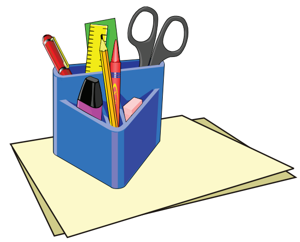
Activity 1



Objective

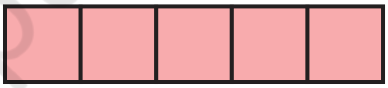
To verify that addition of whole numbers is commutative

Material Required

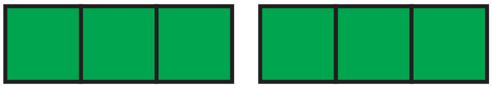
Cardboard, white paper, graph strips, scissors, glue.

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.

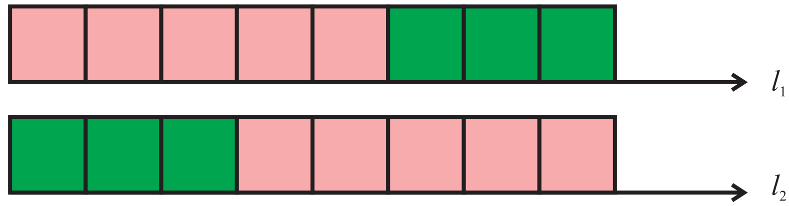


Fig. 2

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.

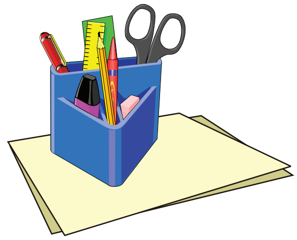
Repeat this activity by taking different pairs of numbers like 4, 5; 7, 2; 6, 7 and strips corresponding to these pairs.

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.

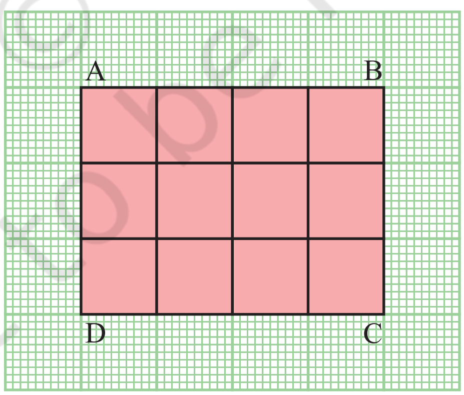


Fig. 1

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

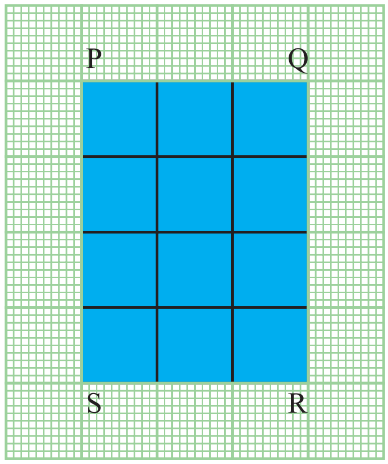


Fig. 2

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.

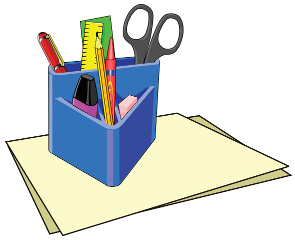
Repeat this activity by taking some more pairs of strips.

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).

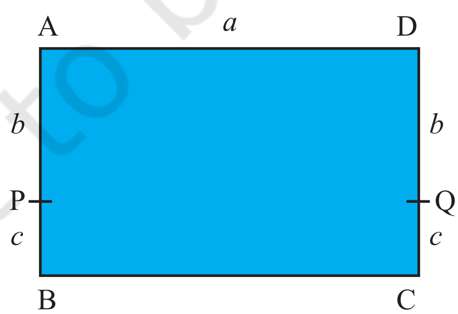


Fig. 2

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.

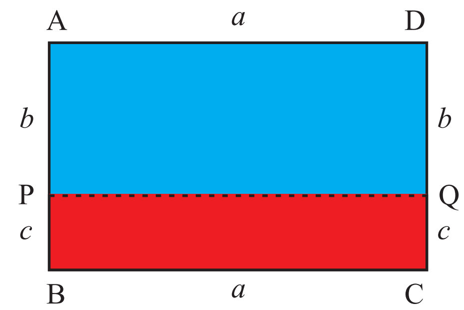


Fig. 3

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

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

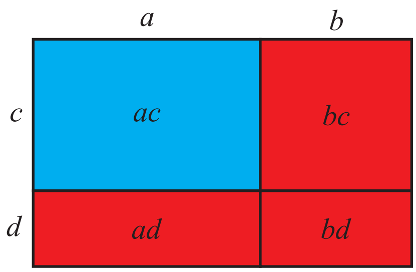
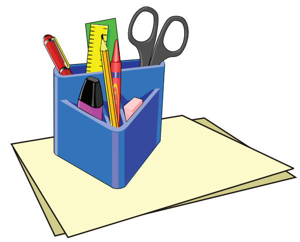


Fig. 4

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.

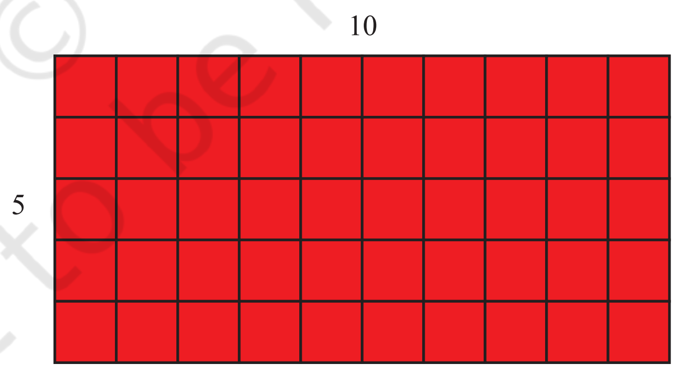


Fig. 1

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

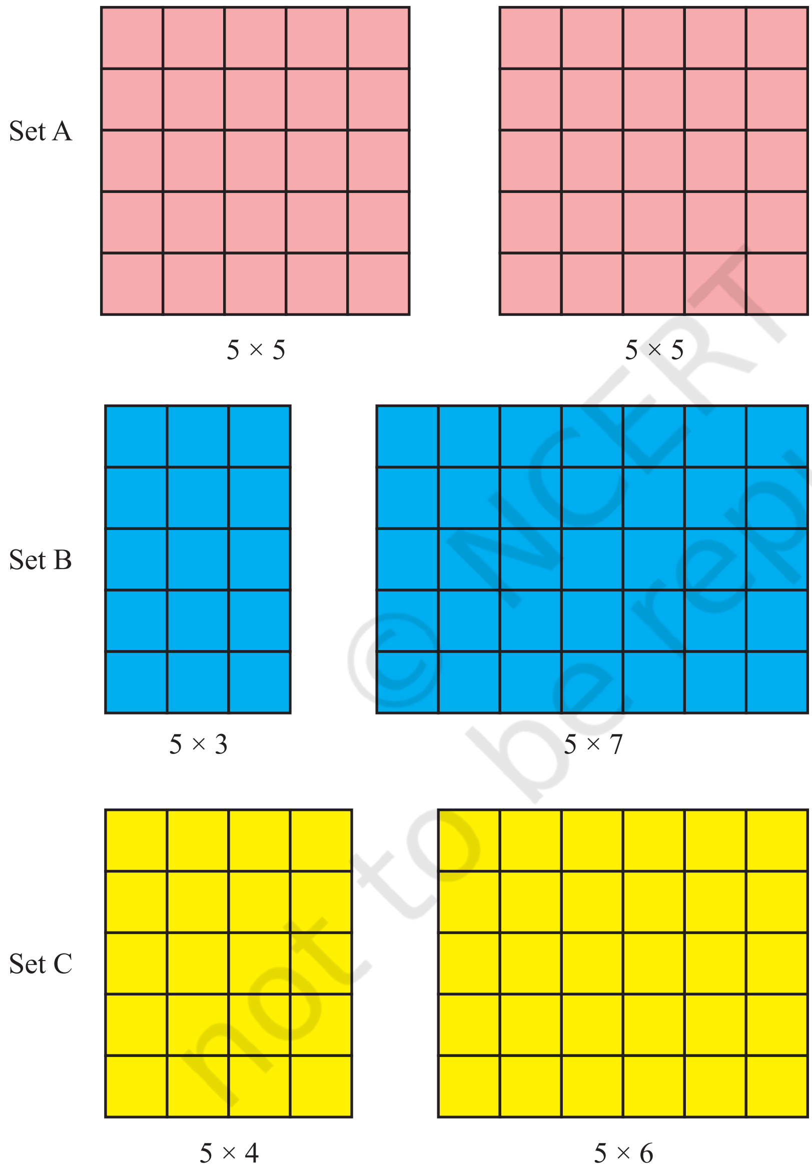


Fig. 2

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:

$5 \times 10 = \underline{\qquad\quad}$, $5 \times 5 = \underline{\qquad\quad}$, $5 \times 5 = \underline{\qquad\quad}$,

$5 \times 3 = \underline{\qquad\quad}$, $5 \times 7 = \underline{\qquad\quad}$,

$5 \times 4 = \underline{\qquad\quad}$, $5 \times 6 = \underline{\qquad\quad}$.

$5 \times 10 = 5 \times 5 + 5 \times \underline{\qquad\quad}$.

$5 \times 10 = 5 \times 3 + 5 \times \underline{\qquad\quad}$.

$5 \times 10 = 5 \times \underline{\quad} + 5 \times 6$.

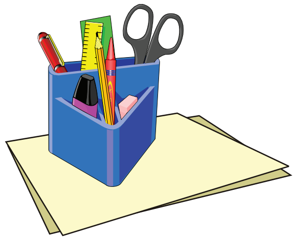
Repeat this activity for different such sets.

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.

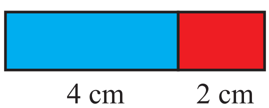


Fig. 3

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.

2 cm 2 cm

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.

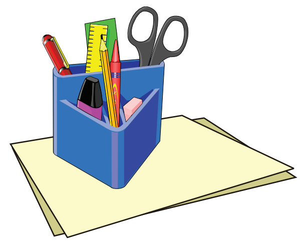
Observation

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

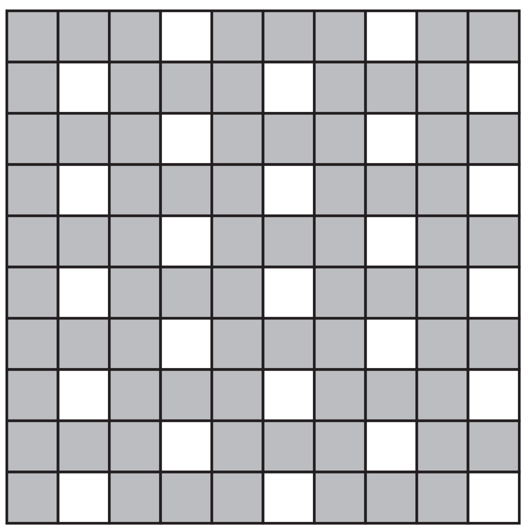


Fig. 2

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

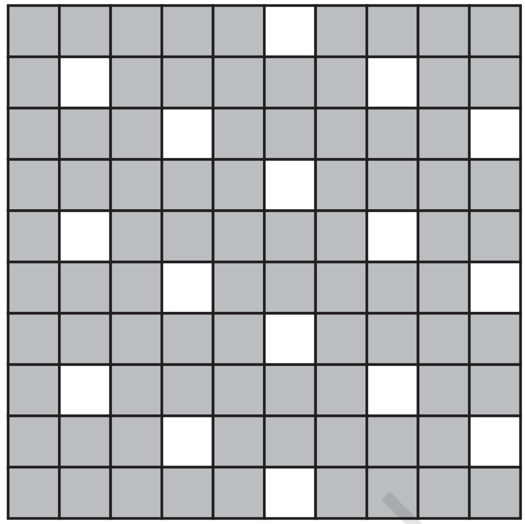


Fig. 3

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.

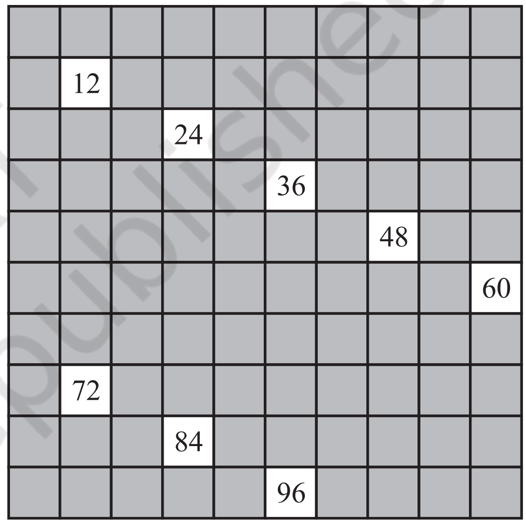


Fig. 4

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:

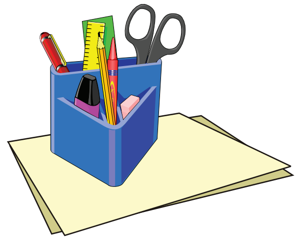
Number a	Number b	L.C.M
4	6	12
5	10	–
6	9	–
3	7	–

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.

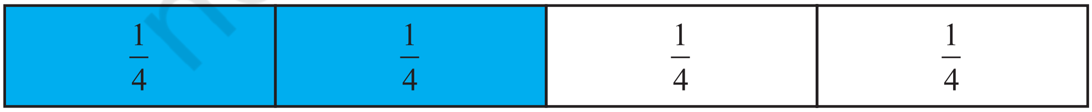


Fig. 2

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.

$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$

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.

$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$

Fig. 4

$\frac{1}{2}$	$\frac{1}{2}$

$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$

$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$

$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$

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,

$\frac{1}{2}$ = ____ = ____ = $\frac{8}{16}$.

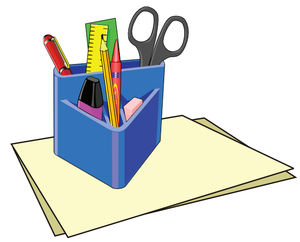
Thus, $\frac{2}{4}, \frac{4}{8}, \frac{8}{16}$ are fractions equivalent to the fraction $\frac{1}{2}$.

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

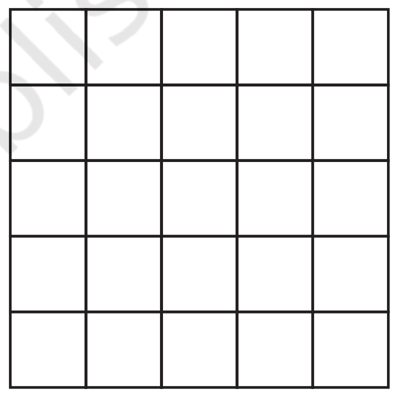


Fig. 1

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).
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).

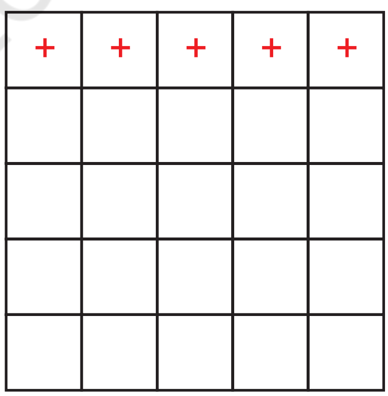


Fig. 2

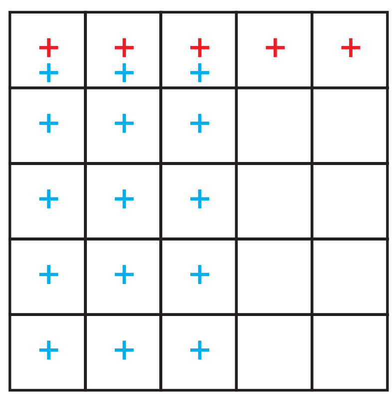


Fig. 3

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

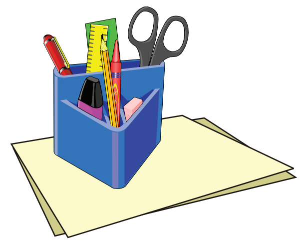
1. Red '+' signs represent the fraction $\frac{\_\_\_}{25} = \frac{\_\_\_}{5}$
2. Blue '+' signs represent the fraction $\frac{\_\_\_}{25} = \frac{\_\_\_}{5}$
3. Total number of '+' signs represents the fraction $\frac{\_\_\_}{25} = \frac{\_\_\_}{5}$

   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).

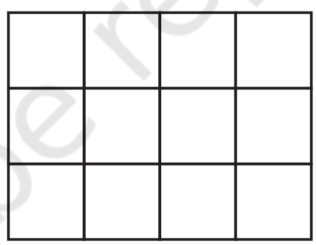


Fig. 1

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

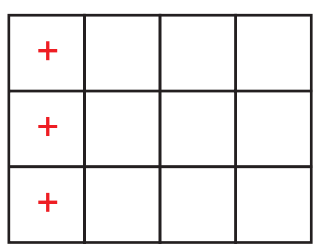


Fig. 2

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

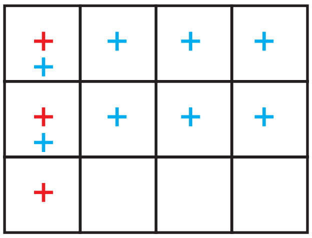


Fig. 3

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

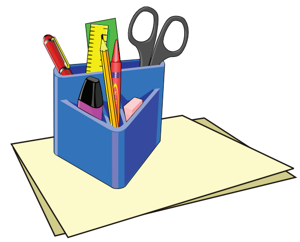
1. Red '+' signs represent the fraction = $\frac{\_\_\_}{12} = \frac{\_\_\_}{4}$.
2. Blue '+' signs represent the fraction = $\frac{\_\_\_}{12} = \frac{\_\_\_}{3}$.
3. Total number of '+' signs represent the fraction = $\frac{\_\_\_}{12}$.

   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).

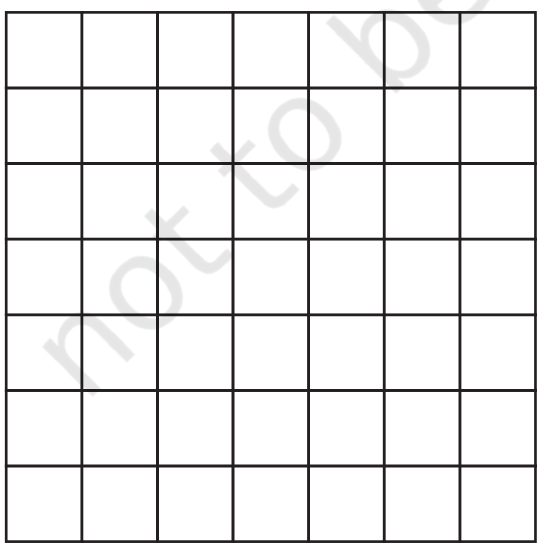


Fig. 1

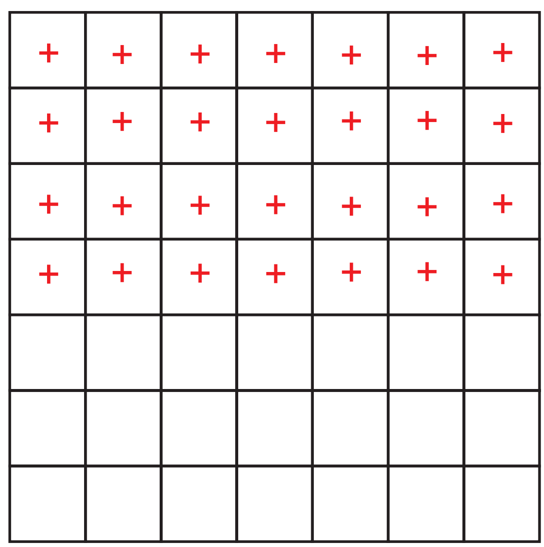


Fig. 2

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.

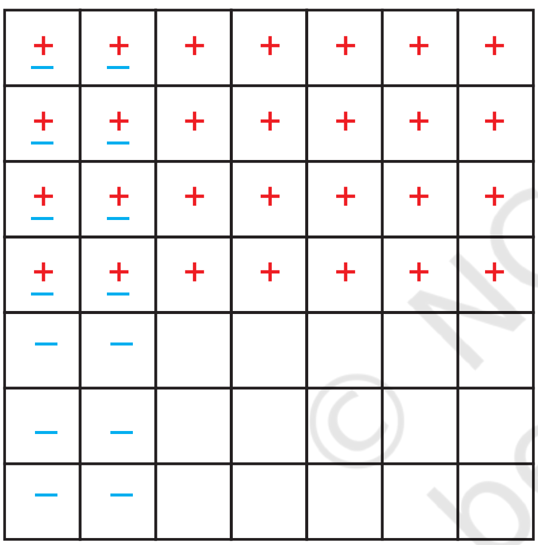


Fig. 3

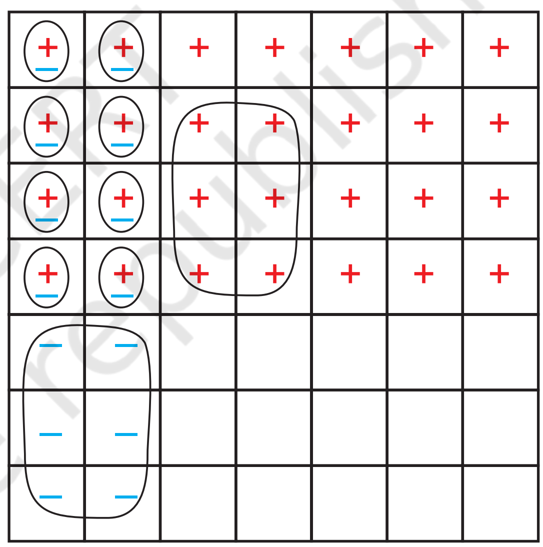


Fig. 4

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 = $\frac{\_\_\_\_}{49}$ = $\frac{\_\_\_\_}{7}$.

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

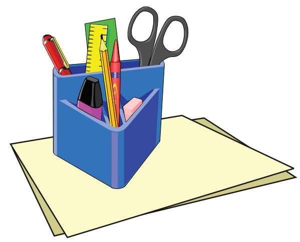
3. Total number of unenclosed signs represents the fraction = $\frac{\_\_\_\_}{49}$ = $\frac{\_\_\_\_}{7}$.

   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).

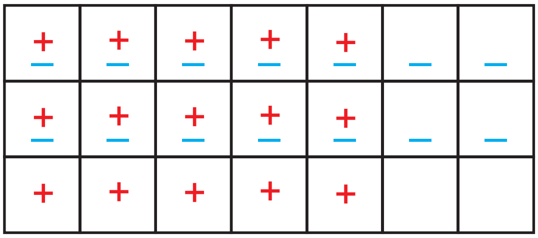


Fig. 3

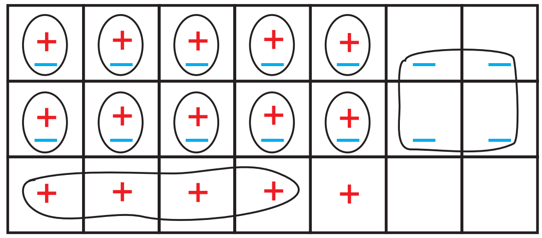


Fig. 4

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

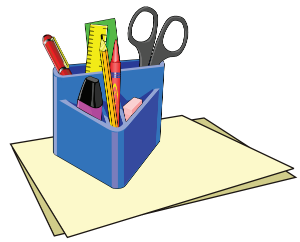
1. Red '+' signs represent the fraction = ________ = ________.
2. Blue '±' signs represent the fraction = ________ = ________.
3. Total number of unenclosed signs represent the fraction = ________.

   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

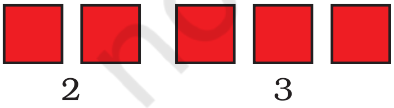
 represents +1

 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:



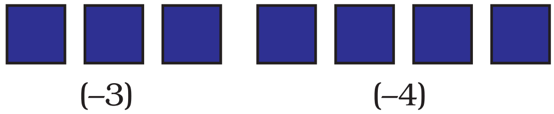
Count the total number of squares and note down their colour.

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.

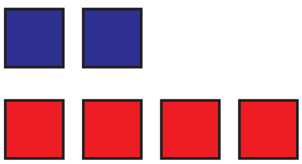
There are 7 squares of blue colour.

So, (–3) + (–4) = –7.

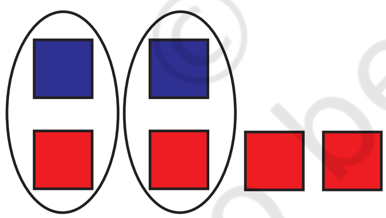
(c) One negative and one positive integer.

(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.

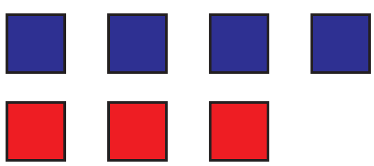


Two squares of red colour are left.

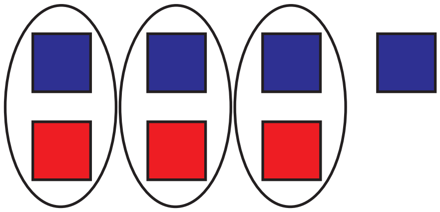
So, (–2) + (4) = 2.

(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

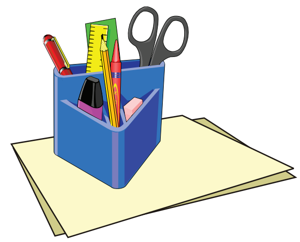
Complete the table:

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

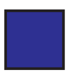
Coloured square paper, adhesive, white sheet, ruler, pen/pencil.

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.

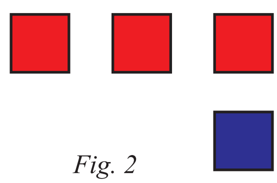


Fig. 2

(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)].

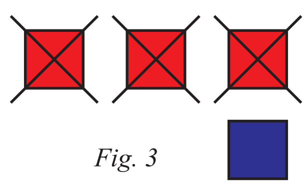


Fig. 3

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

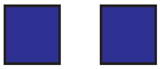


Fig. 4

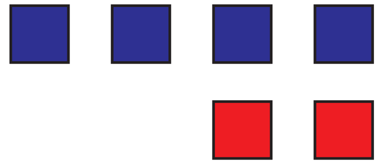


Fig. 5

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

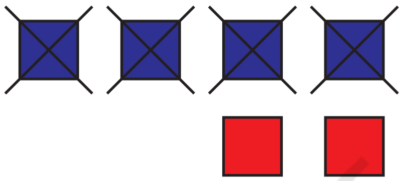


Fig. 6

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.

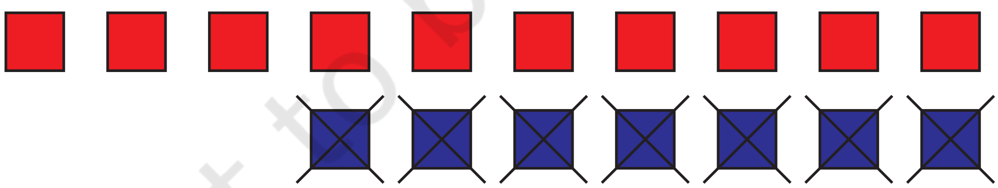


Fig. 7

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.

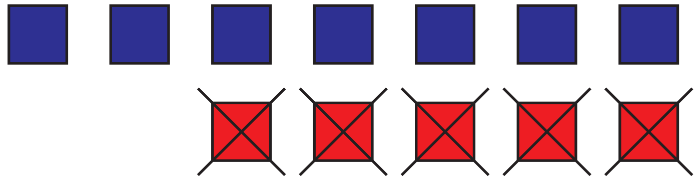


Fig. 8

(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.

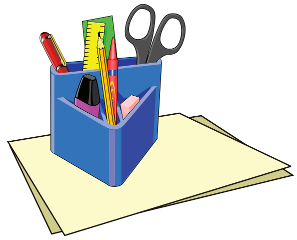
Integers			
a	***b***	***a* – *b***	***a* – *b* =**
2	–3	2 – 3	–1
–2	–4	–2 – (–4)	+2
3	–7	3 – (–7)	10
2	–5	.....	.....
–3	5	.....	.....
–2	–7	.....	.....

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.	–	–	–

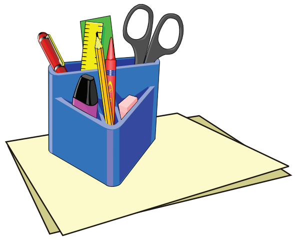
NOTE Teacher may appoint one of the students as a referee to see whether the calculations done are correct or not. Penalty points may be decided if a student commits a mistake while adding.

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	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Fig.1

16	2	3	13
5	11	10	8
9	7	6	12
4	14	15	1

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 = ________.

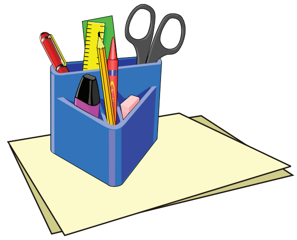
Sum of numbers in each diagonal = _______.

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.

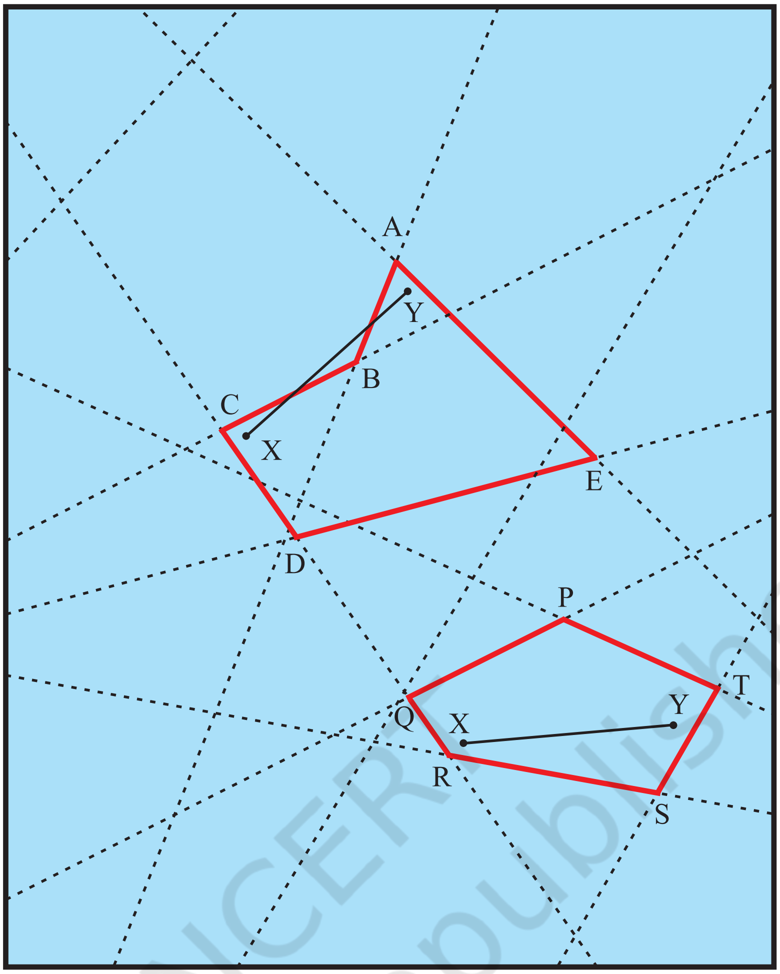


Fig. 1

Observation

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

   So, PQRST is a __________ polygon.

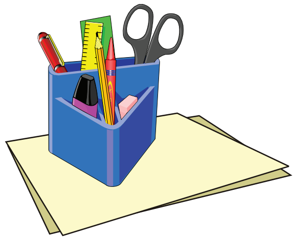
2. In polygon ABCDE, the line segment XY does not completely lie in the interior of the polygon.

   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.

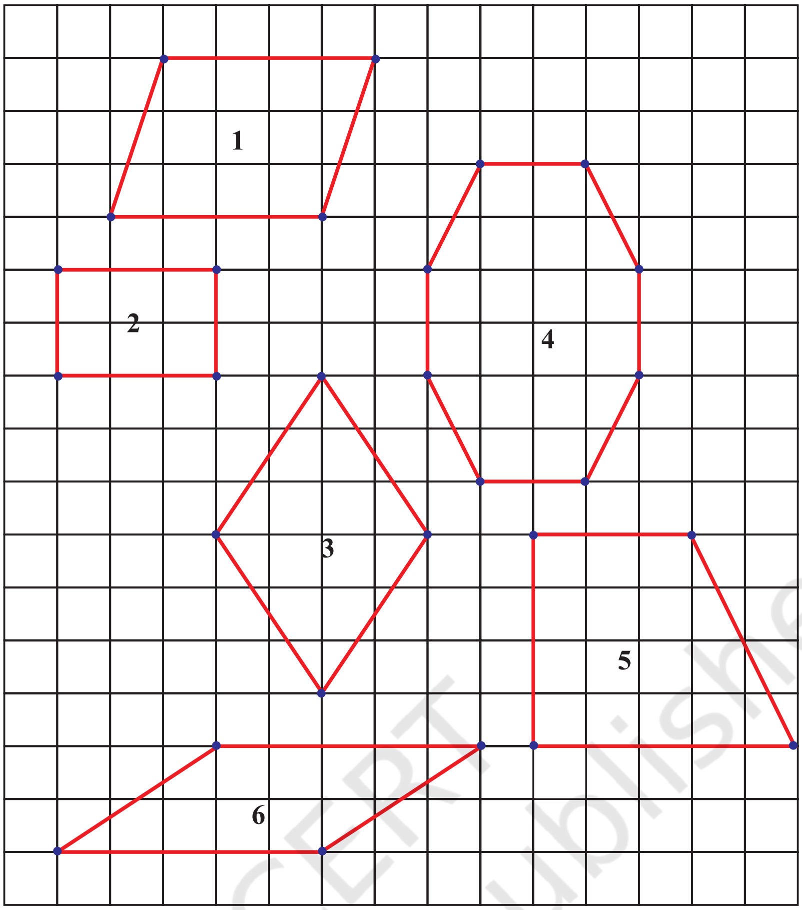


Fig. 1

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	$4 \times 3 = 12$
2	Rectangle	$l \times b$	—
3	Rhombus	$\frac{1}{2} d_1 \times d_2$	—
4	—	—	—
5	—	—	—
6	—	—	—

2.

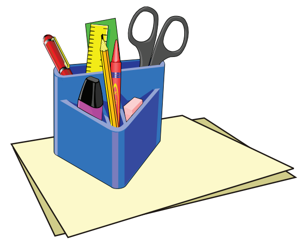
Shape	Actual area	Area obtained using Geoboard
1	12	12
2	6	6
3	—	—
4	—	—
5	—	—
6	—	—

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].

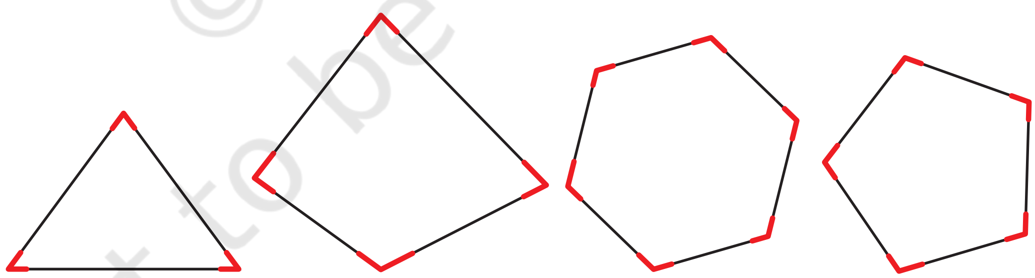


Fig. 1

Demonstration

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

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

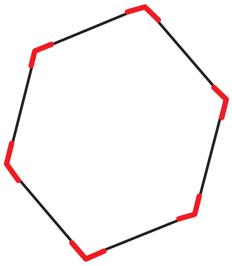


Fig. 2

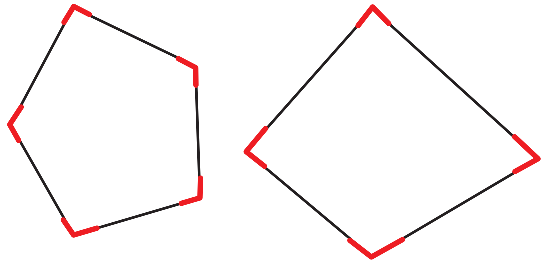


Fig. 3

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].

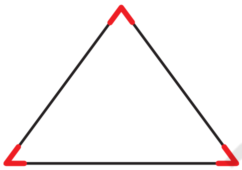


Fig. 4

So, triangle is the most rigid figure.

Observation

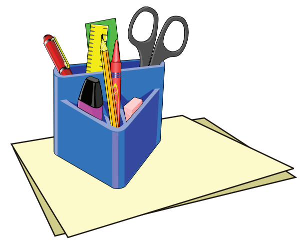
Complete the following table:

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.

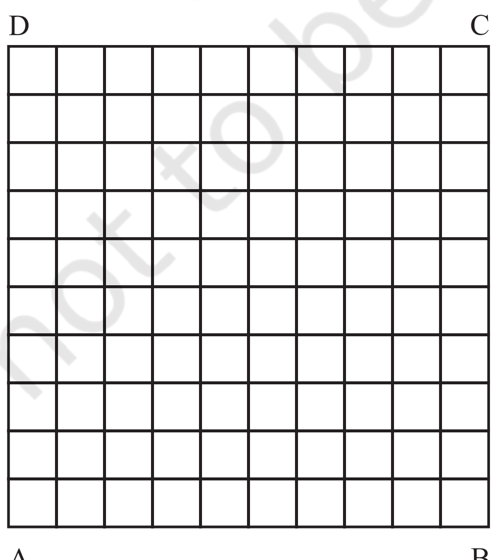


Fig. 1

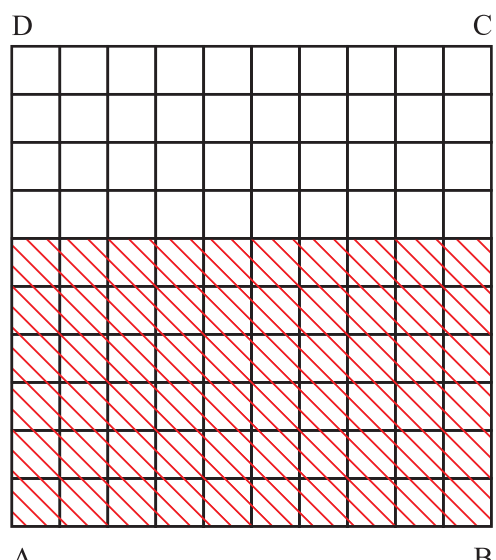


Fig. 2

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.

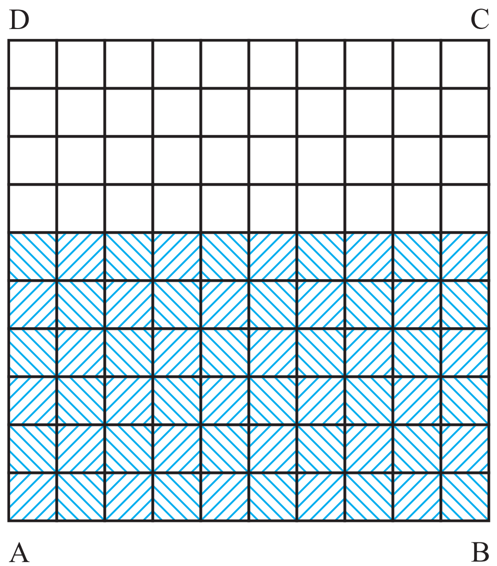


Fig. 3

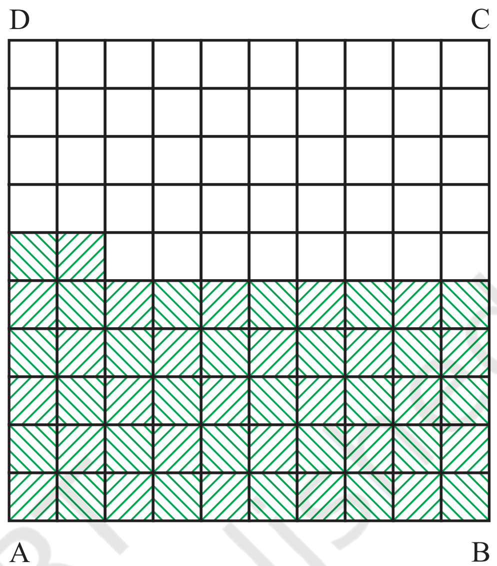


Fig. 4

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 = ________.

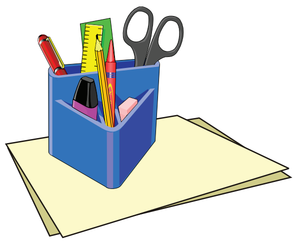
Fig. 2 and Fig. 3 represent _______ portion shaded in Red and Blue respectively.

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).

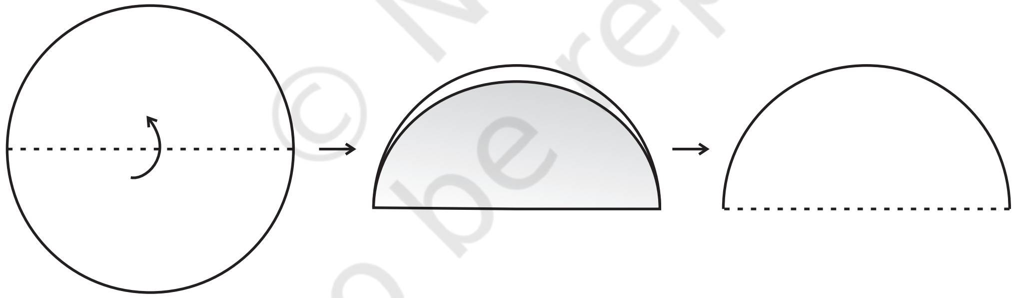


Fig. 1

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.

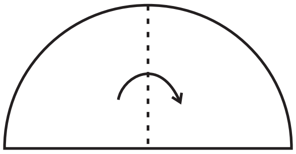


Fig. 2

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

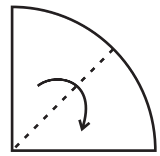


Fig. 3

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

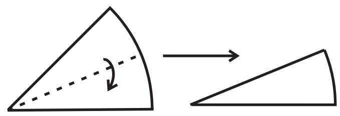


Fig. 4

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

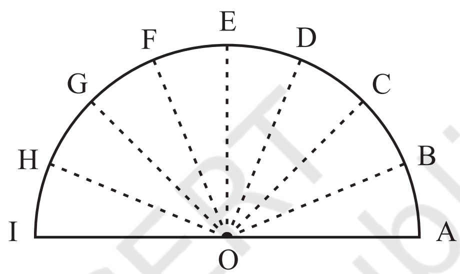


Fig. 5

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.

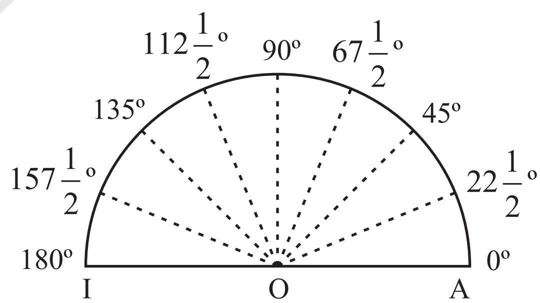


Fig. 6

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

Observation

Measure of $\angle AOI$ = _________.

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

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

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

$$\angle AOD = 45^\circ + \angle COD = \_\_\_\_\_\_\_\_\_.$$

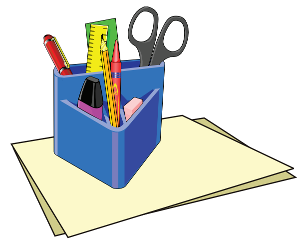
$$\angle AOG = \angle AOE + \angle EOG = \_\_\_\_\_\_\_\_\_.$$

$$\angle AOH = 90^\circ + \angle \_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_.$$

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.

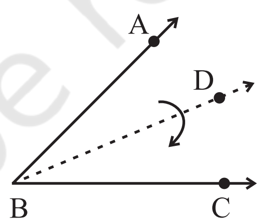


Fig. 1

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 $\angle ABC$ = ________.

Measure of $\angle ABD$ = ________.

Measure of $\angle DBC$ = ________.

$$\angle ABD = \frac{1}{2}\angle \text{ ________.}$$

$$\angle DBC = \angle \text{ ________.}$$

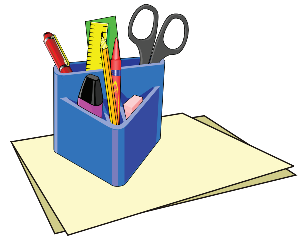
$$\angle ABD = \angle \text{ ________.}$$

BD is _____ of $\angle ABC$.

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.

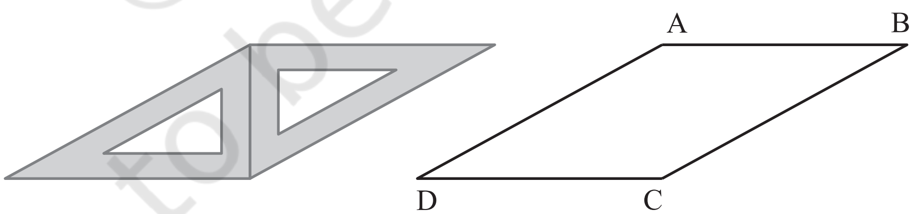


Fig. 1

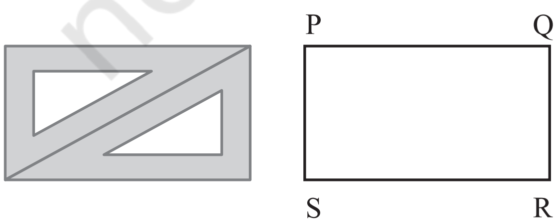


Fig. 2

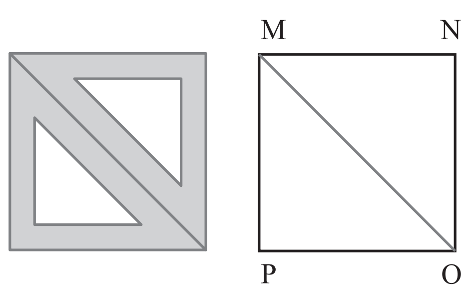


Fig. 3

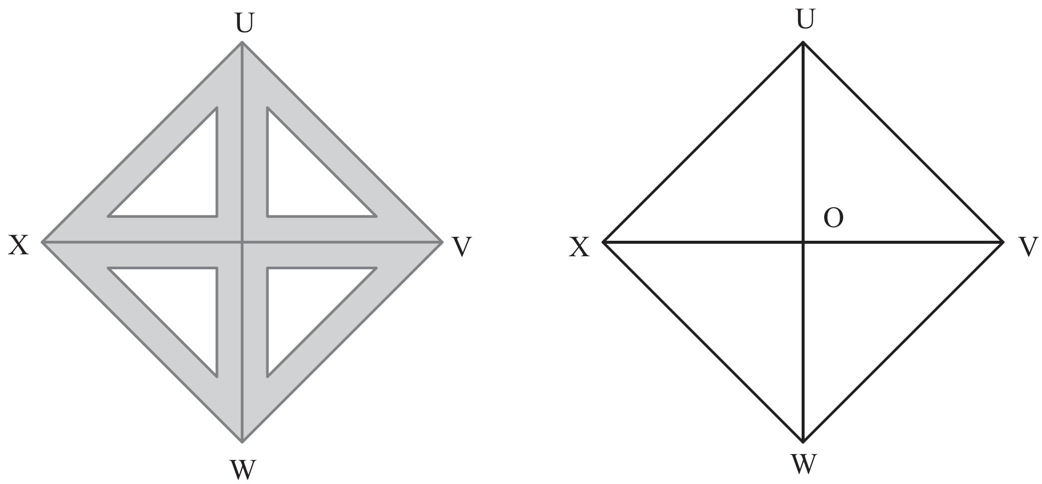


Fig. 4

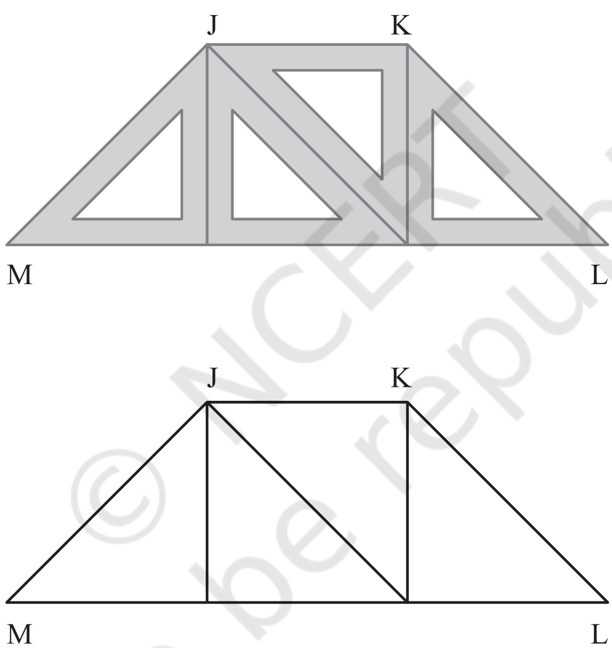


Fig. 5

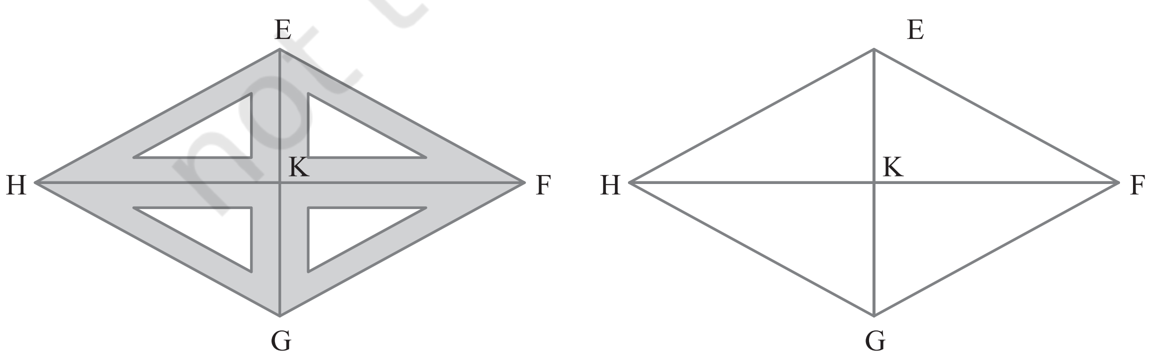


Fig. 6

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° = $\angle$ ______ = $\angle$ ______ = $\angle$ ______.

Therefore, MNOP is a ______.

In Fig 4:

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

So, UV = VW = ______ = ______.

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

$\angle V$ = ______, $\angle W$ = ______, $\angle X$ = ______,

Diagonals intersect at ______.

Each angle at O = ______.

So, diagonal ______ each other at ______.

Thus, UVWX is a ______.

In Fig 5:

$\angle JML$ = ______.

Measure of $\angle KJM$ = ______ + ______ + ______ = ______.

$\angle KJM + \angle JML$ = ______.

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.

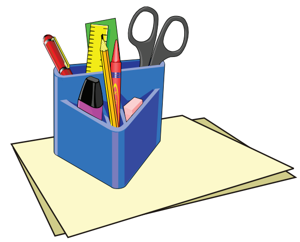
So, diagonals ____ each other ______.

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.

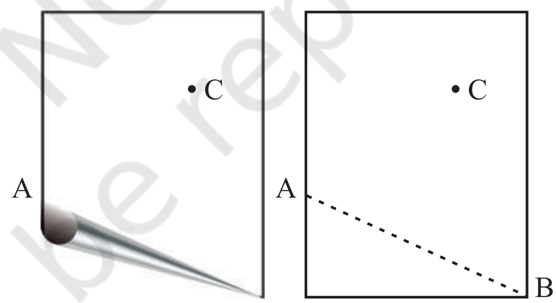


Fig. 1

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

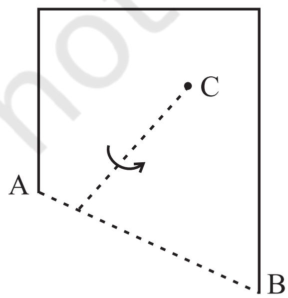


Fig. 2

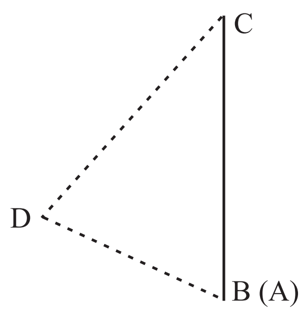


Fig. 3

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.

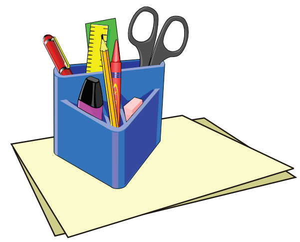
Application

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).

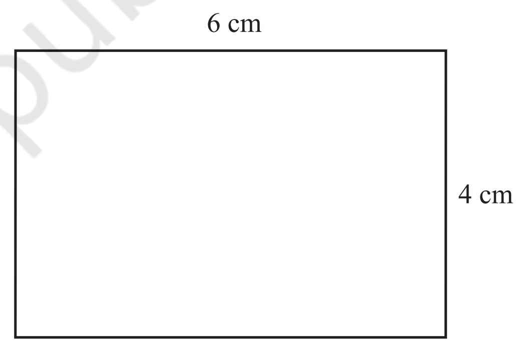


Fig. 1

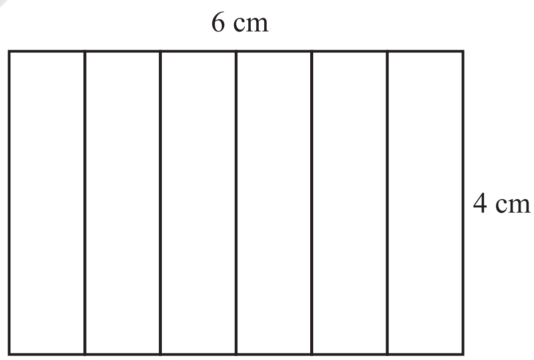


Fig. 2

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

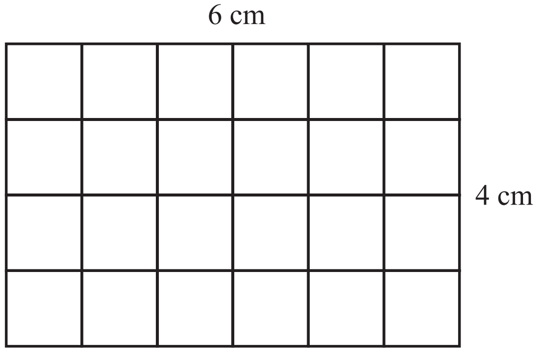


Fig. 3

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 = _________.

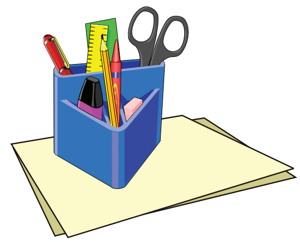
Total number of unit squares =_______ = _______ × _______.

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.

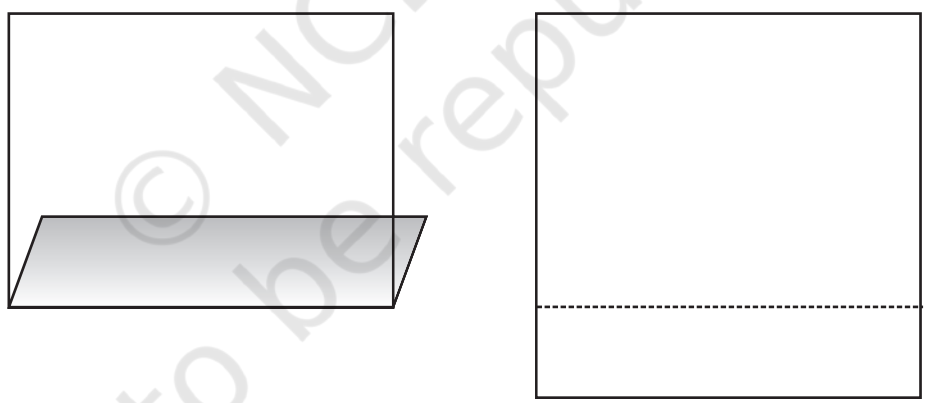


Fig. 1

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.

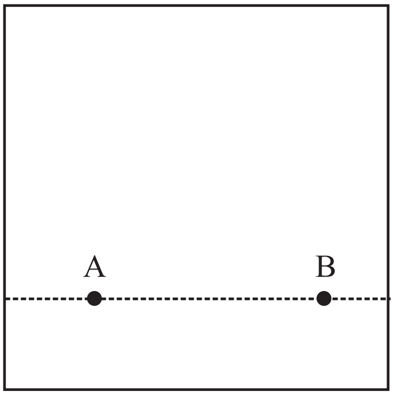


Fig. 2

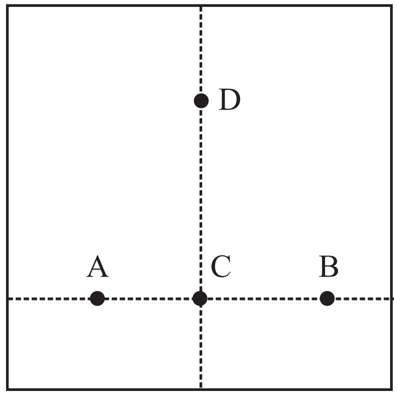


Fig. 3

Demonstration

1. AC is equal to CB as AC exactly covers BC.

2. Since the two rays CA and CB of $\angle$ACB fall on each other, CD is the angle bisector of $\angle$ACB.

   $\angle$ACD exactly covers $\angle$DCB. So, $\angle ACD = \angle DCB = 90°$.

3. CD is perpendicular bisector of AB.

Observation

On actual measurement:

AC = _______, BC = ________.

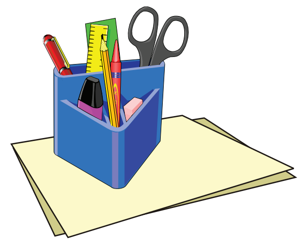
$\angle$ACD = ______, $\angle$BCD = ________.

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

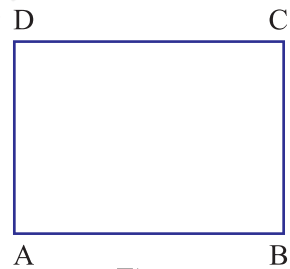


Fig. 1

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

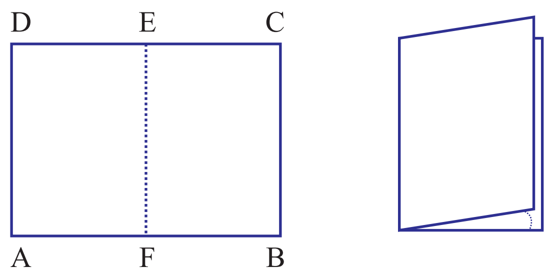


Fig. 2

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).

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

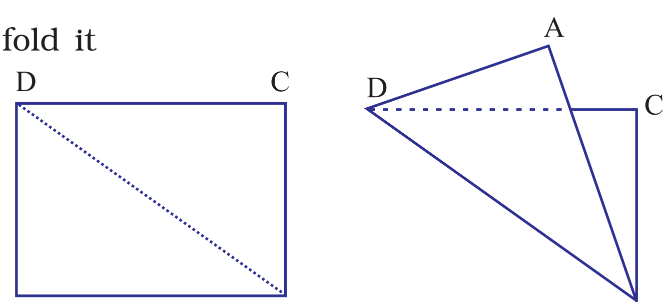


Fig. 3

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	___	___

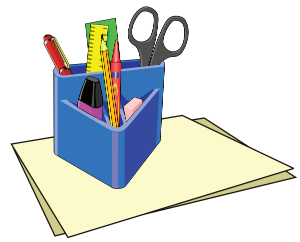
Thus, there are ____ lines of symmetry for a rectangle.

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).

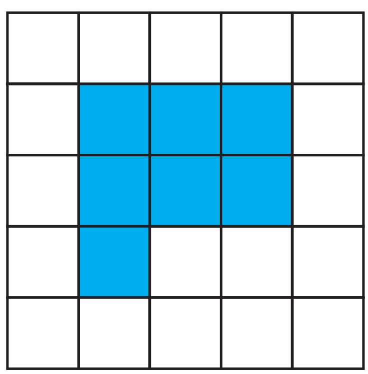


Fig. 1

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).

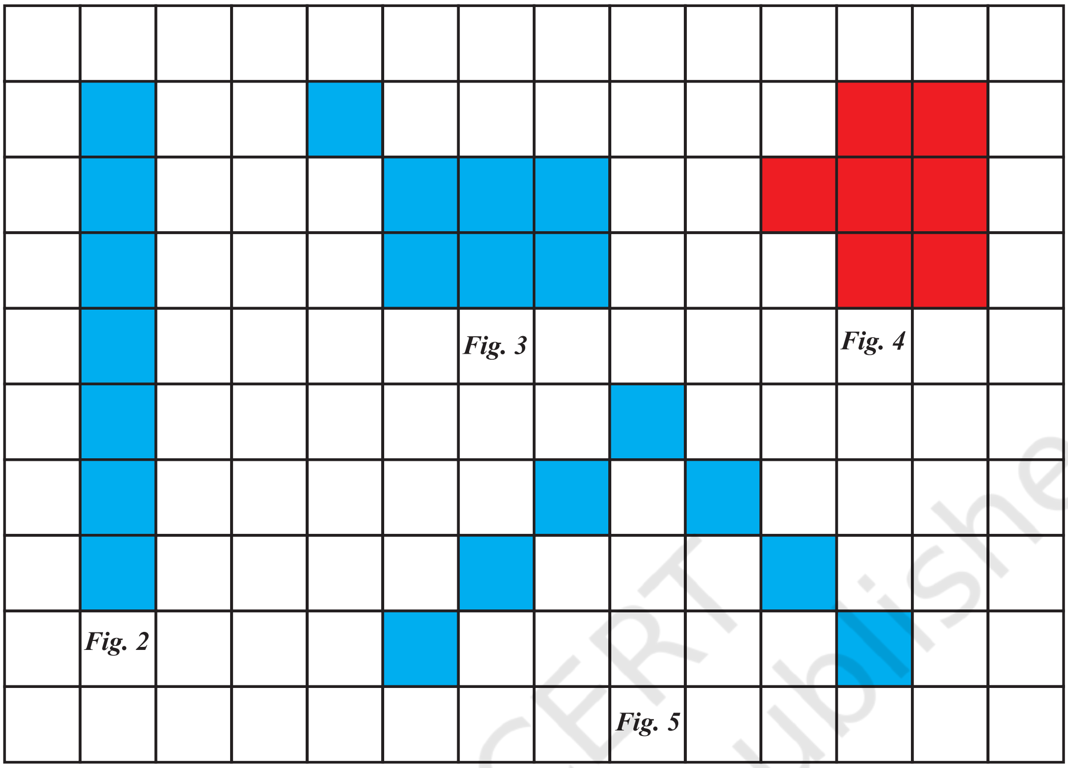


Fig. 2 to 5

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:

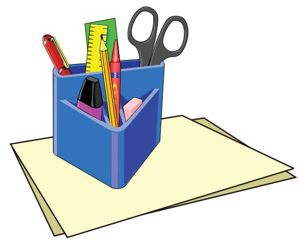
Child	Figure	Area (Square units)	Perimeter
1	1	7	12 cm
2	2	–	–
3	3	–	–
4	4	–	–
5	5	–	–

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.

Activity 28



Objective

To multiply a fraction by a number [say, $\frac{3}{4} \times 7$]

Material Required

Buttons (50 pieces) only.

Method of Construction

1. Take seven boxes each containing 4 balls (Fig. 1).

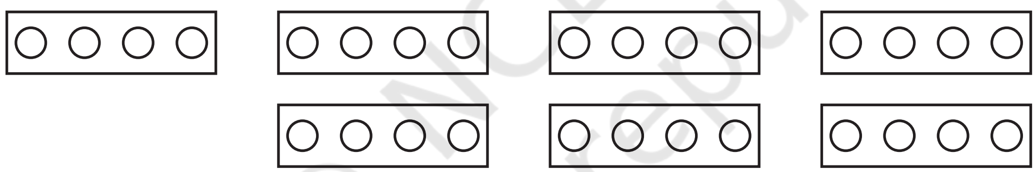


Fig. 1

2. Take out 3 balls from each box (Fig. 2).

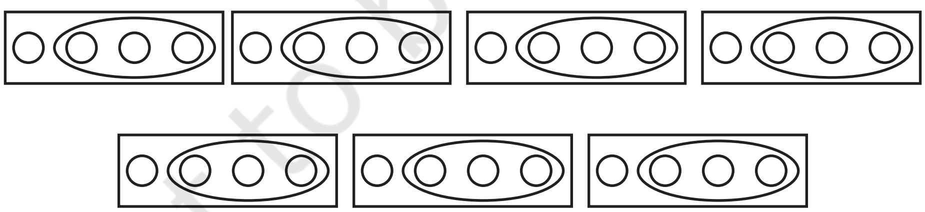


Fig. 2

Demonstration

1. In each box, the 3 balls taken out represent the fraction $\frac{3}{4}$.

2. There are 7 boxes. Thus we have $\frac{3}{4}$ taken 7 times i.e., $\frac{3}{4}$ added 7 times or $\frac{3}{4} \times 7$.

3. Total number of balls taken out from 7 boxes = 21.

   Each remaining ball represents the fraction $\frac{1}{4}$.

   So, fraction represented by 21 balls = $\underbrace{\frac{1}{4}+\frac{1}{4}+......+\frac{1}{4}}_{21\text{ times}}$.

   Thus, $\frac{3}{4} \times 7 = \frac{21}{4}$.

Observation

Number of balls in one box = __________.

Fraction representing 1 ball = _________.

Fraction representing 3 balls in a box = ___________.

Total number of balls taken out from 7 boxes represents $\frac{3}{4}$ × _____.

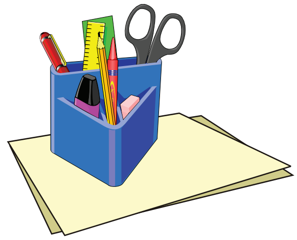
Fraction represented by total number of balls taken out = ______.

So, $\frac{3}{4}$ × _____ = $\frac{\_\_\_}{4}$.

Application

This activity is useful in explaining multiplication of a fraction by a number.

Activity 29



Objective

To divide integers using unit squares of different colours

Materials Required

Cardboard, white paper, red and blue grid paper, colour pens/pencils (Red and Blue), adhesive, ruler, scissors.

Method of Construction

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

2. Take a blue grid paper and cut out sufficient number of square pieces of unit squares. Let each square represent an integer '+1' (Fig.1).

Fig. 1

3. Take a red grid paper and cut out sufficient number of square pieces of unit area. Let each square represent an integer '–1' (Fig. 2).

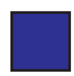


Fig. 2

4. Paste one blue unit square and one red unit square together back to back so that one side of the square is blue and the other is red.

I. Positive integer divided by a positive integer, 6 ÷ 2

1. Take 6 blue squares and arrange them in a row as shown in Fig. 3.

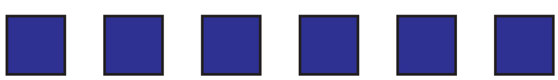


Fig. 3

2. Divide these blue squares into two groups taking one by one as shown in Fig. 4.

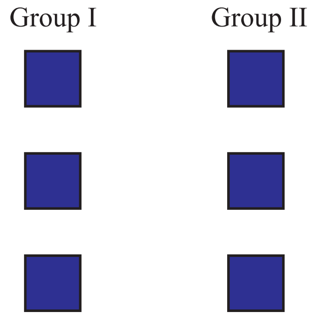


Fig. 4

3. Each group contains 3 blue squares. So, 6 ÷ 2 = 3

II. (–6) ÷ 2 (negative integer divided by a positive integer)

4. Take 6 red unit squares and arrange them as shown in Fig. 5.

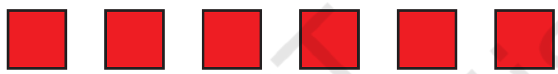


Fig. 5

5. Now divide the above red squares into two groups taking them one by one [Fig. 6].

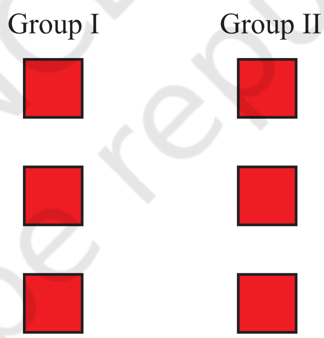


Fig. 6

6. Each group contains 3 red squares. Thus, (–6) ÷ 2 = –3.

III. 6 ÷ (–2) (positive integer divided by a negative integer)

7. Take 6 blue unit squares and arrange them in a row as shown in Fig. 7.

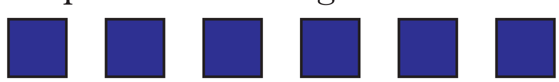


Fig. 7

8. Since we have to divide by a negative integer so invert each square of Fig. 7 once (Fig. 8).

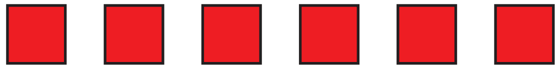


Fig. 8

9. Now divide the above red squares into two groups taking them one by one [Fig. 9].

Group I Group II

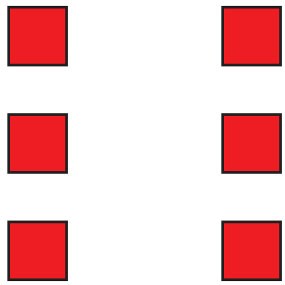


Fig. 9

10. Since each group contains 3 red unit squares so, 6 ÷ (–2) = –3.

IV. (–6) ÷ (–2) (negative integer divided by a negative integer).

11. Take 6 red unit squares and arrange them as shown in Fig. 10.

Fig. 10

12. Since we have to divide by a negative integer, so invert each square of Fig. 10 once (Fig. 11).

Fig. 11

13. Now divide all the squares in Fig. 11 into two groups taking them one by one [Fig. 12].

Group I Group II

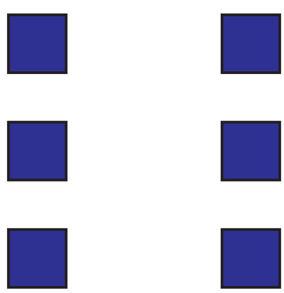


Fig. 12

14. Since each group contains 3 blue squares, so, (–6) ÷ (–2) = 3.

This activity may be performed for finding other quotients such as

6 ÷ 3, –6 ÷ 3, 6 ÷ (–3), (–4) ÷ (–2), –8 ÷ (–4) etc.

Observation

Fill in the blanks:

6 ÷ 2 = ___ 3___.

–6 ÷ 2 = ___ –3___.

6 ÷ (–2) = ___ –3___.

–6 ÷ (–2) = ______.

8 ÷ 4 = ______.

–8 ÷ 4 = ______.

8 ÷ (–4) = ______.

–15 ÷ (–3) = ______.

20 ÷ (–4) = ______.

16 ÷ (–2) = ______.

–14 ÷ 2 = ______.

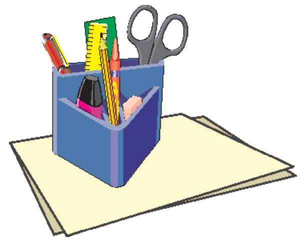
–18 ÷ (–9) = ______.

10 ÷ (–5) = ______.

Application

This activity is useful in explaining division of two integers with same or different signs and to understand rules of division of integers.

Activity 30



Objective

To explain SAS criterion for congruency of two triangles

Material Required

Cardboard, cutter, white paper, geometry box, pencil, sketch pens, coloured glaze papers.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Make a pair of triangles GHI and JKL in which GH = JK, GI = JL and $\angle G = \angle J$ on a glaze paper (Fig. 1) and make cutouts of Δ GHI and Δ JKL.
3. Paste Δ GHI on the cardboard.

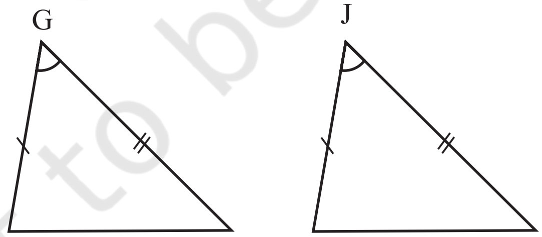


Fig. 1

Demonstration

Superpose the cut out of Δ JKL on Δ GHI and see whether it covers the triangle or not by suitable arrangement. On Δ GHI, Δ JKL covers completely only under the correspondence $G \leftrightarrow J$, $H \leftrightarrow K$, $I \leftrightarrow L$, (Fig. 2).

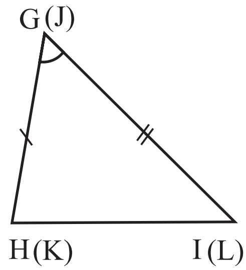


Fig. 2

So, Δ GHI ≅ Δ JKL.

This is SAS criterion for congruency of two triangles.

OBSERVATION

On actual measurement:

∠H = _________.   ∠K = _________.

∠I = _________.   ∠L = _________.

HI = _________.   KL = _________.

∠H = ∠K

∠I = ∠ _________.

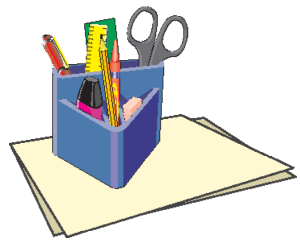
HI = _________.

So, Δ GHI ≅ _________.

APPLICATION

This SAS criterion is useful in solving various geometrical problems.

Activity 31



Objective

To explain the SSS criterion for congruency of two triangles

Material Required

Cardboard, cutter, white paper, geometry box, pencil, sketch pens, coloured glaze papers.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Make a pair of triangles ABC and DEF in which AB = DE, BC = EF and AC = DF on a glaze paper and make cutouts of Δ ABC and Δ DEF.
3. Paste Δ ABC on the cardboard.

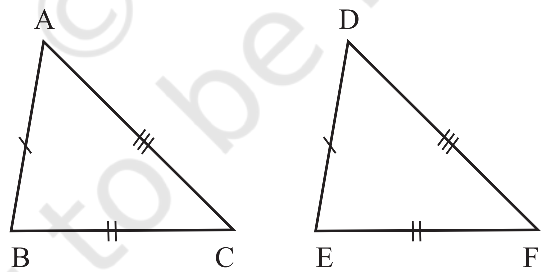


Fig. 1

Demonstration

Superpose the cut out of Δ DEF and see whether one triangle covers the other triangle or not by suitable arrangement. See that Δ DEF covers Δ ABC completely only under the correspondence A ↔ D, B ↔ E, C ↔ F.

So, Δ ABC ≅ Δ DEF.

This is SSS criterion for congruency of two triangles.

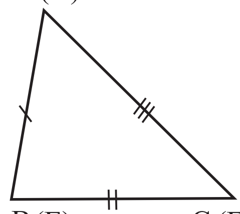


Fig. 2

Observation

On actual measurement in Δ ABC and Δ DEF:

∠A = _________.   ∠D = _________.

∠B = _________.   ∠E = _________.

∠C = _________.   ∠F = _________.

∠A = ∠D

∠B = ∠ _________.

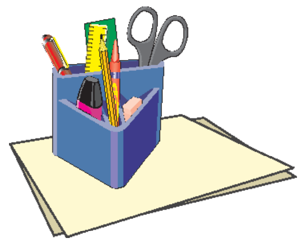
∠C = ∠

So, Δ ABC ≅ _________.

Application

This activity is useful in solving various geometrical problems.

Activity 32



Objective

To explain ASA criterion for congruency of two triangles

Material Required

Cardboard, cutter, white paper, geometry box, pencil, sketch pens, coloured glaze papers.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Make a pair of triangles PQR and STU in which QR = TU, ∠Q = ∠T, ∠R = ∠U on a glaze paper and make cutouts of Δ PQR and Δ STU.
3. Paste Δ PQR on the cardboard.

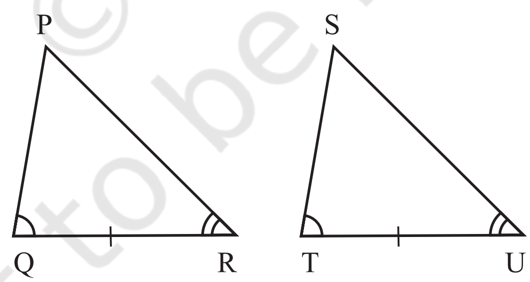


Fig. 1

Demonstration

Superpose the cut out of Δ STU on Δ PQR and see whether it covers the triangle or not by suitable arrangement. See that Δ STU covers Δ PQR completely only under the correspondence P ↔ S, Q ↔ T, R ↔ U. (Fig. 2).

So, Δ PQR ≅ Δ STU.

This is ASA criterion for congruency of two triangles.

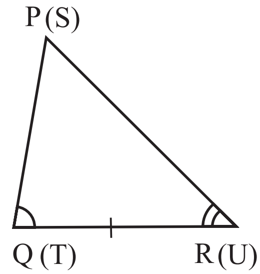


Fig. 2

Observation

On actual measurement, in Δ PQR and Δ STU:

∠P = _________. ∠S = _________.

PQ = _________. ST = _________.

PR = _________. SU = _________.

∠P = ∠S

PQ = _________.

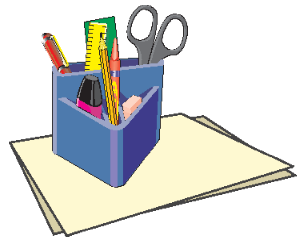
PR = _________.

So, Δ PQR ≅ _________.

Application

This activity is useful in solving of various geometrical problems.

Activity 33



Objective

To explain RHS criterion for congruency of two right triangles

Material Required

Cardboard, cutter, white paper, geometry box, pencil, sketch pens, coloured glaze papers.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Make a pair of right triangles XYZ and LMN in which hypotenuse YZ = hypotenuse MN and side XZ = side LN on a glaze paper and make cut outs of Δ XYZ and Δ LMN.
3. Paste Δ XYZ on the cardboard.

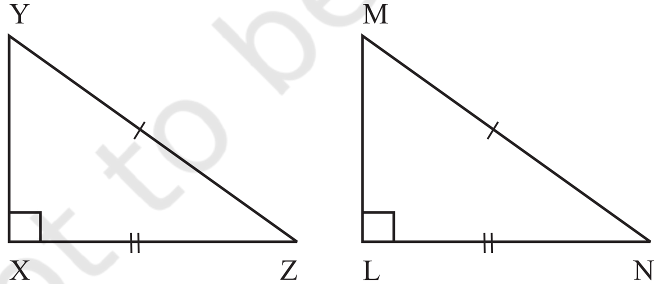


Fig. 1

Demonstration

Superpose the cut out of Δ LMN on Δ XYZ and see whether it covers the triangle or not by suitable arrangement. See that Δ LMN covers Δ XYZ completely only under the correspondence X ↔ L, Y ↔ M, Z ↔ N (Fig. 2).

So, Δ XYZ $\cong$ Δ LMN.

This is RHS criterion for congruency of two triangles.

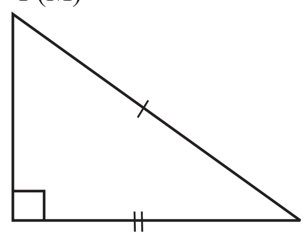


Fig. 2

Observation

On actual measurement, in Δ XYZ and Δ LMN:

$\angle$Y = __________. $\angle$M = __________.

$\angle$Z = __________. $\angle$N = __________.

XY = __________. LM = __________.

$\angle$Y = $\angle$M

$\angle$Z = $\angle$ __________.

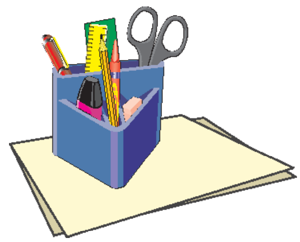
XY = __________.

So, Δ XYZ $\cong$ Δ __________.

Application

This activity is useful in solving various geometrical problems.

Activity 34



Objective

To verify that in an isosceles triangle, angles opposite equal sides are equal

Material Required

Cardboard, white sheet, drawing sheet, different colours, adhesive, scissors, tracing paper, pen/ pencil, geometry box.

Method of Construction

1. Take a cardboard of convenient size and paste a white sheet on it.
2. Draw an isosceles triangle ABC (with AB = AC) on a drawing sheet and cut it out.
3. Colour the three angles of the triangle using different colours as shown in Fig. 1.

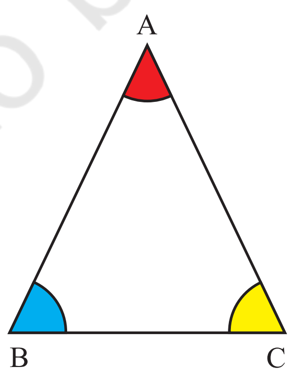


Fig. 1

4. Make a trace copy of the triangle and colour the angles of it exactly the same as the triangle on the board.

5. Make the cutouts of these three angles.

Demonstration

Try to place cutouts of each angle on the other angles of the triangle and see whether it covers the angle or not. Cut out of ∠B should cover exactly ∠C and vice versa.

So, ∠B = ∠C.

Observation

1. Cut out of ∠B covers exactly cut out of ∠ _______.
2. Cut out of ∠C covers exactly cut out ∠ ________.

   Cut out of ∠B does not cover exactly cut out of ∠ _______.

   Cut out of ∠C _______ exactly ∠A.

   Thus ∠B = ∠ _______.

   On actual measurement:

   ∠B = ________.

   ∠C = ________.

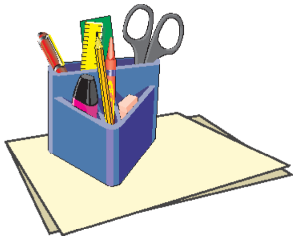
   ∠A = ________.

   Thus, in a triangle angles opposite equal sides are _________.

Application

This result is used in solving many other geometrical problems.

Activity 35



Objective

To multiply two fractions (say, $\frac{3}{4}$ and $\frac{5}{6}$)

Material Required

Cardboard, white chart paper, ruler, pencil, eraser, adhesive, sketch pens of different colours (say Blue and Red).

Method of Construction

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

2. Draw a rectangle ABCD of suitable dimensions (say 8 cm × 3 cm) as shown in Fig.1 on the cardboard.

Fig. 1

3. Divide the rectangle ABCD into 4 equal parts (say along the length) and shade 3 parts in red colour using a sketch pen as shown in Fig. 2.

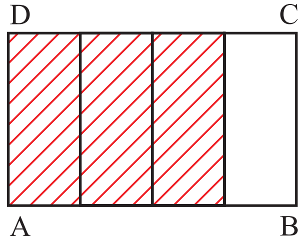


Fig. 2

4. Divide the rectangle ABCD along the breadth into 6 equal parts and shade 5 parts in blue colour as shown in Figure 3.

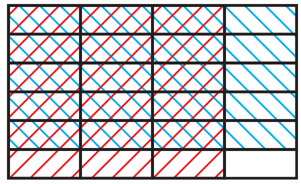


Fig. 3

Demonstration

1. In Fig. 2, portion shaded in red colour represents the fraction $\frac{3}{4}$.

2. In Fig. 3, portion shaded in blue colour represents the fraction $\frac{5}{6}$.

3. In Fig.3, portion shaded in both red and blue colour represents the fraction $\frac{15}{24}$. It also represents $\frac{5}{6}$ of $\frac{3}{4}$ or $\frac{5}{6} \times \frac{3}{4}$.

   Thus, $\frac{5}{6} \times \frac{3}{4} = \frac{15}{24}$.

   Repeat this activity for some other pairs of fractions.

Observation

1. In Fig. 2, the number of equal parts along the length = _________.

   In Fig. 2, the number of parts shaded in red = _________.

   Therefore, shaded part in Fig. 2 represents the fraction = _________.

   In Fig. 3, the number of equal parts along the breadth = _________.

   In Fig. 3, the number of parts shaded in blue = _________.

   Therefore, in Fig. 3, shaded part in blue (along the breadth) represents the fraction = _________.

   In Fig. 3, total number of equal parts = _________.
   (along the length and breadth)

In Fig. 3, the number of parts shaded in both blue and red = ________.

Therefore, in Fig. 3, shaded part (in both blue and red) represents the fraction = ________.

Hence $\frac{5}{6} \times \frac{3}{4} = \boxed{}$

2. Let the rectangular area of the rectangle ABCD represent unit area.

   (i) Area of shaded region in red represents $\boxed{}$ of area of rectangle ABCD.

   (ii) Area of shaded region in blue represents $\boxed{}$ of area of the rectangle ABCD.

   (iii) The whole rectangular region in Fig. 3 is divided into $\boxed{}$ equal parts and each equal part represents $\boxed{}$

   (iv) The area of the double shaded region (in red and blue) represents $\boxed{}$ of area of the rectangle ABCD.

The length and breadth of the double shaded rectangular region represents $\frac{3}{4}$ of the length and $\frac{5}{6}$ of breadth of the rectangle ABCD.

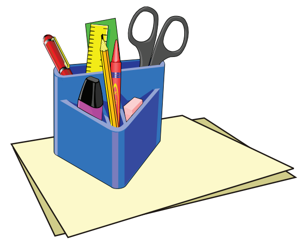
Hence $\frac{3}{4} \times \frac{5}{6} =$ ________.

Thus, the product of two fractions = $\frac{\text{Product of their numerators}}{\text{Product of their denominators}}$.

Application

This activity may be used in explaining product of a pair of proper fractions.

Activity 36



Objective

To divide a fraction by another fraction [say, $\frac{2}{3} \div \frac{1}{6}$]

Material Required

White paper sheet, colour pen/pencils, eraser etc.

Method of Construction

1. Draw a rectangle on a paper and divide it into three equal parts (Fig. 1).

Fig. 1

2. Again divide each smaller rectangle (cell) into two equal parts and get six smaller equal parts (Fig. 2).

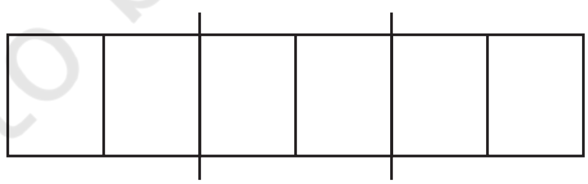


Fig. 2

Demonstration

1. Each part of the rectangle in Fig.1, represents the fraction $\frac{1}{3}$.

   So, fraction $\frac{2}{3}$ is represented by two equal parts (Fig. 3).

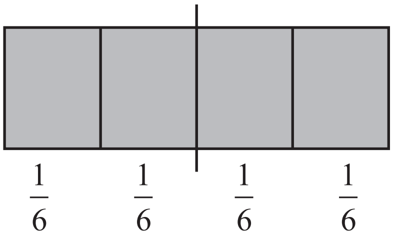


Fig. 3

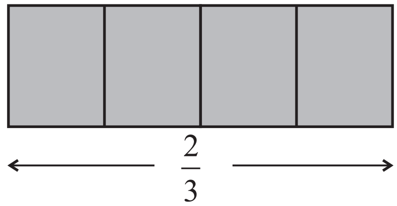


Fig. 4

2. Each part in Fig. 2, represents the fraction $\frac{1}{6}$.

3. Take two equal parts of Fig. 2, we get Fig. 3. $\frac{2}{3} \div \frac{1}{6}$ means, the number of $\frac{1}{6}$ that are contained in $\frac{2}{3}$.

4. There are four $\frac{1}{6}$ in $\frac{2}{3}$ (see Fig. 4).

   So, $\frac{2}{3} \div \frac{1}{6} = 4$

Observation

In Fig. 1, each part represents the fraction = _______.

In Fig. 1, two parts represents the fraction = _______.

In Fig. 2, each part represents the fraction = _______.

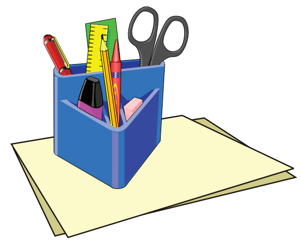
In Fig. 4, number of $\frac{1}{6}$ = _______.

So, _______ = _______.

Application

This activity is useful in explaining the division of two fractions.

Activity 37



Objective

To divide a fraction by a natural number. [say, $\frac{1}{3} \div 4$]

Material Required

White paper sheet, colour pens/pencils, eraser etc.

Method of Construction

1. Draw a rectangle on a paper and divide it into 3 equal parts (Fig. 1).

$\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$

Fig. 1

2. Again divide each smaller rectangle (cell) into four equal parts and obtain 12 smaller equal parts (Fig. 2).

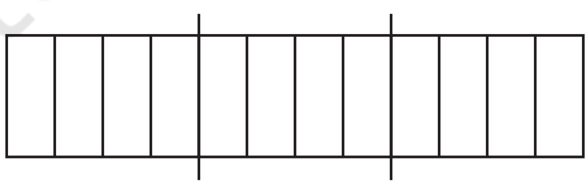


Fig. 2

Demonstration

1. Each part, in the rectangle in Fig.1, represents the fraction $\frac{1}{3}$.

2. Each part of Fig. 2, has been obtained on dividing $\frac{1}{3}$ into 4 equal parts.

So, each part in Fig. 2 represents $\frac{1}{3} \div 4$.

3. Each part in Fig. 2 represents the fraction $\frac{1}{12}$.

Thus, $\frac{1}{3} \div 4 = \frac{1}{12}$.

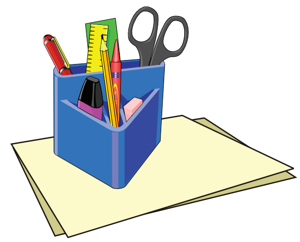
Observation

1. Each part of Fig.1 represents the fraction = _______.
2. Each part of Fig. 2 represents the fraction = _______.
3. Each part of Fig. 2 is obtained on dividing _______ by _______.
4. So, $\frac{1}{3} \div 4$ = _______.

Application

This activity is useful in explaining division of a fraction by a natural number.

Activity 38



Objective

To multiply integers using unit squares of different colours

Material Required

Cardboard, white paper, red and blue grid papers, colour pens (Red and Blue), adhesive, ruler, scissors.

Method of Construction

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

2. Take a blue grid paper and cut out sufficient number of square pieces of unit squares. Each blue square represents an integer '+1' (Fig. 1).

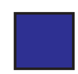


Fig. 1

3. Take a red grid paper and cut out sufficient number of square pieces of unit area. Let each red square represent an integer '–1' (Fig. 2).

Fig. 2

4. Paste one blue unit square and one red unit square together so that one side of the square is blue and the other is red.

Demonstration

I. For two positive integers, say 2 × 3.

1. Draw 5 (= 2 + 3) blue edges of unit length on this cardboard as shown in Fig. 3.

2. Complete the rectangular shape using blue unit squares as shown in Fig. 4.

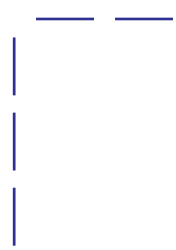


Fig. 3

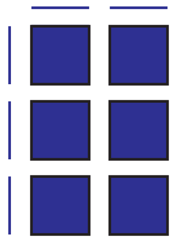


Fig. 4

3. Number of blue unit squares in the rectangle is 6. Thus, 2 × 3 = 6.

II. For one negative and one positive integer, say (–2) × 3.

4. Draw 3 blue edges and 2 red edges each of unit length using coloured pen as we have to multiply (–2) by (3) [Fig. 5].

Fig. 5

5. Complete the rectangle in Fig. 5 using blue unit squares [Fig. 6].

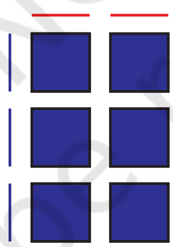


Fig. 6

6. Since one side of the rectangle has red edges, so invert each blue square of Fig. 6 once as shown in Fig. 7.

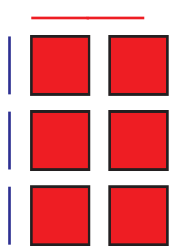


Fig. 7

7. In Fig.7, there are six red unit squares.

So, (–2) × 3 = –6.

III. For two negative integers, say, (–2) × (–3).

8. Draw 5 red edges each of unit length as shown in Fig. 8 as we have to multiply (–2) by (–3).

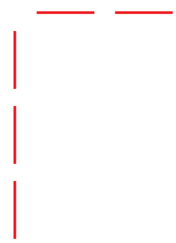


Fig. 8

9. Complete the rectangle in Fig. 8 using blue unit squares [Fig. 9].

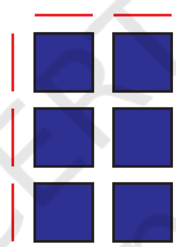


Fig. 9

10. Since two sides of the rectangle in Fig. 9 are having red edges, so invert the squares, two times as shown in Fig. 10 and 11.

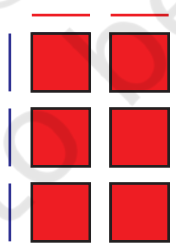


Fig. 10

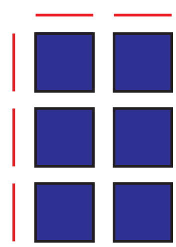


Fig. 11

11. There are now, 6 blue squares in the rectangle.

So, (–2) × (–3) = 6

This activity may be performed for finding other products such as (–4) × 3, 4 × 3, (–3) × (5) etc.

OBSERVATION

2 × 3 = __6___.

–2 × 3 = __–6___.

(–2) × (–3) = _____.

4 × 3 = _____.

–4 × 4 = _____.

(–3) × (–5) = _____.

(–9) × (–10) = _____.

–7 × 4 = _____.

–5 × (–6) = _____.

APPLICATION

This activity is useful in explaining multiplications of two integers with same / different signs and to understand rules of multiplication of integers.

Activity 39

Objective

To divide a natural number by a fraction

Material Required

Chart paper, sketch pens, ruler, pencil, adhesive, cardboard.

Method of Construction

Let us find $2 \div \frac{1}{4}$.

1. Take a cardboard of a convenient size and paste a chart paper on it.
2. Cut out 2 rectangles of same size from the cardboard (Fig. 1).

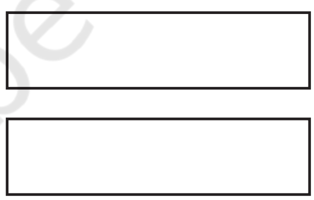


Fig. 1

3. Divide each rectangle to form equal parts as shown in Fig. 2.

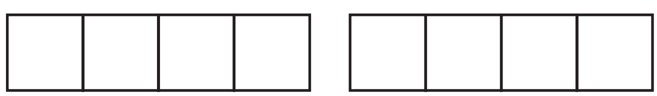


Fig. 2

Demonstration

1. There are two identical rectangles each representing natural number 1.

Thus the two rectangles together represent the natural number 2.

2. Each rectangle has been divided into 4 equal parts. So, each part in a rectangle represents the fraction $\frac{1}{4}$.

3. There are in all eight $\frac{1}{4}$'s in Fig. 2 i.e., Fig. 2 contains eight $\frac{1}{4}$.

   Thus $2 \div \frac{1}{4} = 8$ (or $2 \times \frac{4}{1}$).

This activity can be performed by taking different natural numbers and fractions, such as $3 \div \frac{1}{4}$, $4 \div \frac{1}{5}$, $6 \div \frac{1}{3}$.

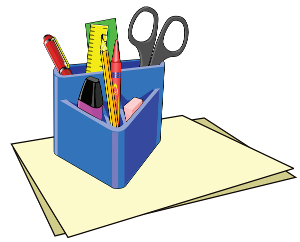
Observation

1. In Fig. 1 each rectangle represents the number _________.
2. In Fig. 2, both rectangles together represent the number _________.
3. In Fig. 2 each part in a rectangle represents _________.
4. In Fig. 2, the number of parts representing $\frac{1}{4}$ is _________.
5. $2 \div \frac{1}{4}$ = _________.

Application

This activity is useful in explaining division of a natural number by a fraction.

Activity 40



Objective

To divide a mixed fraction by a proper fraction [say, $1\frac{3}{4} \div \frac{1}{4}$]

Material Required

Paper, colour pen, eraser, pencil, cardboard, adhesive.

Method of Construction

1. Draw two circles of equal radius on a paper and cut them out and paste on a cardboard.

2. Divide each circle into 4 equal parts as shown in Fig. 1.

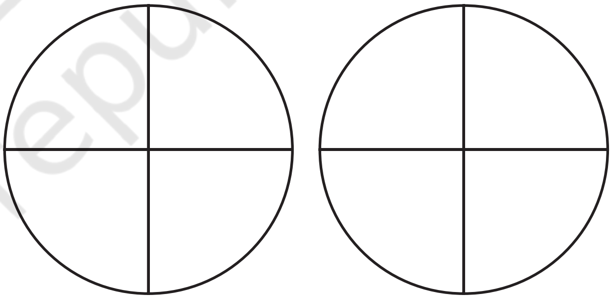


Fig. 1

3. Shade one circle completely and 3 equal parts in other circle (Fig. 2).

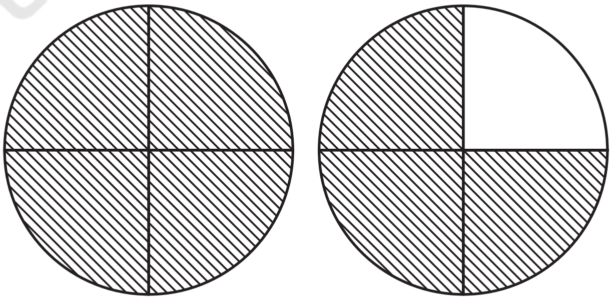


Fig. 2

Demonstration

1. Each part in Fig. 1 represents the fraction $\frac{1}{4}$.

2. Shaded portion in Fig. 2 represents mixed fraction $1\frac{3}{4}$.

3. There are seven $\frac{1}{4}$'s in the shaded part in Fig. 2.

   So, $1\frac{3}{4} \div \frac{1}{4} = 7$.

Observation

Each part in Fig. I represents the fraction = ______.

In Fig. 2 the shaded portion represents mixed fraction = ______.

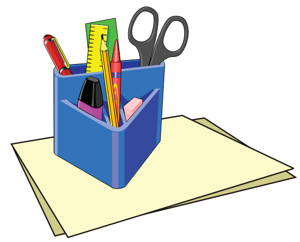
There are ______ 's in the shaded portion in Fig. 2.

So, ____ ÷ ____ = ____.

Application

This activity is useful in explaining division of a mixed fraction by a proper fraction.

Activity 41



Objective

To multiply two decimals (say 0.3 and 0.4) using a grid

Material Required

Cardboard, white chart paper, ruler, pencil, eraser, adhesive, sketch pens of different colours.

Method of Construction

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

2. Make a 10×10 grid on it and label the corners of the grid as A, B, C and D as shown in Fig. 1.

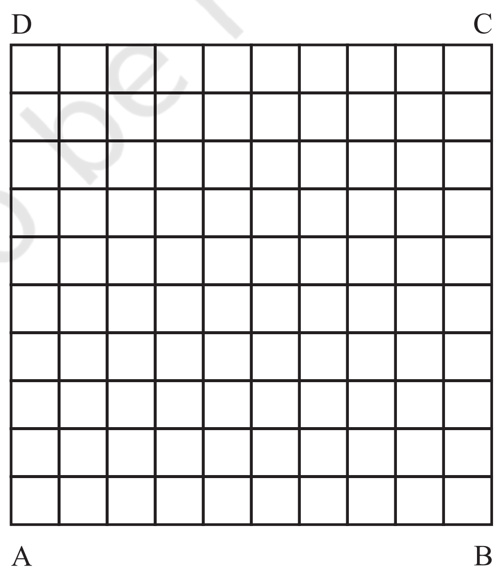


Fig. 1

3. Shade three horizontal strips using a sketch pen of say, red colour starting from the bottom as shown in Fig. 2.

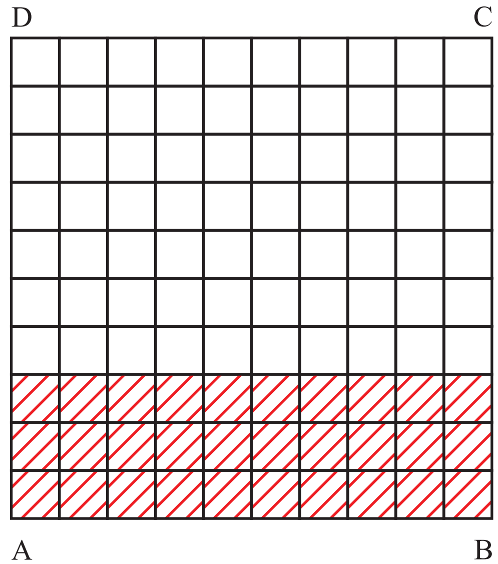


Fig. 2

4. Shade four vertical strips using a sketch pen of say blue colour starting from right most corner as shown in Fig. 3.

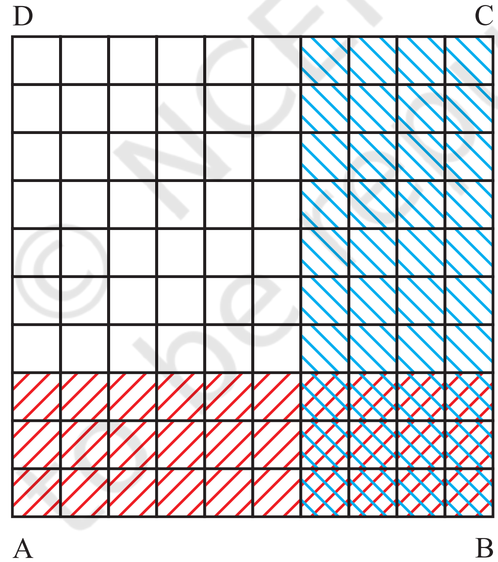


Fig. 3

Demonstration

1. In Fig. 2, portion shaded in red colour (horizontal strips) represents $\frac{3}{10}$ or 0.3.

2. In Fig. 3, portion shaded in blue colour (vertical strips) represents $\frac{4}{10}$ or 0.4.

3. In Fig. 3, portion shaded both in red and blue colours represents $\frac{12}{100}$ or 0.12.

   Thus, $0.3 \times 0.4 = 0.12$

4. Repeat this activity by taking different numbers of horizontal and vertical strips to represent the product of the pairs of decimals such as

   0.5×0.6, 0.2×0.8, 0.6×0.3, 0.5×0.5 etc.

Observation

In Fig. 2, total number of horizontal strips = __________.
Number of horizontal strips shaded in red = __________.

Therefore, decimal represented by the shaded horizontal strips = __________.

In Fig. 3, total number of vertical strips = __________.

Number of vertical strips shaded in blue = __________.

Decimal represented by the shaded vertical strips = __________.

Total number of small squares in the grid = __________.

Number of squares shaded in both blue and red colour = __________.

Decimal represented by double shaded region = __________.

Hence, 0.3×0.4 = __________.

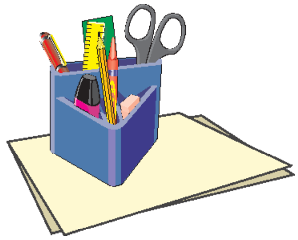
Application

This activity may be used to explain the concept of multiplication of two decimals.

NOTE

1. In Figures 2 and 3, the student may shade the horizontal and vertical strips in any manner not necessarily from bottom.

Activity 42



Objective

To find the value of a^n (where a and n are natural numbers) using paper folding

Material Required

Coloured thin sheets, ruler, pencil, scissors.

Method of Construction

1. Draw a square of convenient size on a coloured thin sheet and cut it out.
2. Fold this sheet one time so that one part exactly covers the other (Fig.1). This fold divides the sheet into two equal parts.
3. Fold the sheet again as in Step 2 (Fig. 2). This will divide the sheet into 4 equal parts.
4. Continue folding the sheet again and again 4 or 5 times as done in steps 2 and 3.
5. Unfold the sheet.

Fig. 1

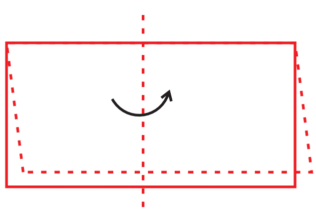


Fig. 2

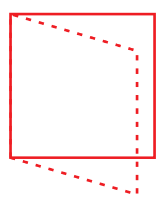


Fig. 3

6. Take another sheet and fold it to divide it into 3 equal parts.

7. Again fold the folded sheet into 3 equal parts and so on for 3 or 4 times (Fig. 4).

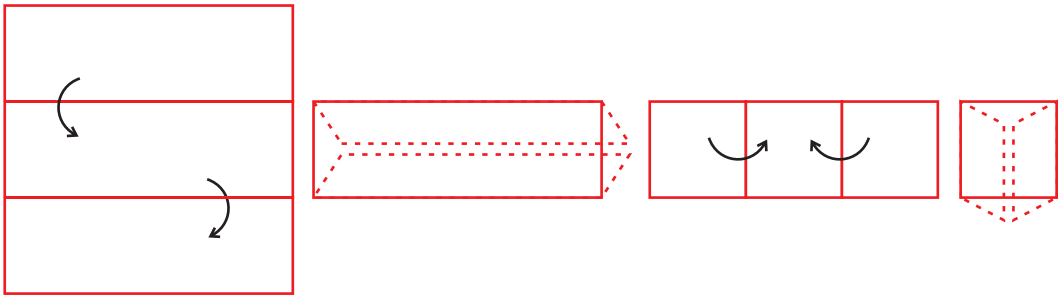


Fig.4

Demonstration

Base (Number of equal parts in which sheet is divided each time)	Number of times sheet is divided	Exponent	Total Number of equal parts (power)
2	0	0	1 (2^0)
2	1	1	2 (2^1)
2	2	2	4 (2^2)
2	3	3	8 (2^3)
3	0	0	1 (3^0)
3	1	1	3 (3^1)
3	2	2	9 (3^2)

Observation

$2^0 = 1$,	$3^0 =$ ____,	$4^0 =$ ____,	$5^0 =$ ____,
$2^1 =$ ____,	$3^1 =$ ____,	$4^1 =$ ____,	$5^1 =$ ____,
$2^2 =$ ____,	$3^2 =$ ____,	$4^2 =$ ____,	$5^2 =$ ____,
$2^3 =$ ____,	$3^3 =$ ____,	$4^3 =$ ____,	$5^3 =$ ____,
$2^4 =$ ____,	$3^4 =$ ____,	$3^5 =$ ____,	

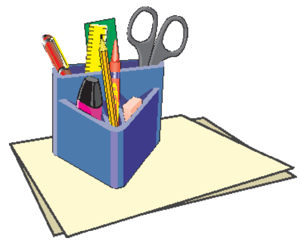
2^4 is called fourth power of 2. 3^5 is called ____ power of ____.

Application

1. This activity can be used to find the power of the base if the number of folds and number of parts the paper is divided is given.

2. This activity can be used to explain the meaning of base, exponent and power.

Activity 43



Objective

To verify exterior angle property of a triangle

Material Required

Drawing sheet, colours, adhesive, scissors, pen/pencil, cardboard, white paper.

Method of Construction

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

2. Make two identical triangles ABC.

3. Colour the angles of the triangles as shown in Fig. 1.

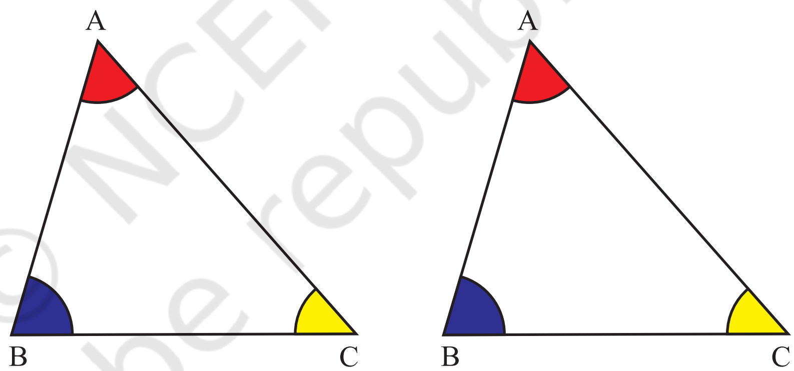


Fig. 1

4. Paste one of the triangles on the cardboard and produce its one side say BC as shown in Fig. 2.

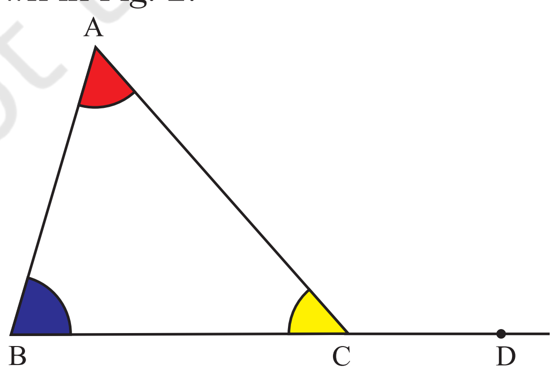


Fig. 2

5. Now cut out the angles A and B from the other triangle (Fig. 3).

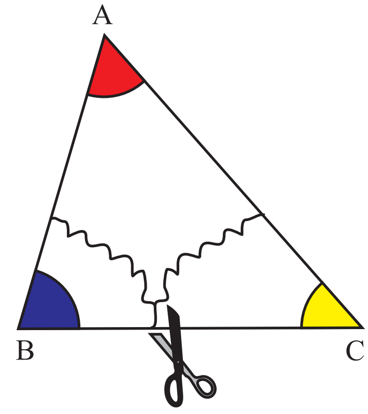


Fig. 3

6. Place the cutouts of ∠A and ∠B on the exterior angle ACD (formed in Fig. 2) as shown in Fig. 4, without leaving any gap between the two angles.

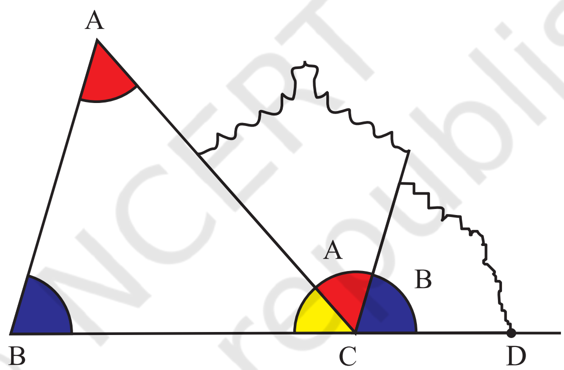


Fig. 4

DEMONSTRATION

1. ∠ACD is an exterior angle of Δ ABC.
2. ∠A and ∠B are its two interior opposite angles. These together cover ∠ACD exactly as in Fig. 4.
3. So in Fig. 4, ∠ACD = ∠A + ∠B.

Thus, the exterior angle of a triangle = sum of its two interior angles.

This activity may also be repeated for exterior angles at other vertices.

Observation

On actual measurement

Measure of $\angle A$ =_____.

Measure of $\angle B$ =_____.

Measure of $\angle ACD$ =_____.

$\angle ACD = \angle A + \angle$ _____.

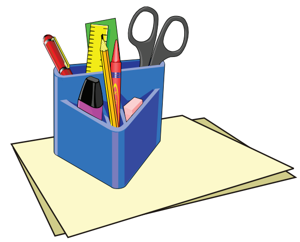
So, the exterior angle of a triangle is the ______ of its two _____ angles.

Application

This activity can be used to explain:

1. The relationship between an exterior angle and its interior angles.
2. Exterior angle of a triangle if interior angles are given.
3. Unknown interior angle of a triangle if exterior angle is given.

Activity 44



OBJECTIVE

To verify that the sum of any two sides of a triangle is always greater than the third side

MATERIAL REQUIRED

Thick sheet, coloured straws, adhesive, a pair of scissors, cardboard, white sheet.

METHOD OF CONSTRUCTION

1. Take a cardboard of convenient size and paste a white sheet on it.
2. Draw a triangle ABC of any dimension as shown in Fig. 1.

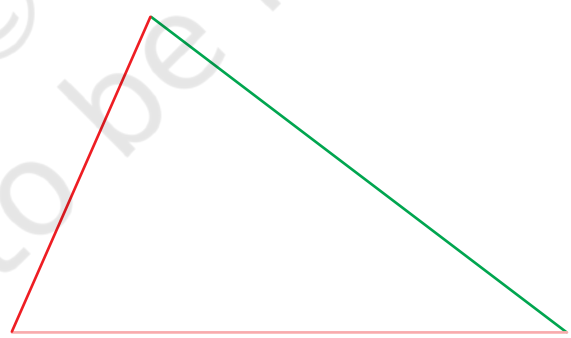


Fig. 1

3. Cut straws of three different colours (say pink, green and red) of the same size as the three sides of the triangle.

4. Paste any two coloured straws in a line leaving no space between them on the cardboard as shown in Fig. 2.

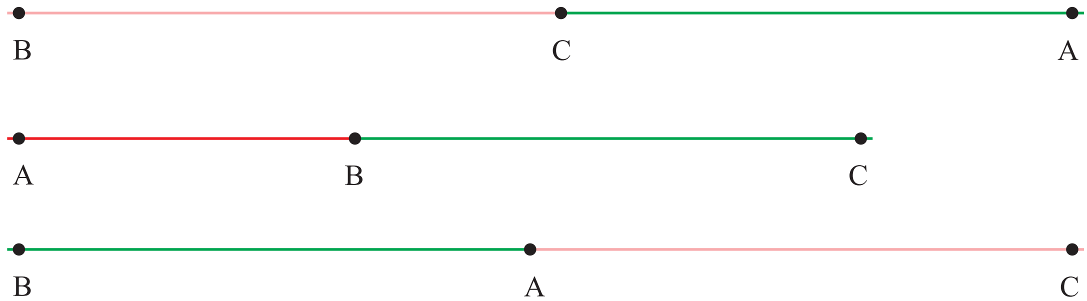


Fig. 2

5. Now paste the left out third straw in each colour on the above two joined straws as shown in Fig. 3.

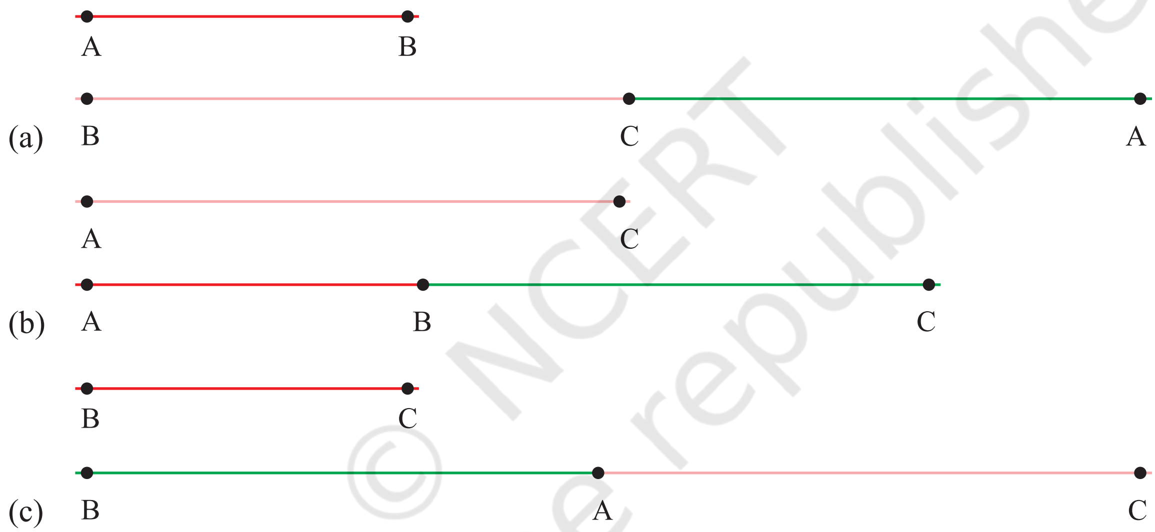


Fig. 3

Demonstration

1. The third straw is always shorter than the two straws combined together in a line in each of the above three cases.

   i.e, BC + AC > AB, AB + BC > AC, AB + AC > BC.

   Sum of any two sides of a triangle is greater than the third side.

OBSERVATION

On actual measurement

AB = _______ cm, BC = _______ cm, CA = _______ cm.

CA + CB = _______ cm, CA + AB = _______ cm, AB + BC = _______ cm.

CA + BC _______ AB.

CA + AB > _________.

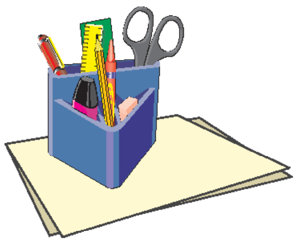
AB + BC _______ AC.

APPLICATION

1. This result can be used to know whether a triangle can be constructed with given sides or not.

2. This activity can also be used to verify that the difference of any two sides of a triangle is less than the third side.

Activity 45



Objective

To verify that in a triangle sides opposite equal angles are equal

Material Required

Cardboard, drawing sheet, colours, tracing paper, scissors, pen/pencil, geometry box.

Method of Construction

1. Take a cardboard of convenient size and paste a white sheet on it.
2. Construct a triangle ABC on a drawing sheet with two of its equal angles say ∠B and ∠C.
3. Colour ∠B as green and ∠C as red [Fig. 1].

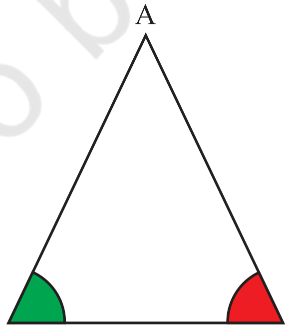


Fig. 1

4. Paste this triangle on the cardboard.
5. Make a trace copy of this triangle using a tracing paper.

Demonstration

Fold the triangle about a line through vertex A such that side BC falls along itself. Vertex B falls on vertex C.

So, side AB covers exactly side AC.

Thus, AB = AC i.e. sides opposite equal angles of a triangle are equal.

Observation

1. Vertex B falls on Vertex ________.
2. Side AB falls on side _________.
3. Side AB covers exactly side ________.
4. On actual measurement, AC = _____, AB = _____, BC = _____.

   AB = ______.

   AC = ______.

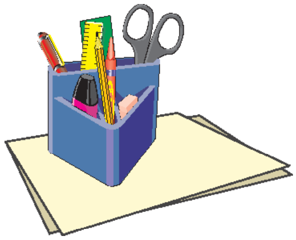
   AC = ______.

   Thus, in a triangle sides opposite equal angles are ______.

Application

This result is used in solving many geometrical problems.

Activity 46



Objective

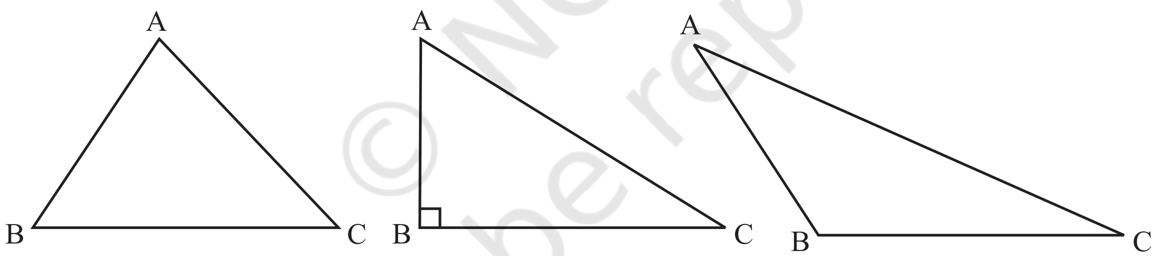
To draw altitudes of a triangle using paper folding

Material Required

Transparents/white sheet, coloured paper, scissors, adhesive, pencil.

Method of Construction

1. Make a triangle using paper folding or draw a triangle. It can be of any type, acute angled, right angled or obtuse angled triangle as in Fig. 1.



(i) (ii) (iii)

Fig. 1

2. Fold the triangle through A in such a way that BC falls along itself. Unfold and mark the point D where the crease meets BC. Draw a line AD (Fig. 2).

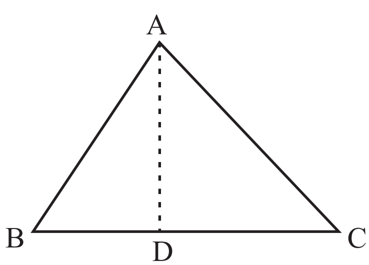


Fig. 2

3. Draw the other two altitudes i.e. from B on AC and from C on AB. Name them as BE and CF, respectively (Fig. 3).

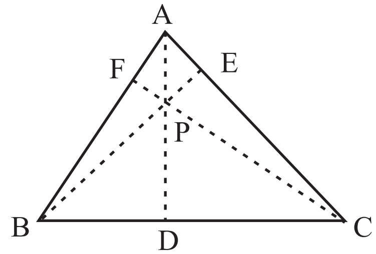


Fig. 3

4. In case of a right triangle, two of its altitudes are the two perpendicular sides AB and BC. The third altitude from B on AC will also pass through the point B.

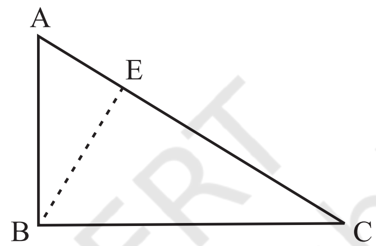


Fig. 4

5. In case of an obtuse angled triangle extend the crease of CB so that altitude from A can be drawn as shown in Fig. 5. Similarly, draw perpendicular from B on AC and from C on AB produced.

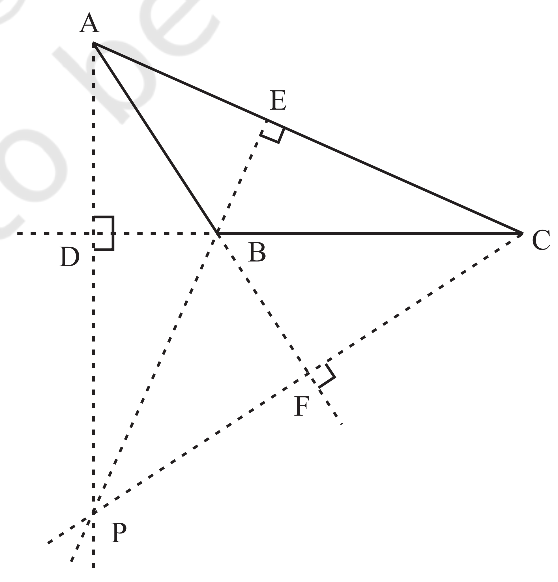


Fig. 5

Demonstration

1. For each triangle, there are 3 altitudes.
2. The altitude of every triangle does not always lie wholly in the interior of the triangle.
3. In an acute angle triangle, the point at which the three altitudes meet, lie in the interior of the triangle.
4. The altitudes of a right angle triangle lies on the triangle and they meet at the vertex of the right angle.
5. The three altitudes of an obtuse angled triangle meet at a point that lies to the exterior of the triangle.

Observation

$\angle ADC$ = _____.

$\angle BEC$ = _____.

$\angle CFA$ = _____.

AD is the altitude to side _____.

BE is the _____ of side AC.

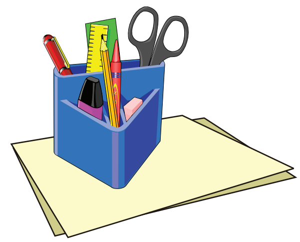
_____ is the altitude of side AB.

All the altitudes of a triangle meet at a _____.

Application

This activity can be used to explain the concept of altitude of a triangle and in solving many problems related to geometry and mensuration.

Activity 47



Objective

To find the ratio of circumference and diameter of a circle

Material Required

Geometry box, thick paper, scissors, eraser, pen/ pencil.

Method of Construction

1. Draw a circle on a thick paper and cut it out.
2. Fold it into two halves and obtain a crease. Name the line of folding as AB [Fig. 1].

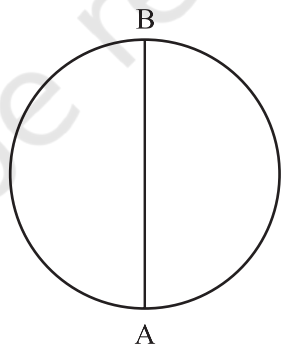


Fig. 1

3. Draw a ray on a paper and mark its initial point as P [Fig. 2].

Fig. 2

4. Hold the circular disc such that point A on the circle coincides with the point P on the ray [Fig. 3].

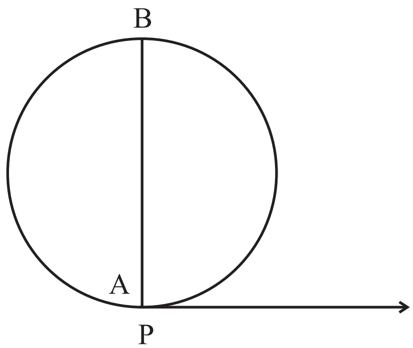


Fig. 3

5. Rotate the circular disc along the ray till the point A again touches the ray. Mark that point on the ray as Q [Fig. 4 (a), 4 (b)].

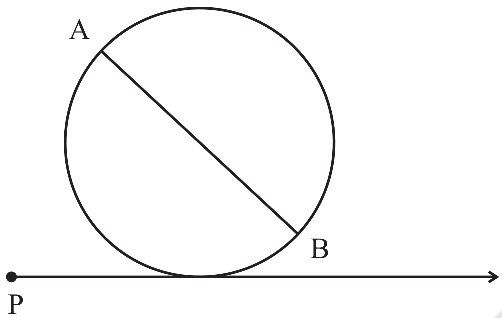


Fig. 4 (a)

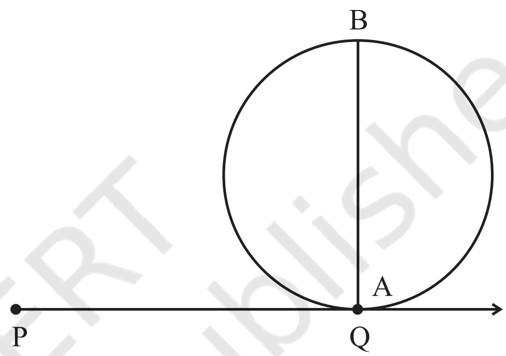


Fig. 4 (b)

6. Repeat the above Steps 4 and 5 for circles of different radii.

DEMONSTRATION

1. Line segment AB in Fig.1 is the diameter (d) of the circle.
2. Measure AB.
3. Length PQ is the circumference (c) of the circle.
4. Measure PQ.
5. Find the ratio $\frac{c}{d}$.
6. Repeat the above process for circles of different radii. Each time, the ratio $\frac{c}{d}$ is constant.

   This constant is denoted by the symbol π. Its value is close to 3.14.

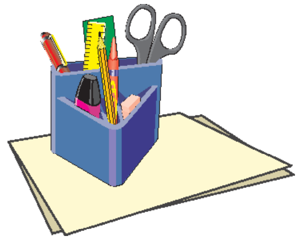
OBSERVATION

Complete the following table:

Circle	Diameter d	Circumference c	Ratio = $\frac{\text{Circumference}}{\text{Diameter}} = \frac{c}{d}$
1			
2			
3			
4			
:			
:			

Value of $\pi = \frac{c}{d}$ = ________ approximately.

Activity 48



Objective

To understand the meaning of less likely and more likely of the outcomes of an experiment

Material Required

Bag, balls of the same size but of different colours, pen/pencil.

Method of Construction

Take a bag and put say 19 balls of red colour and 6 balls of blue colour in the bag.

Demonstration

1. Draw one ball at a time from the bag without looking into the bag. Note the colour of the ball and put it back into the bag.
2. Let the other students come one by one and repeat this activity as in Step 1.
3. Record the colour of the ball each time in the following table:

Student Name	Colour (Red/Blue)
Rita	____
Arun	____
Vinayak	____
:	____

:   ____

Savita   ____

4. Count the number of times a red colour ball is drawn and also the number of times, a blue colour ball is drawn. Compare the two numbers so obtained.

5. The number of red balls drawn is more than the number of blue balls drawn. So drawing of a red ball is more likely than a blue ball.

Observation

1. Number of times, a red ball is drawn = ____.

2. Number of times, a blue ball is drawn = ____.

The number in (1) _______ the number in (2).

So, a red ball is more likely than a ______ or a blue ball is _____ than a red ball.

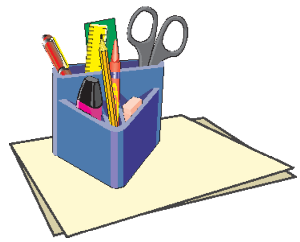
Application

This activity explains the concept of 'less likely' and 'more likely' of outcomes. of a random experiment which is useful in the study of probability.

NOTE

1. This activity may be repeated by placing an equal number of balls of each colour. In this case the chance of drawing a ball of any colour is equally likely when the balls are drawn at random by a sufficient number of students.

Activity 49



Objective

To verify that congruent triangles have equal area but two triangles with equal areas may not be congruent

Material Required

Graph paper, colours, pen/pencil, scissors.

Method of Construction

1. Take a squared graph paper and make two triangles ABC and PQR each of sides 3 cm, 4 cm and 5 cm as shown in Fig. 1.

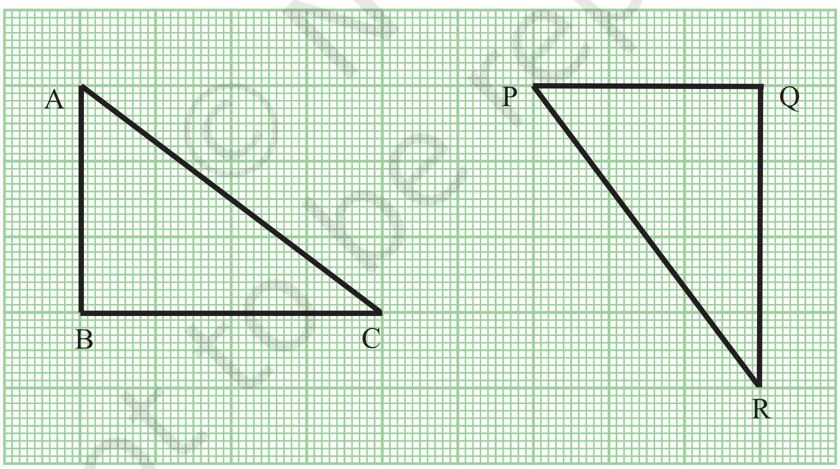


Fig. 1

2. Draw two triangles RST and XYZ (of the same area) as shown in Fig. 2.

3. Make the trace copy of both the triangles of Fig. 1 and Fig. 2 and make their cutouts.

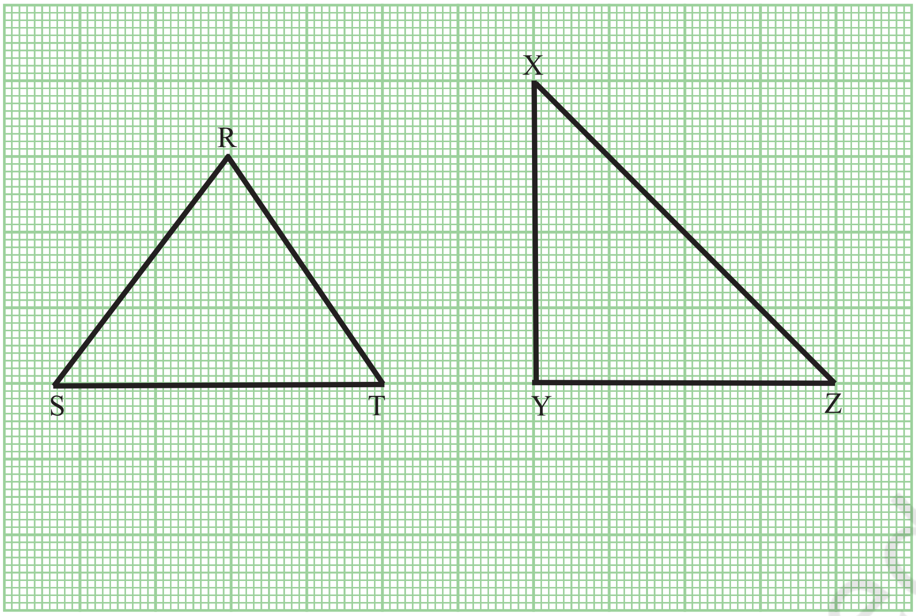


Fig. 2

Demonstration

1. Place the cut out of Δ PQR over Δ ABC. Cut out of Δ PQR covers the cut out of Δ ABC exactly.

2. So, Δ ABC ≅ Δ PQR.

3. Find the areas of Δ PQR and Δ ABC by counting the number of squares enclosed by them.

4. Area of Δ ABC = Area of Δ PQR = 7 sq. units.

   Thus, congruent triangles have equal areas.

5. Area of Δ RST = 8 sq. units. (By counting the squares).

   Area of Δ XYZ = 8 sq. units (By counting the squares).

   So, the two triangles RST and XYZ are equal in area.

6. Now place the cut out of Δ XYZ over the cut out Δ RST and see if both the cutouts cover each other exactly.

   You can see that they do not cover each other.

   So, the two triangles XYZ and RST are not congruent.

   Thus, two congruent triangles have equal area but two triangles having equal area may not be congruent.

Observation

1. Δ PQR and Δ ABC are __________ triangles.

2. Area of Δ PQR = __________ squares.

   Area of Δ ABC = __________ squares.

   Area of Δ PQR = Area of Δ _______.

   So, congruent triangles have _________ area.

3. Area of Δ RST = __________ squares.

   Area of Δ XYZ = __________squares.

   So, area of Δ RST = area of Δ _______.

4. Δ RST and Δ XYZ do not cover each other _______.

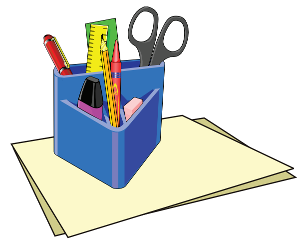
   Δ RST and Δ XYZ are not _______.

Thus, triangles having equal area may not be congruent.

Application

This activity can be used to explain relationship between congruency and areas of different geometric shapes.

Activity 50



Objective

To verify that when two lines intersect, vertically opposite angles are equal

Material Required

Drawing sheet, thumb pins, colour pencil, tracing paper, adhesive, cardboard.

Method of Construction

1. Take a cardboard of convenient size and paste a white sheet on it.
2. Draw a pair of intersecting lines AB and CD as shown in Fig. 1.

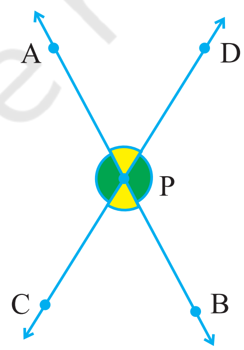


Fig. 1

3. Mark the point of intersection P of these lines.
4. Colour $\angle BPC$ and $\angle APD$ with the same colour, say yellow.
5. Colour $\angle BPD$ and $\angle APC$ with the same colour, say green.

6. Trace Fig.1 on a tracing paper and colour the angles of the figure in the same way as done in Steps 4 and 5.

7. Fix the trace copy on Fig.1 using a thumb pin at the point P, so that the tracing copy can be freely rotated.

Demonstration

1. ∠APD and ∠BPC are vertically opposite angles, in Fig.1.

2. ∠APC and ∠DPB are vertically opposite angles, Fig.1.

3. Rotate the trace copy about the point P through an angle of 180°.

4. ∠BPC covers ∠APD exactly.

   So, ∠BPC = ∠APD.

5. ∠APC covers ∠BPD exactly. So, ∠APC = ∠BPD.

   Thus, vertically opposite angles are equal.

Observation

On actual measurement

∠APC = ________, ∠BPD = ________.

∠BPC = ________, ∠APD = ________.

∠APC = ∠ _______.

∠ _______ = ∠APD.

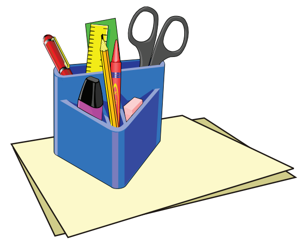
So, vertically opposite angles are ________.

Application

This activity can be used to explain the meaning of vertically opposite angles.

The result is useful in solving many geometrical problems.

Activity 51



Objective

To find the order of rotational symmetry of a given figure

Material Required

White sheets of paper, geometry box, tracing paper, sketch pen, pencil, adhesive, scissors, board pins.

Method of Construction

1. Let the given figure be of the shape as shown in Fig. 1.

2. Make two copies of the given figure and join the diagonals of the central square in each of the figures. Mark the point of intersection of diagonals as O (Fig. 2). For identification, mark a point P as shown in Fig. 2.

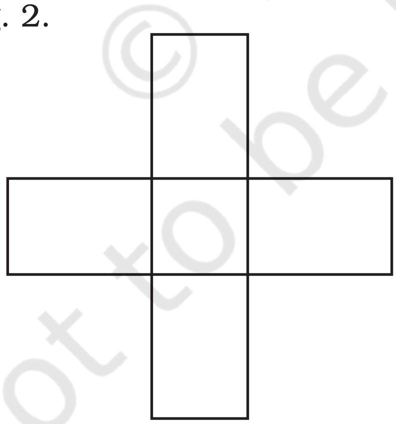


Fig. 1

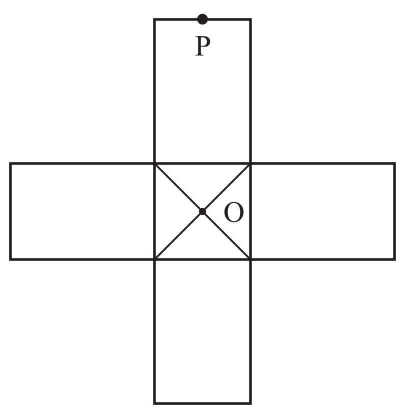


Fig. 2

3. Paste one of them on a cardboard.

4. Place the other figure on the figure pasted on cardboard with the help of a board pin at the point O as shown in Fig. 3.

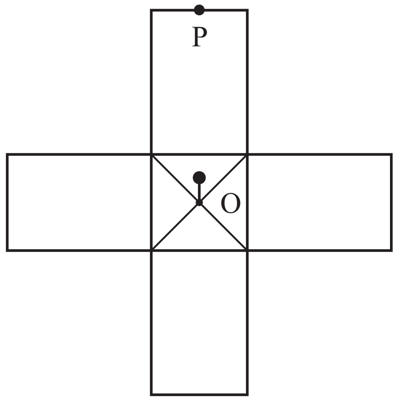


Fig. 3

Demonstration

1. Rotate the upper figure in a clockwise direction about the point O through an angle of 90° (Fig. 4).

2. After a rotation of 90° the upper figure coincides with the original figure.

3. On subsequent rotations of 90°, we obtain Fig. 5, Fig. 6 and Fig. 7, respectively. Each of these figures coincide with the original figure.

4. Thus, the given figure has a rotational symmetry of angles 90°, 180°, 270° and 360°.

5. The figure has a rotational symmetry of order 4.

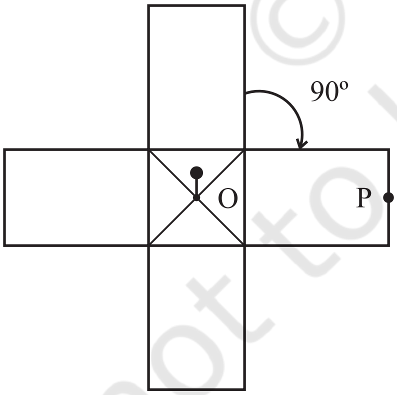


Fig. 4

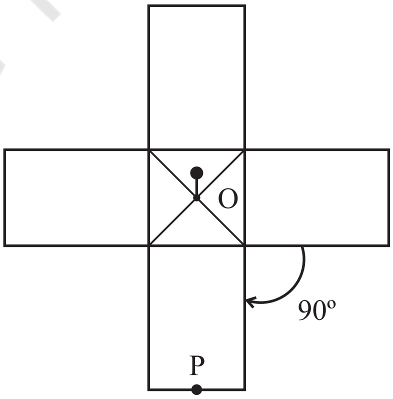


Fig. 5

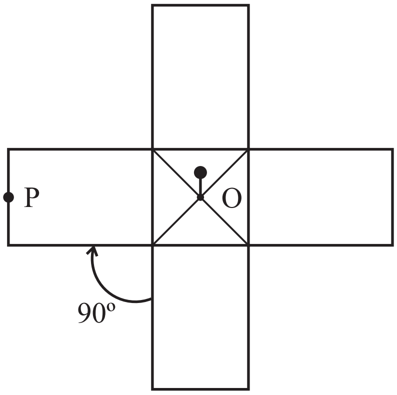


Fig. 6

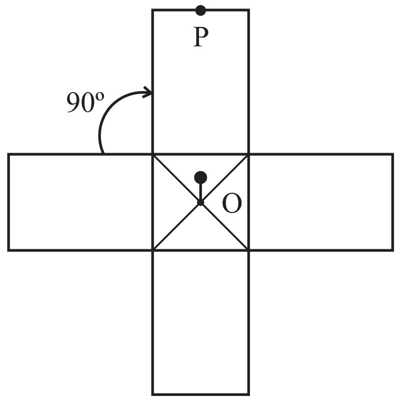


Fig. 7

Observation

1. The upper figure coincides with the original figure after a rotation of ____, ____, ____ and ____. The angles of rotation are ____, ____, ____, ____.

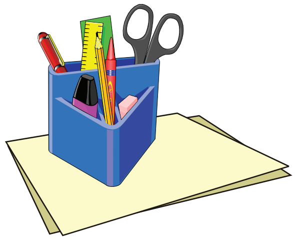
2. Number of times the upper figure coincides with the original figure is = ____.

Order of rotational symmetry = _____.

Application

This activity can be used to determine the order of symmetry of different figures such as equilateral triangles, parallelograms, squares, rectangles etc.

Activity 52



Objective

To obtain a formula for the area of a circle

Material Required

Cardboard, white drawing sheet, compasses, pencil, colours, adhesive, scissors.

Method of Construction

1. Take a cardboard of convenient size and paste a white sheet on it.
2. Draw two identical circles of radius 'a' (say 6 cm) (Fig. 1).
3. Make cutouts of these two circles.
4. Fold the circles as shown in Fig. 2.

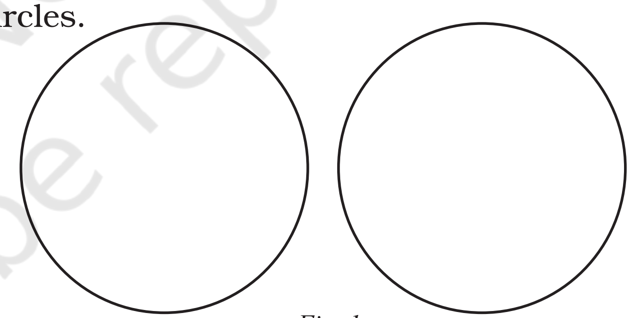


Fig. 1

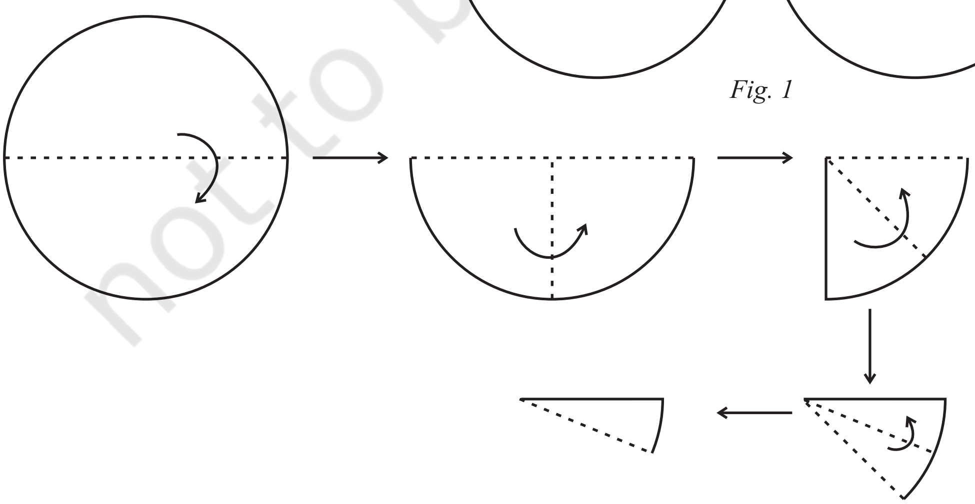


Fig. 2

5. Unfold both the circles and colour the sixteen parts so obtained as shown in Fig. 3.

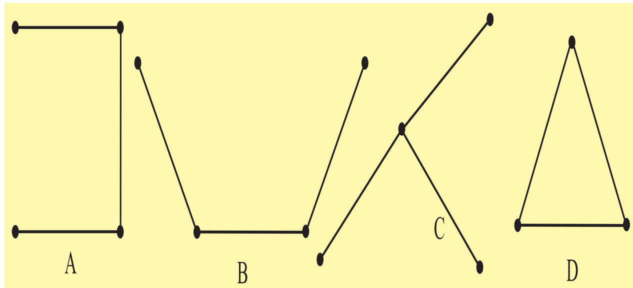


Fig. 3

6. Paste one of the circles on the cardboard sheet (Fig. 4).

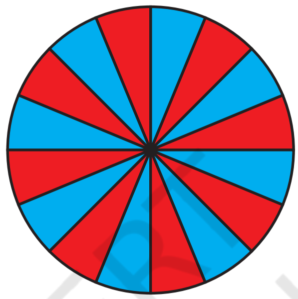


Fig. 4

7. Cut out neatly all sixteen parts from the other circle.

8. Arrange and paste them neatly as shown in Fig. 5.

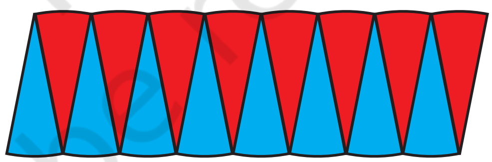


Fig. 5

Demonstration

1. The given figure looks like a rectangle.

2. Length of the rectangle $= \frac{1}{2}$ of circumference of the circle

$$= \frac{1}{2} \times (2\pi r)$$

$$= \pi r.$$

3. Breadth of the rectangle = radius of the circle = r

Therefore, area of the circle = Area of the rectangle

$= l \times b$

$= \pi r \times r$

$= \pi r^2.$

Observation

On actual measurement:

Radius of the circle = _____.

So, circumference of the circle = _____.

Length of rectangle in Fig. 5 = _____.

Breadth of rectangle in Fig. 4 = _____.

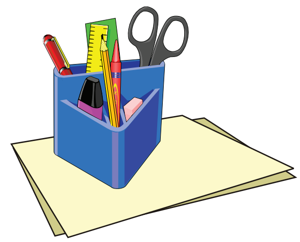
Area of rectangle in Fig. 5 = _____.

Area of circle in Fig. 3 = _____.

Application

This result is useful in finding area of any circular object.

Activity 53



Objective

To verify that vertically opposite angles are equal

Material Required

Cardboard, two straws, 360° protractor thumb pin, white paper.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Take two straws and a 360° protractor and fix them on the cardboard using a thumb pin at the centre of the protractor as shown in Fig.1.
3. Mark the end points of the straws as A, B, C and D either using paper chit's or using marker (see Fig.1).

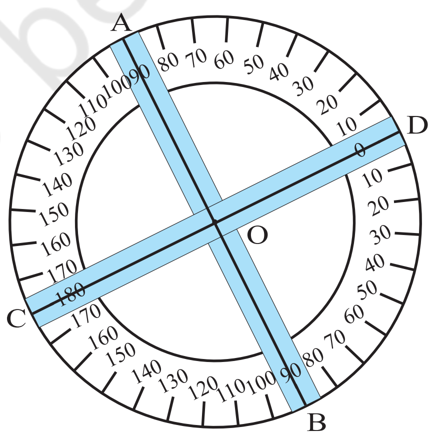


Fig. 1

Demonstration

1. Rotate the straws and note the measures of the angles AOC, BOC, BOD and AOD in different positions with the help of the protractor fixed.

2. From the measurements, $\angle AOD = \angle COB$ and $\angle AOC = \angle DOB$.

   Thus, vertically opposite angles are equal.

Observation

Complete the following table:

Position	$\angle$AOC	$\angle$BOC	$\angle$BOD	$\angle$AOD	
1	______	______	______	______	$\angle$AOC = ..., $\angle$BOC = ...
2	______	______	______	______	.... = $\angle$BOD, ... = $\angle$AOD
3	______	______	______	______	$\angle$..... = $\angle$..... =, $\angle$..... = $\angle$ .....
:					

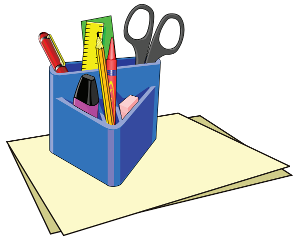
Thus, vertically opposite angles are ______.

Application

This result can be used to explain

1. Property of a linear pair.
2. Meaning of vertically opposite angles.

Activity 54



Objective

To add two algebraic expressions (polynomials) using different strips of cardboard.

Material Required

Cardboard, coloured papers (green, blue and red), geometry box, cutter, eraser, adhesive, sketch pen.

Method of Construction

1. Take three pieces of cardboards and paste coloured papers on them. Green on one, blue on the second and red on the last one.
2. Make sufficiently large number of squares (strips) of side x units on green paper and cut them out [Fig. 1].
3. Similarly, draw rectangle of dimensions $x \times 1$ on blue coloured paper and square of dimensions 1×1 unit on red coloured paper and cut them out [Fig. 2 and Fig. 3].

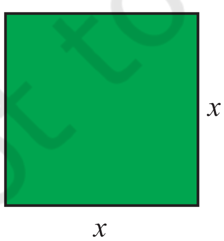


Fig. 1

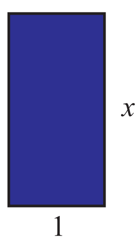


Fig. 2

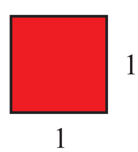


Fig. 3

Demonstration

1. To represent the algebraic expression $3x^2 + 2x + 5$, arrange the strips as shown in (Fig. 4).

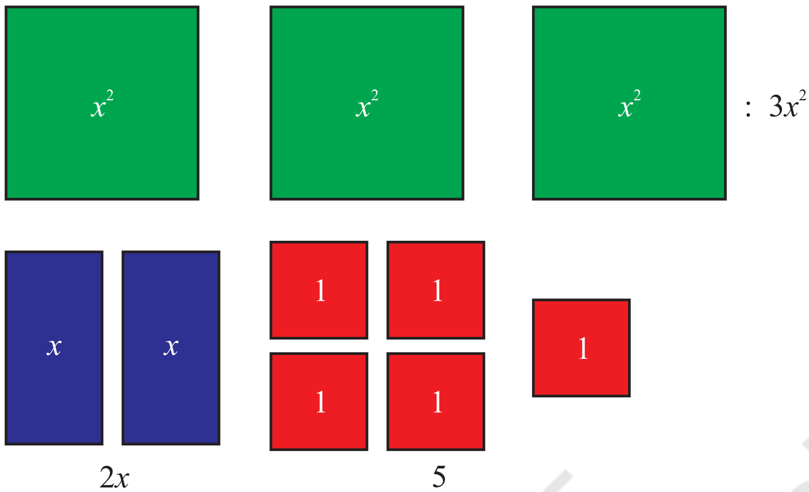


Fig. 4

2. Similarly, as in step 1, represent the algebraic expression $2x^2 + 4x + 2$ as follows (Fig. 5).

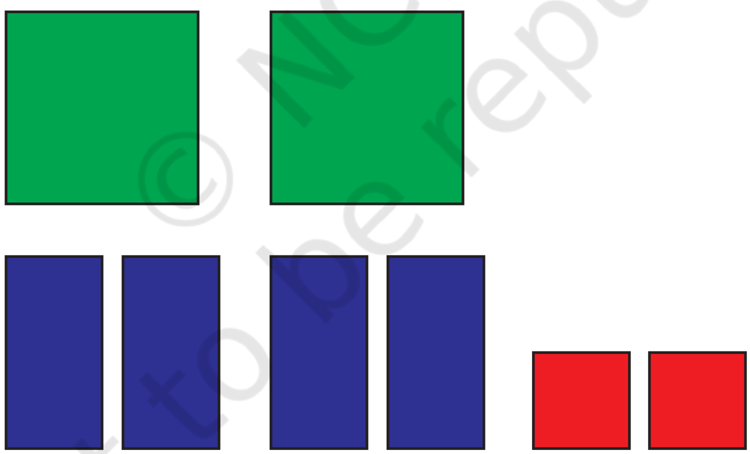


Fig. 5

3. To add the above two expressions, combine the strips in Fig. 4 and Fig. 5 as shown below (Fig. 6).

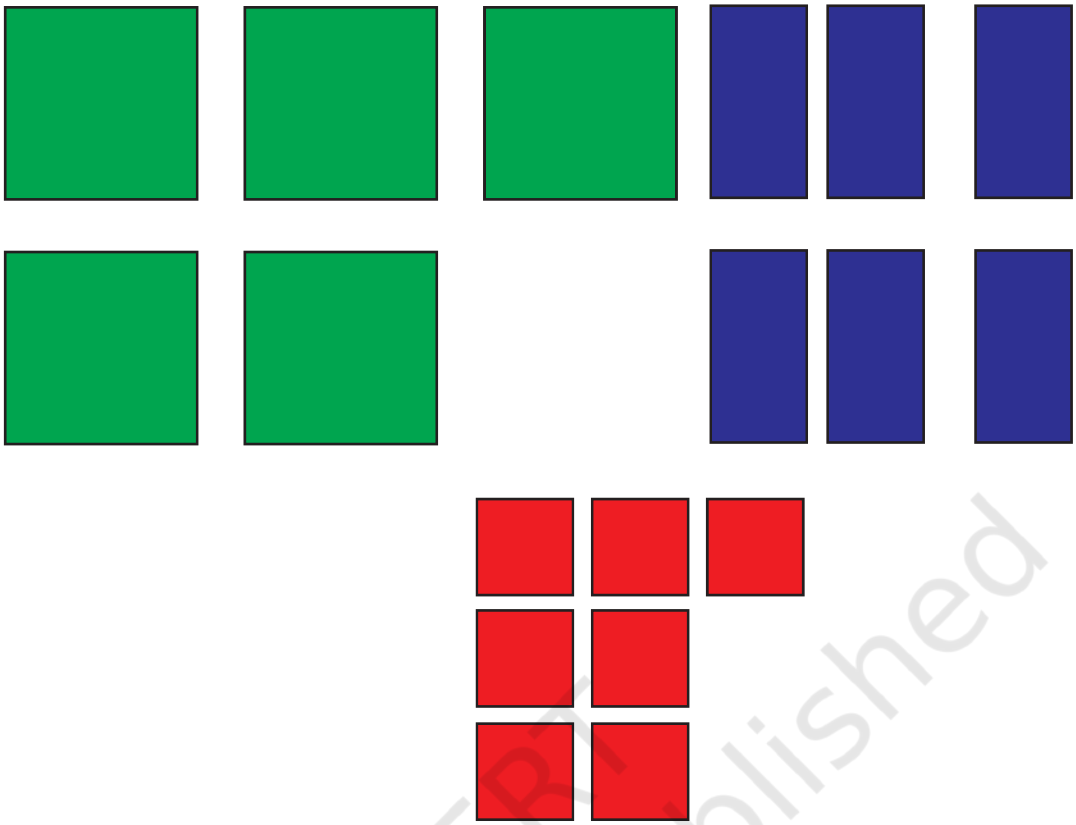


Fig. 6

4. Count the strips of each colour in Fig. 6. We find that it consists of 5 green strips, 6 blue strips and 7 red strips. This represents the sum of two algebraic expressions as mentioned above as $5x^2 + 6x + 7$

Similarly, find the sum of some other two algebraic expressions.

Observation

1. In Fig. 4

   (a) Number of green strips = _______.

   (b) Number of blue strips = _______.

   (c) Number of red strips = _______.

   (d) Algebraic expression represented = _______.

2. In Fig. 5

   (a) Number of green strips = _______.

(b) Number of blue strips = ________.

(c) Number of red strips = ________.

(d) Algebraic expression represented = ________.

3. In Fig. 6

(a) Number of green strips = ________.

(b) Number of blue strips = ________.

(c) Number of red strips = ________.

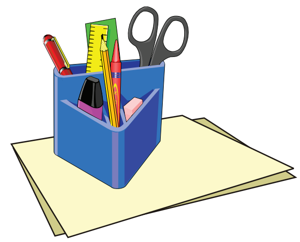
(d) Algebraic expression represented = ________.

Thus $(3x^2 + 2x + 5) + (2x^2 + 4x + 2)$ = _______ + _______ + _______.

Application

The activity is useful in explaining the concept of addition of two algebraic expressions as well as like and unlike terms.

Activity 55



Objective

To subtract a polynomial from another polynomial [for example, $(2x^2 + 5x - 3) - (x^2 - 2x + 4)$]

Material Required

Blue and red colours, scissors, ruler, eraser, white chart paper.

Method of Construction

1. Make sufficient number of cutouts of dimensions 3 cm × 3 cm, 3 cm × 1 cm and 1 cm × 1 cm as shown in Fig. 1.

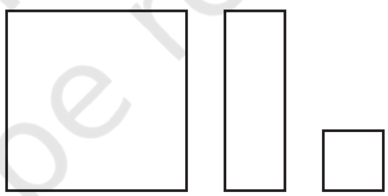


Fig. 1

2. Colour one side of each shape by red colour, and the other by blue colour.

3. Let blue coloured cut out of size 3 cm × 3 cm represent x^2, cut out of size 3 cm × 1 cm represent x and cut out of size 1 cm × 1 cm represent +1.

4. Similarly, let corresponding red coloured cutouts represent $-x^2$, $-x$ and –1, respectively.

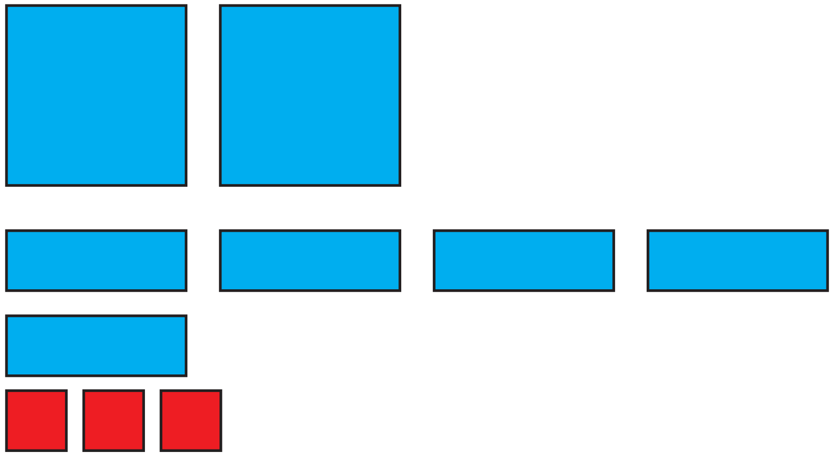


Fig. 2

DEMONSTRATION

1. The polynomial $2x^2 + 5x - 3$ is represented in Fig. 2.

2. The polynomial $(x^2 - 2x + 4)$ is represented in Fig. 3.

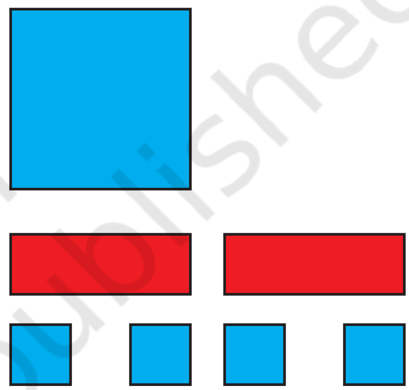


Fig. 3

To subtract the polynomial $x^2 - 2x + 4$ from $2x^2 + 5x - 3$, we have to remove 2nd set of algebraic pieces (Fig. 3). Invert each cut out of Fig. 3 and place it along the cutouts of Fig. 2 as shown in Fig. 4.

4. Cancel one blue cut out with one red cut out of same size, if any, as shown in Fig. 4.

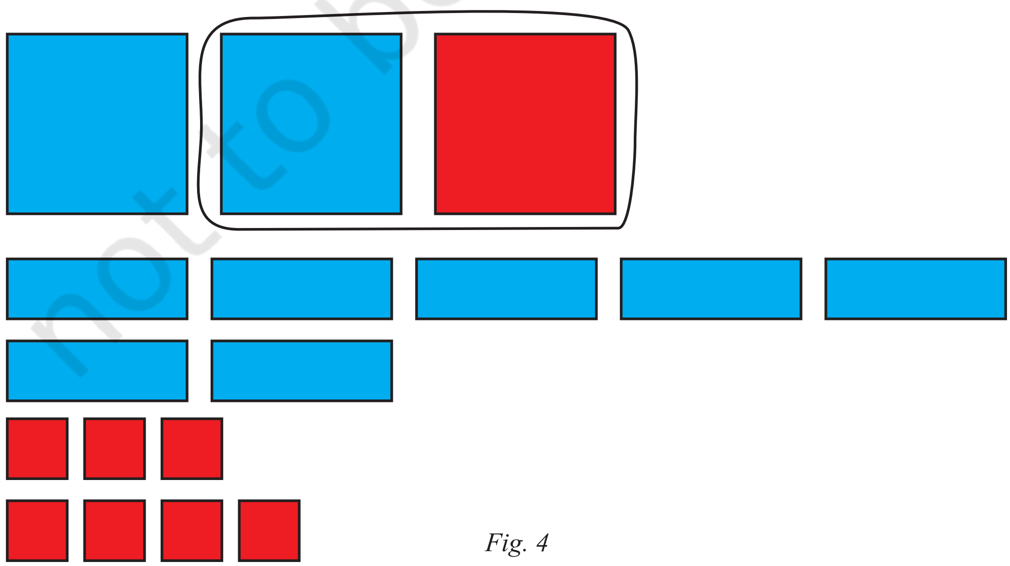


Fig. 4

5. Remaining cut outs represent the polynomial

   $x^2 + 7x - 7$

6. So, $(2x^2 + 5x - 3) - (x^2 - 2x + 4) = x^2 + 7x - 7$

   This result may be checked by finding

   (i) $(x^2 + 7x - 7) + (x^2 - 2x + 4) = 2x^2 + 5x - 3$

   (ii) $(2x^2 + 5x - 3) - (x^2 + 7x - 7) = x^2 - 2x + 4$

   through suitable activities.

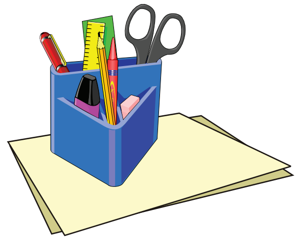
Observation

1. In Fig. 2, the polynomial represented is ________.
2. In Fig. 3, the polynomial represented is ________.
3. In Fig. 4, the polynomial represented is ________.
4. So, $(2x^2 + 5x - 3) - (x^2 - 2x - 1) =$ ___ + ___ $- 7$.

Application

This activity is useful in explaining subtraction of polynomials, and also the concept of like and unlike terms.

Activity 56



Objective

To collect data and represent this through a bar graph

Material Required

An English textbook, pen/pencil, graph paper/grid paper, different colours, ruler.

Method of Construction

1. Divide the class into groups of 4 or 5 students.

2. Let a student of one group open a page of English textbook randomly and record the number of times different vowels *a, e, i, o, u* occur on that page.

3. The other group members will help her in counting vowels. Each group may record the data in the table below.

Vowel	Tally marks	Number of times a vowel occurs on that page
a		
e		
i		
o		
u		
		Total

4. Take a cardboard and paste a grid paper on it.

5. Draw two perpendicular lines on it, through a point say O.
6. Write 'vowels' along the horizontal line and 'number of times a vowel occurs' (frequency) along the vertical axis.
7. Draw bars for each vowel acceding to its frequency.
8. Colour the bars differently.

Demonstration

1. The above table represents the frequency distribution of vowels.
2. The graph obtained after drawing bars in step 6 will be a bar graph representing occurrence of vowels on a page.

This activity will be performed by all the groups and separate bar graphs may be drawn by each group.

Data collected by each student may be combined together and a bar graph may be prepared for the data so obtained.

Observation

The vowel which occurs maximum number of times is ___________.

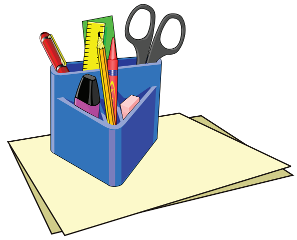
The vowel which occurs minimum number of times is ___________.

Mode of the data is ___________.

Application

This activity may be used in understanding the meaning of data, frequency distribution, bar graph and mode of the data.

Activity 57



Objective

To verify that a minimum of three sides are required to construct a polygon

Material Required

Cardboard, sticks, adhesive, coloured paper.

Method of Construction

1. Take a cardboard of convenient size and cover it with a coloured paper.
2. Take two sticks and place them end-to-end in different positions. Some positions are shown in Fig. 1.

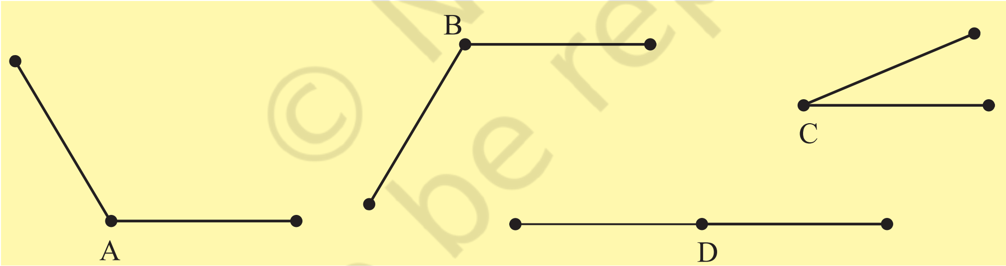


Fig. 1

3. Take three sticks and place them in different positions. Some positions are shown in Fig. 2.

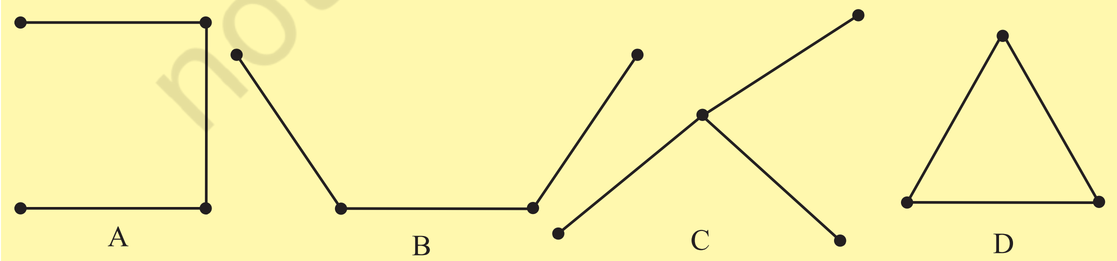


Fig. 2

4. Take four sticks and try to place them in different positions. Some of them are shown in Fig. 3.

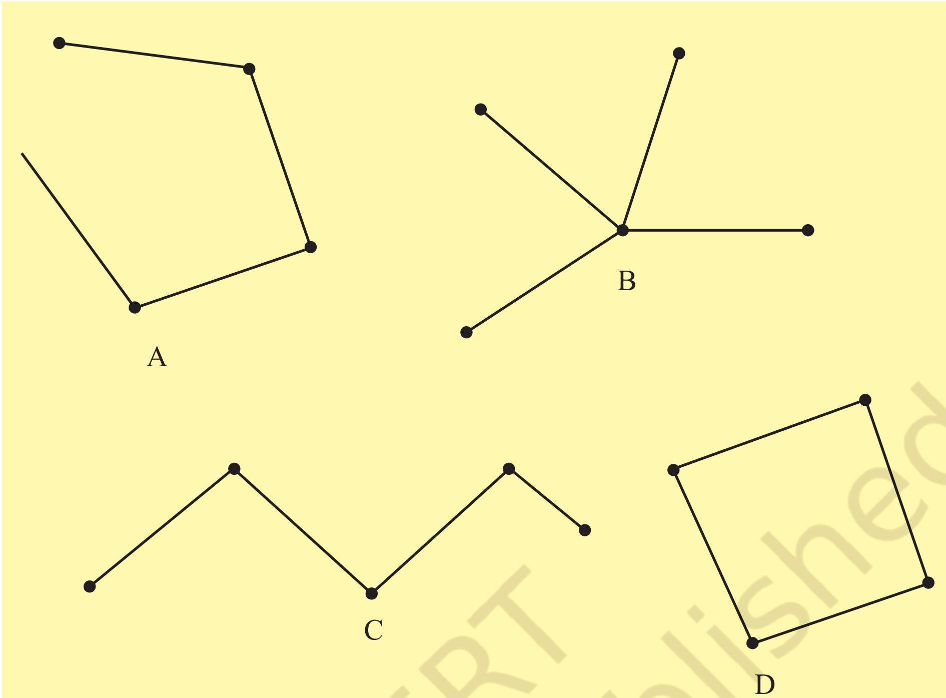


Fig. 3

5. Repeat the activity with more number of sticks.

Demonstration

1. No closed figure is formed with two sticks.
2. Closed figure is formed with three sticks.
3. Closed figure is formed with four sticks.
4. Closed figure is formed with five sticks and so on.

Observation

1. The closed figure formed with these sticks (line segments) is a polygon, called _________.
2. The closed figure formed with four line segments is a polygon, called __________.

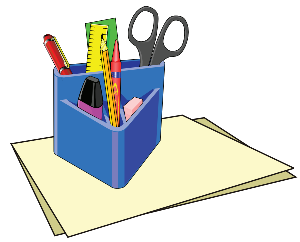
3. The closed figure formed with five line segments is a polygon called __________.

4. No polygon is formed with __________ sticks (line segments) thus, a minimum of __________ line segments are needed to form a figure made up of line __________ , i.e. a __________.

APPLICATION

This activity may be useful in understanding the construction of a polygon.

Activity 58



Objective

To make medians of a triangle by paper folding

Material Required

Coloured paper, pencil, cardboard, scissors, adhesive, ruler.

Method of Construction

1. Make a triangle ABC by paper folding or draw a triangle ABC. Cut it out (Fig. 1).

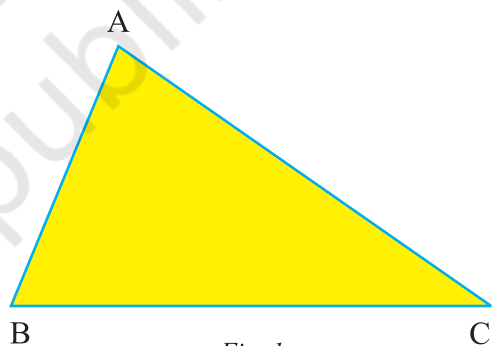


Fig. 1

2. Get the mid point of side BC by folding the paper such that B falls on C. Name this point D as shown in Fig. 2.

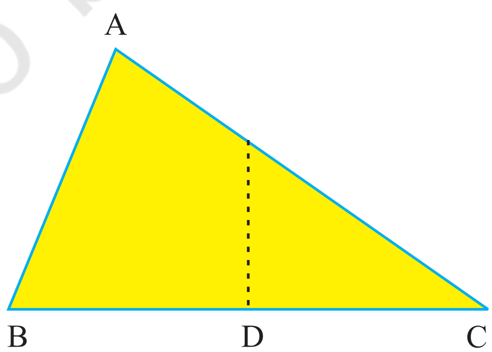


Fig. 2

3. Fold the triangle such that fold passes through A and D. Unfold and mark the crease with pencil as in Fig. 3.

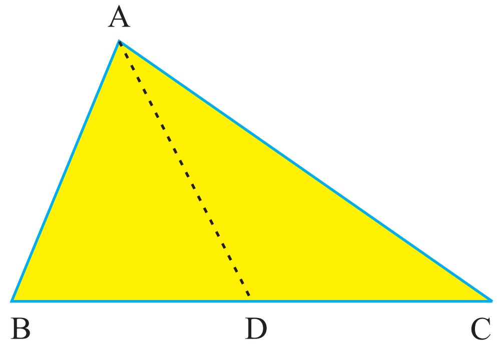


Fig. 3

4. Similarly, get the mid point E and F of sides AB and AC, respectively by paper folding. Join CE and BF by paper folding (Fig. 4).

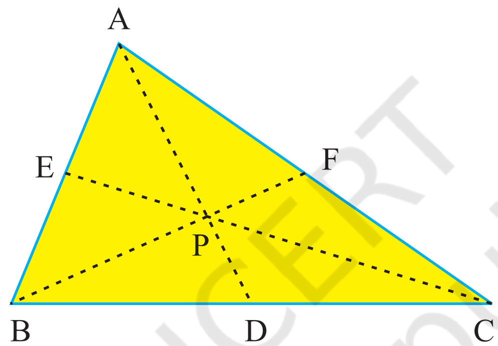


Fig. 4

Demonstration

1. AD, BF and CE are the medians of Δ ABC.
2. They meet at a point P.

Observation

1. On actual measurement (in centimetres)

   BD = ___________, CD = _____________.

   BE = ___________, AE = _____________.

   CF = ___________, AF = _____________.

AD = ___________,   PD = _____________.

CP = ___________,   PE = _____________.

BP = ___________,   PF = _____________.

BD = ___________,   CD = ____________.

$\frac{AP}{AD} = \frac{BP}{PF} = \frac{CP}{PE}$ = _____________.

2. All the three medians pass through the same point.

3. This point lies in the interior of the triangle.

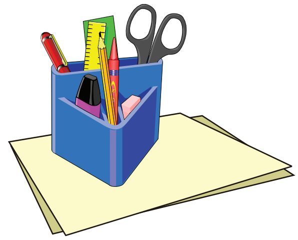
Application

The activity is useful in understanding the meaning of the medians of a triangle. Also in understanding an important result that all the medians meet at a point and this point divides each of these in the ratio 2 : 1.

NOTE

1. Do this activity for all types of triangles namely right angled triangle and obtuse angled triangle and see that in each case the three medians meet in the interior of the triangle.

Activity 59



Objective

To obtain a formula for area of a rhombus

Material Required

Coloured paper, adhesive, scissors, cardboard, pen, pencil.

Method of Construction

1. Take a coloured paper and make a rhombus through paper folding or draw a rhombus on a paper.

2. Cut it out and paste it on a cardboard and name it as ABCD (Fig. 1).

3. Make a trace copy of this figure.

4. Obtain diagonals AC and DB of the trace copy by paper folding and then cut it through AC and DB to get four triangles as shown in Fig. 2.

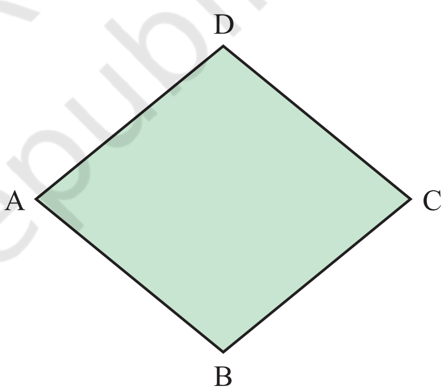


Fig. 1

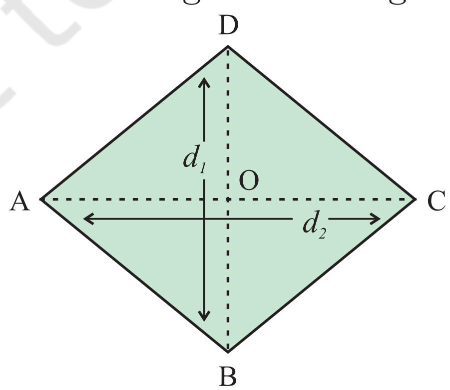


Fig. 2

5. Make replicas of ΔDOC, ΔDOA, ΔAOB and ΔBOC

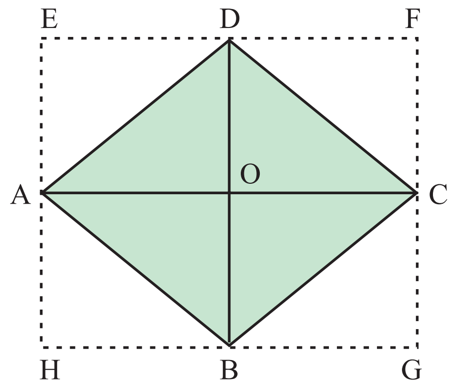


Fig. 3

Demonstration

1. Arrange the replicas of triangles as shown in Fig. 3.
2. EFGH is a rectangle.
3. Diagonal AC is equal to the length of the rectangle EFGH.
4. Diagonal DB is equal to the breadth of the rectangle EFGH.
5. Area of rhombus $= \frac{1}{2} \times$ area of rectangle

$= \frac{1}{2} \times$ length $\times$ breadth

$= \frac{1}{2} \times d_1 \times d_2$

$= \frac{1}{2} \times$ product of diagonals.

Observation

On actual measurement:

d_1 = _______, d_2 = _______.

So, $d_1 \times d_2$ = _______, $\frac{d_1 \times d_2}{2}$ = _______.

Area of rectangle EFGH = _______.

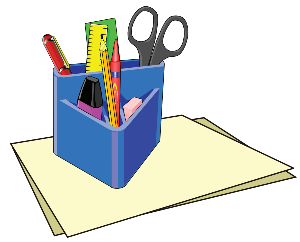
Area of rhombus ABCD $= \frac{1}{2}$ area of rectangle _______.

$= \frac{1}{2} d_1 \times$ _______.

Application

This activity can be used in explaining formula for area of a rhombus.

Activity 60



OBJECTIVE

To verify Pythagoras Theorem for any right triangle

MATERIAL REQUIRED

Cardboard, coloured papers, adhesive, scissors, geometry box, sketch pens, tracing paper.

METHOD OF CONSTRUCTION

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

2. Make cut outs of eight identical right triangles of which four are of one colour (blue) and four are of another colour (red) of convenient size each having sides a, b and c (say 3 cm, 4 cm and 5 cm, respectively) (see Fig. 1).

3. Make two identical squares each of side $a + b$ (Fig. 2).

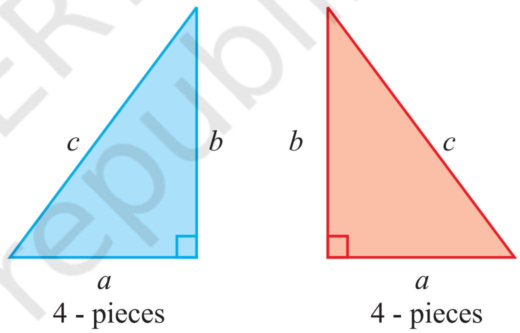
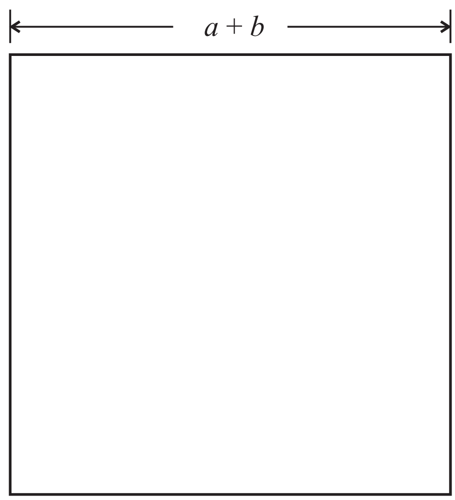


Fig. 1



2 - pieces

Fig. 2

DEMONSTRATION

1. Arrange four right triangles of blue colour in one of the squares as shown in Fig. 3.

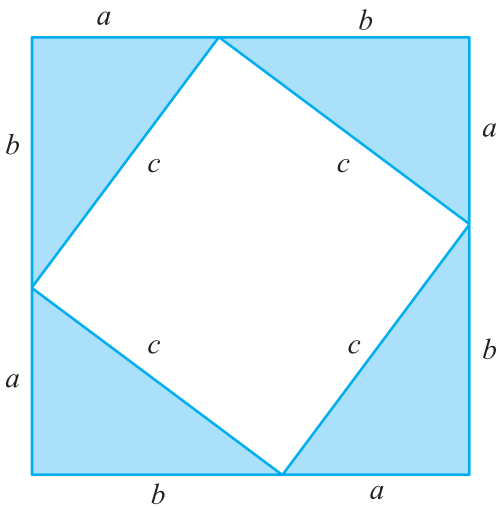


Fig. 3

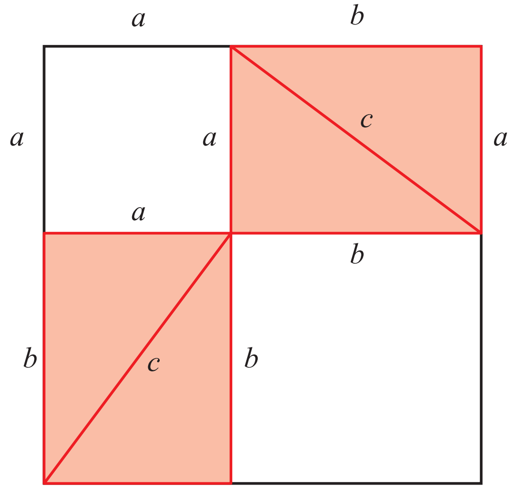


Fig. 4

2. Arrange the other four right triangles (red colour) in the other square as shown in Fig. 4.

3. In Fig. 3, after arranging four right triangles, the part of square of side $a + b$ left is a square of side c.

4. In Fig. 4, after arranging four right triangles, the part of square of side $a + b$ left is made up of two squares one of side a and the other of side b.

5. This shows that $c^2 = a^2 + b^2$.

Observation

On actual measurement (in centimetres)

1. a = ____, b = ____, c = ____.

2. So, a^2 = ____, b^2 = ____, c^2 = ____.

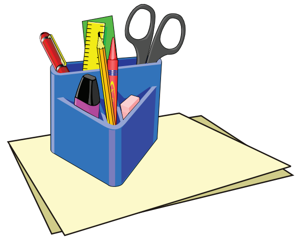
3. $a^2 + b^2$ = ____.

Application

1. Whenever two out of three sides of a right triangle are given, the third side can be found by using Pythagoras Theorem.

2. Pythagoras Theorem can be used to solve problems related to ladder and wall, heights and distances etc.

Activity 61



Objective

To verify Pythagoras Theorem using a grid paper

Material Required

Grid paper, cardboard, pen/pencil, sketch pens of different colours, adhesive, scissors, ruler.

Method of Construction

1. Take a cardboard of convenient size and paste a grid paper on it.
2. Draw a right triangle ABC of sides 3 cm, 4 cm and 5 cm as shown in Fig. 1.

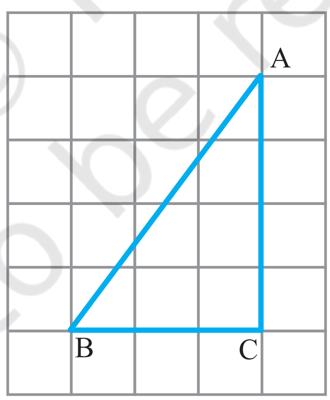


Fig. 1

3. Draw squares on sides AB, BC and CA. Colour square on AC with red and square on BC as blue.
4. Make a cut out of the square on side AC and take out its 16 unit squares in the form of strips each of 4 unit squares.
5. Make a cut out of the square on side BC.

Demonstration

1. Arrange 16 unit squares (red) along the side of the square on AC as shown in Fig. 2.

2. Place the cut out of square on BC (blue) on the remaining part of the square on side AB as shown in Fig. 2.

3. Square on AB is now completely covered with the 16 unit squares (red) and 9 unit squares (blue).

4. Area of square on AC + Area of square on BC = Area of square on AB.

   i.e., $AC^2 + BC^2 = AB^2$

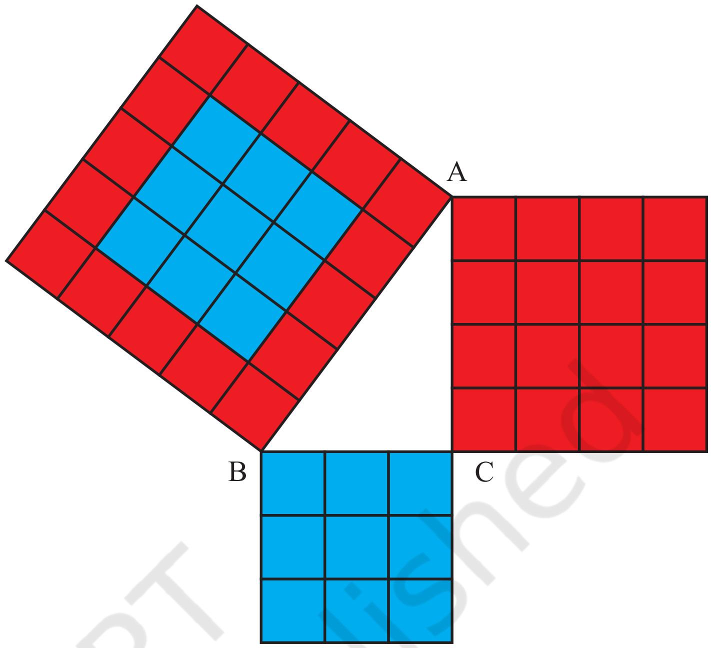


Fig. 2

Observation

Area of square on side AC = _____ square units.

Area of square on side BC = _____ square units.

Area of square on side AB = Area of square on side____ + Area of square on side____.

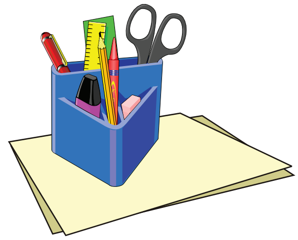
$AB^2 = AC^2 +$ ____.

Application

1. Whenever any two sides of a right triangle are given, the third side can be found out using this result.

2. Pythagoras theorem is helpful in studying problems related to right angled triangles such as ladder and window problems.

Activity 62



Objective

To verify Pythagoras Theorem for an isosceles right triangle

Material Required

Cardboard, plain sheets, adhesive, scissors, sketch pens, pencil, tracing paper, geometry box.

Method of Construction

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

2. Draw an isosceles right triangle of suitable size on a paper and cut it out. Paste this triangle on the cardboard and name it as ABC (Fig. 1).

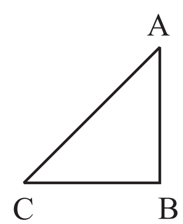


Fig. 1

3. Draw squares on sides AB, BC and AC (Fig. 1).

4. Make cutouts of these two squares on AB and BC using tracing paper in two different colours say purple and blue.

5. Cut each of these squares along one of the diagonals and obtain 4 right triangles.

Demonstration

1. Arrange the cut out triangles in the square on side AC of the triangle as shown in Fig. 2.

2. Four cut out triangles exactly cover the square on side AC of the triangle.

3. Square on side AC is made up of two isosceles purple triangles and two isosceles blue triangles.

4. Square on side AC = Square on side BC + Square on side AB

   or $AC^2 = BC^2 + AB^2$.

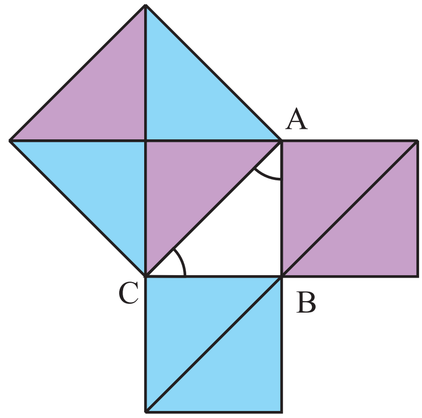


Fig. 2

Observation

On actual measurement (in centimetres)

1. AB = ____, BC = ____.

   CA = ____

   so, AB^2 = ____, BC^2 = ____.

   CA^2 = ____.

   $AB^2 + BC^2$ = ____.

Applications

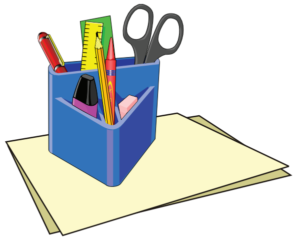
1. Whenever two, out of three sides of a right triangle are given, the third side can be found out by using Pythagoras Theorem.

2. Pythagoras Theorem can be used to solve problems related to ladder and wall, heights and distances etc.

NOTE

This Activity can also be performed by using 45° – 45° – 90° set squares.

Activity 63



Objective

To verify Pythagoras Theorem for a right triangle with one angle 30°

Material Required

Cardboard, plain sheets of paper, adhesive, scissors, sketch pens, pencil, tracing paper, geometry box.

Method of Construction

1. Take a piece of cardboard of convenient size and paste a white paper on it.
2. Draw a right triangle with one angle 30° of a suitable size on a paper and cut it out. Paste this triangle on the cardboard and name it as ABC.
3. Draw squares on sides AB, BC and AC of the triangle as shown in Fig.1.

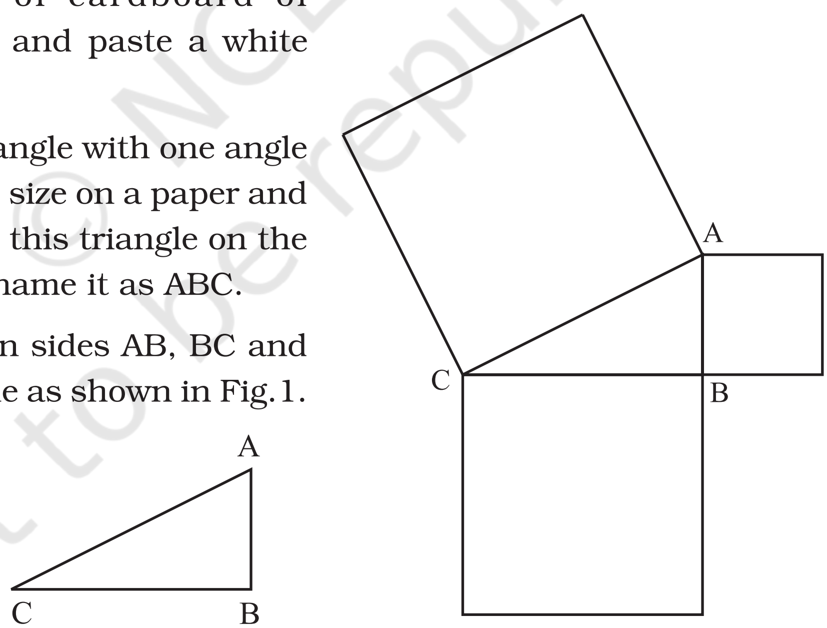


Fig. 1

4. Make cutouts of the squares on sides AB and BC. Divide the cut out of the square on BC into 4 identical right triangles by paper folding/ cutting as shown in Fig. 2.

Demonstration

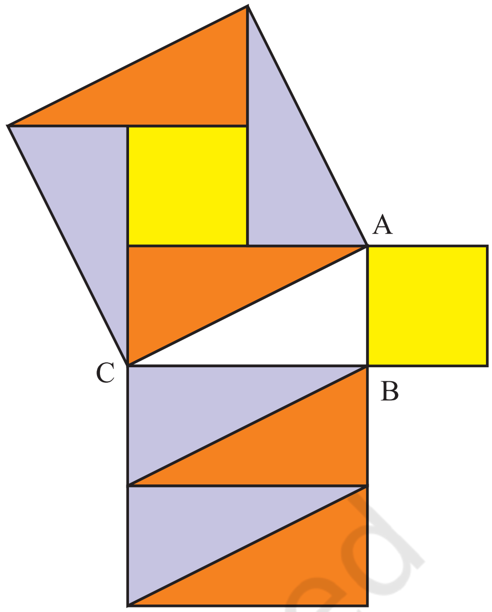


Fig. 2

1. Arrange these 4 triangles and the square on side AB in the square on side AC as shown in Fig. 2.
2. Four cut out triangles and the square on side AB exactly covers the square on side AC of triangle ABC.
3. Square on side AC is made up of four identical right triangles and the square on side AB.
4. Square on side AC = Square on side BC + Square on side AB.

   or $AC^2 = BC^2 + AB^2$.

Observation

1. On actual measurement (in centimetres)

   AB = ____, BC = ____, CA = ____.
2. AB^2 = ____, BC^2 = ____, CA^2 = ____.
3. $AB^2 + BC^2$ = ____, BC^2 = ____ + ____.
4. $AB^2 + BC^2$ = ___.

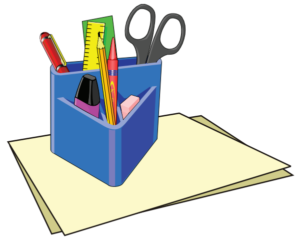
Application

1. Whenever two out of three sides of a right triangle are given, the third side can be found by using Pythagoras Theorem.
2. Pythagoras Theorem can be used to solve problems related to ladder and wall, heights and distances etc.

NOTE

This activity can also be performed by using 30° – 60° – 90° set squares and the square on the smallest side of the set square.

Activity 64



Objective

To verify that if two parallel lines are intersected by a transversal, then

(i) the pairs of corresponding angles are equal.

(ii) the pairs of alternate interior angles are equal.

(iii) the pairs of interior angles on the same side of the transversal are supplementary.

Material Required

Drawing board, drawing pins, wires/thread, broomsticks, pen, adhesive, chart paper/glaze paper.

Method of Construction

1. Take a drawing board paste a white chart paper on it.

2. With the help of a ruler draw two parallel lines AB and CD on the board as shown in Fig. 1.

3. Draw a transversal EF intersecting the two lines AB and CD.

4. Mark the angles so formed as ∠1, ∠2, ∠3, ∠4, ∠5, ∠6, ∠7 and ∠8. (see Fig. 2).

5. Make cutouts of these angles.

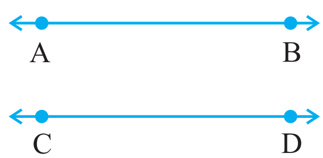


Fig. 1

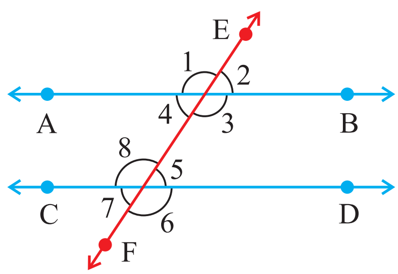


Fig. 2

Demonstration

1. Place the cut out of $\angle 1$ on $\angle 8$ and see whether $\angle 1 = \angle 8$. Now place cut out of $\angle 2$ on $\angle 5$ and see whether $\angle 2 = \angle 5$. Similarly, check the equality of $\angle 3$ and $\angle 6$, $\angle 4$ and $\angle 7$. These pairs of angles are corresponding angles.
2. Take the cut out of $\angle 4$ and place it on $\angle 5$ and see whether $\angle 4 = \angle 5$. Similarly, check that $\angle 3 = \angle 8$. These pairs are alternate interior angles.
3. Place the cut out of $\angle 3$ and $\angle 5$ adjacent to each other as shown in Fig. 3.
4. With the help of a ruler, check that their non common arms are in the same line and hence supplementary. Similarly, check for $\angle 4$ and $\angle 8$. These are pairs of interior angles on the same side of the transversal.

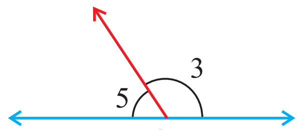


Fig. 3

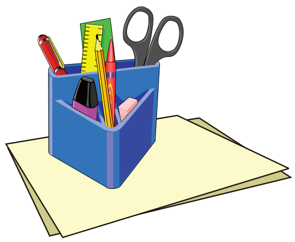
Observations

S. No.	Angles	Type	Are they Equal/ supplementary	Inference
1.	$\angle 1$ and $\angle 8$	Corresponding	Equal	Corresponding
	$\angle 4$ and $\angle 7$	angles	—	angles are equal
	$\angle 2$ and $\angle 5$		—	
	$\angle 3$ and $\angle 6$		—	
2.	$\angle 4$ and $\angle 5$	—	—	
	$\angle 3$ and $\angle 8$	—	—	
3.	$\angle 4$ and $\angle 8$	—	—	
	$\angle 3$ and $\angle 5$	—	—	

Application

1. This activity may be used to verify that the pairs of vertically opposite angles are equal.
2. The results are useful in solving a number of geometrical problems.

Activity 65



Objective

To verify that the sum of three angles of a triangle is 180°

Material Required

Coloured paper/drawing sheet, colours, adhesive, scissors, cardboard.

Method of Construction

1. Take a cardboard of convenient size and paste a coloured paper/drawing sheet on it.

2. Cut out two identical triangles using paper.

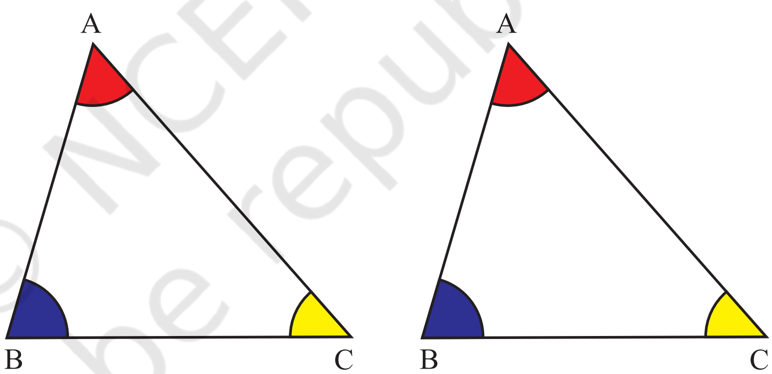


Fig. 1

3. Colour the angles as shown in Fig. 1.

4. Cut out the three angles of one triangle as shown (Fig. 2).

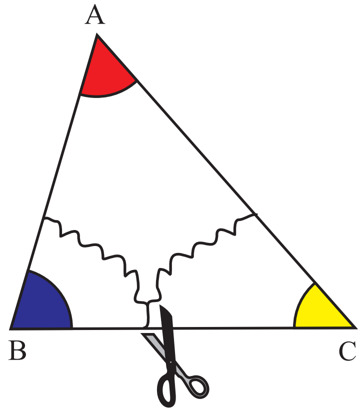


Fig. 2

5. Now paste the three cutouts adjacent to each other with their vertices at a common point P on the cardboard (Fig. 3).

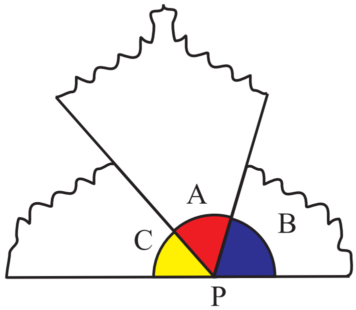


Fig. 3

Demonstration

The cutouts of the three angles A, B and C placed adjacent to each other at a point P have the arms of angles of ∠A and ∠C as opposite rays and hence form a straight angle.

Therefore, angles A, B and C form a straight angle.

Therefore ∠A + ∠B + ∠C = 180°.

Observation

Measure of ∠A = _______,

Measure of ∠B = _______,

Measure of ∠C = _______,

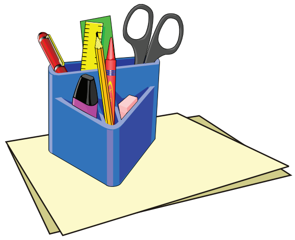
∠A + ∠B + ∠C = _______.

Thus, sum of three angles of a triangle is _______.

Application

This result is used in a number of geometrical problems such as to find the sum of angles of a polygon such as quadrilateral, pentagon etc.

Activity 66



Objective

To obtain formula for the area of a parallelogram

Material Required

Coloured paper, adhesive, scissors, drawing sheet, pen/pencil.

Method of Construction

1. Take a coloured paper and make a parallelogram through paper folding or draw a parallelogram on a paper.

2. Name the parallelogram as ABCD and cut it out. Paste it on a drawing sheet. Through D make DE ⊥ AB by paper folding (Fig.1).

3. Cut out Δ ADE and paste it along the other side of the paralleogram such that DA is adjacent to CB as shown in Fig. 2.

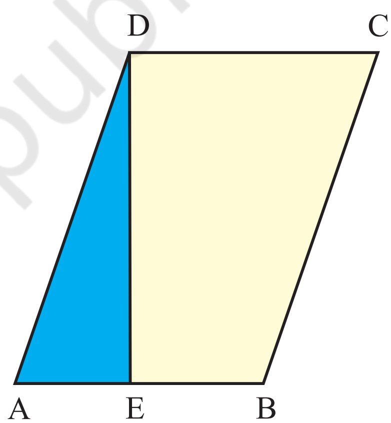


Fig. 1

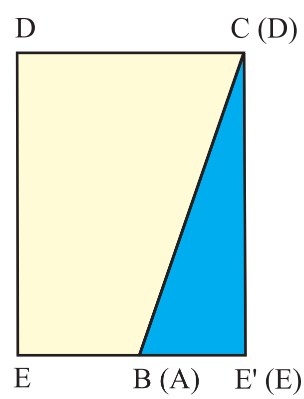


Fig. 2

Demonstration

1. The breadth of rectangle DEE′C is the height of parallelogram ABCD.

2. Length of rectangle DEE′C is the base of parallelogram ABCD.

3. Area of parallelogram ABCD = area of rectangle DEE′C

= Length × Breadth

= Base of parallelogram × Height of parallelogram

= $b \times h$.

Observation

On actual measurement.

Length of the rectangle = _______,

Breadth of the rectangle = _______,

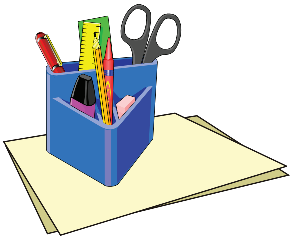
Area of the rectangle = _______,

Area of parallelogram = Area of rectangle = ____ × ____.

Application

The result is used for explaining the formula for Area of a triangle.

Activity 67



Objective

To make a rhombus by paper folding and cutting

Material Required

Cardboard, pen/pencil, coloured paper, scissor and adhesive.

Method of Construction

1. Take a rectangular sheet of coloured paper and fold it such that one part exactly covers the other part as shown in Fig. 1.

Fig. 1

2. Fold it again as shown in Fig. 2.

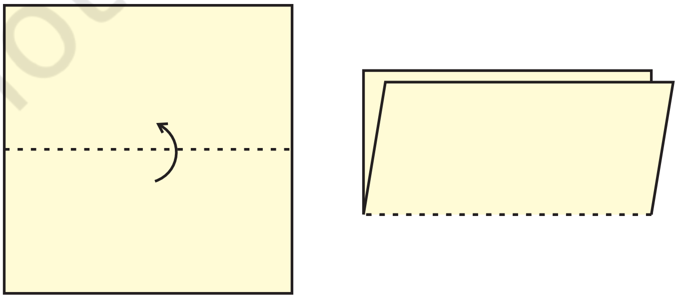


Fig. 2

3. Fold it again as shown in Fig. 3.

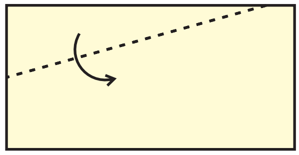


Fig. 3

4. Unfold the sheet and mark the crease with pencil as shown in Fig. 4.

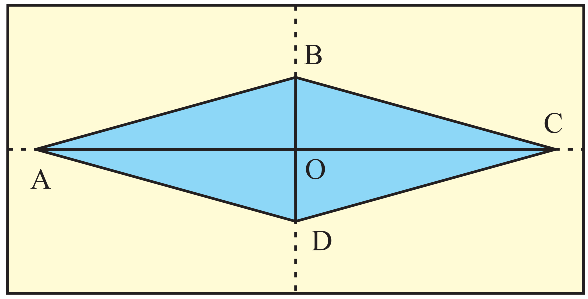


Fig. 4

5. Now cut out the figure ABCD and paste it on a cardboard.

DEMONSTRATION

1. AB = BC = CD = DA as they have been obtained by paper folding.
2. $\angle AOD = \angle COD = 90°$, so, $AC \perp BD$.

Thus figure ABCD is a rhombus.

OBSERVATION

On actual measurement:

OC	= _____,	OA	= _____,
OD	= _____,	OB	= _____,
$\angle DOC$	= _____,	$\angle DOA$	= _____,
$\angle BOC$	= _____,	$\angle BOA$	= _____,
AB	= _____,	BC	= _____,
CD	= _____,	DA	= _____,

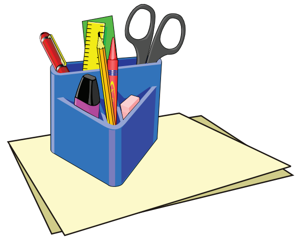
AC and DB are ___________ bisector of each other.

ABCD is a ___________.

APPLICATION

This activity can be used in understanding the shape of a rhombus and also to explain its properties.

Activity 68



Objective

To make a rectangle by paper folding

Material Required

Cardboard, coloured paper, pencil/pen, adhesive.

Method of Construction

1. Take a sheet and fold it to get a crease. Name the crease as AB as shown in Fig. 1.

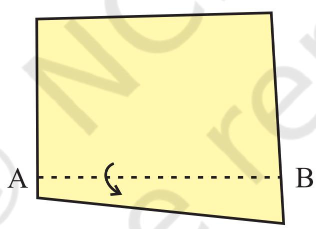


Fig. 1

2. Make CD perpendicular to AB by paper folding as shown in Fig. 2.

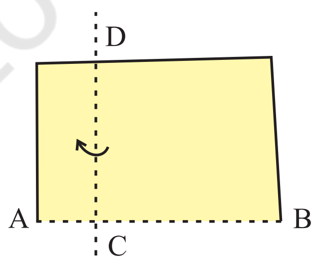


Fig. 2

3. Make EF ⊥ CD by paper folding (see Fig. 3).

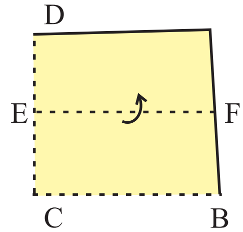


Fig. 3

4. Make GH ⊥ EF by paper folding (see Fig. 4).

5. Take the cut out of the shape ECHG and paste it on a cardboard.

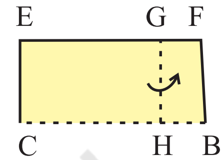


Fig. 4

Demonstration

1. CH ⊥ EC as AB ⊥ CD
2. EG ⊥ CE as EF ⊥ CD
3. GH ⊥ EG as GH ⊥ EF
4. So, ECHG is a rectangle.

Observation

On actual measurement:

EG = _____ ; CH = _____.

EC = _____ ; GH = _____.

∠ECH = _____ , ∠CHG = _____ , ∠HGE = _____ , ∠GEC = _____ ,

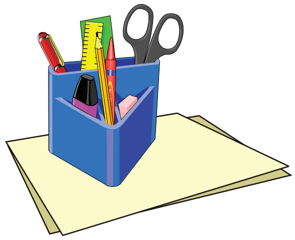
So, ECHG is a _____.

Application

The activity may be used to understand the properties of a rectangle.

NOTE Similar activity can be done to make a square.

Activity 69



OBJECTIVE

To make a square by paper folding

MATERIAL REQUIRED

Cardboard, thick paper/pen, pencil, adhesive.

METHOD OF CONSTRUCTION

1. Take a sheet of thick paper. Fold it as shown in Fig. 1.

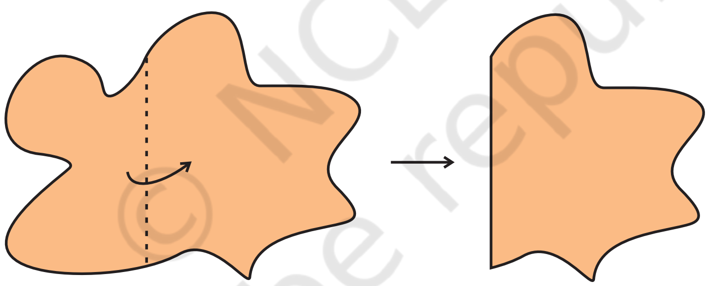


Fig. 1

2. Fold it again as shown in Fig. 2.

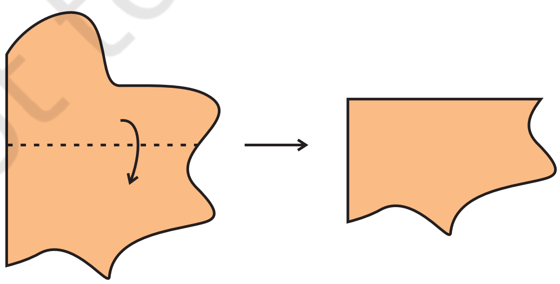


Fig. 2

3. Fold it again as in Fig. 3.

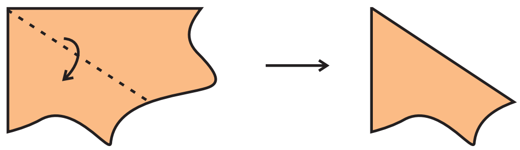


Fig. 3

4. Fold it again as in Fig. 4.

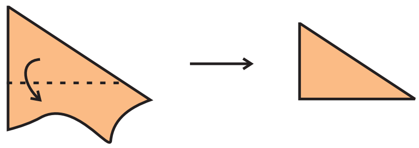


Fig. 4

5. Unfold and mark the crease as in Fig. 5.

6. Name the square as ABCD and point of intersection of diagonal AC and BD as O.

7. Cut out shape ABCD and paste it on a card board.

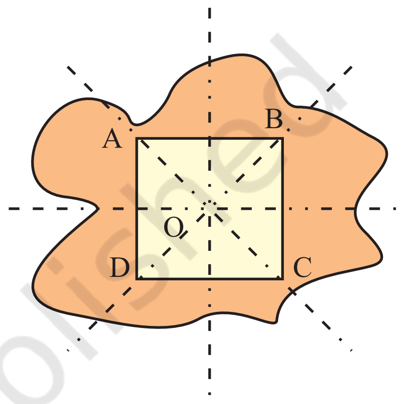


Fig. 5

Demonstration

1. From Fig. 5 DO = OB = OC = OA.
2. DB = AC.
3. AB = BC = CD = DA.
4. ABCD is a square.

Observation

On actual measurement

DB = _____ ; AC = _____.

AB = _____ ; BC = _____.

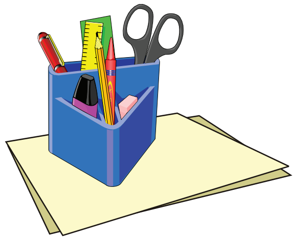
DC = _____ ; AD = _____.

ABCD is a _____.

Application

This activity may be used to understand the properties of a square.

Activity 70



Objective

To obtain a parallelogram by paper folding

Material Required

Rectangular sheet of paper, coloured pen.

Method of Construction

1. Take a rectangular sheet of paper.
2. Fold it parallel to its breadth at a convenient distance and make a crease (1) as shown in Fig. 1.

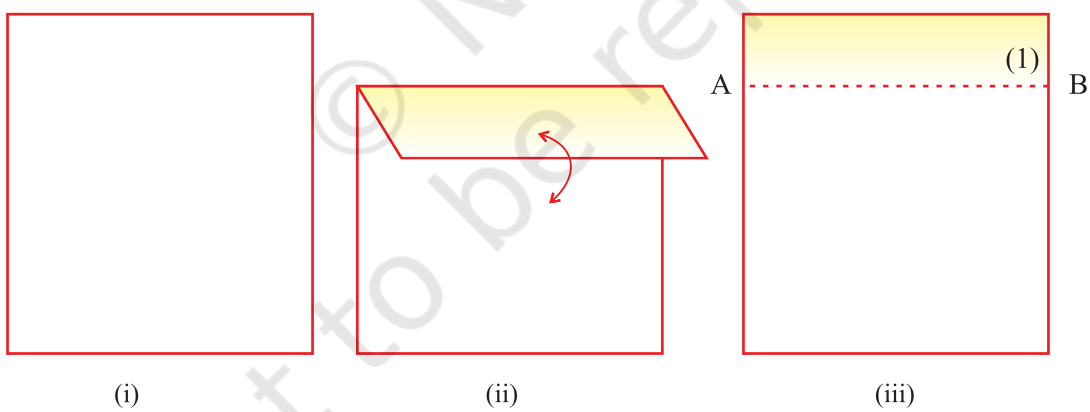


Fig. 1

3. Obtain a crease perpendicular to crease (1) at any point on it to get a crease (2) as shown in Fig. 2. Call it as CD.

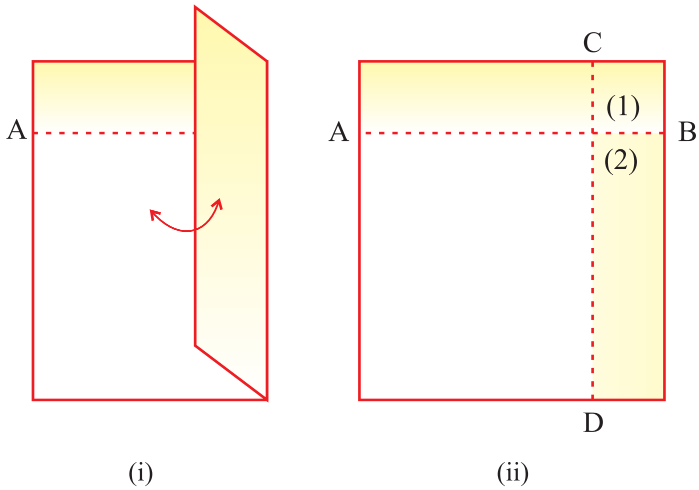


Fig. 2

4. Obtain a third crease perpendicular to crease (2) at any point on crease (2) and call it as crease (3) as shown in Fig. 3. Call it as EF.

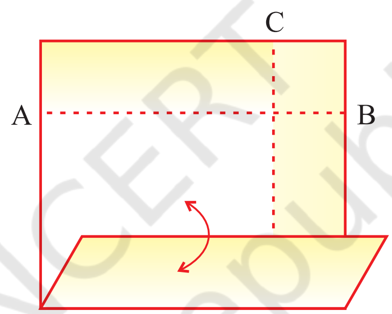


Fig. 3

5. Mark crease (1) and (3) with pen as shown in Fig. 4.

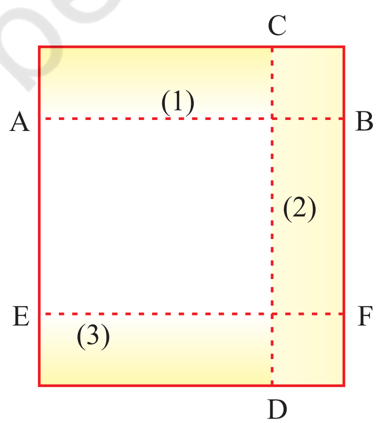


Fig. 4

6. Make a fold, cutting the creases (1) and (3) as shown in Fig. 5. Call it crease (4).

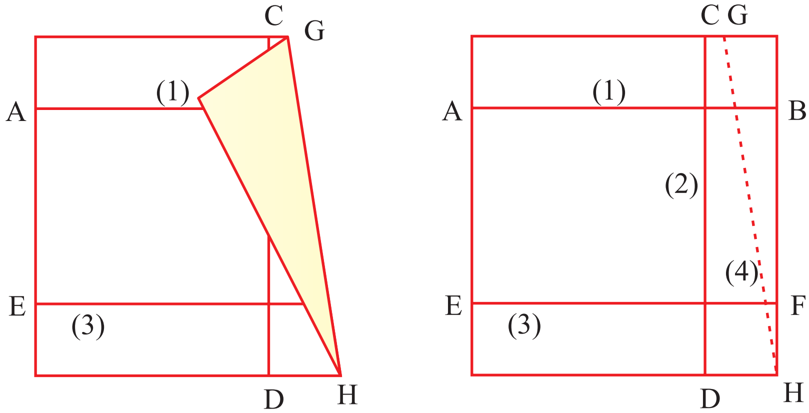


Fig. 5

7. Adopting the method used for getting a pair of parallel lines as explained in Steps 2 to 5, get a fold parallel to crease (4), call this as crease (5) as shown in Fig. 6.

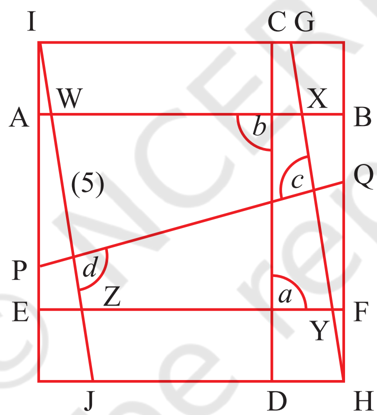


Fig. 6

DEMONSTRATION

In Fig 6, $CD \perp AB$

$EF \perp CD$

Therefore,

$AB \parallel EF$

$PQ \perp GH$

$IJ \perp PQ$

Therefore,

$GH \parallel IJ$

Thus, WXYZ is a parallelogram.

Observation

$\angle a =$ ________

Therefore, $CD \perp$ ________.

$\angle b =$ ________

Therefore, $EF \perp$ ________.

Thus,

AB ________ EF

$\angle c =$ ________

Therefore, $PQ \perp$ ________.

$\angle d =$ ________

Therefore, $IJ \perp$ ________.

Thus

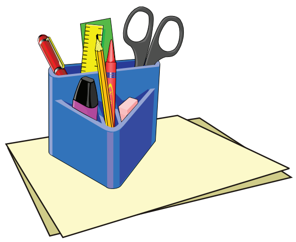
GH ________ IJ

This shows that WXYZ is a ________.

Application

Construction of a rectangle can also be done using this activity.

Activity 71



Objective

To draw regular polygons, using circles

Material Required

Coloured paper, scissors, geometry box.

Method of Construction

1. Draw three circles of the same radii on a coloured paper.

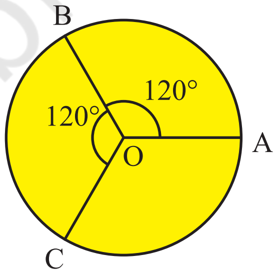


Fig. 1

2. Take one of the circles and draw three angles each of 120° $(= \frac{360°}{3})$ at the centre as shown in Fig.1.

3. Take second circle and draw four angles each of 90° $(= \frac{360°}{4})$ at the centre as shown in Fig. 2.

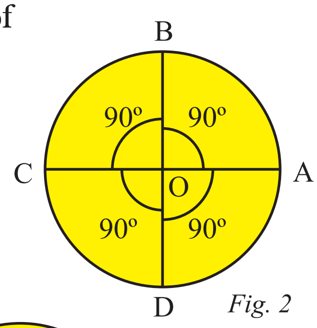


Fig. 2

4. On the third circle, draw five angles each of 72° $(= \frac{360°}{5})$ at the centre as shown in Fig. 3.

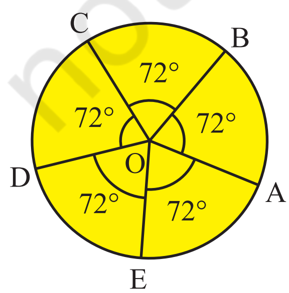


Fig. 3

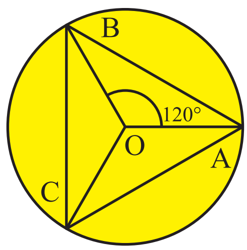


Fig. 4

Demonstration

1. In Fig.1, join AB, BC and CA as shown in Fig. 4. ABC is a regular polygon of sides three (an equilateral triangle).

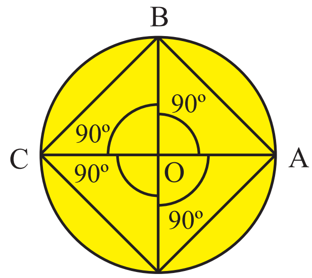


Fig. 5

2. In Fig. 2, join AB, BC, CD and DA as shown in Fig. 5. ABCD is a regular polygon of sides four (a square).

3. In Fig. 3, join AB, BC, CD, DE and EA as shown in Fig. 6.

   ABCD is a regular polygon of sides five.

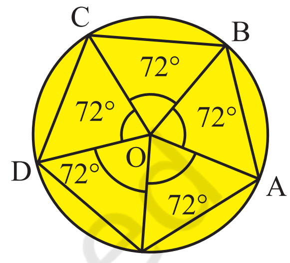


Fig. 6

Similarly, regular polygons of sides six, eight, nine and ten sides can be drawn.

Observation

On actual measurement:

S. No.	Name of sides	Length of sides (cm)
Figure 4	Equilateral Δ	—
	AB = ____, ∠A = ____.	—
	BC = ____, ∠B = ____.	—
	AC = ____, ∠C = ____.	—
Figure 5	AB = ____, ∠A = ____.	—
	BC = ____, ∠B = ____.	—
	CD = ____, ∠C = ____.	—
	AD = ____, ∠D = ____.	—
Figure 6	AB = ____, ∠A = ____.	—
	BC = ____, ∠B = ____.	—
	CD = ____, ∠C = ____.	—
	DE = ____, ∠D = ____.	—
	AE = ____, ∠E = ____.	—

In Fig. 4 all the three sides are ____ and all the three angles are ____. So, ABC is a regular polygon of sides ____.

In Fig. 5, all the four sides are _____and all the four angles are_____.

So, ABCD is a regular polygon of sides _____.

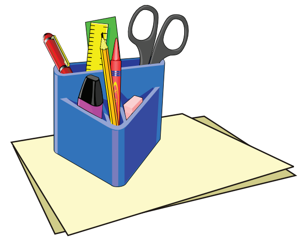
In Fig. 6, all the five sides are _____ and all the five angles are _____.

So, ABCDE is a polygon of sides_____.

Application

This activity is useful in explaining the meaning of a regular polygon and how to draw a regular polygon.

Activity 72



OBJECTIVE

To make a kite by paper folding and cutting

MATERIAL REQUIRED

Thick paper, cardboard, pen/pencil, ruler, scissors, adhesive.

METHOD OF CONSTRUCTION

1. Take a rectangular thick white paper.

2. Fold it once as shown in Fig. 1.

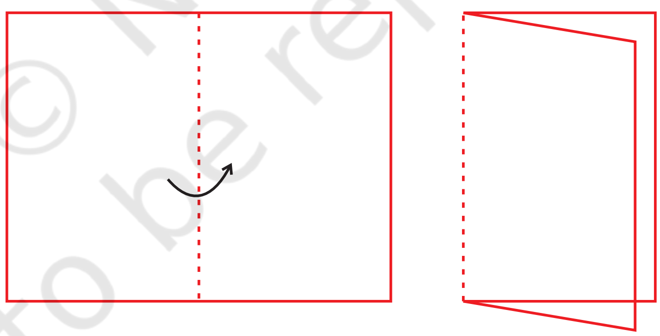


Fig. 1

3. Draw two line segments of different lengths as shown in Fig. 2.

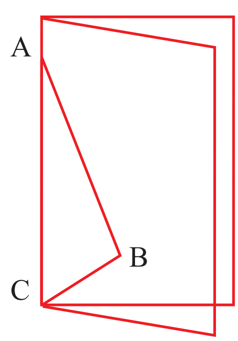


Fig. 2

4. Cut along AB and BC and unfold it to get a figure as shown in Fig. 3. Paste the cut out on a cardboard.

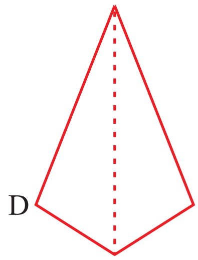


Fig. 3

Demonstration

1. AB is equal to AD as AB covers AD exactly in Fig. 2.
2. BC is equal to DC as BC covers DC exactly in Fig. 2.
3. So, ABCD is a kite.

Observation

On actual measurement:

AB = _____. AD = _____.

BC = _____. DC = _____.

Measure of $\angle$DAC = _______.

$\angle$BAC = _______.

$\angle$DCA = _______, $\angle$BCA = _______.

$\angle$DAC = $\angle$ _______.

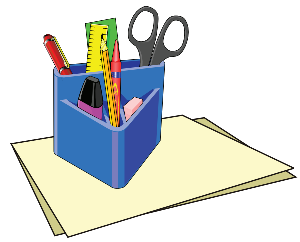
$\angle$DCA = $\angle$ _______.

So, ABCD is a _______.

Application

This activity will help in understanding the shape of a kite and all its properties.

Activity 73



Objective

To verify that the sum of four angles of a quadrilateral is 360°

Material Required

Cardboard, coloured glaze paper, colours, ruler, pencil, drawing sheet, scissors, tracing paper.

Method of Construction

1. Take a cardboard of convenient size and cover it with a light coloured glaze paper.
2. Take a drawing sheet and draw a quadrilateral on it.
3. Cut it out and paste it on the cardboard. Name it as ABCD (Fig.1).

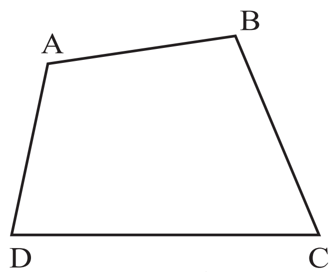


Fig. 1

   Make a trace copy of the quadrilateral ABCD.
4. Colour the four angles with different colours in both the quadrilaterals (Fig. 2).

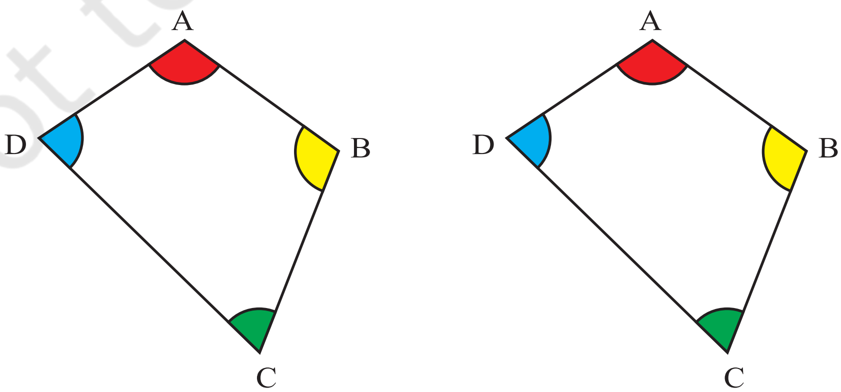


Fig. 2

5. Cut out the angles A, B, C and D from the trace copy and arrange them on the cardboard at a point P so that there is no gap between adjacent angles as shown in Fig. 3.

Demonstration

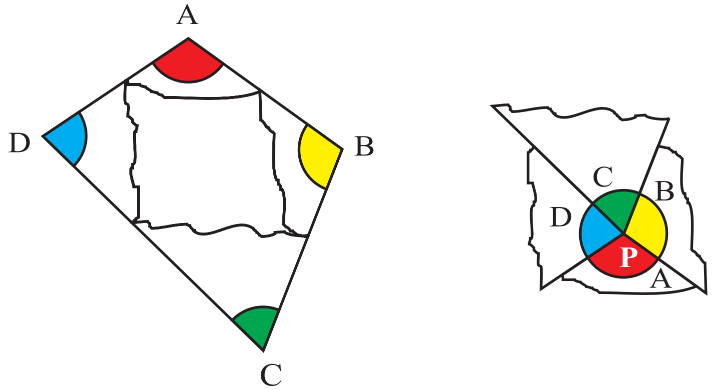


Fig. 3

1. The four angles A, B, C and D make a complete angle at the point P.
2. Sum of angles at point P is 360°.

   So, $\angle A + \angle B + \angle C + \angle D = 360°$.

Observation

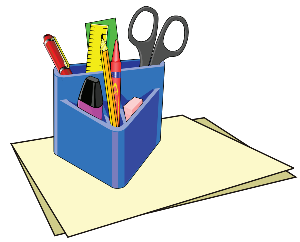
On actual measurement:

Angle	**Measure**
$\angle A$	____
$\angle B$	____
$\angle C$	____
$\angle D$	____
$\angle A + \angle B + \angle C + \angle D$	____

Application

This activity can be used in solving many geometrical problems.

Activity 74



Objective

To verify that sum of exterior angles of a triangle and quadrilateral taken in order is 360° or four right angles

Material Required

Cardboard, white drawing sheet, colours, pencil, ruler, scissors, tracing paper.

Method of Construction

(A) Triangle

1. Take a cardboard of convenient size and paste a coloured glaze paper on it.
2. Draw a triangle ABC on a drawing sheet and produce its sides in an order as shown in Fig.1.
3. Name the exterior angles as 1, 2 and 3 and colour them as shown above in Fig.1.
4. Make a trace copy of the above figure and colour the exterior angles with the same colours as in Fig. 1.
5. Cut out the exterior angles neatly.

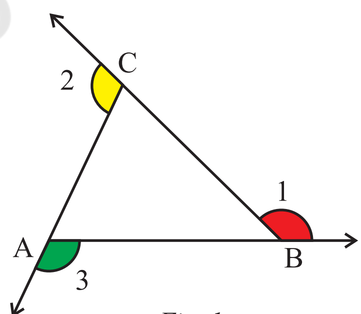


Fig. 1

(B) Quadrilateral

1. Draw a quadrilateral ABCD on a drawing sheet and produce its sides in an order as shown in Fig. 2.

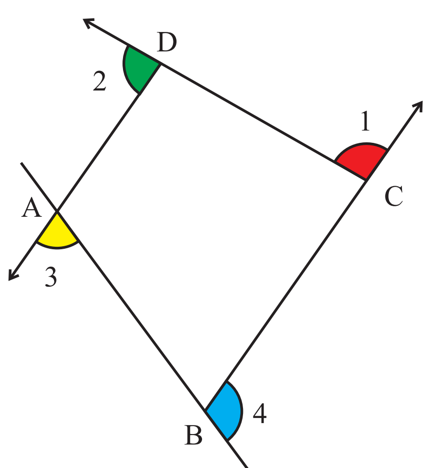


Fig. 2

2. Name the exterior angles as 1, 2, 3 and 4 and colour them as shown in Fig. 2.

3. Make the trace copy of the above figure and colour the exterior angles with the same colours as in Fig. 2.

4. Cut out the exterior angles neatly.

DEMONSTRATION

(A)

1. Place the cutouts of the exterior angles of Fig. 1 adjacent to each other at a point P without having any gap between any two consecutive angles as shown in Fig. 3.

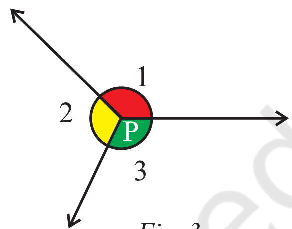


Fig. 3

(B)

2. Place the cutouts of the exterior angles of Fig. 2 adjacent to each other at a point Q without having any gap between any two consecutive angles as shown in Fig. 4.

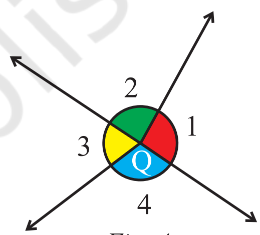


Fig. 4

3. The exterior angles in Fig. 3 as well as in Fig. 4 make a complete angle at the points P and Q respectively.

4. The sum of angles at a point is 360°.

So, $\angle 1 + \angle 2 + \angle 3 = 360°$. for (A)

and $\angle 1 + \angle 2 + \angle 3 + \angle 4 = 360°$ for (B)

OBSERVATION

On actual measurement:

(A) Triangle

Angle	Measure
$\angle 1$	___
$\angle 2$	___
$\angle 3$	___
$\angle 1 + \angle 2 + \angle 3$ =	___.

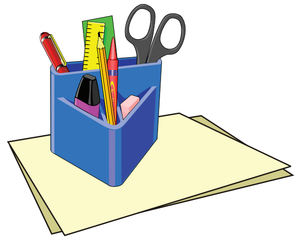
(B) Quadrilateral

Angle	Measure
$\angle 1$	___
$\angle 2$	___
$\angle 3$	___
$\angle 4$	___
$\angle 1 + \angle 2 + \angle 3 + \angle 4 =$	___.

APPLICATION

This activity can be used to find the sum of exterior angles produced in order, of a pentagon, a hexagon or in general any polygon.

Activity 75



Objective

To make different types of prisms and pyramids and verifying Euler's formula

Material Required

Thick sheet, drawing sheet, pencil, colours, adhesive, scissors, white sheet, cellotape.

Method of Construction

Prism

1. Draw an equilateral triangle of side 'a' (say 5 cm) on a thick sheet.
2. Cut it out and make a copy of it using thick sheet.
3. Make congruent rectangles whose breadth is the same as the side of the triangle and length b (say 8 cm) using thick sheet.
4. Arrange these triangles and rectangles using cellotape to get a solid as shown in Fig. 1.

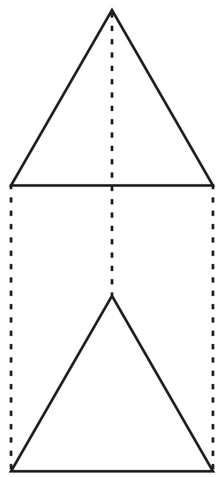


Fig. 1

5. Make 4 cutouts of equilateral triangles of side a using thick sheet.
6. Arrange these triangles to get a solid as shown in Fig. 2

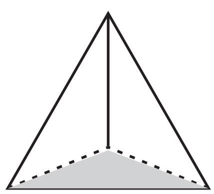


Fig. 2

Demonstration

1. Solid in Fig. 1, is a prism of base as a triangle. It is a triangular prism
2. Solid in Fig. 2, is a pyramid of base as a triangle. It is a triangular pyramid.
3. Similarly you can make a square, pentagonal prism or regular hexagonal prism by taking base and top as regular pentagon or regular hexagon, respectively.
4. Similarly you can make pyramids with base as square, pentagon and hexagon.
5. In prism (Fig.1),

   Number of faces (F) = 5, Number of vertices (V) = 6

   Number of edges (E) = 9.

   Thus, F + V – E = 5 + 6 – 9 = 2
6. In pyramid (Fig. 2)

   Number of faces (F) = 4, Number of vertices (V) = 4

   Number of edges (E) = 6.

   Thus, F + V – E = 4 + 4 – 6 = 2

   Hence, the Euler's formula is verified both for prism and pyramid.

Observation

Prism

Base	Number of faces (F)	Number of edges (E)	Number of vertices (V)	F + V – E =
Triangle	5	___	___	2
Square	___	___	___	___
Regular pentagon	___	___	___	___
Regular hexagon	___	___	___	___

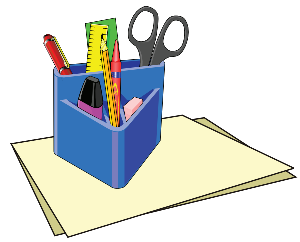
Pyramid

Base	**Number of faces (F)**	**Number of edges (E)**	**Number of vertices (V)**	**F + V – E =**
Triangle	4	___	___	2
Square	___	___	___	___
Regular pentagon	___	___	___	___
Regular hexagon	___	___	___	___

Hence F + V – E = _______, in each case.

Application

This activity may be used to explain construction of prisms and pyramids and to identify their faces, edges and vertices.



Activity 76

Objective

To verify the algebraic identity : $(a + b)^2 = a^2 + 2ab + b^2$

Material Required

Drawing sheet, cardboard, adhesive, coloured papers, cutter and ruler.

Method of Construction

1. Cut out a square of side with length a units from a drawing sheet/ cardboard and name it as square ABCD [see Fig. 1].

2. Cut out another square of length b units from a drawing sheet/ cardboard and name it as square CHGF [see Fig. 2].

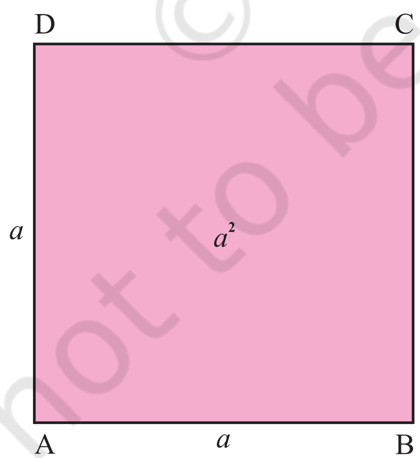


Fig. 1

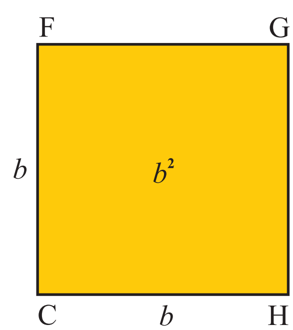


Fig. 2

3. Cut out a rectangle of length a units and breadth b units from a drawing sheet/cardboard and name it as a rectangle DCFE [see Fig. 3].

4. Cut out another rectangle of length b units and breadth a units from a drawing sheet/cardboard and name it as a rectangle BIHC [see Fig. 4].

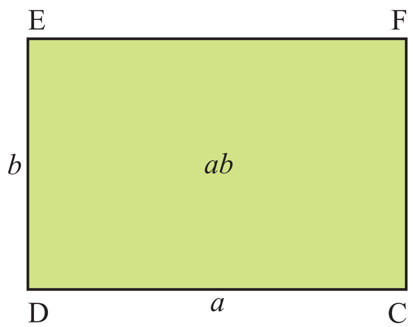


Fig. 3

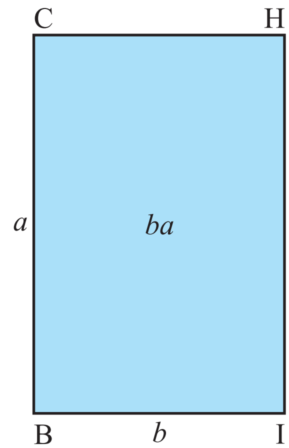


Fig. 4

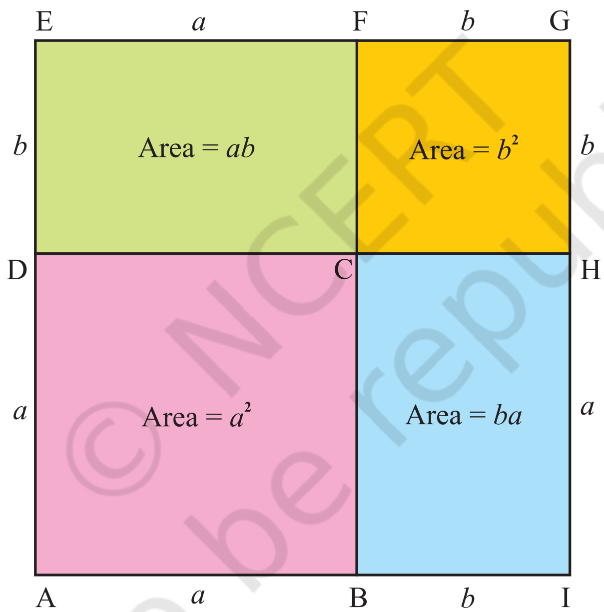


Fig. 5

Demonstration

1. Arrange the four quadrilaterals as shown in Fig. 5.

2. Total area of these four cut out figures.

   = Area of square ABCD + Area of square CHGF + Area of rectangle DCFE + Area of rectangle BIHC.

   $= a^2 + b^2 + ab + ba = a^2 + b^2 + 2ab.$

3. Clearly, AIGE is a square of side $(a + b)$. Therefore, its area is $(a + b)^2$.

Hence, the algebraic identity $(a + b)^2 = a^2 + 2ab + b^2$ is verified.

Here, area is in square units.

OBSERVATION

On actual measurement:

a = ________ cm, b = ________ cm,

So, $(a + b)$ = ________ cm.

a^2 = ________, b^2 = ________, ab = ________,

$(a + b)^2$ = ________, $2ab$ = ________ .

Therefore, $(a + b)^2 = a^2 + 2ab + b^2$.

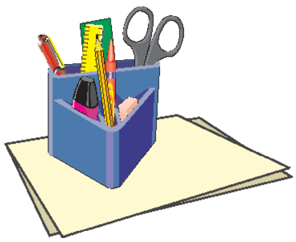
The identity may be verified by taking different values of a and b.

APPLICATION

The identity may be used for

1. calculating the square of a number by expressing it as the sum of two convenient numbers.
2. simplification/factorisation of some algebraic expressions.

Activity 77



Objective

To verify the algebraic identity : $(a - b)^2 = a^2 - 2ab + b^2$

Material Required

Drawing sheets, cardboard, coloured papers, scissors, ruler and adhesive.

Method of Construction

1. Cut out a square ABCD of side a units from a drawing sheet/cardboard [see Fig. 1].
2. Cut out a square EBHI of side b units ($b < a$) from a drawing sheet/cardboard [see Fig. 2].
3. Cut out a rectangle GDCJ of length a units and breadth b units from a drawing sheet/cardboard [see Fig. 3].
4. Cut out a rectangle IFJH of length a units and breadth b units from a drawing sheet/cardboard [see Fig. 4].

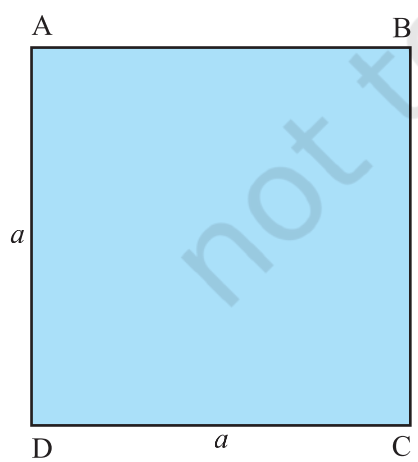


Fig. 1

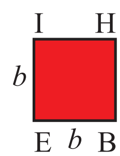


Fig. 2

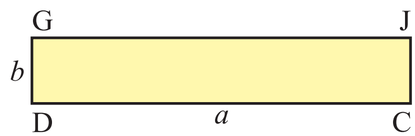


Fig. 3

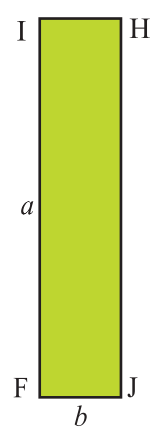


Fig. 4

Demonstration

1. Arrange these cutouts as shown in Fig. 5.

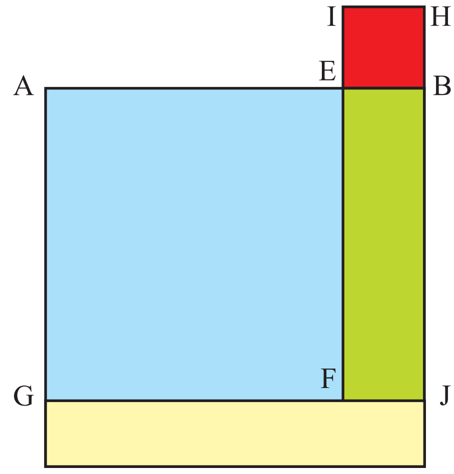


Fig. 5

2. According to Fig.1, 2, 3 and 4, Area of square ABCD = a^2, Area of square EBHI = b^2. Area of rectangle GDCJ = ab, Area of rectangle IFJH = ab

3. From Fig. 5, area of square AGFE = AG × GF

   = $(a - b)(a - b) = (a - b)^2$

4. Now, area of square AGFE = Area of square ABCD + Area of square EBHI – Area of rectangle IFJH – Area of rectangle GDCJ

   = $a^2 + b^2 - ab - ab = a^2 - 2ab + b^2$

Here, area is in square units.

Observation

On actual measurement:

a = ________, b = ________,

So, $(a - b)$ = ________,

a^2 = ________, b^2 = ________, $(a - b)^2$ = ________,

ab = ________, $2ab$ = ________.

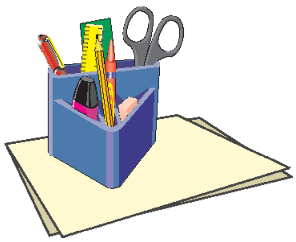
Therefore, $(a - b)^2 = a^2 - 2ab + b^2$

Application

The identity may be used for

1. calculating the square of a number expressed as a difference of two convenient numbers.
2. simplifying/factorisation of some algebraic expressions.

Activity 78



Objective

To verify the algebraic identity : $a^2 - b^2 = (a + b)(a - b)$

Material Required

Drawing sheets, cardboard, coloured papers, scissors, sketch pen, ruler, transparent sheet.

Method of Construction

1. Take a cardboard of convenient size and paste a coloured paper on it.
2. Cut out one square ABCD of side a units from a drawing sheet [see Fig. 1].
3. Cut out one square AEFG of side b units ($b < a$) from another drawing sheet [see Fig. 2].

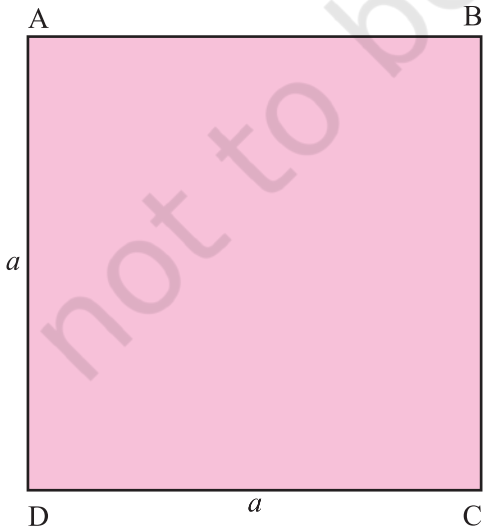


Fig. 1

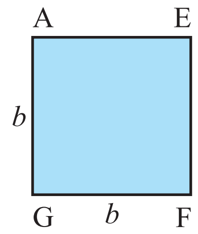


Fig. 2

4. Arrange these squares as shown in Fig. 3.

5. Join F to C using sketch pen. Cut out trapeziums congruent to EBCF and GFCD using a transparent sheet and name them as EBCF and GFCD, respectively [see Fig. 4 and 5].

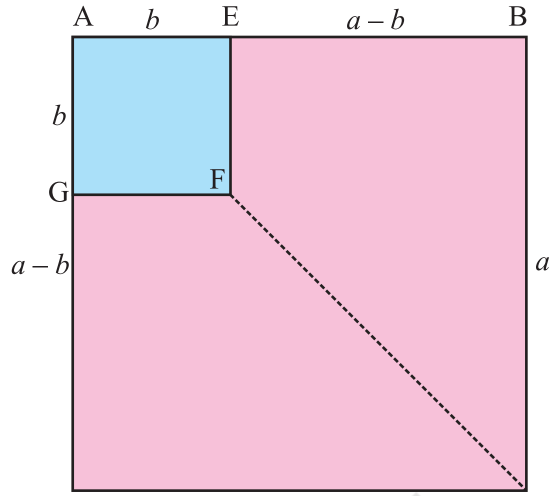


Fig. 3

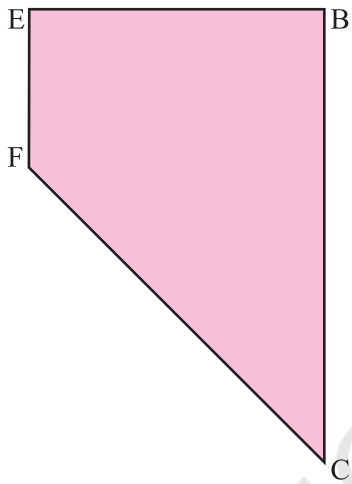


Fig. 4

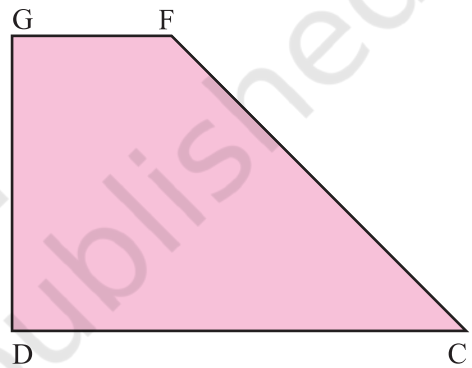


Fig. 5

Demonstration

1. Arrange the trapeziums in Figures 4 and 5 as shown in Fig. 6.

2. Area of square ABCD = a^2

3. Area of square AEFG = b^2

In Fig. 3,

Area of square ABCD – Area of square AEFG

= Area of trapezium EBCF + Area of trapezium GFCD

= Area of rectangle EBGD [Fig. 6].

= ED × DG.

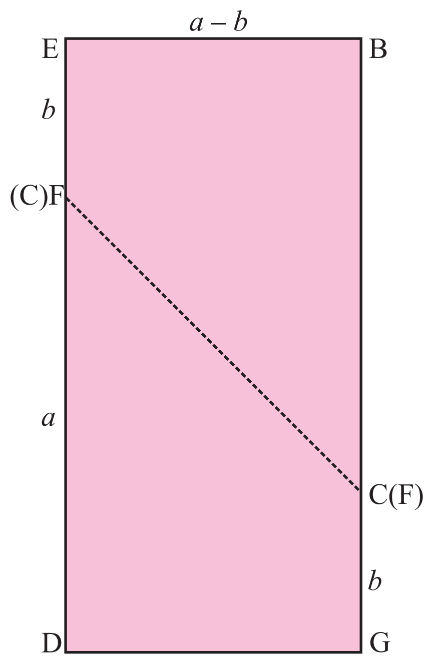


Fig. 6

Thus, $a^2 - b^2 = (a + b)(a - b)$

Here, area is in square units.

Observation

On actual measurement:

a = _______, b = _______,

So, $(a + b)$ = _______,

a^2 = _______, b^2 = _______, $(a - b)$ = _______,

$a^2 - b^2$ = _______, $(a + b)(a - b)$ = _______,

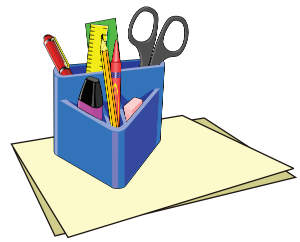
Therefore, $a^2 - b^2 = (a + b)(a - b)$.

Application

The identity may be used for finding values of

1. difference of two squares.
2. some products involving two numbers.
3. This identity may be used for simplification and factorisation of algebraic expressions.

Activity 79



Objective

To obtain a formula for the area of a trapezium

Material Required

Cardboard, coloured glaze papers, adhesive, scissors.

Method of Construction

1. Take a piece of cardboard to serve as a base for the activity.
2. Draw two identical trapeziums of parallel sides as 'a' and 'b' units on a coloured paper and cut them out (see Fig. 1).
3. Place them on the cardboard as shown in Fig. 2.

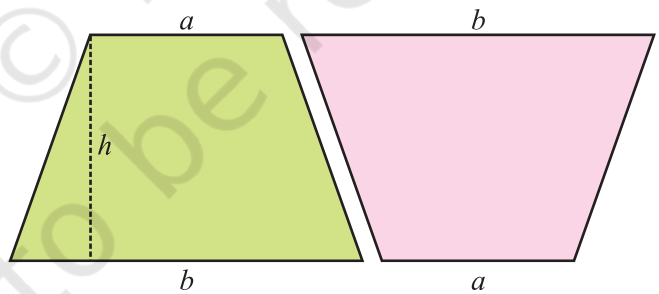


Fig. 1

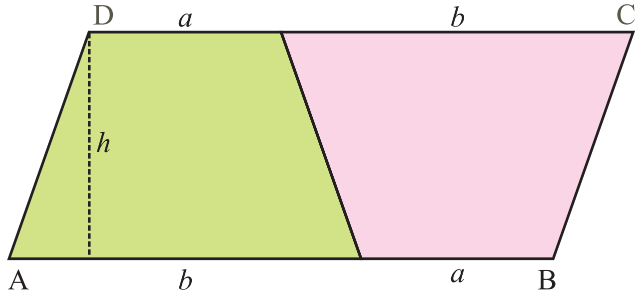


Fig. 2

Demonstration

1. Figure formed by the two trapeziums [see Fig. 2] is a parallelogram ABCD.
2. Side AB of the parallelogram = $(a + b)$ units and its corresponding altitude = h units.
3. Area of each trapezium $= \frac{1}{2}$ (area of parallelogram) $= \frac{1}{2}(a+b) \times h$

   Therefore, area of trapezium $= \frac{1}{2}(a+b) \times h$

   $= \frac{1}{2}$ (sum of parallel sides) × perpendicular distance between parallel sides.

Here, area is in square units.

Observation

On actual measurement:

a = ________, b = ___________.

Distance between parallel sides = h = ________.

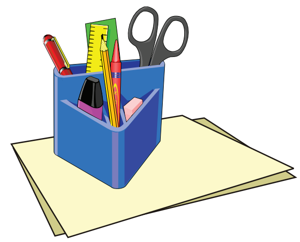
So, the area of the parallelogram in Fig. 2 = ________.

Thus, the area of the trapezium $= \frac{1}{2}$ (sum of ________ sides) × ________.

Application

1. This may be used in finding the area of a field which can be split into different trapeziums and right triangles.
2. This concept is also used for finding the formula for area of a triangle in coordinate geometry which you will study in higher classes.

Activity 80



Objective

To form a cube and obtain a formula for its surface area

Material Required

Cardboard, ruler, cutter, cellotape, sketch pen/ pencil, white paper, chart paper.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Make a shape involving six identical squares each of side a units, using a thick chart paper as shown in Fig. 1.
3. Fold the squares along the dotted markings to form a solid as shown in Fig. 2.

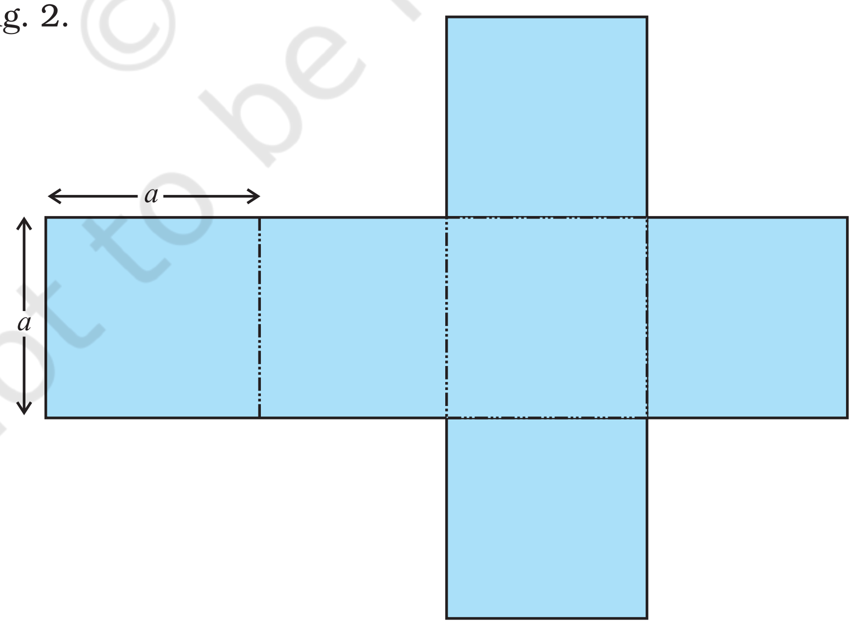


Fig. 1

Demonstration

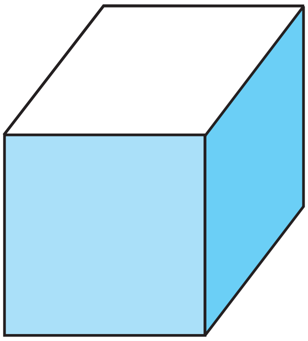


Fig. 2

1. Solid obtained in Fig. 2 is a cube. Place the cube on the cardboard.
2. Each face of the cube so obtained is a square of side a. Therefore, the area of one face of the cube is a^2.
3. Thus, the surface area of the cube with side a units = $6a^2$.

Observation

On actual measurement:

Length of side a = ________,

So, area of one face = a^2 = ________.

The sum of the areas of all the faces = ________ + ________ + ________ + ________ + ________ + ________.

Therefore, the surface area of the cube = $6a^2$.

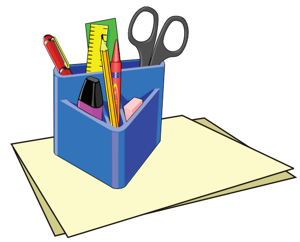
Application

This result is useful in estimating materials required for making cubical boxes needed for packing.

NOTE

Shape in Fig. 1 is called a **net** of the cube.

Activity 81



Objective

To form a cuboid and obtain a formula for its surface area

Material Required

Cardboard, cellotape, cutter, ruler, sketch pen, pencil, white paper, chart paper.

Method of Construction

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

2. Make a shape involving two identical rectangles of dimensions a units × b units, two identical rectangles of dimensions b units × c units and two identical rectangles of dimensions c units × a units, using a thick chart paper as shown in Fig. 1.

3. Fold the six rectangles along the dotted lines to obtain a solid as shown in Fig. 2.

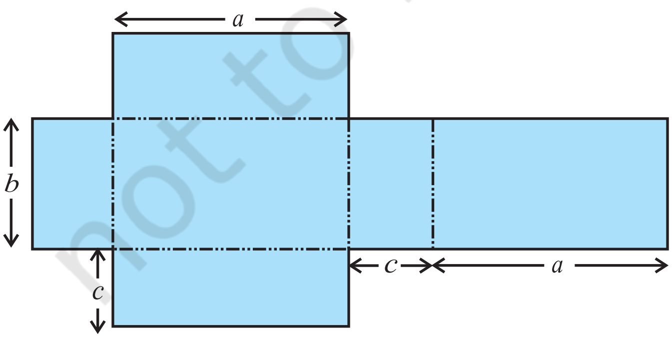


Fig. 1

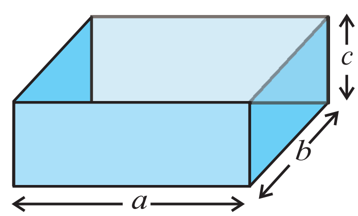


Fig. 2

DEMONSTRATION

1. Solid obtained in Fig. 2 is a cuboid. Place it on the cardboard.
2. Area of a rectangle of dimensions (a units × b units) = ab square units.
3. Area of a rectangle of dimensions (b units × c units) = bc square units.
4. Area of a rectangle of dimensions (c units × a units) = ca square units.
5. Surface area of the cuboid so formed

   $= (2 \times ab + 2 \times bc + 2 \times ca) = 2\,(ab + bc + ca).$

OBSERVATION

On actual measurement:

a = ____________, b = ____________, c = ____________,

So, ab = ____________, bc = ____________, ca = ____________,

$2ab$ = ____________, $2bc$ = ____________, $2ca$ = ____________,

Sum of areas of all the six rectangles = ________.

Therefore, surface area of the cuboid = 2 (ab + bc + ca).

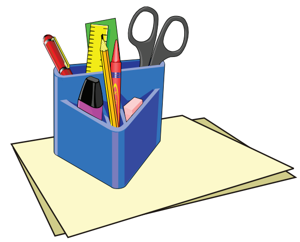
APPLICATION

This result is useful in estimating materials required for making cuboidal boxes/almirahs etc.

NOTE

Shape in Fig. 1 is called the **net** of the cuboid.

Activity 82



Objective

To obtain a formula for finding the volume of a cuboid

Material Required

Net of a cuboid, plasticine or clay, cutter, ruler, cardboard.

Method of Construction

1. Take net of a cuboid of length l, breadth b and height h (say l = 5 units, b = 4 units, h = 2 units)

2. Fold it to form an open cuboid. Fill this cuboid with clay/plasticine and remove the net.

3. Place the cuboid on the cardboard and cut it into five equal pieces along its length as in Fig. 1.

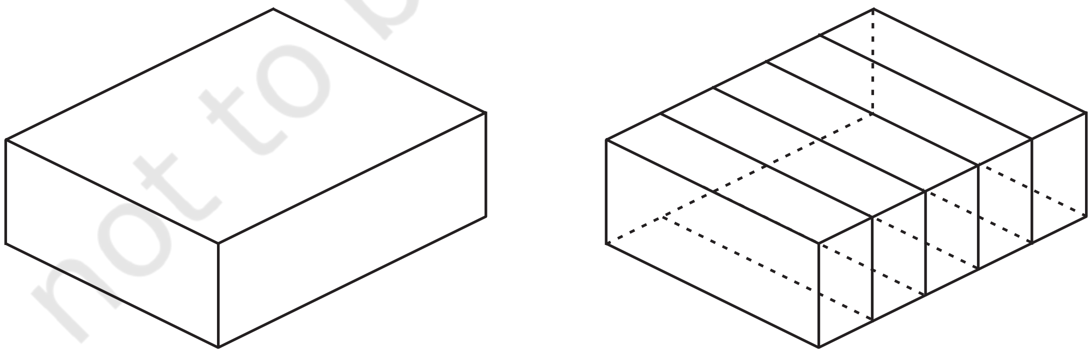


Fig. 1

4. Cut the cuboid into four equal pieces along its breadth as shown in Fig. 2.

5. Now cut the cuboid into two equal pieces along its height as shown in Fig. 3.

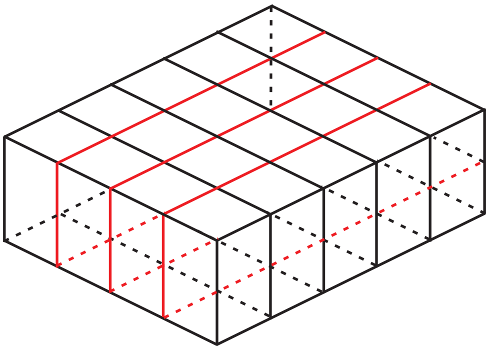


Fig. 2

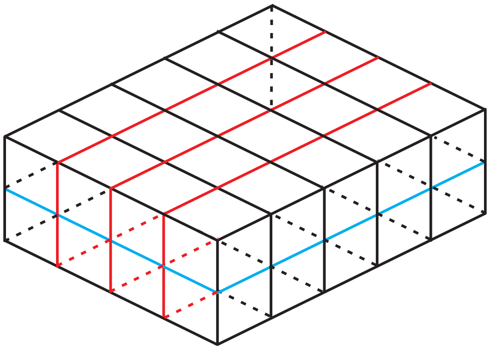


Fig. 3

Demonstration

1. The cuboid is divided into cubes of unit length (i.e., unit cubes).

2. The number of unit cubes so formed is 40, which can be expressed as $5 \times 4 \times 2$.

3. Volume of the cuboid is = $5 \times 4 \times 2$ cubic units i.e., $l \times b \times h$.

4. Similarly, make cuboids of dimensions $2 \times 1 \times 2$ cubic units, $3 \times 4 \times 2$ cubic units, $5 \times 4 \times 2$ cubic units, $5 \times 3 \times 2$ cubic units and repeat the above steps.

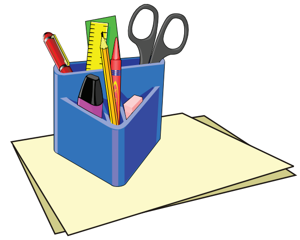
Observation

S. No	l	b	h	No. of Units cuboids (Volume)	$l \times b \times h$ (Volume)
1.	5	4	2	40	$5 \times 4 \times 2$
2.	2	1	2	__	__ × __ × __
3.	3	4	2	__	__ × __ × __
4.	5	3	2	__	__ × __ × __

Application

This activity can be used in explaining the formula for volume of a cube.

Activity 83



Objective

To establish a formula for the volume of a right circular cylinder

Material Required

Cylindrical can, cutter, plastic clay, ruler, piece of cardboard, pen/pencil

Method of Construction

1. Take any metallic cylindrical can open at both ends. Measure its height. Let it be *h*.
2. Put this firmly on the cardboard and fill it with plastic clay.
3. Push the clay gently out of the can.
4. Cut the clay into as many sections as you can as shown below and number them as 1, 2, 3, 4, 5, 6, 7, 8... (Fig. 1).

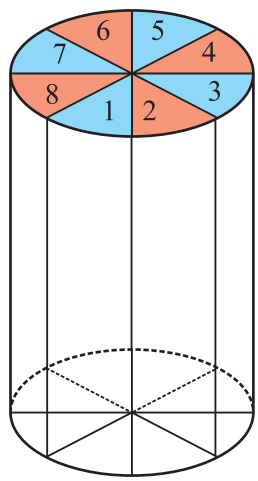


Fig. 1

5. Arrange these sections as shown in Fig. 2.

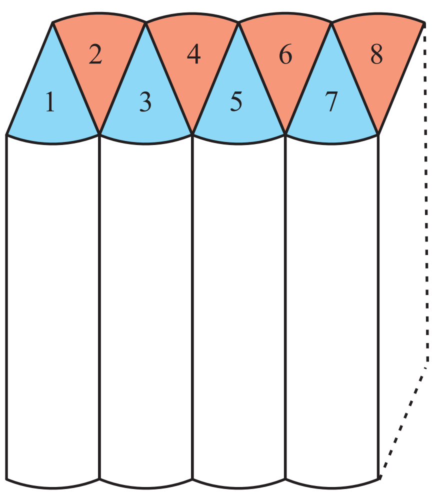


Fig. 2

Demonstration

The shape in Fig. 2 looks like a cuboid.

Length of cuboid $= \frac{1}{2}$ the circumference of the base of the cylinder

$= \frac{1}{2} \times (2\pi r) \quad = \pi r$

Breadth of cuboid = radius of cylinder

$= r$

Height of cuboid = Height of cylinder

$= h$

Volume of cuboid $= l \times b \times h$

$= \pi r \times r \times h$

$= \pi r^2 h$

Volume of the cylinder = Volume of cuboid $= \pi r^2 h$.

OBSERVATION

On actual measurement:

Height of the cuboid (cylinder) = _____.

Radius of the base = _____.

Breadth of the cuboid (cylinder) = _____ $(= r)$

Length of the cuboid (cylinder) = _____ $(= \frac{1}{2} \times 2\pi r)$

Volume of the cuboid $= l \times b \times h$ = _____.

Volume of the cylinder = _____.

Thus, volume of the cylinder = Volume of the cuboid _____.

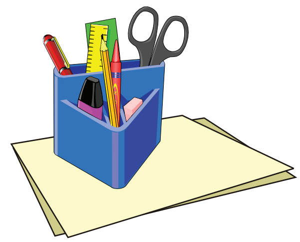
$= \frac{1}{2} \times 2\pi r \times r \times h$ = _____.

= _____.

APPLICATION

This activity is useful in finding the volumes and capacities of various cylindrical objects/containers.

Activity 84



Objective

To obtain a formula for the curved surface area of a right circular cylinder

Material Required

Coloured chart paper, cellotape, ruler.

Method of Construction

1. Take a rectangular chart paper of length l units and breadth b units [see Fig. 1].

2. Fold this paper along its breadth and join the two ends by using cellotape and obtain a solid as shown in Fig. 2.

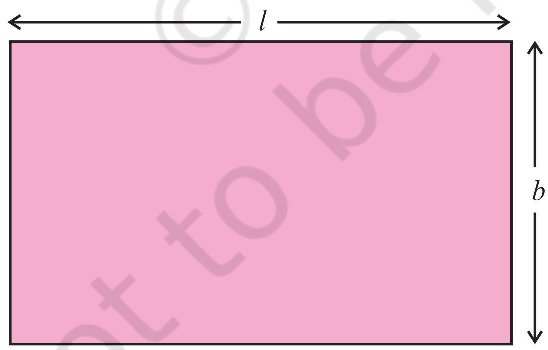


Fig. 1

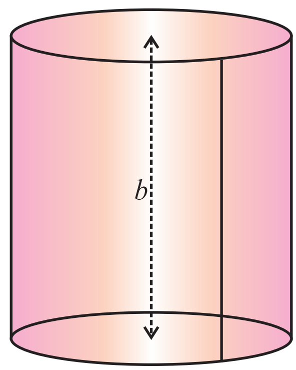


Fig. 2

Demonstration

1. The solid obtained is a cylinder.

2. Length of the rectangular paper = l = circumference of the base of the cylinder = $2\pi r$, where r is the radius of the cylinder.

3. Breadth of the rectangular paper = b = height (h) of the cylinder.

4. The curved surface area of the cylinder is equal to the area of the rectangle = $l \times b = 2\pi r \times h = 2\pi rh$ square units.

Observation

On actual measurement :

l = ____________, b = ____________,

So, $2\pi r = l$ = ____________, $h = b$ = ____________,

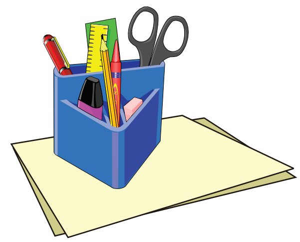
Area of the rectangular paper = $l \times b$ = ____________.

Therefore, the curved surface area of the cylinder = $2\pi rh$.

Application

This result can be used in finding the material used in making cylindrical containers, i.e., powder tins, drums, oil tanks used in industrial units, overhead water tanks etc.

Activity 85



Objective

To verify that the opposite sides of a parallelogram are equal

Material Required

Cardboard, white sheet of paper, adhesive, scissors, red sketch pen.

Method of Construction

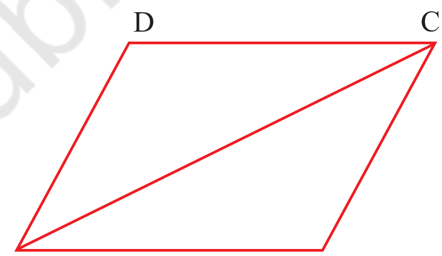


Fig. 1

1. Take a cardboard of convenient size and paste a white paper on it.
2. Draw two identical parallelograms on a white sheet of paper. Name them as ABCD. Join AC in both the parallelograms. Cut out both the parallelograms.
3. Paste one of the parallelograms on the cardboard (Fig. 1).
4. Cut the other parallelogram ABCD along the diagonal AC as shown in Fig. 2 to get two triangles ABC and ACD.
5. Superpose and paste the triangle CDA on the triangle ABC as shown in Fig. 3.

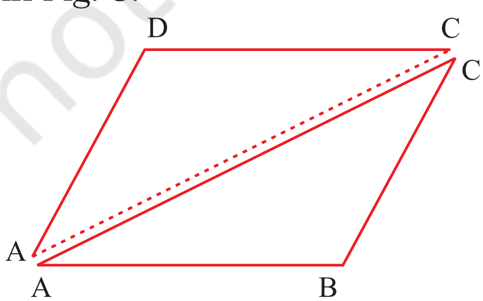


Fig. 2

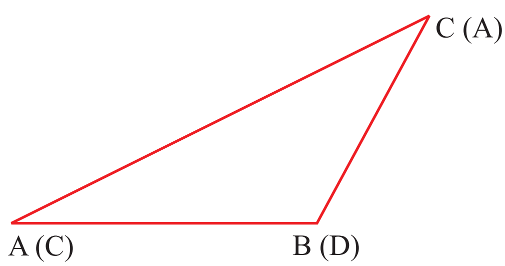


Fig. 3

Demonstration

Triangle CDA exactly covers the triangle ABC.

The vertex A of Δ CDA falls on the vertex C of Δ ABC.

The vertex C of Δ CDA falls on the vertex A of Δ ABC.

The vertex D of Δ CDA falls on the vertex B of Δ ABC.

This shows that the side AB of Δ ABC is equal to the side DC of Δ CDA and the side BC of Δ ABC is equal to the side AD of Δ CDA.

Thus, the opposite sides of a parallelogram are equal.

Observation

In Fig. 1, length of the side AB of parallelogram ABCD = ________ cm.

Length of the side BC = ______________ cm,

Length of the side CD = ______________ cm,

Length of the side AD = ______________ cm.

In Fig. 3, side CD covers the side ____________,

side DA covers the side ____________.

Thus,

AB = ________,

and BC = ________.

i.e. opposite sides of a parallelogram are equal ________ .

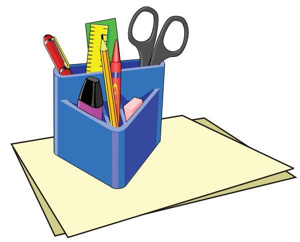
Application

This result is useful in solving many other geometrical problems and also in the construction of parallelograms.

NOTE

1. The parallelogram ABCD may also be cut along the diagonal BD.
2. This activity can be used to show that the opposite angles of a parallelogram are equal.

Activity 86



OBJECTIVE

To verify that adjacent angles of a parallelogram are supplementary

MATERIAL REQUIRED

Cardboard, coloured glaze paper, set square, ruler, pencil, colours, scissors.

METHOD OF CONSTRUCTION

1. Take a cardboard of convenient size and paste a light coloured glaze paper on it.
2. Draw a parallelogram ABCD on a paper and paste it on the cardboard.
3. Make a trace copy of this parallelogram.
4. Colour the angles of the parallelogram ABCD in such a way that colours of A and C and that of B and D are same (Fig. 1).
5. Cut the four angles from the trace copy as shown in Fig. 2.

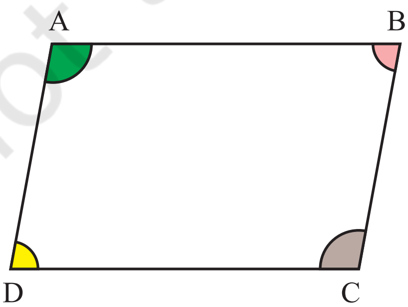


Fig. 1

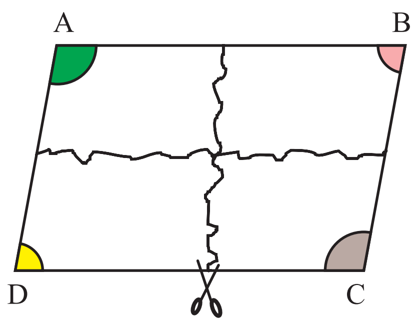


Fig. 2

6. Draw a straight line l and take points P and Q on it at sufficient distance.

7. Place the cut outs of $\angle A$ and $\angle D$ at the point P so that there is no gap between the two angles (Fig. 3).

8. Place the cut outs of $\angle B$ and $\angle C$ at the point Q so that there is no gap between the two angles as shown in Fig. 3.

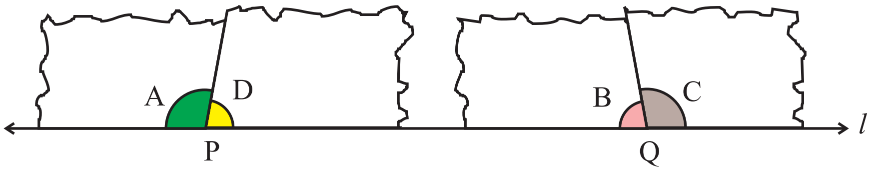


Fig. 3

9. Try this placement with $\angle A$ and $\angle B$, $\angle C$ and $\angle D$.

Demonstration

1. $\angle A$ and $\angle D$ form a straight angle.

2. $\angle B$ and $\angle C$ form a straight angle.

3. $\angle A + \angle D = 180°$

   $\angle B + \angle C = 180°$.

4. $\angle A$ and $\angle B$ form a straight angle. Angles C and D also form a straight angle.

5. $\angle A + \angle B = 180°$

   $\angle C + \angle D = 180°$.

Observation

On actual measurement:

$\angle A$ = ____________,

$\angle B$ = ____________,

$\angle C$ = ____________,

$\angle D$ = ____________.

Therefore, $\angle A + \angle D =$ __________, $\angle B + \angle C =$ ___________,

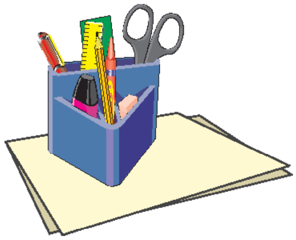
$\angle A + \angle B =$ __________, $\angle C + \angle D =$ ___________,

APPLICATION

1. This activity can be used to verify that adjacent angles of a square, rectangle and rhombus are supplementary.

2. This activity can also be used to verify that when two parallel lines are intersected by a transversal then its consecutive interior angles are supplementary.

Activity 87



Objective

To verify that the diagonals of a parallelogram bisect each other

Material Required

Cardboard, white sheet of paper, adhesive, scissors, geometry box, coloured sketch pens, thumb pins, thick tracing paper.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Make two identical parallelograms using a white paper and a thick tracing paper. Name them as ABCD. Join their diagonals AC and BD using different colours. Let O be their point of intersection.
3. Paste parallelogram ABCD (drawn on white paper) on the cardboard (Fig. 1).
4. Place the other parallelogram (drawn on thick tracing paper) on the first parallelogram using a thumb pin at O as shown in Fig. 3.

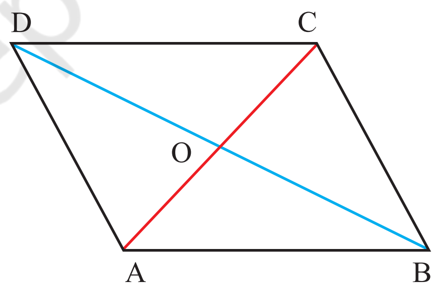


Fig. 1

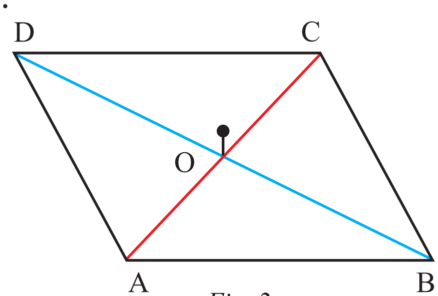


Fig. 2

Demonstration

1. Rotate the upper parallelogram clockwise (or anticlockwise) till the upper parallelogram covers exactly the other parallelogram again as shown in Fig. 3.

2. From Fig. 3,

AO = OC

OB = OD

Thus, the diagonals of a parallelogram bisect each other.

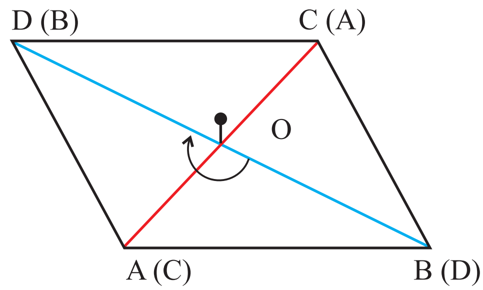


Fig. 3

OBSERVATION

On actual measurement:

In Fig. 2,

OA = ___________, OC = ___________,

OB = ___________, OD = ___________,

AC = ___________, AD = ___________.

$OA = \frac{1}{2} AC$

$OB = \frac{1}{2}$ _________.

In Fig. 3, OA of upper parallelogram falls exactly on _______ of lower parallelogram.

OB of the upper parallelogram falls exactly on ________ of lower parallelogram.

OC and OD of upper parallelogram falls exactly on ____ and ____ respectively of lower parallelogram.

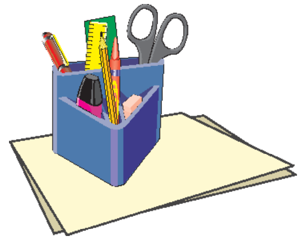
Thus, the diagonals of a parallelogram ________ each other.

This shows that diagonals of a parallelogram bisect each other.

APPLICATION

1. This result is useful in solving many other geometrical problems related to parallelograms.
2. This activity can be used in verifying the other properties of a parallelogram such as opposite angles are equal, opposite sides are equal.

Activity 88



Objective

To multiply two linear algebraic expressions (polynomials) using different strips of cardboard

Material Required

Cardboard, coloured papers (green, blue and red), geometry box, cutter, eraser, adhesive, sketch pen.

Method of Construction

1. Take three pieces of cardboard and paste coloured papers on them. Green on one, blue on the other and red on the last one.
2. Make a large number of squares of side x units using green cardboard and cut them out [Fig. 1].

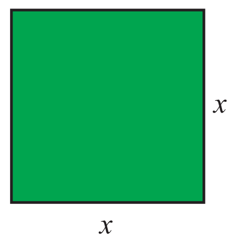


Fig. 1

3. Similarly, draw many rectangles of dimensions x units × 1 unit using blue coloured cardboard and squares of dimensions 1 unit × 1 unit on red coloured paper and cut them out [Fig. 2 and 3].

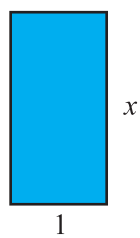


Fig. 2

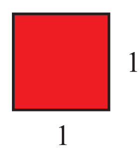


Fig. 3

Demonstration

1. To represent algebraic expression $3x + 5$, arrange these strips as in Fig. 4.

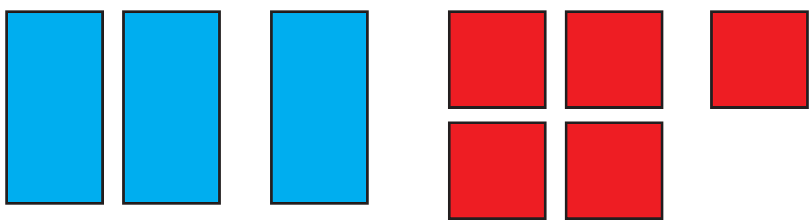


Fig. 4

2. Similarly, represent the algebraic expression $2x + 3$, as in Step 1 in Fig. 5.

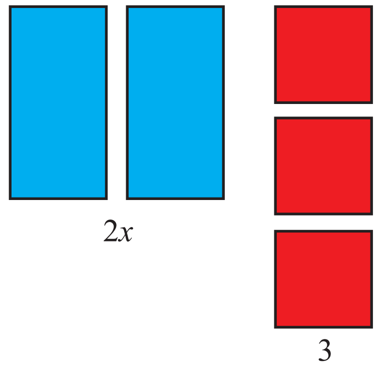


Fig. 5

3. Make a rectangle whose length and breadth are $3x + 5$ and $2x + 3$ respectively (Fig. 6).

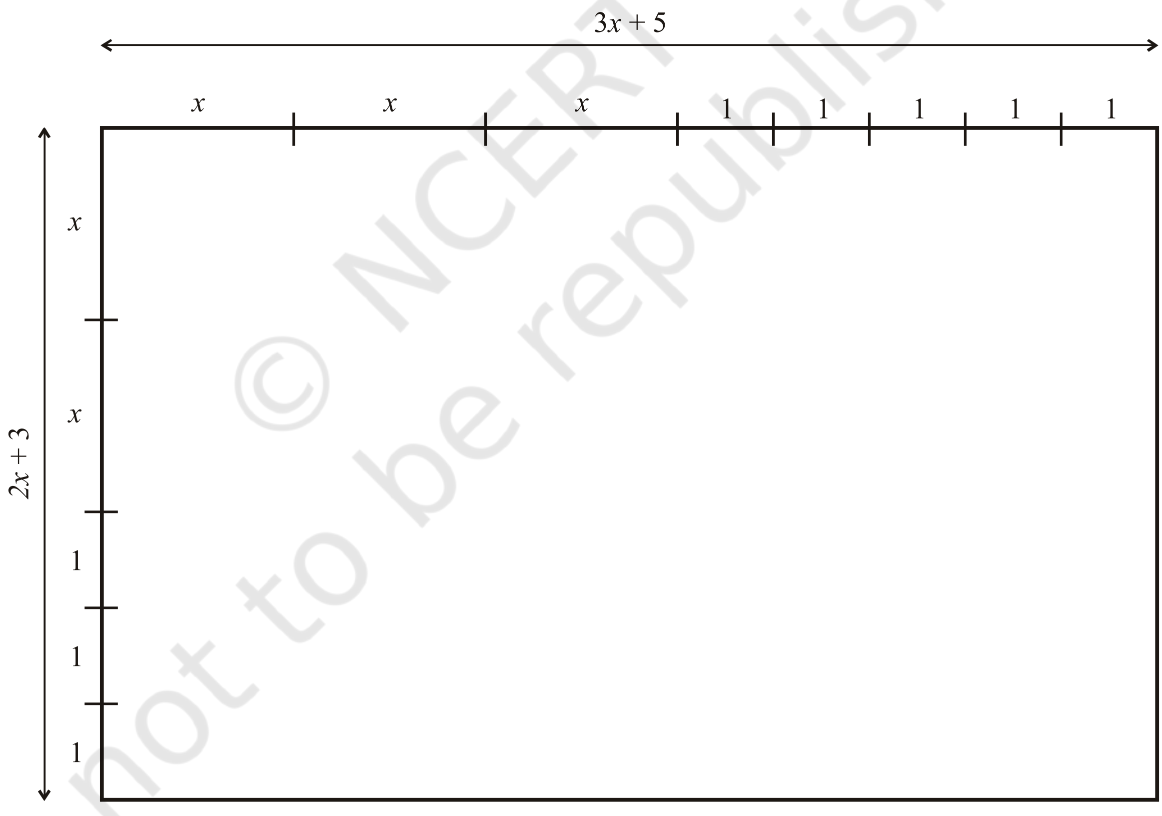


Fig. 6

4. Arrange the strips obtained in Steps 2 and 3 in the rectangle of Fig. 6 as shown in Fig. 7.

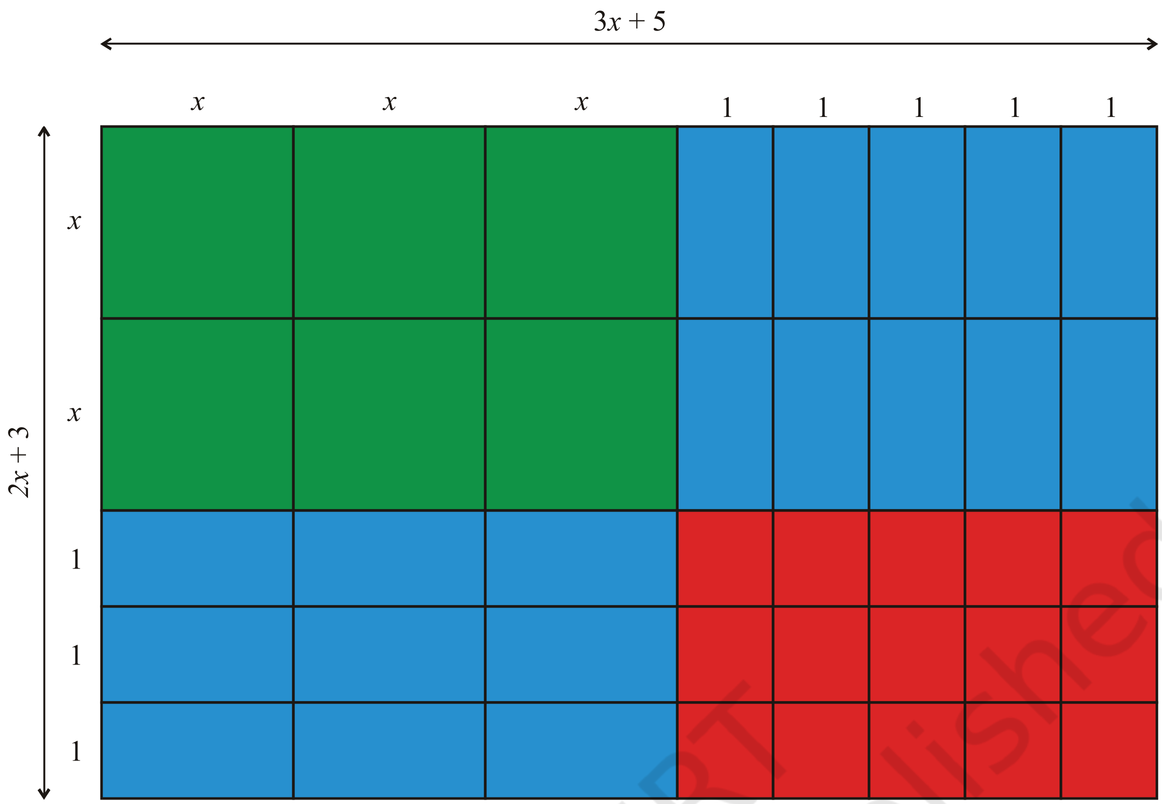


Fig. 7

Area of rectangle in Fig. 6 $= l \times h = (3x + 5)\ (2x + 3)$

Area of strips in Fig. 7 $= 6x^2 + 19x + 15$

So, $(3x + 5)\ (2x + 3) = 6x^2 + 19x + 15$

Similarly, find the product of some other two linear algebraic expressions.

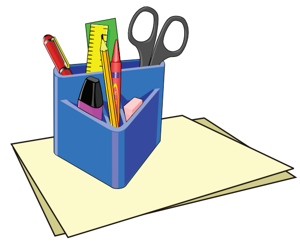
Observation

1. In Fig. 6, area of the rectangle = $(3x + 5) \times$ (____ + ____).
2. In Fig. 7:
   (a) Number of green strips = _________.
   (b) Number of blue strips = _________.
   (c) Number of red strips = _________.
   (d) Algebraic expressions represented = _________.
3. Thus $(3x + 5)\ (2x + 3)$ =
   = ____ x^2 + _____ x + _____.

Application

The activity is useful in explaining the concept of multiplication of two linear algebraic expressions.

Activity 89



Objective

To verify that opposite angles of a parallelogram are equal

Material Required

Cardboard, coloured paper, ruler, pencil, scissors, colours.

Method of Construction

1. Take cardboard of convenient size and paste a light coloured glaze paper on it.
2. Take a white sheet and draw a parallelogram. Name it as ABCD.
3. Make a copy of this parallelogram and colour the angles of both the parallelograms exactly in the same way.
4. Paste one of the parallelograms on the cardboard and cut out the other parallelogram as shown in Fig. 1.

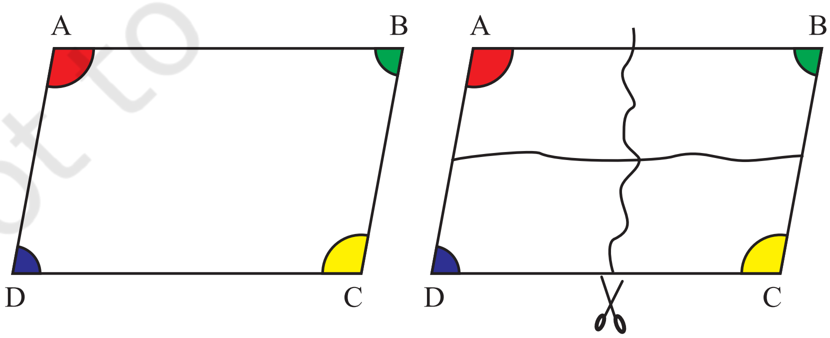


Fig. 1

Place the cutouts of the four angles so formed over each other to see which cut out exactly covers the other.

Demonstration

1. Place the cutouts of the four angles so formed over each other to see which cut out exactly covers the other.
2. Cut out of $\angle A$ exactly covers the cut out of $\angle C$.

   So, $\angle A = \angle C$
3. Cut out of $\angle B$ exactly covers cut out of $\angle D$.

   So, $\angle B = \angle D$

   Thus, opposite angles of a parallelogram are equal.

Observation

On actual measurement:

Measure of $\angle A$ = __________,

Measure of $\angle C$ = __________,

Measure of $\angle B$ = __________,

Measure of $\angle D$ = __________.

So, $\angle A$ = ______ , _______ = $\angle D$

Opposite angles of a parallelogram are ________.

Application

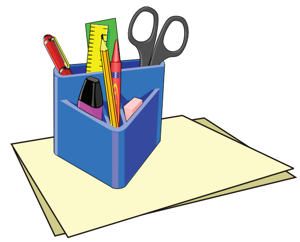
This activity can be used to verify that opposite angles of the following figures are equal:

(i) Square

(ii) Rectangle

(iii) Rhombus

Activity 90



OBJECTIVE

To factorise a polynomial, say $(2x^2 + 4x)$

MATERIAL REQUIRED

Blue and red chart papers, scissors, geometry box, eraser, pen/pencil

METHOD OF CONSTRUCTION

1. Cut out sufficient number of pieces of dimensions 3 cm × 3 cm to represent x^2 from a blue coloured chart paper and of 3 cm × 1 cm to represent x from a red coloured chart paper (Fig. 1).

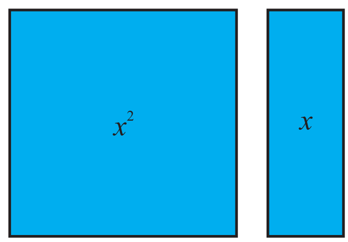


Fig. 1

DEMONSTRATION

1. Take $2x^2$ and $4x$ using the above cut outs as in Fig. 2.

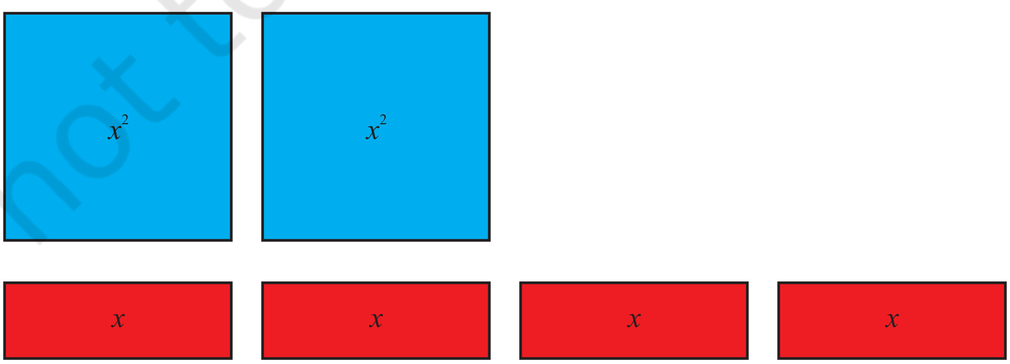


Fig. 2

2. Try to form different types of rectangles using all cutouts of Fig. 2. (Fig. 3 and 4).

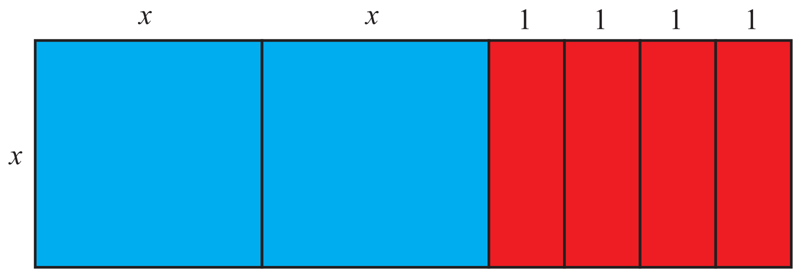


Fig. 3

3. From Fig. 3, dimensions of rectangle are x and $2x + 4$.

   So, area of the rectangle is $x(2x + 4)$.

   Thus, $2x^2 + 4x = x(2x + 4)$.

4. Also from Fig. 4, $2x^2 + 4x = 2x(x + 2)$.

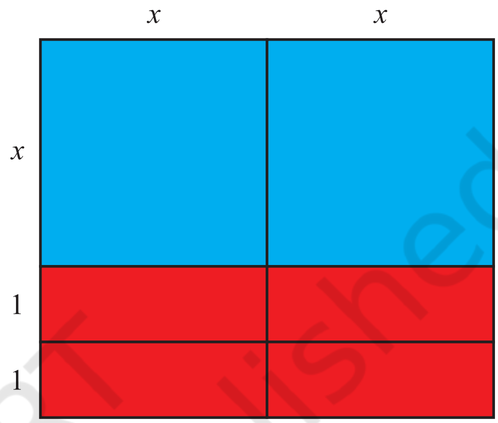


Fig. 4

Observation

In Fig. 3,

(i) Length of rectangle = ________.

(ii) Breadth of rectangle = _______.

(iii) Area of rectangle = _______.

So, $2x^2 + 4x$ = ____ × ($2x$ + ___).

In Fig. 4,

(iv) Length of rectangle = ________.

(v) Breadth of rectangle = _______.

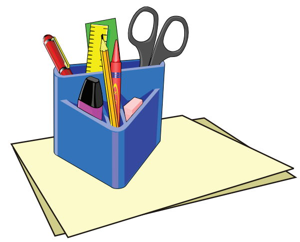
(vi) Area of rectangle = _________.

So, $2x^2 + 4x = 2x$ × (____+ ____).

Application

This activity is useful in understanding the concept of factorisation of a polynomial.

Activity 91



Objective

To factorise a polynomial , say ($x^2 + 4x + 3$)

Material Required

Blue chart paper/rubber sheet, scissors, scale, eraser etc.

Method of Construction

1. Cut some pieces from blue chart paper/rubber sheet as shown in Fig. 1.

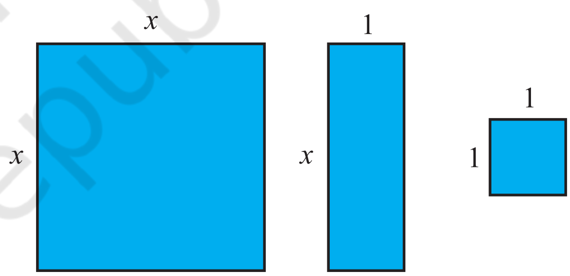


Fig. 1

The big square piece represents x^2, the rectangular piece represents x and the small square piece represents 1.

Demonstration

1. Represent polynomial ($x^2 + 4x + 3$), as in Fig. 2.

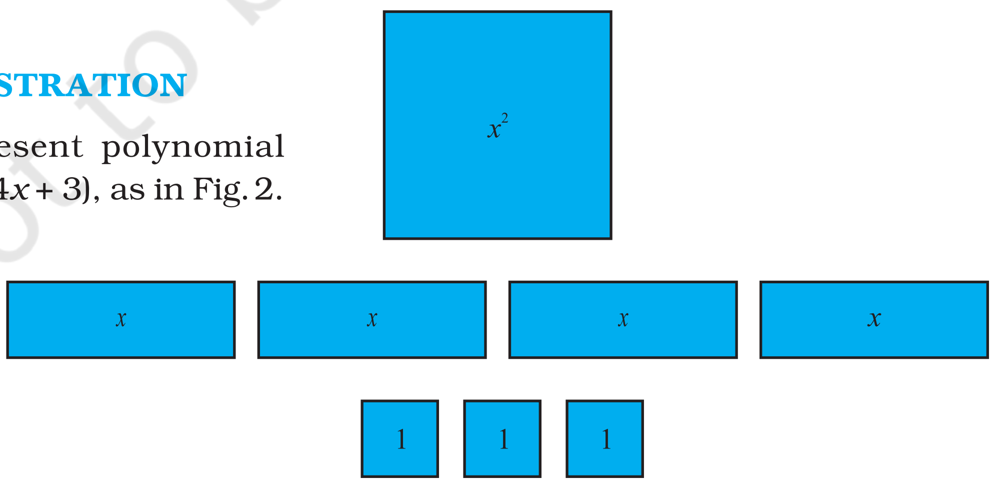


Fig. 2

2. Try to form a new rectangle (if possible, a square) taking all pieces at a time as shown in Fig. 3.

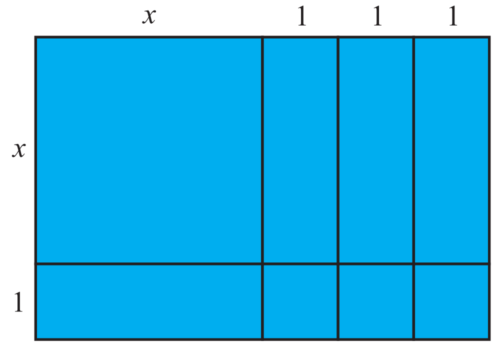


Fig. 3

3. The area of the above rectangle

= Sum of the areas of all rectangles of which the bigger rectangle is made.

= $x^2 + 4x + 3$.

4. The sides of the above rectangle are $(x + 3)$ and $(x + 1)$.

So area of the rectangle = $(x + 3)(x + 1)$

So, $x^2 + 4x + 3 = (x + 3)(x + 1)$.

Repeat the activity to factorise some other polynomials.

Observation

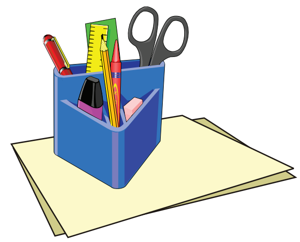
Complete the table

Polynomial	Factors
$x^2 + 4x + 3$	$(x + 3)(x + 1)$
$x^2 + 8x + 7$	____________
$x^2 + 8x + 16$	____________
$2x^2 + 3x + 1$	____________

Application

This activity is useful in explaining the meaning of factors of a polynomial.

Activity 92



Objective

To solve a linear equation, say $2x + 3 = 5$

Materials Required

Blue and red chart papers/rubber sheets, scissors, ruler, pencil, eraser, cardboard, white paper, adhesive.

Method of Construction

1. Take a cardboard and paste a white paper on it.
2. Cut some blue and red rectangular pieces (size $x \times 1$) and some blue and red square pieces (size 1×1) from the chart paper/rubber sheet as shown in Fig.1.

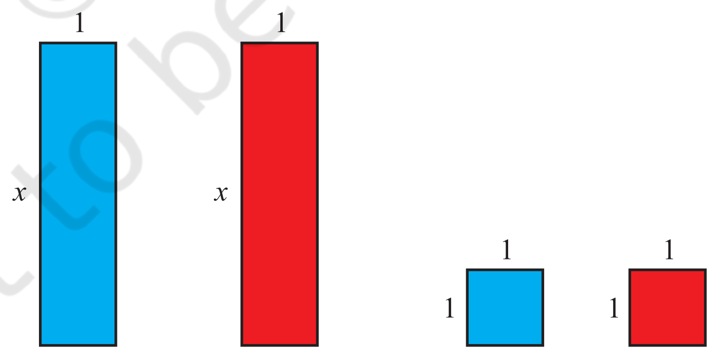


Fig. 1

3. Consider each blue rectangular piece as $(+x)$ and red rectangular piece as $(-x)$. Similarly consider the blue and red square pieces as $(+1)$ and (-1) respectively.

Demonstration

1. For the equation $2x + 3 = 5$, arrange 2 rectangular and 8 blue square pieces on the cardboard in the following manner (Fig. 2).

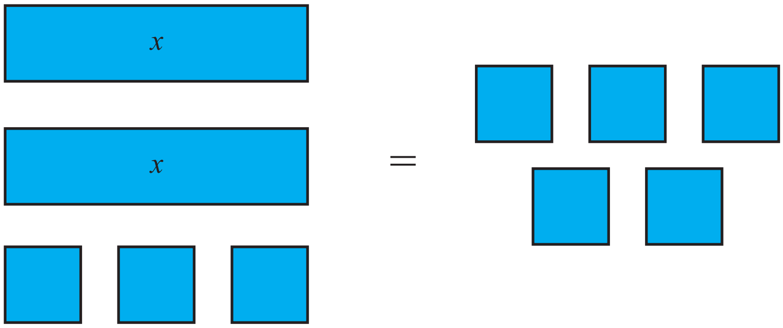


Fig. 2

2. Add three red small square pieces on both sides (Fig. 3).

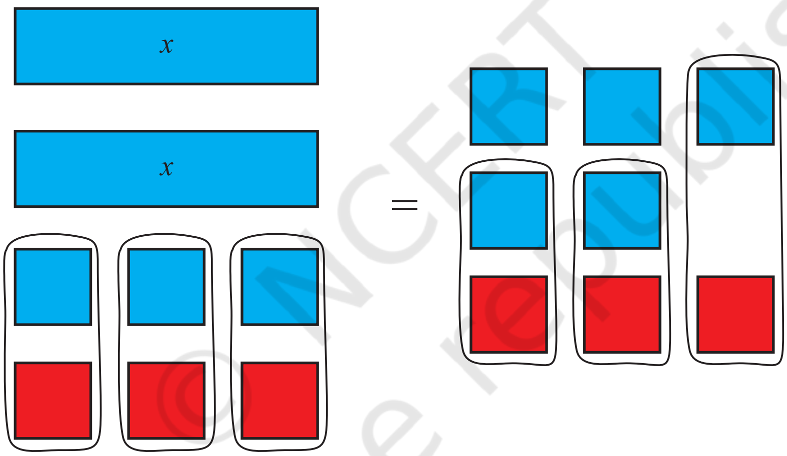


Fig. 3

3. Pair each red square with a blue square as shown in Fig. 3.

4. Remove these pairs to obtain Fig. 4.

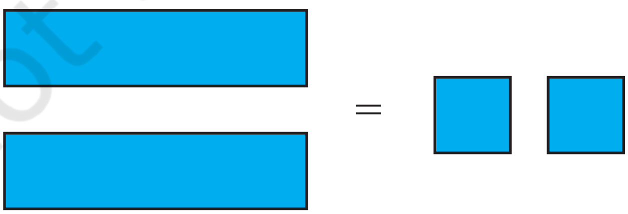


Fig. 4

5. Taking half the number of pieces on both sides we get Fig. 5.

Fig. 5

Thus, solution of the equation $2x + 3 = 5$ is $x = 1$.

This activity may be repeated by taking some more linear equations.

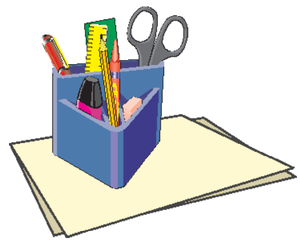
Observations

Equation	Pieces in LHS		Pieces in RHS		Pieces added on both sides		Solution
	Rectangle	Square	Rectangle	Square	Rectangle	Square	
$2x + 3 = 5$	2 Blue	3 Blue	0	5 Blue	0	3 Red	$x = 1$
$2x - 7 = 3$	2 Blue	7 Red	___	___	___	7 Blue	$x = 5$
$3x - 2 = x + 4$	___	___	1 Blue	___	1 Red	___	__ = __
$2x - 7 = 5 - 2x$	___	___	2 Red	___	2 Blue	___	__ = __

Application

This application is useful in explaining the process of solving an equation.

Activity 93



Objective

To sketch a cube on an isometric dot paper and also to draw its oblique sketch on the square paper

Materials Required

Isometric dot paper, ruler, sketch pen, squared dot paper, pencil.

Method of Construction

1. Take an isometric dot paper and mark a point A on it as shown in Fig. 1.
2. Draw a horizontal line through A.
3. Identify 3 dots nearest to the point A which are above the horizontal line and mark them as X, Y and Z [See Fig. 1].

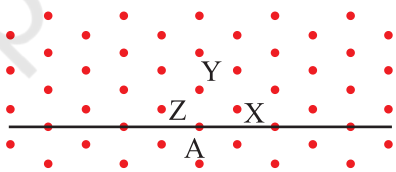


Fig. 1

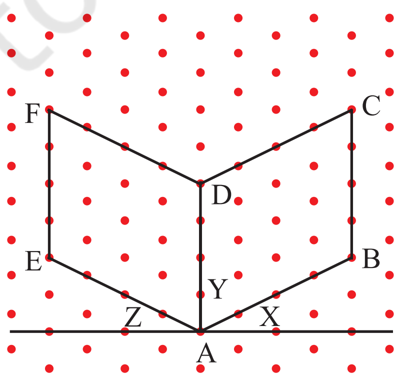


Fig. 2

4. Starting from point A, move 4 dots along AX and mark 4^{th} dot as B [Fig. 2].

5. Starting from point B, now move 4 dots upward and mark the 4^{th} dot as C [Fig. 2].

6. Starting from point A, move 4 dots along AY and mark the 4^{th} dot as D [Fig. 2].

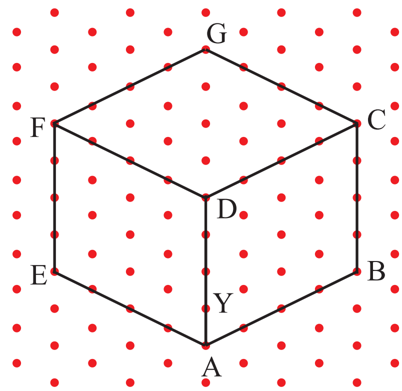


Fig. 3

7. Starting from point A, move 4 dots along AZ and mark the 4^{th} dot as E [Fig. 2].

8. Starting from point E, move 4 dots in the upward direction and mark the 4^{th} dot as F [Fig. 2].

9. Join F, D and C, D.

10. Starting from point C move 4 dots in the direction parallel to DF. Mark the 4^{th} dot as G.

11. Join FG, CG, BC, AB, AE, EF and AD [Fig. 3].

Oblique Sketch of the Cube

1. Take a squared dot paper and mark a point A on it [Fig. 4].

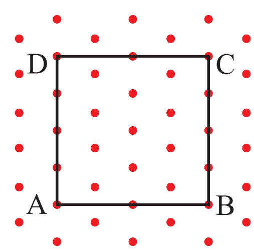


Fig. 4

2. Starting from A, move 4 dots to the right and mark the 4^{th} dot as B.

3. Again, starting from A, move 4 dots vertically upwards from the point B and mark the 4^{th} dot as C. Similarly, starting from A, move 4 dots vertically upward and mark the fifth dot as D [Fig. 4].

4. Join AB, BC, CD and AD to get the square ABCD of side 4 units.

5. Now take one more point say E on the square dot paper and draw the square EFGH of side 4 units by following steps 2 to 4 [Fig. 5].

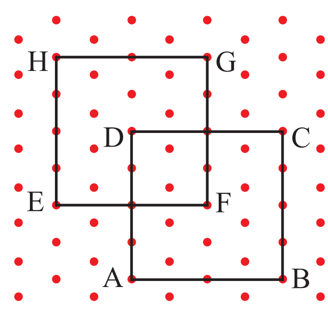


Fig. 5

6. Join AE, BF, CG and DH as shown in Fig. 6.

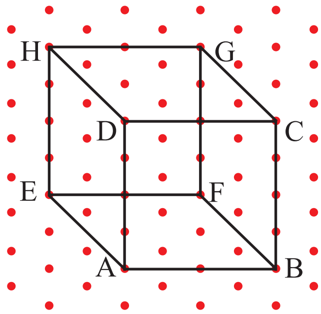


Fig. 6

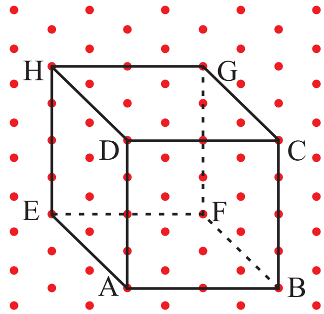


Fig. 7

Demonstration

1. In Fig. 3, ABCDEFG is an isometric sketch of the cube of side 4 units.
2. In Fig. 7, ABCDEFG is an oblique sketch of the cube of side 4 units.

Observation

On actual measurement:

1. In Fig. 3, AB = _____, AD = _____, AE = _____

   So, AB = _____ = _____.

   Thus, shape obtained in Fig. 3 is an isometric ________ of a cube of side _______.

2. In Fig. 6, AB = _____ , AD = _____ and AE = _____.

   So, AB = _____.

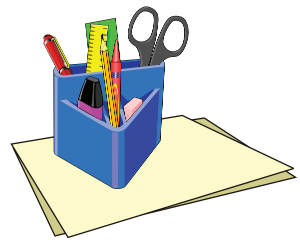
   Thus, shape obtained in Fig. 6 is an ________ sketch of a cube of side _______.

Application

This activity is useful in drawing a 3-D shape in 2-D shape.

Similar activity may be performed for a cuboid.

Project 1



[Perimeters and Areas of Rectangles]

Background

The most common problems that people come across in daily life are to fence their fields and to determine the size of the field to grow a particular type of crop. These two problems are closely related with the mathematical concepts - perimeter and area, respectively. There is an impression that if the perimeter of a figure is increased, then its area will also increase and vice-versa. However, this impression is not always correct. This project tries to explain this idea by taking rectangle as a basic figure.

Objective

To explore the changes in behaviours of perimeters and areas of rectangles with respect to each other.

Description

(A) Rectangles with equal perimeters

Let us consider the rectangles of the following lengths and breadths:

(i) Length = 10 cm ; Breadth = 6 cm

(ii) Length = 11 cm ; Breadth = 5 cm

(iii) Length = 8 cm ; Breadth = 8 cm

(iv) Length = 9.5 cm ; Breadth = 6.5 cm

(v) Length = 8.5 cm ; Breadth = 7.5 cm

We may note that perimeter of each of the above rectangles is the same, namely, 32 cm. Let us calculate the areas of these rectangles:

(i) Area of the rectangle of length 10 cm and breadth 6 cm

$= 10 \text{ cm} \times 6 \text{ cm} = 60 \text{ cm}^2$.

(ii) Area of the rectangle of length 11 cm and breadth 5 cm

= 11 cm × 5 cm = 55 cm^2

(iii) Area of the rectangle of length 8 cm and breadth 8 cm

= 8 cm × 8 cm = 64 cm^2 (**Maximum**)

(iv) Area of the rectangle of length 9.5 cm and breadth 6.5 cm

= 9.5 cm × 6.5 cm = 61.75 cm^2

(v) Area of the rectangle of length 8.5 cm and breadth 7.5 cm

= 8.5 cm × 7.5 cm = 63.75 cm^2

From the above, it can be observed that in case (iii), the rectangle has the maximum area. Also, in this case, the rectangle is a square.

(B) Rectangles with equal areas

Let us consider the rectangles with following lengths and breadths:

(i) Length = 16 cm ; Breadth = 4 cm

(ii) Length = 8 cm ; Breadth = 8 cm

(iii) Length = 10 cm ; Breadth = 6.4 cm

(iv) Length = 32 cm ; Breadth = 2 cm

(v) Length = 64 cm ; Breadth = 1 cm

We may note that area of each of the above rectangles is the same, namely, 64 cm^2. Let us calculate the perimeter of each of these rectangles:

(i) Perimeter of rectangle of length 16 cm and breadth 4 cm

= 2 (16 + 4) cm = 40 cm

(ii) Perimeter of rectangle of length 8 cm and breadth 8 cm

= 2 (8 + 8) cm = 32 cm (**Minimum**)

(iii) Perimeter of rectangle of length 10 cm and breadth 6.4 cm

= 2 (10 + 6.4) cm = 32.8 cm

(iv) Perimeter of rectangle of length 32 cm and breadth 2 cm

= 2 (32 + 2) cm = 68 cm

(v) Perimeter of rectangle of length 64 cm and breadth 1 cm

$= 2\,(64 + 1)$ cm = 130 cm

From the above, it can be observed that in case (ii), the rectangle has the minimum perimeter. Further, in this case, the rectangle is a square.

Conclusion

The impression that when the perimeter of a rectangle is increased, its area is also increased and vice-versa is not correct. In fact,

(i) Of all the rectangles with equal perimeters, the square has the maximum area.

(ii) Of all the rectangles with equal areas, the square has the minimum perimeter.

Application

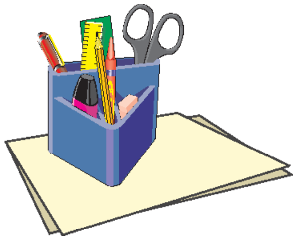
1. This project is useful in estimating a field of maximum area within a given fencing (perimeter) and also a fencing (or boundary) of minimum length enclosed in a given area.

2. A square is a regular quadrilateral. Increasing the number of sides of a regular polygon, we can arrive at the result in Description (A) above, that **with a given perimeter, a circle has the maximum area.**

3. If the measures of length and breadth are considered only in **terms of natural numbers,** then in Description (B) above, it can be seen that **with a given area, the perimeter is maximum, when one of the sides is of unit length [case (v) of B].** However, if this condition is not there, then there is no limit for the perimeter to be maximum. That is, **for a given area, a rectangle can have infinitely large perimeter.**

> Is it not surprising that you can make a belt of infinite length having a given area ?

Project 2



[Methods for Finding Value of π]

Background

In a circle, the ratio of the circumference to its diameter is a constant and is denoted by Greek letter π. For calculation purpose, value of π is generally taken as $\frac{22}{7}$ or 3.14.

Objective

In this project, an attempt has been made to find some approximation to the value of π, using simple different methods.

Description

Method-1

Take a circular disc. Mark a point on the edge of the disc. Take a cardboard of convenient size and paste a white paper on it. Draw a line on the paper. Mark a point P on the line. Place the card on the line such that the point marked on it touches the point marked on the line (Fig. 1). Now roll the card along the line till its marked point again touches the line at some point Q (Fig. 2).

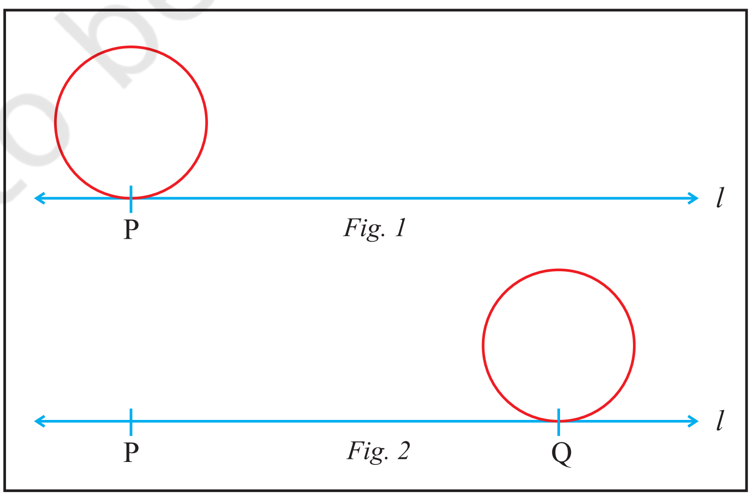


Fig. 1

Fig. 2

PQ is the circumference of the disc. Denote it by c. Measure the diameter of the circular disc and denote it by d. Find the ratio $\frac{c}{d}$ which is equal to π.

Thus $\pi = \frac{c}{d}$.

On actual measurement:

$c = 21.9$ cm

$d = 7.0$ cm

So, $\pi = \frac{21.9}{7} = 3.13$ approx.

Method-2:

A Take a squared paper of dimensions say 20 cm × 20 cm. Draw a circle of radius say 8 cm on it as shown in Fig. 3.

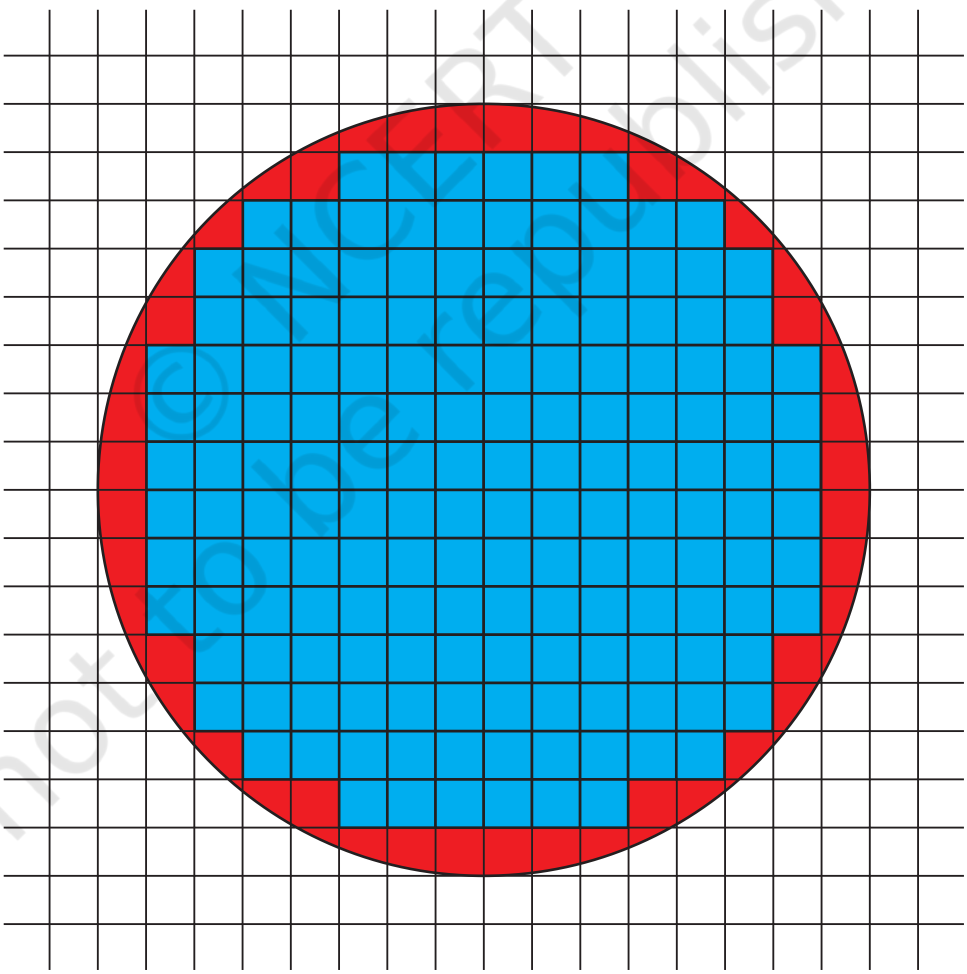


Fig. 3

Count the number of complete squares inside the circle and denote it by a.

Count the number of squares through which the circle passes and denote it by b.

Find $a+\frac{b}{2}$

In this case, $a = 14 \times 6 + 12 \times 4 + 10 \times 2 + 6 \times 2 = 164$

$b = 60$

So $a+\frac{b}{2} = 164+\frac{60}{2} = 164 + 30 = 194$

That is area of the circle = 194 sq. units approx.

Divide $a+\frac{b}{2}$ by $(\text{radius})^2$, to get approximate value of π,

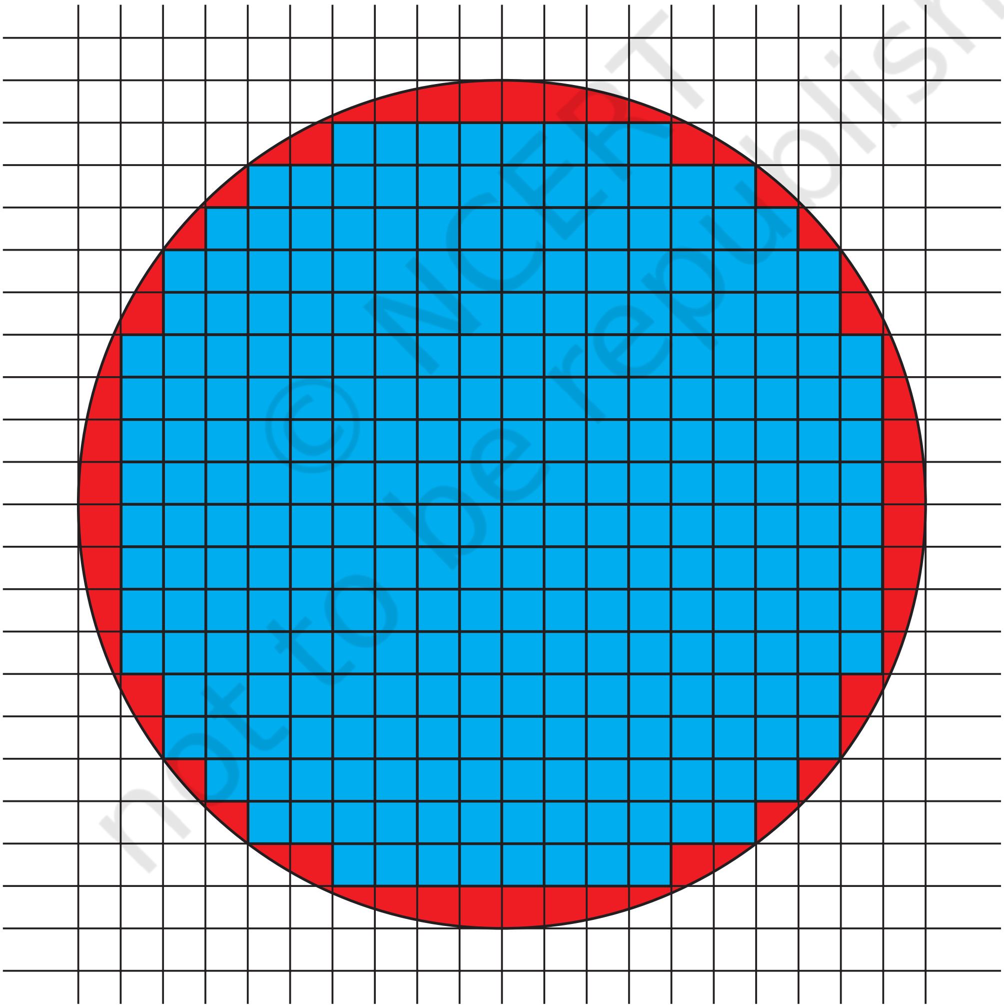


Fig. 4

i.e. $\frac{194}{8^2} = \frac{194}{64} = 3.03125$ (approx.).

B Again draw a circle of radius 10 cm on the squared paper and repeat the above process to find value of π.

In this case,

$a = 18 \times 8 + 16 \times 4 + 14 \times 2 + 12 \times 2 + 8 \times 2 = 276$

$b = 68$

So $a + \frac{b}{2} = 276 + \frac{68}{2} = 310$

Thus $\pi = \frac{310}{10^2} = \frac{310}{100} = 3.1$ approx.

As radius r increases, the value of π comes closer to 3.14.

Method-3:

Take a squared paper of dimension say 20 cm × 20 cm. Draw a circle of radius say 10 cm on it as shown in Fig. 4.

Count the number of vertices of the squares in the circles. Let it be a.

Divide a by r^2 to get value of π.

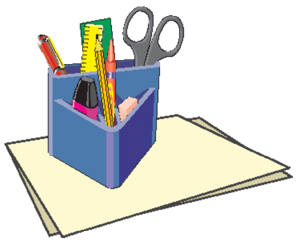
In this case, $\pi = \frac{317}{10^2} = \frac{317}{100} = 3.17$

As radius r increases, the value of π comes closer to 3.14.

Conclusion

The ratio of the circumference and diameter of a circle is always constant and is denoted by π. Its approximate value is 3.14.

Suggested List of Projects



1. About an Indian mathematician and his/her contributions to mathematics.
2. Verification of Pythagoras theorem in different ways.
3. Magic squares : 3 × 3, 4 × 4, and 5 × 5.
4. Congruent shapes.
5. Exploring Pythagorean Triplets.
6. Drawing map of your school/locality.
7. Collection of data and its pictorial representation in different ways.
8. Decimal system versus other number systems with base 5, 8 and 2.
9. Divisibility Tests with special reference to 7, 11 and 13.
10. Verification of Euler's formula for different 3 D shapes (polyhedra).
11. Application of direct and inverse proportions in day to day life.
12. Use of double bar graph in different situations.
13. Hardy – Ramanujan Numbers.
14. Use of algebraic identities in solving problems.
15. Areas of different polygons.
16. Graphs in day to day life.

Notes