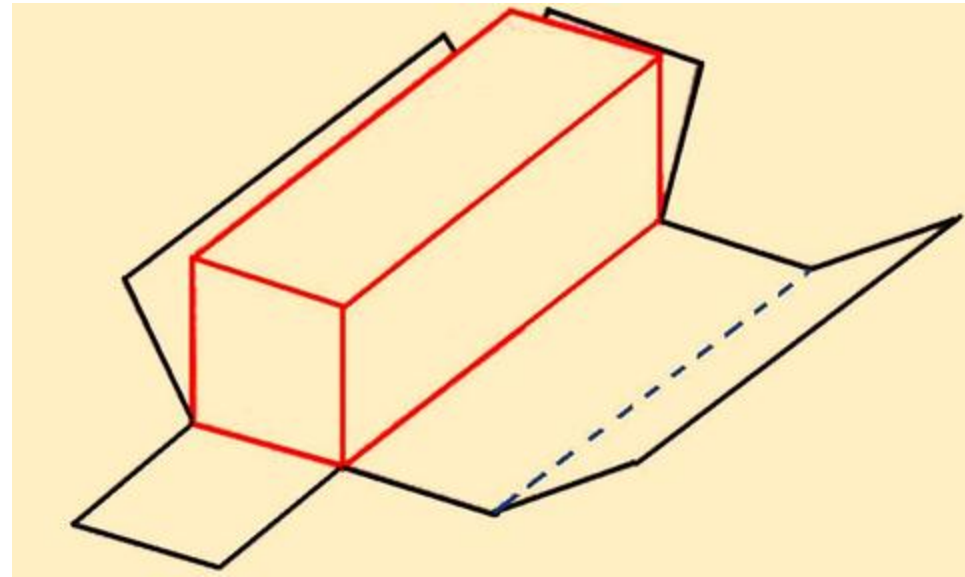# UNIT - IV

DEVELOPMENT OF LATERAL SURFACES OF SIMPLE AND SECTIONED SOLIDS

Definitions

Development of Surfaces of the solid :

1. Suppose an object like a square prism is wrapped around by using paper.

2. When the wrapper is opened and spread out on a plane surface, the resulting figure is called the development of the surfaces of the solid.

Note :

The development of any solid shows the true shape of all the surfaces of the solid.

Methods of Development

1. Parallel line method

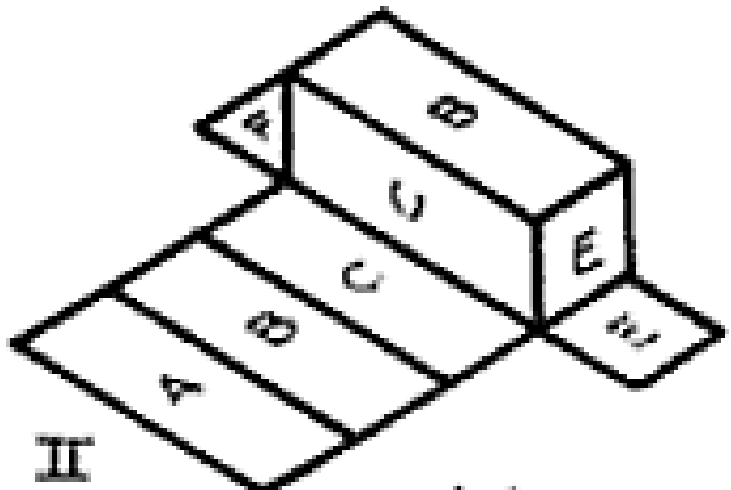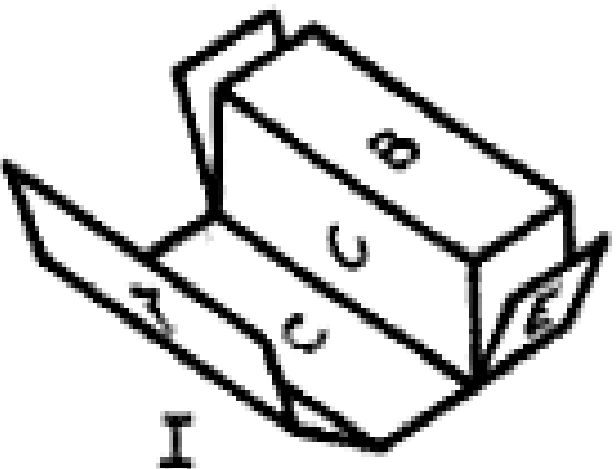2. Radial line method

3. Approximate method

Note :

1. The development of the lateral surfaces of the objects only are shown.

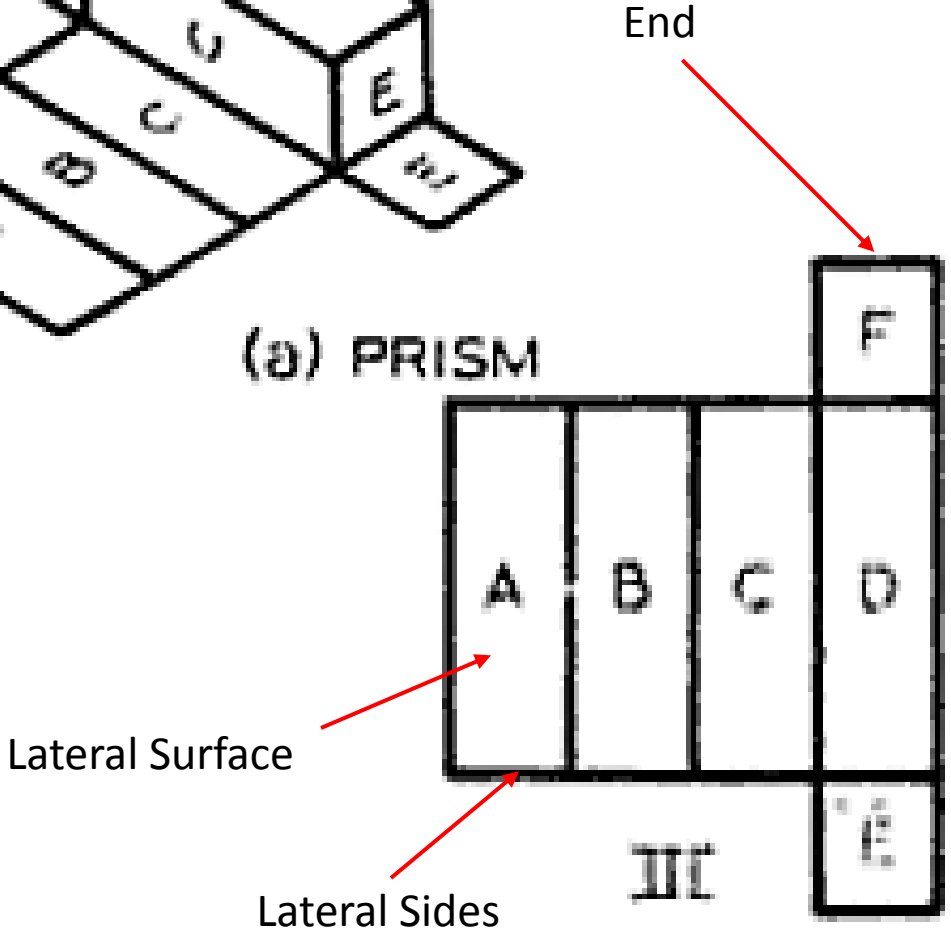2. The base and top are cut to the required geometrical shape and fastened suitably.

PRISMS & CYLINDERS –
Parallel Line Development Method

<http://www.youtube.com/watch?v=IwlrJOHgOB8>

Development of Prism

I

II

(a) PRISM

End

III

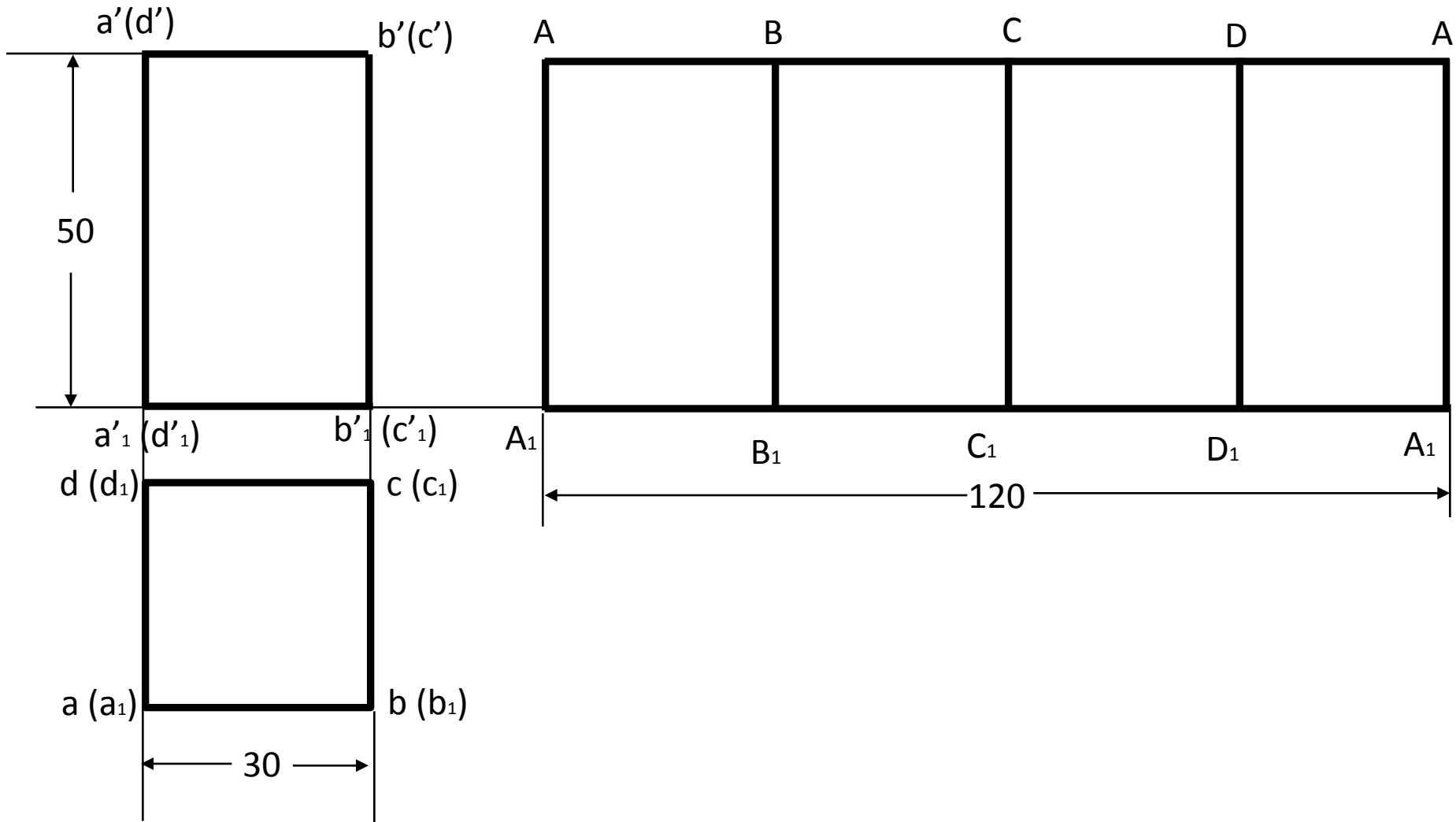| A | B | C | D |
| | | | F |
| | | | E |

Lateral Surface

Lateral Sides
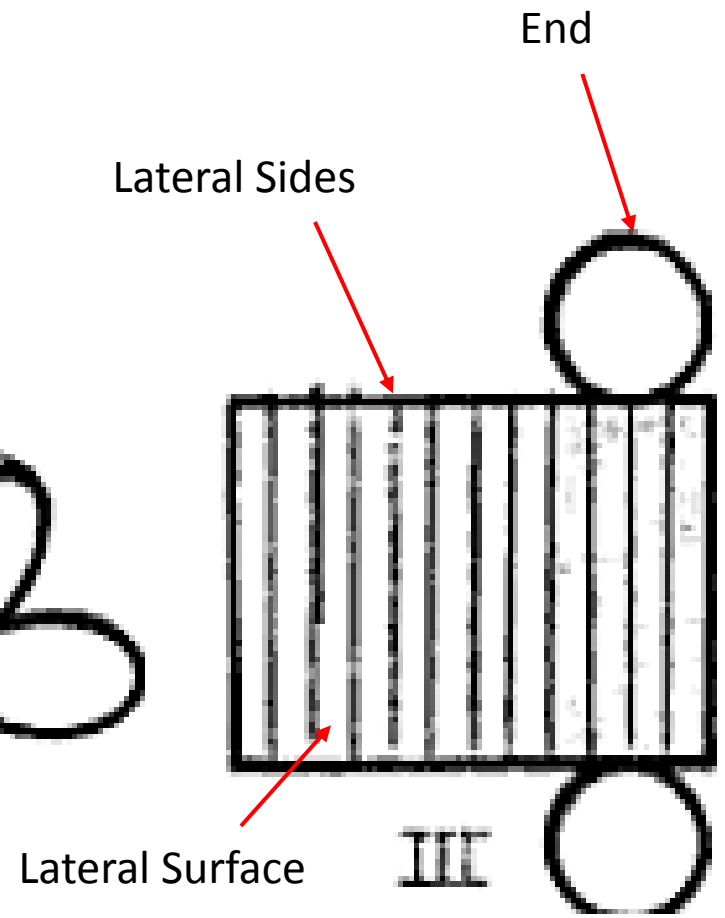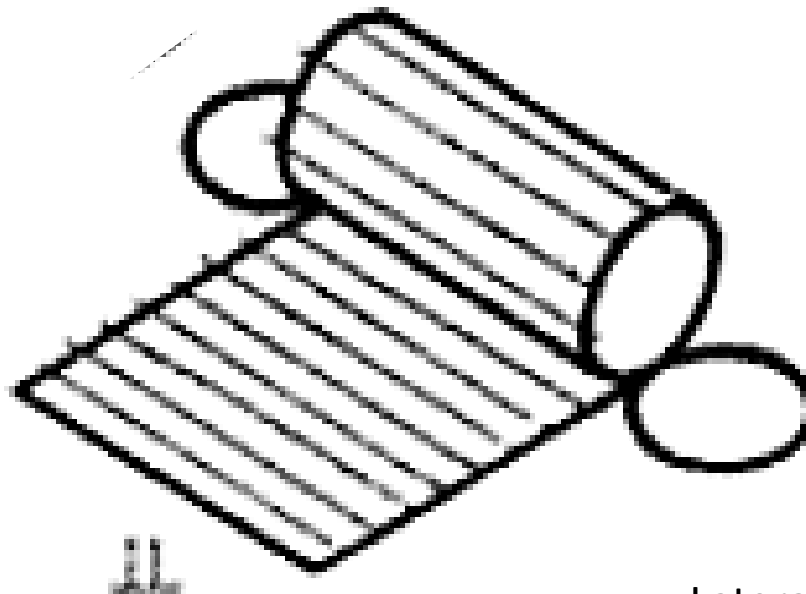
Problem 1

Draw the development of the lateral surfaces of a right square prism of edge of base 30 mm and axis 50 mm long.

Problem 1

Draw a line equal to the length of the perimeter of the base of the prism.

a'(d')   b'(c')   A   B   C   D   A

50

a'$_1$ (d'$_1$)   b'$_1$ (c'$_1$)   A$_1$ B$_1$ C$_1$ D$_1$ A$_1$

d (d$_1$)   c (c$_1$) $\longleftarrow$ 120 $\longrightarrow$

a (a$_1$)   b (b$_1$)

$\longleftarrow$ 30 $\longrightarrow$

Development of Cylinder

I

II

III

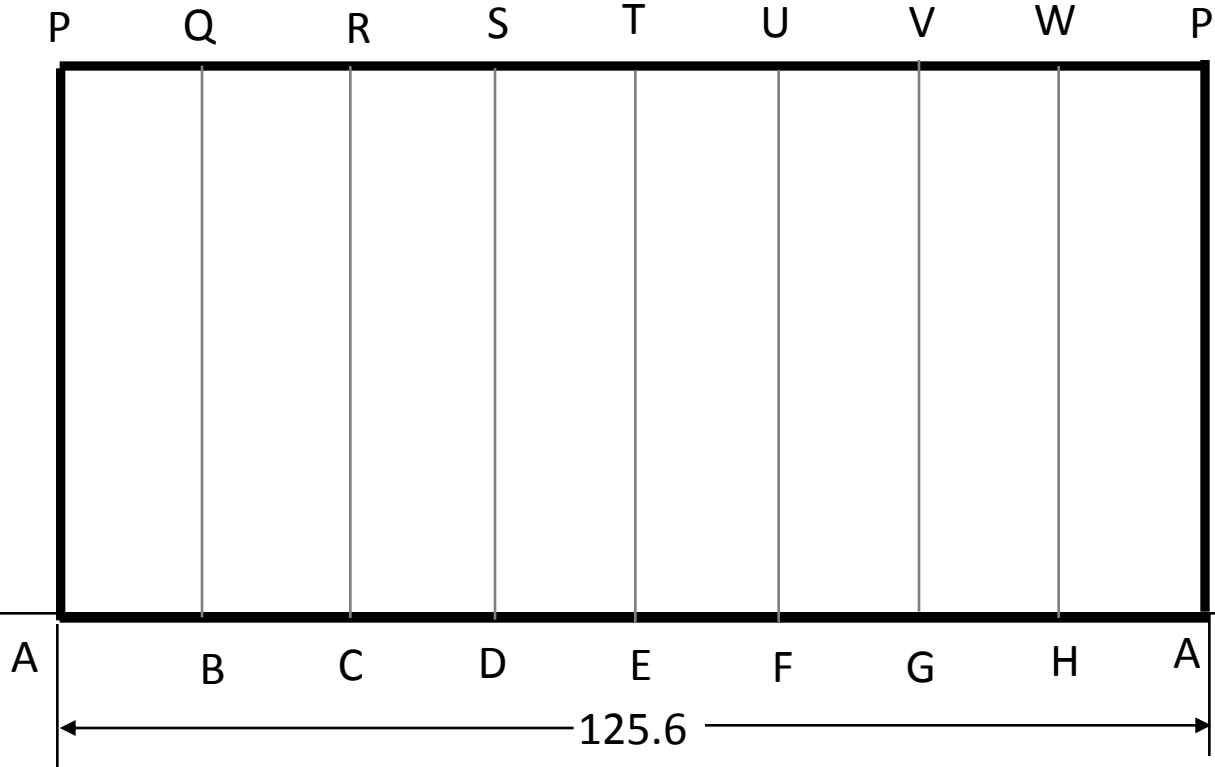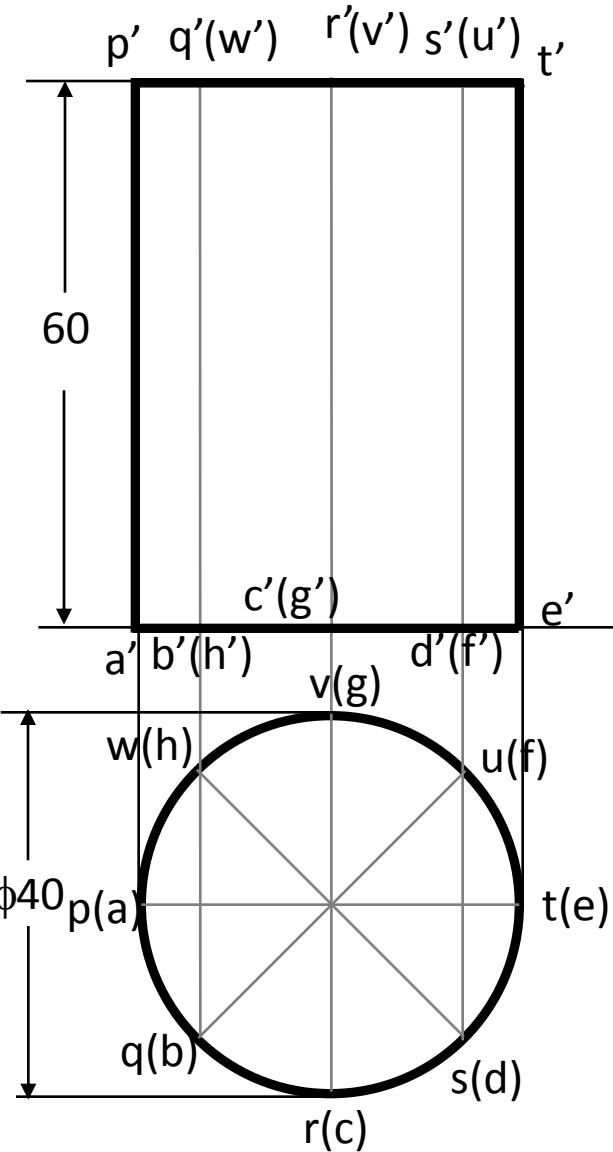End

Lateral Sides

Lateral Surface
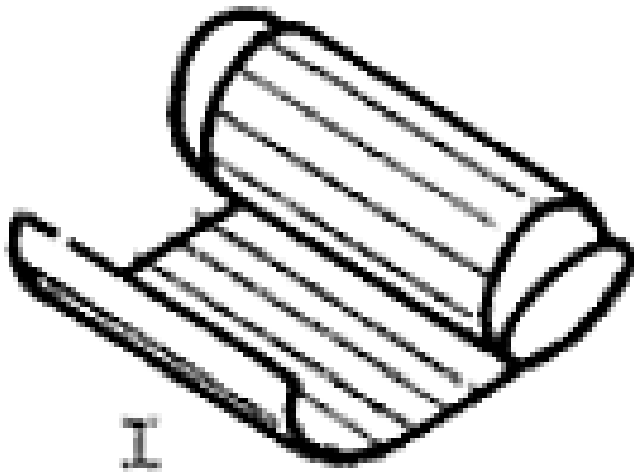
Problem 2

Draw the development of the complete surface of a cylindrical drum. Diameter is 40 mm and height 60 mm.

Problem 2

Draw a line equal to the length of the circumference of the base circle (πD).

Problem 3

A hexagonal prism, edge of base 20 mm and axis 50 mm long, rests with its base on HP such that one of its rectangular faces is parallel to VP. It is cut by a plane perpendicular to VP, inclined at 45° to HP and passing through the right corner of the top face of the prism.

(i) Draw the sectional top view.

(ii)Develop the lateral surfaces of the truncated prism.

Problem 3

Draw six equal rectangles to represent the development of the lateral surfaces of the hexagonal prism in **thin** lines.
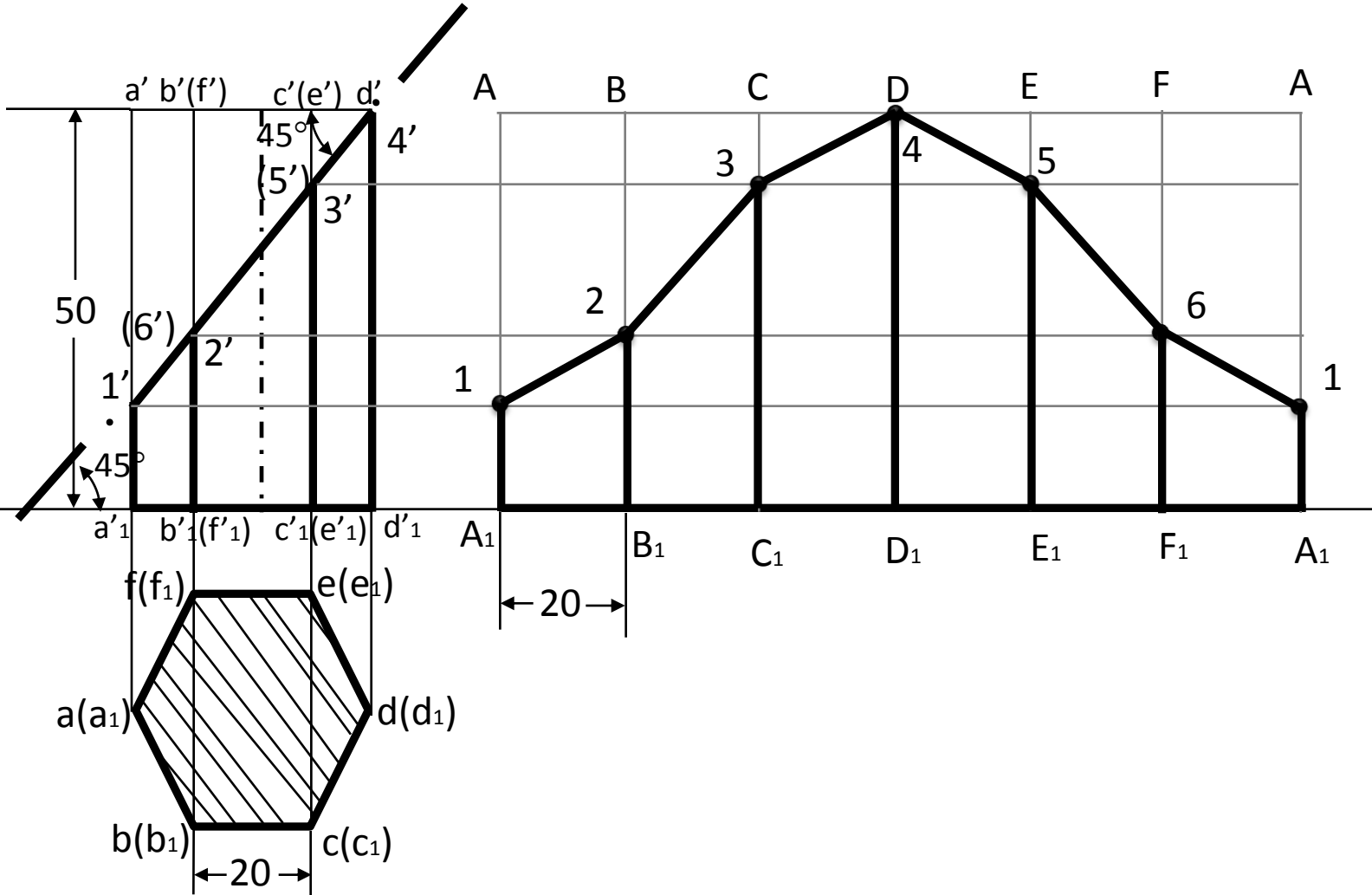
Problem 4

A hexagonal prism of base side 20 mm and height 45 mm is resting on one of its ends on the HP with two of its lateral faces parallel to the VP. It is cut by a plane perpendicular to the VP and inclined at 30° to the HP. The plane meets the axis at a distance of 20 mm above the base. Draw the development of the lateral surfaces of the lower portion of the prism. Page no 300

Problem 4

Removed portion

Stretch out line

45

20

1'

(6')

2'

30°

(5')

3'

4'

p'   q'(u')   r'(t')   s'

×

20

(a)

1

1

2

3

4

5

6

P   20   Q   R   S   T   U   P

Stretch out line

6x20=120

(b)
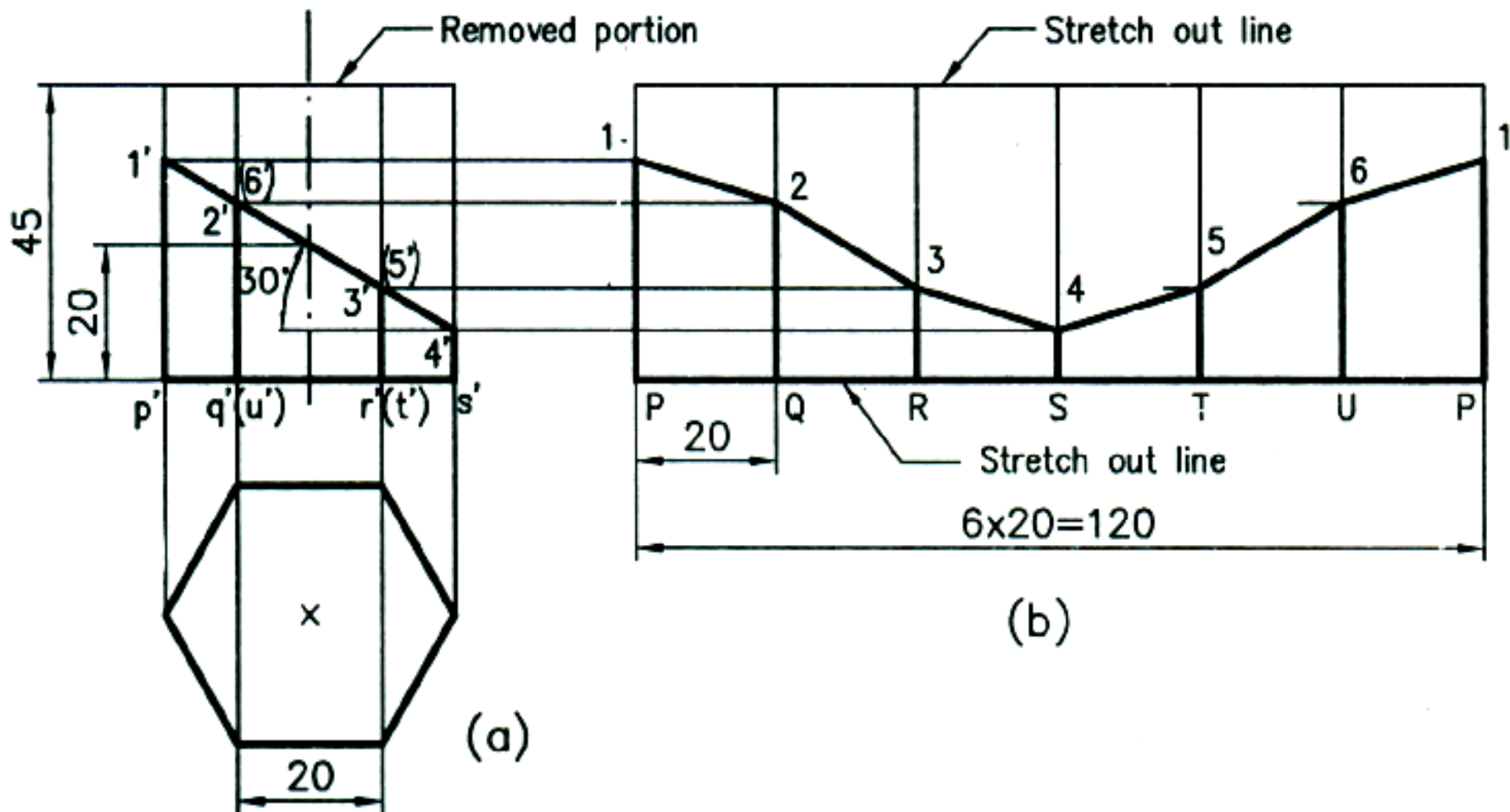
Problem 5

A pentagonal prism, side of base 25 mm and altitude 50 mm, rests on its base on the HP such that an edge of the base is parallel to VP and nearer to the observer. It is cut by a plane inclined at 45° to HP, perpendicular to VP and passing through the center of the axis.

(i) Draw the development of the complete surfaces of the truncated prism.

Problem 5

Problem 6

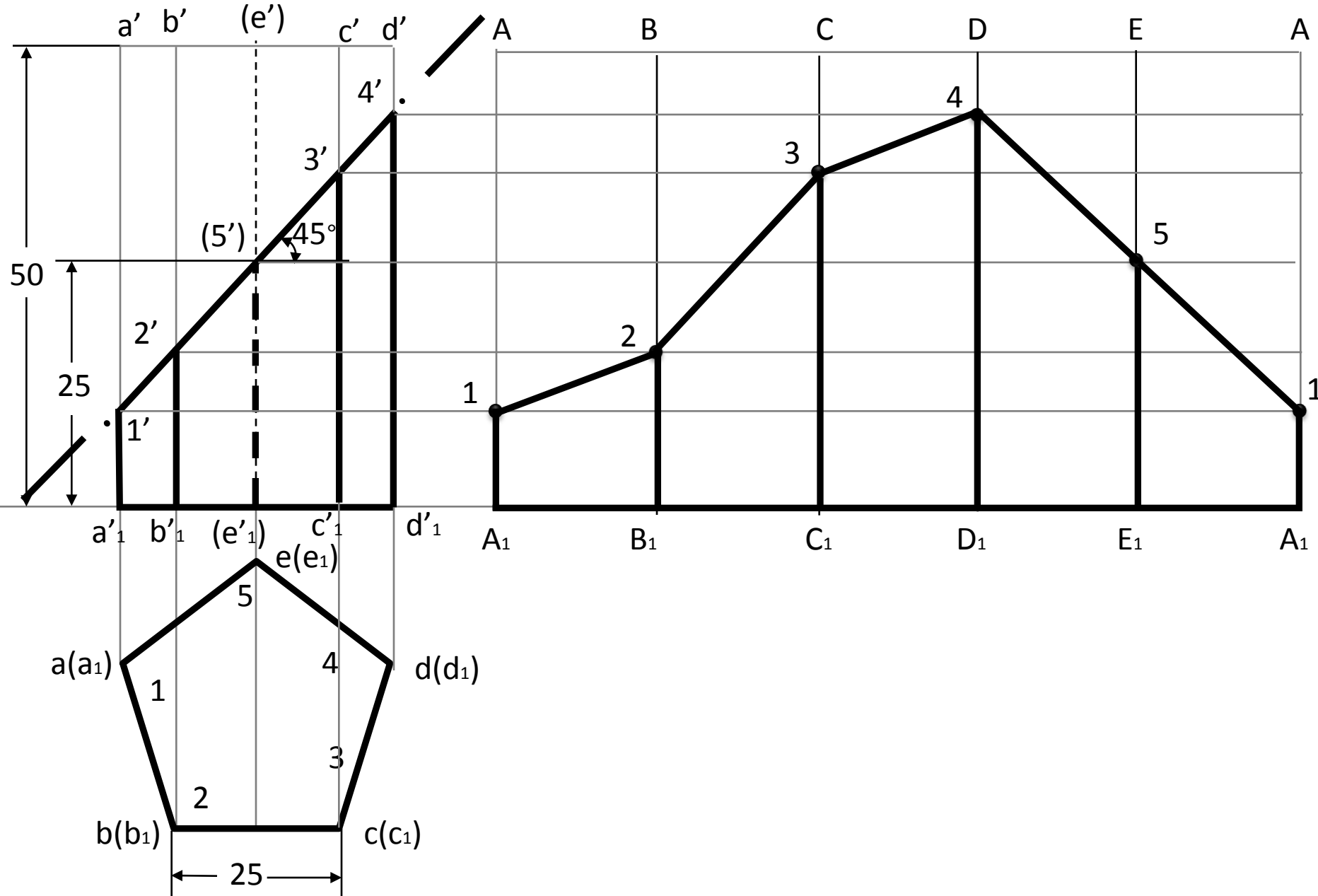A pentagonal prism of side of base 30 mm and altitude 60 mm stands on its base on HP such that a vertical face is parallel to VP and away from observer. It is cut by a plane perpendicular to VP, inclined at an angle of 50° to HP and passing through the axis 35 mm above the base. Draw the development of the lower portion of the prism. Page no 15.4 (Exercise)

Problem 7

Draw the development of the lateral surface of the lower portion of a cylinder of diameter 50 mm and axis 70 mm when sectioned by a plane inclined at 40° to HP and perpendicular to VP and bisecting axis.
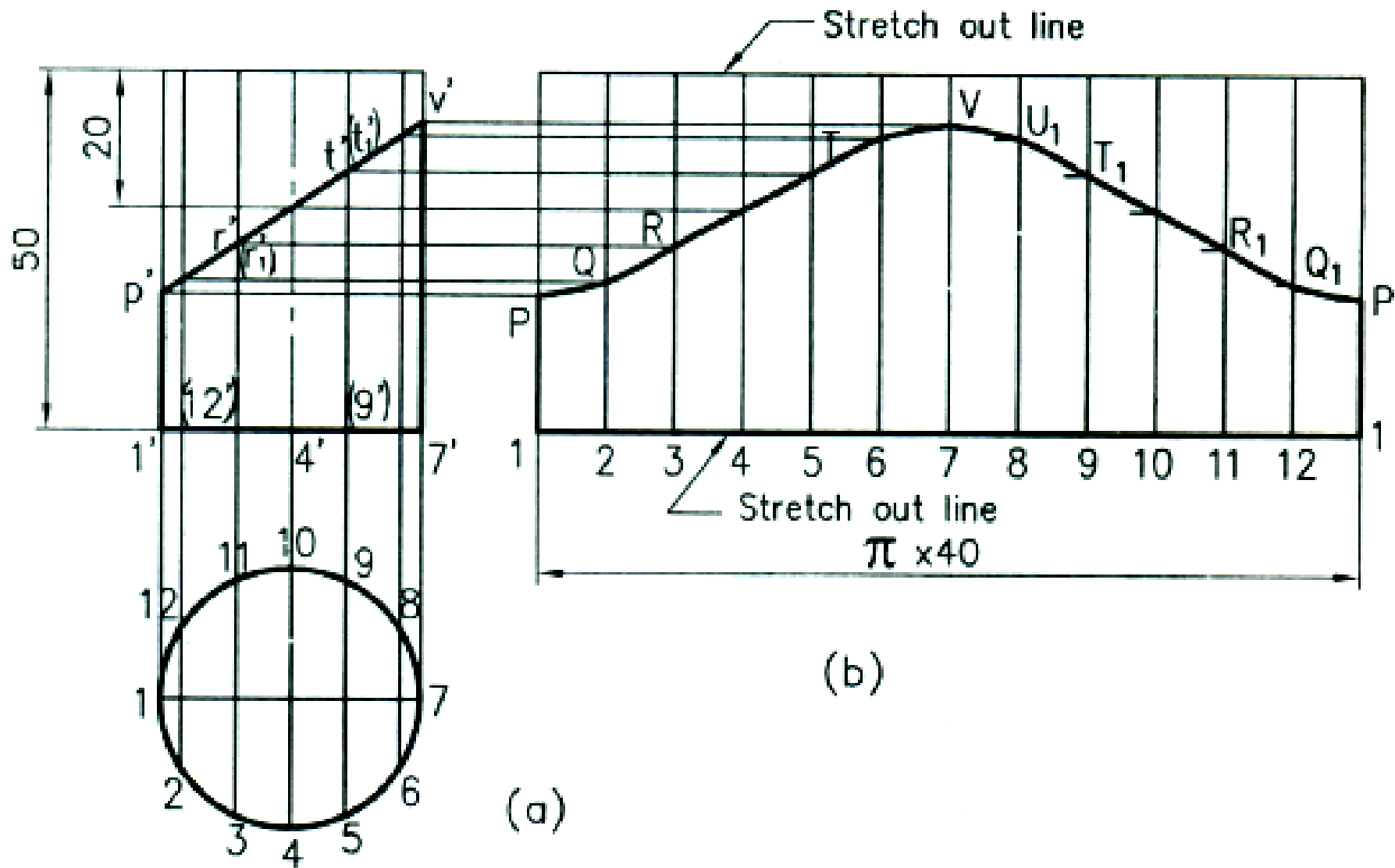
Problem 7

Draw a line equal to the length of the circumference of the base circle (πD).
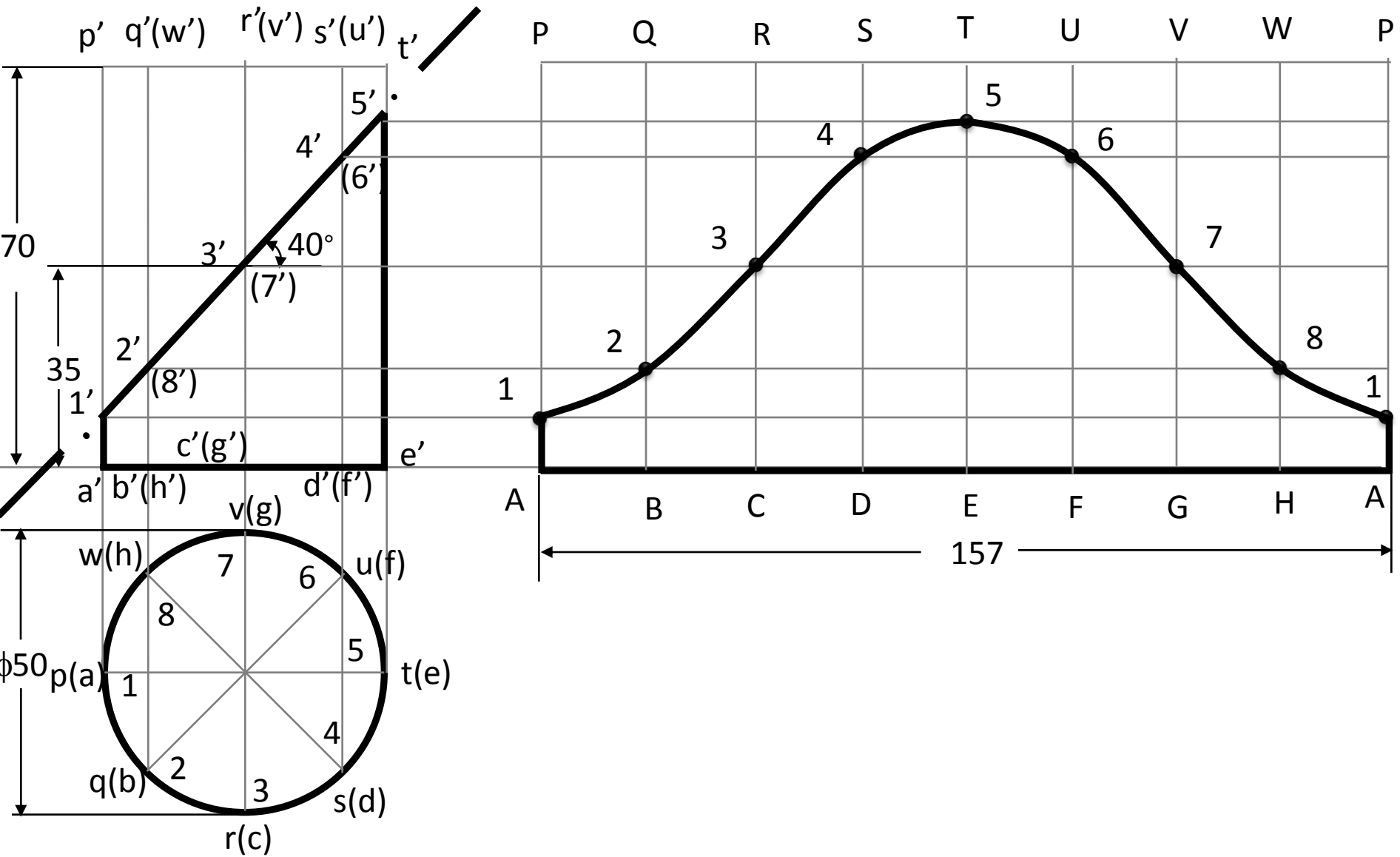
Problem 8

A cylinder of diameter 40 mm and height 50 mm is resting vertically on one of its ends on the HP. It is cut by a plane perpendicular to the VP and inclined at 30° to the HP. The plane meets the axis at a point 30 mm from the base. Draw the development of the lateral surface of the lower portion of the truncated cylinder. Page no 305

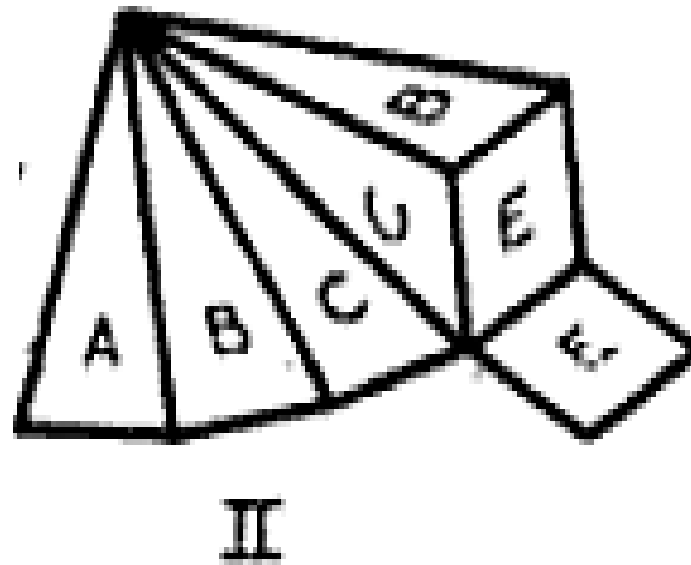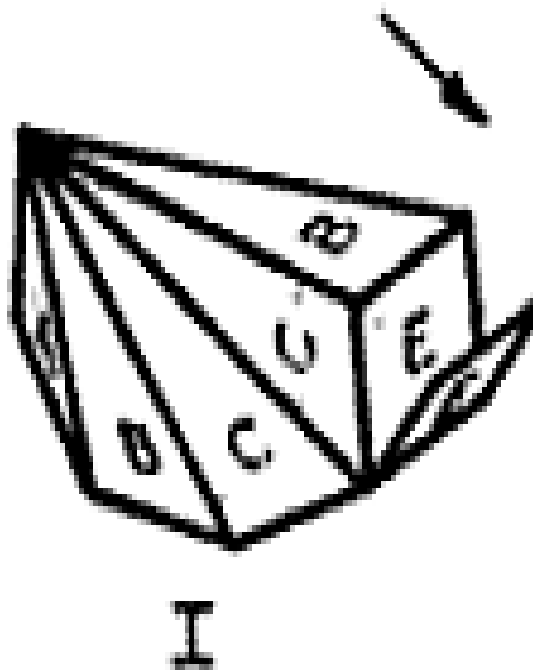**Problem 8**

Stretch out line

$\pi \times 40$

(a)

(b)

Problem 9

A cylinder of diameter 40 mm, height 75 mm is cut by a plane perpendicular to VP and inclined at 55° to HP meeting the axis at top face. Draw the lateral development of the solid.
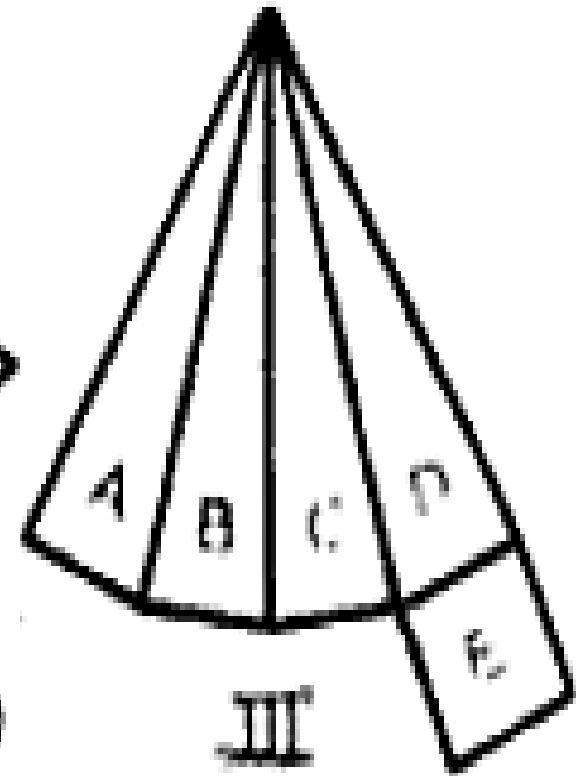
PYRAMIDS **&** *CONES* –
Radial Line Development Method

Development of Pyramid

(c) PYRAMID

Problem 10

Draw the development of the lateral surfaces of a square pyramid, side of base 25 mm and height 50 mm, resting with its base on HP and an edge of the base parallel to VP.

Problem 10   If the top view of a slant edge of a pyramid is parallel to XY, then the front view of that edge will give its true length.

To obtain the true length of a slant edge make **"ob"** parallel to XY.
O as center and ob as radius draw an arc to cut the horizontal drawn from o at a1.

o'

50

a'(d')   b'(c')

a'₁

d

c

25

a₁

o

a   b

True length of slant edge

O

A

25

B

C

D

A

Development of Cone

Slant length

Circumference
of base circle

End

I

II

III
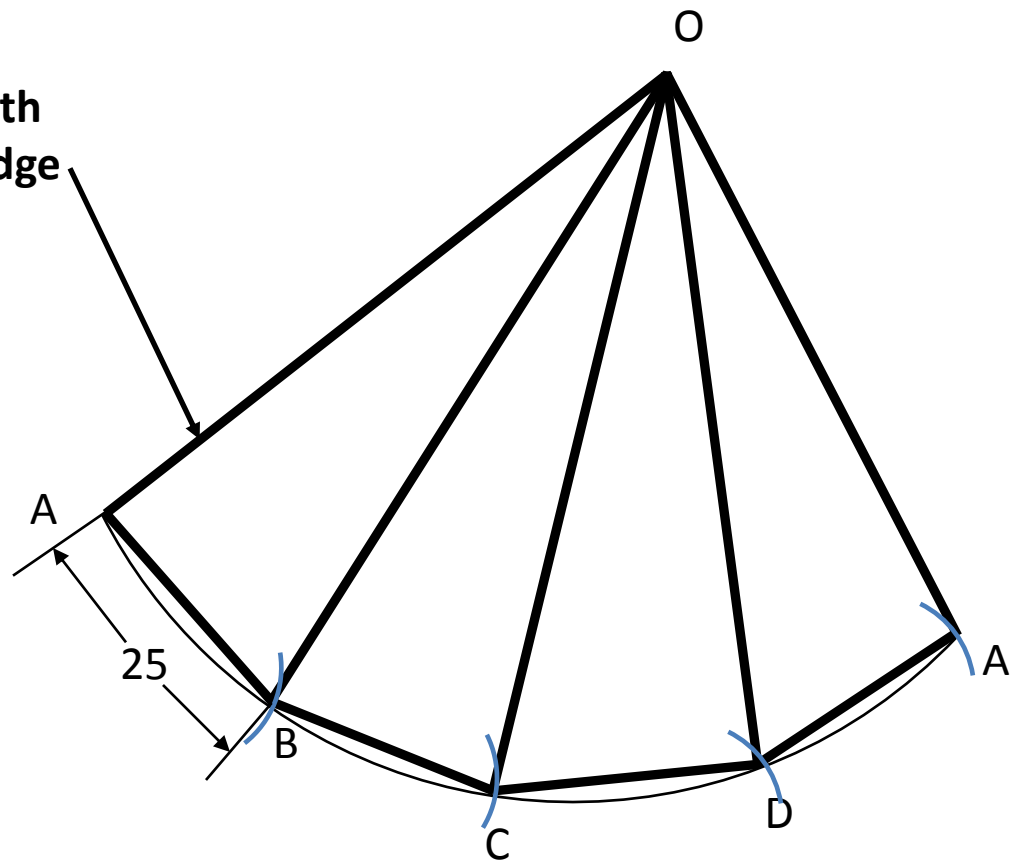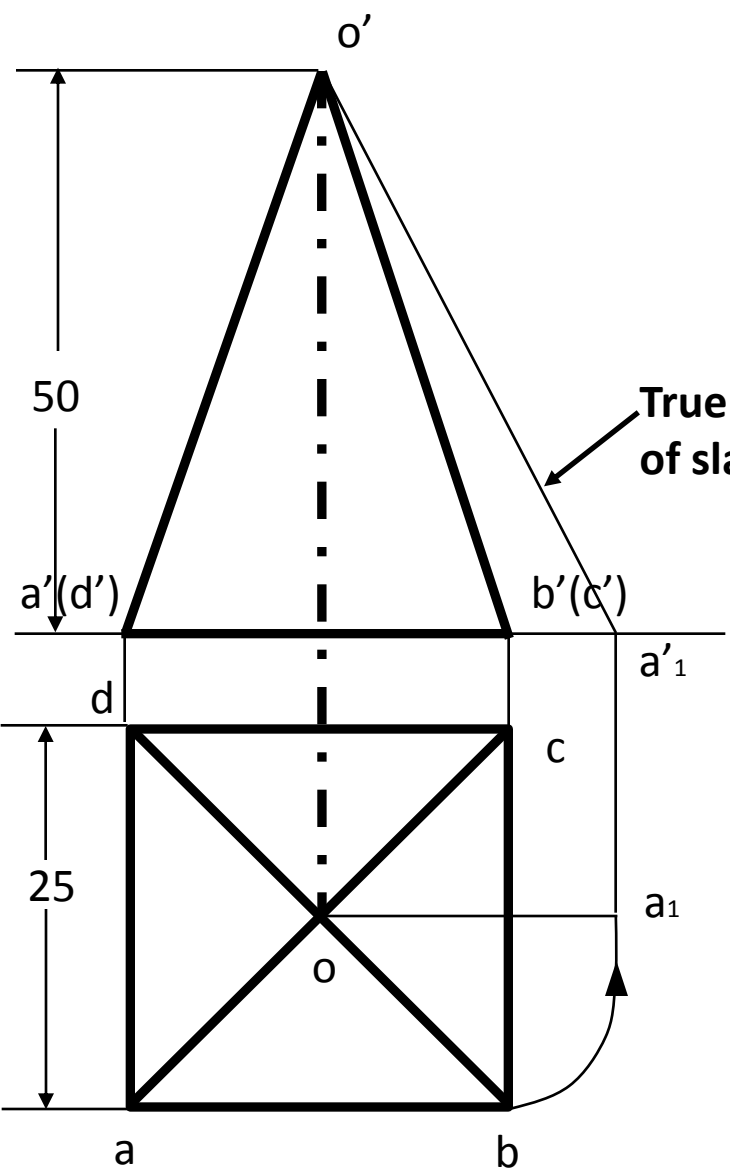
(d) CONE
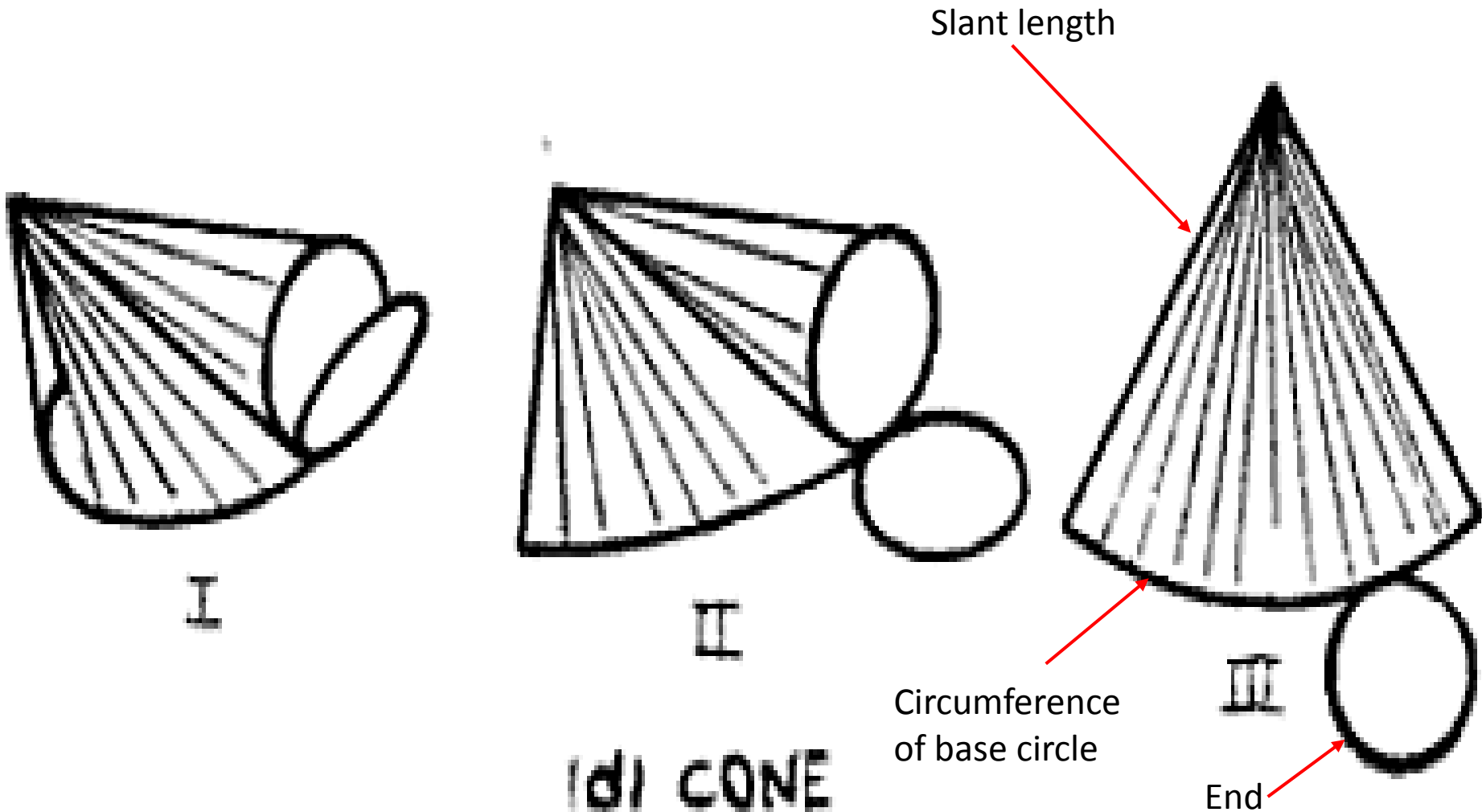
Problem 11

Draw the development of the lateral surface of a cone of base diameter 48 mm and altitude 55 mm.

Problem 11

θ = (Base circle radius/True slant length)*360°
θ = (24/60)*360°
θ =144°

Divide 144° into 4 equal parts.
Per division 36°

o'

True length (L) of slant generator

55

a'   b'(d')   c'

d

ϕ48

a   c

o

b

O

36°   144°

A

A

B

C

D
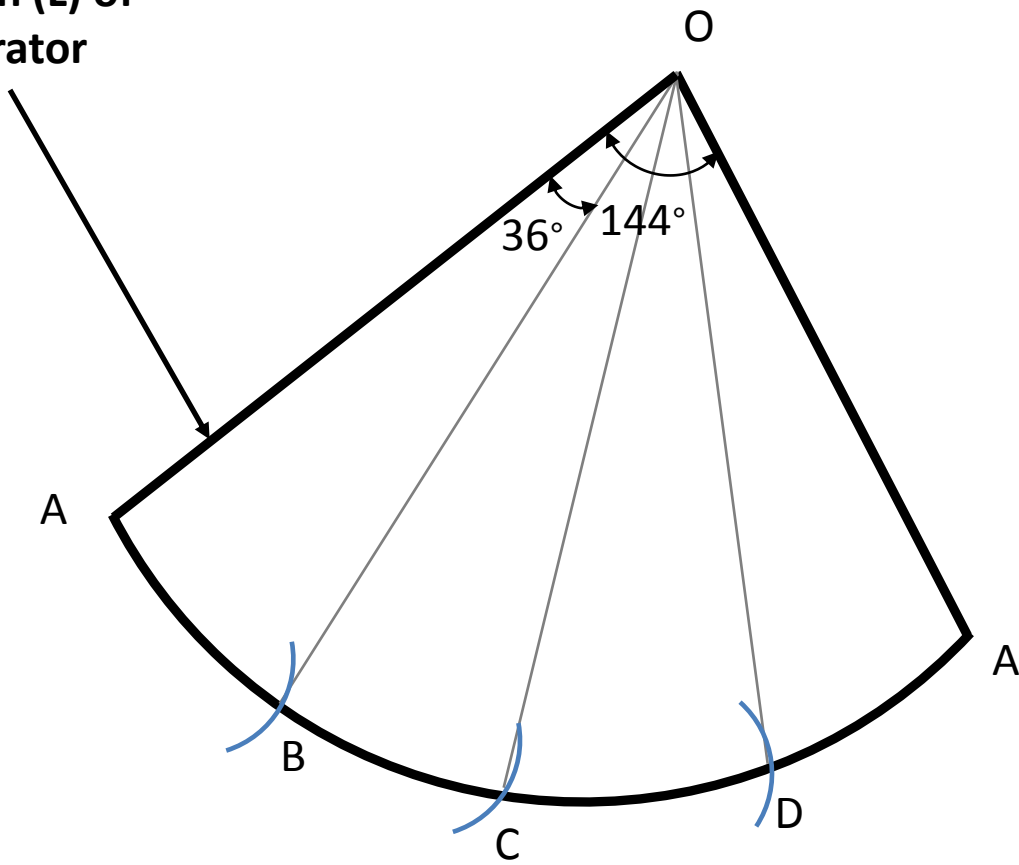
Problem 12

A square pyramid of base side 25 mm and altitude 50 mm rests on it base on the HP with two sides of the base parallel to the VP. It is cut by 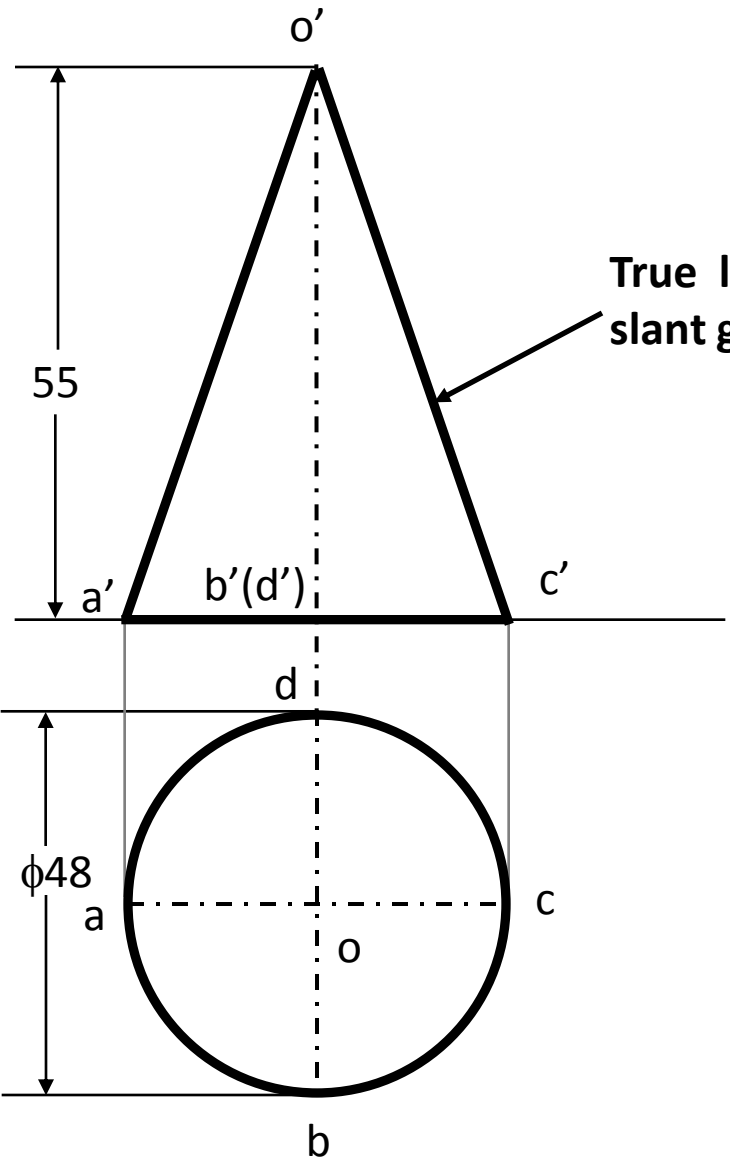a plane bisecting the axis and inclined a 30° to the base. Draw the development of the lateral surfaces of the lower part of the cut pyramid.

Problem 12

o'a'₁ gives the true length of the slant edge.

O1=O4=o'1" , similarly O2=O3=o'2"

To obtain the true length of a slant edge make **"ob"** parallel to XY.

O as center and ob as radius draw an arc to cut the horizontal drawn from o at a1.
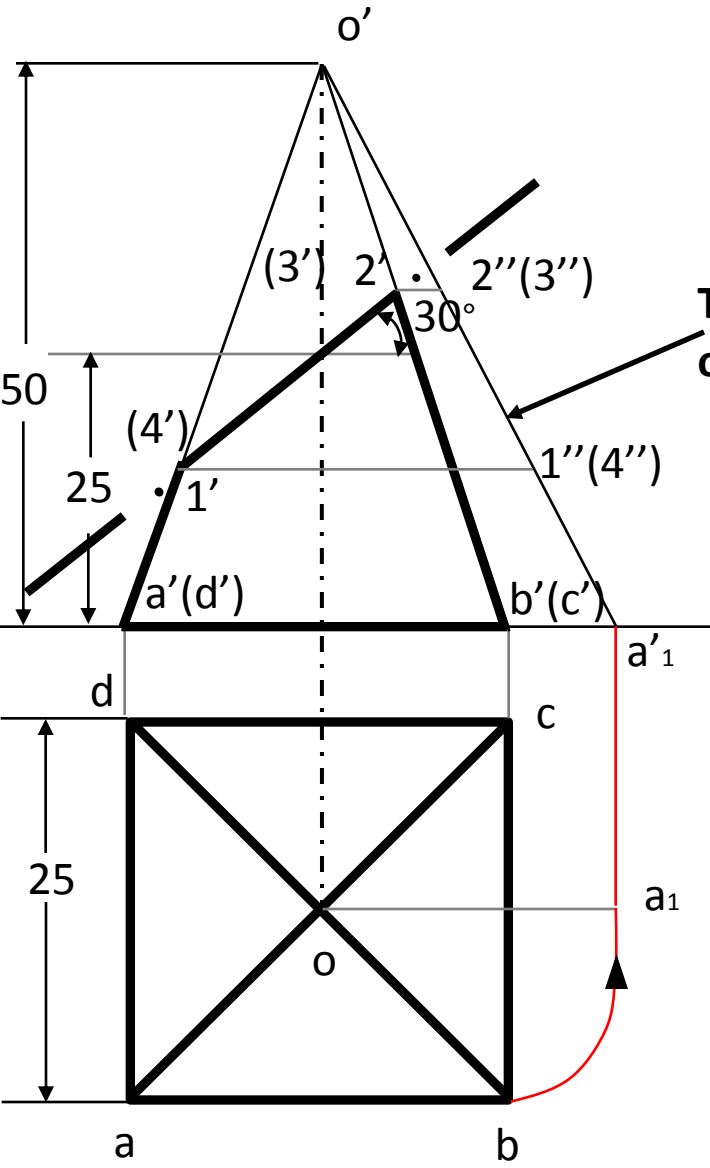
True length of slant edge
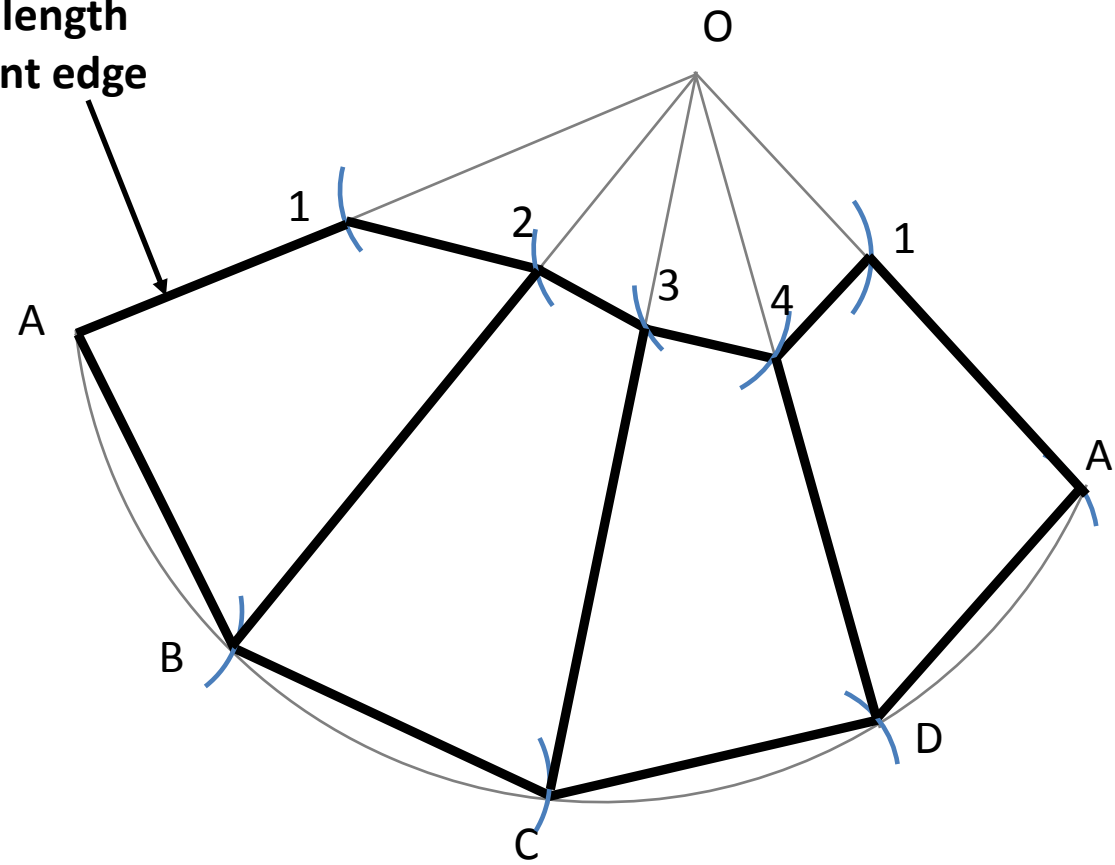
Problem 13

A square pyramid base 35 mm side axis 70 mm long rests on its base on HP such that two adjacent sides of the base are equally inclined to VP. It is sectioned by a plane perpendicular to VP inclined a 30° to HP and passing through the mid-point of the axis. Draw the sectional top view and develop the lateral surfaces of the truncated pyramid. Page no 15.12

Problem 13

70

35

o'

2₁ 2' (4') 3'
30°
1'

b (d')

a' d c'

a c
4
o
1 3
2

35

(i) b

T.L. of Slant Edge

O

1 2 3 4 1

A A

B D

C
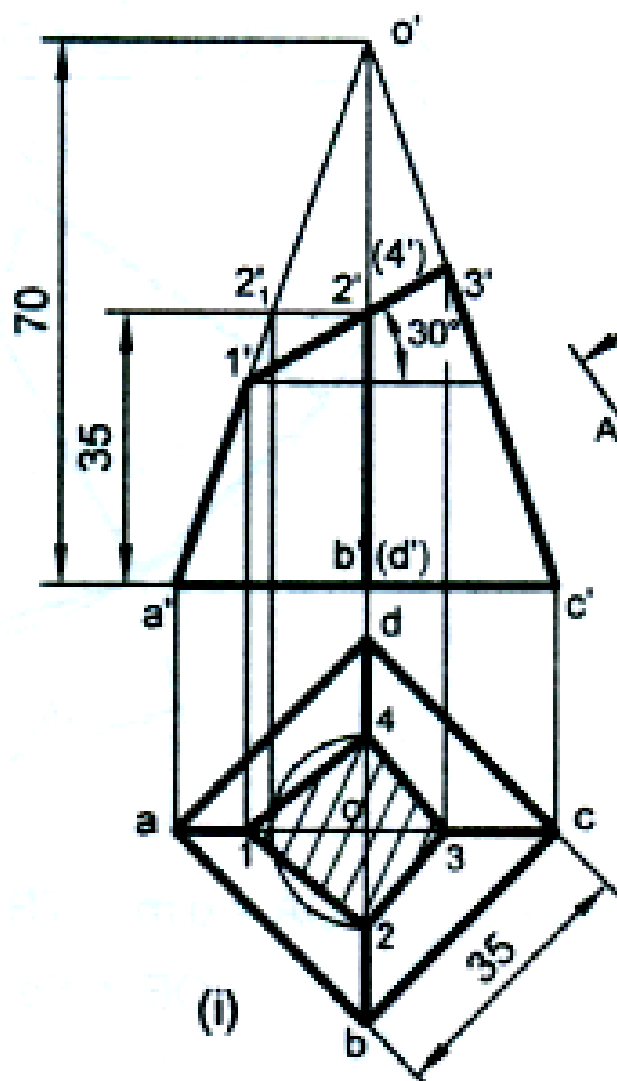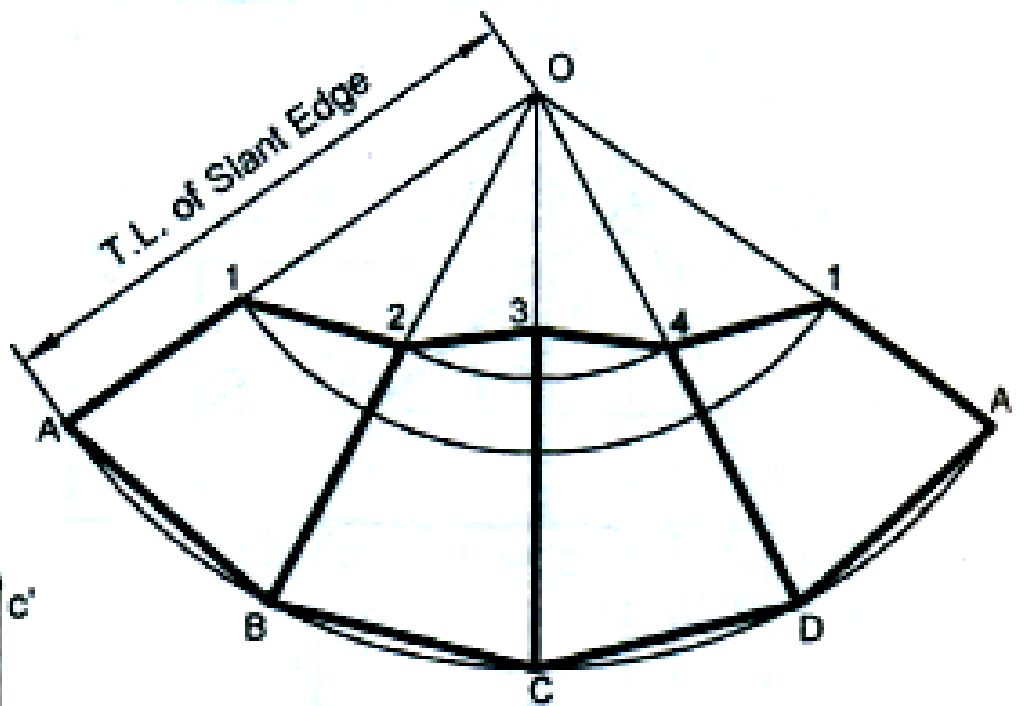
OA = o'a' , O2 = o'2'₁

(ii) DEVELOPMENT OF L.S. OF
TRUNCATED SQUARE PYRAMID

Problem 14

A regular hexagonal pyramid of side of base 30 mm and height 60 mm is resting vertically on its base on HP such that two of the sides of the base are perpendicular to VP. It is cut by a plane inclined at 40° to HP and perpendicular to VP. The cutting plane bisects the axis of the pyramid. Obtain the development of the lateral surface of the truncated pyramid.

Problem 14

o'

30

60

1'(6')

40°

a' 2'(5')

1''(6'')

2''(5'')

3''(4'')

3'(4')

p'(u')   q (t')   r'(s')   a'₁

t

5

u   s

6

a   4   a₁

30

o

1   3

p   2   r

q

Sectional top view

O

1

1

6

2

5

P

3   4

U

P

Q   R   S   T
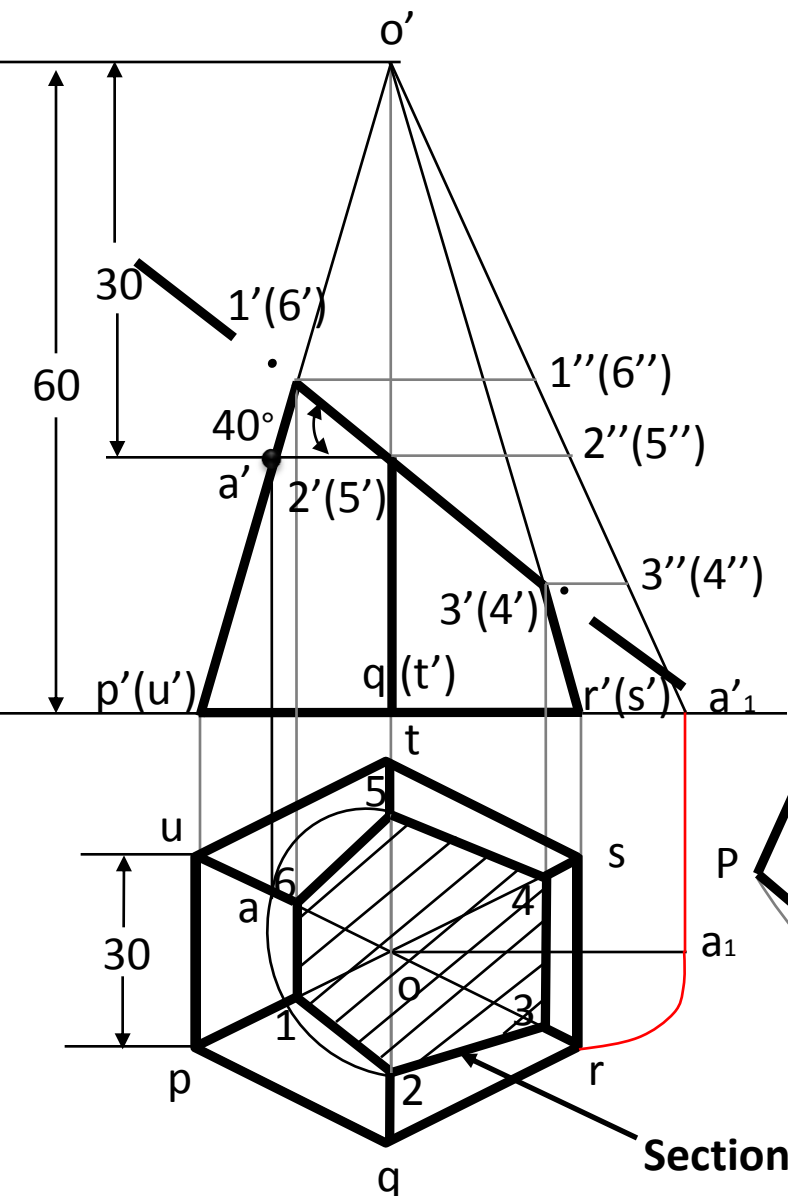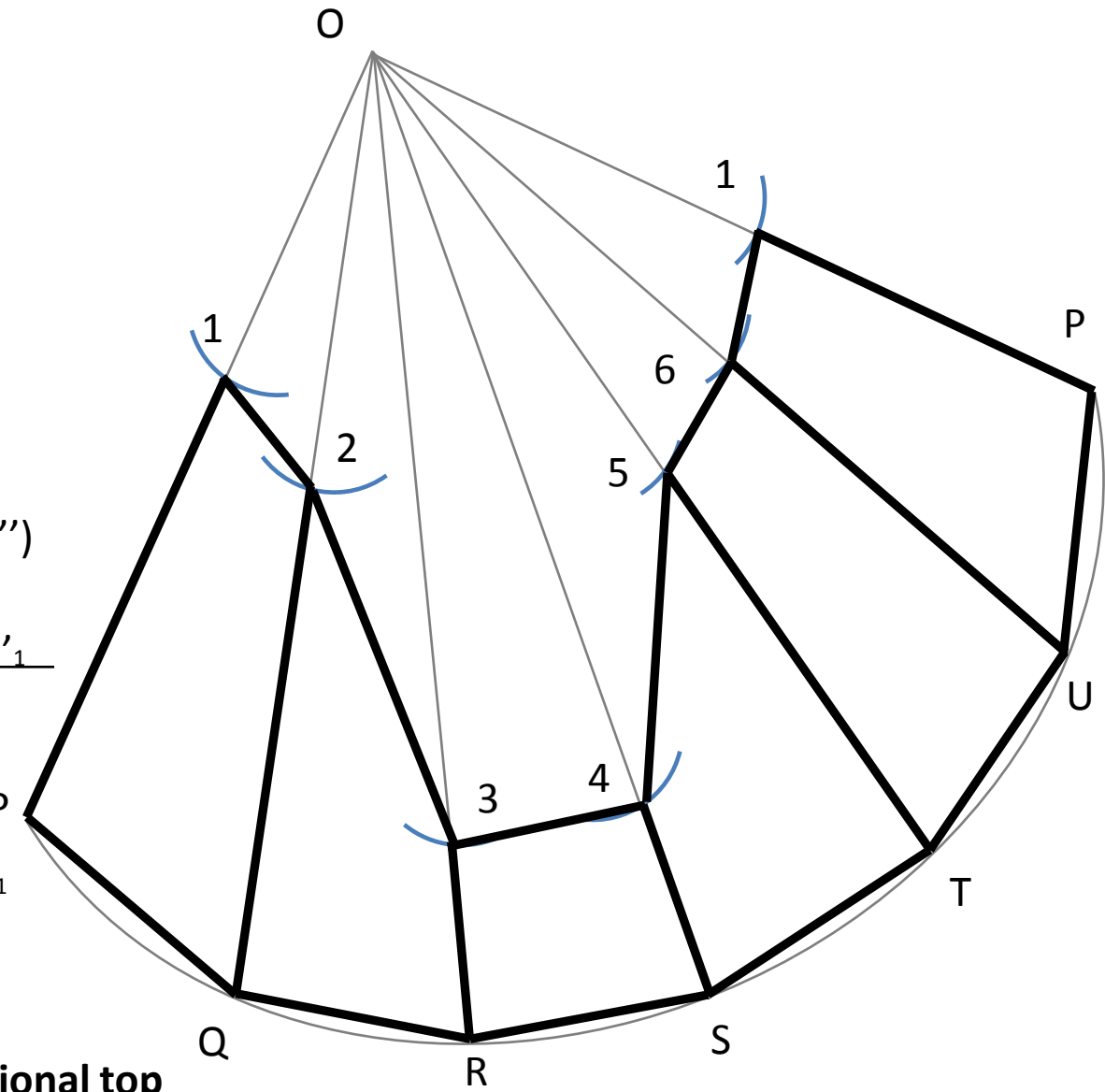
Problem 15

A hexagonal pyramid of base of side 25 mm and altitude 50 mm is resting vertically on its base on the ground with two of the sides of the base perpendicular to the VP. It is cut by a plane perpendicular to the VP and inclined at 40° to the HP, The plane bisects the axis of the pyramid. Draw the development of the lateral surfaces of the pyramid. Page no 313

Problem 15

True length of slant edge

Radius = True length of slant edge

$OP = o'p_1'$, $PQ = pq$, $01 = o'1''$, $02 = o'2''$

(a)
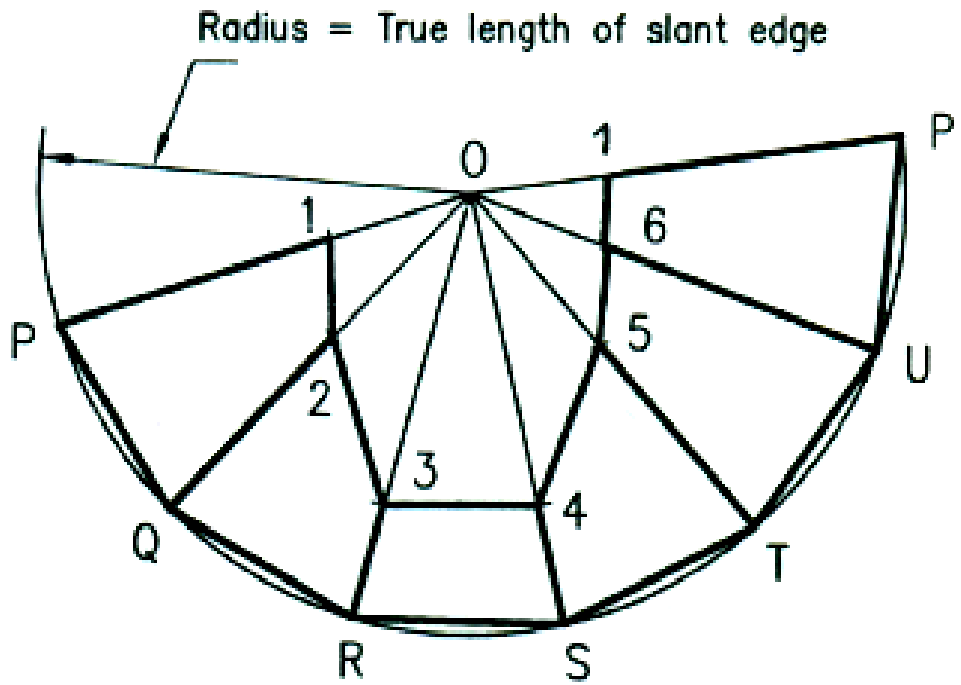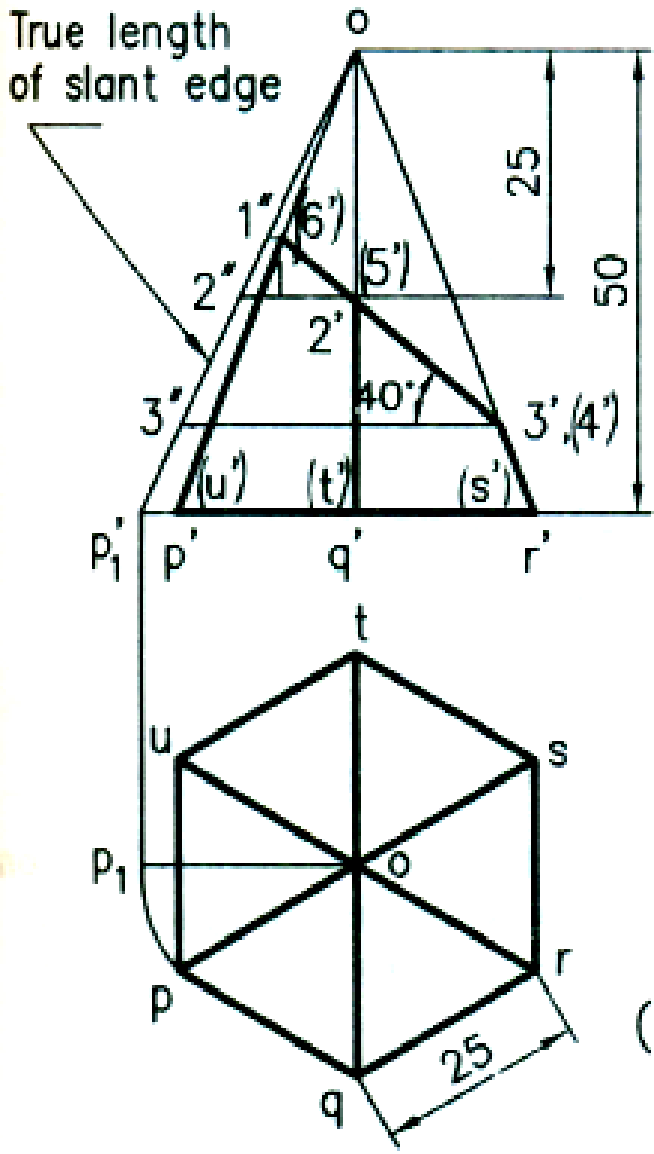
(b)

Problem 16

A pentagonal pyramid side of base 30 mm and height 52 mm stands with its base on HP and an edge of the base is parallel to VP and nearer to it. It is cut by a plane perpendicular to VP, inclined at 40° to HP and passing through a point on the axis 32 mm above the base. Draw the sectional top view. Develop the lateral surface of the truncated pyramid. Page no 15.12

Problem 16
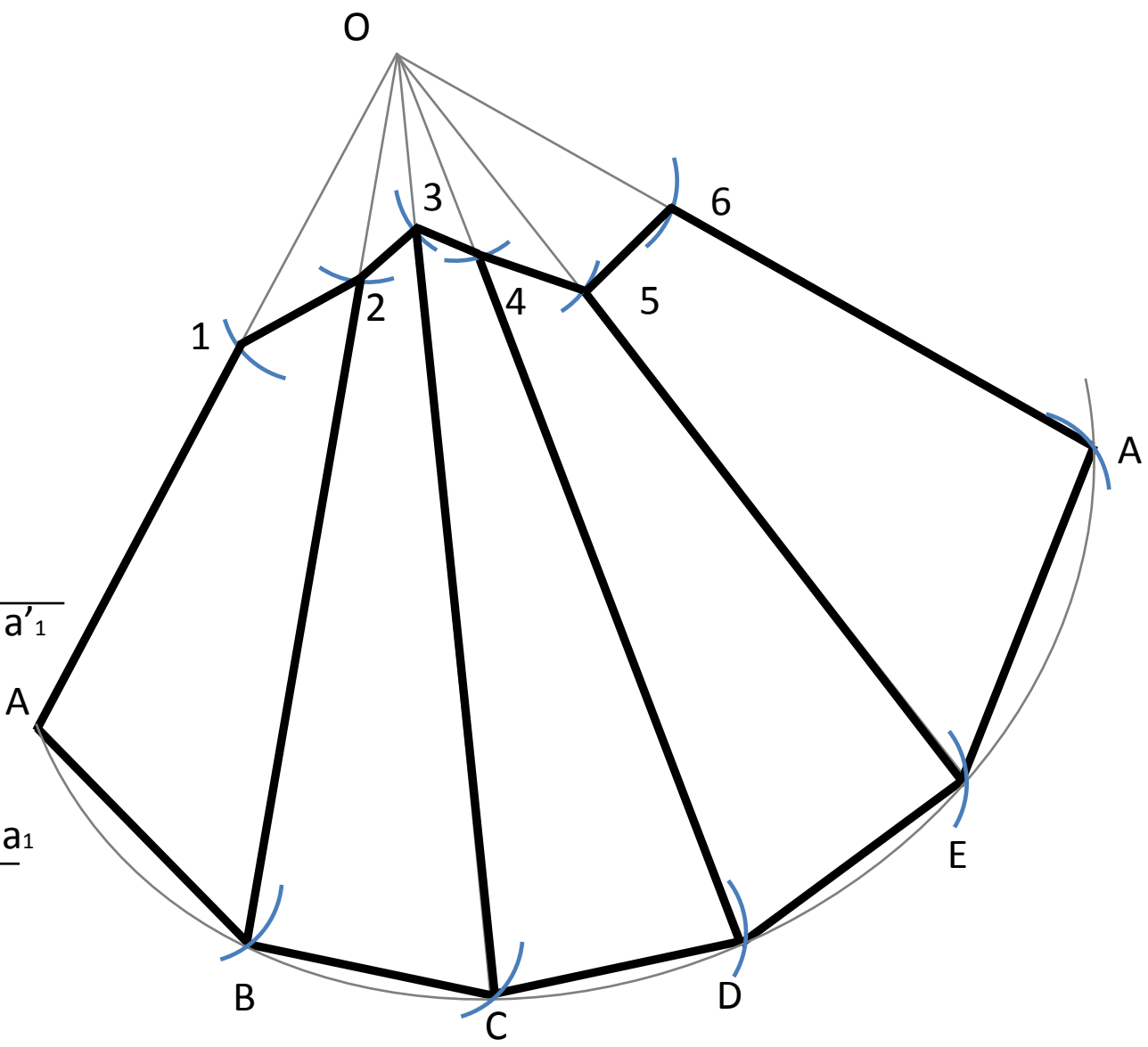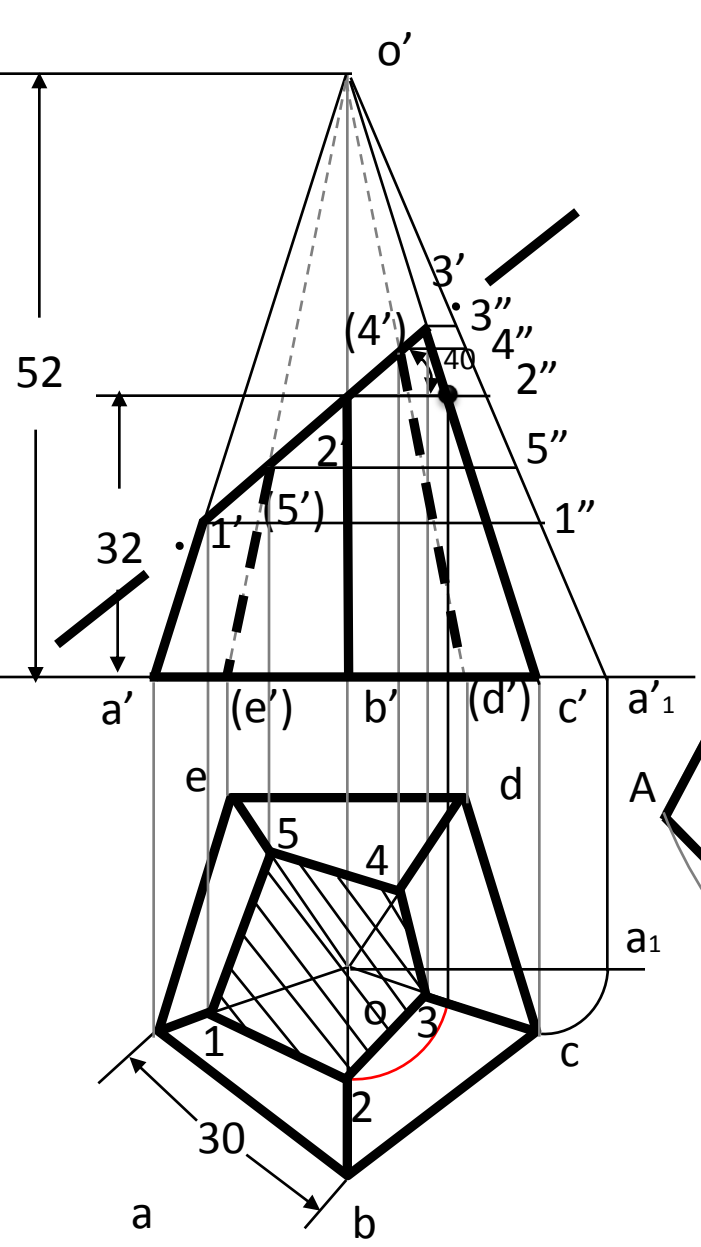
Problem 17

A pentagonal pyramid of base side 25 mm and height 60 mm is resting vertically on its base on the ground with one of the sides of the base parallel to the VP. It is cut by a plane perpendicular to the VP and parallel to the HP at a distance of 25 mm above the base. Draw the development of the lateral surfaces of the frustum of the pyramid . Also show the top view of the cut surface. Page no 311

Problem 17

Removed portion

True length of slant edge

Radius = True length of slant edge

PQ = pq, OP = o's'$_1$, O1 = o'4"

(a)
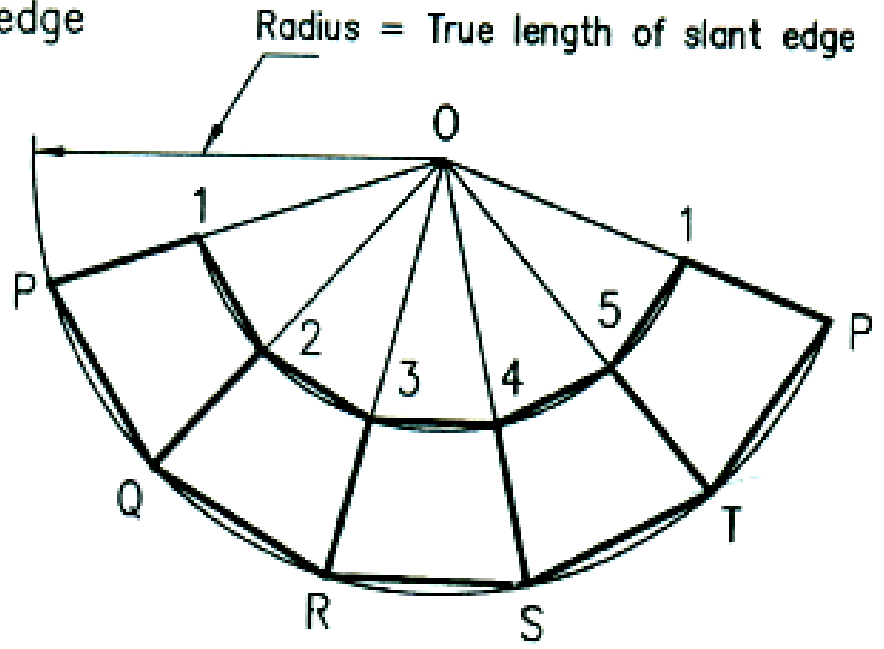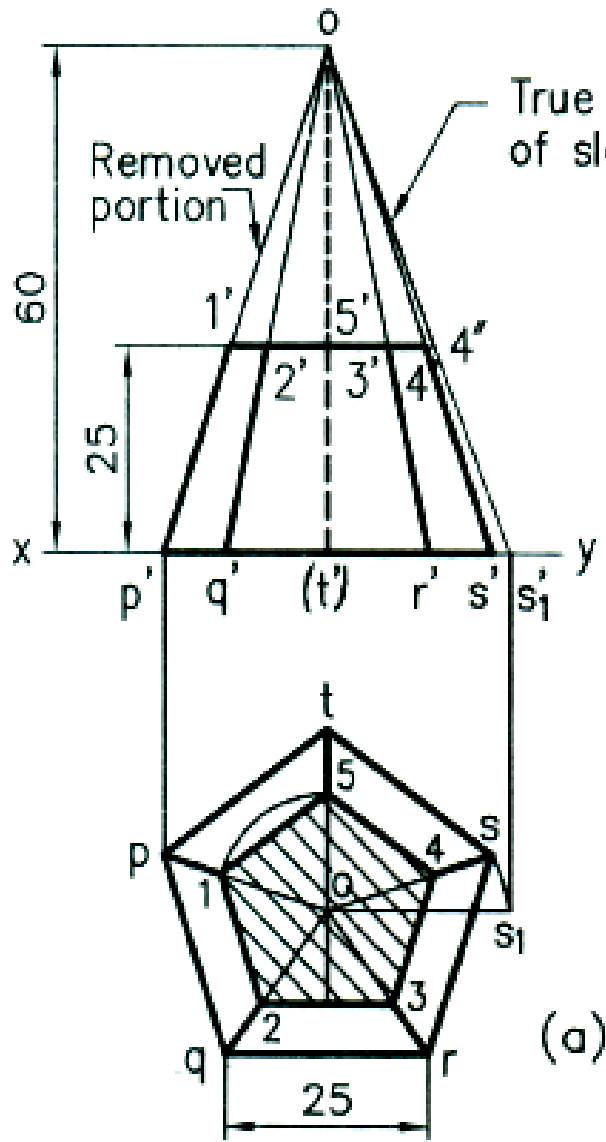
(b)

Problem 18

A Cone of base diameter 60 mm and height 70 mm is resting on its base on HP. It is cut by a plane perpendicular to VP and inclined at 30° to HP. The plane bisects the axis of the cone. Draw the development of its lateral surface.

Problem 18

oa is parallel to XY. So o'a' = OA = True length
of the generator (slant height)

o'

5" 5'
(6") 4" 4'(6')
(7") 3"   30°
(8") 2"   3'(7')
        2'(8')
1"
1'

70

35

c'(g')

H.P.

X ——————————————————— Y

a' b'(h')   d'(f') e'   V.P.

g

h   f

A

φ60 a   e

b   d   B

o

c
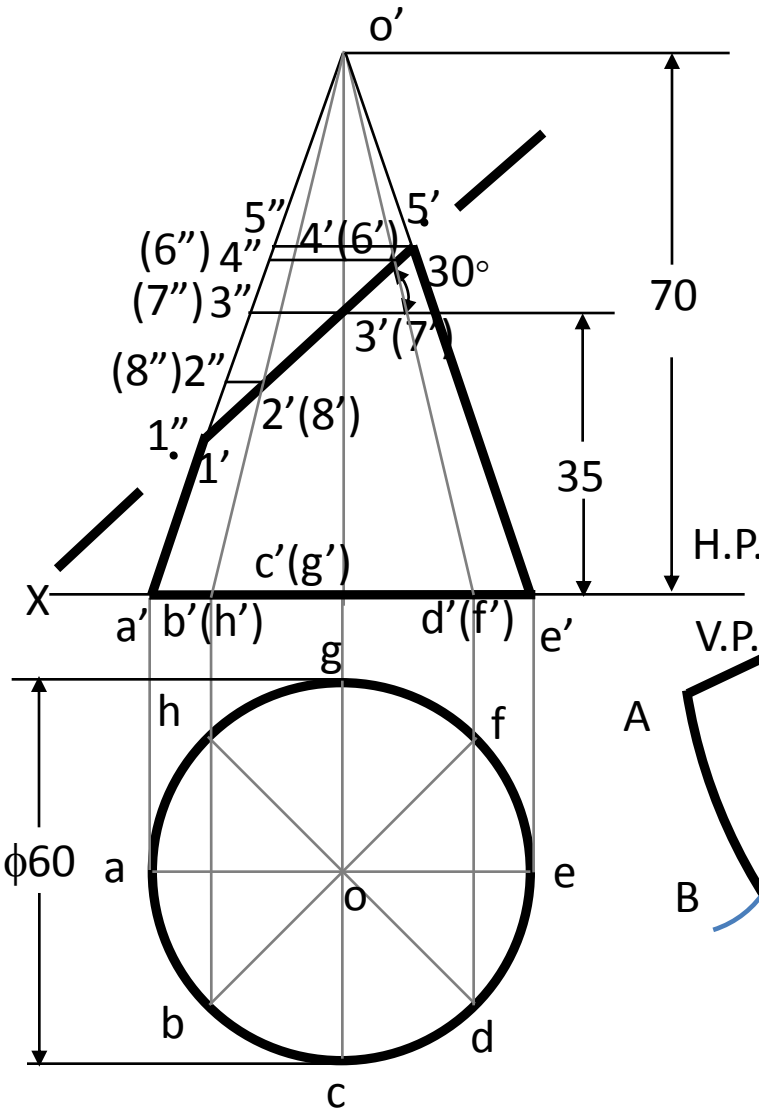
$\theta = (r/L)*360°$
$\theta = (30/76)*360°$
$\theta = 142°$
Divide 142° into 8 equal parts.
Per division 17.75°

O

1   17.8°   142°   1

A   2

3   4   5   6   7

8

A

B

H

C

G

D   E   F
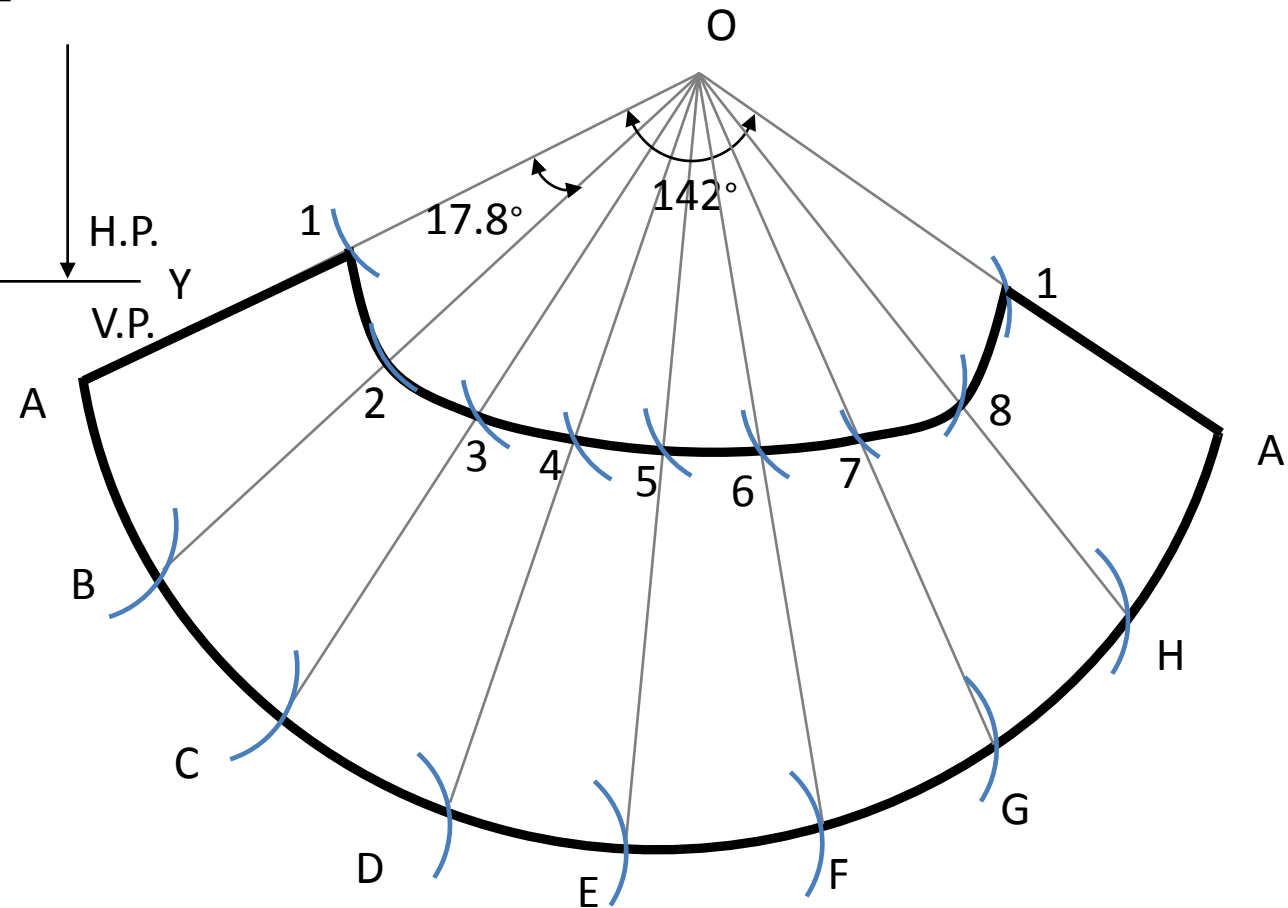
Problem 19

A Cone of base 50 mm diameter and 60 mm height, rests with its base on HP. It is cut by a section plane perpendicular to VP, parallel to one of the generators and passing through a point on the axis at a distance of 22 mm from the apex. Draw the sectional top view and develop the lateral surface of the remaining portion of the cone. Page no 15.23

Problem 19

Measure in top view b to 1.
b1=B1 ; g7=G7
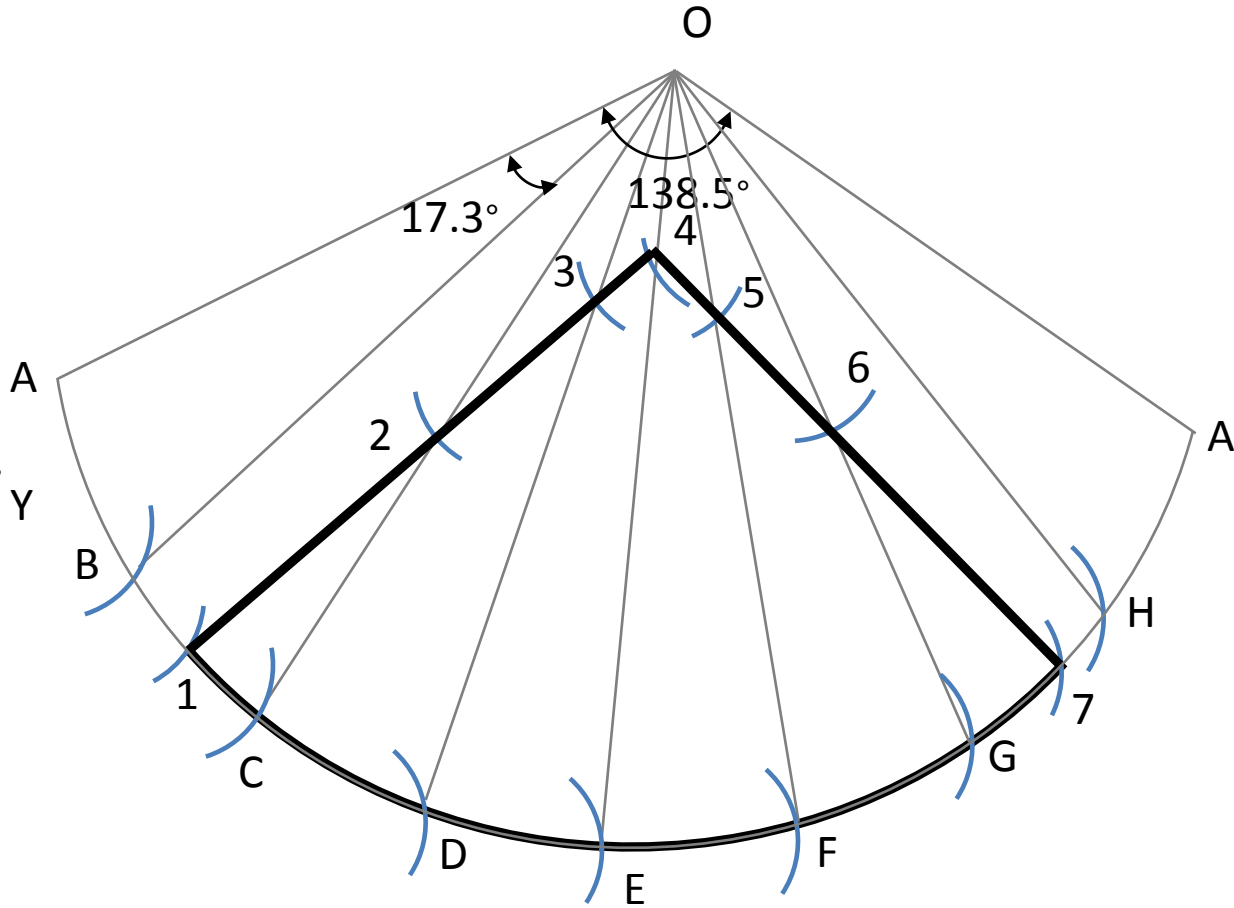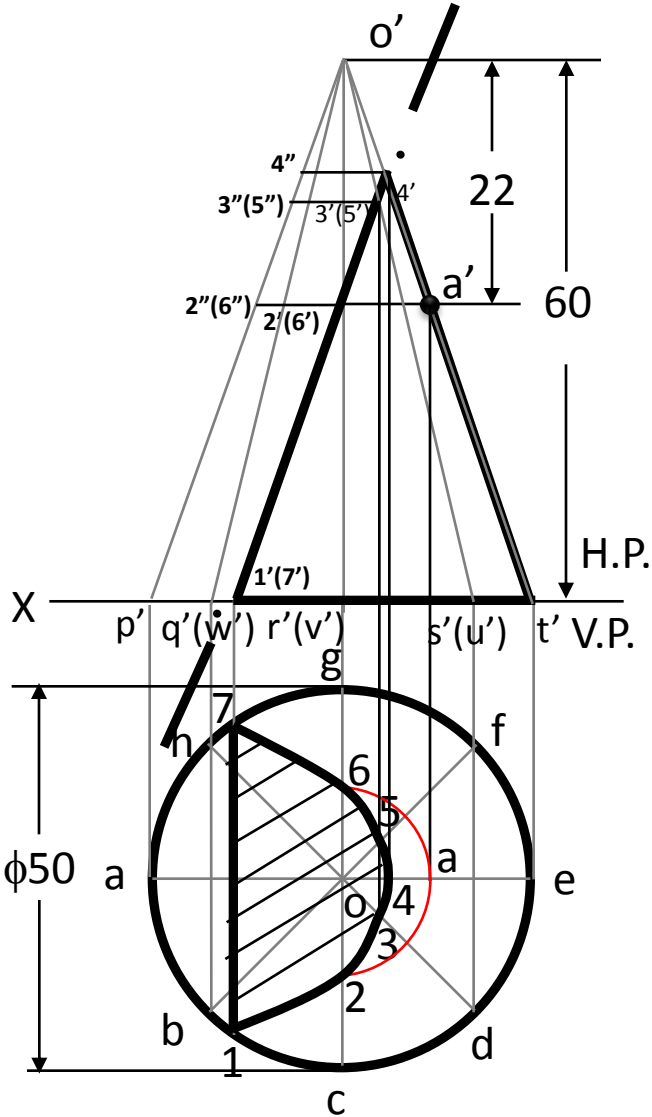
DEVELOPMENT OF LATERAL SURFACES OF SOLIDS WITH CUT-OUTS AND HOLES

Problem 20

A Square prism of 36 mm edge of base and 64 mm height stands on HP with two of its base edges equally inclined to VP. It has a square hole of 24 mm side centrally cut right through the prism such that its faces are equally inclined to HP. Axis of the hole is parallel to HP and perpendicular to VP. Draw the development of the lateral surfaces of the prism showing the true shape of the square cutout formed it. Page no 16.1

Problem 20

64

32

24

4'(4₁')

1'(1₁')

3'(3₁')

2'(2₁')

b'(d')

c'

a'

d

A

M

B

N

C

N₁

D

M₁

A

36 X 4

4

1

3

2

3₁

4₁

1₁

2₁

m₁

n₁

c

a

n

m

36

b

AM=am   CN = cn

AM₁ = am₁   CN₁ = cn₁
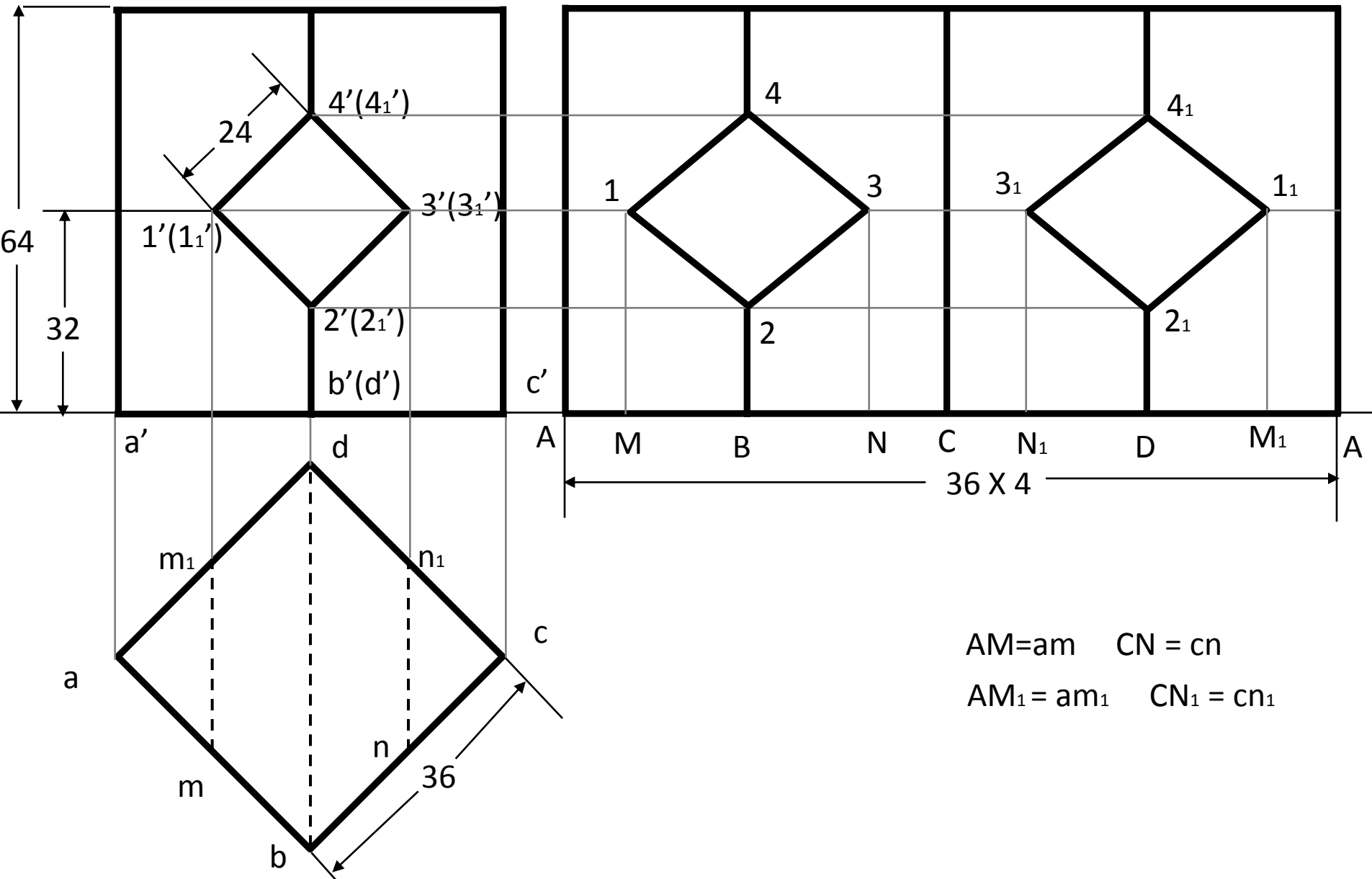
Problem 21

A hexagonal prism of side of base 24 mm and axis 64 mm is on HP on one of its ends with a base edge parallel to VP. A square hole of side 26 mm is drilled such that the axis of the hole is perpendicular to VP an bisects the axis of the prism with all the faces equally inclined to HP. Develop lateral surfaces. page no 16.2

Problem 21

STRETCH-OUT LENGTH = 24 x 6
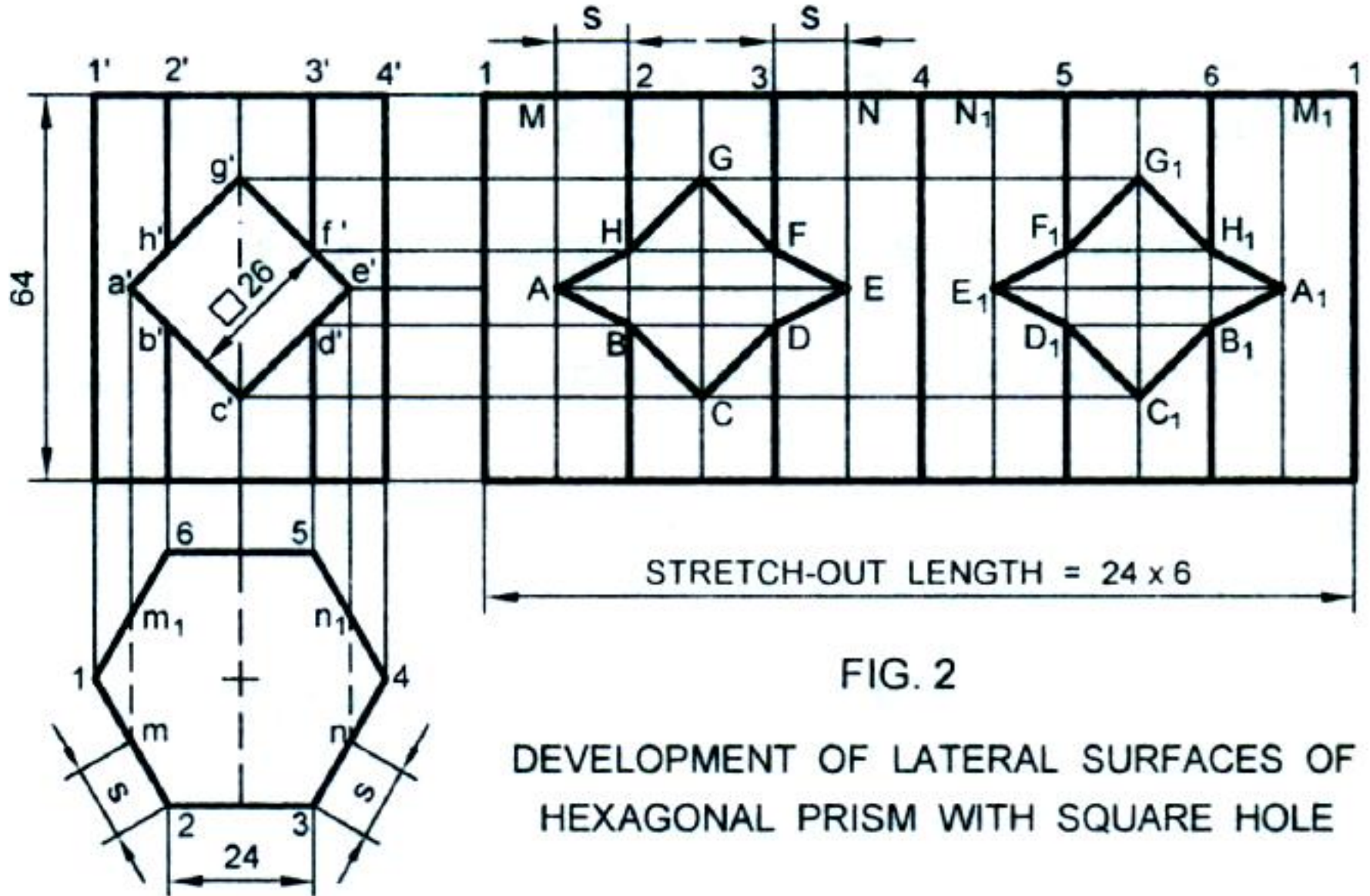
FIG. 2

DEVELOPMENT OF LATERAL SURFACES OF HEXAGONAL PRISM WITH SQUARE HOLE

Problem 22

A Pentagonal prism of side of base 25 mm and axis 60mm is on HP on one of its ends with a base edge parallel to VP and nearer to it. A square hole of side 25 mm is drilled such that axis of the hole is perpendicular to VP and bisects axis of the prism with all the faces equally inclined to HP. Draw the development of lateral surfaces of the prism showing true shape of the hole on it. Page no 16.2

Problem 22

$\square 25$

60

30

1'

2'

(a')
(b')

(d')
(c')

4'

3'

25

(p)

(t)

(s)

(q)

p'

(t') q'

(s')

r'

P

1

2

4

3

Q

R

S

D

C

A

B

1_1

4_1

2_1

3_1

T

P

STRETCH-OUT LENGTH = 25 x 5
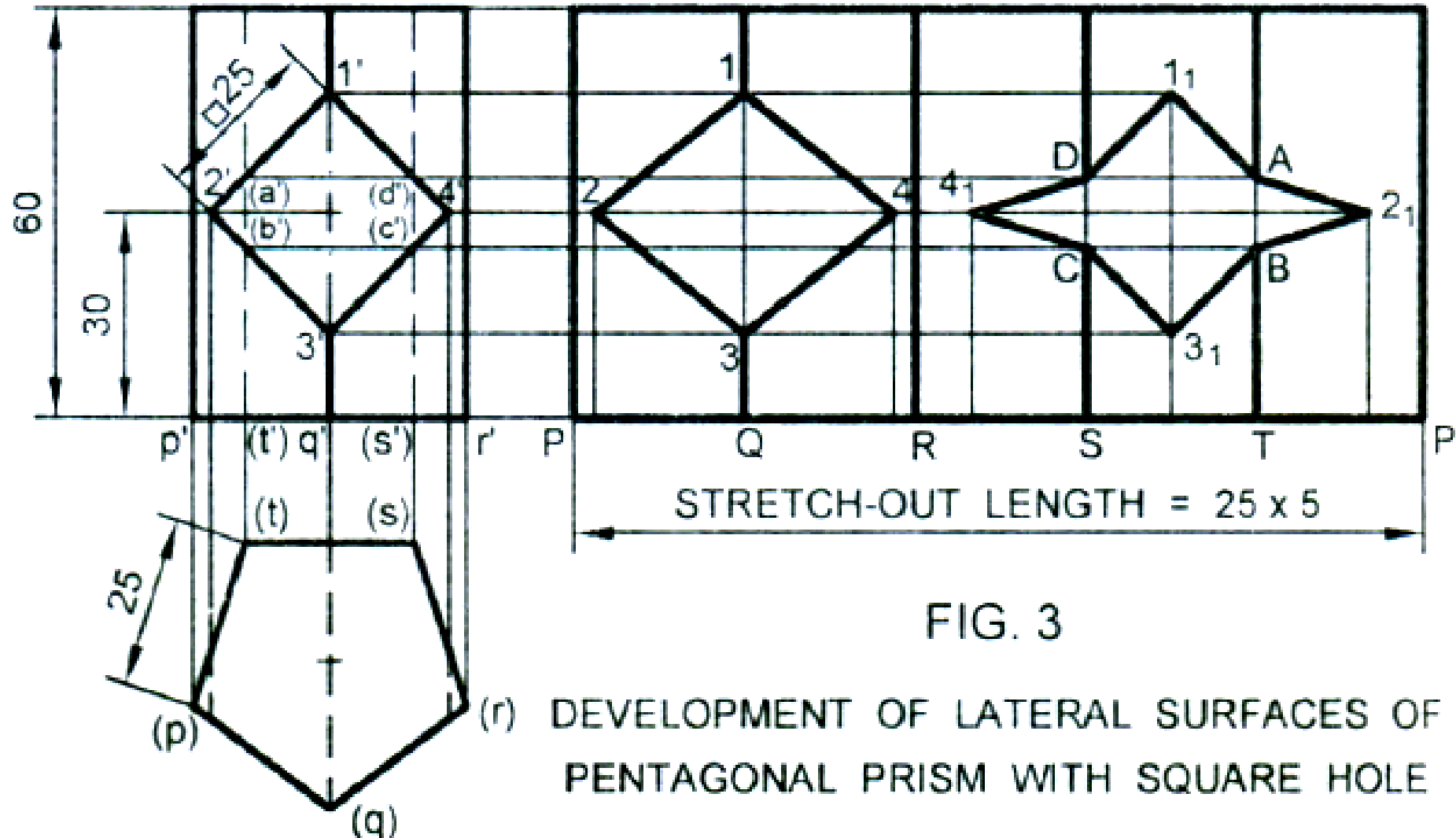
FIG. 3

(r) DEVELOPMENT OF LATERAL SURFACES OF
PENTAGONAL PRISM WITH SQUARE HOLE

Problem 23

A Cylinder of 50 mm base diameter and axis 70 mm long rests on its base on HP. A square cutout of 35 mm side is drilled through the cylinder such that axis of cutout is perpendicular to the axis of the cylinder. The center of the cutout is 35 mm above HP and 15 mm away from the axis of cylinder. Two faces of the cutout are equally inclined to HP. Develop lateral surfaces. Page no 16.3

Problem 23
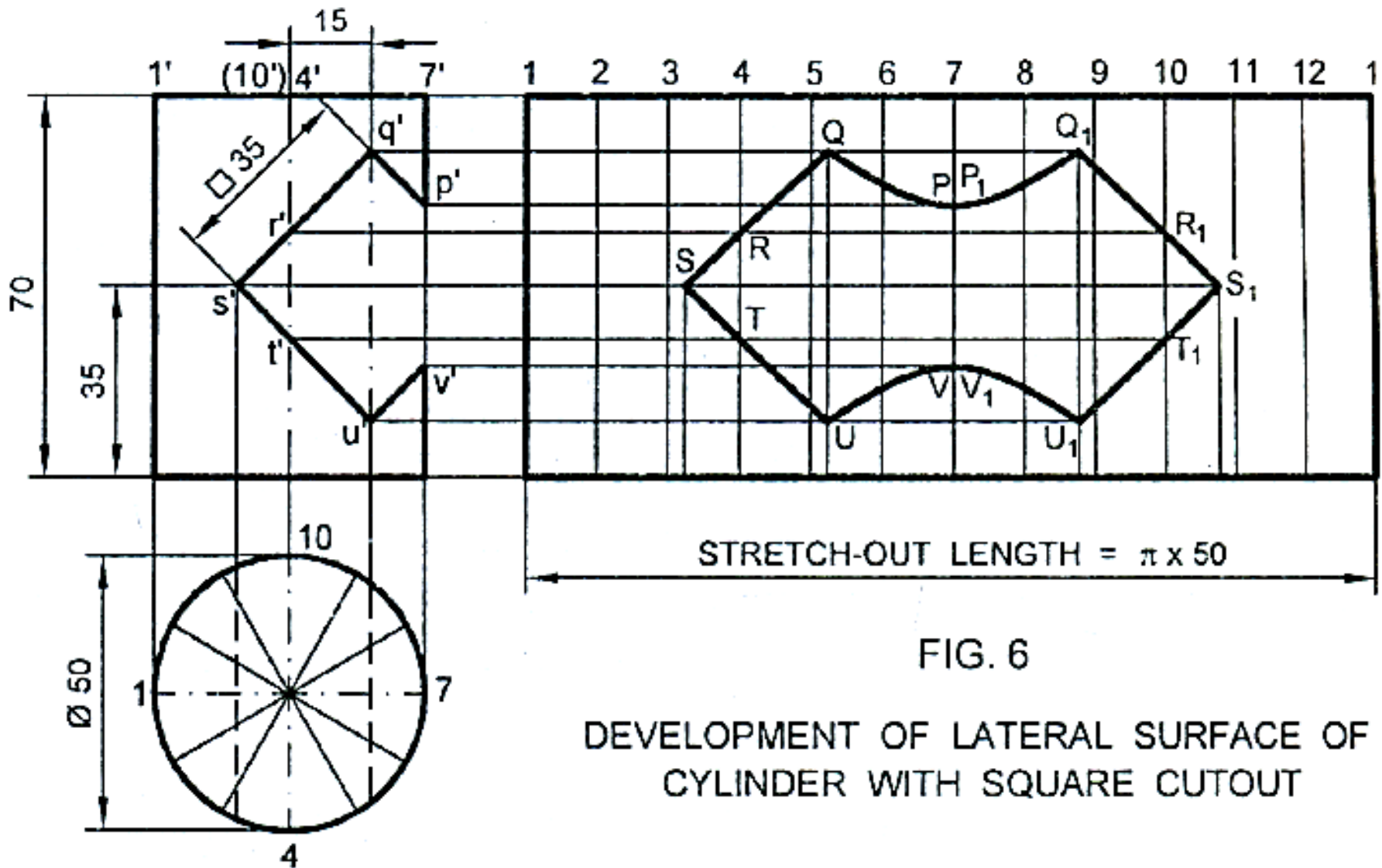
FIG. 6

DEVELOPMENT OF LATERAL SURFACE OF
CYLINDER WITH SQUARE CUTOUT

STRETCH-OUT LENGTH = π x 50

Problem 24

A hexagonal prism of side of base 25 mm and altitude 65 mm rests on its base on HP, having a rectangular face of the prism parallel to VP. A horizontal hole of 35 mm diameter is centrally drilled in it, such that the axis of the hole is normal to VP. Develop the lateral surfaces of the prism with the shape of hole.

Problem 24

$\phi 35$

a' b'(f')   c'(e') d'

A   B   C   D   E   F   A

6'   5'   4'

1'

6   5 6_1 5_1

1   1_1

65

O   4 O_1 4_1

2'   3'

32.5

2   3 2_1 3_1

a'₁ b'₁(f'₁) c'₁(e'₁) d'₁ A_1 P B_1 C_1 Q D_1 E_1 F_1 A_1

f(f₁)   e(e₁)

←25→

a(a₁)   d(d₁)

p   q

ap = A_1P   CN = cn

b(b₁)   c(c₁)

←25→
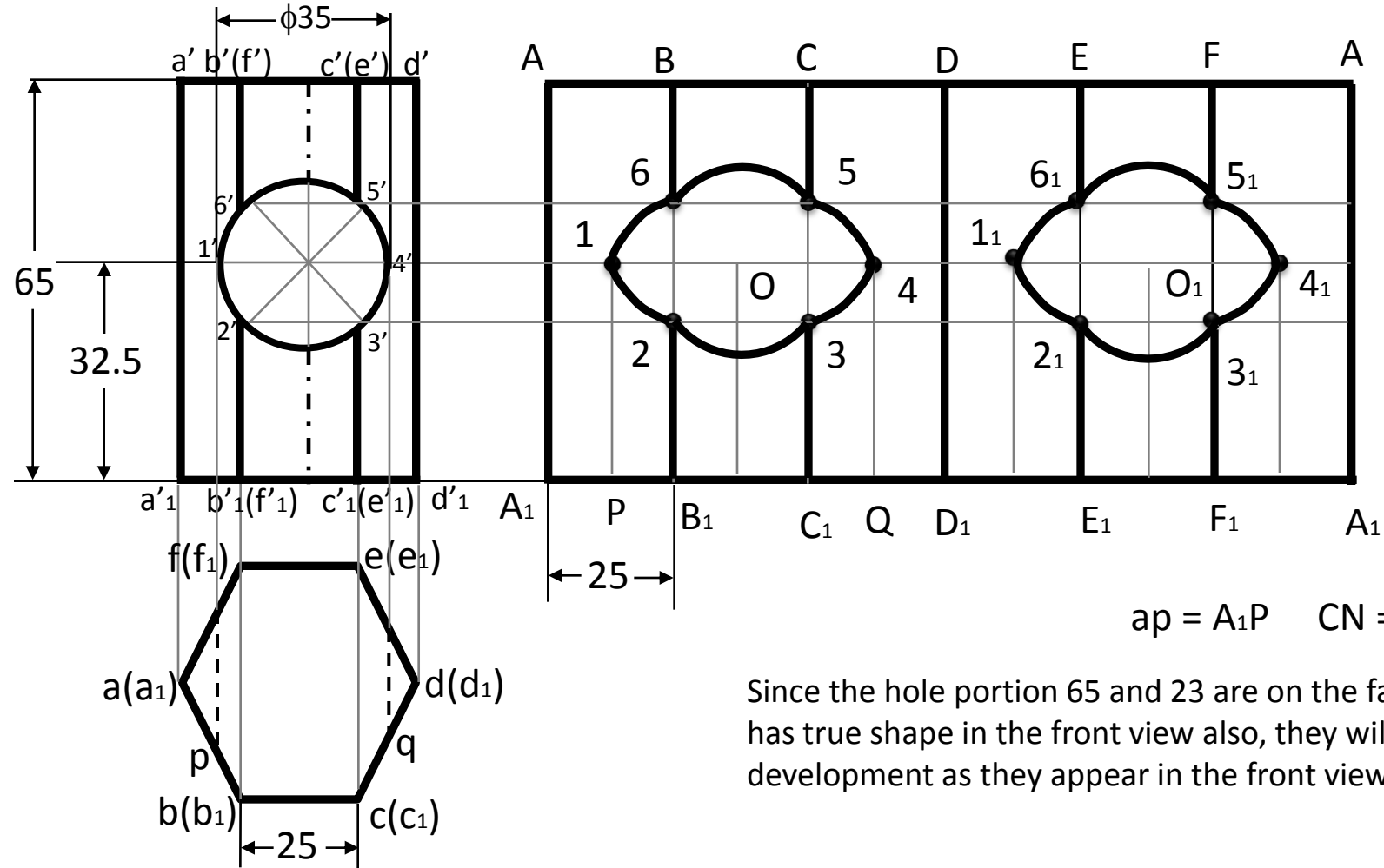
Since the hole portion 65 and 23 are on the face BCB_1C_1 which has true shape in the front view also, they will appear in the development as they appear in the front view.

The curves 65 and 23 are circular and can be drawn with O as centre and 17.5 mm as radius.

Problem 25

A pentagonal pyramid of side of base 24 mm and axis 60 mm long stands on its base on HP with a side of base parallel to VP and nearer to it. A square cutout of 15 mm side is drilled through it such that its axis is parallel to HP and perpendicular to VP. Axis of cutout meets the axis of the pyramid 15 mm from base. Faces of the cutout are equally inclined to HP. Develop the lateral surfaces. Page no 16.8
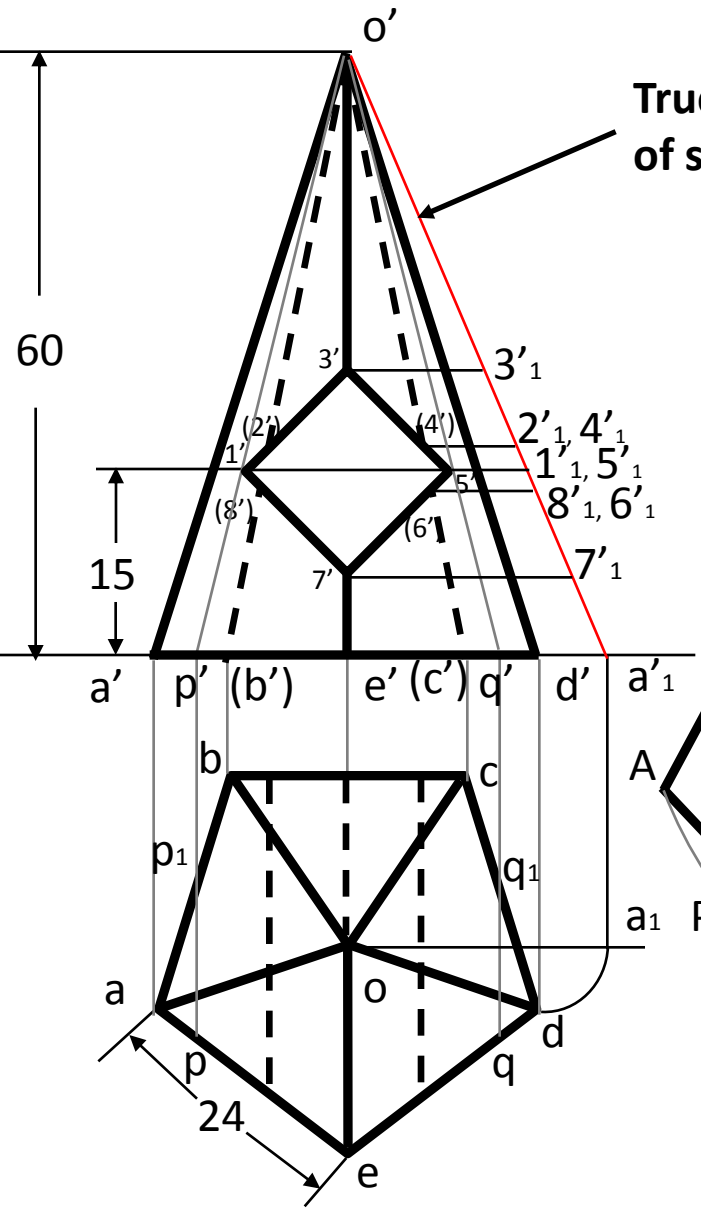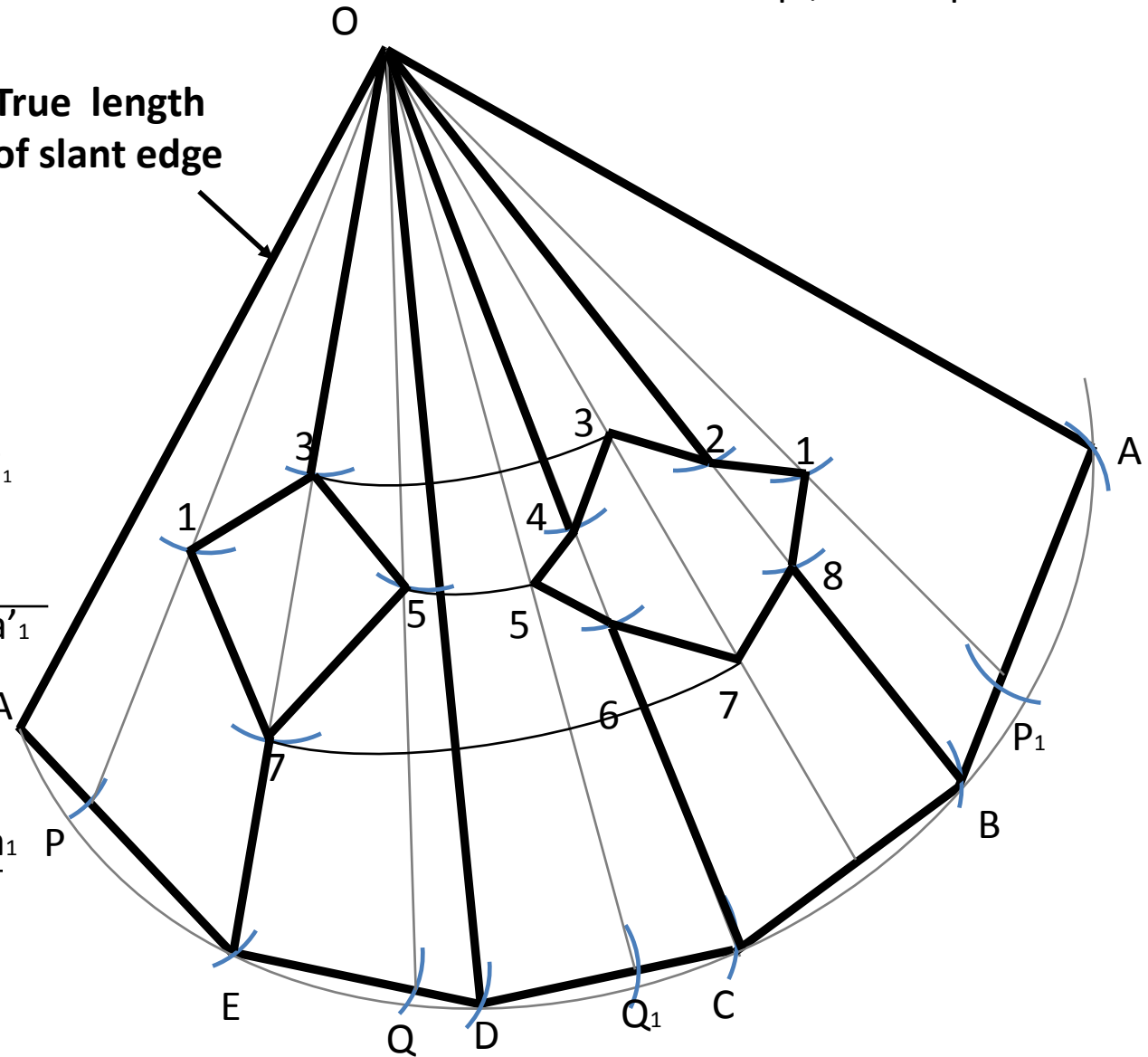
Problem 25

$AP = ap$; $AP_1 = ap_1$

True length of slant edge

o'

60

15

3' $3'_1$

(2')   (4') $2'_1, 4'_1$

1' $1'_1, 5'_1$

(8')   5' $8'_1, 6'_1$

(6')

7' $7'_1$

a' p' (b')   e' (c') q' d' a'_1

b   c   A

p_1 q_1

            a_1 P

a   o   d

p   q

24

e

O

3   3   2 1

1   4   8 A

5   5

7   6   7

7   P_1

A   B

P

E Q_1 C

Q D

Join the apex to the extreme points of the square hole to meet the base, i.e.,join o'1'. Extend it to meet the base of the pyramid at p'. Similarly mark q'.