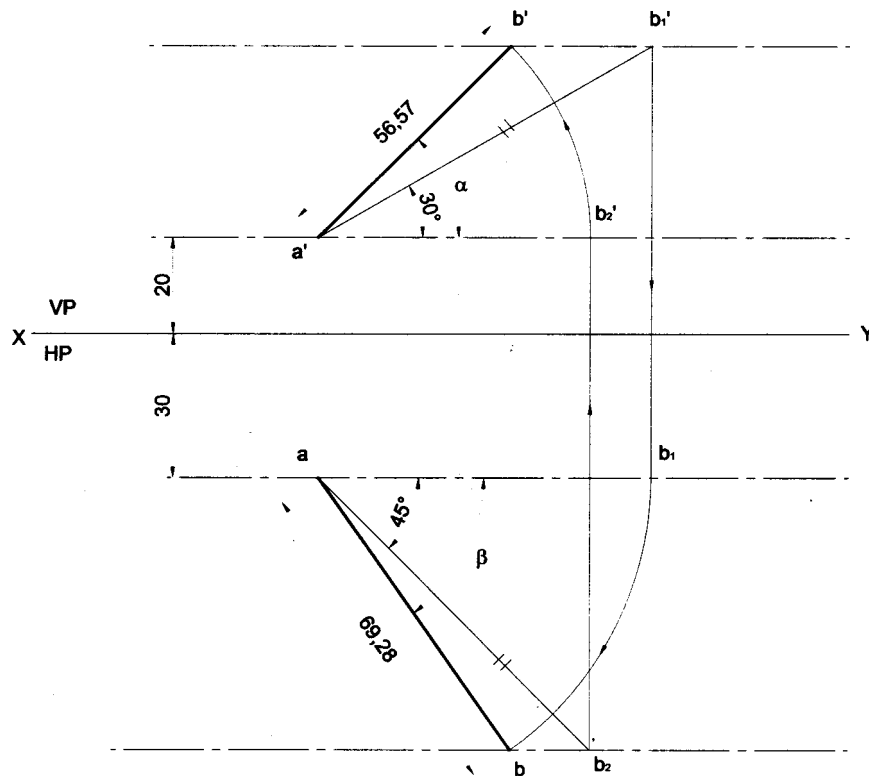# CHAPTER 2

PROJECTIONS OF LINES

Problem 1 A line AB 80 mm long has its end A 20 mm above the HP and 30 mm infront of VP. It is inclined at 30° to HP and 45° to VP. Draw the projections of the line and find apparent lengths and apparent inclinations.
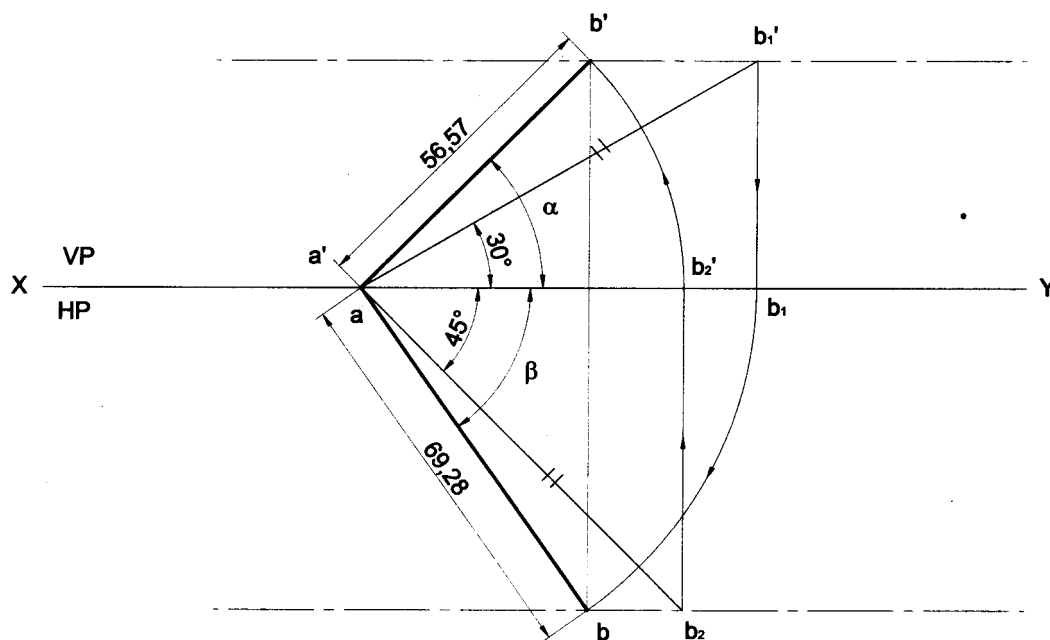**Solution**

ANSWERS :
β = 55°
a'b' = 57
ab = 69

Problem 2 A line AB 80 mm long is inclined to HP at 30° and inclined to VP at 45°. Draw front and top views of line and determine their lengths. Also measure the perpendicular distance of end B from both HP and VP.
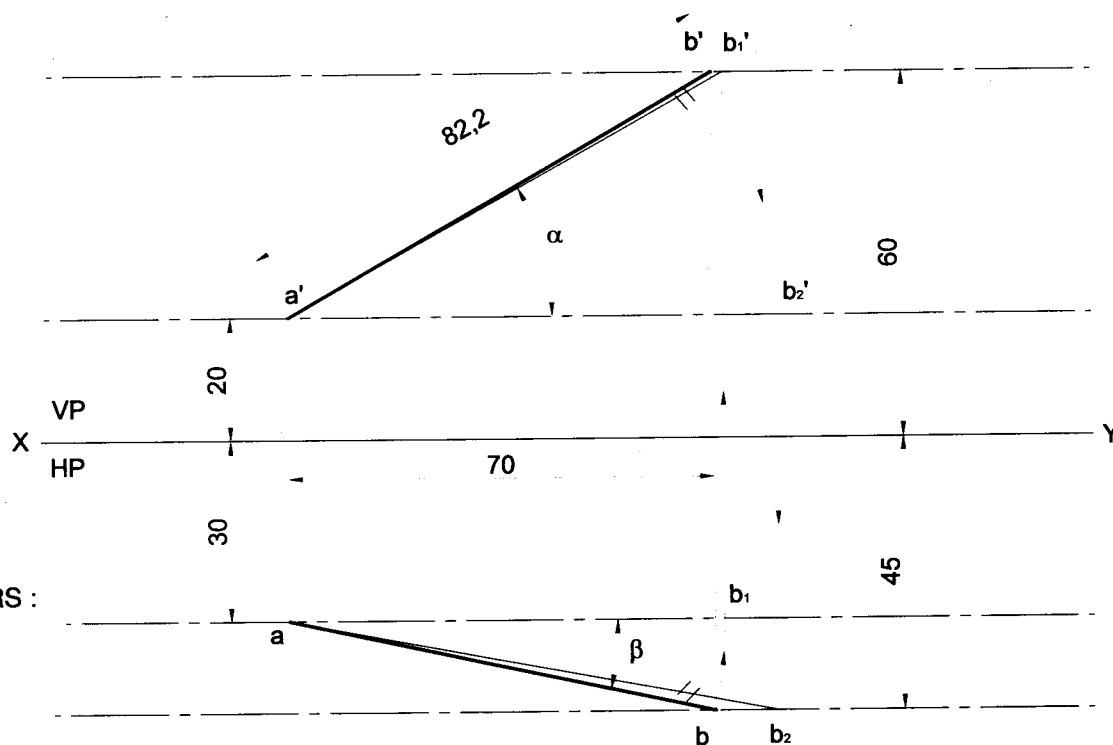**Solution**

ANSWERS :
α = 45°
β = 55°
a'b' = 57
ab = 69

Problem 3 A line AB has its end A 20 mm above the HP and 30 mm infront of the VP. The other end B is 60 mm above the HP. The distance between end projectors is 70 mm. draw its projections. Determine the true length and apparent inclinations.
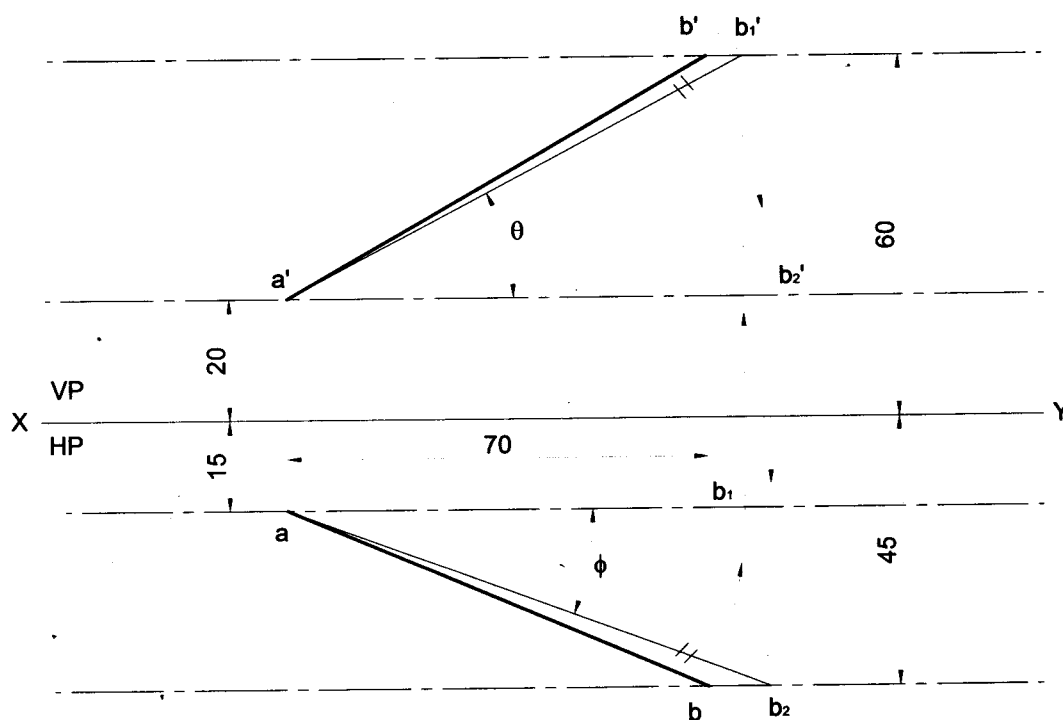
Solution

b' b₁'

82.2

α

60

a'

b₂'

20

VP

X ——————————————— Y

HP

70

30

45

ANSWERS :

$\alpha = 30^0$

b₁

β

a

$\beta = 12^0$

$a'b' = 82$

b   b₂

Problem 4 A line AB has its end A 20 mm above the HP and 15 mm infront of the VP. The other end B is 60 mm above the HP. The distance between end projectors is 70 mm. draw its projections. Determine the apparent lengths and true inclinations.

Solution

b'   b₁'

θ

60

a'

b₂'

20

VP

X ——————————————— Y

HP

15

70
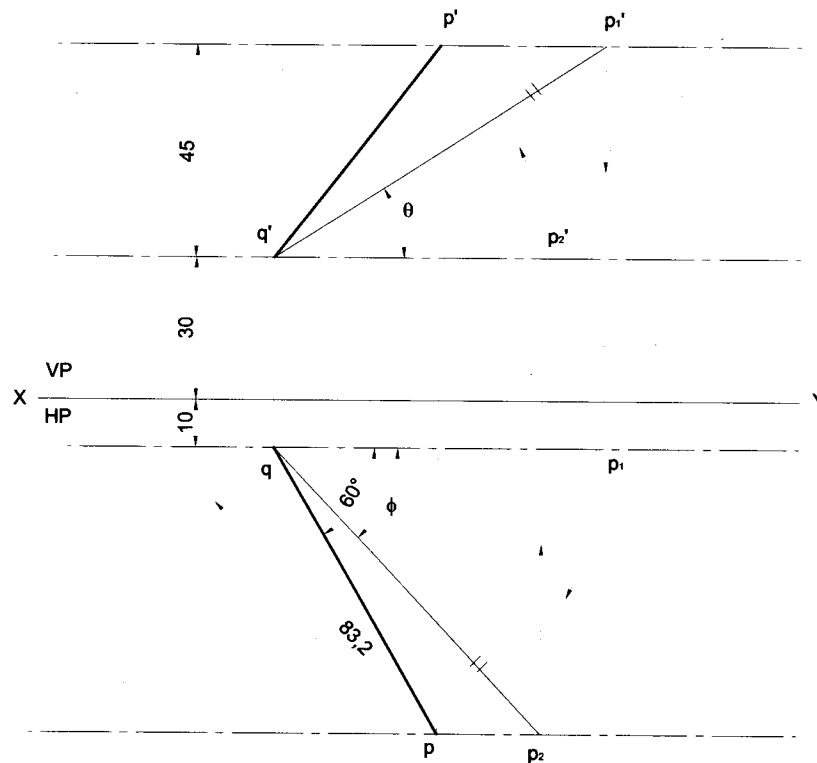
b₁

45

a

ANSWERS :

φ

$\theta = 28^0$

$\phi = 20^0$

$a'b' = 81$

$ab = 76$

b   b₂

28

Problem 5 The top view PQ of a straight line is 70 mm and makes an angle of 60^0 with XY line. The end Q is 10 mm infront of VP and 30 mm above the HP. The difference between the distances of P and Q above the HP is 45 mm. draw the projections. Determine its true length and true inclinations with HP and VP.
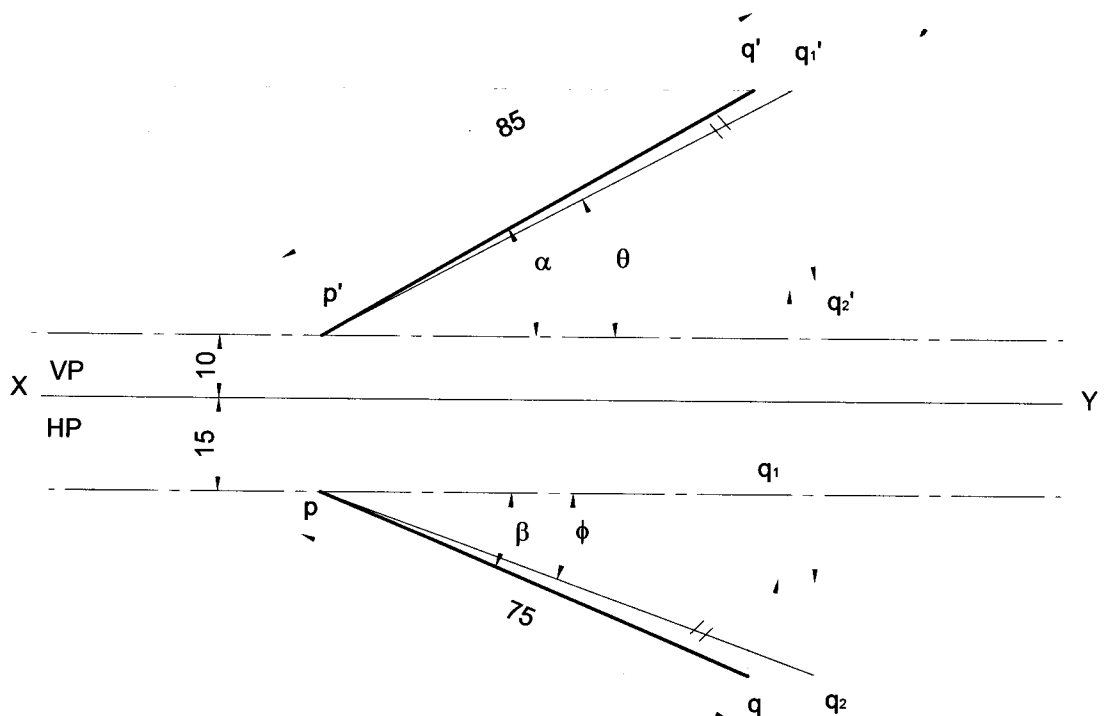
Solution

Problem 6 A line PQ 85 mm long has its end P 10 mm above the HP and 15 mm infront of the VP. The top view and front view of line PQ are 75 mm and 80 mm respectively. Draw its projections. Also determine the true and apparent inclinations of the line.

Solution

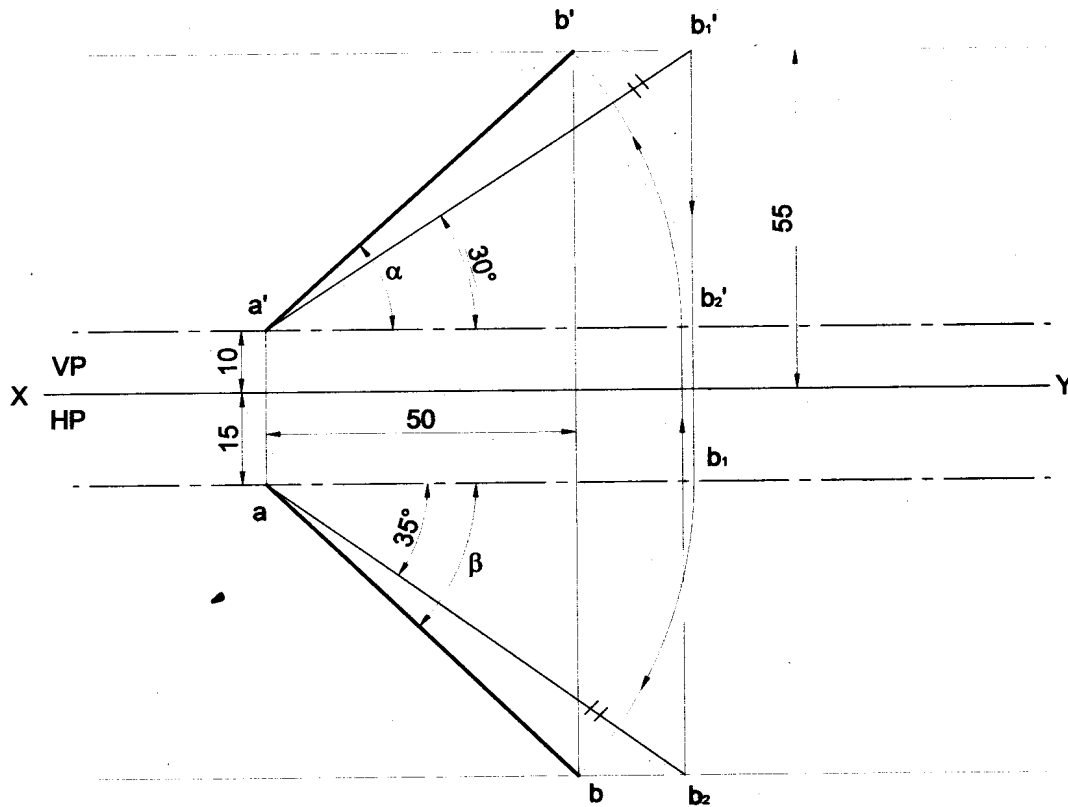**Problem 7** A line has its end A 10 mm above HP and 15 mm infront of VP. The end B is 55 mm above HP and line is inclined at 30° to HP and 35° to VP. The distance between the end projectors is 50 mm. draw the projections of the line. Determine the true length of the line and its inclination with VP.
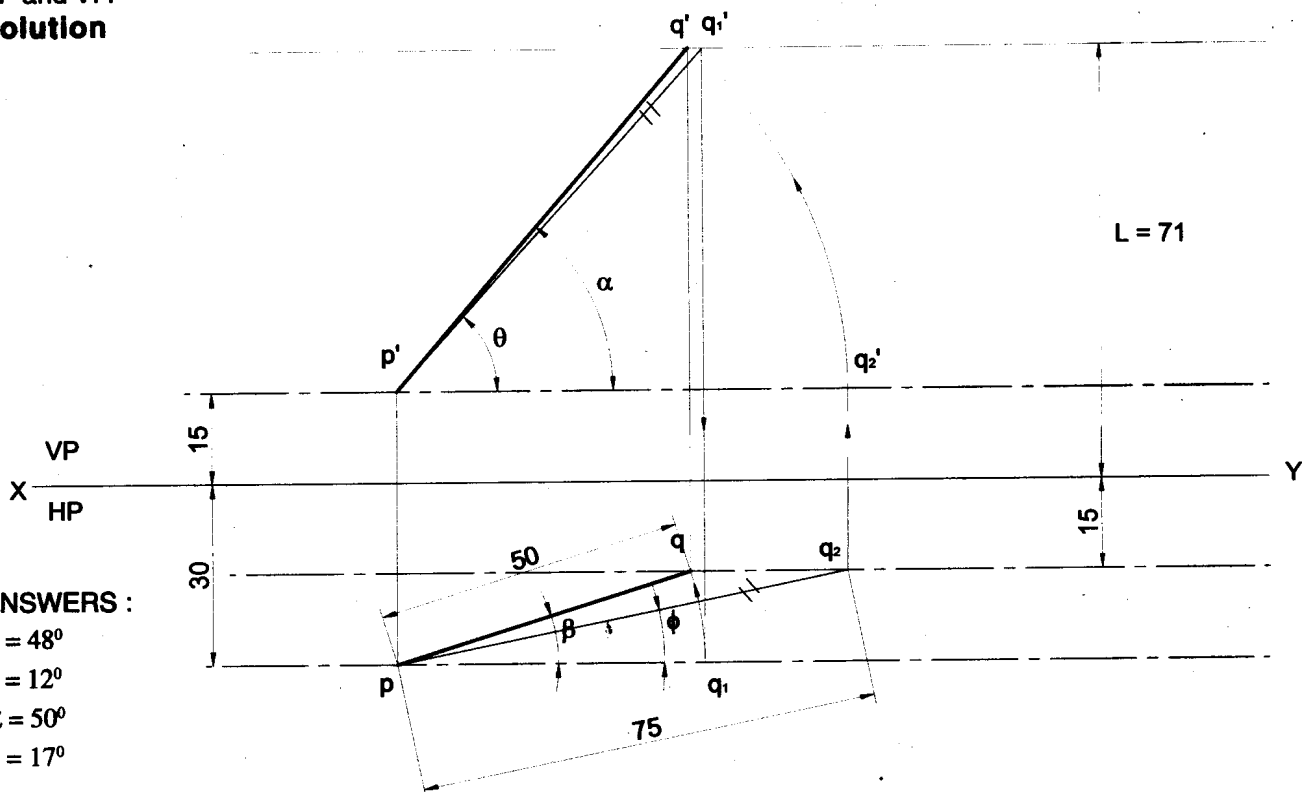
Solution

ANSWERS :
α = 42°
β = 44°
TL = 80

Problem 8 The top view of a line 75 mm long measures 50 mm. the end P is 30 mm infront of VP and 15 mm above HP. The end Q is 15 mm infront of VP and above HP. Draw the projections of the line and find its true inclinations with HP and VP.
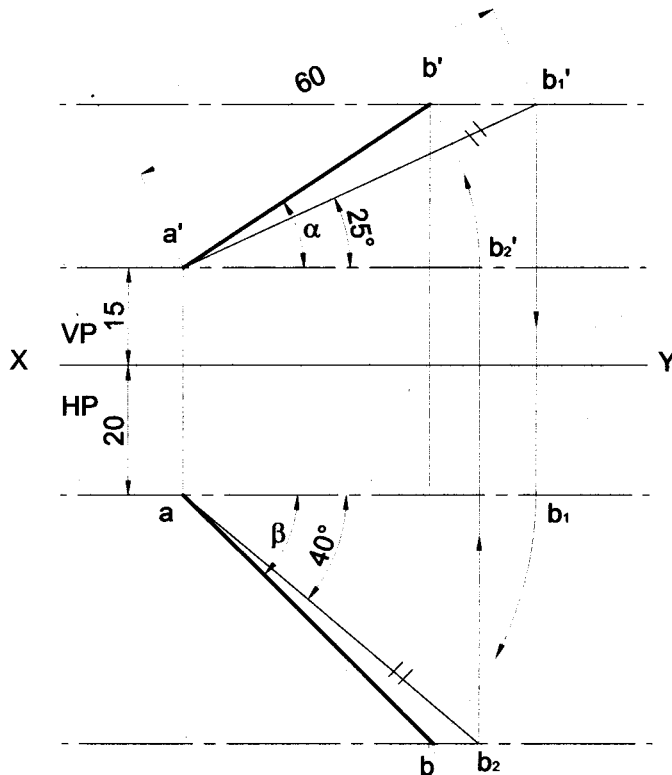
Solution

L = 71

ANSWERS :
θ = 48°
φ = 12°
α = 50°
β = 17°

30

Problem 9 A line AB 60 mm long has one of its extremities 20 mm infront of VP and 15 mm above HP. The line is inclined at 25° to HP and 40° to VP. Draw its top and front views.
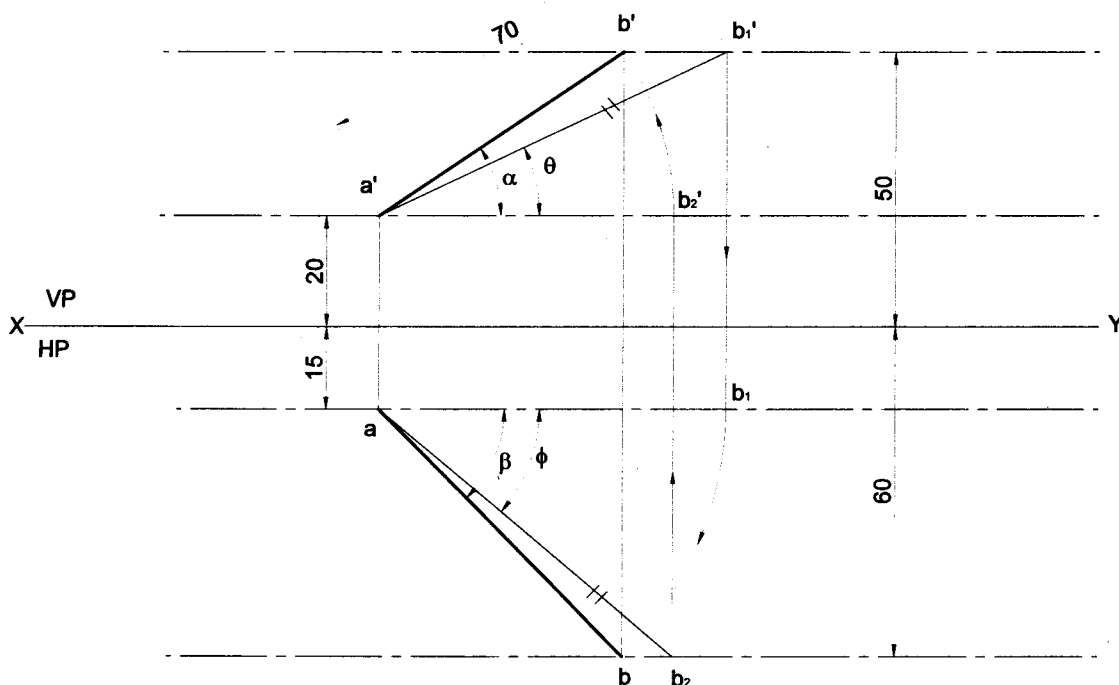**Solution**

ANSWERS :
$\alpha = 34^0$
$\beta = 45^0$
a'b' = 46
ab = 56

Problem 10 A line AB measuring 70 mm has its end A 15 infront of VP and 20 mm above HP and the other end B is 60 infront of VP and 50 mm above HP. Draw the projections of the line and find the inclinations of the line with both the reference planes of projection.
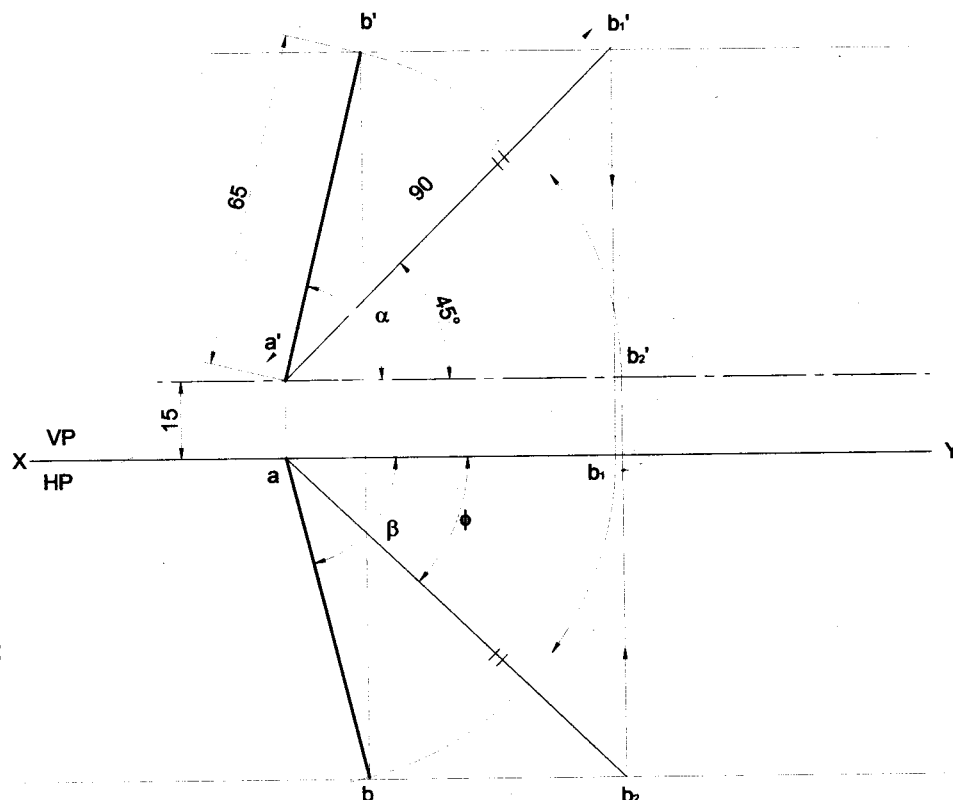**Solution**

June 2009

ANSWERS :
$\theta = 25^0$
$\phi = 40^0$
$\alpha = 34^0$
$\beta = 45^0$

31

Problem 11 The front view of a 90 mm long line which is inclined at 45° to the XY line, measures 65 mm. End A is 15 mm above the XY line and is in VP. Draw the projections of the line and find is inclinations with HP and VP.
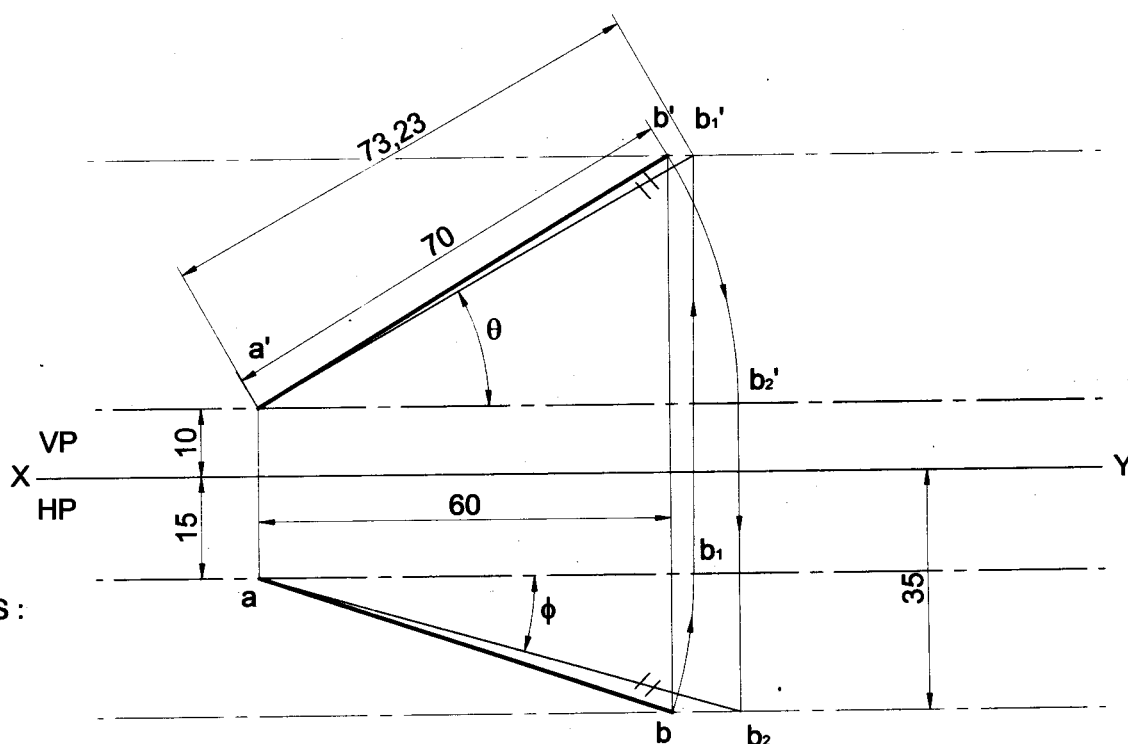**Solution**

ANSWERS :
$\phi = 43^0$
$\alpha = 76^0$
$\beta = 76^0$

Problem 12 The distance between the end projectors through the end points of a line AB is 60 mm. The end A is 10 mm above HP and 15 mm infront of VP. The end B is 35 mm infront of VP. The line AB appears 70 mm long in the front view. Complete the projections. Find the true length of the line and its inclinations with HP and VP.
Solution

ANSWERS :
$\theta = 29^0$
$\phi = 16^0$
• TL = 73

32

Problem 13 The distance between the end projectors through the end points of a line AB is 40 mm. The end A is 20 mm above HP and 15 mm in front VP. The end B is 45 mm infront of VP. The line AB appears 50 mm long in the front view. Complete the projections. Find the true length of the line and its inclinations with HP and VP.
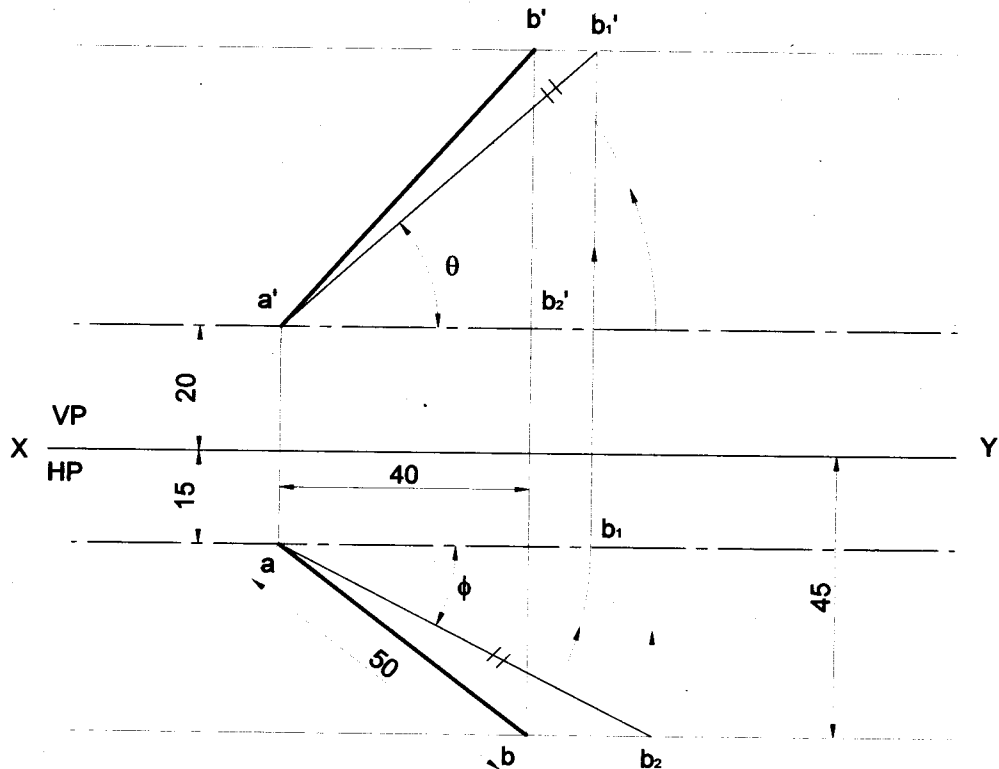
Solution

ANSWERS :
$\theta = 42^0$
$\phi = 27^0$
TL = 67

Problem 14 The point B of a line AB is on the horizontal plane, the top view of the line makes an angle of 30° with XY line, being 80 mm. The point A is on the vertical plane and 50 mm above the horizontal plane. Draw the top and front views of the line and obtain the true length of the line. Also find the inclinations of the line with the two planes.
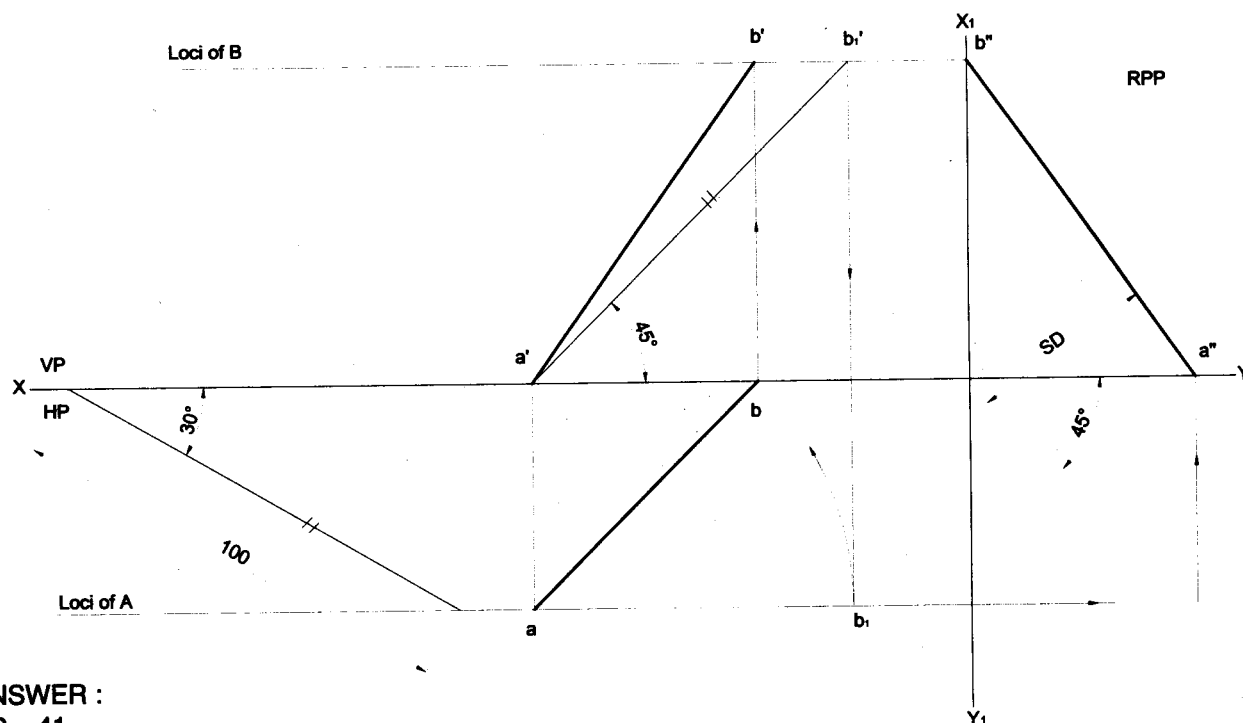
Solution

ANSWERS :
$\theta = 25^0$
$\phi = 32^0$
TL = 95

33
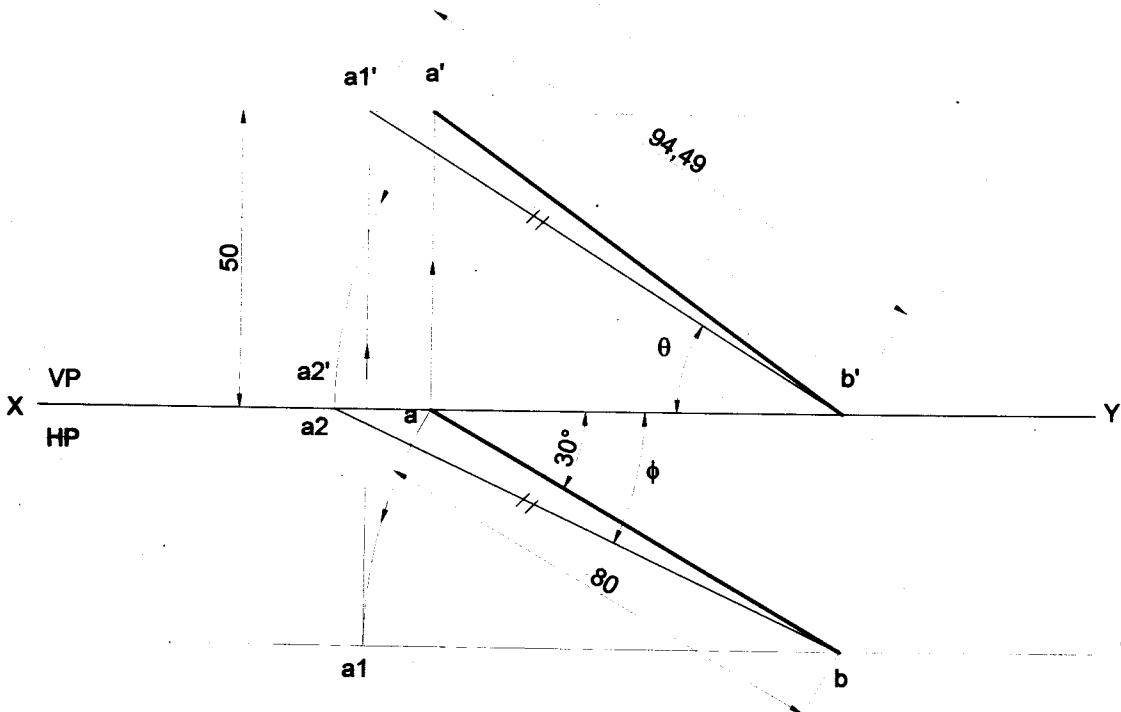
Problem 15 Draw the projections of a straight line AB, 100 mm long, inclined at 45° to HP and 30° to VP. The end A is in HP and the end B is in VP. Find the shortest distance between the straight line AB and the line of intersection of planes of projection.
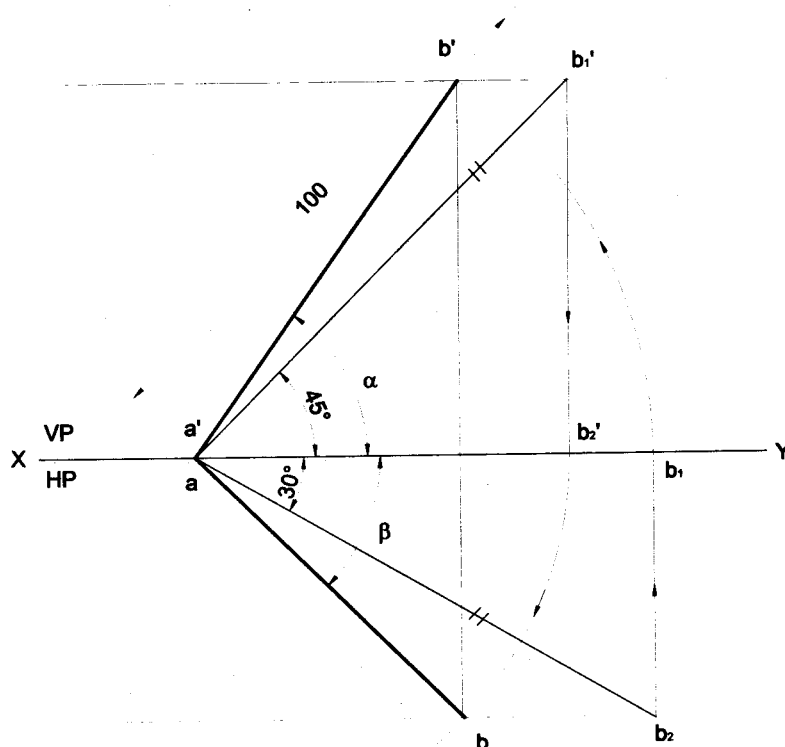
Solution

Loci of B

b'   b₁'   X₁
              b"

RPP

a'

45°

SD

a"

VP
X —————————————————————————— Y
HP

30°

b

45°

100

Loci of A

a

b₁

a

ANSWER :
SD = 41

Y₁

Problem 16 A line AB 100 mm long is inclined to HP at 45° and inclined to VP at 30°. Draw front and top views of line and determine their lengths. Also determine the perpendicular distance of end Q from both HP and VP.

Solution

b'   b₁'

100

α

VP
a'   b₂'
X ——————————————————————— Y
HP a   b₁

45°

30°

β

ANSWERS :
α = 55°
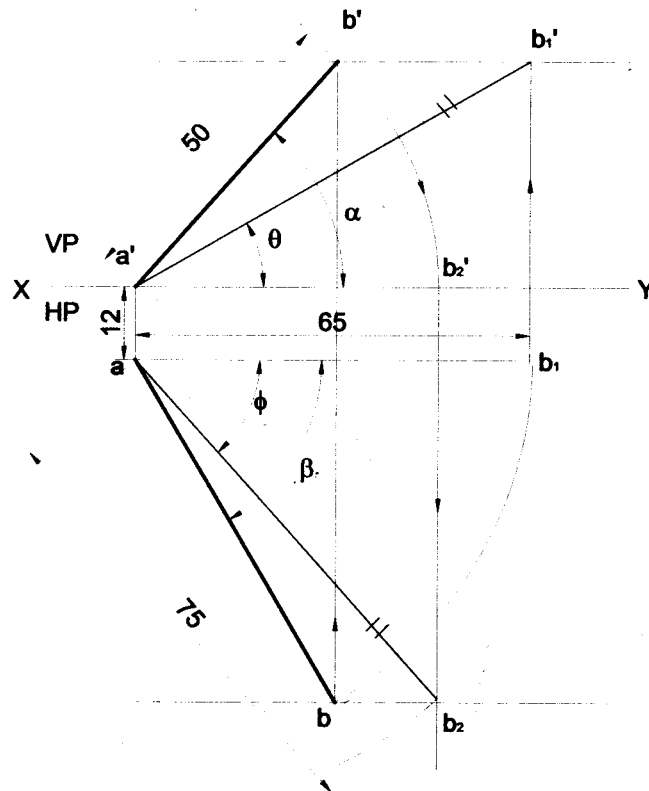β = 65°
a'b' = 87
ab = 71
b'b' = 71
b₁'b₂ = 50

b   b₂

34

Problem 17 The top view of a 75 mm long line AB measures 65 mm, while the front view is 50 mm. Its one end A is in the H.P and 12 mm in front of the V.P. Draw the projections of AB and determine its inclinations with the H.P. and the V.P.
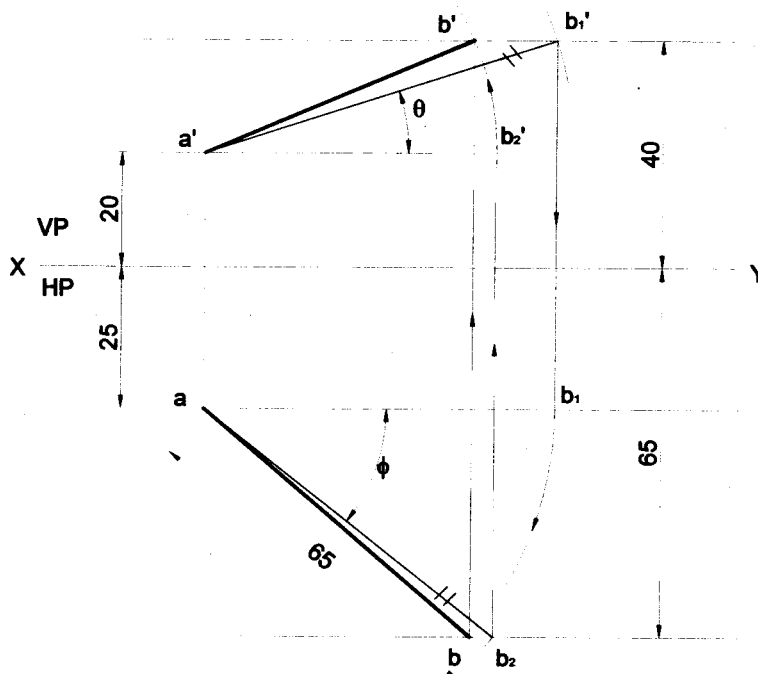
Solution

ANSWERS :
$\theta = 30^0$
$\phi = 48^0$
$\alpha = 48^0$
$\beta = 60^0$

Problem 18 A line AB, 65 mm long, has its end A 20 mm above the H.P and 25 mm in front of the V.P The end B is 40 mm above the H.P. and 65 mm in front of the V.P. Draw the projections of AB and show its inclinations with the H.P. and the V.P.
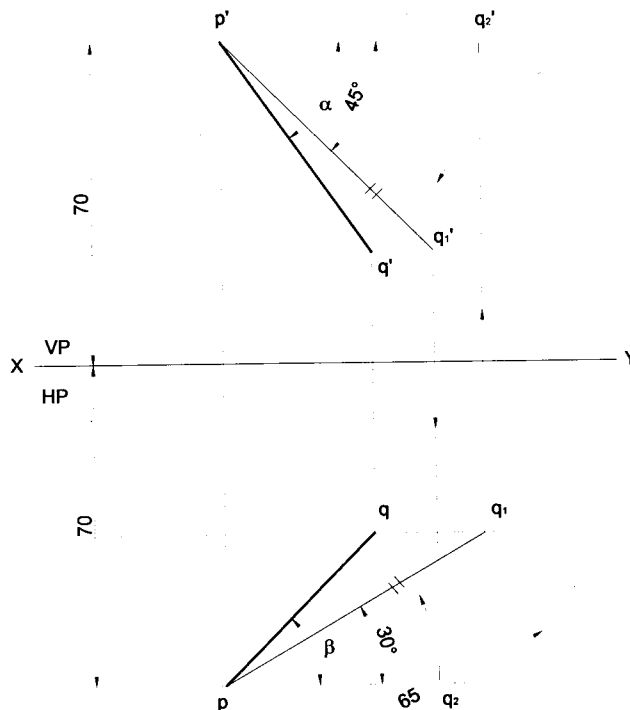
Solution

ANSWERS :
$\theta = 10^0$
$\phi = 38^0$

Problem 19 A straight line PQ, 65 mm long, is inclined at 45° to HP and 30° VP. The point P is 70 mm from both the reference planes and the point Q is towards the reference planes. Draw the projections.
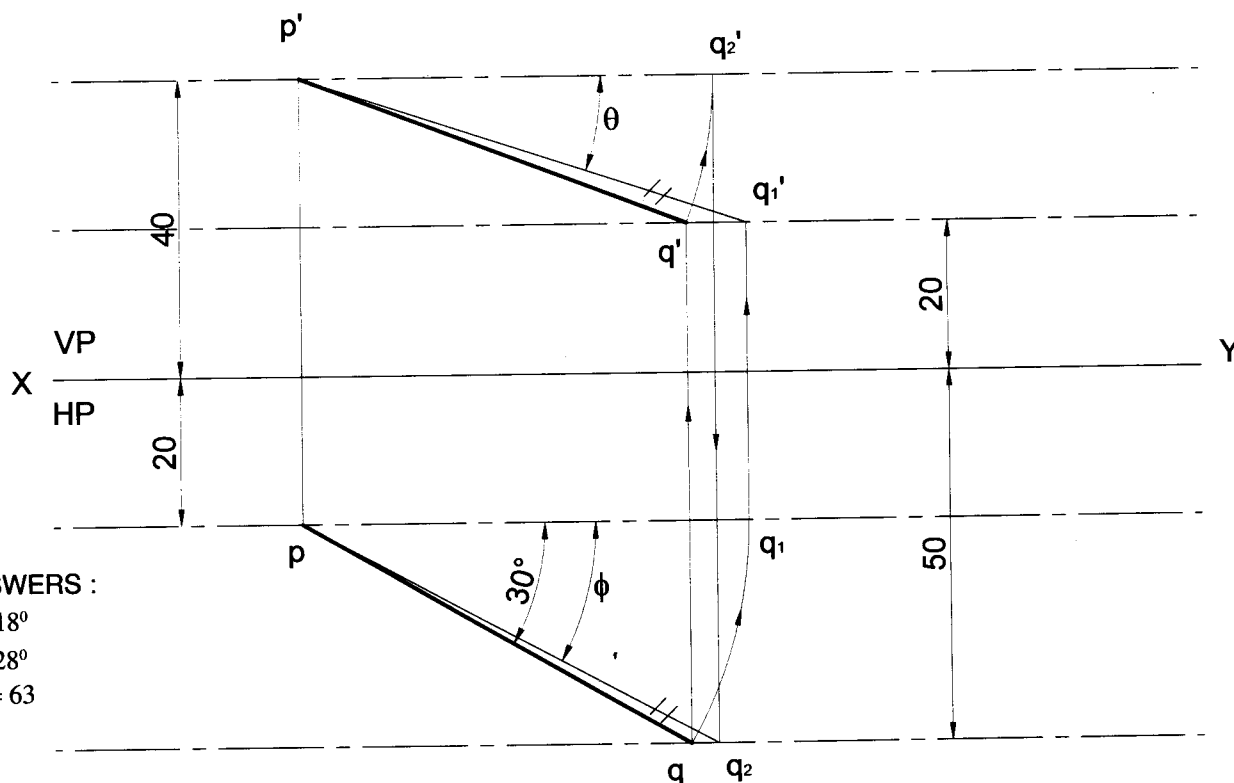
Solution

p'

q₂'

α 45°

q₁'

q'

70

X —— VP —————————————————————— Y
      HP

70

q   q₁

β   30°

p   65 q₂

ANSWERS :

$\alpha = 55^0$

$\beta = 45^0$

Problem 20 A point P is 40 mm above HP and 20 mm infront of VP another point Q is 20 mm above HP and 50 mm infront of VP. The top view of line PQ is inclined at 30° to XY. Draw the projections.

Solution

p'

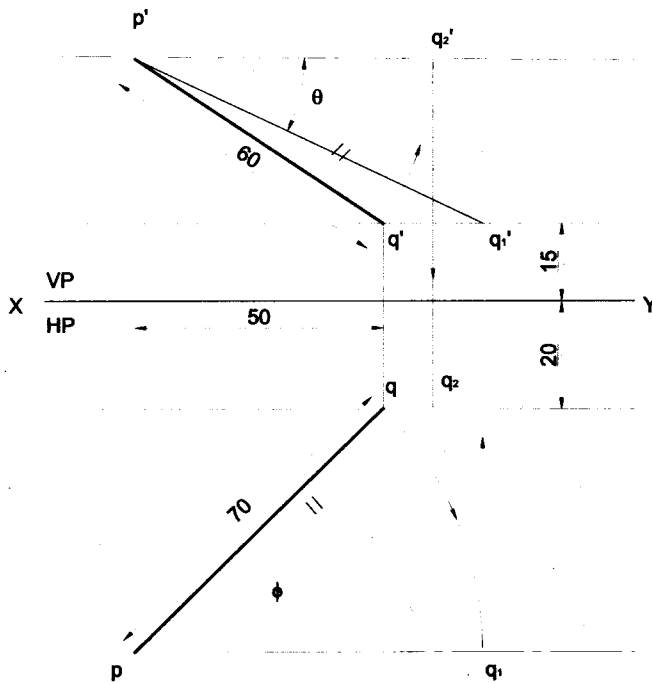q₂'

θ

q₁'

q'

40

VP

X

HP

20

20

p

p

30°   φ

q₁

50

ANSWERS :

$\theta = 18^0$

$\phi = 28^0$

TL = 63

q   q₂

36

Problem 21 The top view of a line PQ is 70 mm and front view is 60 mm long. The end Q is nearer to both HP and VP than the end P and is 15 above HP and 20 mm infront of VP. Draw the projections of the line if the distance between projectors is 50 mm.
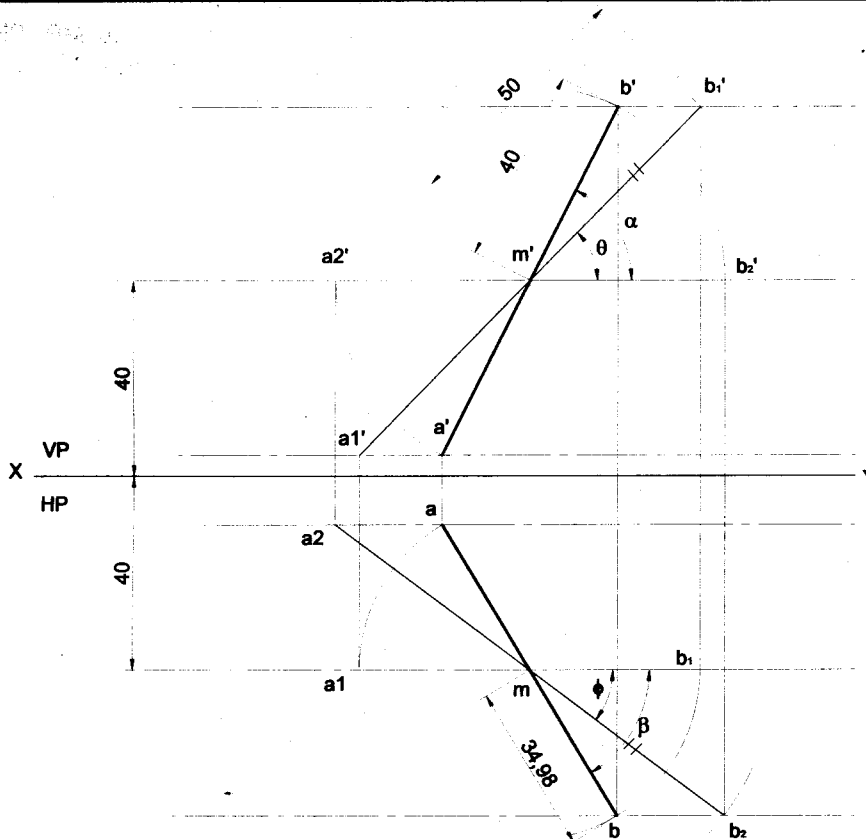
Solution

p'

q₂'

θ

60

q'   q₁'

15

VP

X ——— 50 ——— Y

HP

q   q₂

20

70

φ

p   q₁

Problem 22 A line AB 100 mm long measures 80 mm in front view and 70 mm in top view the mid point M of the line is 40 mm from both HP and VP. Draw its projections. Find its inclinations.

Solution

50   b'   b₁'

40

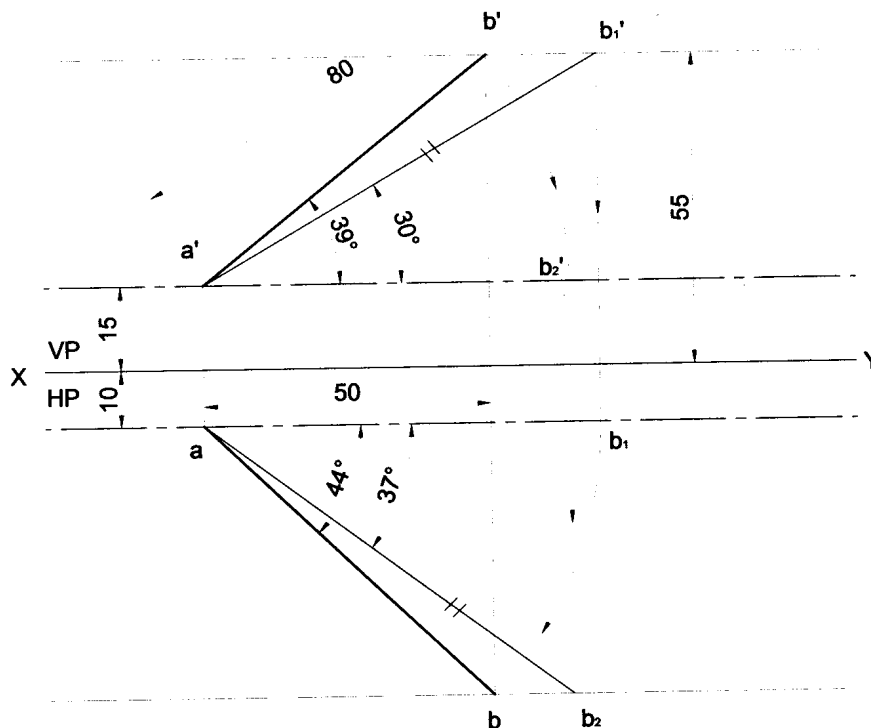a2'   m'   θ   b₂'

α

40

a1'   a'

VP

X ——————————— Y

HP

a

a2

40

b₁

a1   m   φ

β

34.98

b   b₂

Problem 23 A line has its end A 15 mm above HP and 10 mm infront of VP. The end B is 55mm above HP and the line is inclined at 30⁰ to HP. The distance between the end projectors is 50 mm. draw the projections of the line and determine the true length of the line and its inclinations with VP.

Solution

b' b₁'
80
a' 39° 30° 55
b₂'
VP 15
X
HP 10 50 b₁
a
44° 37°

ANSWERS :
$\phi = 37^0$
$\alpha = 39^0$
$\beta = 44^0$
TL = 80

b b₂

Problem 24 A line MN 90 mm long has a point P on it which divides the line in the ration 2:1, i.e. MP : PN = 2:1. this point P is 50 mm above HP and 60 mm in front of VP. The line is inclined at 35⁰ to HP and 40⁰ to VP. Draw the projection of the line. Find the distance between end projector and the position of the ends of the line with HP and VP.

Solution

30
60 n' n₁'
p' 35°
n₂'
50
m₁' m'
X VP Y
HP
m₁ m
60
m₂ 40° n₂
p
n n₁

38
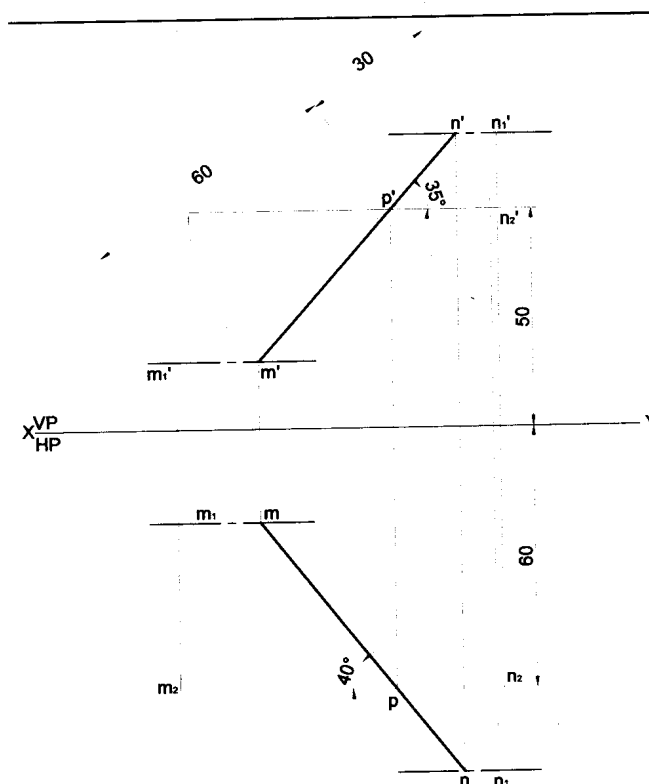
Problem 25 A straight line PQ inclined at 40^0 to VP has pq = 60 mm and p'q' = 50 mm. The end P is both in HP and VP, and 40 mm to the right of left profile plane
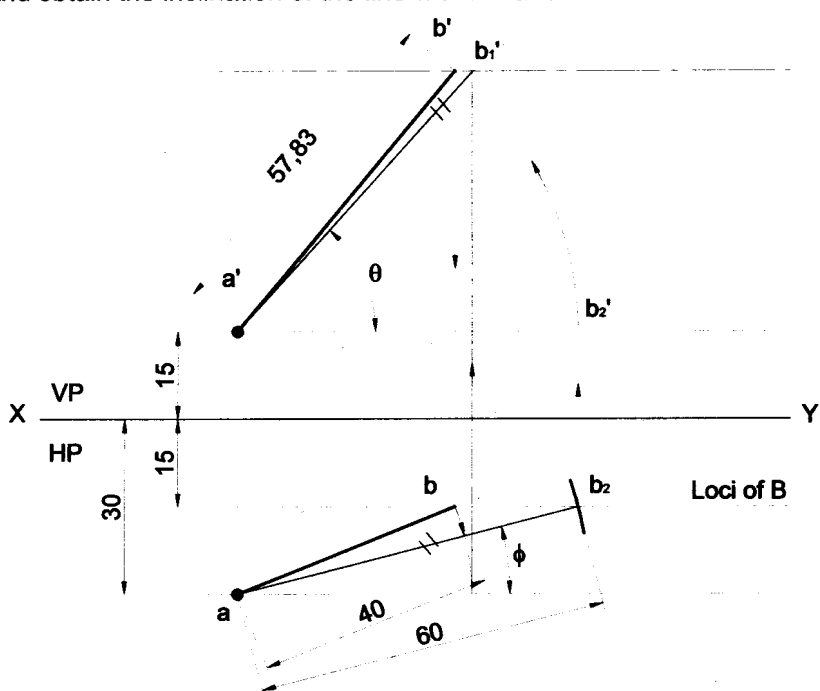
- a) Draw the projections of the straight line PQ.
- b) Find the true length and true inclination with HP.
- c) Draw the profile view of the straight line.
- d) Find the position of the end Q with HP and VP.

Solution

ANSWERS :
$\theta = 19^0$
$\phi = 38^0$
$\alpha = 23^0$
$\beta = 40^0$
TL = 59
L = 39
M = 20
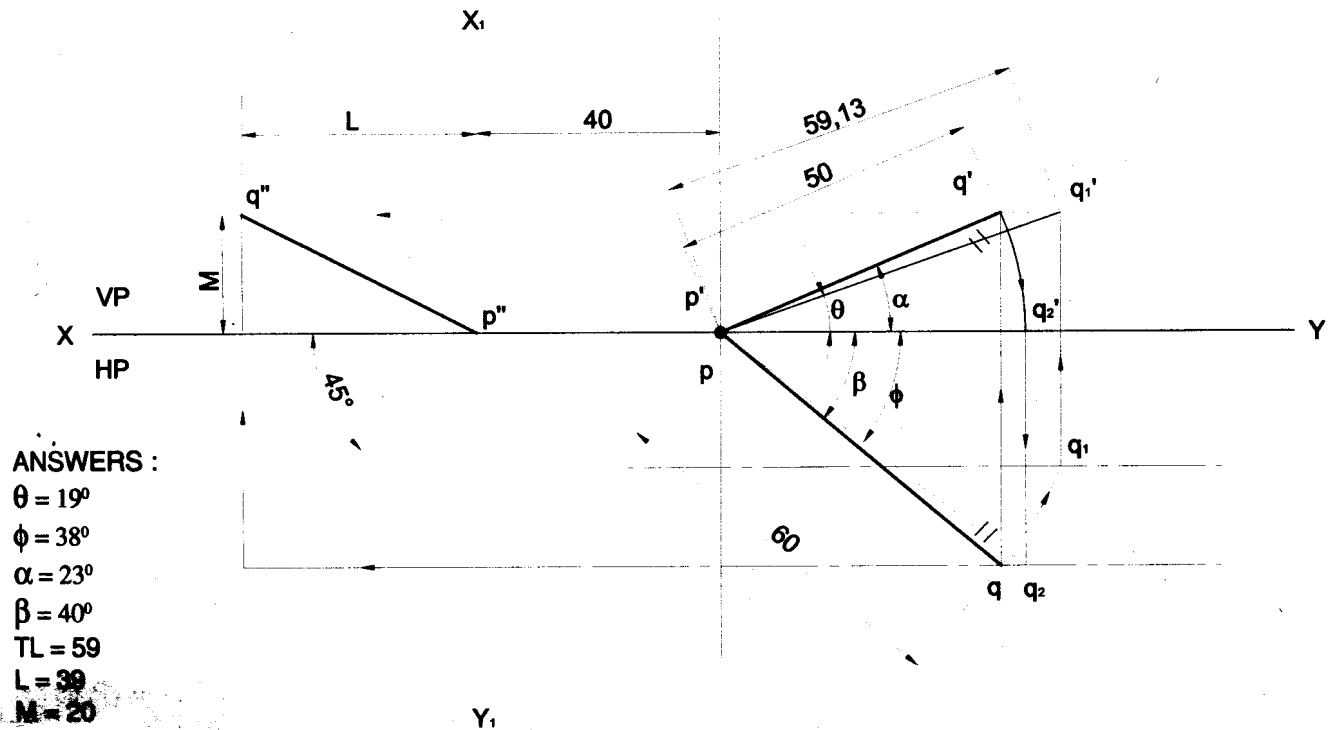
Problem 26 A line has one end 30 mm in front of VP and 15 mm above HP and the other end is 15 mm in front of VP and is above HP. Length of the line is 60 mm. Top view of the line is 40 mm long. Draw the two views of the line and obtain the inclination of the line with HP and VP.

Solution

Loci of B

ANSWERS :
$\theta = 48^0$
$\phi = 14^0$

39

Problem 27 The top view of line PQ 75 mm long measures 50 mm. The end P is 30 mm in front of VP and 15 mm above HP. The end Q is 15 mm in front of VP and above HP. Draw the Projections of the line and find its true inclinations with HP and VP. Find the length of front view and distance between the end Projectors.

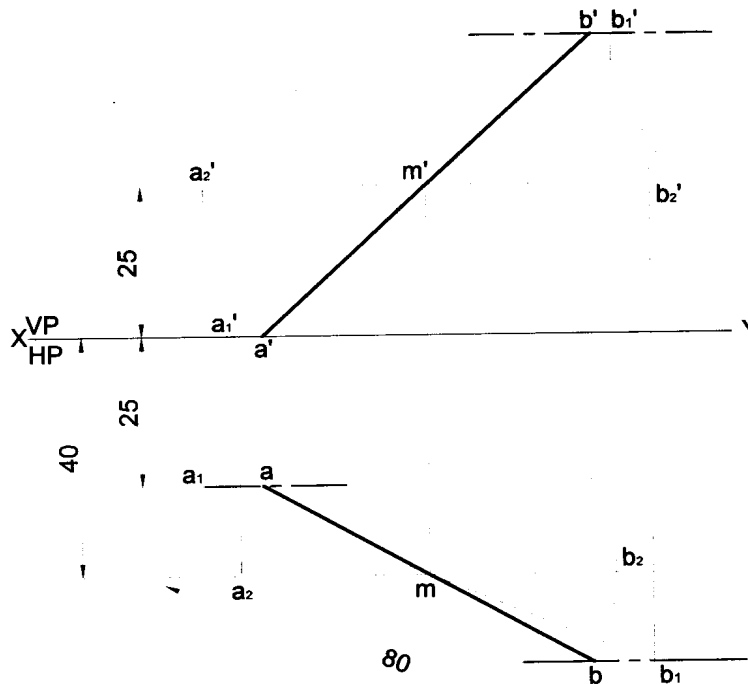**Solution**

ANSWERS :

$\theta = 12^0$

$\phi = 48^0$
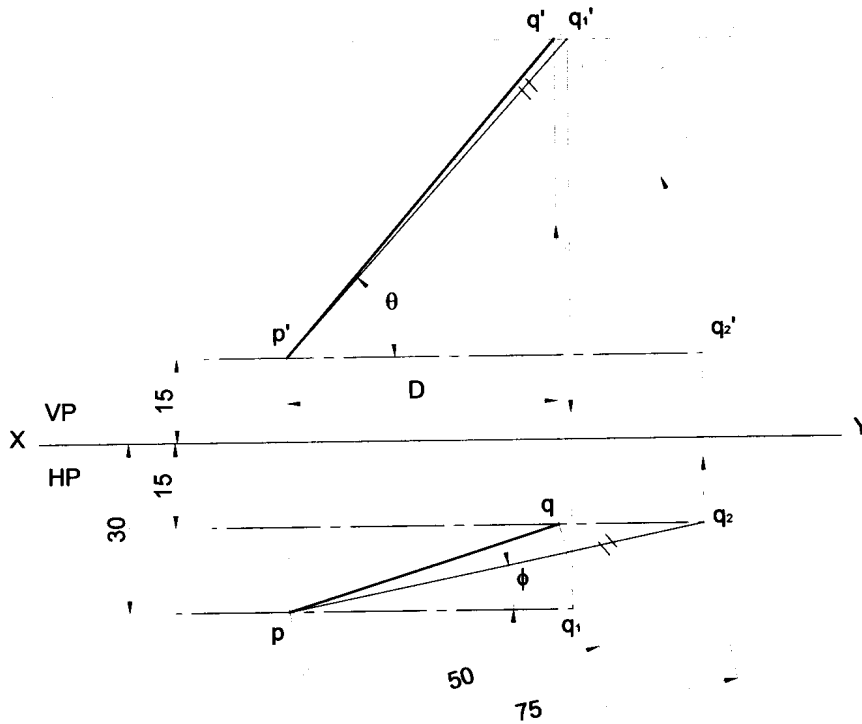
D = 48

p'q' = 73

Problem 28 A straight line AB measuring 80 mm long has the end A in the HP and 25 mm in front of the VP. Its mid point M is 25 mm above the HP and 40 mm in front of the VP. Draw the projections of the line and determine the inclination of the line with HP and VP.

Solution

40

Problem 29 The front view of the line PQ 80 mm long measures 50 mm and it is inclined to XY (reference line) at 50°. One end of the line P is 20 mm above the HP and 25 mm in front of the VP. Draw the front view and top view of the line and find the inclinations of the line with HP and VP.
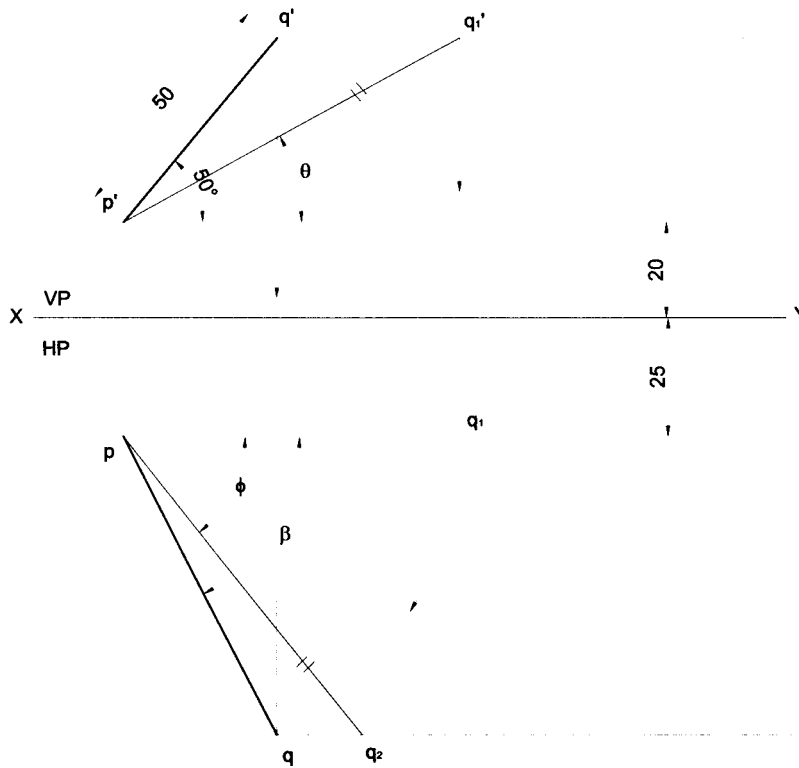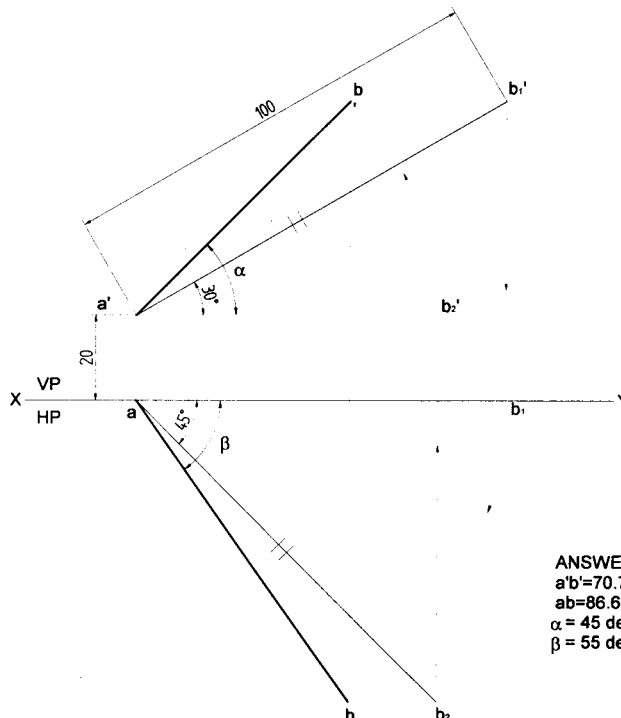
Solution

ANSWERS :

$\theta = 29°$

$\phi = 51°$

$\beta = 63°$

Problem 30 Draw the projections of a line AB 100 mm long inclined at 45° to VP and 30° to HP. One end of the line is 20 mm above the HP and in the VP. Also determine the apparent length and inclinations.

Solution

ANSWERS
a'b'=70.71
ab=86.6
α = 45 degrees
β = 55 degrees

41

Problem 31 Draw the projections of a line PQ and find its true length and inclinations when the line is inclined at 30^0 to the HP and 45^0 to the VP. The line is having one of its ends 15 mm above HP and 20 mm in front of VP. The distance between the end projectors on the XY line is 60 mm.

Solution

ANSWERS
α = 45 degrees
β = 55 degrees
TRUE LENGTH(p'q₂1&pq₂) = 119
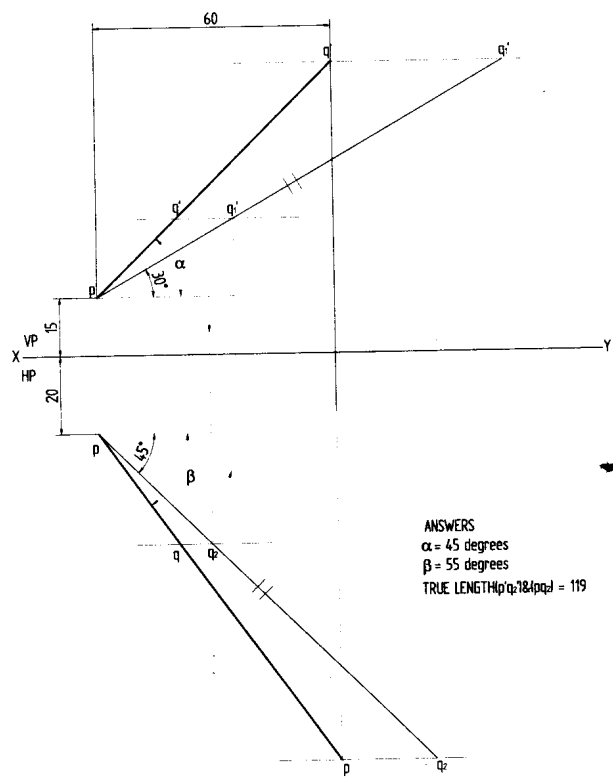
Problem 32 The top view ab of a straight line AB is 60 mm long and makes an angle of 30^0 with the XY line. The end A is in VP and 30 mm above HP. The end B is 65 mm above HP. Draw the projections of the line AB and determine i) length of the front view ii) its true length and true inclinations with the reference planes.

Solution

ANSWERS :
$\theta = 30^0$
$\phi = 26^0$
$\alpha = 34^0$
TL = 69
a'b' = 63

42
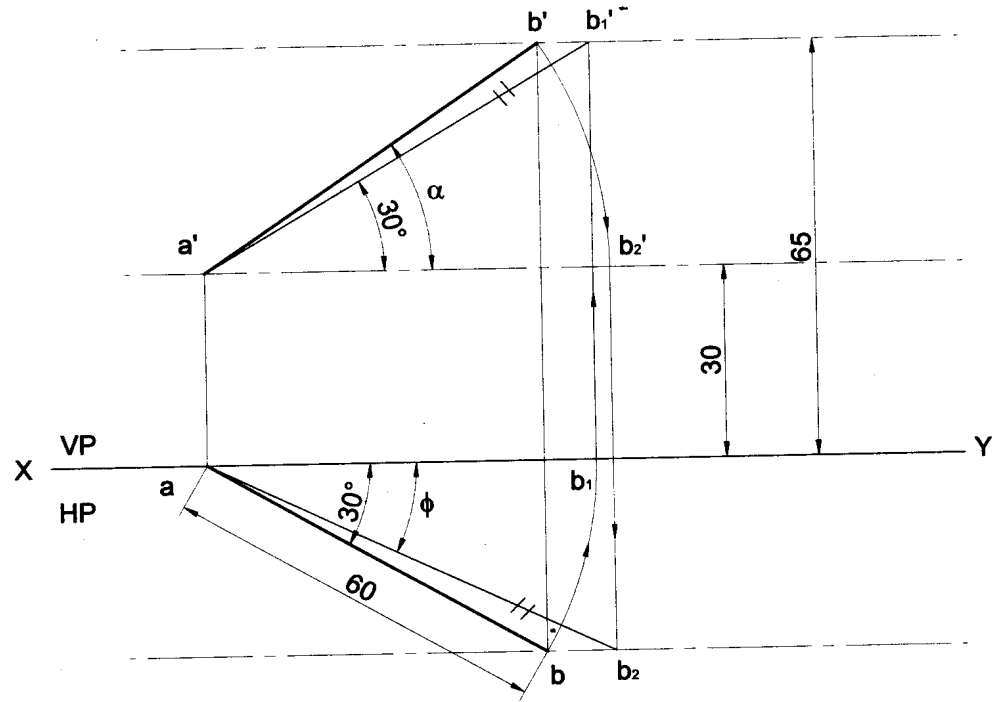
Problem 33 A line AB 65 mm long, has its end A 25 mm above HP and 30 mm in front of VP. The other end is 45 mm above HP and 50 mm in front of VP. Draw the projections and determine its inclinations.
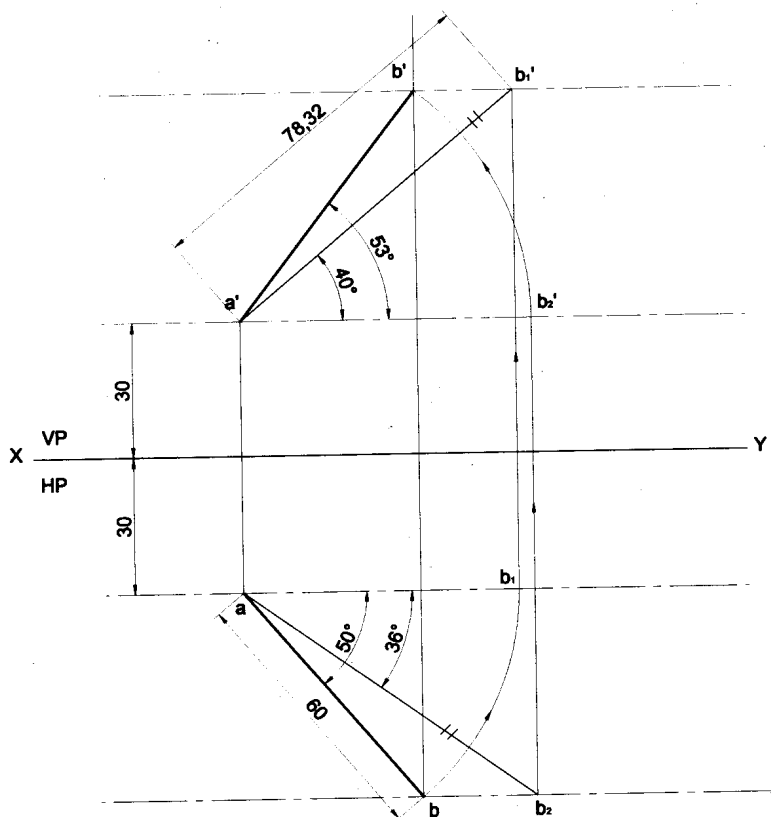**Solution**
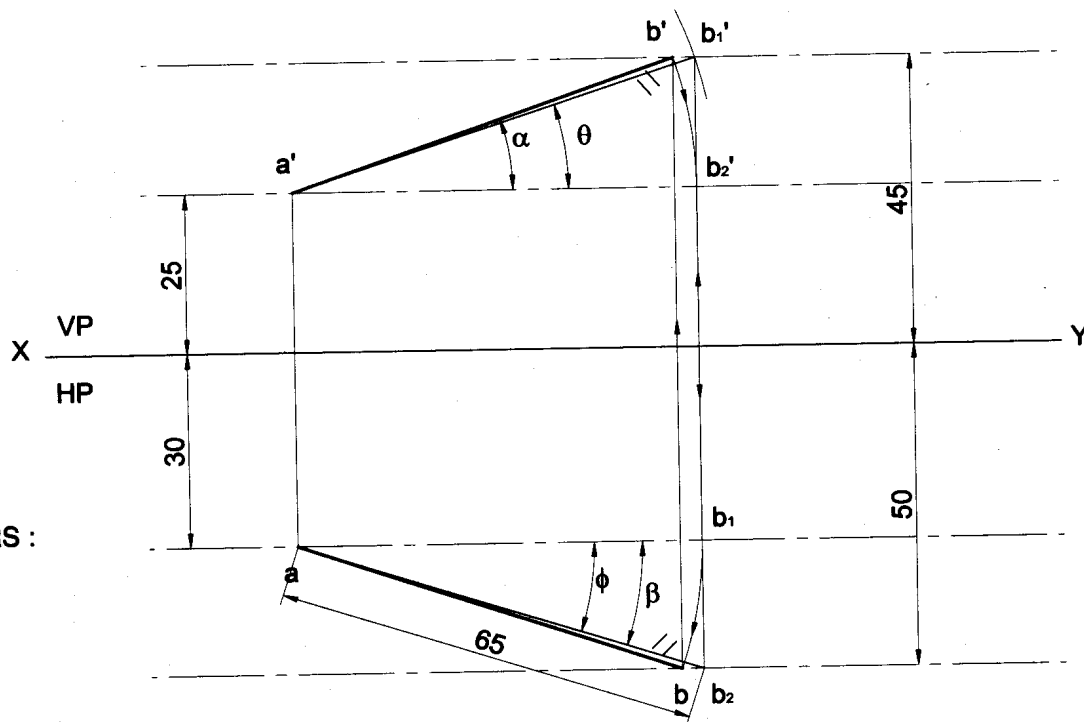
ANSWERS :
$\theta = 18^0$
$\phi = 17^0$
$\alpha = 19^0$
$\beta = 18^0$

Problem 34 One end of a line is 30 mm in front of VP and 30 mm above HP. The line is inclined at 40^0 to HP and its top view measuring 60 mm, is inclined at 50^0 to XY. Draw the projections of the line and determine true length and inclination with VP.
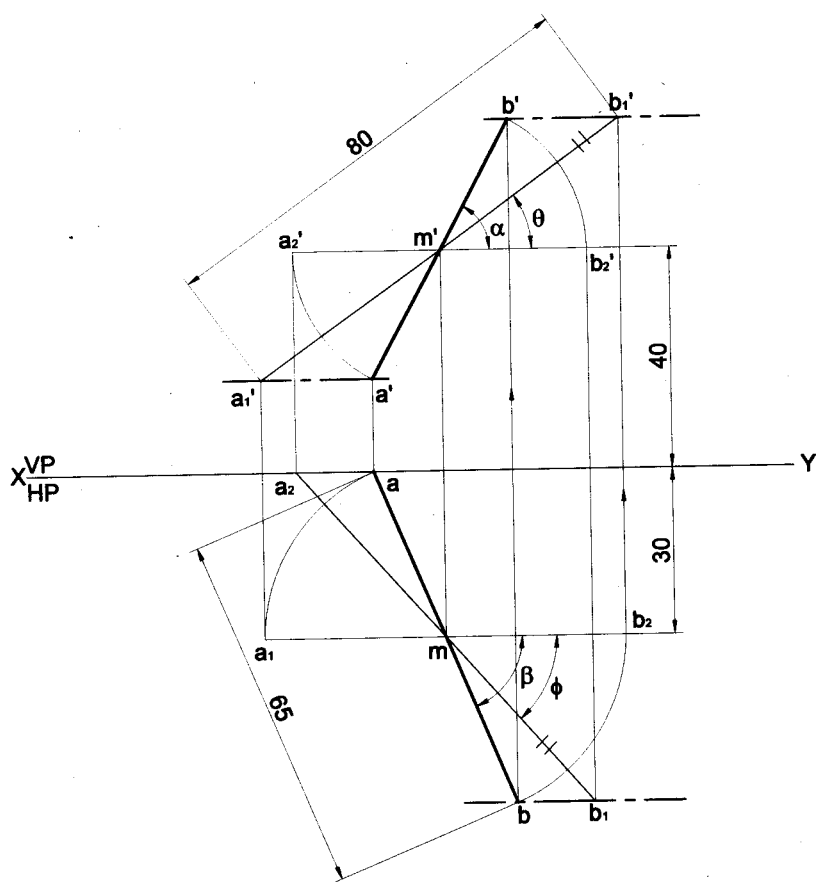**Solution**

ANSWERS :
$\phi = 36^0$
TL = 78

43

Problem 35 The top view of the line AB 80 mm long, measures 65 mm. The mid point of the line is 60 mm in front of VP and 70 mm above HP. The point A is in the VP. Draw its projections and find its inclinations.
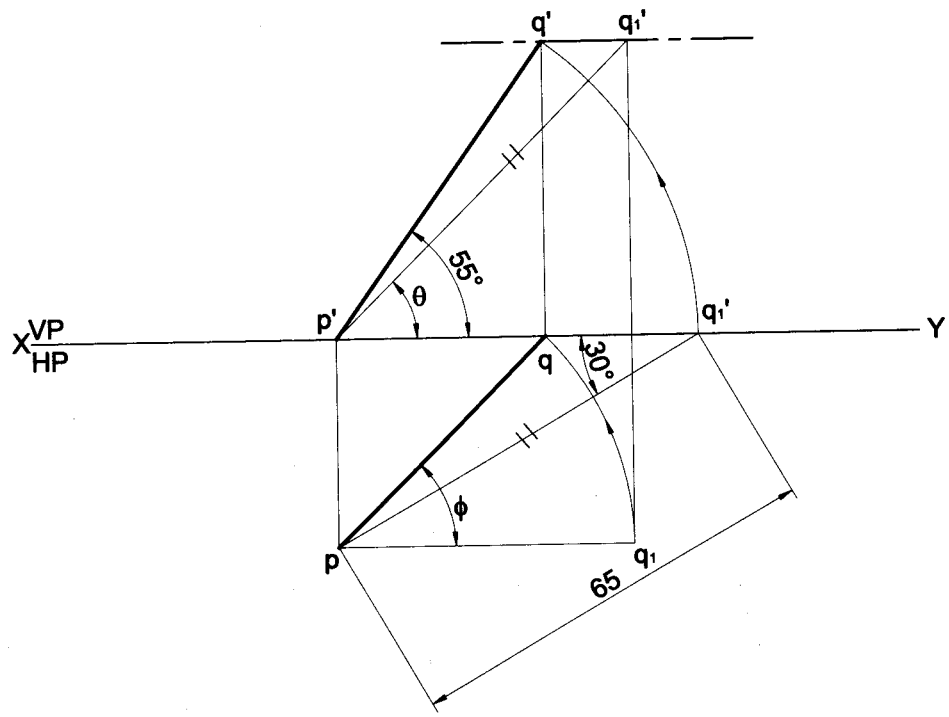**Solution**

ANSWERS :
$\theta = 36^0$
$\phi = 49^0$
$\alpha = 62^0$
$\beta = 67^0$

Problem 36 A straight line PQ is inclined at 45° to HP and 30° to VP. The point P is in HP and the point Q is in VP. The length of the straight line is 65 mm. draw the projections of the straight line AB.
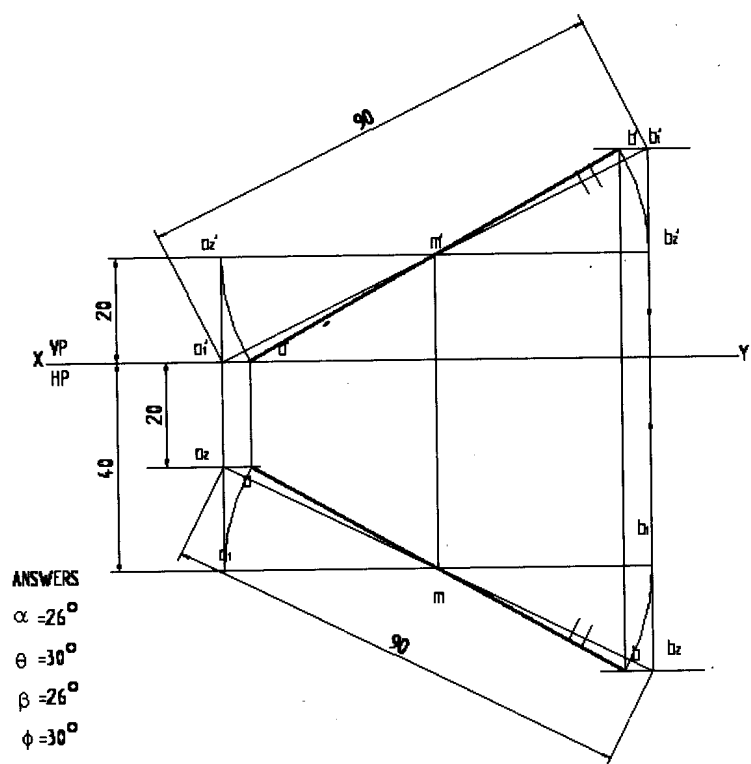**Solution**

ANSWERS :
$\theta = 36^0$
$\phi = 49^0$

44

Problem 37 Draw the projections of a line AB 90 mm long and find its true and apparent inclinations with HP and VP, when its end A is on HP and 20 mm in front of VP. Its midpoint M is 20 mm above the HP and 40 mm in front of the VP.

Solution

ANSWERS

$\alpha = 26°$

$\theta = 30°$

$\beta = 26°$

$\phi = 30°$

Problem 38 A line PQ is inclined to both HP and VP by 30° and 45° respectively. one of its ends P is at a distance of 10 mm from HP and 15 mm from VP. The distance between the end projectors is 45 mm. Draw the top, front and right side views of the line. Determine the true length of the line and the distances of the end Q from VP and HP.
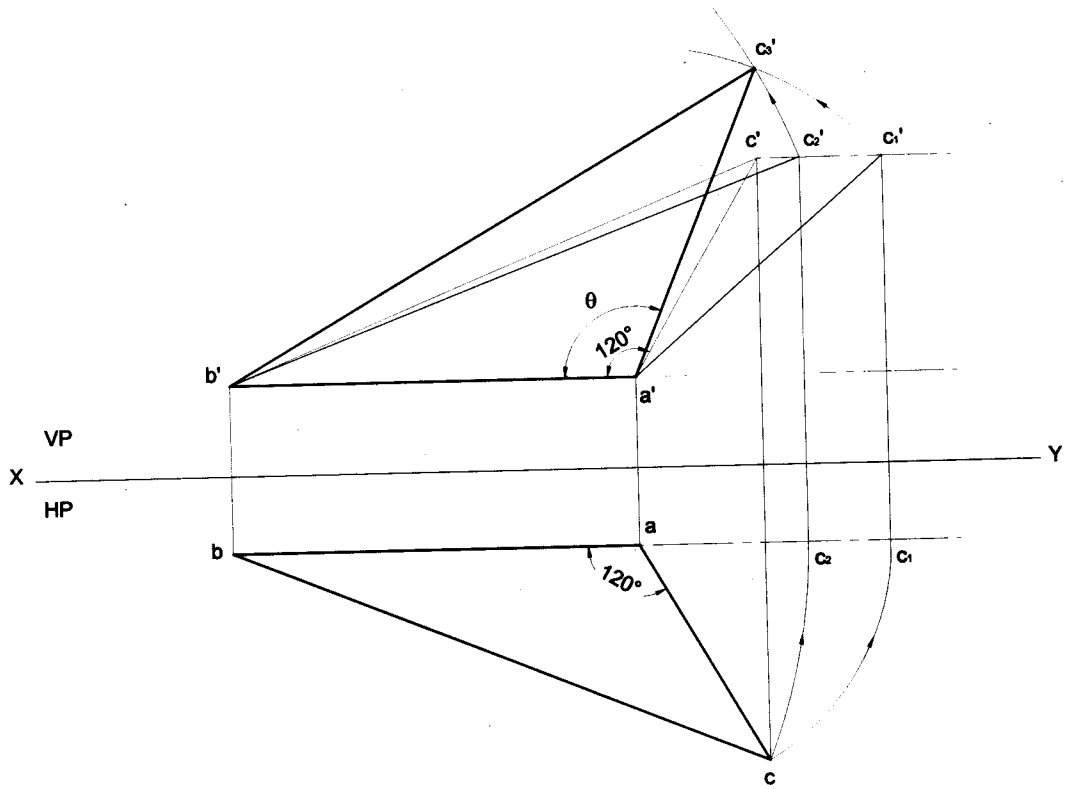
Solution

ANSWERS :

$\alpha = 46°$

$\beta = 55°$
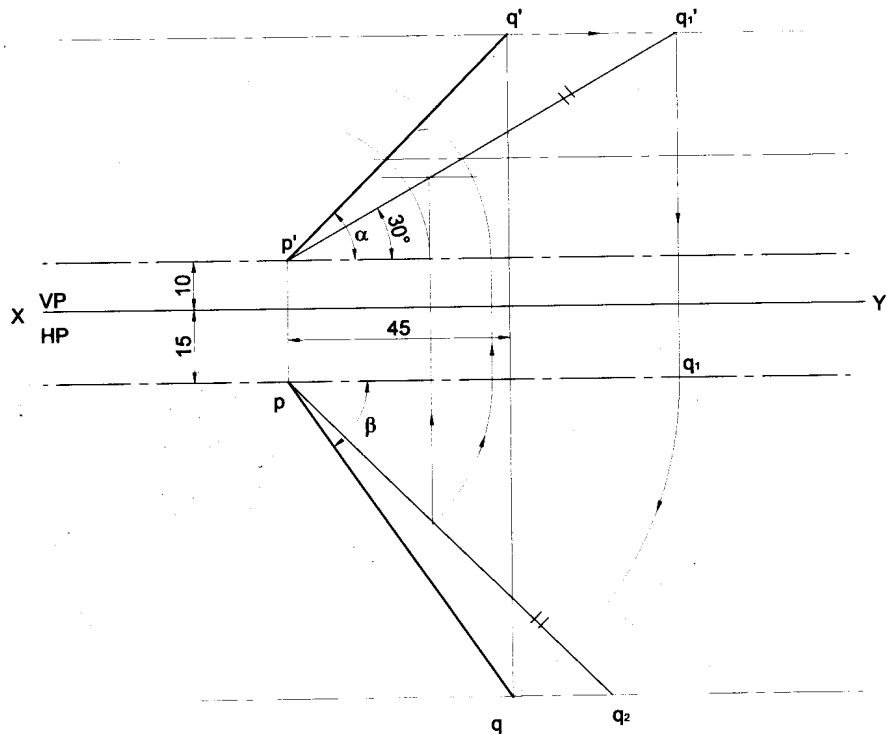
45

Problem 39 Two lines AB and AC make an angle of 120° between them in their front view and top view. AB is parallel to both the HP and the VP. Determine the real angle between AB and AC.
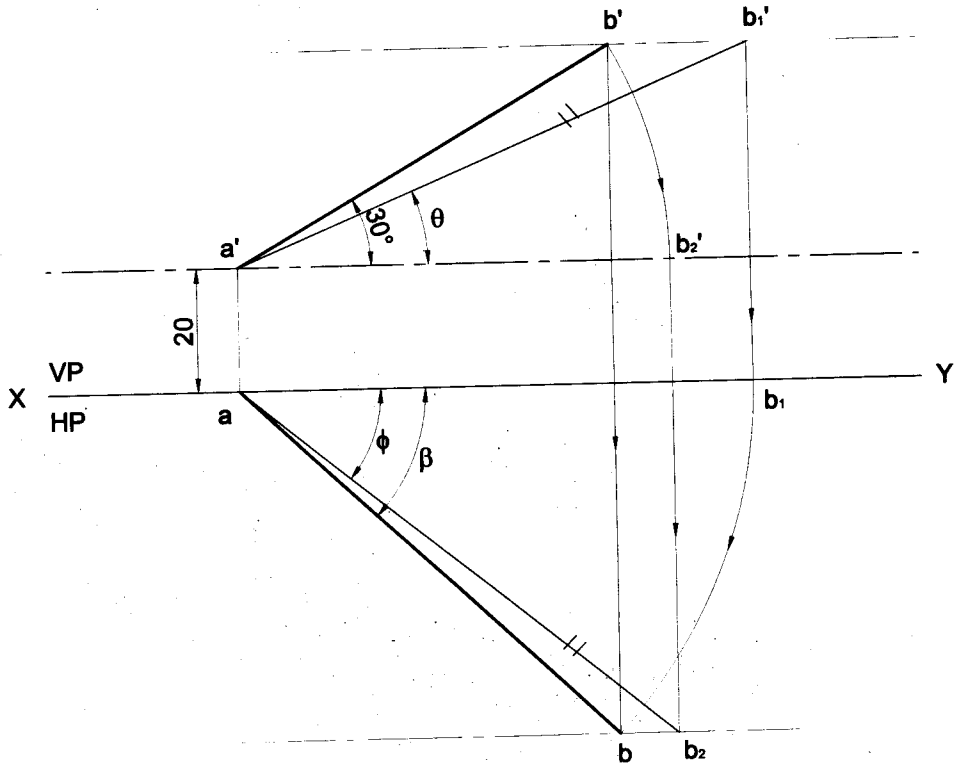
Solution

ANSWER :

$\theta = 112^0$

Problem 40 The elevation of a line AB 90 mm long, is inclined at 30° to HP and measures 70 mm. The end A is 20 mm above HP and is in VP. Draw the projections of the line and find its inclination with VP.
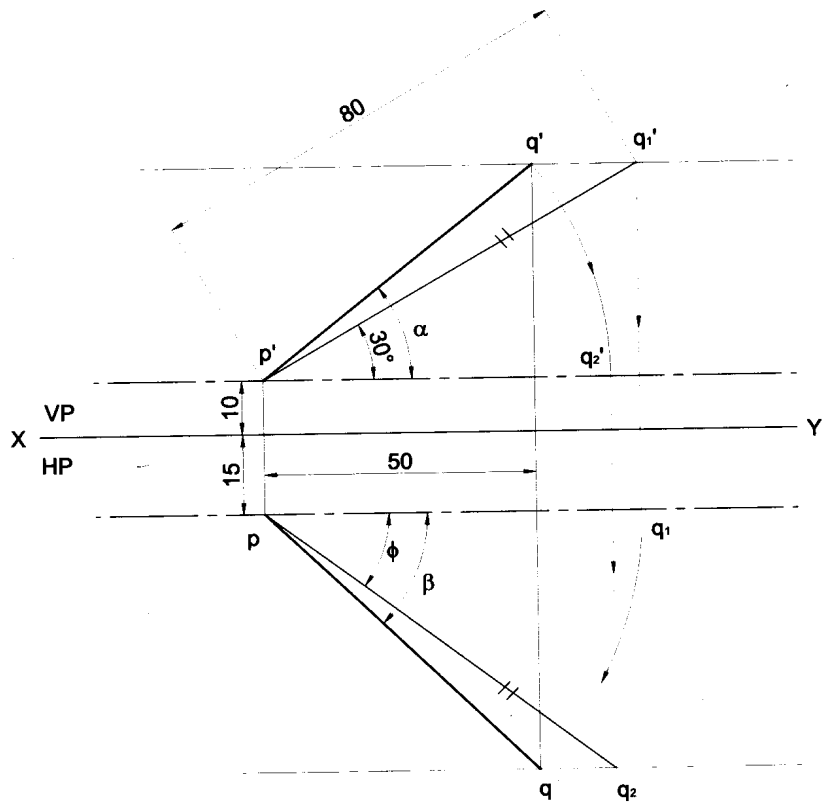
Solution

ANSWERS :

$\theta = 23^0$

$\phi = 39^0$

$\beta = 43^0$

Problem 41 A line PQ measures 80 mm in length. The point P is above HP and infront of VP by 20 mm and 30 mm respectively. The distance between the end projectors is 50 mm. the line is inclined to VP by 30°. Draw the projections of the line and specify its true inclination with HP.
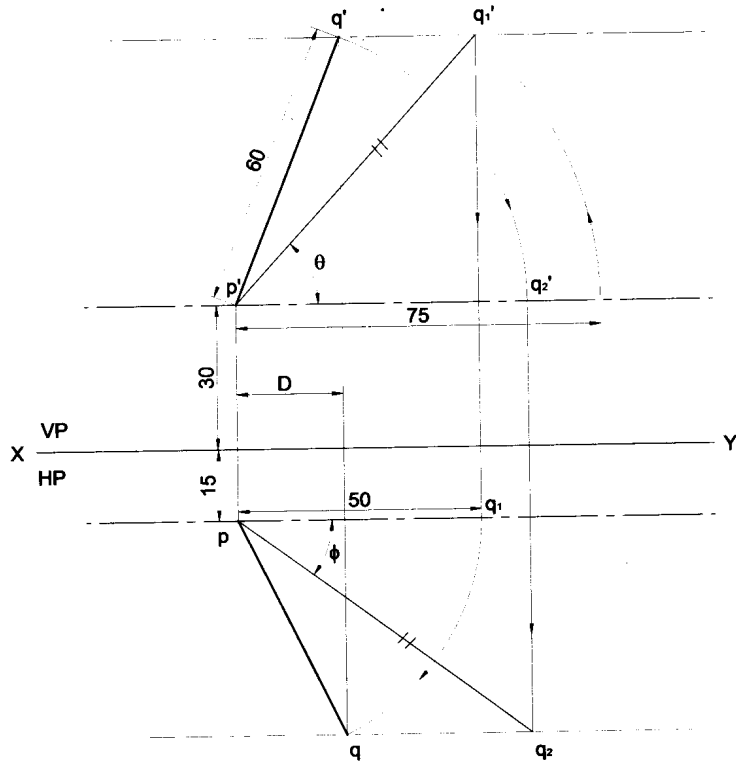
Solution

ANSWERS :
$\phi = 37^0$
$\alpha = 39^0$
$\beta = 44^0$

Problem 42 The top view of a line PQ 75 mm long measures 50 mm and the front view measures 60 mm. The end P is 30 mm above HP and 15 mm infont of VP . Draw the projections of the line and find its true inclinations with HP and VP. Find length of front view and distance between the end projectors.
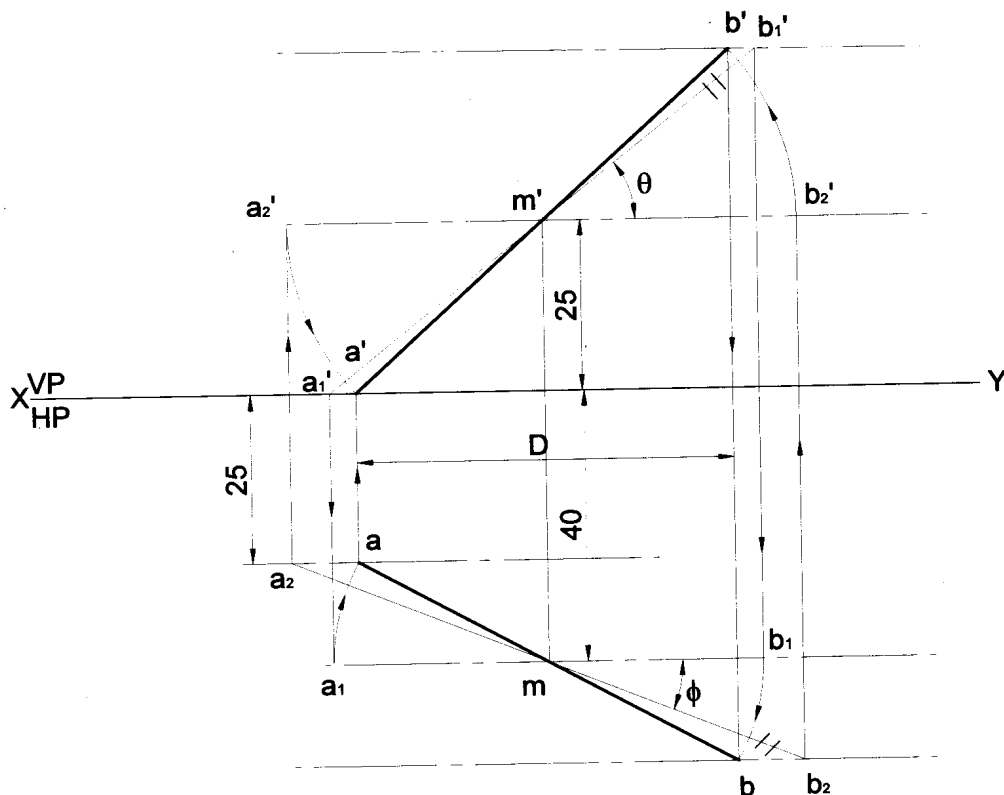
Solution

ANSWERS :
$\theta = 48^0$
$\phi = 37^0$
$D = 22$

47

Problem 43 A straight line AB measuring 80 mm long has the end A in the HP and 25 mm infront of the VP. Its mid point M is 25 mm above HP and 40 mm infront of the VP. Draw the views of the line and determine the inclination of the line with HP and VP and also find distance between end projectors.
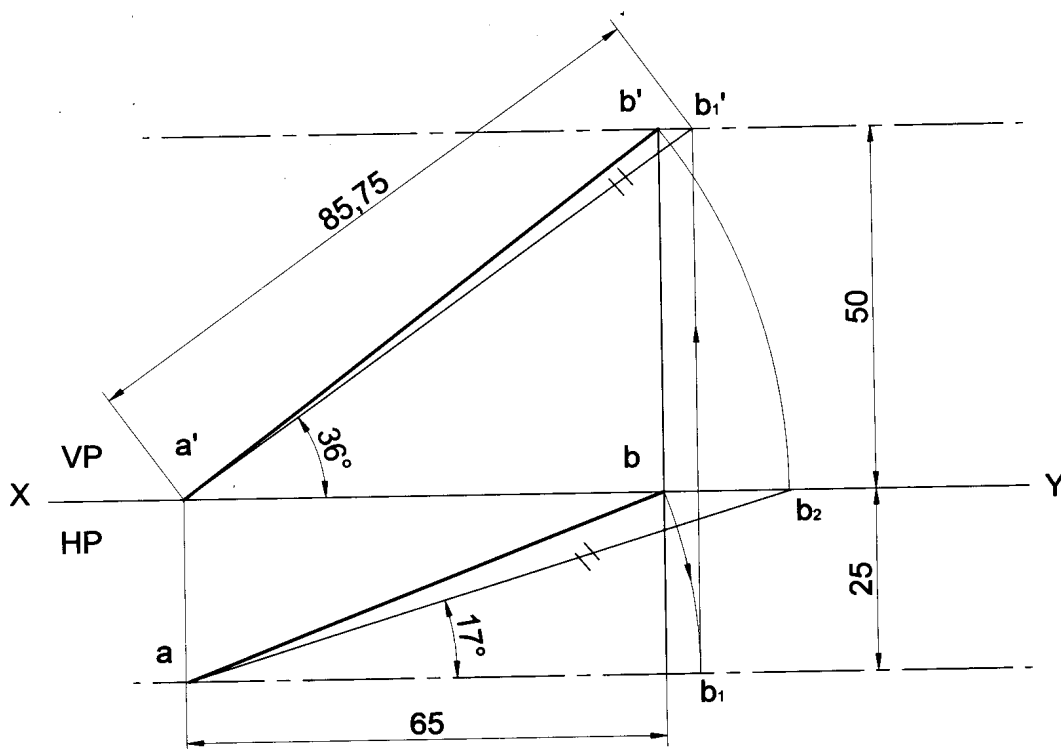
Solution

ANSWERS :
$\theta = 39^0$
$\phi = 22^0$
D = 55

Problem 44 The end A of a line AB is in HP and 25mm in front of VP. The end B is 25 mm infront of VP and 50mm above HP. The distance between the end projectors when measured parallel to the line of intersection of HP & VP is 65mm. Draw the projections of the line AB and determine its true length and true inclinations with HP & VP.
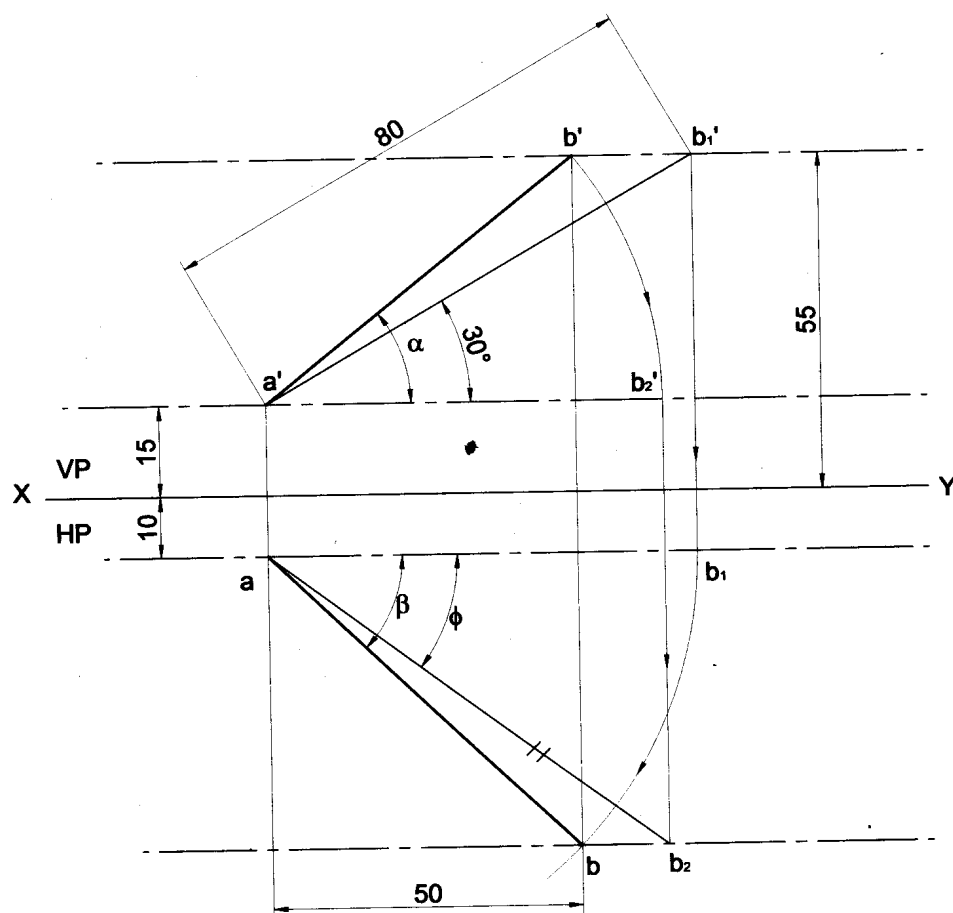
Solution

ANSWERS :
$\theta = 36^0$
$\phi = 17^0$
TL = 86

48

Problem 45 A line has its end A, 15mm from HP & 10 mm from VP. The end B is 55mm from HP and the line is inclined at 30° to HP. The distance between the end projectors is 50mm. Draw the projections of the line. Determine the true length of the line and its inclination with VP.

Solution
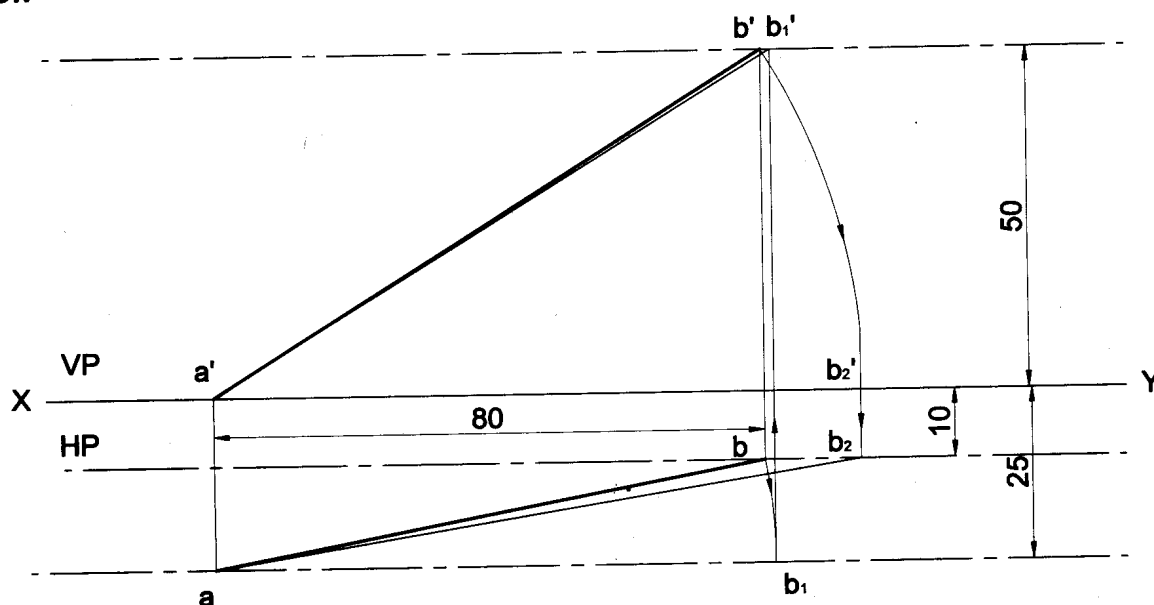

ANSWERS :
$\theta = 28^0$
$\phi = 37^0$
$\alpha = 39^0$
$\beta = 44^0$

Problem 46 The end A of a line AB is in HP and 25mm in front of VP. The end B is 10 mm in front of VP and 50mm above HP. The distance between the end projectors when measured parallel to the line of intersection of HP & VP is 80 mm. Draw the projections of the line AB and determine its true length and true inclinations with HP & VP.

Solution

49

Problem 47 A straight line PQ 80 mm long appears to a length of 50 mm and inclined at 300 to xy line in its top view Draw its projections when its end point P is 15 mm above HP and 60 mm infront VP. Point Q is nearer to VP than P.
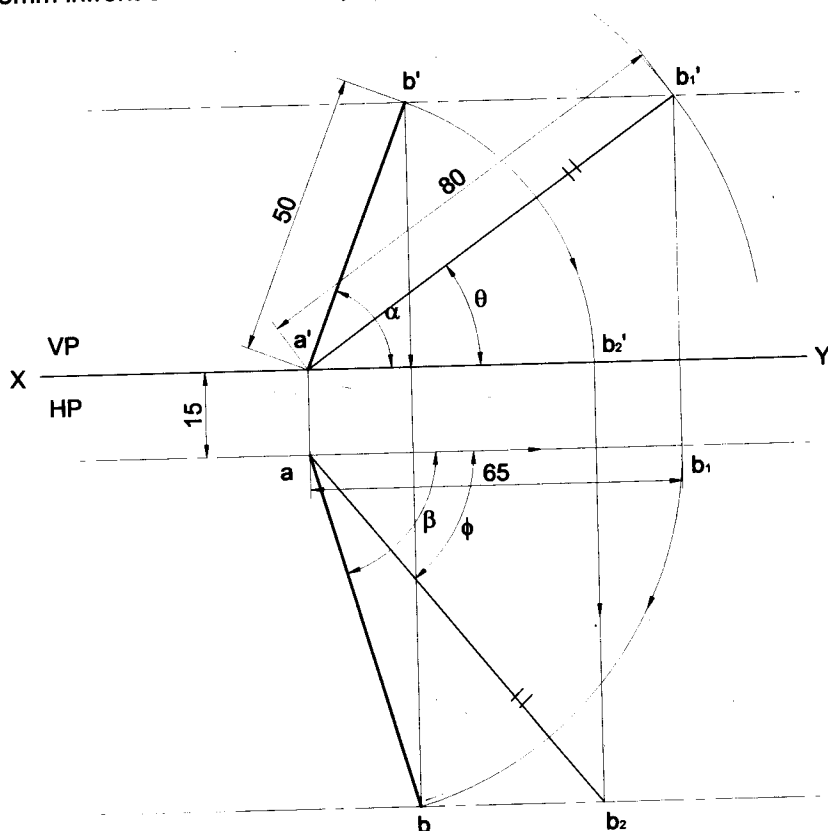
Solution

ANSWERS :

$\theta = 18^0$

$\phi = 33^0$

$\alpha = 22^0$

$\beta = 35^0$
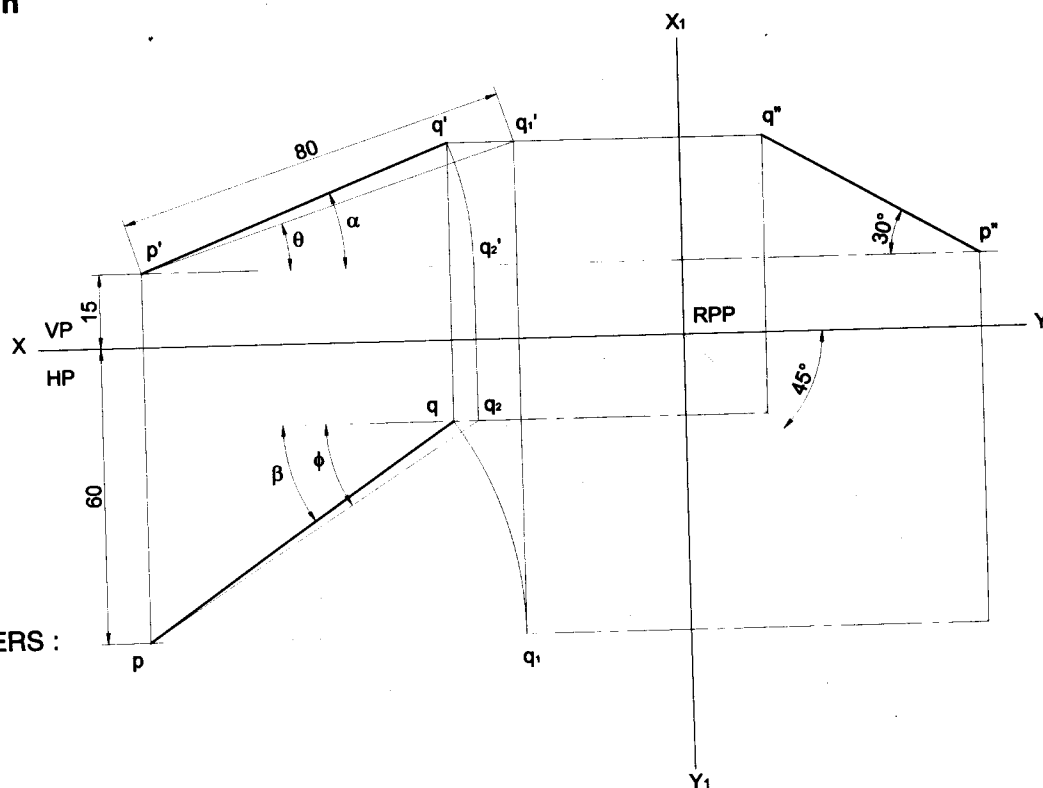
Problem 48 The top view of a line AB, 80mm long measures 65mm and the length of the front view is 50mm. The end A is on HP and 15mm infront of VP. Draw the projections

Solution

ANSWERS :

$\theta = 36^0$

$\phi = 51^0$

$\alpha = 69^0$

$\beta = 74^0$

50

Problem 49 Draw the projections of a line PQ and find its apparent lengths, true length and true inclination with HP when the line PQ has its end P 25 mm above HP and 20 mm infront of VP. The distance between the end projectors of the line when measured parallel to the line of intersection of the HP and VP is 60 mm. The end Q is 50 mm above the HP and the line is inclined at 30^0 to the VP.

Solution
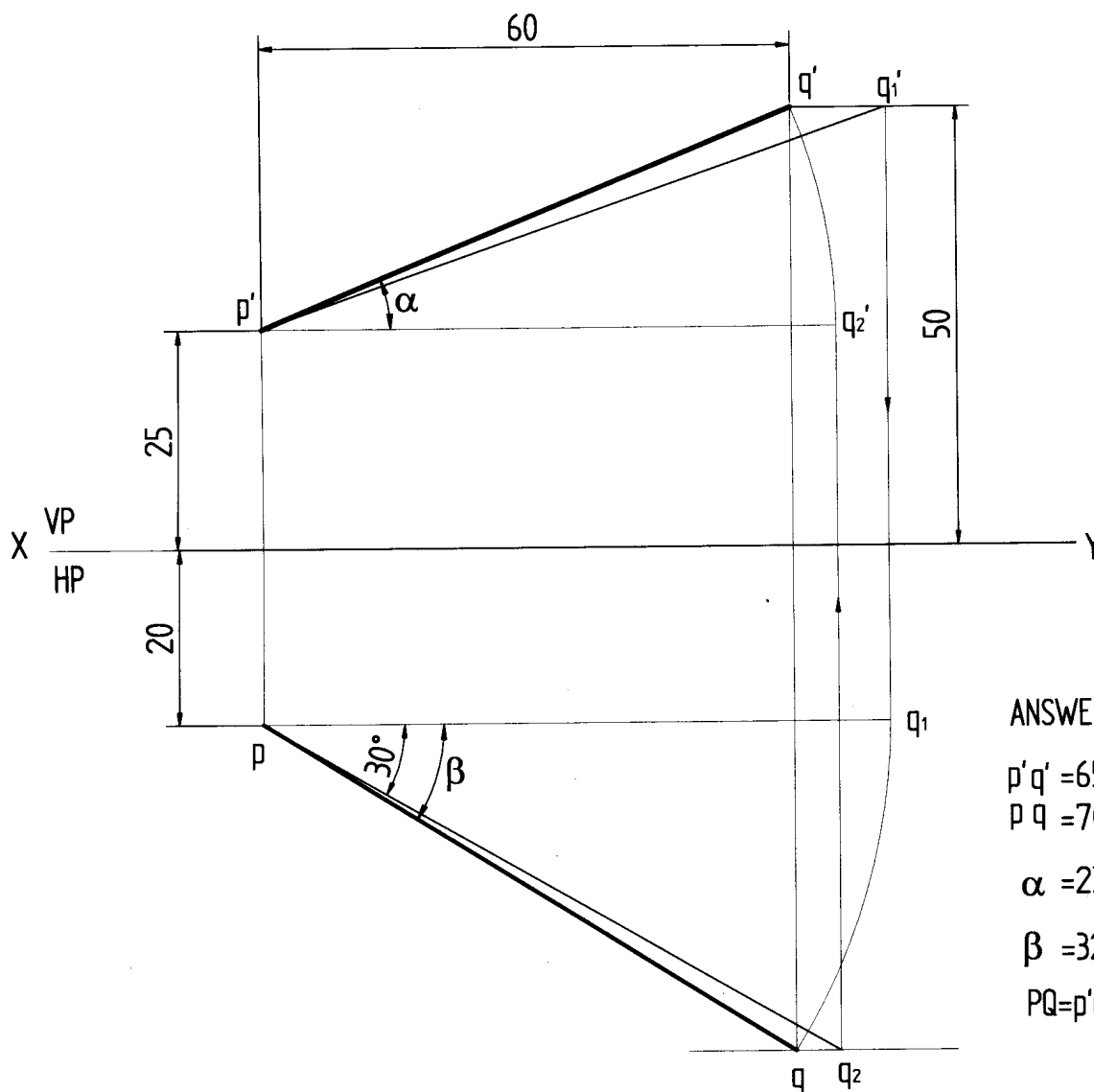
ANSWER

$p'q' = 65$

$pq = 70.77$

$\alpha = 23^O$

$\beta = 32^O$

$PQ = p'q_1' = pq_2 = 75.06$

51

Problem 50 Find the true length and true inclination of a line AB with HP having one of its ends 20 mm in front of VP and 30 mm above the HP. The line is inclined at 40^0 to VP and the right side view of the line is 60 mm long and inclined at 60^0 to the X1Y1 line. Draw all the three views of the line.

Solution

True length = 80.84

θ = 22 degrees