Activity 21

OBJECTIVE

To verify Pythagoras theorem by Bhaskara method.

MATERIAL REQUIRED

Chart papers of different colours, glazed papers, geometry box, scissors, adhesive.

METHOD OF CONSTRUCTION

1. Take a chart paper and draw a right angled triangle whose sides are *a, b* and *c* units, as shown in Fig. 1.
2. Make three replicas of the triangle from different coloured chart papers.
3. Paste all the four triangles to make a square as shown in Fig. 2.
4. Name the square as PQRS whose side is *c* units.

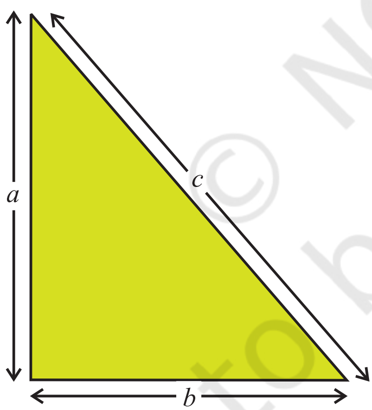

Fig. 1

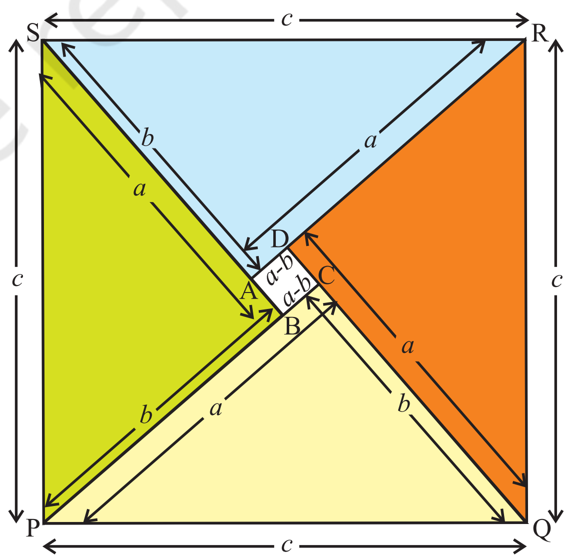

Fig. 2

5. A square ABCD of side $(a - b)$ units is formed inside the square PQRS.

   The area of the square PQRS is equal to the area of square of side $(a - b)$ units added to the areas of four identical right angled triangles of sides a, b and c units.

DEMONSTRATION

1. Area of one right angled triangle = $\frac{1}{2}ab$ sq.units

   Area of four right angled triangles = $4 \times \frac{1}{2}ab$ sq.units $= 2ab$ sq. units.

   Area of the square of side $(a - b)$ units = $(a - b)^2$ sq. units $= (a^2 - 2ab + b^2)$ sq. units.

2. Area of the square PQRS of side c units = c^2 sq. units.

   Therefore, $c^2 = 2ab + a^2 - 2ab + b^2$

or $c^2 = a^2 + b^2$.

Hence, the verification of Pythagoras theorem.

OBSERVATION

By actual measurement:

Side a of the triangle = __________ units.

Side b of the triangle = __________ units.

Side c of the triangle = __________ units.

$a^2 + b^2$ = __________ sq. units. c^2 = __________ sq. units.

Thus, a^2 + __________ = c^2

APPLICATION

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

Activity 22

Objective

To verify experimentally that the tangent at any point to a circle is perpendicular to the radius through that point.

Material Required

Coloured chart paper, adhesive, scissors/cutter, geometry box, cardboard.

Method of Construction

1. Take a coloured chart paper of a convenient size and draw a circle of a suitable radius on it. Cut out this circle and paste it on a cardboard.
2. Take points P, Q and R on the circle [see Fig. 1].
3. Through the points P, Q and R form a number of creases and select those which touch the circle. These creases will be tangents to the circle.

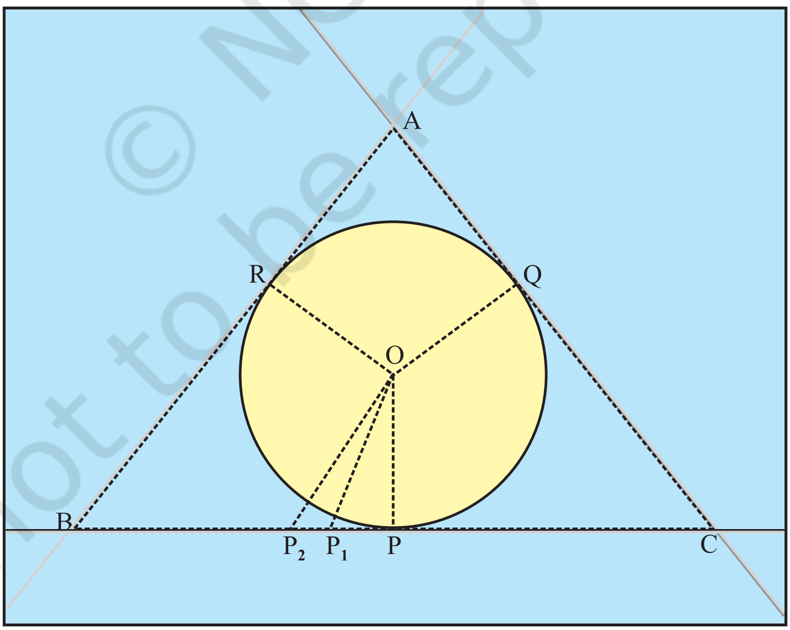

Fig. 1

4. Let the creases intersect at the points A, B and C forming a ΔABC (creases has been shown by dotted lines)
5. The circle now can be taken as incircle of ΔABC with O as its centre. Join OP, OQ and OR.
6. Take points P_1 and P_2 on the crease BC.

Demonstration

Take triangles POP_1 and POP_2

Clearly $OP_1 > OP$, $OP_2 > OP$.

In fact, OP is less than any other line segment joining O to any point on BC other than P, i.e., OP is the shortest of all these.

Therefore, $OP \perp BC$.

Hence, tangent to the circle at a point is perpendicular to the radius through that point.

Similarly, it can be shown that $OQ \perp AC$ and $OR \perp AB$.

Observation

By actual measurement:

OP = ..., OQ =.............., OR = ...

OP_1 = ..., OP_2 =..............

$OP < OP_1$, OP .... OP_2

Therefore, OP ..... BC

Thus, the tangent is .... to the radius through the point of contact.

Application

This result can be used in proving various other results of geometry.

Activity 23

Objective

To find the number of tangents from a point to a circle.

Material Required

Cardboard, geometry box, cutter, different coloured sheets, adhesive.

Method of Construction

1. Take a cardboard of a suitable size and paste a coloured sheet on it.
2. Draw a circle of suitable radius on a coloured sheet and cut it out [see Fig. 1].

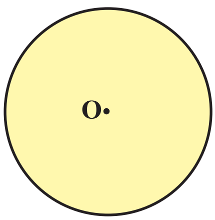

Fig. 1

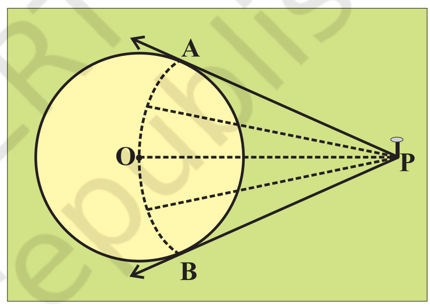

Fig. 2

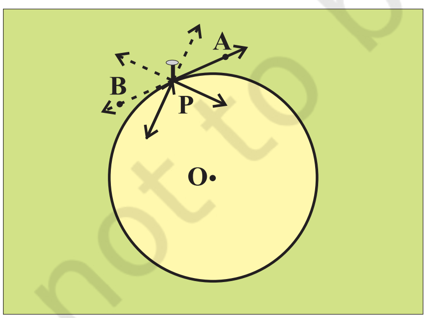

Fig. 3

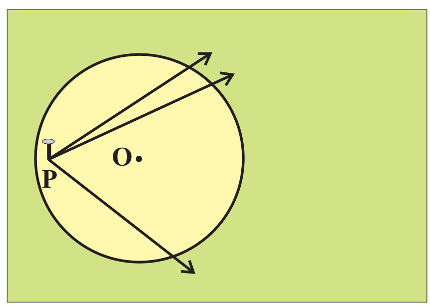

Fig. 4

3. Paste the cutout circle on the cardboard.
4. Take any point P outside (on or inside) the circle and fix a nail on it. [see Fig. 2, Fig. 3 and Fig. 4].
5. Take a string and tie one end of it at the point P and move the other end towards the centre of the circle. Also move it up and down from the centre such that it may touch the circle. [see Fig. 2, Fig. 3 and Fig. 4].

DEMONSTRATION

1. If the point P is outside the circle, there are two tangents PA and PB as shown in Fig. 2.
2. If the point P is on the circle, there is only one tangent at P [see Fig. 3].
3. If the point P is inside the circle, there is no tangent at P to the circle. [see Fig. 4].

OBSERVATION

1. In Fig. 2, number of tangents through P = -------------------.
2. In Fig. 3, number of tangents through P = ----------------.
3. In Fig. 4, number of tangents through P = ------------------.

APPLICATION

This activity is useful in verifying the property that the lengths of the two tangents drawn from an external point are equal.

Activity 24

OBJECTIVE

To verify that the lengths of tangents to a circle from some external point are equal.

MATERIAL REQUIRED

Glazed papers of different colours, geometry box, sketch pen, scissors, cutter and glue.

METHOD OF CONSTRUCTION

1. Draw a circle of any radius, say *a* units, with centre O on a coloured glazed paper of a convenient size [see Fig. 1].
2. Take any point P outside the circle.
3. Place a ruler touching the point P and the circle, lift the paper and fold it to create a crease passing through P [see Fig. 2].

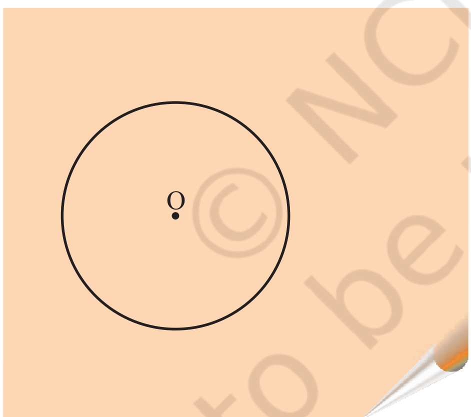

Fig. 1

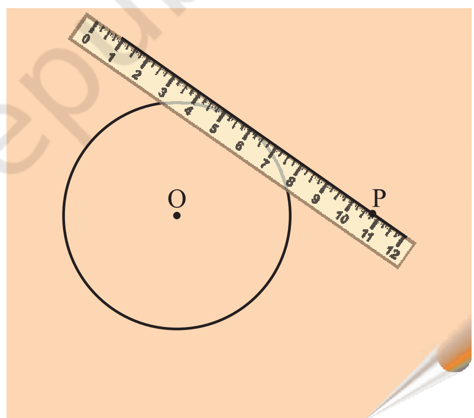

Fig. 2

4. Created crease is a tangent to the circle from the point P. Mark the point of contact of the tangent and the circle as Q. Join PQ [see Fig. 3].
5. Now place ruler touching the point P and the other side of the circle, and fold the paper to create a crease again [see Fig. 4].

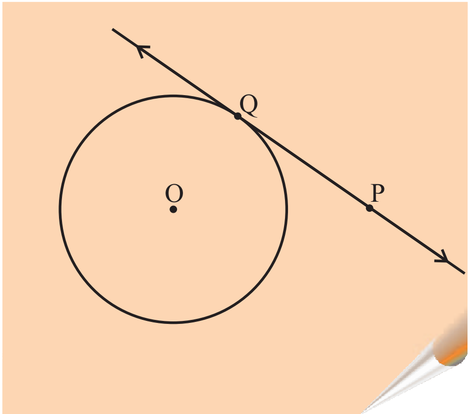

Fig. 3

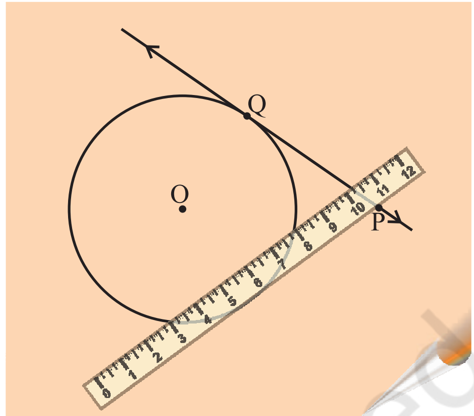

Fig. 4

6. This crease is the second tangent to the circle from the point P. Mark the point of contact of the tangent and the circle as R. Join PR [see Fig. 5].
7. Join the centre of the circle O to the point P [see Fig. 6].

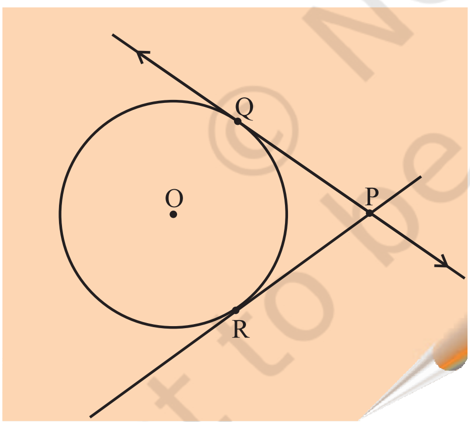

Fig. 5

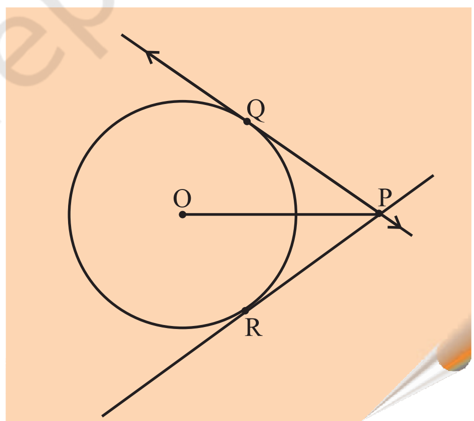

Fig. 6

Demonstration

1. Fold the circle along OP.

2. We observe that Q coincides with R. Therefore, QP = RP, i.e., length of the tangent QP = length of the tangent RP.

   This verifies the result.

OBSERVATION

On actual measurement:

1. Length of tangent QP = ...
2. Length of tangent RP = ...

   So, length of tangent QP = length of tangent ....

APPLICATION

This result is useful in solving problems in geometry and mensuration.

Activity 25

Objective

To find the height of a building using a clinometer.

Material Required

Clinometer (a stand fitted with a square plate which is fitted with a movable 0º–360º protractor and a straw), a measuring tape 50 m long, table or stool.

Method of Construction

1. Place a table on the ground of a school.
2. Place a clinometer (a stand fitted with 0º–360º protractor and a straw whose central line coincides with 0º–360º line) on the table.
3. Now face it towards the building of the school.
4. Peep out through the straw to the top of the school building and note the angle (θ) through which the protractor turns from 0º–360º line.

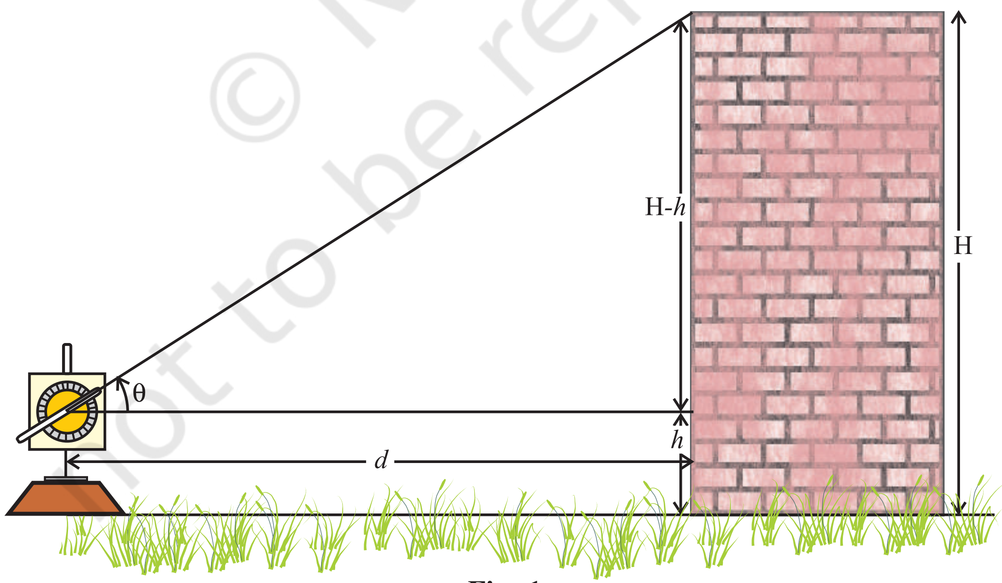

Fig. 1

5. Measure the height (h) of the centre of the protractor from the ground.
6. Measure the distance (d) of the building from the point lying on the vertical line of the stand (centre of the protractor) kept on table [see Fig. 1].
7. Repeat the above method keeping the clinometer at different positions and collect the values of q, h, d for different settings.

Demonstration

Using the knowledge of trigonometric ratios, we have :

$\tan\theta = \dfrac{H-h}{d}$, where H is the height of the building.

i.e., $H = h + d\tan\theta$

Observation

S.No.	Angle measured through protractor (Angle of elevation) θ	Height of the protractor from ground (h)	Distance (d) of the building from the centre of the protractor	tan θ	$H = h + d \tan\theta$
1.	----	---	---	---	---
2.	----	---	---	---	---
3.	----	---	---	---	---
...	----	---	---	---	---
...	----	---	---	---	---
...					

Application

1. A clinometer can be used in measuring an angle of elevation and an angle of depression.
2. It can be used in measuring the heights of distant (inaccessible) objects, where it is difficult to measure the height directly.