Problems

PROBLEM 1

Fig. 4.51 shows the plan of a sphere with a point P on its underside.

(i) Draw the plan and elevation of the sphere and find the projections of point P.

(ii) Find the projections of the sphere which rests on the horizontal plane and has point P as its point of contact.

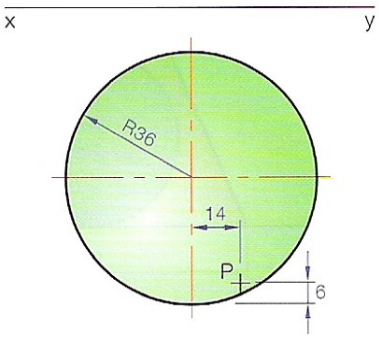

Fig. 4.51

(1) Draw the sphere in plan and elevation.

(2) Find point P in elevation in the usual way. Rotate point P onto the horizontal axis in plan and project to the sphere's circumference in elevation giving P_1.

(3) Draw a line from C through P_1 and extend.

(4) Draw a locus of points equidistant from the circumference and the xy line.

(5) The locus and CP_1 extended cross giving the sphere centre, Fig. 4.52.

(6) Draw the sphere and roll it into position, Fig 4.53.

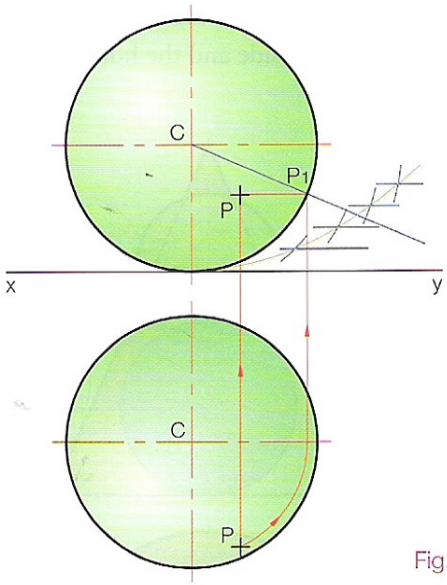

Fig. 4.52

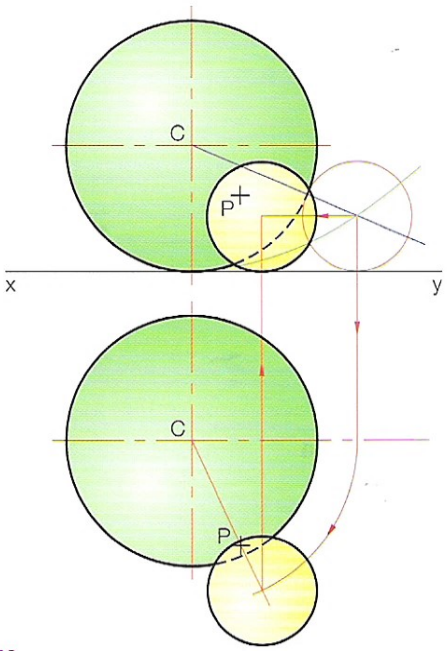

Fig. 4.53

HIGHER LEVEL

PROBLEM 2

The diagram in Fig. 4.54 shows the elevation of two spheres and a cone in contact with one another. Draw the elevation and plan of the solids showing all points of contact.

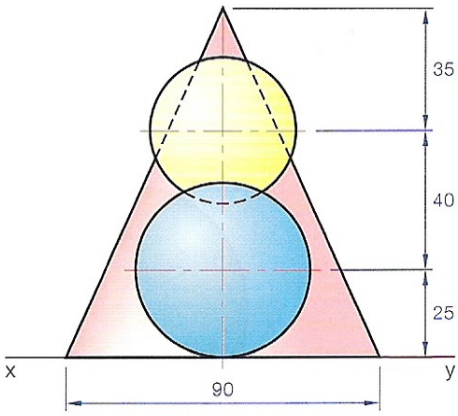

Fig. 4.54

(1) Draw the plan and elevation of the cone. The elevation of sphere A can also be drawn.

(2) The location of sphere A in plan is found by rolling the sphere to the side of the cone, dropping it to the side of the plan and rotating it into position. The centre point is brought across in elevation and intersects with the bisector of the angle formed by the cone side and the horizontal plane, Fig. 4.55.

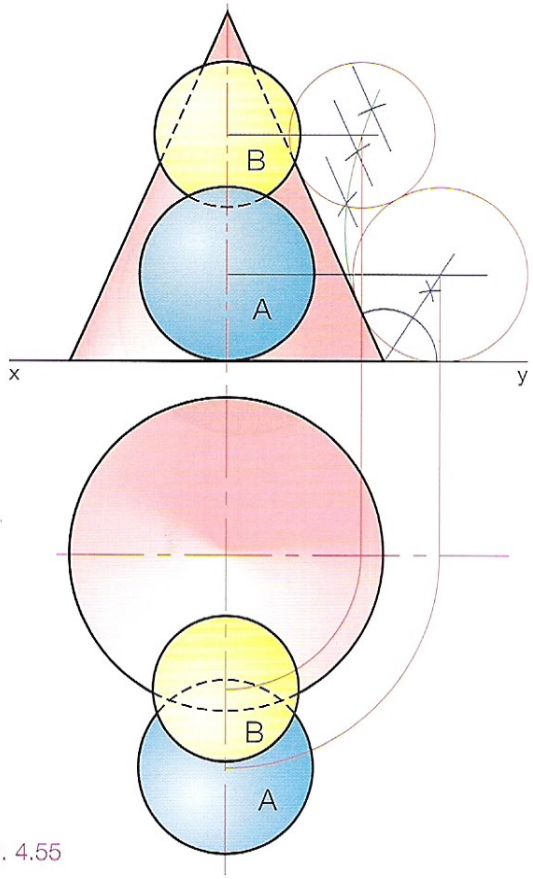

Fig. 4.55

(3) The radius of sphere B is not given. It too must be brought to the side of the cone. Project the given centre point across to the side. This line intersects with the locus of points which are equidistant from the cone side and the circumference of sphere A rotated.

(4) Project the sphere centres back to the elevation and plan, Fig. 4.55.

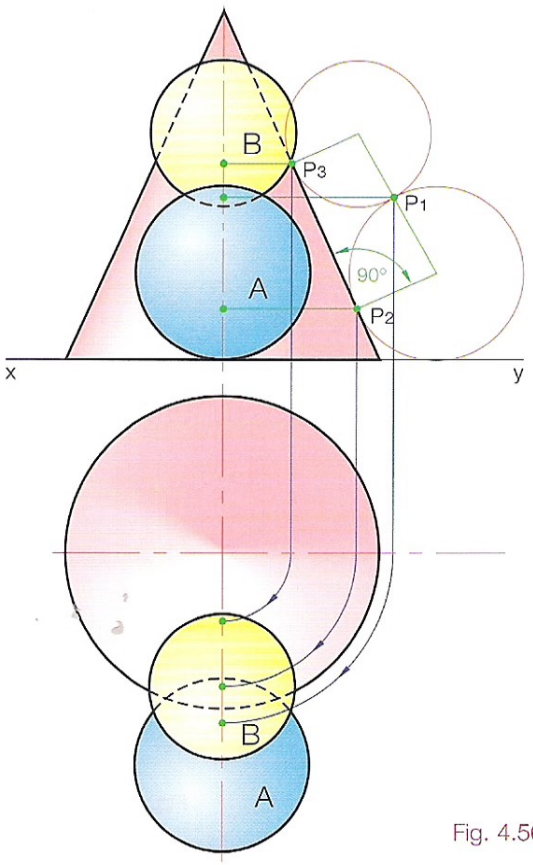

Fig. 4.56

(5) The points of contact must now be found. Join the centres of the two rotated spheres giving P_1. Draw a perpendicular from the rotated spheres centres to the cone side, as shown in Fig. 4.56, thus locating P_2 and P_3. The three points of contact may then be projected back onto the plan and elevation.

PROBLEM 3

Fig. 4.57 shows the plan and elevation of a sphere A and a cylinder B.

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

(ii) Draw the elevation and plan of a cone of 60 mm base diameter and 60 mm height, which rests on the horizontal plane in position S and is in contact with the given solids. Show all points of contact.

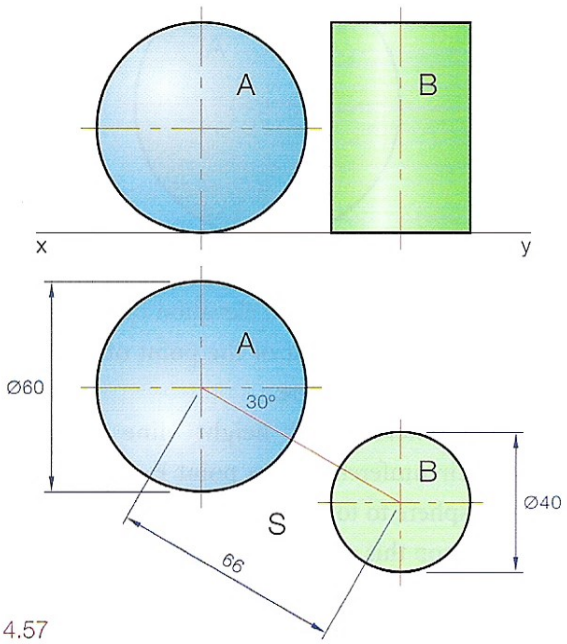

Fig. 4.57

(1) Draw the required cone to the side of the elevation and slide it across to come into contact with sphere A.

(2) The point of contact is located.

(3) Drop the cone centre and point of contact down to plan and rotate about the plan of sphere A, Fig. 4.58.

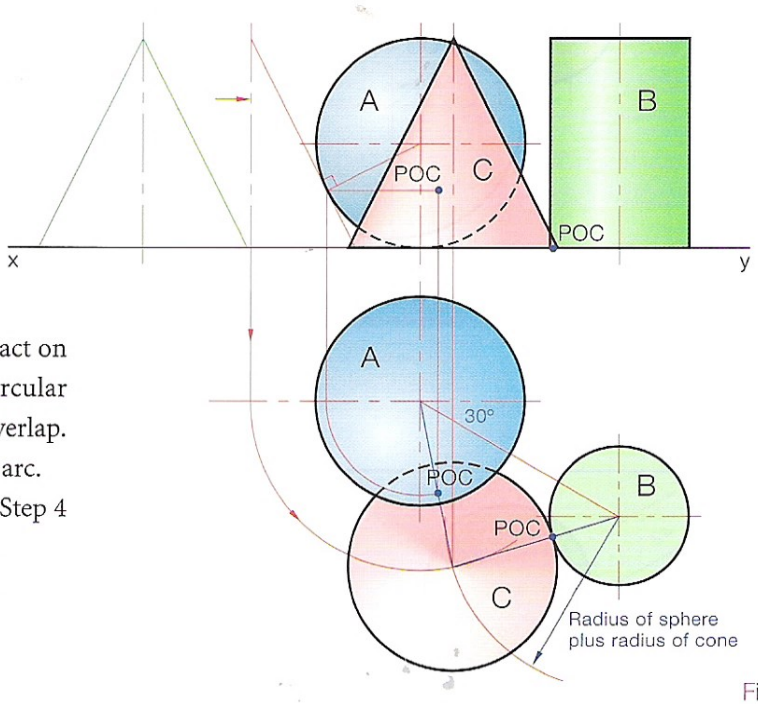

Fig. 4.58

(4) The cone and cylinder will make contact on the horizontal plane and their circular plans will make contact but not overlap. Add their radii in plan and scribe an arc.

(5) Where the arcs cross from Step 3 and Step 4 gives the centre of the required cone.

(6) Complete the views in the usual way.

PROBLEM 4

The diagram shows the projection of a sphere A which rests on the horizontal plane, Fig. 4.59.

(i) Draw the sphere in plan and elevation.

(ii) Draw the projections of a sphere of 50 mm diameter which touches the sphere A at a point 60 mm above the horizontal plane and also touches the vertical plane. Show the point of contact in both views.

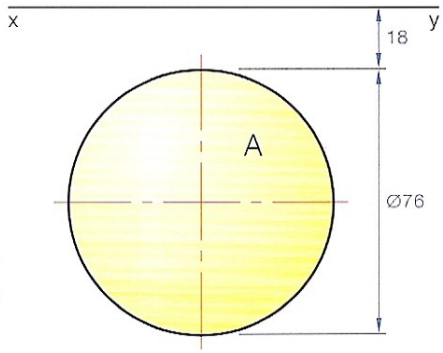

Fig. 4.59

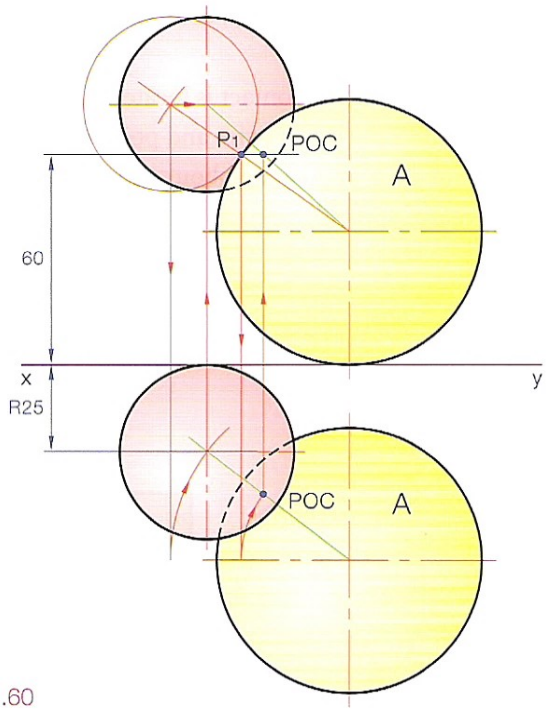

Fig. 4.60

(1) Draw the plan and elevation of sphere A.

(2) Mark the height of the point of contact, 60 mm above the xy line.

(3) Where this height line intersects the circumference gives point P_1. Construct the new sphere to touch P_1 as shown in Fig. 4.60.

(4) Drop this sphere's centre to plan and rotate about the plan until it crosses a line 25 mm (the radius of the new sphere) from the xy line, the vertical plane.

(5) Draw the elevation of this sphere and find the point of contact in the usual way, Fig. 4.60.

PROBLEM 5

Fig. 4.61 shows the plan of two spheres A and B resting on the horizontal plane.

(i) Draw the plan and elevation of the two spheres and show the projections of the smallest sphere which rests on the horizontal plane and touches both sphere A and sphere B.

(ii) Show the points of contact in all views.

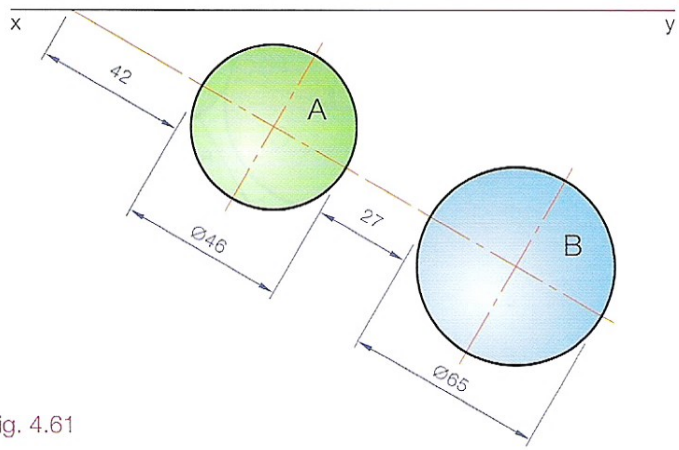

Fig. 4.61

(1) Draw the plan and elevation of the solids.

(2) The smallest sphere to touch both existing solids will have its centre in line with the centres of sphere A and sphere B in plan. Project an auxiliary elevation with the x_1y_1 line parallel to the line joining the centres of sphere A and B. This auxiliary will show the space between the spheres.

(3) Locate the centre of the new sphere by the use of locii. Draw the locus of points which are equidistant from the circumference of sphere A and the x_1y_1 line.

(4) Similarly for sphere B and the x_1y_1 line.
(5) The locii intersect giving a point which is equidistant from the sphere A, the sphere B and the x_1y_1 line.
(6) Draw the sphere and project back through the views.
(7) The points of contact are also found in the auxiliary and projected back through the views, Fig. 4.62.

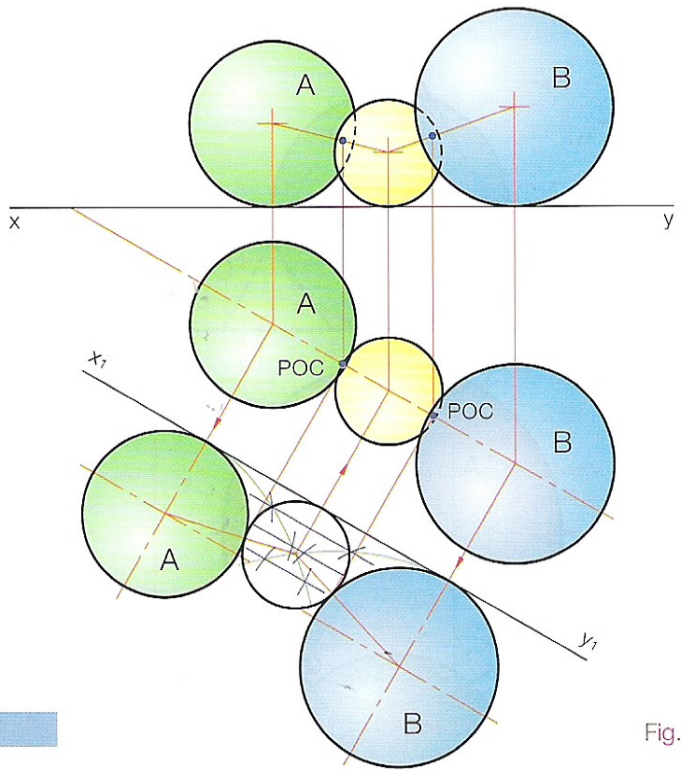

Fig. 4.62

PROBLEM 6

The diagram Fig. 4.63 shows the plan of a right cone A having an altitude of 90 mm, resting on the horizontal plane.

(i) Draw the plan and elevation of the cone and show the projections of a sphere B which rests on the horizontal plane and makes contact with the cone at point P.

(ii) Show the projections of another right cone C resting on the horizontal plane. This cone is to make contact with sphere B, 15 mm above the horizontal plane, and to touch cone A at the point Q.

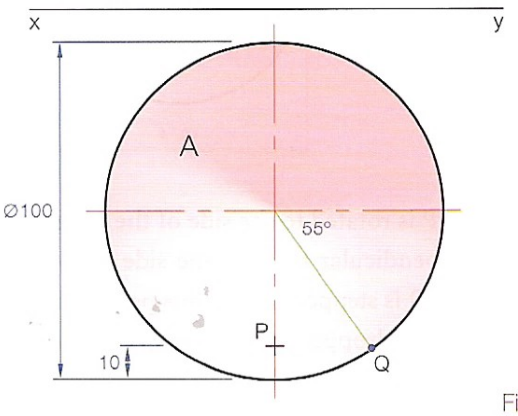

Fig. 4.63

(1) Draw the plan and elevation of the cone.
(2) Find sphere B in the usual way, Fig. 4.64.

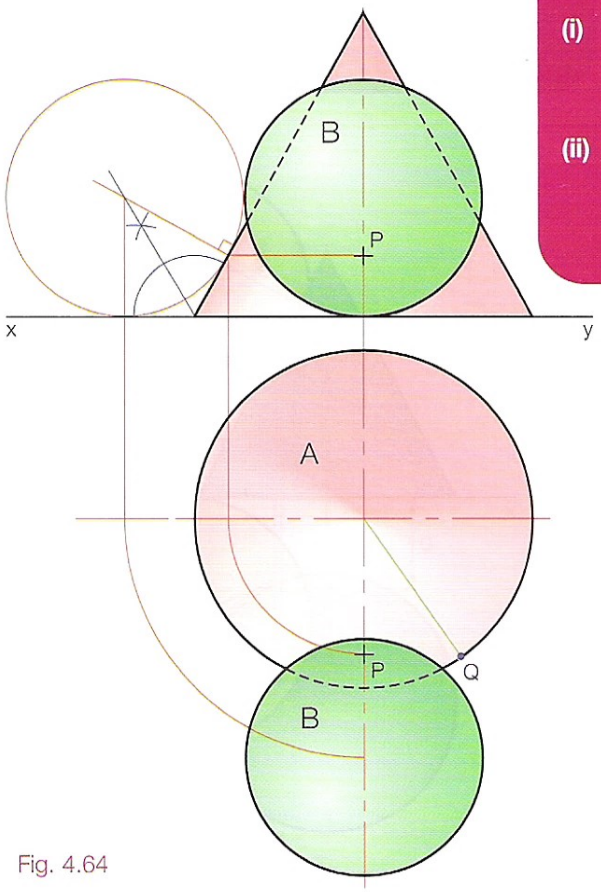

Fig. 4.64

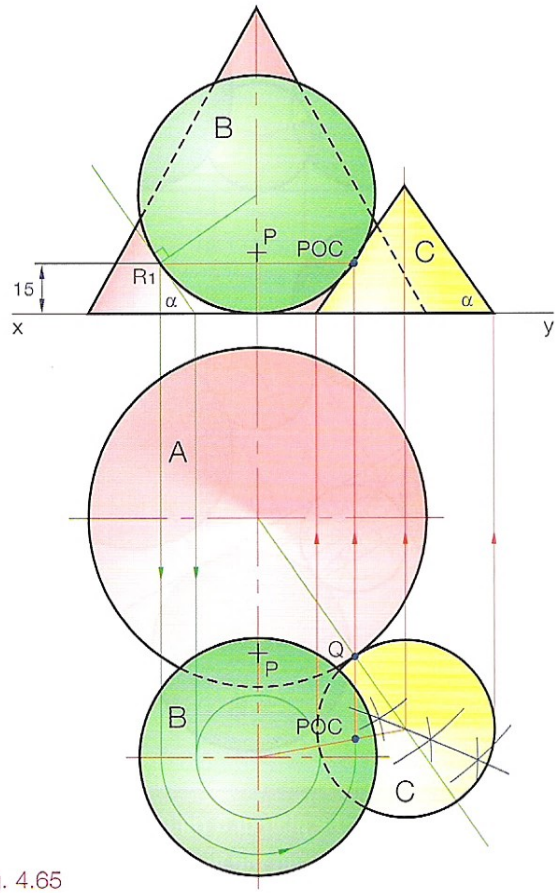

Fig. 4.65

PROBLEM 7

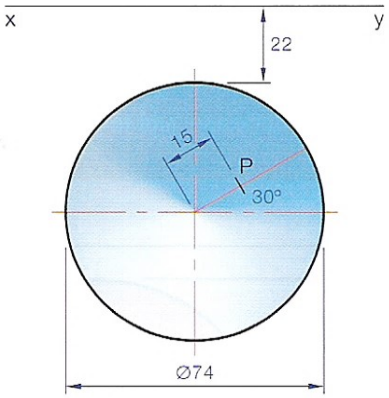

Fig. 4.66

(1) Point P is rotated to the side of the cone.
(2) A perpendicular to the cone side is constructed. A possible radius D is stepped out on this perpendicular to point d. This point d is dropped to plan and rotated about the cone.
(3) A line is drawn parallel to the xy line in plan the same distance D away. The arc and line intersect giving a point on the locus.
(4) Repeat for larger distances forming the locus.
(5) The centre of the required sphere will be on this locus and the line extended from the cone centre through P, Fig. 4.67.

(3) The angle of the cone C can be found by constructing a tangent at the height of the point of contact, on the circumference of sphere B, at point R_1.
(4) The base of cone C projects underneath sphere B and is rotated.
(5) The base circle of cone C must touch this rotated point and point Q and is found by using a locus as shown in Fig. 4.65.
(6) Once the base circle is found, the point of contact is obtained by joining the centres in plan and by dropping point R_1 from elevation and rotating.
(7) The elevation of cone C is found by projection, having its base angle matching that of the tangent at R_1.

The plan of a right cone is shown in Fig. 4.66. The cone has an altitude of 70 mm. Also shown is a point P on the cone's surface.

(i) Draw the projections of the cone and point P.

(ii) Draw the elevation and plan of a sphere that makes contact with the cone at point P and also touches the vertical plane.

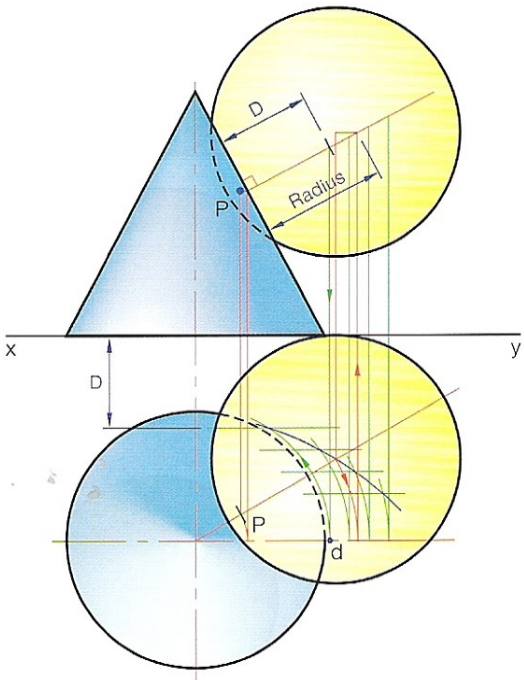

Fig. 4.67