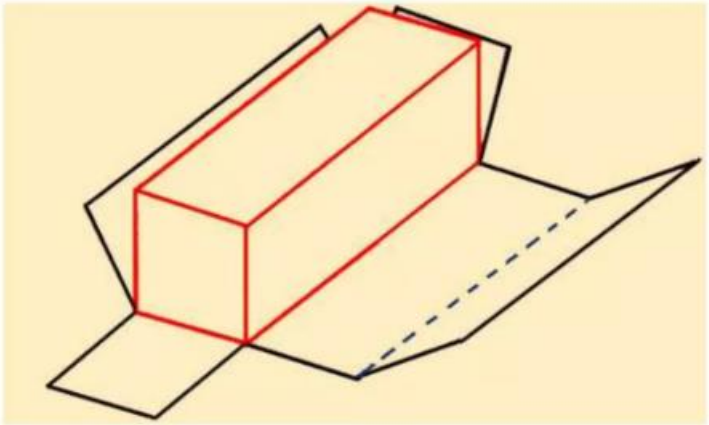
DEVELOPMENT OF SURFACES

Introduction

A development is the unfold / unrolled flat / plane figure of a 3-D object. It is also called a pattern where the plane may show the true size of each area of the object.



Typical development of the surface of a cuboid

Imagine that a solid is enclosed in a wrapper of thin material, such as paper. If this covering is opened out and laid on a flat plane, the flattened-out paper is the development of the solid.

Thus, when surfaces of a solid are laid out on a plane, the figure obtained is called its development.

The knowledge of development of surfaces is essential in many industries such as automobile, aircraft, ship building, packaging and sheet-metal work. In construction of boilers, bins, process-vessels, hoppers, funnels, chimneys etc.,






- it is very important to note that every line on the development must be the true length of the corresponding edge on the surface.
- the plates are marked and cut according to the developments which, when folded, form the desired objects.

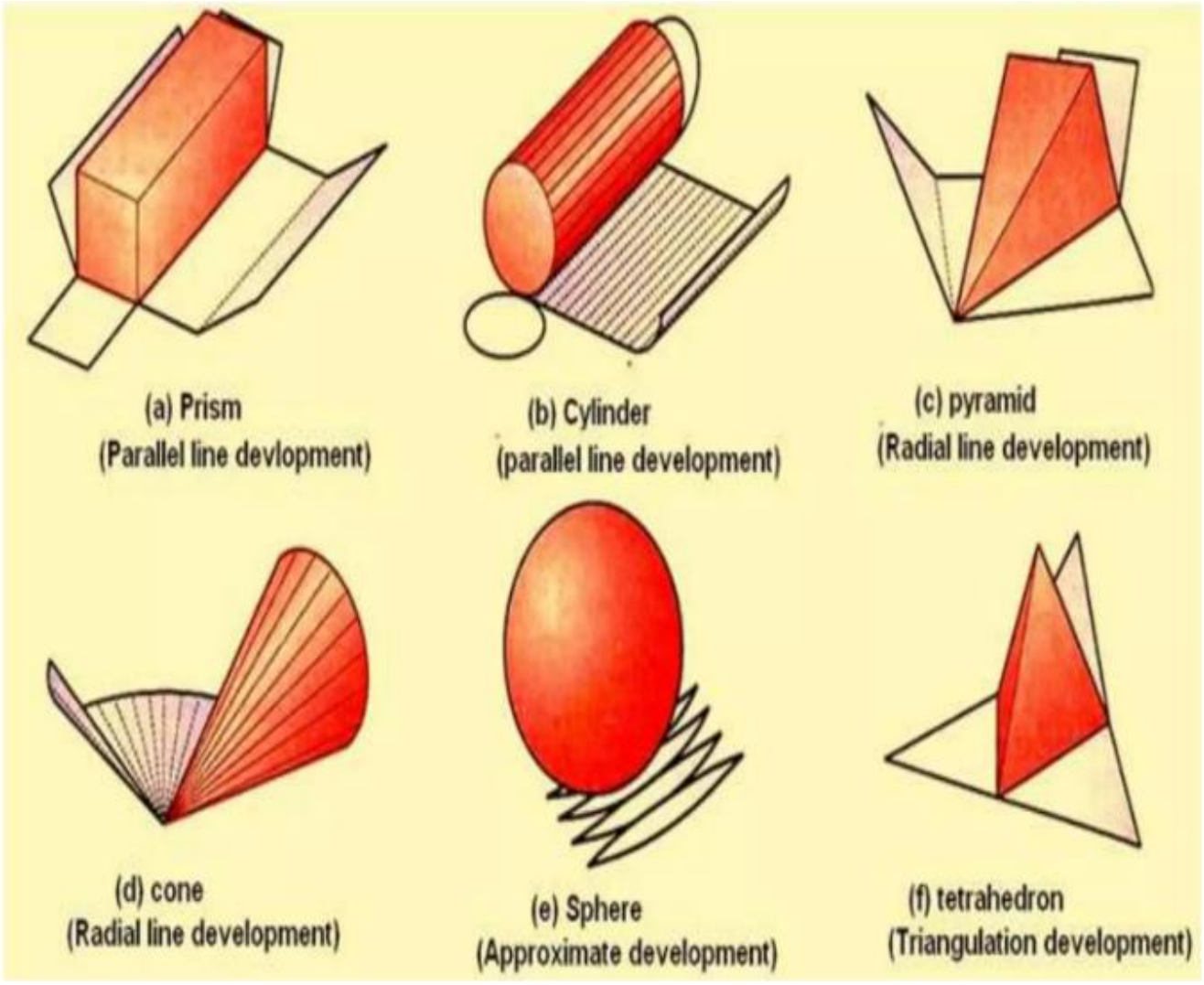
The following are the principal methods of development:

(1) Parallel-line development: It is employed in case of prisms and cylinders in which stretch-out-line principle is used.

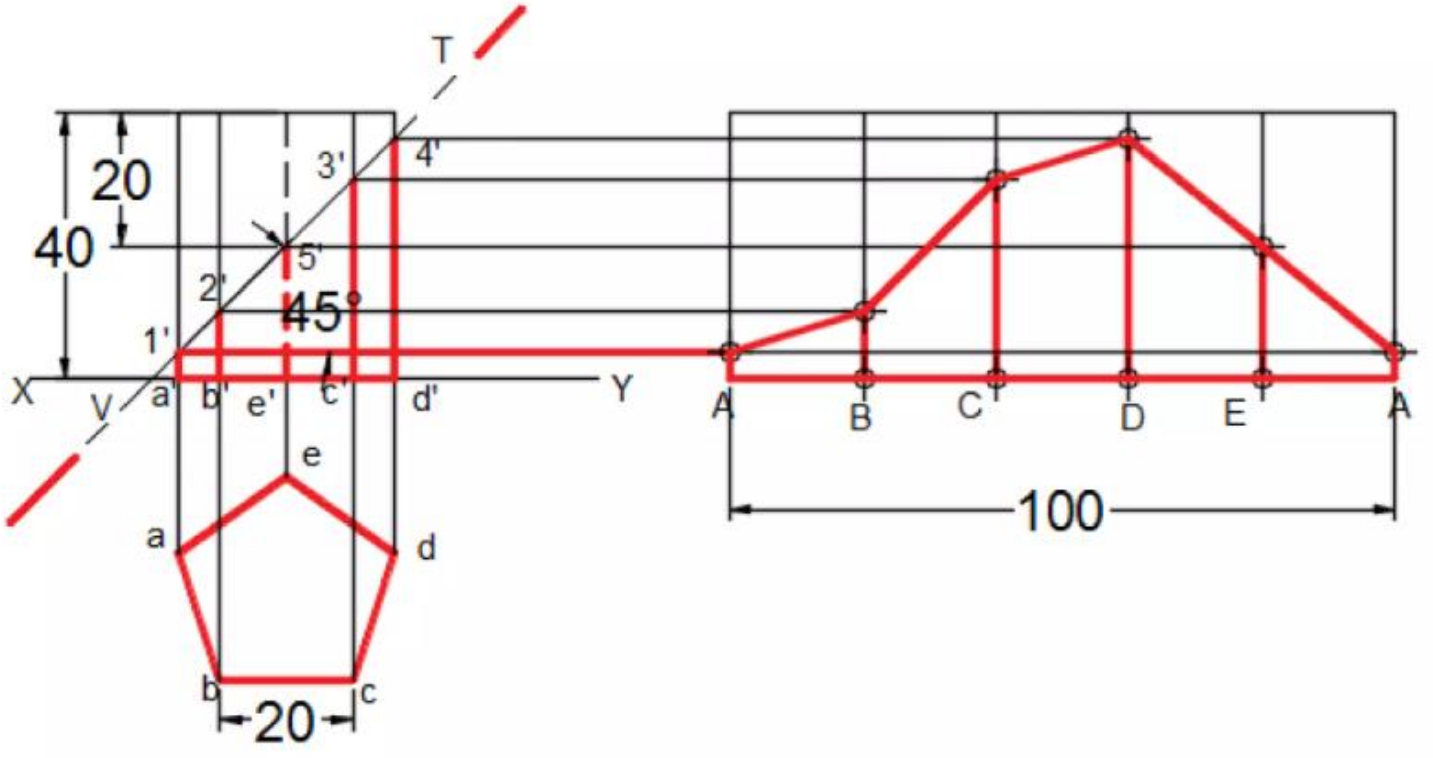
(2) Radial line development: It is used for pyramids and cones in which the true length of the slant edge or the generator is used as radius.

(3) Triangulation development: This is used to develop transition pieces. This is simply a method of dividing a surface into a number of triangles and transferring them into the development.

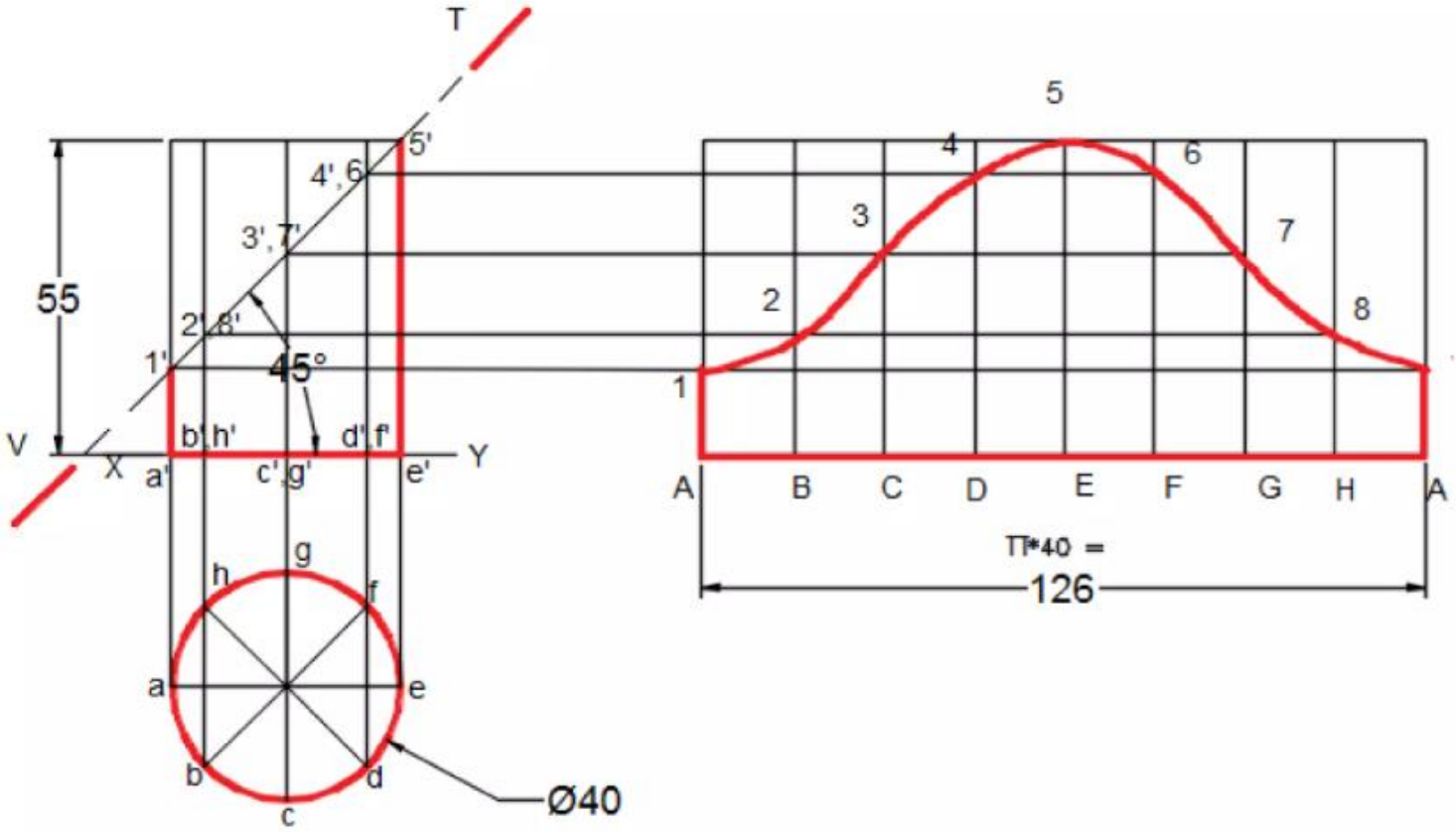
(4) Approximate method: It is used to develop objects of double curved or warped surfaces as sphere, paraboloid, ellipsoid, hyperboloid and helicoid


(a) Prism
(Parallel line devlopment)
(b) Cylinder
(parallel line development)
(c) pyramid
(Radial line development)
(d) cone
(Radial line development)
(e) Sphere
(Approximate development)
(f) tetrahedron
(Triangulation development)

Q1.A Pentagonal prism of side of base 20, the axis is 40 long it is resting on its base on H.P with a rectangular face is parallel to V.P and nearer to the observer. It cut by a section plane inclined at 45^0 to H.P and perpendicular to V.P passing through mid point of the axis. Draw the development of the lateral surface of the cut prism


T
20
40
3'
4'
5'
2'
45°
1'
X
Y
a'
b'
e'
c'
d'
e
a
d
b
c
20
A
B
C
D
E
A
100

Q2. A cylinder of diameter of base 40 and axis 55 long is resting on its base on H.P. It cut by a section plane inclined at 45^0 to H.P and perpendicular to V.P passing through top end of an extreme generator of the cylinder. Draw the development of the lateral surface of the cylinder.

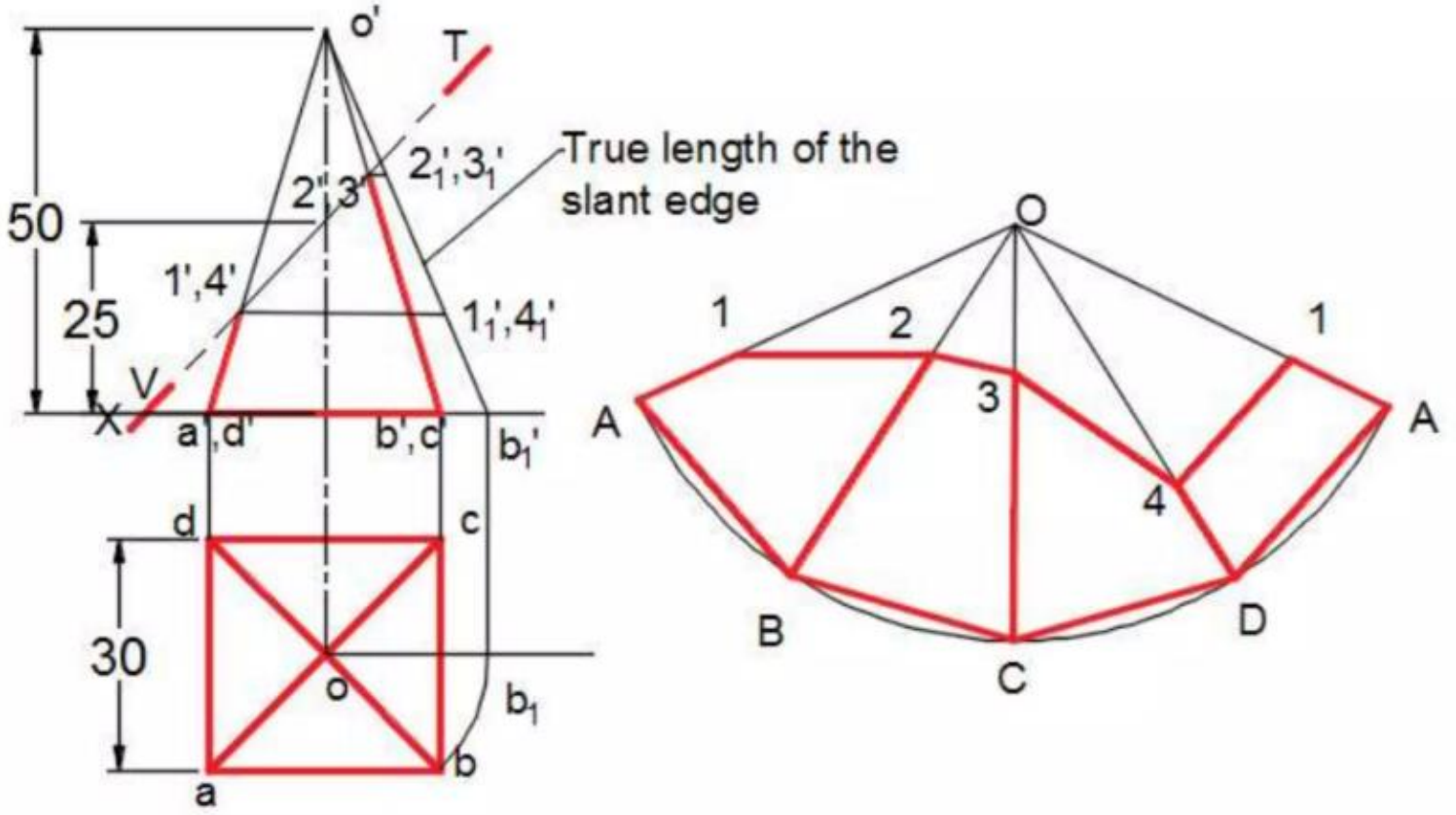

T
5'
4', 6
3', 7'
2', 8'
1'
55
45°
V
X
Y
b' h'
d' f'
a'
c' g'
e'
h
g
f
a
e
b
d
c
Ø40
5
4
6
3
7
2
8
1
A
B
C
D
E
F
G
H
A
TT*40 =
126

Method of drawing the development of the lateral surface of a pyramid:

(i) With any point O as centre and radius equal to the true length of the slant edge of the pyramid, draw an arc of the circle. With radius equal to the true length of the side of the base, step-off (on this arc) the same number of divisions as the number of sides of the base.

(ii) Draw lines joining the division-points with each other in correct sequence and also with the centre for the arc. The figure thus formed (excluding the arc) is the development of the lateral surface of the pyramid.

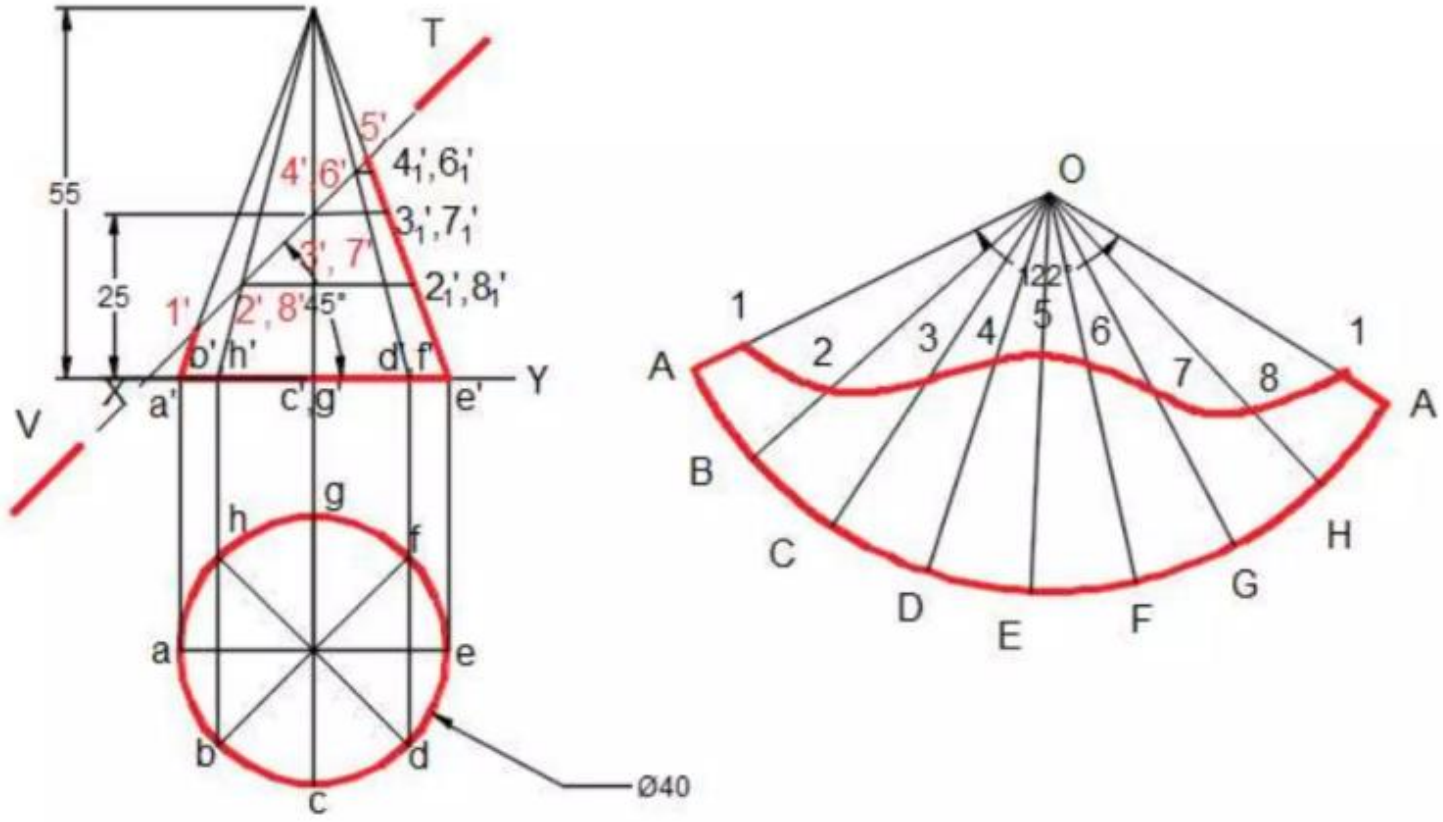
Q3. A square pyramid, with side of the base 30 and axis 50 long is resting on its base on H.P with an edge of the base is parallel to V.P. It cut by a section plane inclined at 45^0 to H.P and perpendicular to V.P passing mid point of the axis. Draw the development of the surface of the cut pyramid.


o'
T
2',3'
$2_1',3_1'$
True length of the slant edge
50
25
1',4'
$1_1',4_1'$
V
X
a',d'
b',c'
b_1'
d
c
30
o
b_1
b
a
O
1
2
1
A
3
A
4
B
D
C

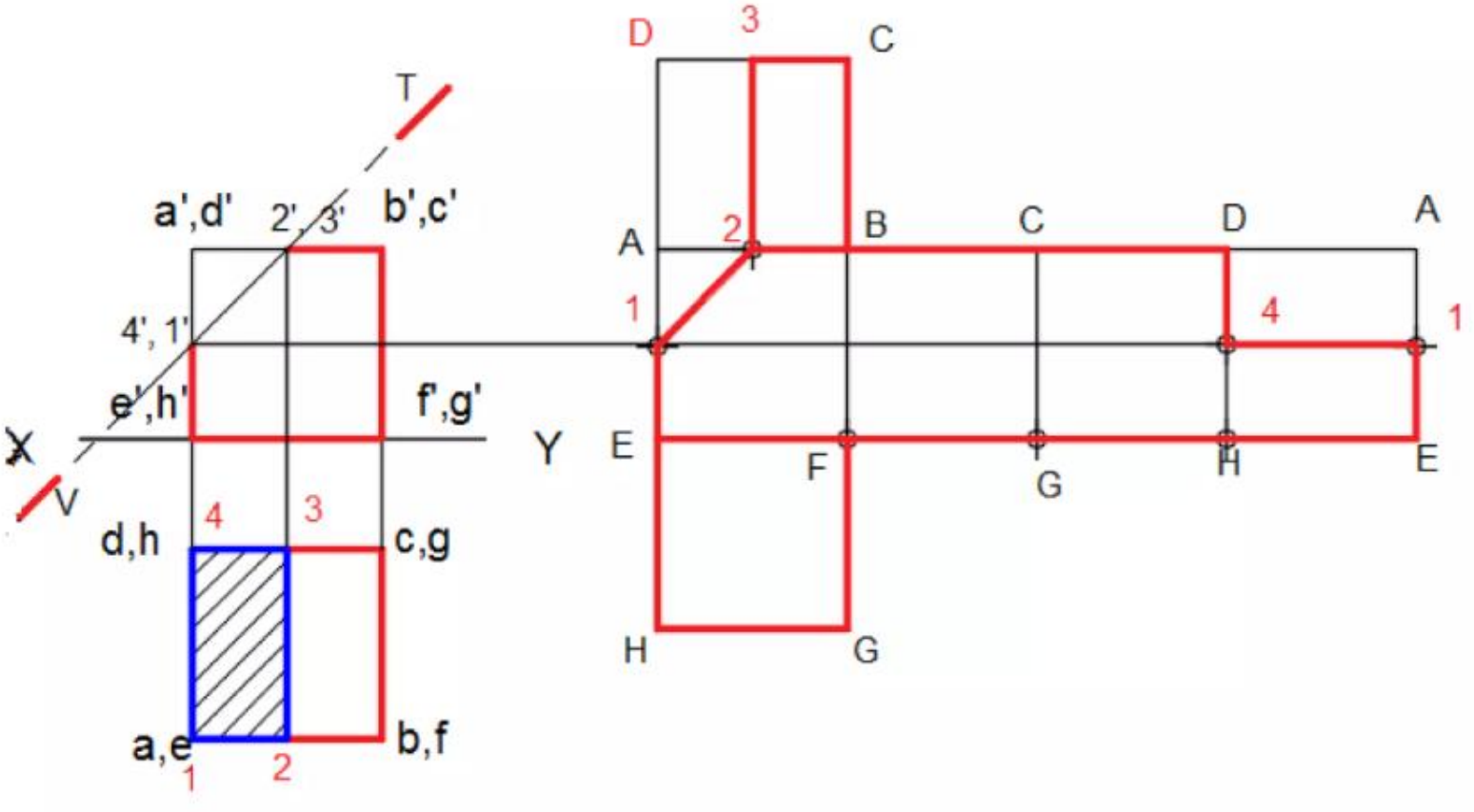
Q4. A cone of base 40 diameter and axis 55 long is resting on its base on H.P. with an edge of the base is parallel to V.P. It cut by a section plane inclined at 45^0 to H.P and perpendicular to V.P passing through a point on the axis at a distance 25 above the base. Draw the development of the surface of the cut solid.

Calculate the subtended angle θ by the formula,

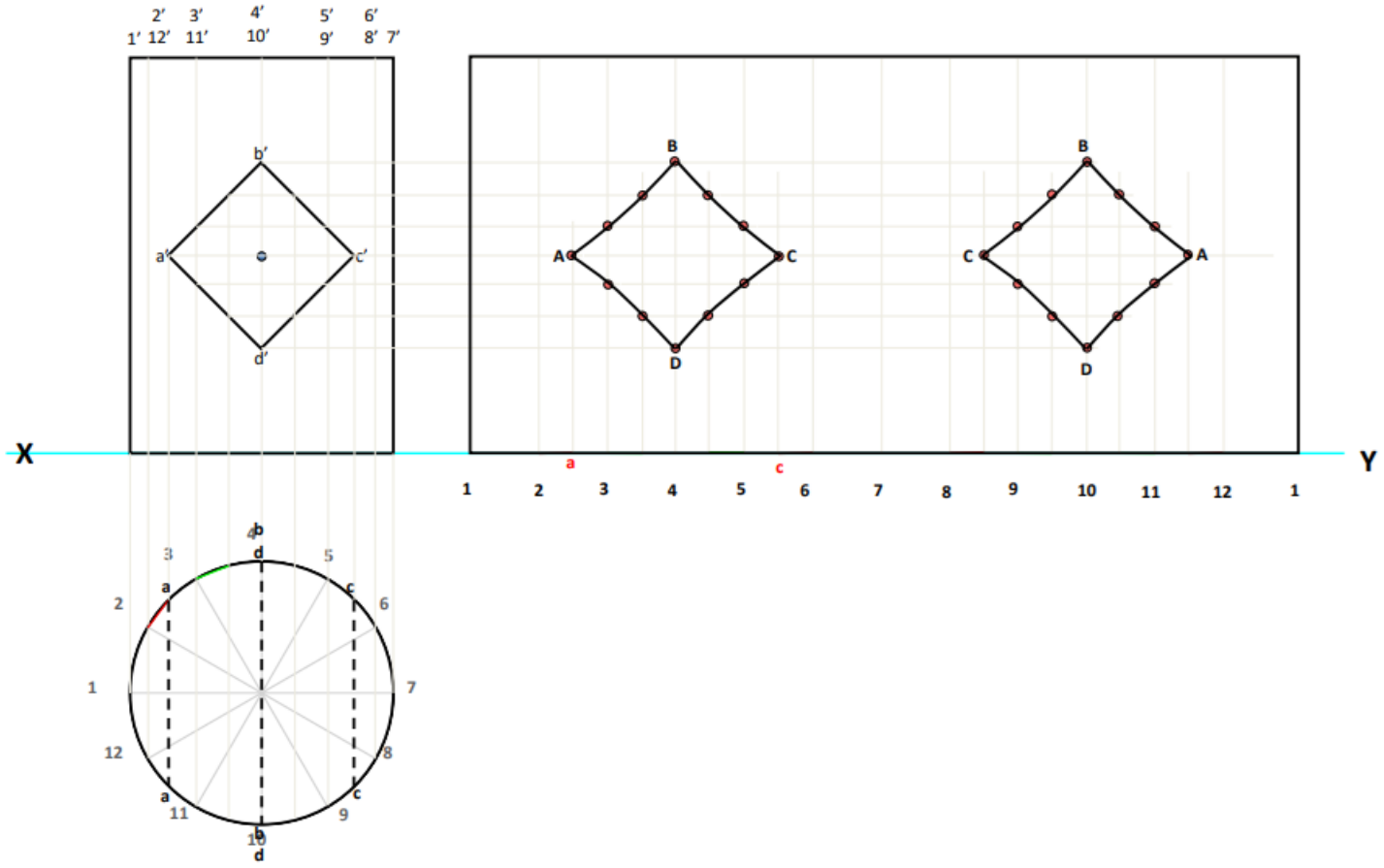
$$\theta = 360^\circ \times \frac{\text{radius of the base circle}}{\text{slant height}}.$$


T
5'
4',6'
4₁',6₁'
55
3₁',7₁'
3', 7'
2₁',8₁'
25
1'
2', 8'
45°
b' h'
d' f'
Y
V
a'
c' g'
e'
h
g
f
a
e
b
d
c
Ø40
O
122°
1
2
3
4
5
6
7
8
1
A
A
B
C
D
E
F
G
H

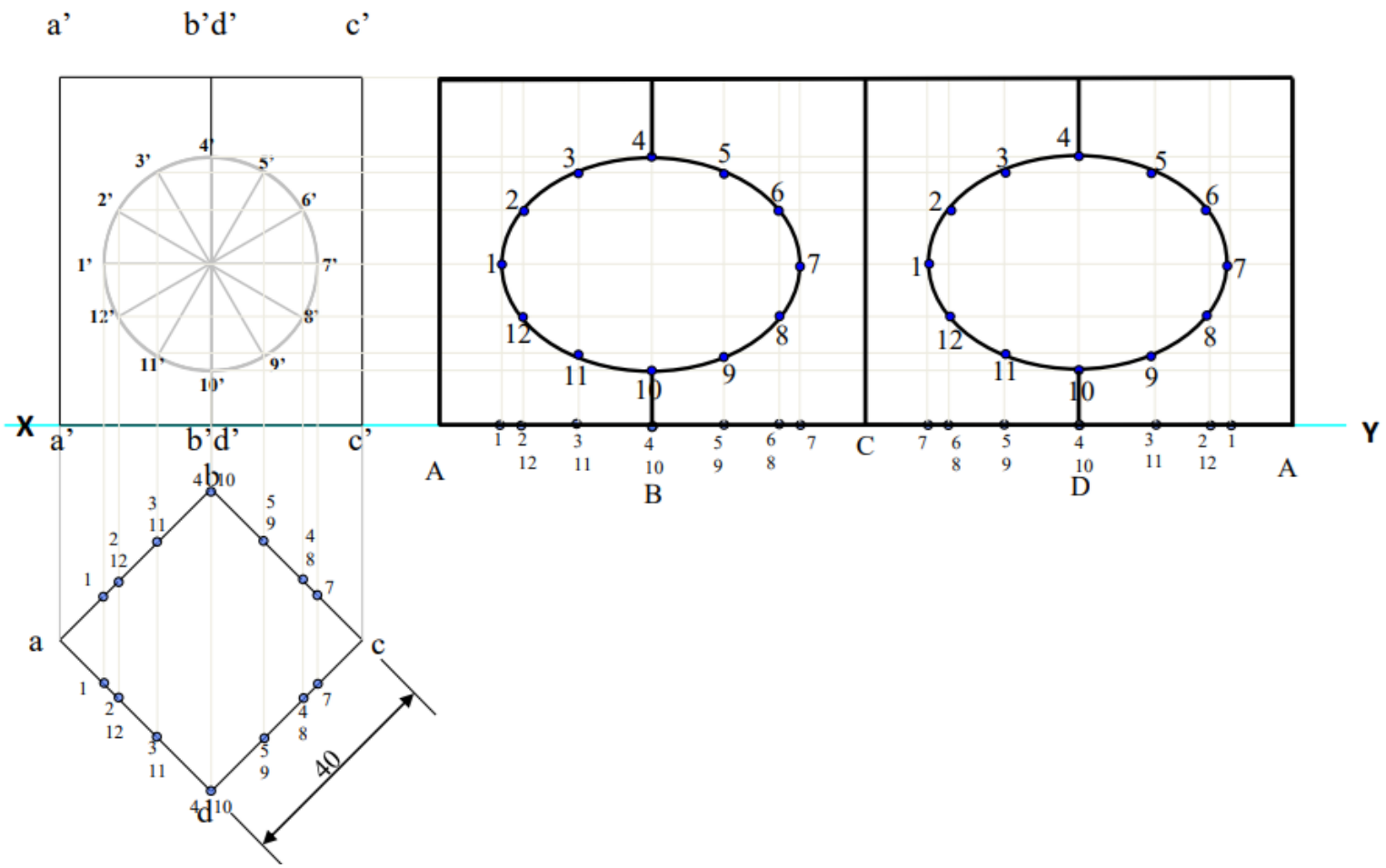
Q5.Draw the development of the surface of the cut portion of the cube, the front view and top view is shown in fig.



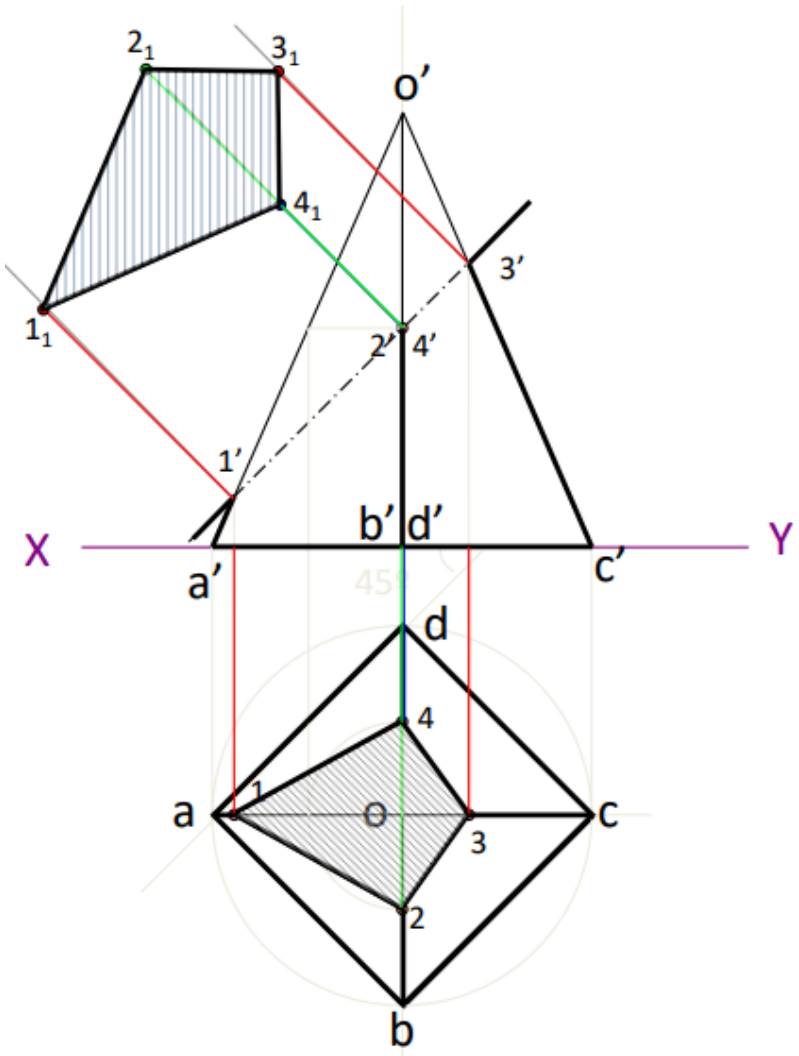
Q.15.11: A right circular cylinder, base 50 mm diameter and axis 60 mm long, is standing on HP on its base. It has a square hole of size 25 in it. The axis of the hole bisects the axis of the cylinder and is perpendicular to the VP. The faces of the square hole are equally inclined with the HP. Draw its projections and develop lateral surface of the cylinder.

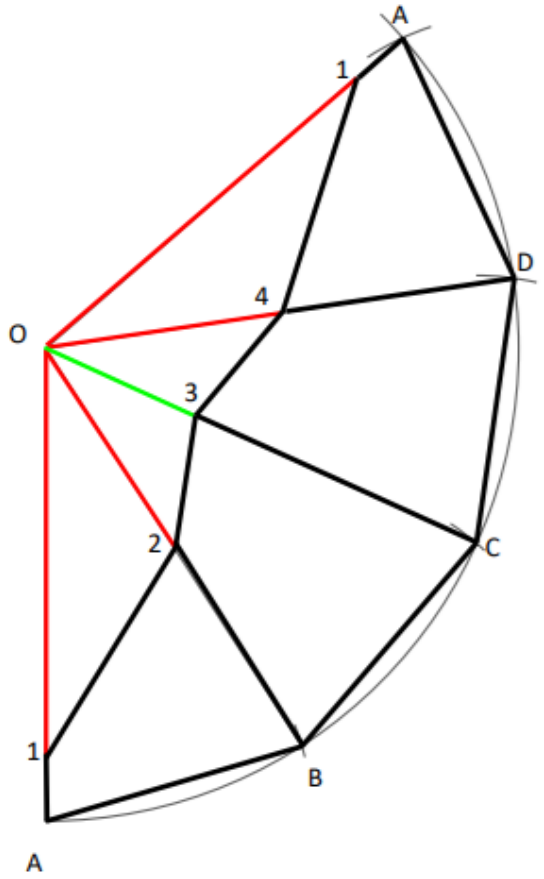

2′ 3′ 4′ 5′ 6′
1′ 12′ 11′ 10′ 9′ 8′ 7′
b′
a′
c′
d′
B
A
C
D
B
C
A
D
X
Y
a
c
1 2 3 4 5 6 7 8 9 10 11 12 1
b
d
3
5
a
c
2
6
1
7
12
8
a
c
11
9
b
d

Q: A square prism of 40 mm edge of the base and 65 mm height stands on its base on the HP with vertical faces inclined at 45º with the VP. A horizontal hole of 40 mm diameter is drilled centrally through the prism such that the hole passes through the opposite vertical edges of the prism, draw the development og the surfaces of the prism.

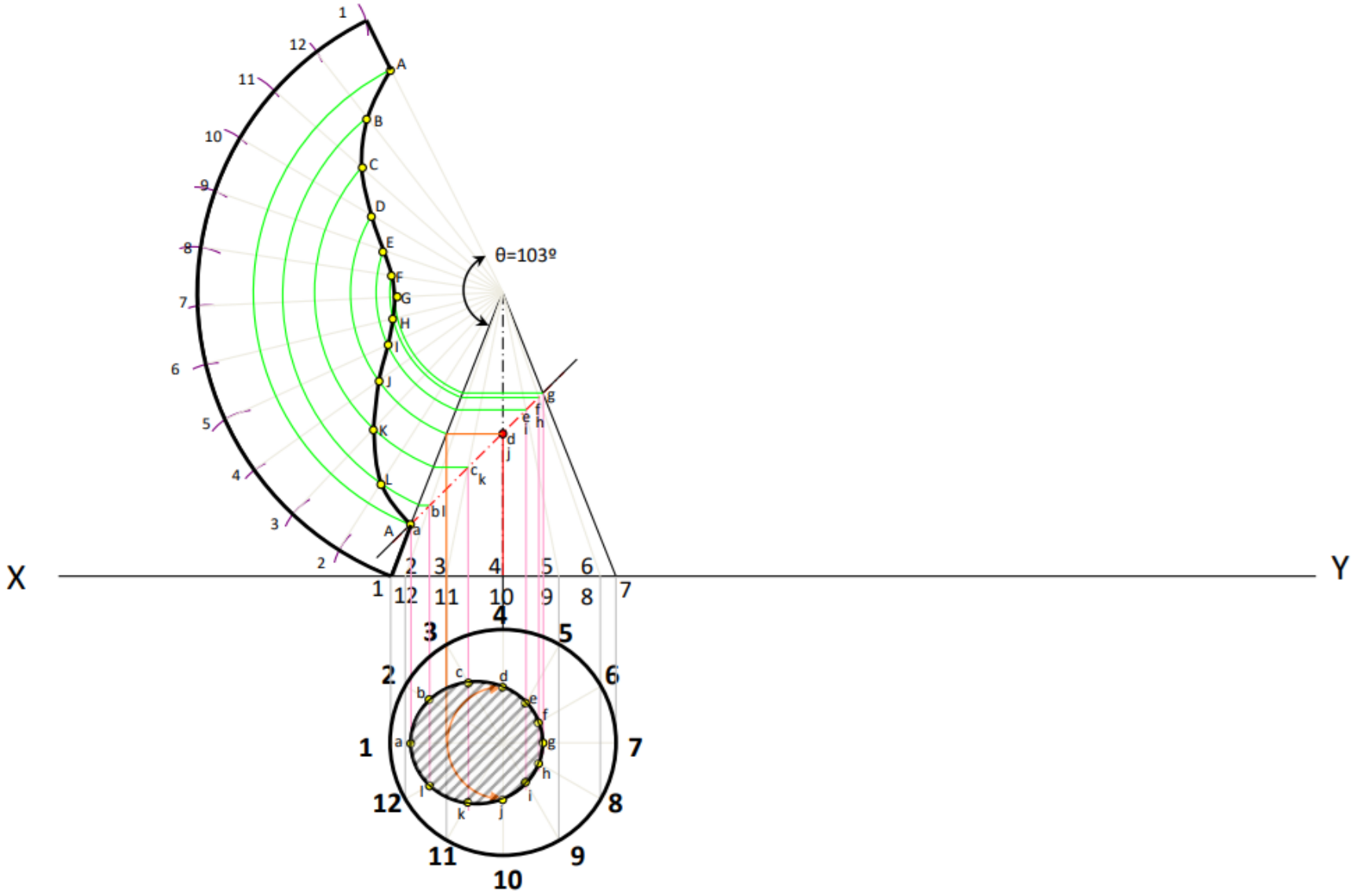

a’
b’d’
c’
X
Y
A
B
C
D
a
b
c
d
40

Q 14.11: A square pyramid, base 40 mm side and axis 65 mm long, has its base on the HP and all the edges of the base equally inclined to the VP. It is cut by a section plane, perpendicular to the VP, inclined at 45º to the HP and bisecting the axis. Draw its sectional top view, sectional side view and true shape of the section. Also draw its development.

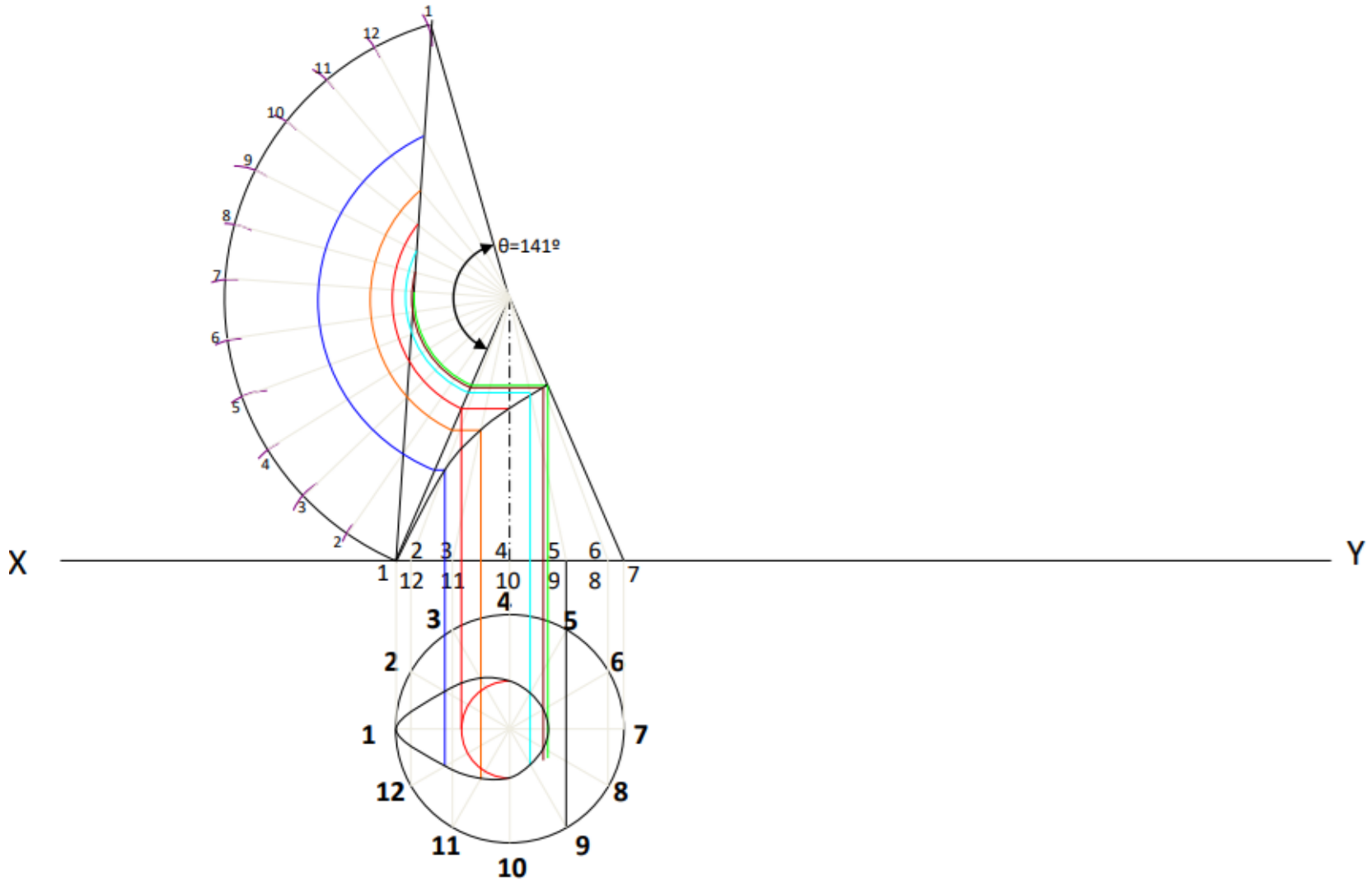

2₁
3₁
o’
4₁
3’
1₁
2’
4’
1’
X
b’
d’
Y
a’
c’
d
4
a
1
O
c
3
2
b


A
1
D
4
O
3
2
C
1
B
A

Q 15.26: A right circular cone base 30 mm side and height 50 mm rests on its base on H.P. It is cut by a section plane perpendicular to the V.P., inclined at 45° to the H.P. and bisecting the axis. Draw the projections of the truncated cone and develop its lateral surface.


θ=103º
X
Y
A
B
C
D
E
F
G
H
I
J
K
L
1
2
3
4
5
6
7
8
9
10
11
12

Q 15.26: draw the projections of a cone resting on the ground on its base and show on them, the shortest path by which a point P, starting from a point on the circumference of the base and moving around the cone will return to the same point. Base ofn cone 65 mm diameter ; axis 75 mm long.


X
Y
θ=141º
1
2
3
4
5
6
7
8
9
10
11
12