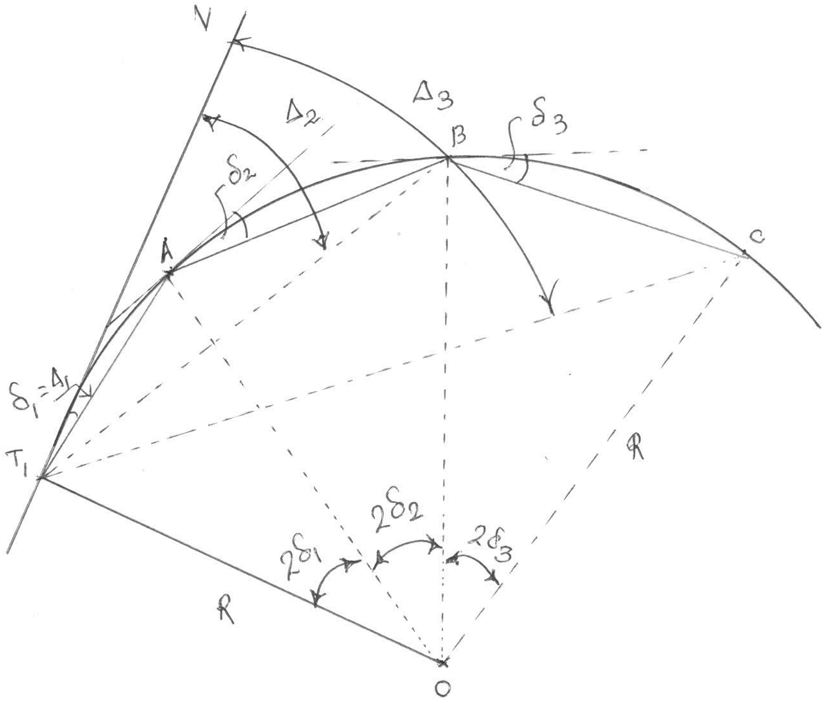
QN. 1.



(03 Mark)

Procedure:

(i) Set up the theodolite at T_1. With both plates clamped to zero-zero, direct the theodolite to bisect the P.I. (V).

(ii) Release the vernier plate and set angle Δ_1 on the vernier directing to chord T_1A.

(iii) With zero end of tape at T_1 and arrow held at A with distance $T_1A = c$, swing the tape around T_1 till the arrow is bisected by the cross hairs at A. Thus the point A is fixed.

(iv) Set up the deflection angle Δ_2 on the vernier so that the line of sight is directed to T_1B.

(v) With zero end of the tape pinned at A, and arrow held at $AB = c = C'$, swing the tape till the arrow is bisected by the cross hairs thus fixing point B.

(vi) Repeat steps (iv) & (v) till the last point T_2 is reached.

(07 Mark)

QN.2.

- Tangent length $= R\tan\left(\frac{\Delta}{2}\right) = 15\tan\left(\frac{50^\circ 30'}{2}\right) = 7.074$ chain

$= 7.074 * 20 = 141.48\,m.$

- length of Curve $= (l) = \frac{\pi R \Delta}{180^\circ} = \frac{\pi * 15 * 50^\circ 30'}{180^\circ} = 13.22$ chain

$l = 13.221 * 20 = 264.42\,m.$

		(chain)		(link)		(m)
Chainage of P.I.	=	59	+	60	=	1192.00
Deduct tangent length	=	7	+	7.4	=	141.48
Chainage of P.C.	=	52	+	52.60	=	1050.52
Add length of Curve	=	13	+	22.10	=	264.42
Chainage of P.T.	=	65	+	74.70	=	1314.94

04 Marks

Chainage of each peg will be multiples of 20m.

Length of 1st Sub chord $= c = 1060 - 1050.52 = 9.48\,m$

Length of last Sub chord $= c' = 1314.94 - 1300 = 14.94\,m.$

No of full chords of 20 m length $= C = \frac{1300 - 1060}{20} = 12.$

Total number of chords $= c + c' + C = 1 + 1 + 12 = 14.$

Length of first off Set $= O_1 = \frac{c^2}{2R} = \frac{(9.48)^2}{2 * 300} = 0.15\,m.$

Length of intermediate off Set $= O_2 = \frac{C(c + C)}{2R} = \frac{20}{2*300}(9.48+20)$

$O_2 = 0.98\,m.$

Length of Successive off sets $O_3 = O_4 = O_5 = \cdots O_{13} = \frac{C^2}{2R} = \frac{(20)^2}{2*300} = 1.33\,m$

length of last off Set $= O_{14} = \frac{c'}{2R}(C + c') = \frac{14.94}{2*300}(20 + 14.94) = 0.87\,m$

06 Marks

QN. 3. R_S = Radius of Smaller Curve

R_L = Radius of larger Curve

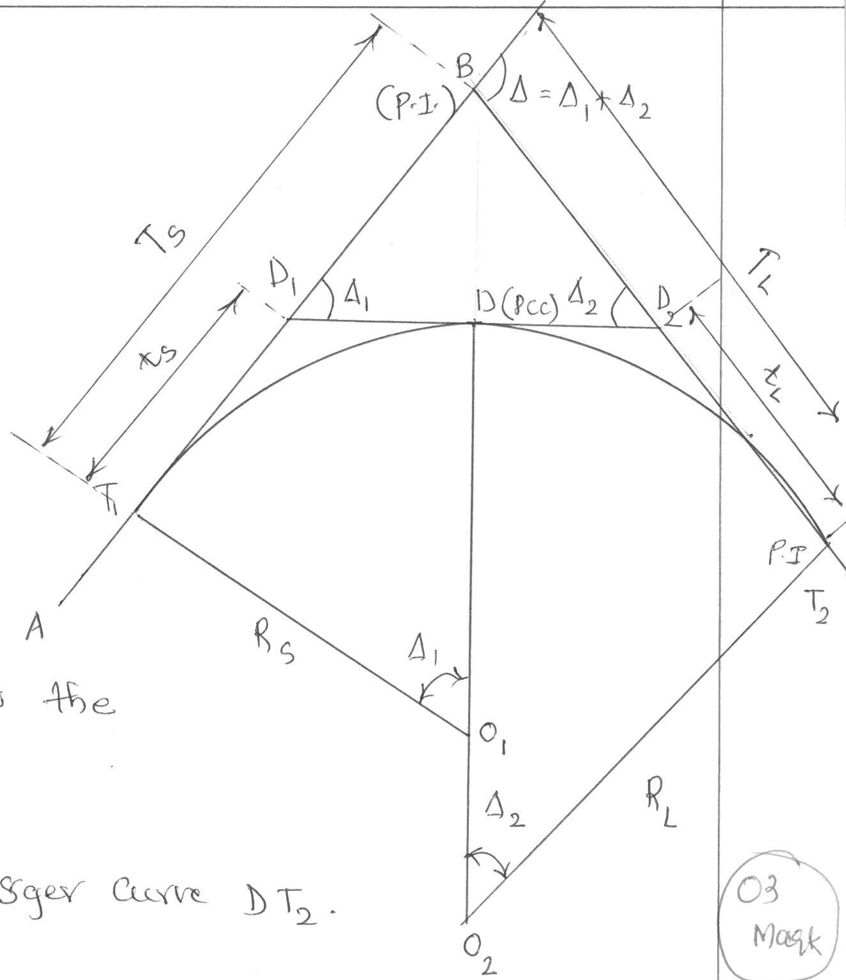
$D_1 D_2$ = Common tangent

Δ_1 = Deflection angle of Smaller Curve

Δ_2 = Deflection angle of larger Curve

t_S = length of tangent to the Smaller Curve $T_1 D$

t_L = length of tangent to larger curve $D T_2$.



03 Mark

T_S = Total tangent distance = $T_1 B$ Corresponding to short radius

T_L = Total tangent distance = $T_2 B$ Corresponding to larger radius

$$t_S = T_1 D_1 = D_1 D = R_S \tan\left(\frac{\Delta_1}{2}\right)$$

$$t_L = T_2 D_2 = D D_2 = R_L \tan\left(\frac{\Delta_2}{2}\right)$$

$$\Delta = \Delta_1 + \Delta_2, \quad D_1 D_2 = D_1 D + D D_2 = (t_S + t_L)$$

from Δ^{le} $B D_1 D_2$, by Sine rule,

$$\frac{D_1 D_2}{\sin \Delta} = \frac{B D_2}{\sin \Delta_1} = \frac{B D_1}{\sin \Delta_2}$$

$$BD_1 = \frac{(t_S + t_L)\sin \Delta_2}{\sin \Delta}, \quad BD_2 = \frac{(t_S + t_L)\sin \Delta_1}{\sin \Delta}$$

$$T_S = t_S + BD_1, \quad T_L = t_L + BD_2.$$

04 Mark

Procedure: • (i) for the first curve, Calculate the tangential angles by Rankines method.

• (ii) Set out the theodolite at T_1 and set out the first branch T_1D by Rankines method.

(iii) After reaching the point 'D', Shift the theodolite to D and set it there. Set vernier to $(360° - \frac{\Delta_1}{2})$, take backsight and plunge the telescope. orient the theodolite at D.

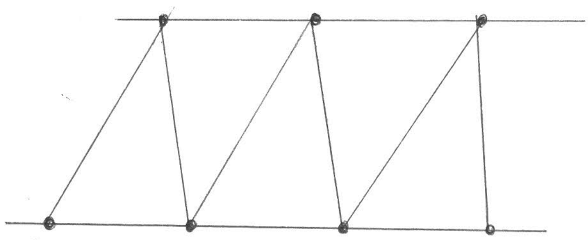
(iv) Calculate tangengial angles for the second branch of curve by Rankines method. Set out the curve till T_2 is reached. (03 Mark)

QN 4 Triangulation Systems are:

(i) Single chain of Δ'les (ii) Double chain of Δ'les

(iii) Centered figures (iv) Quadrilaterals.

(a) Single chain of Δles:

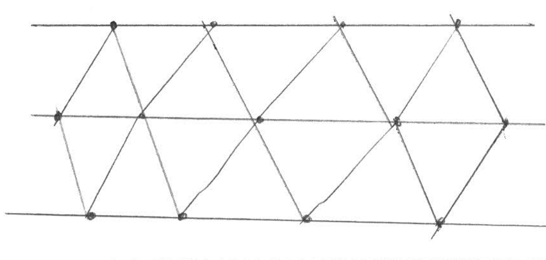


It is used when a narrow strip of terrain is to be covered.

It is not so accurate and is used for primary work. (04 Mark)

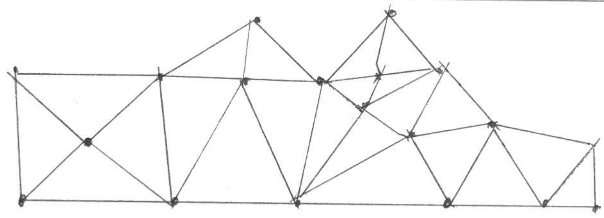
If accumulation of errors is to be not excessive, then a large number of base lines must be introduced.

(b) Double chain of Δles:



It is used to cover a greater area. (03 Mark)

(c) Centered figures:



They are used to cover very large areas and give Satisfactory results in a flat Country. However, the Progress of work will be slow due to frequent settings of the instrument.

(d). Quadrilaterals: These are 4 Cornered stations which are best suited for hilly Country. This System will be more accurate. (03 Mark)

QN. 5. Versed Sine $= O_0 = R - \sqrt{R^2 - (L/2)^2}$

$4 = R - \sqrt{R^2 - (40)^2}$

$\therefore \sqrt{R^2 - 40^2} = (R-4)$ or $R^2 - 40^2 = (R-4)^2$ (03 Mark)

$R^2 + 4^2 - 2 * 4R = R^2 - 40^2$

$16 - 8R = -1600$ or $8R = 1616$ or $R = 202\,m.$

$\therefore (R - O_0) = 202 - 4 = 198\,m.$

$O_x = \sqrt{R^2 - x^2} - (R - O_0)$ (04 Mark)

$O_{10} = \sqrt{(202)^2 - 10^2} - (198) = 3.75\,m.$

$O_{20} = \sqrt{(202)^2 - 20^2} - (198) = 3.01\,m$

$O_{30} = \sqrt{(202)^2 - 30^2} - (198) = 1.76\,m$

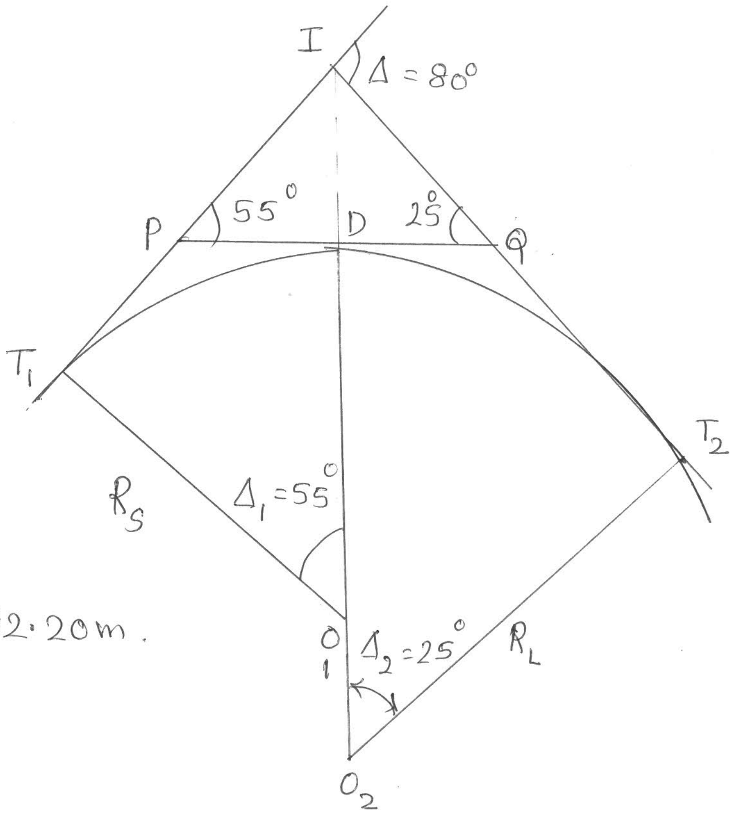
$O_{40} = \sqrt{(202)^2 - 40^2} - (198) = 0.00\,m$ (03 Mark)

QN. 6. $R_S = 350m$, $R_L = 500m$.

$\Delta_1 = 55°$, $\Delta_2 = 25°$

$t_S = ?$ $t_L = ?$

$T_S = ?$ $T_L = ?$



$t_S = R_S \tan\left(\frac{\Delta_1}{2}\right)$

$t_S = 350 \tan\left(\frac{55°}{2}\right) = 182.20m.$

$t_L = R_L \tan\left(\frac{\Delta_2}{2}\right)$

$t_L = 500 \tan\left(\frac{25°}{2}\right) = 110.85m.$

$\therefore PQ = t_S + t_L = 182.20 + 110.85 = 293.05m$

04 Mark

$$\frac{PQ}{\sin\Delta} = \frac{IP}{\sin\Delta_2} = \frac{IQ}{\sin\Delta_1}$$

$$\therefore \frac{293.05}{\sin 80°} = \frac{IP}{\sin 25°} = \frac{IQ}{\sin 55°}$$

$$\therefore IP = \frac{293.05}{\sin 80°} * \sin 25° = 125.76m$$

$$IQ = \frac{293.05}{\sin 80°} * \sin 55° = 243.76m.$$

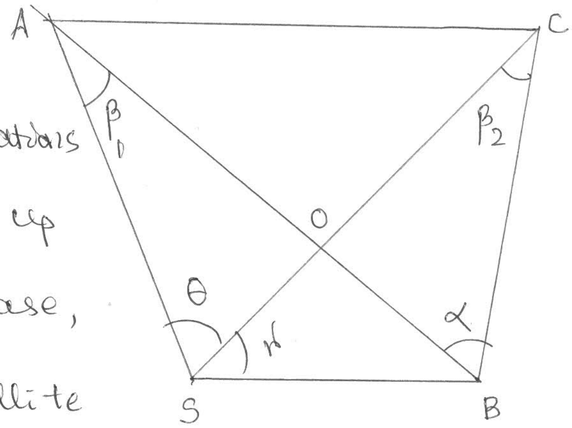
$T_1I = t_S + IP = 182.20 + 125.76 = 307.96m.$

$T_2I = t_L + IQ = 110.85 + 243.76 = 354.61m$

06 Mark

x x x

QN 7. In order to secure well conditioned triangle & better visibility



towers are sometimes selected as triangulation stations. when observations are taken, it is impossible to set up instrument over it. In such a case, a subsidiary station called satellite station is selected near to the main station and observations are taken to the other triangulation stations with the same precision as that of true station. Such stations are called Satellite Stations. The process of applying corrections due to eccentricity of the station is generally called reduction to center. The distance b/w the true station and the satellite station is determined by either trigonometric levelling or by triangulation. Satellite stations should be avoided as far as possible in primary triangulation.

(03) Mark

(07) Mark

— x — x —

End of Scheme.