TEDC(15) - 3012
(REVISION - 2015)

Scoring Indicators

Surveying - II

356

12 NOV 23

17-11-23

Qn. No.	Scoring Indicators	Split Score	Sub Total	Total
I	Part A			
1.	Theodolite, 20"	1+1	2	
2.	vertical circle, Telescope, Levelling head, Level tubes, clamp & tangent screwes.	4×½	2	
3.	open traverse - Traverse that does not returns to the starting point. closed traverse - Traverse that returns to the starting point.	1+1	2	5×2 = 10
4.	Tacheometry - method of surveying in which horizontal & vertical distances are calculating trigonometrically using the observed staff readings.	2	2	
5.	i) To avoid an abrupt change in direction. ii) To make the vehicle move safely, smoothly & comfortably.	1+1	2	
II	Part B			
1.	**Repetition method**: i) It is preferred for the measurement of single angle when high accuracy is required. ii) more time consuming iii) Chances of personal errors iv) Errors of graduations are minimised. **Reiteration method**: i) Preferred in triangulation, where a no. of angles may be required at one point. ii) comparitively less tedious method. iii) Graduation errors can be eliminated by reading values of each angle on different parts.	Any 2 2×3	6	

2. Traverse balancing – The operation of applying corrections to latitudes & departures of a closed traverse, so that $\Sigma L = 0$ & $\Sigma D = 0$. 2

i) Bowditch's method – $C_L = \Sigma L \times \frac{l}{\Sigma L}$ & $C_D = \Sigma D \cdot \frac{l}{\Sigma l}$

C_L – corr. to latitude of any side

C_D – corr. to departure of any side 2

ΣL – Total error in latitude (6)

ΣD – Total error in departure

Σl – Length of the perimeter.

l – Length of any side

ii) Transit method – $C_L = \Sigma L \times \frac{L}{L_T}$ & $C_D = \Sigma D \times \frac{D}{D_T}$ 2

L_T – Arithmetic sum of latitudes

D_T – Arithmetic sum of departures.

3. Length of closing error $= \sqrt{\Sigma L^2 + \Sigma D^2}$

$= \sqrt{(1.39)^2 + (-2.17)^2} = \underline{2.58\,m.}$ 3

RB of closing error, $\theta = \tan^{-1}\left(\frac{\Sigma D}{\Sigma L}\right)$ (6)

$= \tan^{-1}\left(\frac{2.17}{1.39}\right)$ 3

$= 57^\circ\, 21'\, 29.83''$

$= \underline{N\, 57^\circ 21' 29.83''\, W}$

4. $D = KS + C$

$D_1 = KS_1 + C$

$\Rightarrow 100 = K(0.99) + C$ —— ①

$D_2 = KS_2 + C$ 6

$\Rightarrow 300 = K(3) + C$ —— ②

solving ① & ②

$K = 99.5$

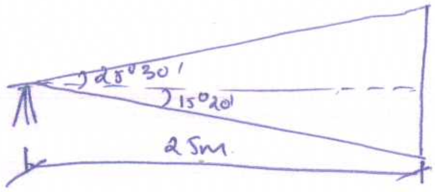
$C = 1.5$

constants of instruments are 99.5 & 1.5

5. $h_1 = D\tan\alpha_1$

$= 25 \times \tan(15^\circ 20')$

$= 6.85m.$



$h_2 = D\tan\alpha_2$

$= 25\tan(25^\circ 30')$

$= 11.924m.$ 6

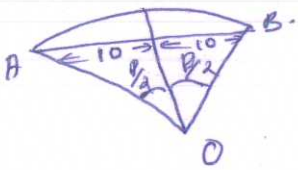
$h = h_1 + h_2 = 18.77m.$

6. Remote sensing – Science & art of acquiring information about a material object by making measurements at a distance from, without coming into a physical contact with the help of electromagnetic energy. 2 6

Applications

Detection of geology & mineral resourses, Detection of water pollution, Detection & mapping of water resourses, Monitoring environmental hazards. Any 4 $4 \times 1 = 4$

7. Let, AB be the length of the chord = 30m



D – Angle subtended by the chord at the centre O.

Then,

$$\sin D/2 = \frac{10}{R}$$

$$R = \frac{10}{\sin D/2}$$

For small values of $D/2$, $\sin D/2 \approx D/2$.

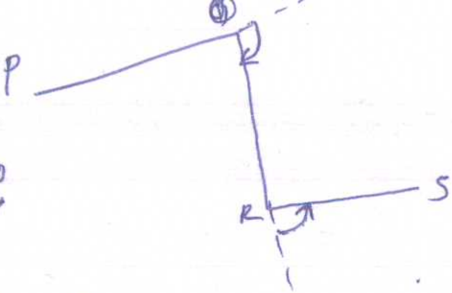
$$\therefore R = \frac{10}{\frac{D}{2} \times \pi/180}$$

$$R = \frac{1146}{D}$$

Any 5

$5 \times 6 = 30$

III a) 1) Set instrument at Q & level it.



2) With both plates clamped at 0°, take back sight on P.

3) Plunge the telescope. Thus the line of sight is in the direction PQ produced when the reading on vernier A is 0°.

4) Unclamp the upper clamp & turn the telescope clockwise to take the foresight on R. Read both the verniers. 7

5) Unclamp the lower clamp & turn the telescope to sight P again. The verniers still read the same reading. Plunge the telescope.

6) Unclamp the upper clamp & turn the telescope to sight R. Read both the verniers. Since the deflection angle is doubled by taking both face readings, one-half of the final reading gives the deflection angle at Q. 15

b i) Vertical circle – circular graduated arc attached to the trunnion axis of the telescope of theodolite. 2

ii) Index frame – T-shaped frame consisting of a vertical leg known as clipping arm & a horizontal bar known as vernier arm. 2 8

iii) ~~spindle and axis~~ Face change – operation of bringing the face of the telescope of theodolite from left to right & vice versa. 2

iv) Horizontal axis – Axis about which the telescope & the vertical circle rotate in vertical plane. 2

IV a) Temporary adjustments

i) Setting over the station – centring & approximate levelling.

ii) Levelling up 7

iii) Elimination of parallax → Focusing the eye piece
→ Focusing the objective

[With explanation]

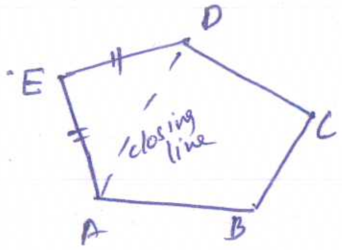
IVb. Fundamental lines of theodolite

The vertical axis, the horizontal axis, The line of collimation, Axis of plate level, Axis of altitude level, Axis of striding level.

Desired relations

1) The axis of the plate level must lie in a plane perpendicular to the vertical axis.
2) The line of collimation must be perpendicular to the horizontal axis at its intersection with the vertical axis.
3) The horizontal axis must be perpendicular to the vertical axis
4) The axis of the altitude level must be parallel to the line of collimation.
5) The vertical circle vernier must read zero when the line of collimation is horizontal.
6) The axis of the striding level must be parallel to the horizontal axis.

Va The affected sides are adjacent.



Line	Latitude	Departure
AB	−73.91	+ 494.5
BC	+ 535.11	+ 313.11
CD	+ 223.45	− 411.29

$\Sigma L' = +684.55$ $\Sigma D' = +396.32$

$\therefore$ Lat. of DA = −684.55 & Dep. of DA = −396.32

Length of DA $= \sqrt{(-684.55)^2 + (-396.32)^2} = \underline{791.01m}$.

RB of DA, $\theta = \tan^{-1}\left(\frac{396.32}{684.55}\right) = 30^\circ 4'$

$= S\,30^\circ 4' W$

consider ΔDEA & apply sine rule,

Then, DE = 695.27 m

EA = 273.99 m.

8

Vb **Gales Traverse table**

Traverse computations are usually done in a tabular form, a more common form being Gales traverse table 2

Procedure

1) Adjust the interior angles to satisfy the geometrical conditions, ie; sum of interior angles to be equal to $(2N-4)90^0$ & exterior angles $(2N+4)90^0$.

2) Starting with observed bearings of one line, calculate the bearings of all other lines. Reduce all bearings to quadrantal system. 6

3) Calculate the consecutive co-ordinates

4) Calculate ΣL & ΣD. 5

5) Apply necessary corrections to the latitudes & departures of the lines so that $\Sigma L = 0$ & $\Sigma D = 0$.
~~The corrections may b.~~

6) Using the corrected consecutive co-ordinates, calculate the independent co-ordinates to the points so that they are all positive, the whole of the traverse thus lying in the NE quadrant.

OR

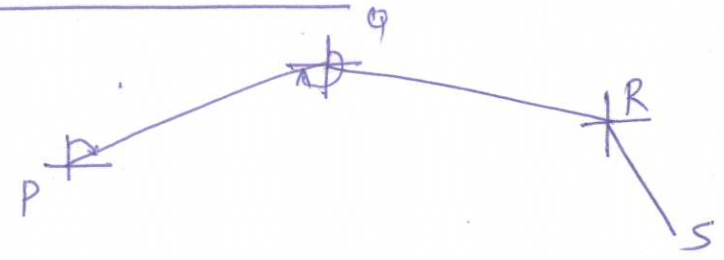
VIa

0	0	634.8	1068.4	0
0	-893.8	-728.8	699.3	0

$$\text{Area} = \frac{1}{2}\Big[0\times(-893.8) - (0\times 0) + (0\times(-728.8)) - (634.8\times(-893.8)) + (634.8\times 699.3) - (1068.4\times(-728.8)) + (1068.4\times 0) - (699.3\times 0)\Big]$$ 8

$$= \underline{894974.9 m^2}$$

VI b) Back bearing method



1) Set the instrument at P & measure the magnetic bearing of PQ.

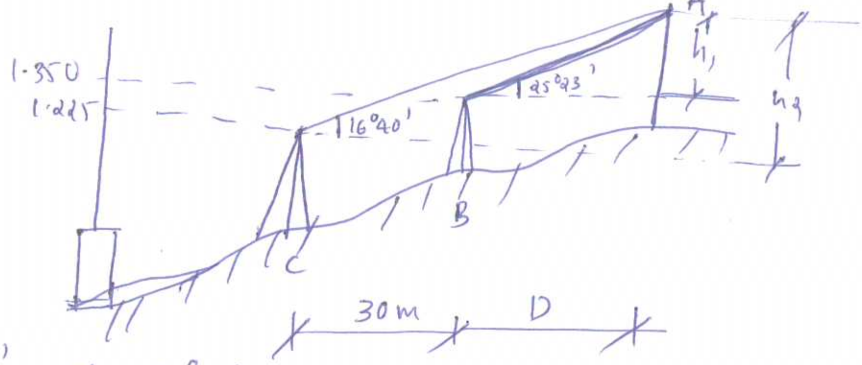
2) Shift the instrument & set at Q. Before taking back sight on P, set vernier A to read back bearing of PQ & fix the upper clamp.

3) Using lower clamp & tangent screw, take a back sight on P. The instrument is now oriented since the line of sight is along QP & the instrument is reading the bearing of QP.

4) Loose the upper clamp & rotate the instrument clockwise to take a foresight on R, the reading on vernier A gives directly the bearing on QR

5) The process is repeated at other stations.

VII a)



$\alpha_1 = 25^\circ 23'$, $\alpha_2 = 16^\circ 40'$

RL of instr. axis at B = RL of BM + staff reading

= 152.26 + 1.350 = 153.61

RL of instr. axis at C = RL of BM + staff reading.

= 152.26 + 1.225 = 153.485

S = 1.35 − 1.225 = 0.125 m.

$$D = \frac{S - b\tan\alpha_2}{\tan\alpha_2 - \tan\alpha_1}$$

$$= \frac{0.125 - 30(\tan 16^\circ 40')}{\tan 16^\circ 40' - \tan 25^\circ 23'}$$

= 50.6 m

h_1 = $D\tan\alpha_1$ = $50.6 \times \tan 25^\circ 23'$ = 24 m

RL of A = RL of instr. axis at B + h_1

= 153.61 + 24 = 177.61 m

Check

b + D = 30 + 50.6 = 80.6

h_2 = $80.6 \tan 16^\circ 14'$ = 24.13.

RL of A = RL of instr. axis at C + h_2

= 153.485 + 24.13

= 177.61 m

Hence ok.

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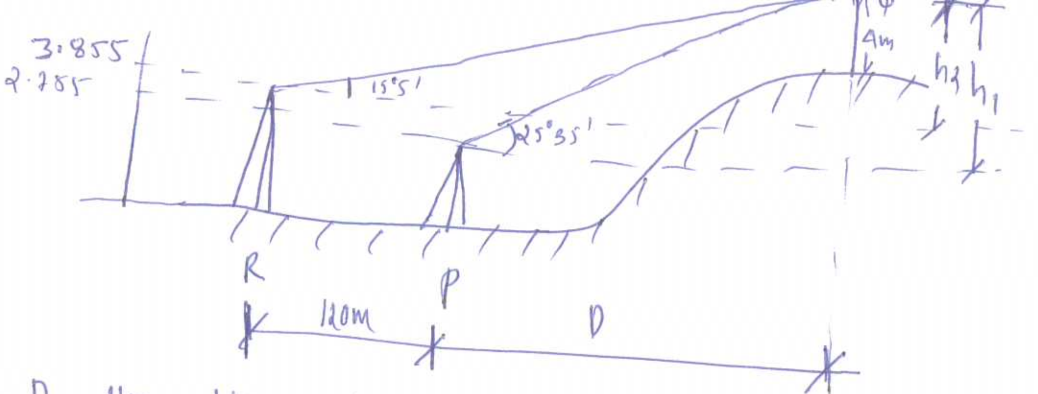
VII b



Let, D - Hor. distance b/w the base of the signal & instr. at P.

From fig, $h_1 = D \tan 25°35'$

$h_2 = (120 + D) \tan 15°5'$

$h_1 - h_2 = D \tan 25°35' - [(120+D)\tan 15°5']$ —— (1)

From fig. we have, $h_1 - h_2 = 3.855 - 2.755 = 1.1$ —— (2)

From Equating (1) & (2)

$\Rightarrow D(\tan 25°35') - [(120+D)\tan 15°5'] = 1.1$

$\therefore D = 159.811 m.$

Now, $h_1 = D \tan 25°35' = 159.811 \tan 25°35' = 76.51m$

Elevation of Q = Elev. of instr. axis at P + h_1

$= (105.42 + 2.755) + 76.512$

$= 184.687 m.$

Elevation of foot of signal = $184.687 - 4 = 180.687 m$

Check

$h_2 = (b+D)\tan 15°5' = (120 + 159.811)\tan 15°5' = 75.41m$

Elevation of Q = $105.42 + 3.855 + 75.411 = 184.687$

Elevation of foot of signal $= 184.687 - 4$

$= 180.687 m.$

VIII a. Anallactic lens is an additional convex lens placed between the diaphragm & objective at a fixed distance from the latter. 2

By providing anallactic lens, the vertex is formed at vertical axis & its position is always fixed irrespective of the staff position. 2

Advantages 7

* The additive constant vanishes & the computations are made quicker.
* The loss of light may be compensated by the use of slightly larger object glass. 3

Disadvantages

* It absorbs much of the incident light.
* It cannot be easily cleaned.

VIII b. $K = 100$, $C = 0.15$.

The staff is held vertical & line of sight is inclined.

$$D = KS\cos^2\theta + C\cos\theta$$

$$V = KS\frac{\sin 2\theta}{2} + C\sin\theta$$

In 1st observation, $S = 2.450 - 1.150 = 1.3$

$$\theta = -5^\circ 20'$$

$$V_1 = 100 \times 1.3 \times \frac{\sin(2 \times 5^\circ 20')}{2} + 0.15\sin 5^\circ 20'$$ 3 8

$$= \underline{\underline{12.045m}}$$

In 2nd observation,

$$S = 2.250 - 0.750 = 1.5, \quad \theta = +8^\circ 12'$$

$$V_2 = 100 \times 1.5 \times \frac{\sin(2 \times 8^\circ 12')}{2} + 0.15\sin 8^\circ 12' = \underline{21.19m}$$ 3

$$D = 100 \times 1.5 \times \cos^2 8^\circ 12' + 0.15\cos 8^\circ 12' = \underline{\underline{147.097m}}$$

RL of instr. axis $= \text{RL of BM} + h_1 + V_1 = 750.50 + 1.8 + 12.045m$

$= 764.345m$ 2

RL of Q $= \text{RL of instr. axis} + V_2 - h_2$

(10) $= 764.345 + 21.19 - 1.5 = \underline{784.035m}$

IX a) Deflection angle, $\Delta = 180^\circ - 120^\circ = 60^\circ$

i) Tangent distance $= R \tan \Delta/2 = 600 \times \tan \frac{60}{2}$

$= \underline{346.41m}$ — 2

ii) Chainage of PC $=$ Chainage of PI $-$ Tangent length.

$= 2500 - 346.41 = \underline{2153.59m}$ — 2

iii) Chainage of PT $=$ Chainage of PC $+$ length of curve

$= 2153.59 + \frac{\pi R \Delta}{180}$

$= 2153.9 + \left(\frac{\pi \times 600 \times 60}{180}\right)$ — 2 — 8

$= \underline{2781.91m.}$

iv) Length of longchord $= 2R \sin \Delta/2$

$= 2 \times 600 \times \sin\left(\frac{60}{2}\right) = \underline{600m}$ — 2 — 15

IX b.

1) To measure the area with single station.
2) To correct the defects due to curvature & refraction. — Any 7
~~3) To find the heights in trigonometric levelling.~~ — $7 \times 1 = 7$
3) To find the vertical heights directly.
4) To adjust the measurements from the pressure of climate & temperature changes. — 7
5) To measure the slope distances.
6) To change inclined lengths to horizontal lengths.
7) To give average angles & measurements electronically.

X a. Remote sensing – The science & art of acquiring information about a material object by making measurements at a distance from it, without coming into a physical contact, with the help of electro magnetic energy. 2

Applications in civil Engg. 6

1) Detection of water pollution Any 4

2) Detection of geology & mineral resources. $4\times1=4$

3) For mapping of land resources.

4) Monitoring of environmental hazards.

X b) Length of radius $= 15\times20 = 300m.$

Deflection angle, $\Delta = 180^\circ - 127^\circ 30' = 52^\circ 30'$

Length of the tangent $= R\tan\Delta/2 = 300 \times \tan\left(\frac{52^\circ 30'}{2}\right) = 147.94m.$ 15

General eqn. for radial offsets from tangent,

$$O_x = \sqrt{R^2 + x^2} - R$$ 2 9

$O_{20} = \sqrt{300^2 + 20^2} - 300 = 0.67m.$

$O_{40} = \sqrt{300^2 + 40^2} - 300 = 2.66m$

$O_{60} = \sqrt{300^2 + 60^2} - 300 = 5.94m.$

$O_{80} = \sqrt{300^2 + 80^2} - 300 = 16.23m.$

$O_{100} = \sqrt{300^2 + 100^2} - 300 = 10.48m.$

$O_{120} = \sqrt{300^2 + 120^2} - 300 = 23.11m.$

$O_{140} = \sqrt{300^2 + 140^2} - 300 = 31.06\ m.$

$O_{147.94} = \sqrt{300^2 + (147.94)^2} - 300 = 34.49m$