# Tangent Planes to Solids



## PROBLEM 1

**To draw a plane tangential to a sphere at a given point P on its surface.**

(1) In plan join the sphere centre to P.
(2) Project an auxiliary view having $x_1y_1$ parallel to cP.
(3) Locate point P in the auxiliary. It will be on the circumference.
(4) Draw the edge view of the tangent plane in auxiliary.
(5) Find the traces.

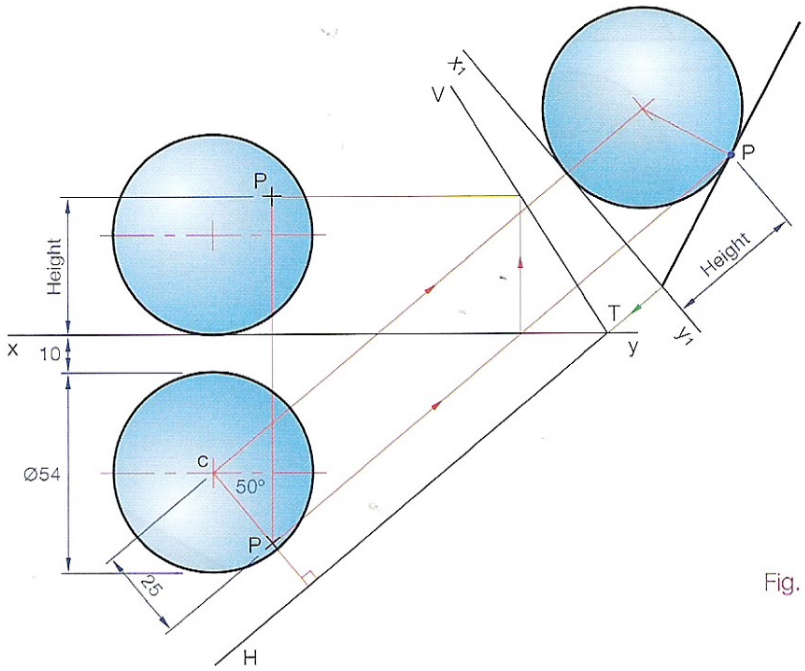


Fig. 4.68

## PROBLEM 2

**To draw the traces of a plane tangential to a cone at a given point P on its surface.**

(1) In plan, draw the generator from the cone apex through point P to the base of the cone. The horizontal trace will be perpendicular to this.
(2) Find P in elevation and the vertical trace in the usual way.

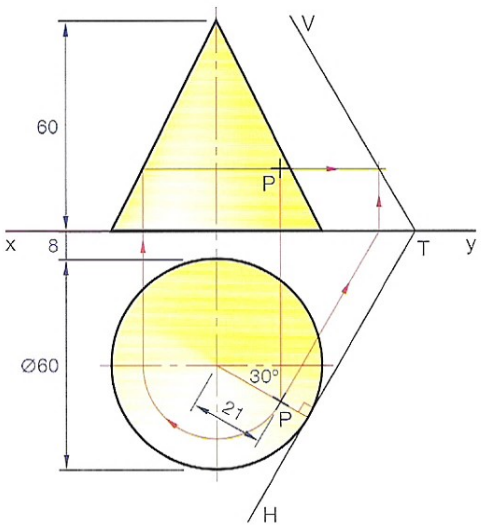


Fig. 4.69

PROBLEM 3

**To draw the traces of a plane that is tangential to the cone A and that contains point P.**

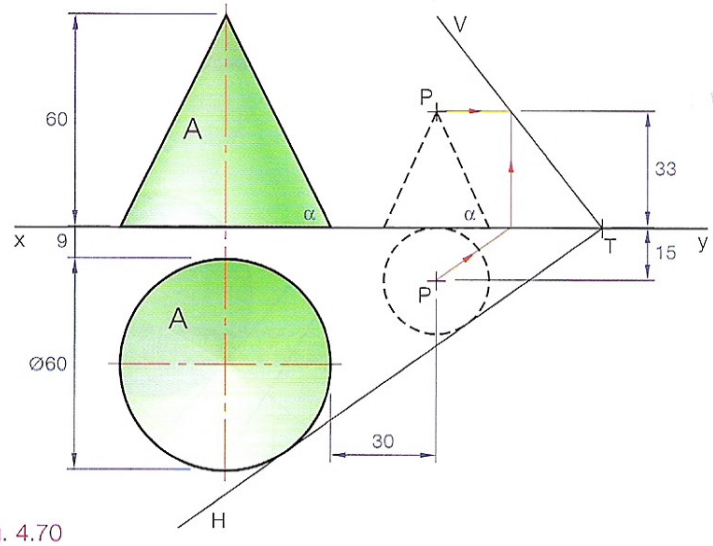


Fig. 4.70

(1) Set up the question.

(2) Draw the plan and elevation of a cone, having the same base angle as cone A and having point P as its apex.

(3) The horizontal trace will be tangential to the two base circles. The vertical trace is found as before.

The tangent plane's horizontal trace will be tangential to the base circles of the cones. It can also be seen from the pictorial that the plane makes contact with the cones along a whole generator, Fig. 4.71.

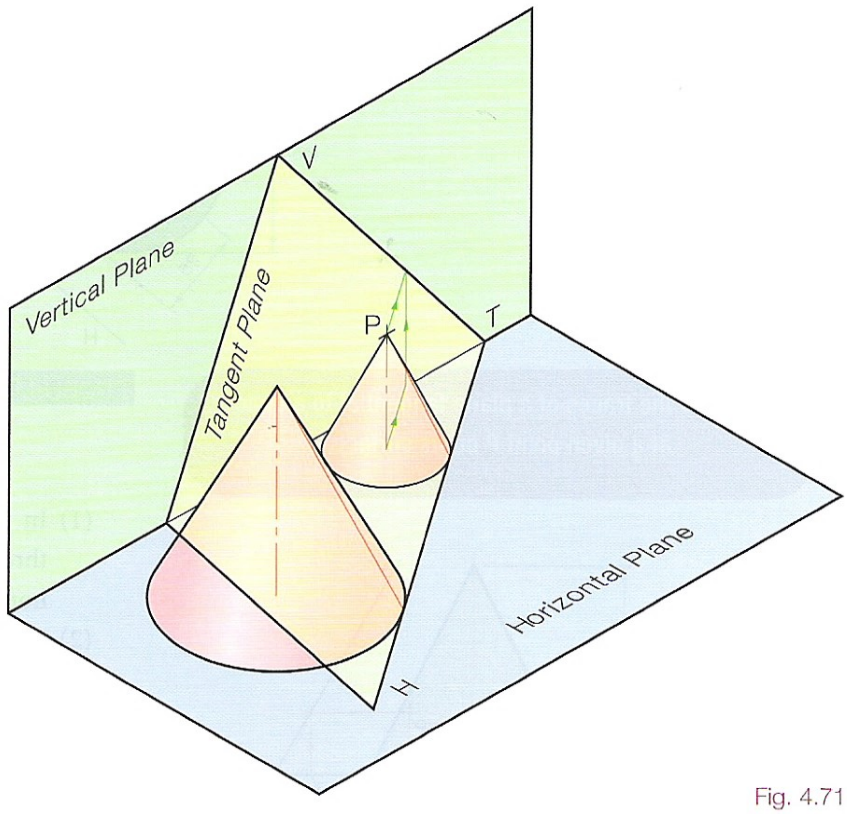


Fig. 4.71

PROBLEM 4

**To determine the traces of a plane which shall be tangential to a given cone and a given sphere.**

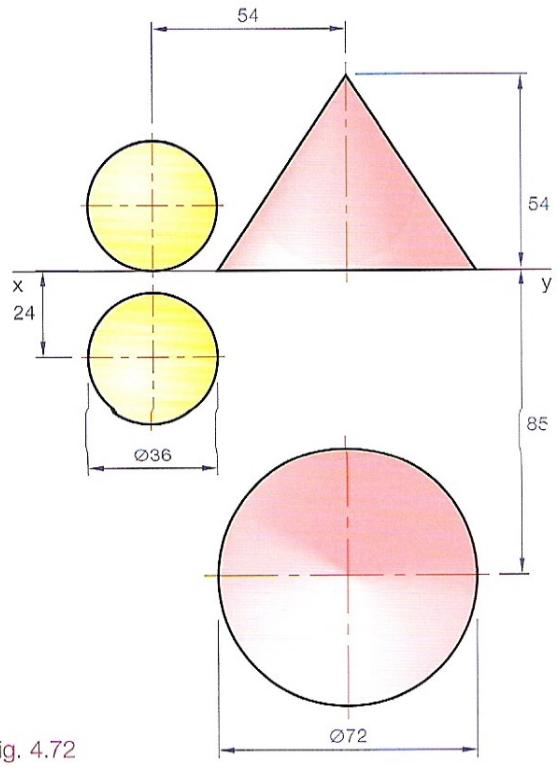


Fig. 4.72

A cone is placed over the sphere having the same base angle as the given cone. This cone's generators are tangential to the sphere.

The problem is now similar to the previous one and is solved in the same way, Fig 4.73.

It should be noted that there are four possible solutions to this problem. These are shown in Figures 4.74 and 4.75.

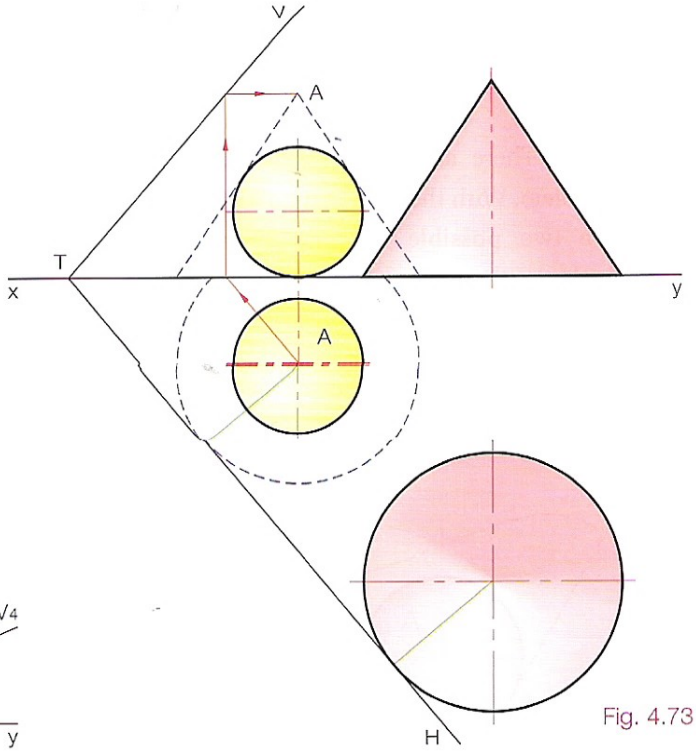


Fig. 4.73

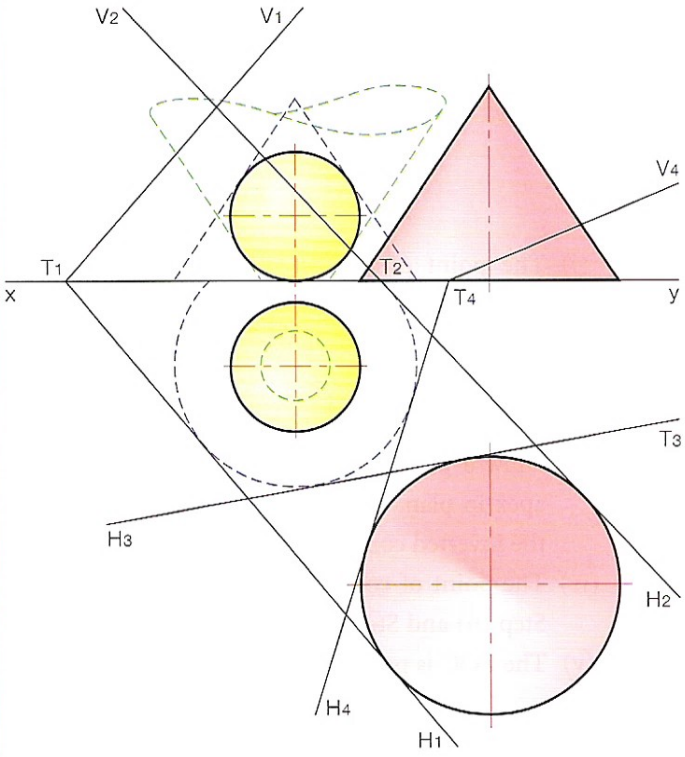


Fig. 4.74

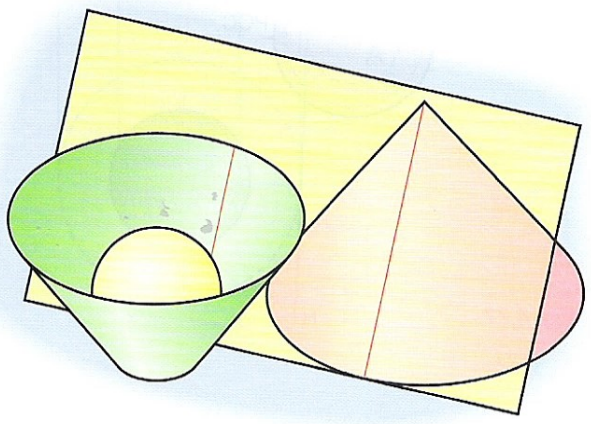

Fig. 4.75

**Given the plan and elevation of two spheres A and B. Determine the traces of a plane that is tangential to both solids, makes an angle of 60° to the horizontal plane and passes between the spheres. Find the points of contact.**

(1) Construct a 60° base angle cone over one of the spheres. Now place an inverted 60° base angle cone to envelop the other sphere.
(2) Find the circles in plan where these cones make contact with the horizontal plane.
(3) Construct the horizontal trace (HT) as a tangent to these two circles.
(4) The vertical trace is constructed as before.

**Note:** There are four possible solutions to this problem. With the cones set up as in Fig. 4.77 there are two possible tangents (horizontal traces) between the cones. The inverted cone could be drawn around sphere B and the upright cone around sphere A, giving two other traces.

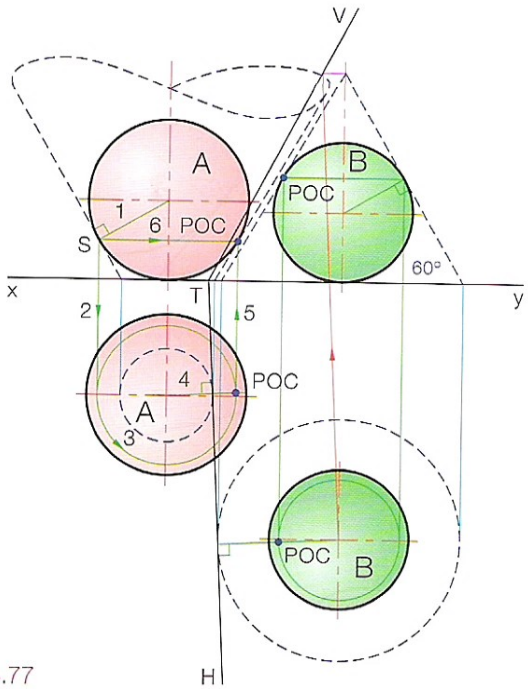


Fig. 4.77

PROBLEM 5

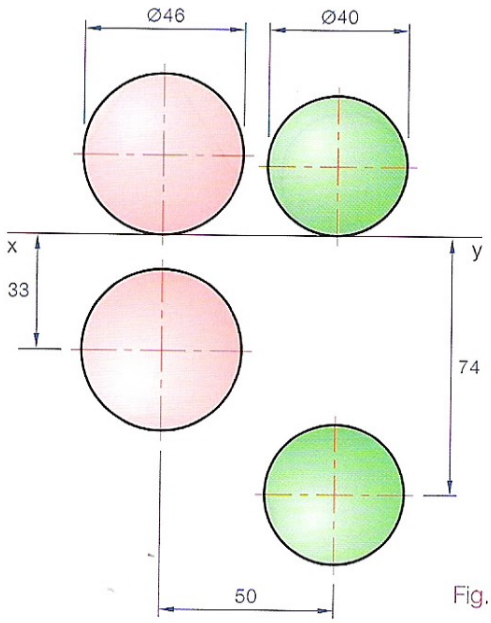


Fig. 4.76

(i) The point of contact is located by drawing a perpendicular to the side of the cone from the sphere centre giving point S. This gives the height of the POC above the xy line.
(ii) Drop S to the plan and rotate.
(iii) Draw a perpendicular to the HT from the cone apex in plan. This is the line of contact between the inverted cone and the plane.
(iv) The point of contact is the intersection between Step (ii) and Step (iii).
(v) The POC is projected to elevation.

# Activities

HIGHER LEVEL

Q1. Fig. 4.78 shows the elevation of a cone and a sphere. The cone is in contact with the sphere A at point P.
Draw the elevation and plan of the solids in contact and determine the exact position of point P.

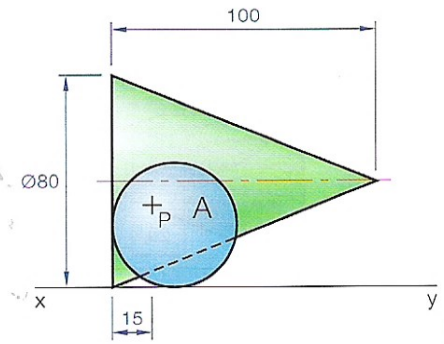

Fig. 4.78

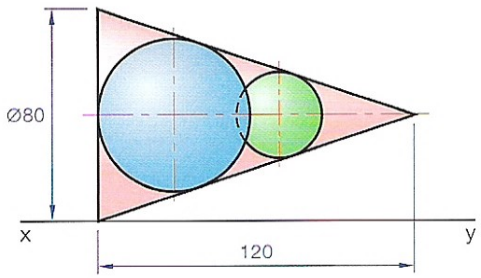

Fig. 4.79

Q2. Fig. 4.79 shows the elevation of a square-based pyramid and two spheres. The solids are in contact with each other.
Draw the elevation and plan of the solids showing all points of contact.

Q3. Fig. 4.80 shows the elevation of a sphere A and a cone B. The two solids are in contact.
(i) Draw the plan and elevation of the sphere and cone in contact.
(ii) Draw the projections of another sphere C of 40 mm diameter that is in contact with the cone and sphere and has its centre on line S–S.

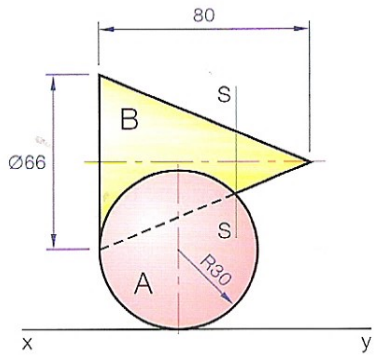

Fig. 4.80

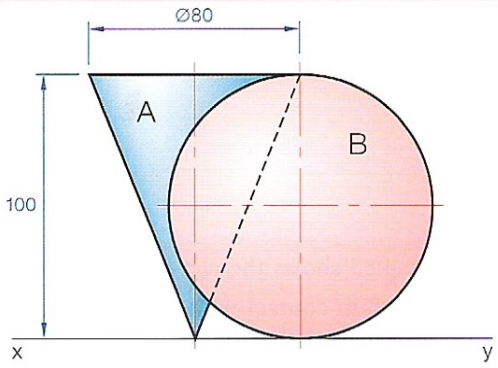

Fig. 4.81

Q4. Fig. 4.81 shows the elevation of a right cone A and a sphere B. Both solids are in contact.
(i) Draw the plan and elevation of the solids.
(ii) Draw the projections of the smallest possible sphere that touches the cone A, the sphere B and the horizontal plane.

Q5. Fig. 4.82 shows the elevation of a sphere A in contact with a cone B.
(i) Draw the plan and elevation of the two solids showing the point of contact clearly.
(ii) Draw the projections of a second sphere C of diameter 30 mm which touches both solids. Sphere C makes contact with sphere A at a point 44 mm above the horizontal plane.

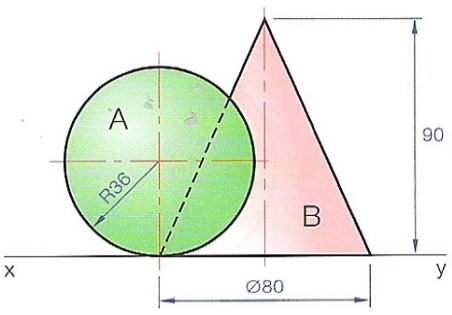

Fig. 4.82

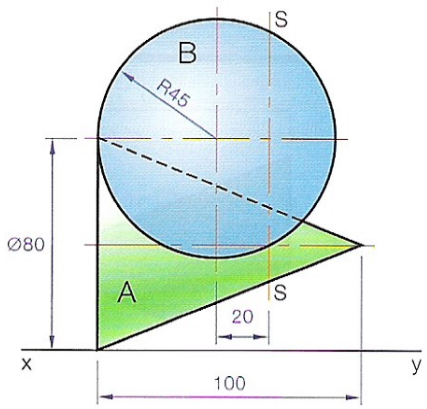


Fig. 4.83

Q6. The diagram Fig. 4.83 shows a right cone A and a sphere B, which are in contact with each other.

(i) Draw the front elevation, end elevation and plan of the solids showing the point of contact in all views.

(ii) Draw the projections of another sphere C of 36 mm diameter and having its centre on line S–S. Sphere C must make contact with the other two solids. Show all points of contact.

(iii) Draw the traces of a plane that passes through the centre of sphere B and the apex of cone A. The plane is to make an angle of 75° to the horizontal plane.

Q7. Fig. 4.84 shows the elevation of a right cone A in contact with a sphere B.

(i) Draw the elevation and plan of the two solids showing the point of contact in both views.

(ii) Draw the projections of another sphere C of 30 mm diameter is position S. Sphere C must make contact with the other two solids. Show all points of contact.

(iii) Draw the traces of a plane that is tangential to cone A and sphere C.

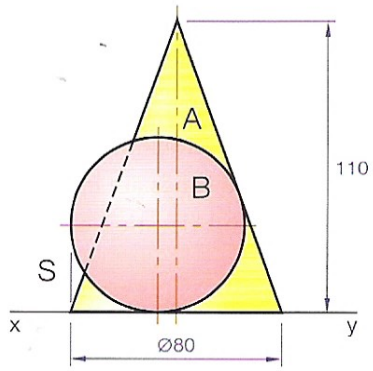


Fig. 4.84

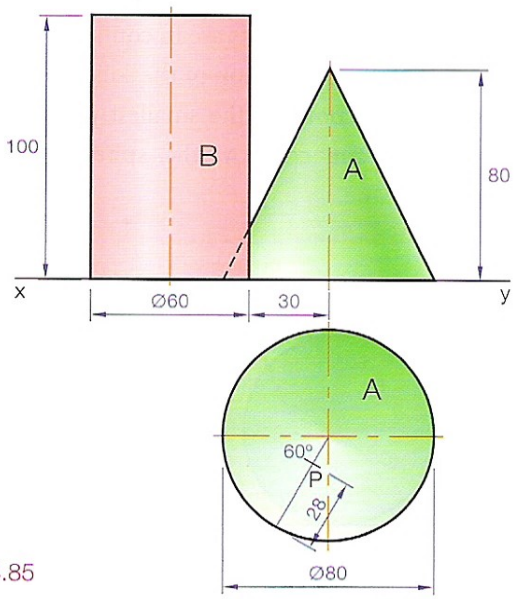


Fig. 4.85

Q8. Fig. 4.85 shows the elevation of a cone A and a cylinder B in contact with each other. The plan of the cone is also shown with a point P on its surface.

(i) Draw the plan and elevation of both solids.

(ii) Draw the projections of a sphere C which makes contact with the cone A at point P and which also makes contact with the cylinder.

(iii) Draw the traces of the plane that passes through the lowest point of sphere C and is tangential to cone A.