Q.1 F.

$i = 2*1.20 = 2.40mm = 0.24$ cm
$f = 24$ cm
$d = 10$cm

$f/i = \frac{24}{0.24} = 100$

and $(f+d) = 24+10 = 34$ cm

∴ Multiplying constant = 100.
Additive constant = 34 cm ≈ 0.34 } Tacheometric constants.

Q.2a

Looking at the given readings, it is seen that F.B and B.B of CD differ exactly by 180°. Hence, stations C and D are free from local attraction. A and B are the stations affected by local attraction.

Thus, F.B and B.B of CD and F.B of DA are free from error

Correct B.B of DA = correct F.B of DA − 180°

= 306°40' − 180° = 126°40'.

Error in measurement at A = Observed B.B of DA − correct B.B of DA

= 126° − 126°40'

= −0°40'0"

correct F.B of AB = observed Fore bearing of AB + Error at A.

= 74°20' + 0°40' = 75°0'0"

correct B.B of AB = correct F.B of AB + 180°

= 75° + 180°

Error in measurement at B

= Observed B.B of AB − correct B.B of AB

= 256° − 255° = +1°

Correct F.B of BC

= Observed F.B of BC − Error at B

= 107°20' − 1° = 106°20'.

∴ B.B of BC = 106°20' + 180° = 286°20'. ← equal to the given data.

∴ corrected F.B and B.B are as follows:–

Line	F.B	B.B
AB	75°0'0"	255°0'0"
BC	106°20'0'	286°20'0"
CD	224°50'0"	44°50'0"
DA	306°40'0"	126°40'0"

Q.2c Formation Level at P = 161.4 m. There is an uniformly Falling gradient of 1 in 50 From P to Q.

∴ Formation level (F.L) at successive cross-sections are obtained by deducting $\frac{1}{50} * 100 = 2m$ from level of preceding section.

F.L at P i.e. zero m = 161.4 m.

F.L at 100 metres = 159.4 m

at 200 m = 157.4 m

300 m = 155.4 m

400 m (at Q) = 153.4 m.

Thus, the depths of the embankments at various section

= F.L − G.L

at P = 161.4 − 153.0 = 8.4 m.

at 100 m = 159.4 − 151.8 = 7.6 m.

at 200 m = 157.4 − 151.2 = 6.2 m.

at 300 m = 155.4 − 150.6 = 4.8 m

at 400 m = 153.4 − 149.2 = 4.2 m
i.e (at Q)

P.T.O –

Q.2c continued

Name - Mohd Shahnawaz

C/S Area

at P (zero metres)(A_0) = $(b+sh)*h$

$= [30+(2*8.4)]*8.4$

$= 393.12\ m^2$

at 100 metres (A_{100}) $= [30+(2*7.6)]*7.6$

$= 343.52\ m^2$

at 200 metres (A_{200}) $= [30+(2*6.2)]*6.2$

$= 262.88\ m^2$

at 300 metres (A_{300}) $= [30+(2*4.8)]*4.8$

$= 190.08\ m^2$

at 400 metres (A_{400}) $= [30+(2*4.2)]*4.2$

$= 161.28\ m^2$

Applying Prismoidal Formula,

Volume = $\frac{d}{3}$ (Area of 1st section + 4 times area of even sections + 2 times area of odd section + Area of last section)

$$= \frac{100}{3}\left(393.12 + 4(343.52+190.08) + 2(262.88) + 161.28\right)$$

$$\boxed{V = 107152\ m^3}$$

Q.4c Correct length of chain at commencement = 20 m

Length of chain after chaining 1420 m = 20.04 m

∴ Mean length of chain while measuring $= \left(\frac{20+20.04}{2}\right) = 20.02$ m.

True distance for wrong chainage of 1420 m

$= \frac{20.02}{20} * 1420 = 1421.42$ m

Now, remaining distance = 2400 − 1420 = 980 m

Mean length of chain while measuring remaining distance $= \frac{20.04+20.08}{2}$

$= 20.06$ m.

∴ True length of remaining 980 m $= \frac{20.06}{20} * 980 = 982.94$ m.

Thus, total true distance = 1421.42 + 982.94 = 2404.36 m.

Stn	B.S	I.S	F.S	Rise	Fall	RL	Remarks
1	2.150					450.00	BM
2	1.645	2.150 − 0.500 → 1.650		0.500		450.500	← 450 + 0.5 =
3		2.345			2.345 − 1.645 → 0.700	449.80	← 450.50 − 0.70
4	(1.825 − 0.400) → 1.425		1.965	2.345 − 1.965 → 0.380		450.18	← 449.80 + 0.38
5	2.050	1.825			0.400	449.780	← 450.18 − 0.40
6	(2.050 − 1.950) 0.100			451.73 − 449.780 → 1.950		451.730	
7	(−) 1.690	0.10 − 0.12 → (−) 0.020		0.120		(451.73 + 0.12) → 451.850	Inverted staff.
8	2.865 (8.445 − ΣBS 1 to 7)	2.100			(−)1.69 − 2.100 → 3.790	448.06	← (451.80 − 3.79)
9			1.825 (ΣFS − Σ(FS 1 to 8))	1.040		(499.100) ××× ↑ 449.100.	

ΣBS = 8.445

Last R.L − 1st R.L = ΣBS − ΣFS

449.10 − 450 = 8.445 − ΣFS

−0.9 = 8.445 − ΣFS

ΣFS = 9.345

★ KINDLY CONSIDER the last R.L as 449.100.

★ By Mistake, in the Question Paper, it was printed as 499.100

Q.5a

Line	length (metres)	WCB	R.B	N +ve, S −ve Latitude (L cos θ)	E +ve, W −ve. Departure (L sin θ)
AB	89.31	45°10'	N45°10'E	+ 62.967	+ 63.335
BC	219.76	72°05'	N72°05'E	+ 67.605	+ 209.103
CD	151.18	161°52'	S18°08'E	− 143.671	+ 47.051
DE	159.10	228°43'	S48°43'W	− 104.971	− 119.556
EA	232.26	300°42'	N59°18'W.	+ 118.578	− 199.709.

★ If the student calculates corrected Latitudes & Departures, full marks should be given.

★ If student calculates only latitude & departure without corrections, the assessor may judiciously decide.

Q.5b

Interval = 15m

Dist	O(A)	15	30	45	60	75	90	105	120 (B)
offset	2.30	3.80	4.55	6.75	5.25	7.30	8.95	8.25	5.50

By simpson's Rule,

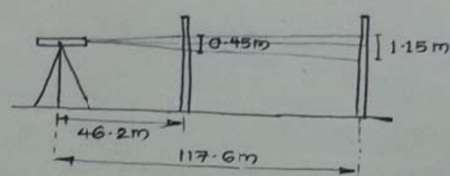
$$\text{Area} = \frac{d}{3}\left[\text{1st Offset} + \text{Last Offset} + 2\left(\text{sum of remaining odd offsets}\right) + 4\left(\text{Sum of remaining even offsets}\right)\right]$$

$$= \frac{15}{3}\left[2.30 + 5.50 + 2(4.55 + 5.25 + 8.95) + 4(3.8 + 6.75 + 7.30 + 8.25)\right]$$

$$= \frac{15}{3} * (2.30 + 5.50 + 37.5 + 104.40)$$

$A = 15/3 * 149.70 = 748.50$ sq.m. $\therefore$ $\boxed{A = 748.50 m^2}$

Q.6a



When telescope is horizontal & staff is held vertical

with reference to above sketch we have,

$D = AS + B$

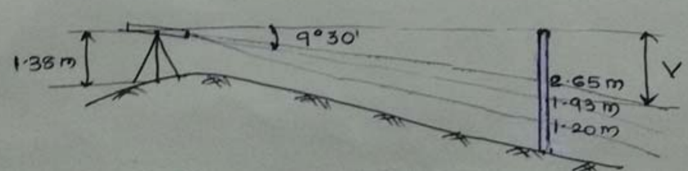
$46.2 = A * 0.45 + B$ ...(i)

$117.6 = A * 1.15 + B$ ...(ii)

A → Multiplying constant

B → Additive constant.

Solving (i) & (ii) we get, $\boxed{A = 102,\ B = 0.3}$



When telescope is Inclined downwards & staff is held vertical

Now $S = 2.65 - 1.20 = 1.45m$ $\theta = 9.5°$.

$PQ = A \cdot S \cdot \cos^2\theta + B\cos\theta = (102 * 1.45 * \cos^2 9.5°) + (0.3 * \cos 9.5°)$

$\therefore$ $\boxed{PQ = 144.17 m}$

vertical component (V) = $AS\frac{\sin 2\theta}{2} + B\sin\theta$

$= 102 * 1.45 * \frac{\sin(2*9.5°)}{2} + 0.3 * \sin 9.5°$

$= 24.08 + 0.05 = 24.13$ m

$\therefore$ RL of Q = RL of P + H.I − V − central hair Rdg = 150 + 1.38 − 24.13 − 1.93 = 125.32 m

Q.6b

Distance PQ = 180 m. R.L of BM = 100.125 m.

At P	At Q
$\theta_P = 64°30'$	$\theta_Q = 58°15'$
$\alpha_P = 20°43'20''$	$\alpha_Q = 19°44'55''$
B.S on BM = 1.625 m	B.S on BM = 1.125 m
H.I at P = 1.450 m	H.I at Q = 1.550 m

Soln :-

Line of collimation at P = R.L of BM + B.S on BM from P
= 100.125 + 1.625
= 101.75 m

R.L of P = 101.75 − H.I at P
= 101.75 − 1.450

R.L of P = 100.30 m

Line of collimation at Q
= R.L of BM + BS on BM from Q
= 100.125 + 1.125
= 101.25 m

∴ RL of Q = 101.25 − H.I at Q
= 101.25 − 1.550
= 99.70 m

∴ **RL of Q = 99.70 m**

Now, $\theta_R = 180° - \Sigma(\theta_P + \theta_Q)$

$\theta_R = 180° - (64°30' + 58°15')$ **$\theta_R = 57°15'$**

$$\text{dist } PR = \frac{\sin 58°15'}{\sin 57°15'} * \underset{\text{i.e. } 180\,m}{\text{Dist } PQ} = 182\,m$$

$$\text{dist } QR = \frac{\sin 64°30'}{\sin 57°15'} * \underset{\text{i.e. } 180\,m}{\text{Dist } PQ} = 193.17\,m$$

$V_P = D_{PR} * \tan\alpha_P = 182 * \tan 20°43'20'' = 68.85\,m$

$V_Q = D_{QR} * \tan\alpha_Q = 193.17 * \tan 19°44'55'' = 69.34\,m$

R.L of R = R.L of P + V_P = 100.30 + 68.85 = 169.15 m
= R.L of Q + V_Q = 99.70 + 69.34 = 169.04 m

$$\therefore \text{R.L of R} = \left(\frac{169.15 + 169.04}{2}\right) = 169.10\,m$$