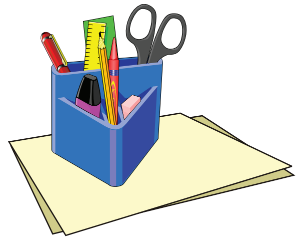
Observation

a	*b*	HCF
16	6	2
18	12	-
20	8	-
21	5	-

Application

The activity may be used for explaining the meaning of HCF of two or more numbers, which is useful in simplifying rational expressions.

Activity 6



Objective

To find L.C.M. of two numbers

Material Required

White drawing sheet, colours, glue, scissors, cardboard, pen/pencil.

Method of Construction

1. Make three grids each of size 10 cm × 10 cm and write numbers 1 to 100 on one grid (Fig. 1).

2. Stick this grid on a cardboard base of a suitable size.

3. Cut out the multiples of one of the numbers a (say 4) from one grid (Fig. 2).

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	38	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Fig. 1

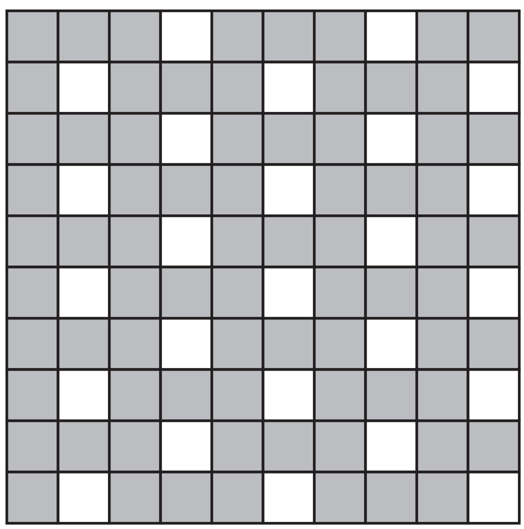


Fig. 2

4. Cut out the multiples of another number *b* (say 6) from another grid (Fig. 3).

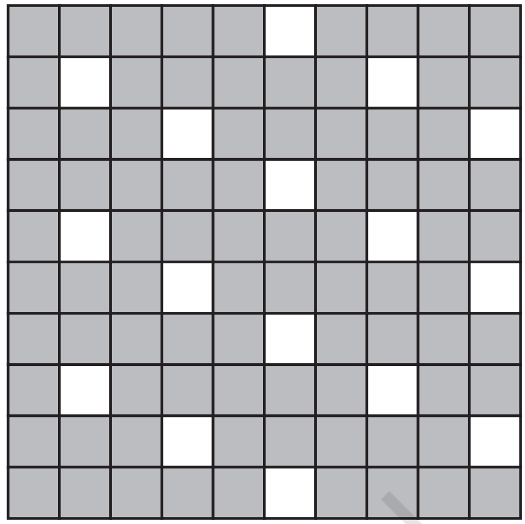


Fig. 3

Demonstration

1. Place both the cut out grids one above the other over the base grid (Fig. 4).
2. Common multiples of 4 and 6 visible through the holes are 12, 24, 36, 48, 60, 72, 84, 96.
3. The smallest of these common multiples is the L.C.M of 4 and 6.

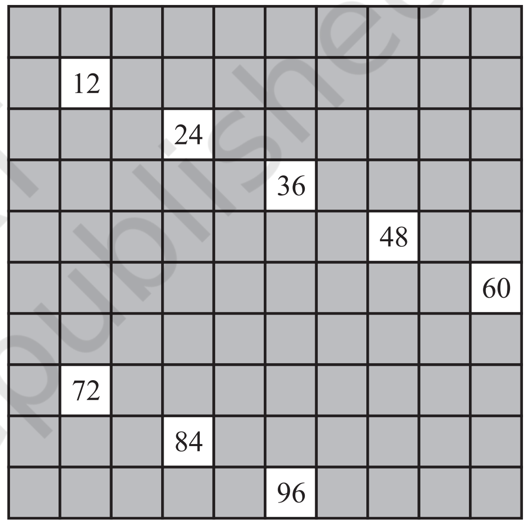


Fig. 4

Observation

1. The smallest visible common multiple of 4 and 6 is ______.
2. LCM of 4 and 6 is ______.

Now complete the table by making different grids:

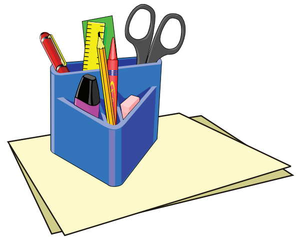
Number *a*	Number *b*	L.C.M
4	6	12
5	10	–
6	9	–
3	7	–

Application

This activity can be used to find:

1. Common multiples of given numbers.
2. Least common multiple of given numbers.

Activity 7



Objective

To find fractions equivalent to a given fraction

Material Required

White chart paper, soft cardboard, glue, ruler, pencil, sketch pens, scissors.

Method of Construction

Let us find fractions equivalent to $\frac{1}{2}$.

1. Draw four rectangles of dimensions 16 cm × 2 cm on the white chart paper and cut these out with the help of scissors.
2. Fold all the strips into two equal parts.
3. Unfold one of them, colour one part and paste the strip on the cardboard as shown in Fig.1.

Fig. 1

4. Take another strip, fold it again, unfold it and colour its two equal parts as shown in Fig. 2.

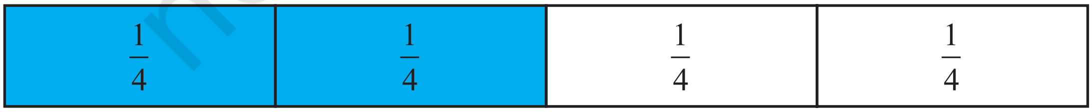


Fig. 2

5. Paste it on the cardboard below the first strip as shown in Fig. 2.

6. Take the third strip. Fold it twice. Unfold it and colour its 4 equal parts as shown in Fig. 3.

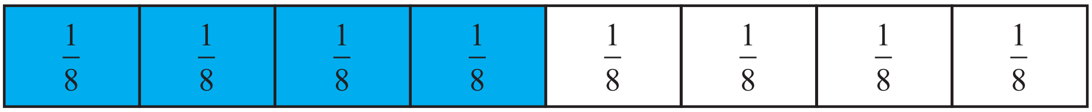


Fig. 3

7. Paste it on the cardboard just below the second strip as shown in Fig. 3.

8. Continue the process for the fourth strip and paste it on the cardboard as shown in Fig. 4.

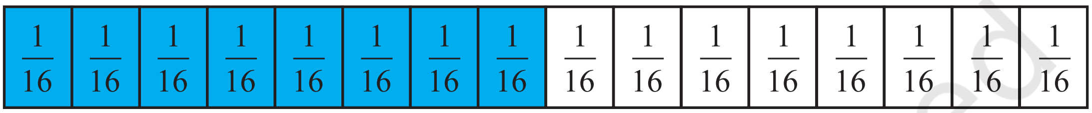


Fig. 4

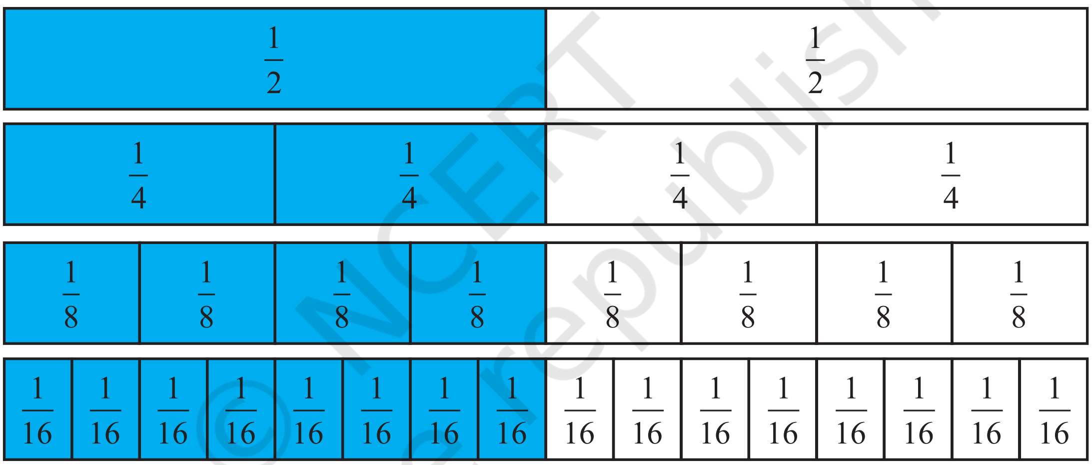


Fig. 5

Demonstration

1. In all the figures, coloured portion in each strip is equal (Fig. 5).

2. Note down the fractions represented in Fig. 1, Fig. 2, Fig. 3 and Fig. 4.

Observation

1. In Fig. 1, coloured portion represents the fraction $\frac{1}{2}$.

In Fig. 2, coloured portion represents the fraction $\frac{2}{4}$.

In Fig. 3, coloured portion represents the fraction _______.

In Fig. 4, coloured portion represents the fraction _______.

Since, coloured portions of all strips are equal, so,

$\frac{1}{2} = \underline{\qquad} = \underline{\qquad} = \frac{8}{16}$.

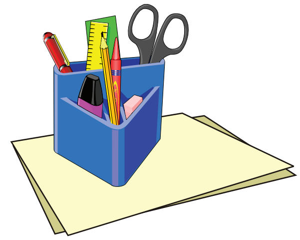
Thus, $\frac{2}{4}, \frac{4}{8}, \frac{8}{16}$ are fractions equivalent to the fraction $\frac{1}{2}$.

In a similar way the activity can be performed for finding equivalent fractions of $\frac{1}{3}, \frac{2}{3}, \frac{3}{4}$ etc.

APPLICATION

This activity can be used to explain the meaning of equivalent fraction.

Activity 8



Objective

To find the sum of fractions with same denominators [say, $\frac{1}{5}+\frac{3}{5}$]

Material Required

Square sheet, sketch pens of different colours.

Method of Construction

1. First fold the square sheet along any side four times to make five equal parts.

2. Again fold the square sheet four times along another side to make five equal parts to get a 5 × 5 grid having 25 small squares (Fig. 1).

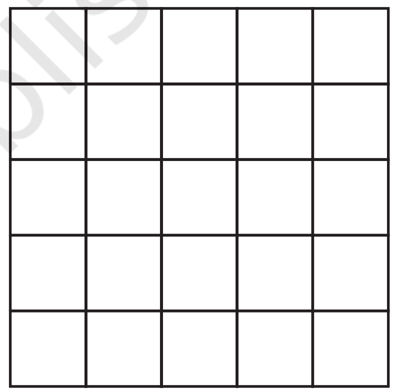


Fig. 1

3. Mark each small square of any row, say first row, by '+' sign with red sketch pen (Fig. 2).

4. Mark each small square of first three columns by '+' with blue sketch pens (Fig. 3).

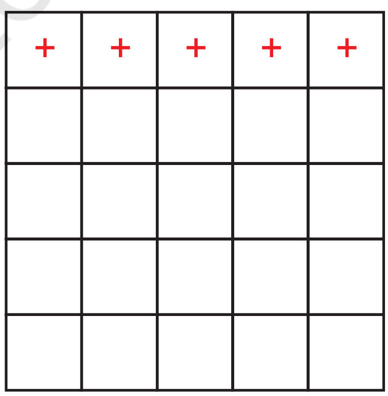


Fig. 2

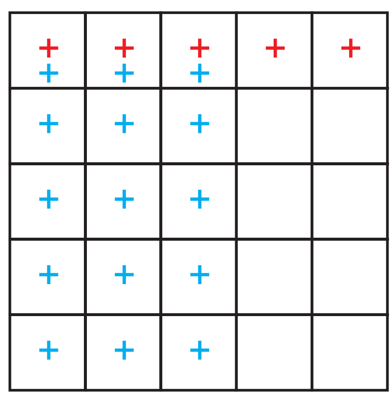


Fig. 3

5. We obtain 20 coloured '+' signs in the box of 25 small squares.

Demonstration

1. Count the total number of '+' signs in Fig. 3. There are 20 '+' signs in all.

2. Fraction represented by 20, '+' signs = $\frac{20}{25} = \frac{4}{5}$.

3. In Fig. 3, there are 25 small squares in all.

4. Five red '+' signs represent the fraction $\frac{5}{25} = \frac{1}{5}$.

5. Fifteen blue '+' signs represent the fraction $\frac{15}{25} = \frac{3}{5}$.

6. Fraction of the portion covered by '+' signs = $\frac{5}{25} + \frac{15}{25}$.

7. So, $\frac{5}{25} + \frac{15}{25} = \frac{20}{25}$ or $\frac{1}{5} + \frac{3}{5} = \frac{4}{5}$.

NOTE

This activity can also be performed by directly taking any row to represent $\frac{1}{5}$ and any other three rows to represent $\frac{3}{5}$.

Observation

1. Red '+' signs represent the fraction $\frac{\_\_\_}{25} = \frac{\_\_\_}{5}$

2. Blue '+' signs represent the fraction $\frac{\_\_\_}{25} = \frac{\_\_\_}{5}$

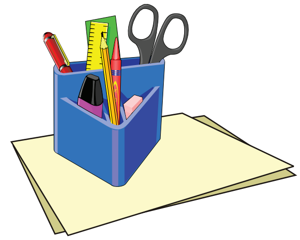
3. Total number of '+' signs represents the fraction $\frac{\_\_\_}{25} = \frac{\_\_\_}{5}$

   So, $\frac{1}{5} + \frac{3}{5} =$ __________

Application

This activity may be used to explain the addition of two (or more) fractions with the same denominator.

Activity 9



Objective

To find the sum of fractions with different denominators say, $\frac{1}{4}+\frac{2}{3}$

Material Required

Rectangular sheet, sketch pens of different colours.

Method of Construction

1. First fold a rectangular sheet along the length three times to make four equal parts.
2. Again fold the rectangular sheet along the breadth two times to make three equal parts to get a 4 × 3 grid in which there are 12 squares (Fig. 1).

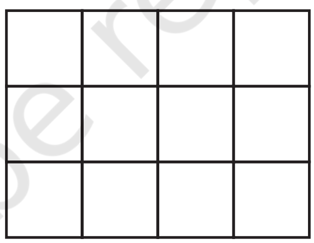


Fig. 1

3. Mark each square of any column, say, first column by '+' sign with red sketch pen (Fig. 2).

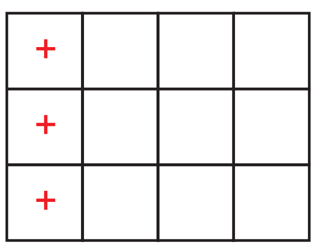


Fig. 2

4. Now mark any two rows, say first two rows, by '+' signs with blue sketch pen (Fig. 3).

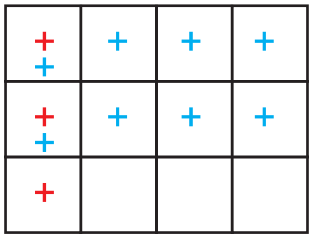


Fig. 3

Demonstration

1. Count the total number of '+' signs in Fig. 3. There are 11 '+' signs in all.
2. In Fig. 3, there are in all 12 squares.
3. Three red '+' signs represent the fraction $\frac{3}{12} = \frac{1}{4}$.
4. Eight blue '+' signs represent the fraction $\frac{8}{12} = \frac{2}{3}$.
5. Fraction represented by 11 '+' signs = $\frac{11}{12}$.

   So, $\frac{1}{4} + \frac{2}{3} = \frac{11}{12}$.

Observation

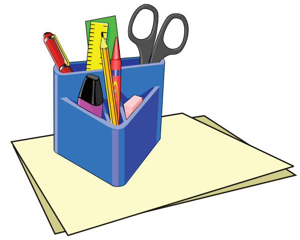
1. Red '+' signs represent the fraction = $\frac{\_\_\_}{12} = \frac{\_\_\_}{4}$.
2. Blue '+' signs represent the fraction = $\frac{\_\_\_}{12} = \frac{\_\_\_}{3}$.
3. Total number of '+' signs represent the fraction = $\frac{\_\_\_}{12}$.

   So, $\frac{1}{4} + \frac{2}{3} =$ ______.

Application

This activity may be used to explain addition of two fractions with different denominators.

Activity 10



Objective

To subtract a smaller fraction from a greater fraction with the same denominator [say, $\frac{4}{7} - \frac{2}{7}$]

Material Required

Square sheet, sketch pens of different colours.

Method of Construction

1. First fold a square sheet six times along any side to make seven equal parts.
2. Again fold the square sheet six times along the other side to make seven equal parts to get a 7 × 7 grid in which there are 49 squares (Fig. 1).
3. Mark each square of any four rows by '+' sign with red sketch pen (Fig. 2).

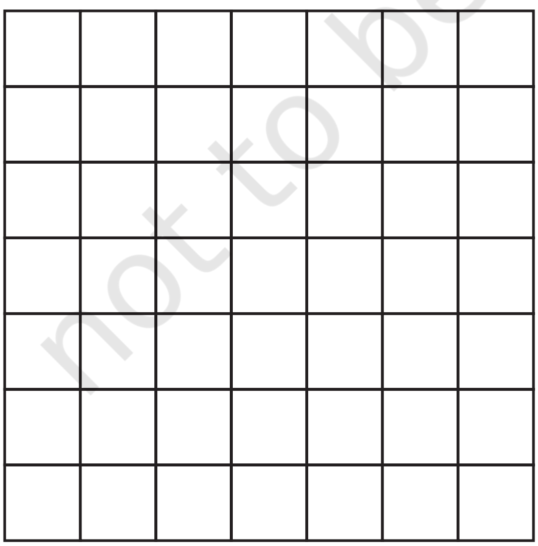


Fig. 1

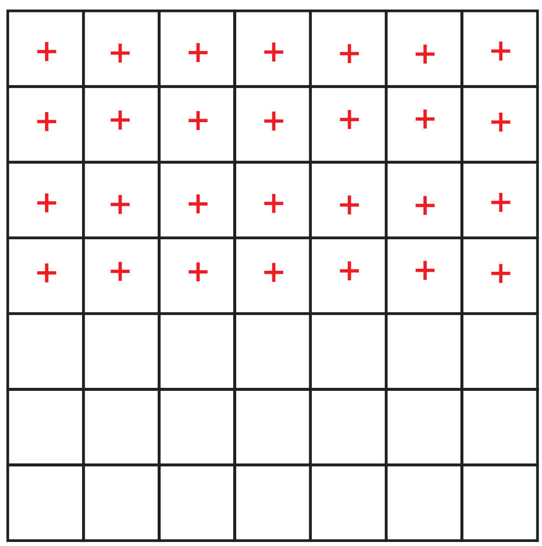


Fig. 2

4. Mark each square of any two columns by '–' sign with blue sketch pen (Fig. 3).

Demonstration

1. Count the total number of '+' signs in Fig. 3. There are 28, '+' signs.
2. Fraction represented by '+' signs = $\frac{28}{49} = \frac{4}{7}$.
3. Count the total number of '–' signs in Fig. 3. There are 14, '–' signs.
4. Fraction represented by '–' signs = $\frac{14}{49} = \frac{2}{7}$.
5. Enclose one '+' sign with one '–' sign (Fig. 4).
6. Count the number of enclosed signs in Fig. 4.

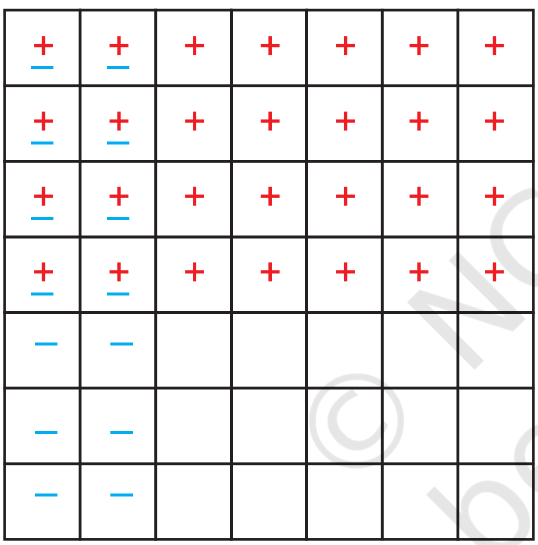


Fig. 3

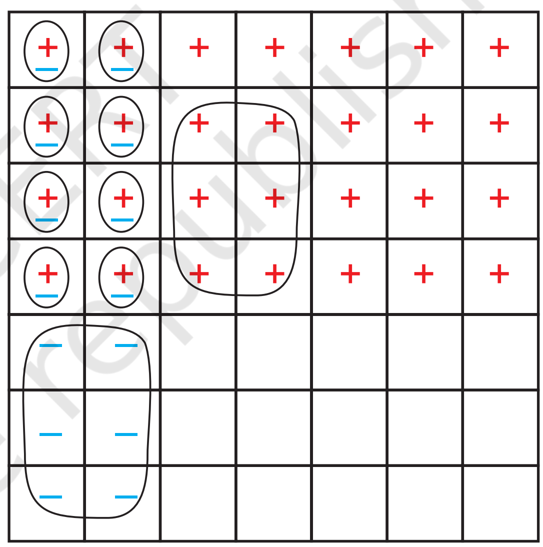


Fig. 4

They are 14 in all.

7. Fraction represented by unenclosed signs = $\frac{14}{49} = \frac{2}{7}$.

   So, $\frac{4}{7} - \frac{2}{7} = \frac{2}{7}$.

Observation

1. Red '+' signs represent the fraction = $\frac{\boxed{}}{49}$ = $\frac{\boxed{}}{7}$.

2. Blue '+' signs represent the fraction = $\frac{\boxed{}}{49}$ = $\frac{\boxed{}}{7}$.

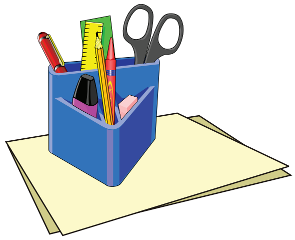
3. Total number of unenclosed signs represents the fraction = $\frac{\boxed{}}{49}$ = $\frac{\boxed{}}{7}$.

   So, $\frac{4}{7} - \frac{2}{7}$ = _____.

Application

This activity may be used to explain subtraction of two fractions with the same denominator.

Activity 11



Objective

To subtract a smaller fraction from a greater fraction with different denominators [say, $\frac{5}{7} - \frac{2}{3}$]

Material Required

Rectangular sheet, sketch pens of different colours.

Method of Construction

1. First fold a rectangular sheet along its length six times to make seven equal parts.
2. Again fold the sheet along its breadth two times to make three equal parts to get a 7 × 3 grid in which there are 21 squares (Fig. 1).

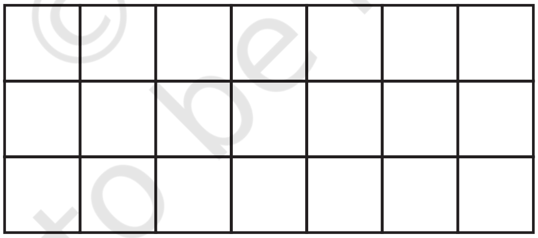


Fig. 1

3. Mark each square of any 5 columns by '+' sign with red sketch pen (Fig. 2).

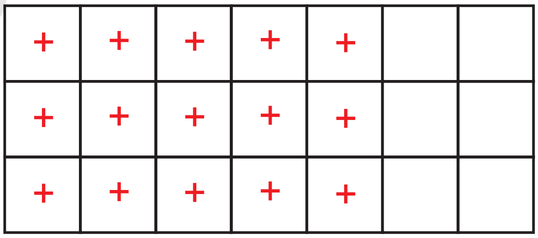


Fig. 2

4. Mark each square of any two rows with '–' sign using a blue sketch pen (Fig. 3).

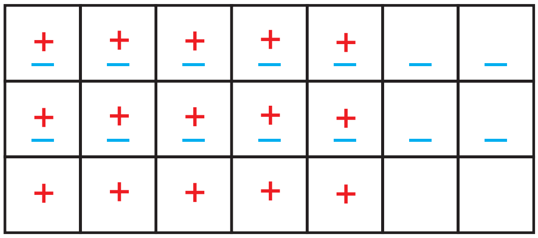


Fig. 3

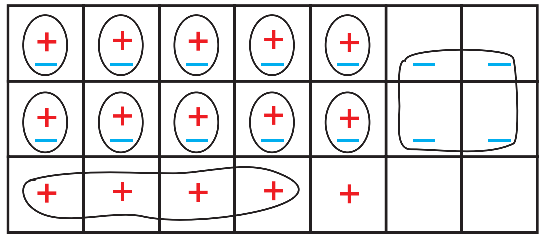


Fig. 4

Demonstration

1. Count the total number of '+' signs in Fig. 3. There are 15 '+' signs.
2. Fraction represented by '+' signs = $\frac{15}{21} = \frac{5}{7}$.
3. Count the total number of '–' signs in Fig. 3. There are 14.
4. Fraction represented by '–' signs = $\frac{14}{21} = \frac{2}{3}$.
5. Enclose one '+' sign with one '–' sign as shown in Fig. 4.
6. Count the number of unenclosed signs in Fig. 4. There is only 1 unenclosed sign.
7. Fraction represented by unenclosed sign = $\frac{1}{21}$.

   So, $\frac{5}{7} - \frac{2}{3} = \frac{1}{21}$.

Observation

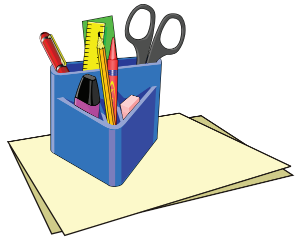
1. Red '+' signs represent the fraction = ________ = ________.
2. Blue '±' signs represent the fraction = ________ = ________.
3. Total number of unenclosed signs represent the fraction = ________.

   So, = ________.

Application

This activity may be used to explain subtraction of two fractions having different denominators.

Activity 12



Objective

To add integers

Material Required

Coloured square paper, scissors, adhesive, ruler, pen/pencil.

Method of Construction

Make some squares of two different colours, say red and blue.

Demonstration

 represents +1

 represents –1

To add:

(a) Two positive integers say, 2 and 3.

Place 2 red squares and 3 red squares in the same row as shown below:

2 3

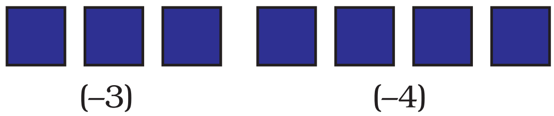
Count the total number of squares and note down their colour.

There are 5 squares of red colour.

So, $2 + 3 = 5$.

(b) Two negative integers say –3 and –4.

Place 3 blue squares and 4 blue squares and place them in a row as shown below:



Count the total number of squares and note down their colour.

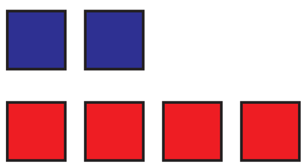
There are 7 squares of blue colour.

So, (–3) + (–4) = –7.

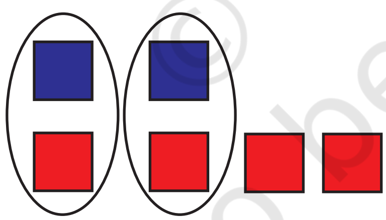
(c) One negative and one positive integer.

(i) (–2) + (4)

Place two squares of blue colour and 4 squares of red colour in two rows as shown below:



Encircle one blue and one red square as shown below. Note down the number of coloured squares left.

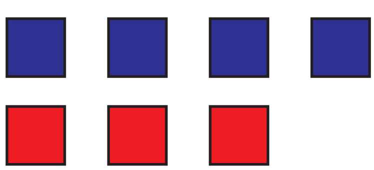


Two squares of red colour are left.

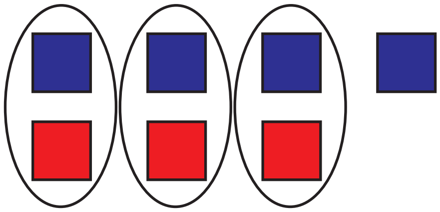
So, (–2) + (4) = 2.

(ii) (–4) + 3

Place 4 blue squares and 3 red squares in two rows as shown below:



Encircle one blue and one red square as shown below.



Note down the number of squares left alongwith its colour.

There is one blue square left.

So, (–4) + 3) = –1

From (a) and (b):

If the integers are of the same sign, then to find their sum, add the two integers ignoring their signs and put the sign of the two integers with the sum.

From (c):

If the integers are of different signs, then to find their sum, subtract the smaller number from the bigger number (ignoring their signs) and put the sign of the bigger number with the sum.

Observation

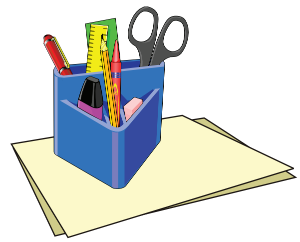
Complete the table:

Integers			
a	***b***	***a + b***	***Sum =***
2	3	2 + 3	5
–2	–3	–2 + (–3)	–5
–2	4	–2 + 4	.....
–4	3	–4 + 3	.....
–7	+5	.....	.....
3	–10	.....	.....
–10	5	.....	.....

Application

This activity is useful in understanding the process of addition of two or more integers.

Activity 13



OBJECTIVE

To subtract integers

MATERIAL REQUIRED

Coloured square paper, adhesive, white sheet, ruler, pen/pencil.

METHOD OF CONSTRUCTION

Make different squares of two different colours, say red and blue.

DEMONSTRATION

 represents +1

 represents –1

1. To find: 2 – 3

Fig. 1

(i) To subtract 3 from 2, take 2 red squares (Fig. 1). Try to cross 3 red squares from it. But there are only 2 red squares, so to cross three, we add one red and one blue as shown in Fig. 2.

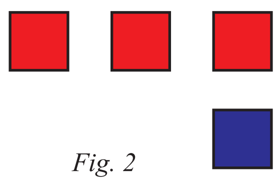


Fig. 2

(ii) Now cross three red squares. Count the number and colour of squares left (Fig. 3).

One blue square is left.

So, 2 – 3 = –1. [It is same as doing 2 + (–3)].

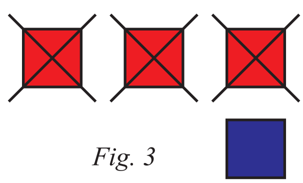


Fig. 3

2. To find: –2 – (–4)

(i) To subtract –4 from –2, take 2 blue squares (Fig. 4) and try to cross 4 blue squares from it. But there are only two blue squares, so add two blue and two red squares as shown in Fig. 5

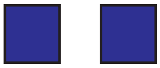


Fig. 4

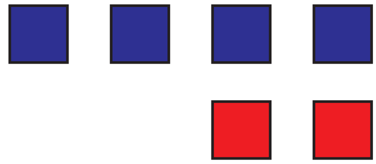


Fig. 5

(ii) Cross blue squares from them and count the number of squares left along with their colour (Fig.6).

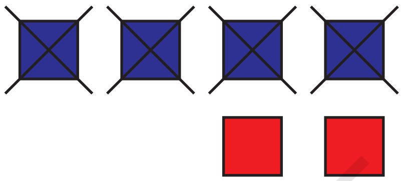


Fig. 6

There are two red squares left.

So, –2 – (–4) = + 2. [It is same as doing –2 + (4)].

3. To find: 3 – (–7)

(i) To subtract –7 from 3 take 3 red squares and add 7 blue and 7 red squares as shown below (Fig. 7).

(ii) Cross seven blue squares.

Count the number of squares left alongwith their colour.

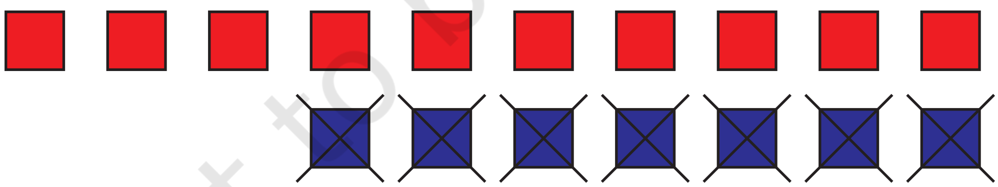


Fig. 7

There are 10 red squares left.

So, 3 – (–7) = 10. [It is same as doing 3 + 7].

4. To find: –2 – (5)

(i) To subtract 5 from –2, take 2 blue squares and add 5 blue squares and 5 red squares (Fig. 8). Cross five red squares.

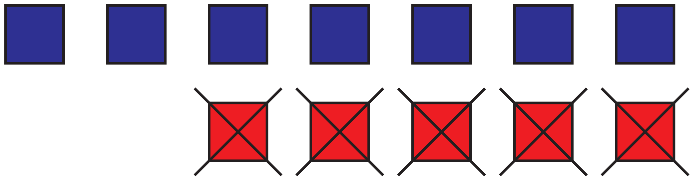


Fig. 8

(ii) Now count the number of squares left alongwith their colour. There are 7 blue squares left.

So, –2 – (5) = –7. [It is same as doing –2 + (–5)].

Thus, to subtract integer *b* from an integer *a*, add additive inverse of *b* to *a*. That is, $a - b = a + (-b)$.

Observation

Complete the table.

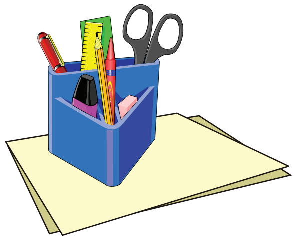
Integers			
a	***b***	***a* – *b***	***a* – *b* =**
2	–3	2 – 3	–1
–2	–4	–2 – (–4)	+2
3	–7	3 – (–7)	10
2	–5	.....	.....
–3	5	.....	.....
–2	–7	.....	.....

Application

This activity can be used to demonstrate subtraction of integers.

Activity 14

[GAME]



OBJECTIVE

Addition of decimals

MATERIAL REQUIRED

Thick sheet of paper, waste card, sketch pen, scissor.

METHOD OF CONSTRUCTION

1. Take a thick sheet of paper.
2. Cut them into sufficient number of small square pieces or rectangular pieces (say 40).
3. Write different decimal numbers on the cards using a sketch pen as shown below.

0.1	0.5	0.9	0.8	0.2	0.6	0.4	0.50
0.85	0.35	0.55	0.25	0.45	0.65	0.15	0.75

Fig. 1

LET US PLAY

1. Teacher may divide the class into groups of say 4.
2. Mix all the cards and place them face down. Now one child will pick any two cards at a time and add the decimal number written on them. If the sum is 1, the child will keep the cards with him/her and if the sum is not 1, then he/she will put the cards back face down.

3. Now the second child will pick two cards and repeat the above steps. The game will continue till all the cards are picked up.

4. The child with maximum number of cards is the winner in that group. Then the winners of all the groups will play the game again and the winner of the whole class will be declared.

Observation

S. No.	Number on first Card	Number on second Card	Sum
1.	0.2	0.8	1
2.	0.45	0.55	1
3.	–	–	–
4.	–	–	–
5.	–	–	–

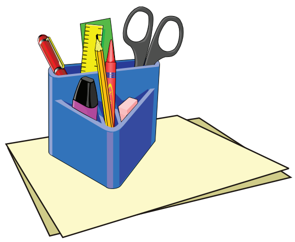
NOTE: Teacher may appoint one of the students as a referee to see whether the calculations done are correct or not. Penalty points may be decided if a student commits a mistake while adding.

Application

1. This game is useful in understanding addition of decimals. In this game, the sum of two decimals may also be taken different from 1.

2. The game can be extended for subtraction and multiplication of decimals also.

Activity 15



Objective

To construct a 4 × 4 Magic Square of Magic Constant 34

Material Required

Chart paper, coloured paper, sketch pen, scissors, ruler.

Method of Construction

1. Take 2 square sheets of size 12 cm × 12 cm.
2. Make two 4 × 4 squares on the chart papers.
3. Write numbers 1 to 16 in an order in the squares and enclose numbers with identical shapes as shown in (Fig.1) on one sheet.
4. Interchange the numbers in identical shapes as in Fig. 2.

1 (triangle)	2	3	4 (circle)
5	6 (diamond)	7 (pentagon)	8
9	10 (pentagon)	11 (diamond)	12
13 (circle)	14	15	16 (triangle)

Fig.1

16 (triangle)	2	3	13 (circle)
5	11 (diamond)	10 (pentagon)	8
9	7 (pentagon)	6 (diamond)	12
4 (circle)	14	15	1 (triangle)

Fig. 2

Demonstration

1. The sum of numbers taken along any row, column or diagonal in Fig. 2 is 34 (magic constant).
2. Thus Fig. 2 gives the required 4 × 4 magic square.

Observation

Sum of numbers in first row = _______ = Magic constant.

Sum of numbers in second row = _______. =_______.

Sum of numbers in third row = _______.

Sum of numbers in fourth row = ______.

Sum of numbers in first column = _______.

Sum of numbers in second column = _______.

Sum of numbers in third column = _______.

Sum of numbers in fourth column = ________.

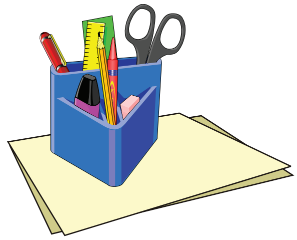
Sum of numbers in each diagonal = _______.

So, Fig. 2 gives a 4 × 4 magic square of magic constant = ______.

Application

This method can also be used to construct a 4 × 4 magic square of some other magic constants such as 38, 42, 46 and so on, using 16 consecutive natural numbers.

Activity 16



Objective

To form various polygons by paper folding and to identify convex and concave polygons

Material Required

White paper, ruler, sketch pens of different colours, pencil.

Method of Construction

1. Take a white sheet of paper and fold it again and again at least 10 to 12 times. Each time the paper is folded, it should be first unfolded before the next fold.

2. Draw various polygons of different number of sides by drawing lines on the creases so formed.

Demonstration

1. Take any two points X and Y in the interior of the polygon PQRST.
2. If the line segment joining X and Y lies wholly inside the polygon for all such points X and Y, then the polygon is said to be convex [see polygon PQRST in Fig. 1].
3. If the line segment joining X and Y is such that a part of it lies outside the polygon for some points X and Y, then the polygon is said to be concave [see polygon ABCDE in Fig. 1].
4. Check convexity and non convexity of some more polygons formed in Fig. 1 using the process stated in Steps 2 and 3.

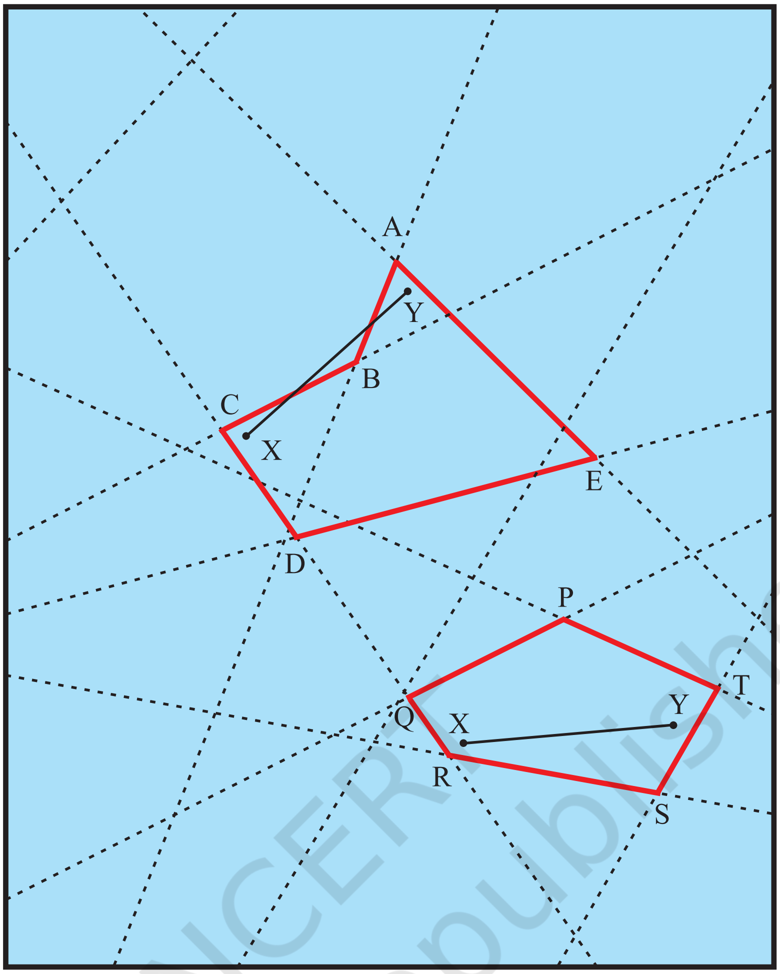


Fig. 1

Observation

1. In polygon PQRST the line segment XY lies in the interior of the polygon.

   So, PQRST is a __________ polygon.

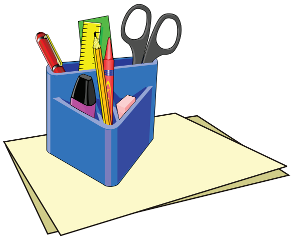
2. In polygon ABCDE, the line segment XY does not completely lie in the interior of the polygon.

   So, it is a _________ polygon.

Application

This activity is useful in identifying a convex or concave polygon.

Activity 17



Objective

To obtain areas of different geometric figures using a Geoboard and verify the results using known formulas

Material Required

Cardboard, grid paper, adhesive, nails, rubber bands, hammer, pen/pencil.

Method of Construction

1. Take a cardboard of convenient size and paste a grid paper on it. Put the nails on the vertices of small squares as shown in Fig. 1.
2. Make different geometric figures using rubber bands as shown in Fig. 1.

Demonstration

1. To find the area of any shape, count the number of complete squares, more than half squares and half squares ignoring less than half squares.

   Area of the figure = Number of complete squares + Number of more than half squares + $\frac{1}{2}$ (Number of half squares)

   For example, area of shape 1 = $9 + 2 + \frac{1}{2}(2) = 12$ sq. units.

   This shape is a parallelogram.

   Its area = base × altitude = $4 \times 3 = 12$ sq. units.

   Both the areas are same.

   This activity may be repeated for other geometric shapes.

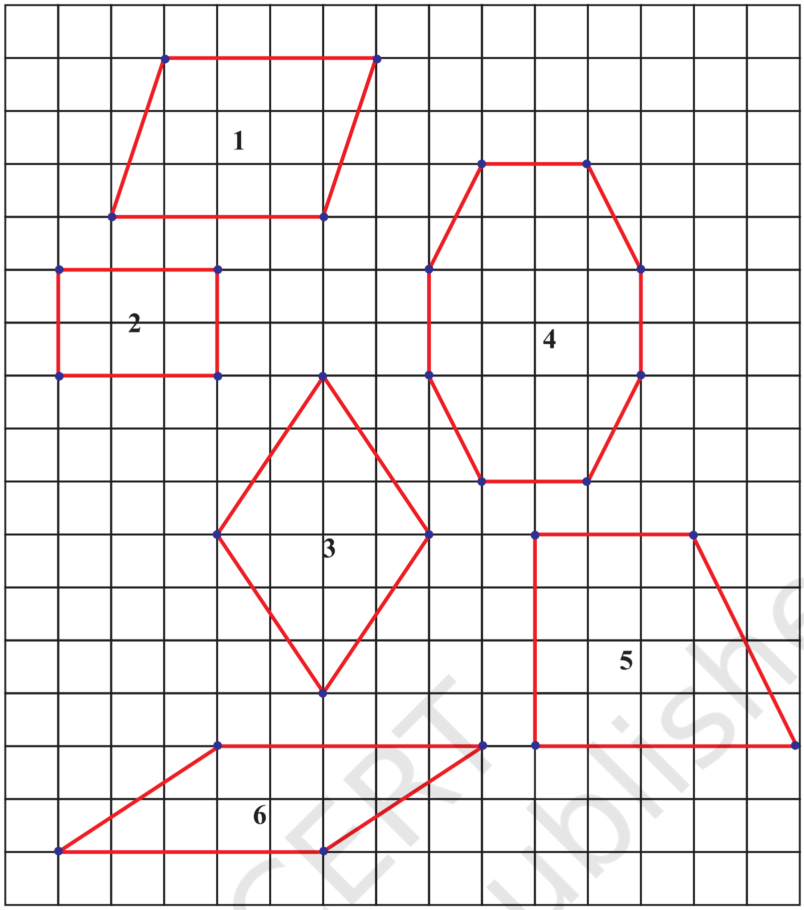


Fig. 1

Observation

1. Complete the following tables:

Shape	Number of complete squares	Number of more than half squares	Number of half squares	Area (Squares)
1	9	2	2	12
2	6	0	0	6
3	—	—	—	—
4	—	—	—	—
5	—	—	—	—
6	—	—	—	—

Actual area of the shapes:

Shape	Shapes	Formula (Area)	Calculation
1	Parallelogram	base × height	4 × 3 = 12
2	Rectangle	$l \times b$	—
3	Rhombus	½ $d_1 \times d_2$	—
4	—	—	—
5	—	—	—
6	—	—	—

2.

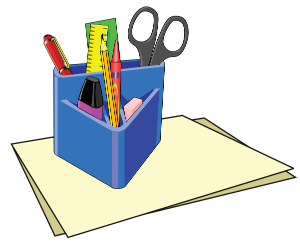
Shape	Actual area	Area obtained using Geoboard
1	12	12
2	6	6
3	—	—
4	—	—
5	—	—
6	—	—

So, the area of each geometric figure obtained using a Geoboard is approximately the same as obtained by using the formula.

Application

This activity may be used to explain the concept of area of various geometrical shapes.

Activity 18



Objective

To establish the fact that triangle is the most rigid figure

Material Required

Cycle spokes/wooden sticks/tooth picks etc., valve tube pieces, nut bolts, thick thread, cutter.

Method of Construction

1. Take a sufficient number of wooden sticks about 10 cm in length.
2. Cut valve tube into several pieces each of length, say, 3 cm.
3. Join the sticks with the help of valve tube pieces to make different shapes such as a triangle, quadrilateral, pentagon and hexagon [Fig.1].

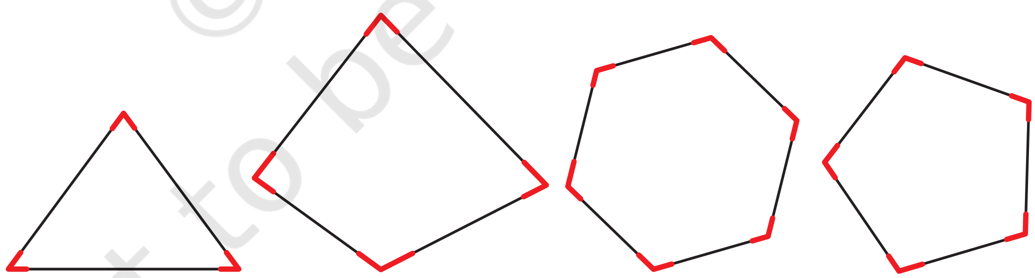


Fig. 1

Demonstration

1. Press any vertex or any side of the hexagon made of sticks.

   Does it change its shape? Yes (Fig. 2).

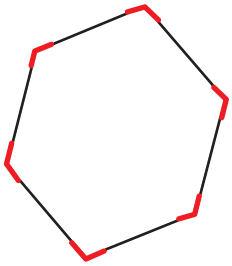


Fig. 2

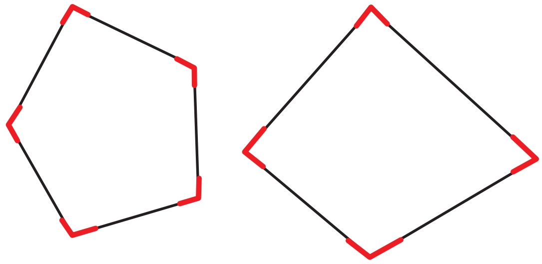


Fig. 3

2. Press any vertex or any side of the pentagon and the quadrilateral.

   Do these change their shape? Yes [Fig. 3].

3. Press any vertex of a triangle. Does it change its shape? It does not change its shape [Fig. 4].

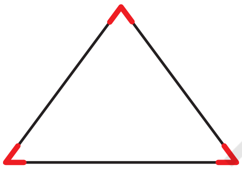


Fig. 4

So, triangle is the most rigid figure.

Observation

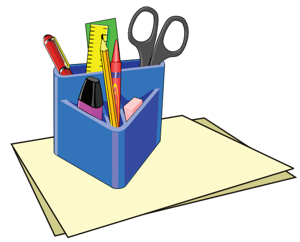
Complete the following table:

Number of sticks used	Shape formed	Change shape after pushing at a vertex
3	Triangle	No
4	Quadrilateral	—
5	Pentagon	—
6	Hexagon	—
7	Septagon	—
8	Octagon	—

Application

This property of rigidity of triangles is used in day to day life in the construction of bridges, ropes, ladders, furniture etc.

Activity 19



Objective

To represent a decimal number using a grid paper

Material Required

3 cardboards, 3 white chart papers, ruler, pencil, eraser, adhesive, three sketch pens of different colours (say Blue, Green and Red).

Method of Construction

1. Take 3 cardboards of convenient size and paste a white paper on each one of them.
2. Make three 10 × 10 grids on them and label the corners of the grids as A, B, C and D as shown in Fig. 1.
3. Take one of the grids and shade 6 horizontal strips out of 10 strips by using red sketch pen starting from the bottom as shown in Fig. 2.

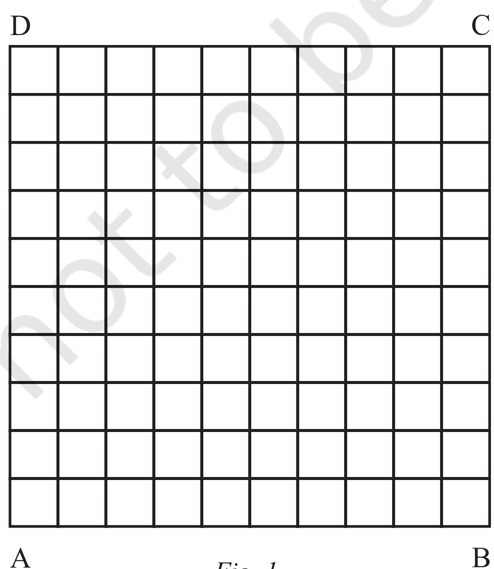


Fig. 1

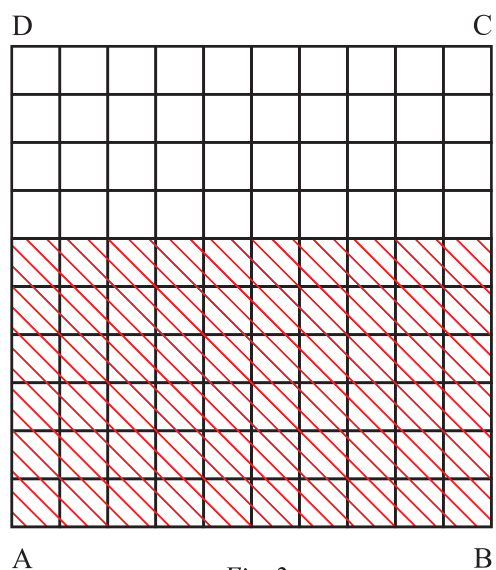


Fig. 2

4. Take another grid and shade 60 small squares using a blue sketch pen as shown in Fig. 3.

5. Take the third grid and shade 52 small squares using green sketch pen as shown in Fig. 4.

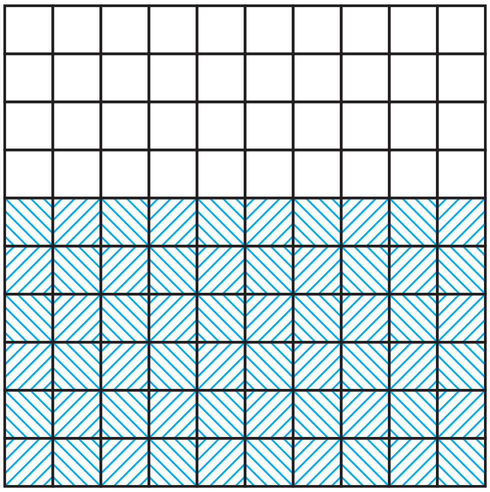


Fig. 3

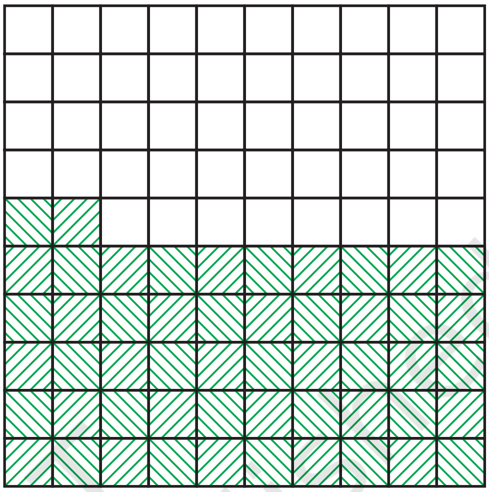


Fig. 4

Demonstration

In Fig. 2, portion shaded in red colour represents $\frac{6}{10}$ or 0.6.

In Fig. 3, portion shaded in blue colour represents $\frac{60}{100}$ or 0.60 or 0.6.

In Fig. 4, portion shaded in green colour represents $\frac{52}{100}$ or 0.52.

Also portions shaded in Fig. 2 and Fig. 3 are the same.

So, 0.60 = 0.6.

Observation

In Fig. 2:

Total number of horizontal strips = _________.

Number of horizontal strips shaded in red = _________.

Decimal represented by the shaded horizontal strips = _________.

In Fig. 3:

Total number of small squares = ________.

Number of squares shaded in blue = ________.

Decimal represented by the shaded region = ________.

In Fig. 4:

Total number of small squares = ________.

Number of squares shaded in green = ________.

Decimal represented by the shaded region = ________.

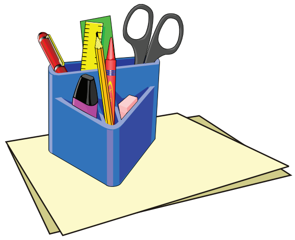
Fig. 2 and Fig. 3 represent _______ portion shaded in Red and Blue respectively.

This shows, 0.6 = _______.

Application

This activity can be used to explain the representation of decimal numbers graphically.

Activity 20



Objective

To make a 'protractor' by paper folding

Material Required

Thick paper, pencil/pen, compasses, cardboard, adhesive, scissor.

Method of Construction

1. Draw a circle of a convenient radius on a sheet of paper. Cut out the circle (Fig. 1).

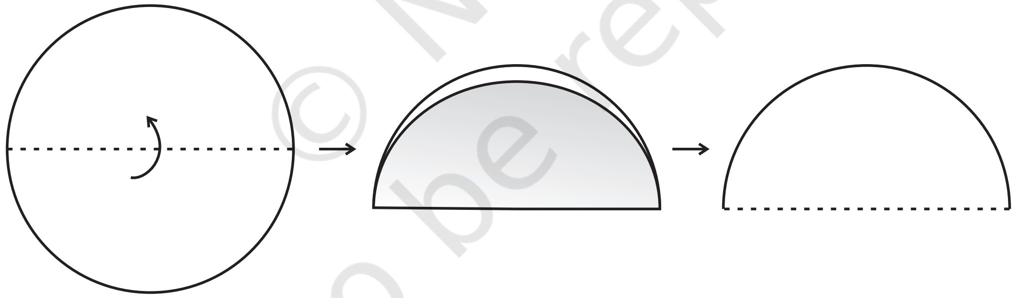


Fig. 1

2. Fold the circle to get two equal halves and cut it through the crease to get a semicircle.

3. Fold the semi circular sheet as shown in Fig. 2.

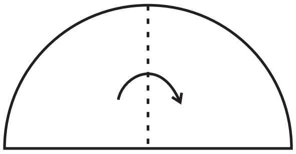


Fig. 2

4. Again fold the sheet as shown in Fig. 3.

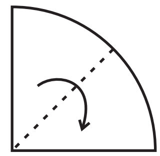


Fig. 3

5. Fold it once again as shown in Fig. 4.

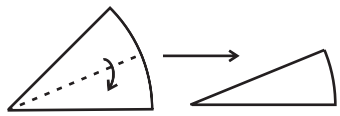


Fig. 4

6. Unfold and mark the creases as OB, OC,.... etc., as shown in Fig. 5.

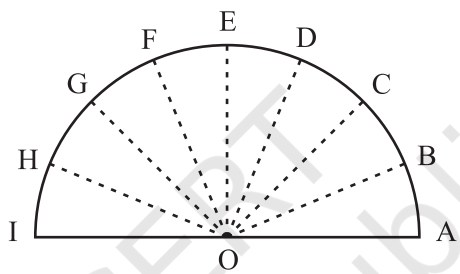


Fig. 5

Demonstration

1. In Fig. 5, ∠AOB = ∠BOC = ∠COD = ∠DOE = ∠EOF = ∠FOG = ∠GOH = ∠HOI as all these angles cover each other exactly as they have been obtained by paper folding.

2. ∠AOI (being straight angle) is 180°. Therefore, the degree marks corresponding to all these angles are as shown in Fig. 6.

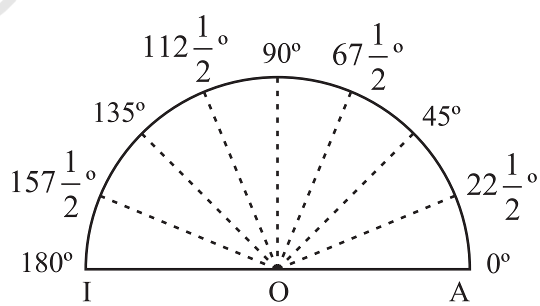


Fig. 6

Fig. 6, gives us a 'protractor'. This may be pasted on a cardboard and then cut out.

Observation

Measure of $\angle AOI$ = _________.

$\angle AOE = \frac{1}{2} \angle AOI$ = _________.

$\angle AOC = \frac{1}{2} \angle AOE$ = _________.

$\angle AOB = \frac{1}{2} \angle AOC$ = _________.

$\angle AOD = 45° + \angle COD$ = _________.

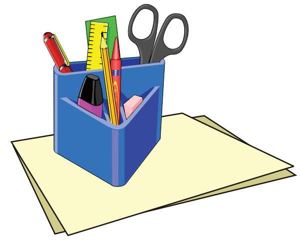
$\angle AOG = \angle AOE + \angle EOG$ = _________.

$\angle AOH = 90° + \angle$ _________ = _________.

Application

1. This activity can be used to measure and construct some specific angles.
2. Similar activity can be used to make a 'protractor' of 360°.

Activity 21



Objective

To obtain angle bisector of an angle by paper folding

Material Required

Thick paper, pencil/pen, ruler, scissors.

Method of Construction

1. Take a thick paper and make an ∠ABC by paper folding (or by drawing) and cut it out.
2. Fold ∠ABC through the vertex B such that ray BA falls along ray BC.
3. Now, unfold it. Mark a point D anywhere on the crease as shown in Fig. 1.

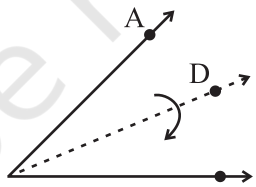


Fig. 1

4. Make cut outs of ∠ABD and ∠DBC.

Demonstration

1. Place the cut out of ∠ABD on ∠DBC or the cut out of ∠DBC on ∠ABD.
2. ∠ABD exactly covers ∠DBC.
3. So, ∠ABD is equal to ∠DBC.

   i.e., BD is the angle bisector of ∠ABC.

OBSERVATION

On actual measurement:

Measure of ∠ABC = _________.

Measure of ∠ABD = _________.

Measure of ∠DBC = _________.

$\angle ABD = \frac{1}{2}\angle$ _________.

∠DBC = ∠ _________.

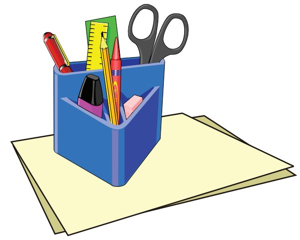
∠ABD = ∠ _________.

BD is _____ of ∠ABC.

APPLICATION

1. This activity may be used in explaining the meaning of bisector of an angle.
2. This activity can also be used in finding bisectors of angles of a triangle and to show that they meet at a point.

Activity 22



Objective

To make a parallelogram, rectangle, square and trapezium using set squares.

Material Required

Four pieces of 30° - 90° - 60° set squares and four pieces of 45° - 90° - 45° set squares, cardboard, white paper, pen/pencil, paper, eraser.

Method of Construction

1. Take a piece of cardboard of a convenient size and paste a white paper on it.

2. Arrange different sets of set squares as shown in Figures 1 to 5 and trace the boundary of the figure using pen/pencil.

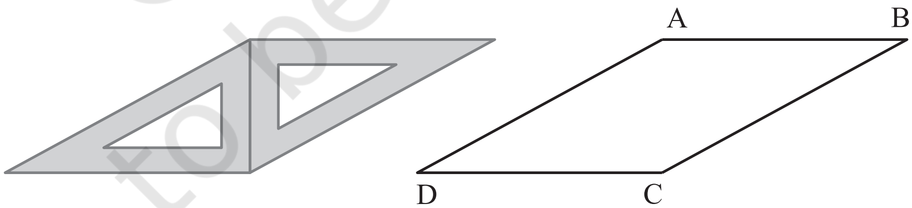


Fig. 1

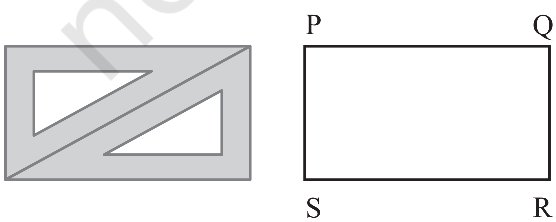


Fig. 2

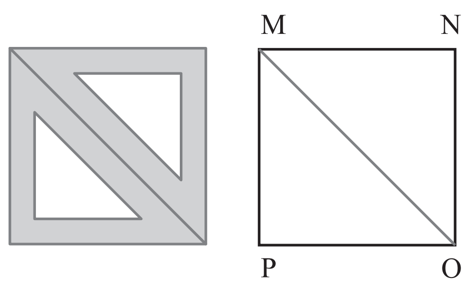


Fig. 3

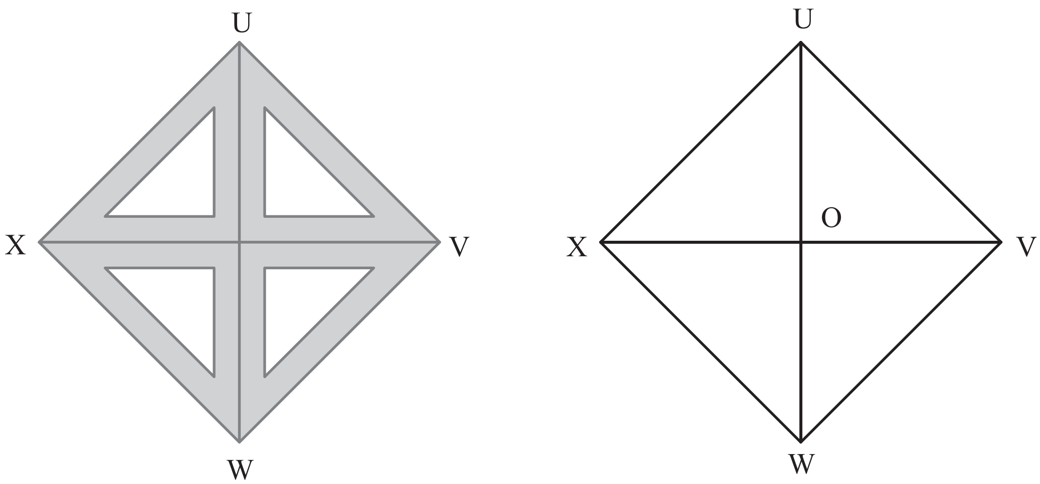


Fig. 4

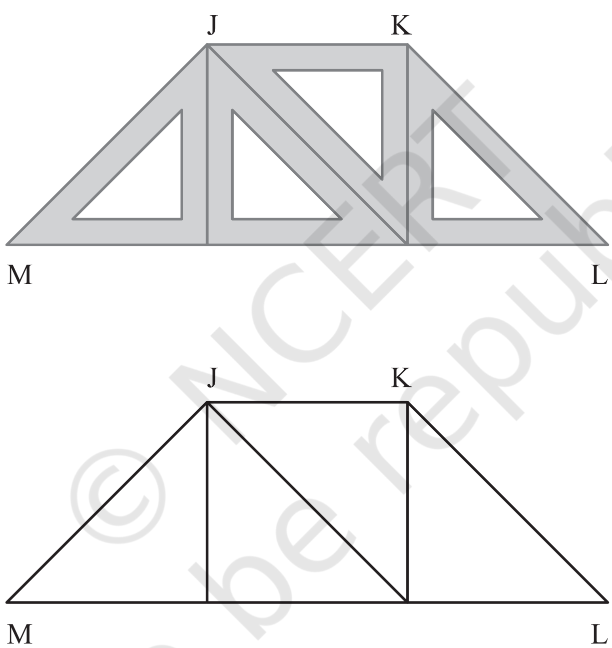


Fig. 5

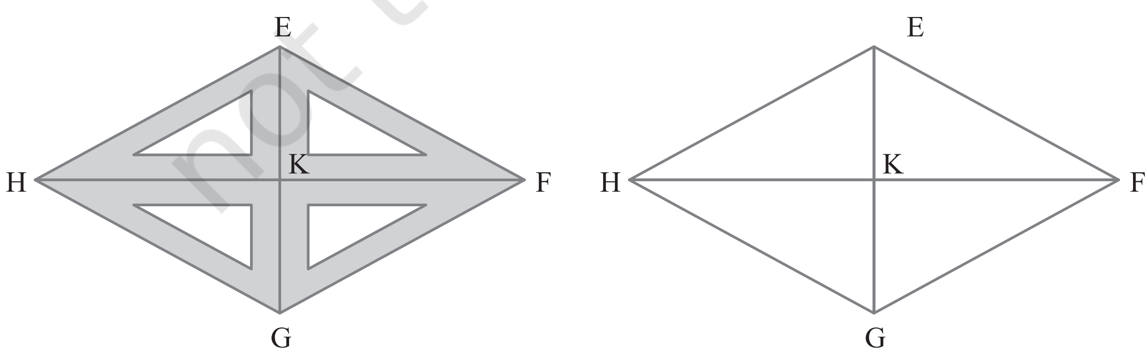


Fig. 6

Demonstration

1. Shape in Fig. 1 is a parallelogram.

   Its opposite sides are equal.

   Its opposite angles are equal.

2. Shape in Fig. 2 is a rectangle.

   Its opposite sides are equal.

   Its each angle is 90°.

3. Shapes in Figures 3 and 4 are squares.

   All its sides are equal.

   Its diagonals bisect at 90° (Fig. 4).

   Its diagonals are equal (Fig. 4).

4. Shape in Fig. 5 is a trapezium with sides JK and ML parallel.

5. Shape in Fig. 6 is a rhombus. All its sides are equal.

   Its diagonals bisect at 90°.

Observation

In Fig 1:

AB = ________ cm.

CD = ________ cm.

AD = ________ cm.

BC = ________ cm, so, AB = CD and AD = _______.

So, ABCD is a ________.

In Fig 2:

PQ = ______ cm, SR = ______ cm, PS = ______ cm, QR = ______ cm.

So, PQ = SR and PS = ______.

Therefore, PQRS is a ______.

In Fig 3:

MN = ______ cm, PO = ______ cm, NO = ______ cm, MP = ______ cm.

So, MN = PO = ______ = ______.

$\angle P = 90^\circ = \angle$ ______ $= \angle$ ______ $= \angle$ ______.

Therefore, MNOP is a ______.

In Fig 4:

UV = ______ cm, VW = ______ cm, WX = ______ cm, XU = ______ cm.

So, UV = VW = ______ = ______.

∠U = $45^\circ + 45^\circ = 90^\circ$.

∠V = ______, ∠W = ______, ∠X = ______,

Diagonals intersect at ______.

Each angle at O = ______.

So, diagonal ______ each other at ______.

Thus, UVWX is a ______.

In Fig 5:

∠JML = ______.

Measure of ∠KJM = ______ + ______ + ______ = ______.

∠KJM + ∠JML = ______.

So, JK is ______ to ML.

Hence, JKLM is a ______.

In Fig 6:

EF = ___ cm, FG = ____cm.

GH = ___ cm, HE = ____cm.

So, EF = ___ cm, GH = ____cm.

Diagonals intersect at K.

Each angle at K = ____.

EK = ____ cm.

GK = ____ cm.

HK = ____ cm.

FK = ____ cm.

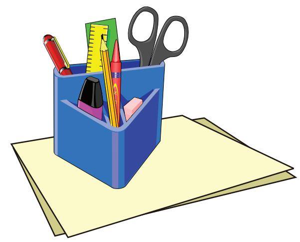
So, diagonals ____ each other ______.

Thus, EFGH is a rhombus.

APPLICATION

This activity may be used to explain different types of quadrilaterals and their properties.

Activity 23



Objective

To draw a perpendicular to a line from a point not on it, by paper folding

Material Required

Thick paper, pencil/pen.

Method of Construction

1. Fold the paper and get a line AB through folding. Mark a point C on the paper such that C is not on AB as shown in Fig. 1.

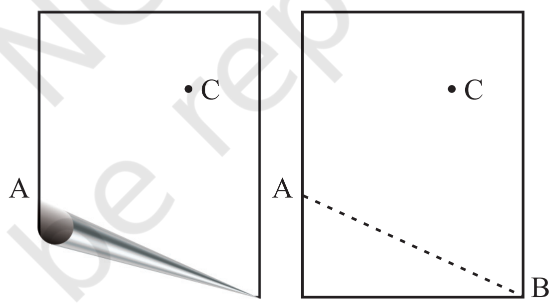


Fig. 1

2. Through C, fold the paper such that A falls on B along AB.

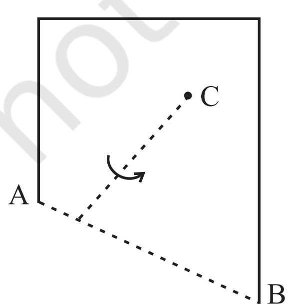


Fig. 2

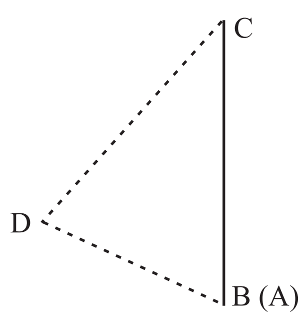


Fig. 3

3. Unfold the sheet.

Demonstration

1. As ∠ADC is equal to ∠BDC so, CD is angle bisector of ∠ADB.
2. ∠ADC and ∠BDC form a linear pair. So, each angle is equal to 90°.
3. Thus, DC is perpendicular from C on AB.

Observation

On actual measurement:

∠ADC = _____.

∠BDC = _____.

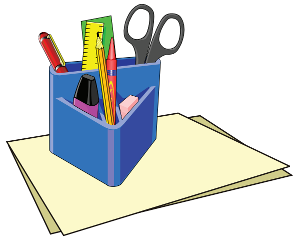
So, CD is ______ to AB.

Application

1. This activity may be helpful in explaining the meaning of a perpendicular on the line.
2. This activity can also be used in drawing three altitudes of a triangle which meet at a point.

NOTE

1. Repeat this activity taking some more points other than C not lying on AB. It can be seen that there may be infinitely many perpendiculars to a line but there is only one perpendicular to a line through a point not on it.
2. Through the same activity, drawing a line parallel to a given line can also be demonstrated.



Activity 24

Objective

To obtain formula for the area of a rectangle

Material Required

Cardboard, ruler, pencil/pen, colours, adhesive, glaze paper.

Method of Construction

1. Take a cardboard and paste a light glaze paper on it.
2. Draw a rectangle of length a and breadth b (say a = 6 cm and b = 4 cm) (Fig. 1).
3. Paste it on the cardboard and draw lines parallel to breadth of the rectangle at a distance of 1cm each (Fig. 2).

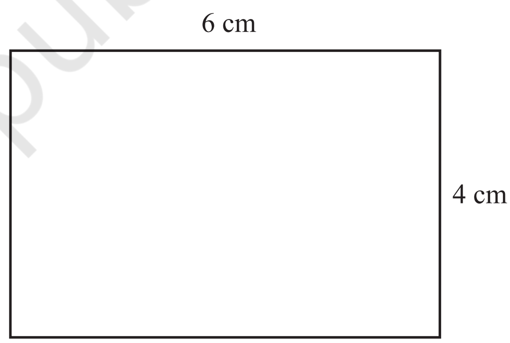


Fig. 1

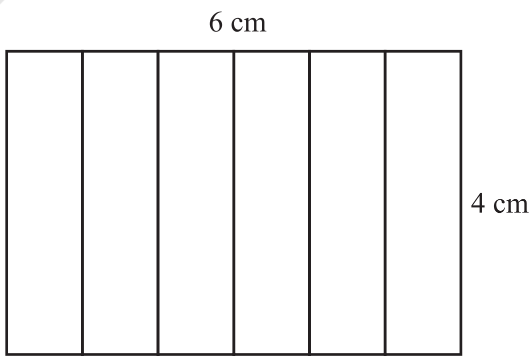


Fig. 2

4. Draw lines parallel to length of the rectangle at a distance of 1 cm each (Fig. 3).

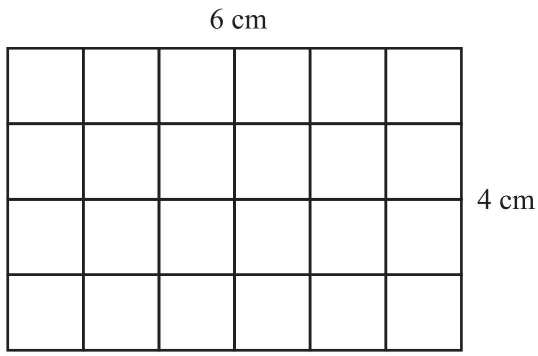


Fig. 3

Demonstration

1. The number of unit squares (1cm × 1cm) in Fig. 3 is 24.
2. $24 = 6 \times 4 = l \times b$.
3. So, area of the rectangle = $l \times b$.

This activity can be repeated by taking rectangles of different lengths and breadths.

Observation

In Fig. 3, the number of unit squares in first row = ________.

The number of unit squares in second row = _________.

The number of unit squares in third row = _________.

The number of unit squares in fourth row = _________.

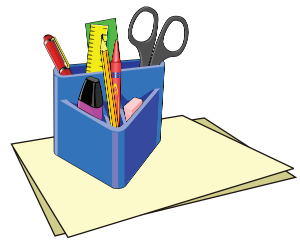
Total number of unit squares =_______ = _______ × _______.

Area of the rectangle = _______ × _______.

Application

This activity can be used to explain meaning of area of a rectangle and also to obtain area of a square.

Activity 25



Objective

To obtain the perpendicular bisector of a line segment by paper folding

Material Required

Thick paper, ruler, pen/pencil.

Method of Construction

1. Take a sheet of thick paper. Fold it in any way. Get a crease by unfolding it. This crease will give a line as shown in Fig.1.

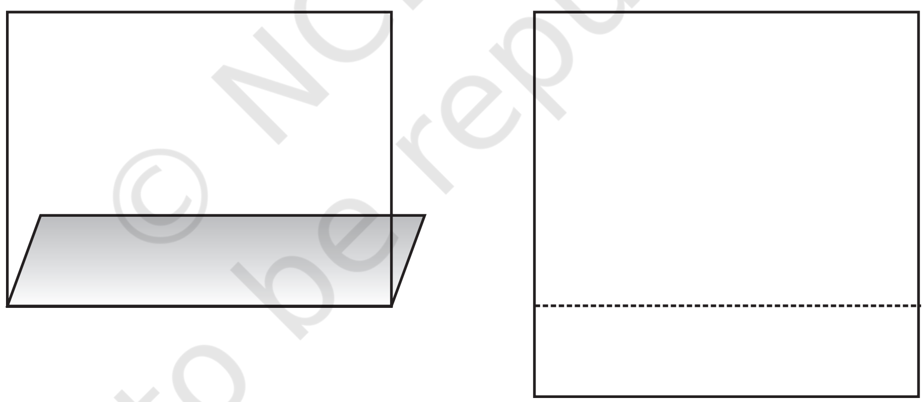


Fig. 1

2. Mark points A and B on this line to get a line segment AB as shown in Fig.2.

3. Fold the paper such that A falls on B. Unfold it and get a crease mark CD on the crease as shown in Fig.3.

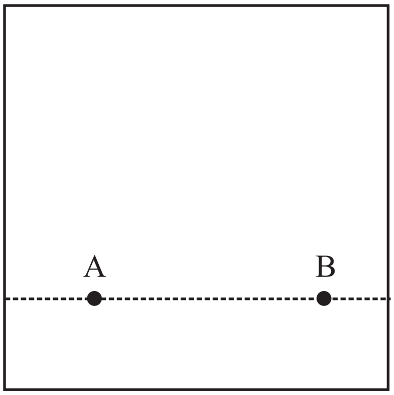


Fig. 2

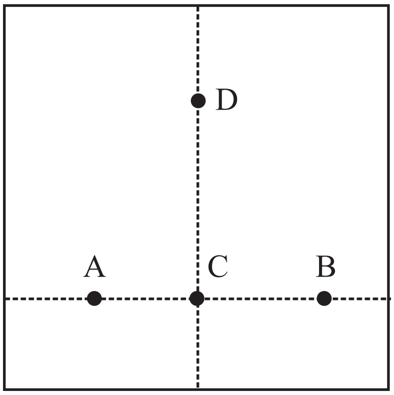


Fig. 3

Demonstration

1. AC is equal to CB as AC exactly covers BC.
2. Since the two rays CA and CB of ∠ACB fall on each other, CD is the angle bisector of ∠ACB.

   ∠ACD exactly covers ∠DCB. So, ∠ACD = ∠DCB = 90°.
3. CD is perpendicular bisector of AB.

Observation

On actual measurement:

AC = _______, BC = ________.

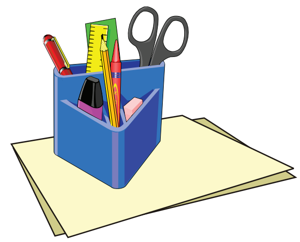
∠ACD = ______, ∠BCD = ________.

Perpendicular bisector of AB is ________.

Application

This activity may be used in obtaining perpendicular bisector of sides of a triangle and to show that the three perpendicular bisectors of a triangle meet at a point.

Activity 26



OBJECTIVE

To find the lines of symmetry of a figure (say, a rectangle) by paper folding

MATERIAL REQUIRED

White sheet, tracing paper, scissors, pen/pencil and geometry box.

METHOD OF CONSTRUCTION

1. Draw a rectangle ABCD on a white sheet of paper (Fig. 1).

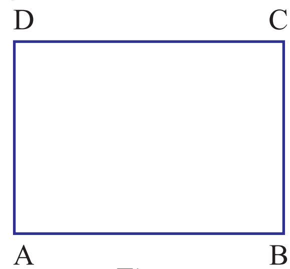


Fig. 1

2. Make a trace copy of the rectangle ABCD and cut it out.

3. Try to fold this cut out of the rectangle along its width into two halves (Fig. 2).

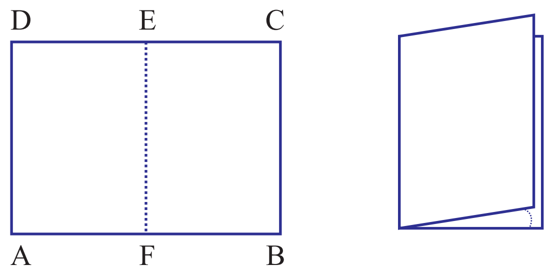


Fig. 2

4. Try to fold this cut out of the rectangle along its length into two halves.

5. Open the fold and try to fold it along some other line say the diagonal BD (Fig. 3).

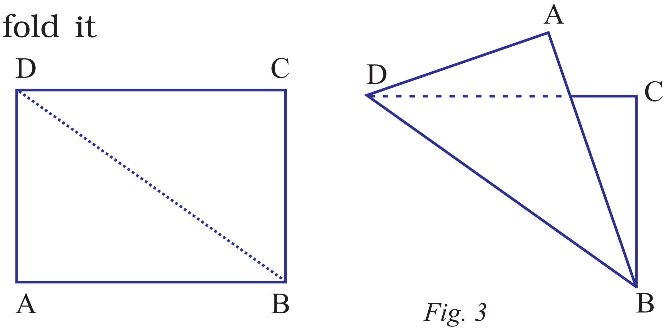


Fig. 3

6. Try to fold the cut out of the rectangle along the other diagonal AC.

7. In Steps 3 and 4, one part of the rectangle exactly covers the other part.

   So, crease gives a line of symmetry in each case.

   Thus, the line segments EF and GH (say) obtained in Steps 3 and 4 respectively, passing through the mid points of opposite sides of the rectangle are two lines of symmetry.

8. In Steps 5 and 6, one part of the rectangle does not cover exactly the other part.

   So, crease along the diagonal is not a line of symmetry.

   Thus, there are only two lines of symmetry for a rectangle.

Observation

Complete the following table:

Fold	Two parts coincide/ Not coincide	Line of Symmetry
Along the width	Coincide	Yes
Along the diagonal AC	Do not coincide	No
Along the length	—	—
Along the diagonal BD	—	—

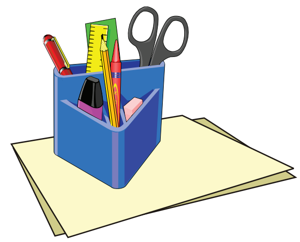
Thus, there are ____ lines of symmetry for a rectangle.

They are the lines passing through ___ points of the opposite _____ of the rectangle.

Application

The activity is useful in finding the lines of symmetry of a figure, if they exist.

Activity 27



Objective

To see that shapes having equal areas may not have equal perimeters

Material Required

Cardboard, white sheet of paper, pencil, ruler, eraser, adhesive, colours.

Method of Construction

1. Take a cardboard of a convenient size and paste a white paper on it.
2. Draw a 10 × 10 square grid on it.
3. Make 30 square cardboard pieces of side 1cm each.

Demonstration

1. Divide the class into groups of 5 children each.
2. Ask one child to arrange 7 square pieces adjacent to each other to get a shape as shown below (Fig. 1).

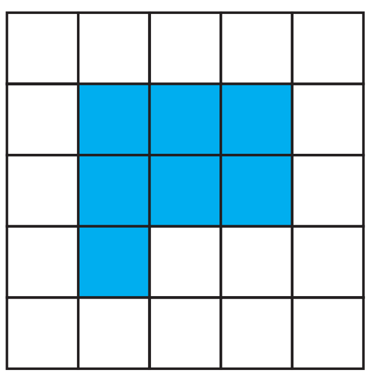


Fig. 1

3. Each child of the group will arrange 7 other square pieces to make a shape different from her/his group members (as shown in Fig. 2 to Fig. 5).

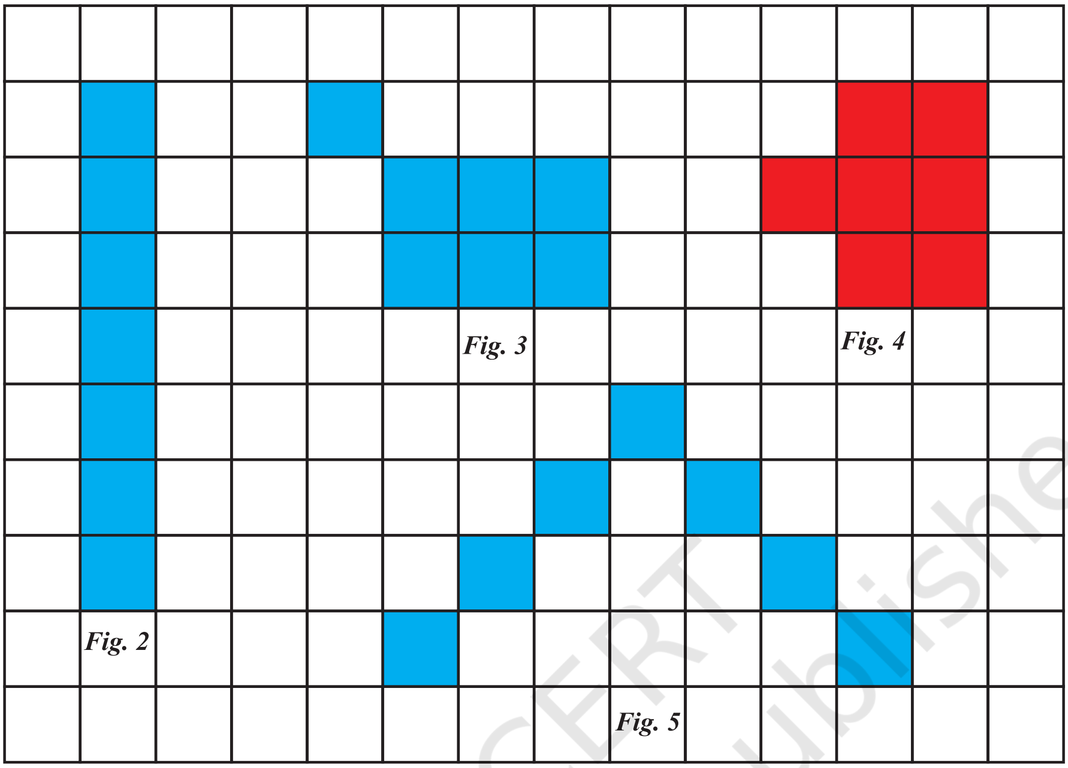


Fig. 2 to 5

4. The children will find the perimeter of each shape so formed and compare their perimeters.
5. Children will find that areas of all the shapes are the same but their perimeters are not the same.

Observation

Complete the table:

Child	Figure	Area (Square units)	Perimeter
1	1	7	12 cm
2	2	–	–
3	3	–	–
4	4	–	–
5	5	–	–

Therefore, if the areas of two or more shapes are same then it is not necessary that their perimeters are also equal.

APPLICATION

1. The activity can also be extended to see if the perimeters of two or more shapes are equal, then their areas are also equal or not?
2. The same activity can be performed using different number of square pieces.
3. This activity can be used to make different packing boxes of the same areas but with minimum perimeter and for tiling the floors and walls in different designs.