Problem 1

Prepare a set of level notes for the data shown below and make the customary arithmetic check. The elevation of BM77 is 131.275 m.

Station	BS (m)	FS (m)
BM77	2.720	-
TP1	0.503	2.892
TP2	0.212	3.056
BM78	1.246	3.302
TP3	2.169	1.257
TP4	2.695	0.678
BM79	-	0.202

Solution

Station	BS (m)	HI (m)	FS (m)	Elevation (m)
BM 77	2.720			131.275
TP 1	0.503	133.995	2.892	131.103
TP 2	0.212	131.606	3.056	128.550
BM 78	1.246	129.762	3.302	125.460
TP 3	2.169	126.706	1.257	125.449
TP 4	2.695	127.618	0.678	126.940
BM 79		129.635	0.202	129.433 ✓

CHECK: $\Sigma BS = 9.545$, $\Sigma FS = 11.387$

$\therefore$ Elevation of BM 79 : $131.275 + (9.545 - 11.387) = 129.433$ m.

checks ✓

Problem 2

A total station was set up at control station O, which is within the list of a five sided property. The coordinated of station O are 2033.000 E (x) and 1990.000 N (y). The azimuths and horizontal distances from O to the five property corners were determined as follows:

Line	Azimuth	Horizontal Distance (m)
OA	286°51'00"	34.482
OB	37°35'28"	31.892
OC	90°27'56"	38.286
OD	166°26'49"	30.916
OE	247°28'43"	32.585

a) Compute the coordinates of the property corners A, B, C, D, and E.
b) Find the length and azimuth of line BC.

Solution

a)

x of A $= 2033.000 + 34.482 \sin 286°51'00'' = 2000.000\ m$

y of A $= 1990.000 + 34.482 \cos 286°51'00'' = 2000.000\ m.$

x of B $= 2033.000 + 31.892 \sin 37°35'28'' = 2052.455\ m.$

y of B $= 1990.000 + 31.892 \cos 37°35'28'' = 2015.271\ m.$

x of C $= 2033.000 + 38.286 \sin 90°27'56'' = 2071.285\ m$

y of C $= 1990.000 + 38.286 \cos 90°27'56'' = 1989.689\ m.$

x of D $= 2033.000 + 30.916 \sin 166°26'49'' = 2040.245\ m.$

y of D $= 1990.000 + 30.916 \cos 166°26'49'' = 1959.945\ m.$

x of E $= 2033.000 + 32.585 \sin 247°28'43'' = 2002.900\ m.$

y of E $= 1990.000 + 32.585 \cos 247°28'43'' = 1977.519\ m.$

b)

Length of BC $= \sqrt{(\Delta x)^2 + (\Delta y)^2} = \sqrt{(2071.285 - 2052.455)^2 + (1989.689 - 2015.271)^2}$

$= \sqrt{(18.830)^2 + (-25.582)^2}$

$= 31.765\ m.$ ANS.

Azimuth of BC $= \tan^{-1} \frac{\Delta x}{\Delta y} = \frac{18.830}{-25.582} = 143.645° = 143°38'40.3''$ ANS.

Problem 3

A 100 ft. steel tape weighs 2 lb., has a cross-section area of 0.006 in^2, and is 100.00 ft. long when standardized at 68°F and 12 lb. pull and supported throughout its entire length. A distance is measured in the field with this tape and found to be 688.32 ft. If, at the time of measurement, the pull on the tape was 20 lb., the temperature was 88°F and if the tape was supported at its ends, what is the correct distance measured? Assume all full tape lengths except the last one.

Solution

Corrections must be made for pull, Temperature & Sag.

- Correction for pull:

$$C_p = (P_1 - P)\frac{L}{AE} = (20-12)\times\frac{688.32}{0.006\times 29\times 10^6} = 0.03\ ft$$

- Correction for temperature:

$$C_t = k(T_1 - T)L = 0.0000065(88-68)\times 688.32 = 0.09\ ft$$

- Correction for Sag:

$$C_s = -\frac{\omega^2 L_s^3}{24 P_1^2} \quad ; \quad \omega = \frac{2}{100} = 0.02\ lb/ft$$

$$C_{s_1} = -\frac{(0.02)^2\times(100)^3}{24\times(20)^2}\times 6 = -0.25\ ft$$

$$C_{s_2} = -\frac{(0.02)^2\times(88.32)^3}{24\times(20)^2} = -0.03\ ft$$

$$\therefore\ C_s = -0.25 - 0.03 = -0.28\ ft.$$

Correct Distance Measured:

$$688.32 + 0.03 + 0.09 - 0.28 = \underline{\underline{688.16\ ft}}$$ ANS.