

Problems on Surveying

Prob. No. 1: Scale of an old map was 1 cm = 40 m. After shrink, a line originally 20 cm long is 19.5 cm. Again the 20 m chain was 5 cm too long. If present area of the map measured by planimeter is 125.5 cm², find the (i) shrunk scale, (ii) true area of survey for correct chain & (iii) true area of survey for error chain.

Solution: (i) Shrinkage factor = $19.5/20 = 0.975$. Representative Fraction (RF) of original scale = $1/4000$
 Shrunk scale = shrinkage factor x original scale. RF of shrunk scale = $0.975 \times 1/4000 = 1/4102.5$
 Therefore, Shrunk scale is **1 cm = 41.025 m**

(ii) 19.5 cm on the map was originally 20 cm. Therefore, 1 cm on the map was originally $20/19.5$ cm.
 1 cm² on the map was originally = $[20/19.5]^2$ cm². ∴ 125.5 cm² was originally = $[20/19.5]^2 \times 125.5 = 132.02$ cm²
 Scale of map was 1 cm = 40 m. 1 cm² = 1600 m². ∴ Area on the ground = $1600 \times 132.02 = 211232$ m².

(iii) True area of land = $(L'/L)^2 \times$ measured area. Where, L = True length of chain, L' = True length ± error
 Length of chain used = $20 + 0.05 = 20.05$ m. Therefore, true area = $[20.05/20]^2 \times 211232 = 212289.5$ m².

Prob. No. 2: Distance between points P and Q = 367 m. Bearing of a tree (T) on the other bank from P and Q are N 36° 25' E and N 40° 35' W respectively. Find the width of river if bearing of PQ is S 86° 35' E

Solution: Let PA = x, then QA = 367 - x

$$\alpha = 180^\circ - (36^\circ 25' + 86^\circ 35') = 57^\circ 0'$$

$$\beta = 86^\circ 35' - 40^\circ 35' = 46^\circ 0'$$

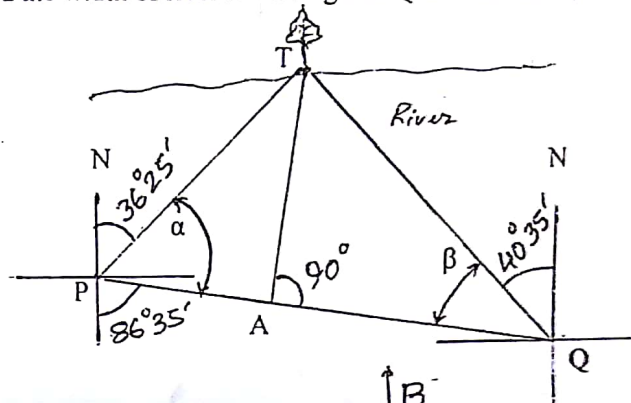
From $\triangle PTA$, $TA = x \tan 57^\circ 0'$ (1)

From $\triangle QTA$, $TA = (367 - x) \tan 46^\circ 0'$ (2)

From (1) & (2) $x \tan 57^\circ 0' = (367 - x) \tan 46^\circ 0'$

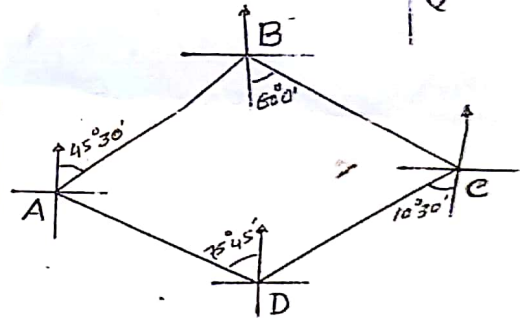
$$2.5754 x = 380.0285$$

Therefore, $x = 147.56$ m. ∴ **TA = 227.23 m**



Prob. No. 3: The following are the bearings of a closed traverse:

Sides of traverse	FB		BB	
	RB	WCB	RB	WCB
AB	N 45° 30' E		S 45° 30' W	
BC	S 60° 00' E		N 60° 00' W	
CD	S 10° 30' W		N 10° 30' E	
DA	N 75° 45' W		S 75° 45' E	



Calculate the interior angles of the traverse.

Solution: Interior $\angle A = 180^\circ - (\text{FB of AB} + \text{BB of DA}) = 180^\circ - (45^\circ 30' + 75^\circ 45') = 58^\circ 45'$

Interior $\angle B = \text{BB of AB} + \text{FB of BC} = 45^\circ 30' + 60^\circ 00' = 105^\circ 30'$

Interior $\angle C = 180^\circ - (\text{BB of BC} + \text{FB of CD}) = 180^\circ - (60^\circ 00' + 10^\circ 30') = 109^\circ 30'$

Interior $\angle D = \text{BB of CD} + \text{FB of DA} = 10^\circ 30' + 75^\circ 45' = 86^\circ 15'$

Check: $(2N - 4) \times 90^\circ = 360^\circ$ Now $\angle A + \angle B + \angle C + \angle D = 360^\circ$. (checked and found correct)

Prob. No. 4: Following is the page of a Level Book. Calculate the missing data & apply necessary checks.

Distance	BS	IS	FS	Rise	Fall	RL
0	4.25					116.13
50		7.65			3.40	112.73
100		9.86			2.21	110.52
150	10.21		11.78		1.92	108.60
200		5.84		4.37		112.97
250		4.96		0.88		113.85
300	7.24		13.21		8.25	105.60
350		6.88		0.36		105.96
400			9.09		2.21	103.75
	Sum = 21.7		Sum = 34.08	Sum = 5.61	Sum = 17.99	

Check: $21.7 - 34.08 = -12.38$; $5.61 - 17.99 = -12.38$ and $103.75 - 116.13 = -12.38$ (correct)