Problem 1 – *Surveying*

The observed interior angles of a quadrilateral and their corresponding number of observation are as follows:

CORNER	ANGLE	NO. OF OBSERVATIONS
1	67°	5
2	132°	6
3	96°	3
4	68°	4

Determine the corrected angle at corner 3.

Solution:
Lowest common denominator = 60

STA.	**WEIGHT**	**CORRECTION**
1	$\frac{60}{5} = 12$	$\frac{12}{57}(180)$
2	$\frac{60}{6} = 10$	$\frac{10}{57}(180)$
3	$\frac{60}{5} = 20$	$\frac{20}{57}(180) = 63.16' = 1^\circ 3.16'$
4	$\frac{60}{4} = 15$ $\overline{\quad 57 \quad}$	$\frac{15}{57}(180)$

Total interior angle = 67 + 132 + 96 + 68 = 363°
Sum of interior angles of a quadrilateral = $(n - 2)(180)$
Sum of interior angles of a quadrilateral = 360°
Error = 363 – 360 = 3° = 180'
Corrected angle at corner 3 = ***95° 56.84'***

Problem 2 – *Surveying*

The scale on the map is 1: x. A lot having an area of 640 sq.m. is represented by an area of 25.6 cm^2 on the map. What is the value of x?

Solution:

$$\frac{\text{Map area}}{\text{Actual area}} = \left(\frac{1}{x}\right)^2$$

$$\text{Actual area} = 640(100)^2$$

$$\text{Actual area} = 6.4 \times 10^6 \ cm^2$$

$$\frac{25.6}{6.4 \times 10^6} = \frac{1}{x^2}$$

x = ***500***

Problem 3 – *Surveying*

A line was measured with a 20 m. tape. There were 3 tallies and 6 pins, and the distance from the last pin and the end of the line was 3.75 m. Find the length of the line in meters.

Solution:

Note: 1 tally = 10 pins

1 pin = 1 chain = 20 m. for this problem

L = 3(10)(20) + 6(20) + 3.75 = ***723.75 m.***

Problem 4 – *Surveying*

A student recorded the following repeated paces of a given line: 456, 448, 462, 447, 452, 455. If his pace factor is 0.628 m/pace, what is the approximate length of line in meters?

Solution:

$$\text{Ave. pace} = \frac{456 + 448 + 462 + 447 + 452 + 455}{6}$$

Ave. pace = 453.333 paces

Length of line = 453.333(0.628) = ***284.69 m.***

Problem 5 – *Surveying*

A rectangular field was measured using a 100 m. tape, which was actually 10 cm too short. The recorded area was 4500 m^2. What is the true area of the field?

Solution:

$$\frac{A_{true}}{A_{measured}} = \left(\frac{L_{true}}{L_{tape}}\right)^2$$

$$\frac{A_{true}}{4500} = \frac{(100 - 0.1)^2}{(100)^2}$$

$$A_{true} = \boldsymbol{4491.0045\ m^2}$$

Problem 6 – *Surveying*

The scale on the map is 1: x. A lot having an area of 640 sq.m. is represented by an area of 25.6 cm^2 on the map. What is the value of x?

Solution:

$$\frac{\text{Map area}}{\text{Actual area}} = \left(\frac{1}{x}\right)^2$$

$$\text{Actual area} = 640(100)^2$$

$$\text{Actual area} = 6.4 \times 10^6 \text{ cm}^2$$

$$\frac{25.6}{6.4 \times 10^6} = \frac{1}{x^2}$$

$x =$ ***500***

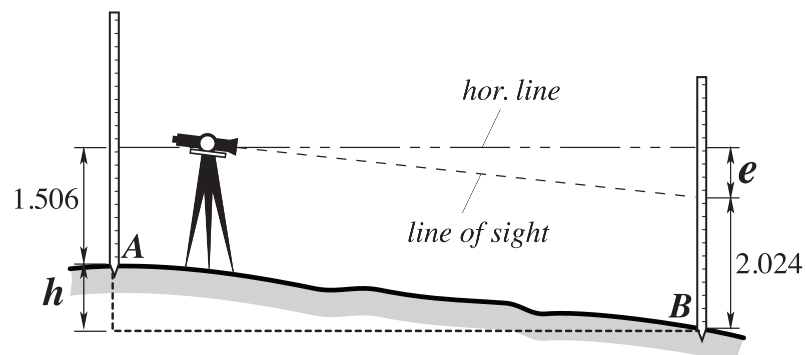
Problem 7 – *Surveying*

In the two-peg test of a dumpy level, the following observations were taken:

	Rod Reading on A	Rod Reading on B
Instrument at A	1.506	2.024
Instrument at B	0.938	1.449

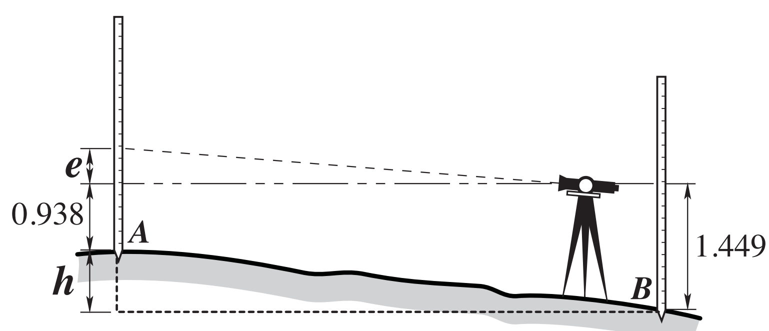
What is the correct difference in elevation between A and B?

Solution :



$h + 1.506 = 2.024 + e$

$h = 0.518 + e$ Eq.❶



$h = 0.511 - e$ Eq.❷

[h= h] $0.518 + e = 0.511 - e$

$2e = -0.007$

$e = -0.0035$ m

In Eq.❶:

$h = 0.518 - 0.0035$

h = ***0.5145 m***

Problem 8 – *Surveying*

The distance from A to B taken at elevation 1200 m above sea level is 6,750 m. Determine the sea-level distance. Assume that the average radius of earth is 6400 km.

Solution:

$$\frac{D}{R} = \frac{D_h}{R + h} \quad \text{or} \quad D = \frac{D_h R}{R + h}$$

$$D = \frac{6570(6400)}{6400 + 1.2} = \boldsymbol{6568.768\ m}$$

Problem 9 – *Surveying*

Due to maladjustment, a transit with the telescope in normal position is deflected 15” to the left of its correct position or not perpendicular to the horizontal axis. Determine the error in the measured horizontal angle if the vertical angle of the first point is 46˚ and that of the second point is 74˚.

Solution:

Error in horizontal angle with line of sight not perpendicular to the horizontal axis.

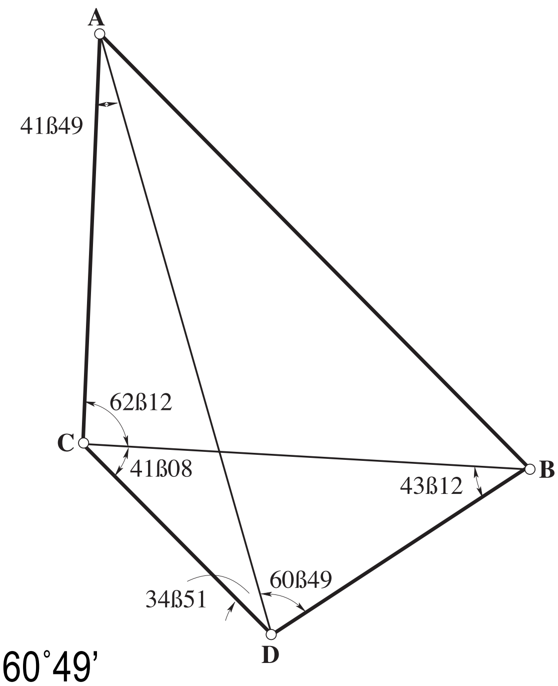
$E = e(\text{Sec}\ \theta_2 - \text{Sec}\ \theta_1)$

$E = 15''(\text{Sec}\ 74^\circ - \text{Sec}\ 46^\circ)$

$E = \boldsymbol{32.82''}$

Problem 10 – *Surveying*

Two inaccessible objects A and B are each viewed from two stations C and D on the same side of AB and 562 m. apart. The angle ACB is 62˚12’, BCD = 41˚08’, ADB = 60˚49’ and ADC is 34˚51’. Find the required distance AB.



Solution:

In △ACD

$$\frac{562}{\sin 41^\circ 49'} = \frac{AD}{\sin 103^\circ 20'}$$

AD = 820.18

$$\frac{BD}{\sin 41^\circ 08'} = \frac{562}{\sin 43^\circ 12'}$$

BD = 540.05 m

Using Cosine Law for triangle ADB:

$(AB)^2 = (820.18)^2 + (540.05)^2 - 2(820.18)(540.05)\cos 60^\circ 49'$

AB = ***729.64 m***

Problem 11 – *Surveying*

A closed traverse has the following data:

Line	Distance	Bearing
AB	179.00	N. 47°02'14" E.
BC	258.20	S. 69°35'59" E.
CD	-------	S. 39°35'17" W.
DE	-------	S. 87°29'48" W.
EA	145.41	N. 24°48'09" W.

What is the length of CD?

Solution:

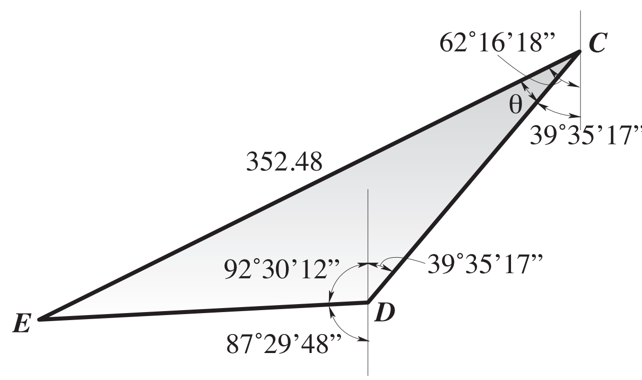
LINE	DIST.	BEARING	LAT	DEP
EA	145.41	N 24° 48' 09"W	+132.00	-61.00
AB	179.00	N 47° 02' 14"E	+122.00	+131.00
BC	258.20	S 69° 35' 59"E	-90.00	+242.00
CE			-164.00	-312.00

Bearing of line CE :

$$\tan \text{Bearing} = \frac{\text{Dep}}{\text{Lat}}$$

$$\tan \text{Bearing} = \frac{312}{164}$$

$$\text{Bearing} = \text{N } 62^\circ 16' 18'' \text{ W}$$



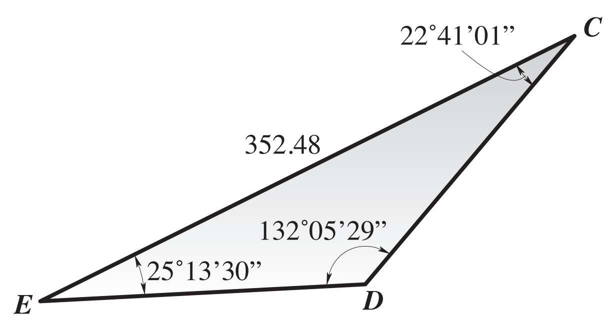
Distance of line CE :

$$\text{Distance} = \sqrt{(164)^2 + (312)^2}$$

$$\text{Distance} = 352.48 \text{ m.}$$

$$\theta = 62^\circ 16' 18'' - 39^\circ 35' 17''$$

$$\theta = 22^\circ 41' 01''$$



Using Sine Law :

$$\frac{CD}{\sin 25^\circ 13' 30''} = \frac{352.48}{\sin 132^\circ 05' 29''}$$

CD = ***202.43***

Problem 12 – *Surveying*

A closed traverse has the following data:

LINE	BEARING	DISTANCE
AB	?	44.47
BC	?	137.84
CD	N 1°45' E	12.83
DE	N 72°10' E	64.86
EA	S. 48°13' E	107.72

Find the bearing of line BC.

Solution:

Line	Bearing	DIST.	LAT.	DEP	LAT	DEP
CD	N.1°45'E	12.83	+12.83	+0.39	+12.83	+0.39
DE	N.72°10'E	64.86	+19.86	+61.74	+19.86	+61.74
EA	S.48°13'E	107.72	-71.78	+80.32	-71.78	+80.30
AC			+39.09	-142.45	+39.09	-142.45

Bearing of line AC :

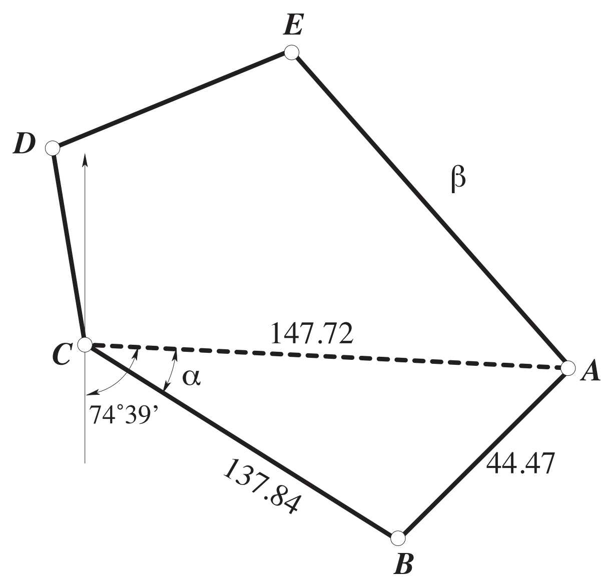
$$\tan \text{bearing} = \frac{\text{Dep}}{\text{Lat}}$$

$$\tan \text{bearing} = \frac{142.45}{39.09}$$

tan bearing = N.74°39' W

$$\text{Distance} = \sqrt{(39.09)^2 + (142.45)^2}$$

Distance = 147.72 m



Using Cosine Law:

$(44.47)^2 = (137.84)^2 + (147.72)^2 - 2(137.84)(147.72) \cos \alpha$

$\alpha = 17°28'$

Bearing BC = 74°39' – 17°28' = ***N. 57°11' W***

Problem 13 – *Surveying*

The offset distance from P.C. to P.T. of a simple curve is 18 m. The angle of intersection of the tangents is 24˚. If the stationing of P.T. is 45 + 158.32, what is the stationing of P.I.?

Solution:

$R - 18 = R \cos 24^\circ$

$R = 208.2 \text{ m}$

$\sin 24^\circ = \dfrac{18}{T}$

$T = 44.25 \text{ m}$

$L_c = R\theta$

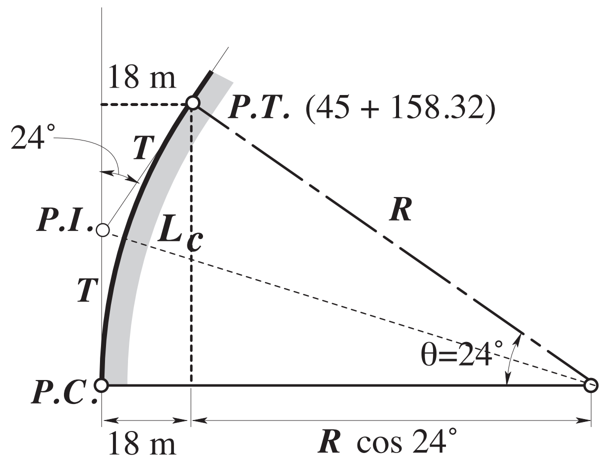
$L_c = \dfrac{208.2(24)\pi}{180} = 87.21$

P.C. = (45 + 158.32) - (87.21)

P.C. = 45 + 71.11

Sta. of P.I. = (45 + 71.11) + 44.25

Sta. of P.I. = ***45 + 115.36***



Problem 14 – *Surveying*

The common tangent AB of a compound curve is 82.38 m. The angles the common tangent makes with the tangents through PC and PT of the compound curve are 21˚10’ and 15˚20’, respectively. If the degree of the first curve is 3˚30’, what is the degree of the second curve?

Solution:

$$R_1 = \frac{1145.916}{3^\circ\ 30'}$$

$$R_1 = 327.40 \text{ m}$$

$$\tan\ 10.583^\circ = \frac{T_1}{327.40}$$

$$T_1 = 61.17 \text{ m}$$

$$T_1 + T_2 = 82.38$$

$$T_2 = 82.38 - 61.17$$

$$T_2 = 21.21 \text{ m}$$

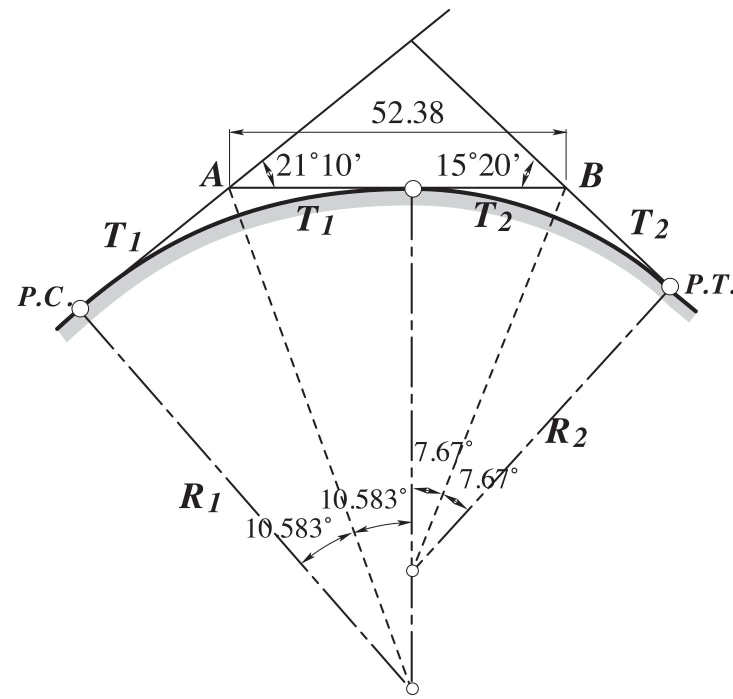
$$\tan 7.67^\circ = \frac{T_2}{R_2}$$

$$R_2 = \frac{21.21}{\tan 7.67^\circ}$$

$$R_2 = 157.56 \text{ m}$$

$$D = \frac{1145.916}{157.56}$$

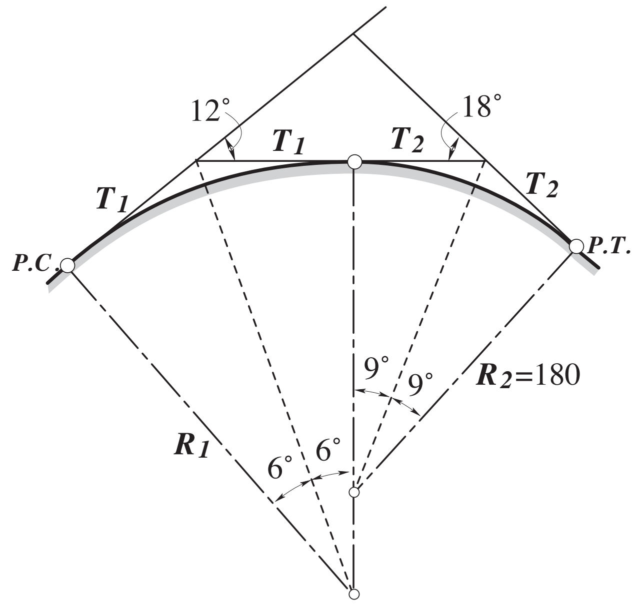
$$D_2 = \boldsymbol{7.27^\circ}$$



Problem 15 – *Surveying*

The common tangent of a compound curve makes an angle of 12° from the tangent passing thru the P.C. and 18° from the tangent passing thru the P.T. If the radius of the second curve is 180 m, find the radius of the first curve if the length of the common tangent is 70 m. long.

Solution:



$$\tan 9^\circ = \frac{T_1}{180}$$

$$T_1 = 28.51 \text{ m}$$

$$T_2 = 70 - 28.51$$

$$T_2 = 41.49 \text{ m.}$$

$$\tan 6^\circ = \frac{T_2}{R_2}$$

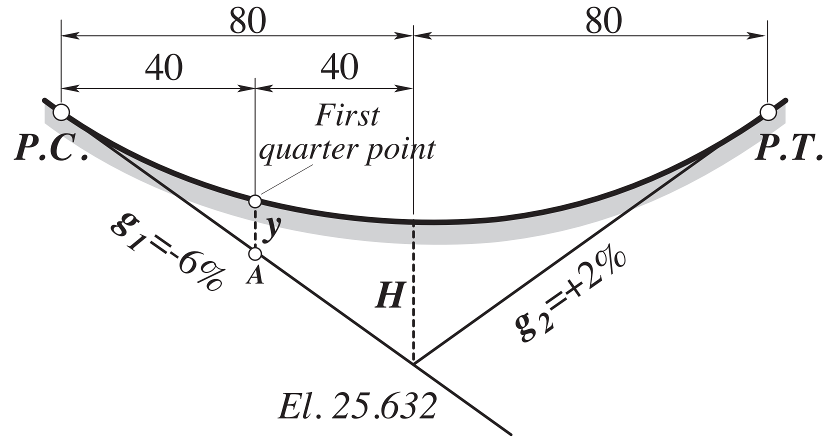
$$R_2 = \frac{41.49}{\tan 6^\circ}$$

$$R_2 = \boldsymbol{394.75 \text{ m.}}$$

Problem 16 – *Surveying*

A -6% grade and a +2% grade intersect at STA 12 + 200 whose elevation is at 25.632 m. The two grades are to be connected by a parabolic curve, 160 m long. Find the elevation of the first quarter point on the curve.

Solution:



$$H = \frac{L}{8}\left(g_1 - g_2\right)$$

$$H = \frac{160}{8}(-0.06 - 0.02)$$

$H = -1.6$ m. *(sag curve)*

$$\frac{(40)^2}{y_1} = \frac{(80)^2}{1.6}$$

$y_1 = 0.40$

Elev. of P.C. = 25.632 + 80(0.06) = 30.432

Elev. of first quarter point:

Elev. = 30.432 - 40(0.6) + 0.40

Elev. = ***28.432 m.***