TED (15) – 3012

(REVISION — 2015)

Reg. No. ....

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THIRD SEMESTER DIPLOMA EXAMINATION IN CIVIL ENGINEERING — OCTOBER, 2016

SURVEYING - II

[*Time* : 3 hours

(Maximum marks : 100)

PART — A

(Maximum marks : 10)

Marks

I Answer the following questions in one or two sentences. Each question carries 2 marks.

1. Define the term swinging the telescope.
2. State independent co-ordinates.
3. What is a tacheometer ?
4. Define a compound curve.
5. Mention the term remote sensing ? (5×2=10)

PART — B

(Maximum marks : 30)

II Answer *any five* questions from the following. Each question carries 6 marks.

1. Explain temporary adjustments of a theodolite.
2. Write the procedure of measuring the bearing of a line with a theodolite.
3. What is meant by omitted measurements ? What are the various cases ?
4. Explain Bowditch's rule and Transit rule.
5. Derive an equation to find out the elevation of a point whose base is inaccessible, instrument axes are at the same level and the instrument stations are in the same vertical plane as the elevated object.
6. Explain the procedure of setting out a simple curve by the method of offsets from long chord.
7. Write the different applications of G.I.S. in Civil Engineering. (5×6=30)

Marks

PART — C

(Maximum marks : 60)

(Answer *one* full question from each unit. Each full question carries 15 marks.)

UNIT — I

III (a) Write the procedure of measurement of a horizontal angle by repetition method. 8

(b) Explain the errors which are eliminated or minimized by repetition method ? 7

OR

IV (a) List out the fundamental axes of a transit theodolite and mention their relationship between them if the theodolite is in perfect adjustment. 8

(b) Define deflection angle. Explain the procedure of measuring deflection angles with a theodolite. 7

UNIT — II

V (a) Explain traversing by the method of included angles. 7

(b) A closed traverse was conducted round an obstacle and the following observations were made. Find out the missing quantities. 8

Line	*Length (m)*	*Bearing*
AB	500	98° 30'
BC	620	30° 20'
CD	468	331° 30'
DE	?	230° 0'
EA	?	150° 10'

OR

VI (a) Define a closed traverse. What are the checks commonly employed in a closed traverse ? 7

(b) The following are the latitudes and departures of the lines of a closed traverse. Compute the area of the traverse. 8

Line	*Latitude (m)*	*Departure (m)*
AB	-116.1	-44.4
BC	+6.8	+58.2
CD	+80.5	+17.2
DA	+28.8	-31.0

Marks

UNIT — III

VII (a) Derive an expression for the horizontal distance 'D' of a vertical staff from the Tacheometer if the line of sight is inclined in stadia tacheometry. 7

(b) Find the reduced level of the top of a chimney from the following data. 8

Instrument Station	*Reading on B.M.*	*Vertical angle*	*R. L. of B.M.*	*Distance AB (m)*	*Remarks*
A	1.578	10° 12'	543.075	30	A and B are in the line with the top of the chimney
B	1.269	8° 20'			

OR

VIII (a) Derive an expression for the horizontal distance D of a vertical staff from a Tacheometer, if the line of sight is horizontal. 7

(b) A tacheometer with multiplying constant 100 and additive constant 0.30 was set up at a station O and the following results were obtained by keeping the staff vertical. Calculate the horizontal distance between stations O and P and the reduced level of Station P. 8

Instrument Station	*Staff Station*	*Hair readings*	*Vertical angle*	*Remarks*
O	B. M.	1.875 2.150 2.425	0° 00'	R.L. of B. M.= 145.867m
	P	1.650 1.800 1.950	-10° 00'	

UNIT — IV

IX (a) How a curve is designated ? 3

(b) Two straights intersect at a chainage of (100 chains +.00m). The angle of intersection is 127° 30' and the radius of the curve is 450m. It is required to set out a simple Curve to connect the tangents. Calculate all the data necessary to set out the curve by the method of offsets from the tangents with a peg interval of 30m. 12

OR

X (a) Name the different parts of a Total Station. 5

(b) What are the basic functions of E. D. M. instruments ? 5

(c) What are the components of a G. P. S. receiver ? 5

THIRD SEMESTER DIPLOMA EXAMINATION IN CIVIL - ENGINEERING - OCTOBER, 2016

SURVEYING - II [Time: 3hrs]

(Maximum marks : 100)

PART - A

(Maximum marks : 10)

I

(1) It is the process of turning the telescope in horizontal plane. If the telescope is rotated in clock-wise direction, It is known as right swinging. If telescope is rotated in the anti clockwise direction It is known as left swinging

(2) The co-ordinates of traverse stations can be calculated with respect to a common Origin. The total latitude and departure of any point with respect to a common origin are known as independent co-ordinates or total co-ordinates of the point.

(3)- An ordinary transit theodolite fitted with a stadia diaphragm is generally used for tacheometric survey and is called tacheometer

(4)- A compound curve consists of two or more simple curves having different radii bending in the same direction and lying on the same side of the common tangent. Their centres lie on the same side of the curve by which the characteristic of objects of interest can be identified, measured, or analysed without direct contact. This is done by sensing and recording reflected energy and processing, analyzing and applying that informations.

PART - B

(Maximum Marks : 30)

II (1)- Temporary Adjustments are

1- Setting up
2- Levelling up
3 - Elimination parallax

1 - Setting up :-

(i) centring of instrument over the station mark by a plumb bob or by optical plummet, and
ii) approximate levelling with the help of tripod legs. Some instruments are Provided with shifting head with the help of tripod legs. Some instruments are provided with shifting head with the help of which accurate centring can be done easily

2- Levelling up :-

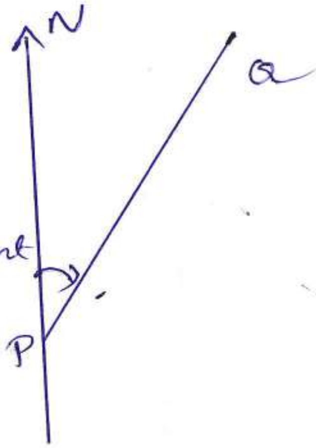
After having centred and approximately levelled the instrument accurate levelling is done with the help of foot screws and with reference to the plate levels.

axis truly vertical. The manner of levelling the instrument by the plate levels depends upon whether there are three levelling screws or four levelling screws.

3- Elimination of parallax

It is a condition arising when the image formed by the objective is not in the plane of the cross hairs. unless parallax is eliminated, accurate sighting is impossible. elimination can be done in two steps i) by focusing the eye piece for distinct vision of the cross hairs, and
ii) by focusing the objective to bring the image of the object in the plane of cross hairs.

(2) To measure the magnetic bearing line, the theodolite should be provided with either a tubular compass or through compass. The following are the steps



(1) set the instrument at P and level
(2) Set accurately the vernier A to zero
(3) Loose the lower clamp. Release the needle of the compass. Rotate the instrument about its outer axis till the Magnetic needle roughly points to North. clamp the lower clamp using the lower tangent screw, bring the needle exactly against the meare so that it is in Magnetic Meridian. The line of sight also then

(4) loose the upper clamp and point the telescope towards Q. bisect Q accurately using the upper tangent screw. Read vernier Aand B

(5) change the face and repeat the steps 2,3 and 4the average of the two will give the correct bearing of the line PQ

3 OMITTED MEASUREMENTS:

In order to have a check on field work and in order to balance a traverse the length and direction of each line is generally measured in the field .there are times ,however, when it is not possible to take all measurements due to obstacle or because of some oversights .such omitted measurements or missing quantities can be calculated by latitudes and departures provided the quantities required are not more than two. in such cases there can be no check on the field work nor can the survey be balanced. all errors propagated throughout the survey are thrown into the computed values of the missing quantities

since for closed traverse, ΣL and ΣD are zero, we have

$$\Sigma L = l_1 \cos\theta_1 + l_2 \cos\theta_2 + l_3 \cos\theta_3 + \cdots = 0 \quad \text{--- (1)}$$

$$\Sigma D = l_1 \sin\theta_1 + l_2 \sin\theta_2 + l_3 \sin\theta_3 + \cdots = 0 \quad \text{--- (2)}$$

where l_1, l_2, l_3 .. etc are the length of the lines and $\theta_1, \theta_2, \theta_3$ etc their reduced bearings. With the help of above two equations, the two missing Quantities can be calculated.

There are 4 general cases of omitted measurements

I (a) when the bearing of one side is omitted

(b) when the length of one side is omitted

(c) when the bearing and length of one side is omitted

II when the length of one side and the bearing of another side are omitted

III when the length of two side is omitted

IV when the bearing of two side is omitted

In case I only one side is affected. in case II,III&IV two sides are affected both of which may either be adjacent or may be away.

4 BOWDITCH'S RULE & TRANSIT RULE:

BOWDITCH'S METHOD:

The basis of this method is on the assumption that the errors in linear measurements are proportional to $\sqrt{l}$ and that the errors in angular measurements are inversely proportional to $\sqrt{l}$ where l is the length of a line. the bowditch's rule also termed as the compass rule ,is the mostly used to balance a traverse where linear and angular measurement of equal precision. the total error in latitude and departure is distributed in proportion to the length of sides

Correction to latitude (or departure) of any side =

Total error in latitude (or departure) x $\frac{\text{length of that side}}{perimeter\ of\ traverse}$

Thus, if C_L=correction to latitude of any side

C_D= correction to departure of any side

$\sum_L$=total error in latitude

$\sum_D$=total error in departure

$\sum_l$=length of the perimeter

l=length of any side

we have $C_L = \sum_L \times \frac{l}{\sum l}$ and $C_D = \sum_D \times \frac{l}{\sum l}$

TRANSIT METHOD:

This may employed where angular measurements are precise that the linear measurements . according to this rule the total errors in latitudes and departures is distributed in proportion to the latitude and departures of the sides . it is claimed that the angles are less affected by correction applied by transit method than by those by bowditch's method.

Correction to latitude (or departure) of any side =

Total error in latitude (or departure) x $\frac{\text{latitude or departure of that line}}{\text{arithmetic sum of latitudes or departure}}$

Thus if L=latitude of any line

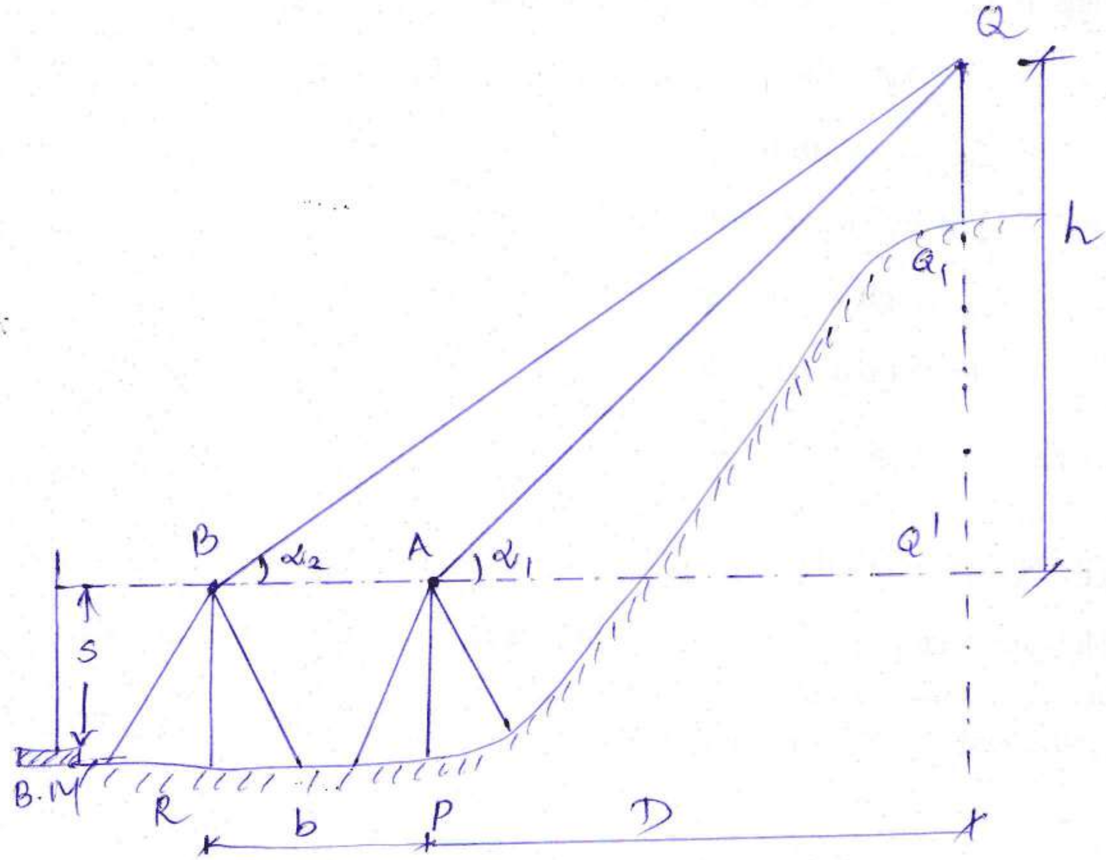
D= departure of any line

L_T= arithmetic sum of latitudes

D_T= arithmetic sum of departure

we have $C_L= \sum_L \times \frac{L}{LT}$ and $C_D=\sum_D \times \frac{D}{DT}$

5 BASE OF THE OBJECT INACCESSIBLE:INSTRUMENT STATION IN SAME VERTICAL PLANE AS THE ELEVATED OBJECT



Instrument Axes At the Same level.

Let $h = QQ'$

α_1 = angle of elevation from A to Q

α_2 = " " B to Q

S = staff reading on B.M. taken from both A and B, the reading being the same in the cases.

b = horizontal distance between the instrument stations

D = horizontal distance b/n P and Q

From $\Delta AQQ'$ $h = D \tan\alpha_1$ — (1)

From $\Delta BQQ'$, $h = (b+D)\tan\alpha_2$ — (2)

Equating (1) & (2) we get

$D \tan\alpha_1 = (b+D)\tan\alpha_2$ or $D(\tan\alpha_1 - \tan\alpha_2) = b\tan\alpha_2$

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

$$h = D\tan\alpha_1 = \frac{b\tan\alpha_1\tan\alpha_2}{\tan\alpha_1 - \tan\alpha_2} = \frac{b\sin\alpha_1\sin\alpha_2}{\sin(\alpha_1 - \alpha_2)}$$

R.L of Q = R.L of B.M + S + h

(6) SETTING OUT OF SIMPLE CURVES

Linear Method (By ordinates from the long chord)

O_0 = Mid ordinate

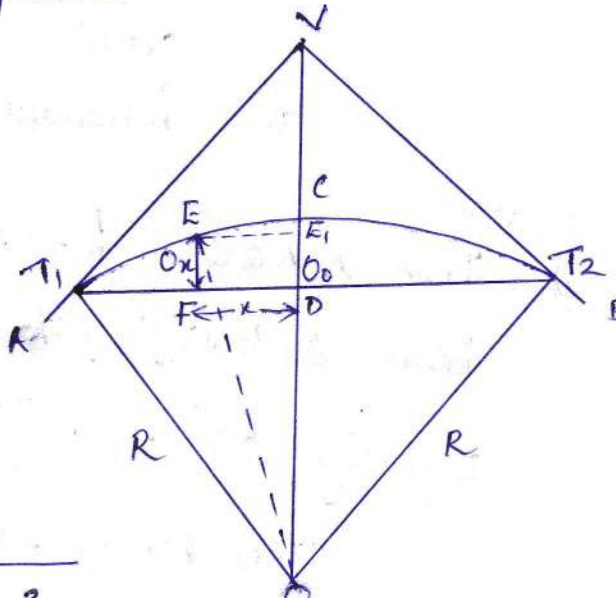
O_x = Ordinate at distance x from the midpoint of the chord

T_1 and T_2 = Tangent points

L = Length of the long chord actually measured on the ground

Bisect the long chord at point D

From triangle OT_1D



$$OT_1^2 = T_1D^2 + DO^2$$

$$R^2 = \left(\frac{L}{2}\right)^2 + (CO - CD)^2$$

$$= \left(\frac{L}{2}\right)^2 + (R - O_0)^2$$

$$\therefore \quad (R - O_0) = \sqrt{R^2 - \left(\frac{L}{2}\right)^2}$$

or $$O_0 = R - \sqrt{R^2 - \left(\frac{L}{2}\right)^2} \quad \text{——— (1)}$$

In order to calculate the ordinate O_x to any point E

Draw the line EE_1 parallel to the long chord T_1T_2.

Join EO to cut the long chord in 'G'

Then $$O_x = EF = E_1D = E_1O - DO$$

$$= \sqrt{(EO)^2 - (EE_1)^2} - (CO - CD)$$

$$= \sqrt{R^2 - x^2} - (R - O_0) \quad \text{——— (2)}$$

into an even number of equal parts, offset calculated from (1) are then set out at each of these points.

(7) Application of GIS

1- Mapping of places of tourist interest or pilgrimage both in hard copy and soft copy form.

2- Consolidation of land holding and land records

3- Natural Disaster Management

4- Planning of Construction of road, Rail, Dam, tunnel etc.

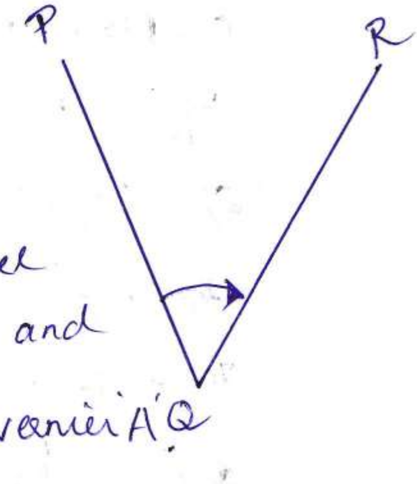
5- Urban and Regional planning.

6- Irrigation and Canal development

7- Waste Land Reclamation projects.

PART : C

UNIT - I



III (a) Repetition Method :-

To Measure the angle PQR

(1) Set the instrument at Q and level it. With the help of upper clamp and tangent screw, set 0° reading on vernier A. Note the reading of vernier - B

(2) Loose the lower clamp and ~~turn~~ direct the telescope towards the point P. clamp the lower

tangent screw.

(3) unclamp the upper clamp and turn the instrument clockwise about the inner axis towards R. clamp the upper clamp and bisect 'R' accurately with the upper tangent screw. Note the reading of verniers A and B to get the approximate value of the angle PQR

(4) unclamp the lower clamp and turn the telescope clockwise to sight 'p' again Bisect 'p' accurately by using the lower tangential screw. It should be noted that the vernier readings will not be changed in this operation since the upper plate is clamped to the lower

(5) unclamp the upper clamp, turn the telescope clockwise and sight R. Bisect R accurately by upper tangent screw.

(6) Repeat the process until the angle is repeated the required number of times usually (3). The average angle with face left will be equal to final reading divided by three.

(7) change face and make three more repetitions as described above. find the average angle with

(8) The average horizontal angle is then obtained by taking the average of the two angles obtained with face left and face right.

III (b) 1) Errors due to eccentricity of verniers and centres are eliminated by taking both vernier readings.

(2) Errors due to inadjustments of line of collimation and the trunnion axis are eliminated by taking both face reading

(3) The Errors due to inaccurate graduations are eliminated by taking the readings at different part of the circle.

(4) Errors due to Inaccurate bisection of the object, eccentric centring etc.. May be to some extent counter-balanced in different observation.

→ It should be noted, however, that in repeating angles, operations such as sighting and clamping are multiplied and hence opportunities for errors are multiplied. The limit of precision in the Measurement of an angle is ordinarily reached after the fifth or sixth repetition.

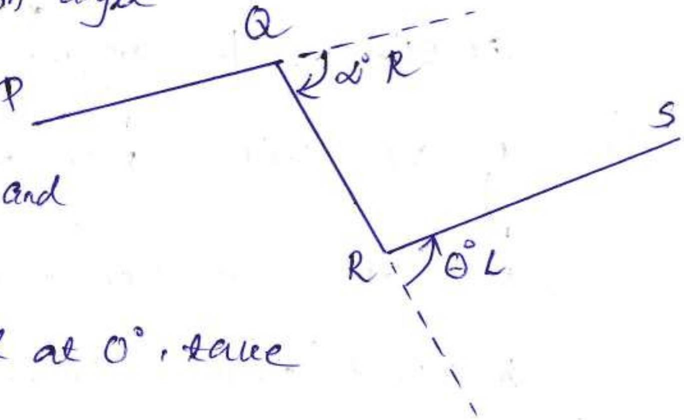
Errors due to slip, displacement of station signals and want of verticality of the vertical axis etc. are not eliminated since they are all cumulative.

1- vertical axis
2- horizontal "
3- the line of collimation
4- Axis of plate level
5- Axis of altitude level
6- Axis of striding level

Desired relationships

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 (If provided) must be parallel to the horizontal axis.

To measure the deflection angle 'Q' :-



1- set the instrument at Q and level it.

2. With both plates clamped at 0°, take 'p' 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°.

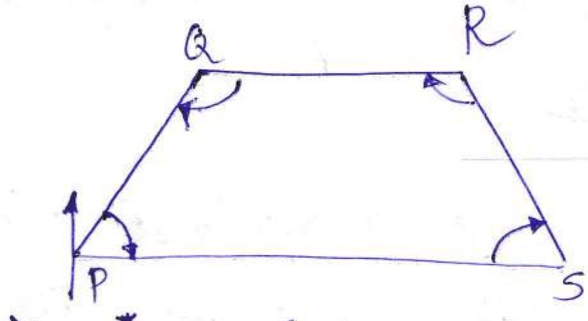
4. unclamp the upper clamp and turn the telescope clockwise to take the foresight on 'R' Read both the verniers

5. unclamp the lower clamp and turn the telescope to sight 'p' again. The vernier still read the same reading as in (4). plunge the telescope.

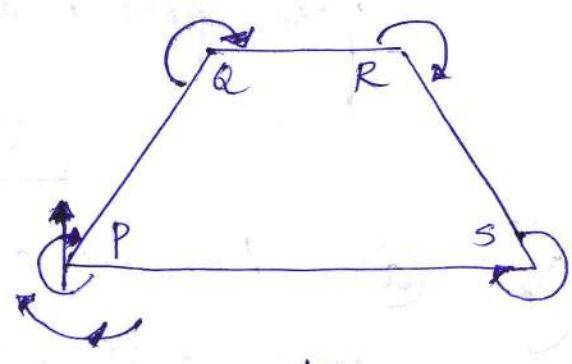
6. unclamp the upper clamp and turn the telescope to sight R. Read both verniers. Since the deflection angle is doubled by taking both face readings, one half of the final reading gives the deflection angle at Q.

UNIT : II

V) (a) An included angle at a station is either of two angles formed by the two survey lines meeting there. The method consist simply in measuring station. The angles may also be measured by repet[ition]. If also desired both face observations must be taken and both the vernier should be read. Included angles can be measured either clockwise or counter-clockwise but it is better to measure all angles clockwise. Since the graduations of the theodolite circle increases in this direction. The angles measured clockwise from the back station may be interior or exterior depending upon the direction of progress round the survey. Thus the figure (a), direction of progress in counter clockwise and hence the angles measured clockwise, are directly the interior angles. In figure (b), the direction of progress around the survey is clockwise and hence the angles measured clockwise are Exterior angles.



(a)



(b)

traverse ABCDE in which DA is closing line of the polygon ABCD. The latitude and departure of the closing line DA can be calculated. The calculations are.

Line	Latitude		Departure	
	+	−	+	−
AB		73.91	494.50	
BC	535.11		313.11	
CD	223.45			411.29
sum	758.56	73.91	807.61	411.29
	$\Sigma L' = +684.55$		$\Sigma D' = +396.32$	

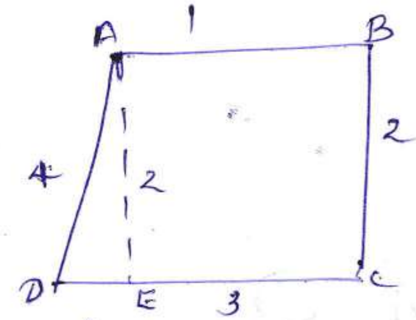


fig (a)

∴ Latitude of $DA = -\Sigma L' = -684.55$

& Departure $DA = -\Sigma D' = -396.32$

Since the both latitude and departure are negative, the line DA is in third (ie, SW) quadrant, the reduced bearing (θ) of DA is given by

$$\tan\theta = \frac{D}{L} = \frac{396.32}{684.55}$$

$$\therefore \theta = 30^\circ 4'$$

Length of DA $= l = L\sec\theta = 684.55 \sec 30°4'$

$= 791.01\,m$

fig (a), $\angle ADE = \alpha = 230°0' - 210°4' = 19°56'$

$\angle DEA = \beta = 150°10' - (230° - 180°)$

$= 100°10'$

$\angle DAE = \gamma = 210°4' - 150°10' = 59°54'$

(Check $\alpha + \beta + \gamma = 19°56' + 100°10' + 59°54' = 180°$)

from the $\triangle ADE$, using the sine Rule, we get

$$DE = DA \frac{\sin\gamma}{\sin\beta} = 791.01 \frac{\sin 59°54'}{\sin 100°10'} = \underline{\underline{695.27\,m}}$$

$$EA = DA \frac{\sin\alpha}{\sin\beta} = 791.01 \frac{\sin 19°56'}{\sin 100°10'} = \underline{\underline{273.99\,m}}$$

(VI) (a)

Figure (b) shows a closed chain traverse. At A, the directions, AB and AD are fixed by

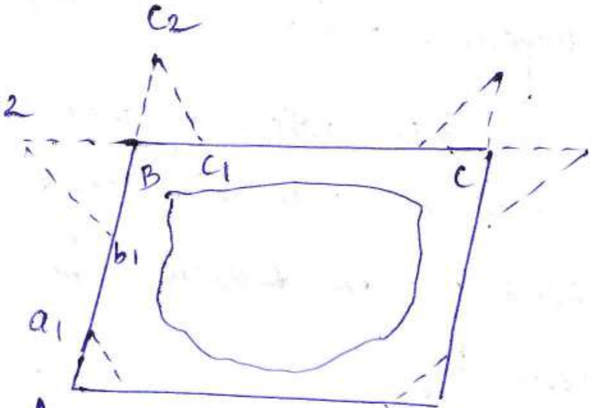


fig (b)

internal Measurements Aa_1, Ad_1, and a_1d_1,

However, the direction may also be

VI) (b)

Line	station	Northing	East
	A	200	200
AB			
	B	83.9	155.6
BC			
	C	90.7	213.8
CD			
	D	171.2	231
DA			
	A	200	200

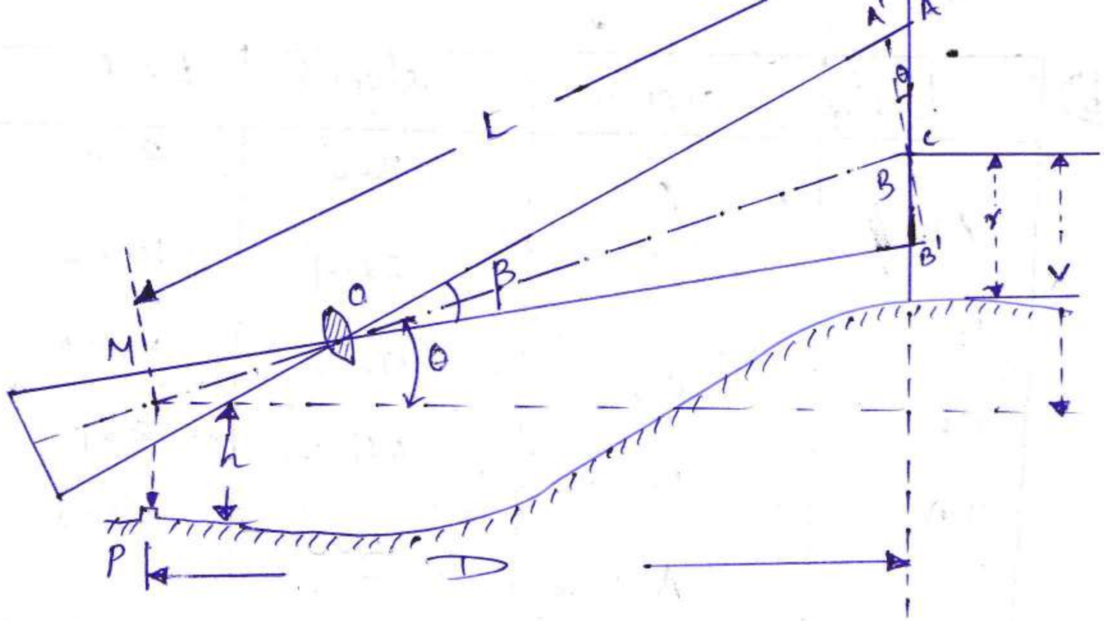
$$A = \frac{1}{2}\Big\{\big((200 \times 155.6) + (83.9 \times 213.8) + (90.7 \times 231) + (171.2 \times 200) - ((83.9 \times 200) + 90.7 \times 155.6 + (171.2 \times 213.8) + (200 \times 231)\big)\Big\}$$

$$= \frac{1}{2}\Big\{(31120 + 17937.82 + 20951.7 + 34240) - (16780 + 14112.92 + 36602.56 + 46200)\Big\}$$

$$= \frac{1}{2}\left[104249.52 - 113695.48\right]$$

$$= \frac{1}{2}\left[-9445.96\right]$$

$$= 4722.98\ m^2$$



ELEVATED SIGHT : VERTICAL HOLDING

Let, P = Instrument station , Q = staff station

M = position of Instrument Axis , O = optical centre of the objective.

A, C, B = point corresponding to the readings of the 3 hairs

S = AB = staff Intercept ; i = stadia interval

θ = Inclination of the line of sight from the horizontal

L = Length MC measured along the line of sight

D = MQ' = Horizontal distance between the instrument and the staff

V = vertical intercept , at Q, between the line of sight and the horizontal line.

h = Height of the instrument

r = Central hair reading

β = angle between the two extreme rays corresponding to stadia hairs

OC.

$\angle AA'C = 90° + \frac{\beta}{2}$, being the exterior angle of the $\Delta COA'$

Similarly, from $\Delta COB'$, $\angle OB'C = \angle BB'C = 90° - \beta/2$

Since $\frac{\beta}{2}$ is very small (its value being equal to 17' 11" for K=100), $\angle AA'C$ and $\angle BB'C$ may be approximately taken equal to 90°

$\therefore \angle AA'C \doteq \angle BB'C = 90°$

From $\Delta ACA'$, $A'C = AC\cos\theta$ or $A'B' = AB\cos\theta = S\cos\theta$

Since the line $A'B'$ is perpendicular to the line of sight OC, equation is directly applicable. Hence we have,

$$MC = L = K \cdot A'B' + C = KS\cos\theta + C$$

— The horizontal distance

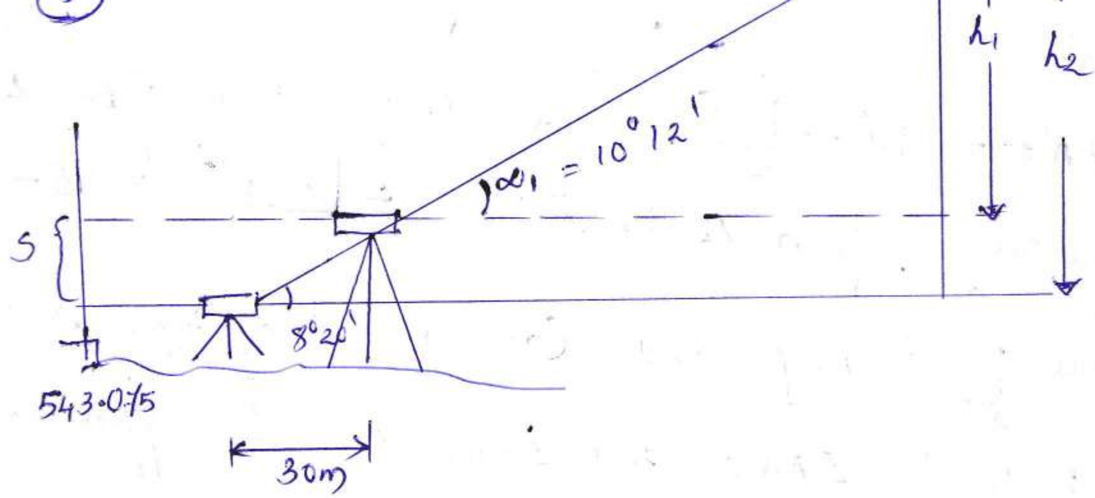
$$D = L\cos\theta = (KS\cos\theta + C)\cos\theta$$

$$\boxed{D = KS\cos^2\theta + C\cos\theta} \quad —①$$

$$V = L\sin\theta = (KS\cos\theta + C)\sin\theta = [KS\cos\theta . \sin\theta + C\sin\theta]$$

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

— Thus, equation ① & ② are the distance and elevation formulae for Inclined line of sight.



Given :-

$$D = \frac{(b - s\cot\alpha_2)\tan\alpha_2}{\tan\alpha_1 - \tan\alpha_2}$$

$$= \frac{30 - \left((1.578 - 1.269)\cot 8°20'\right)\tan 8°20'}{\tan 10°12' - \tan 8°20'}$$

$$= \frac{\left[30 - (0.309 \times 6.8269)\right] 0.146}{0.0334}$$

$$= \underline{\underline{121.91m}}$$

$$h_1 = \frac{(b - s\cot\alpha_2)\sin\alpha_1 \sin\alpha_2}{\sin(\alpha_1 - \alpha_2)}$$

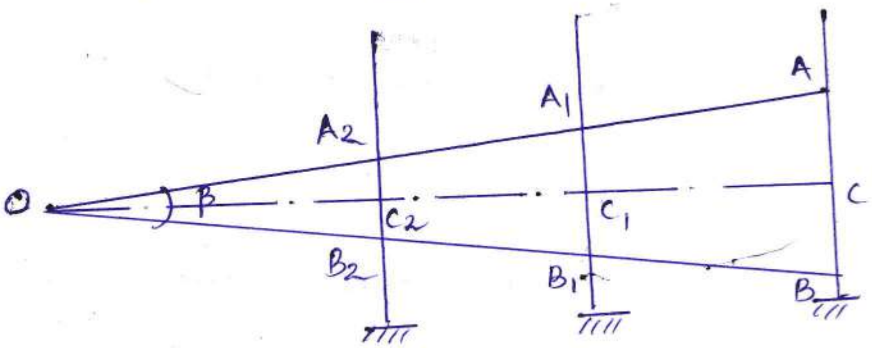
$$= \frac{(30 - 0.309 \times 6.8269)\sin 10°12' \sin 8°20'}{\sin(10°12' - 8°20')}$$

$$= \underline{\underline{21.975m}}$$

$= 543.075 + 1.578 + 21.975$

$= 566.628\,m$

VIII (a) The stadia Method is based on the principle that the ratio of the perpendicular to the base is constant in similar isosceles triangles

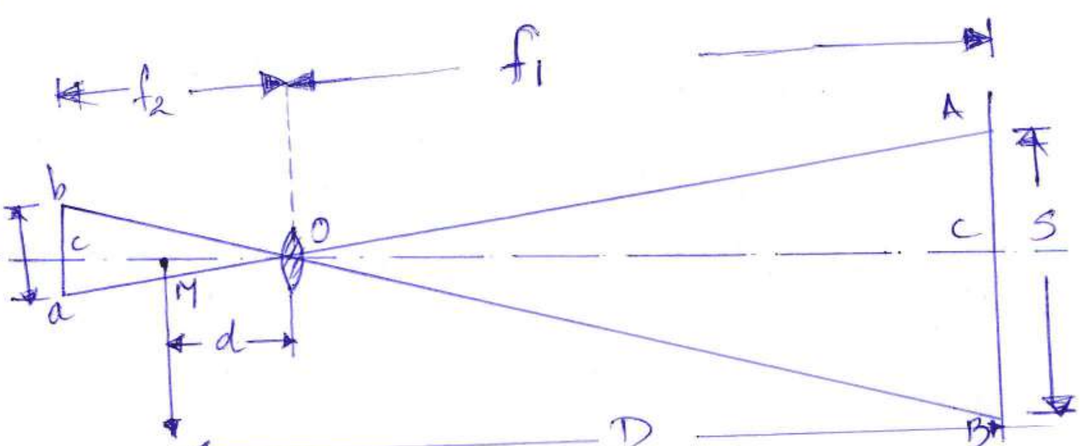


(a)

In figure (a) let two rays OA and OB be equally inclined to the central ray OC let A_2B_1, A_1B_1 and AB be the staff intercepts. Evidently

$$\frac{OC_2}{A_2B_2} = \frac{OC_1}{A_1B_1} = \frac{OC}{AB} = \text{Constant } K = \frac{1}{2}\cot\frac{\beta}{2}$$

→ Deriving the distance - elevation formulae for the horizontal sights



(b) Principle of stadia Method

the optical centre of the objective of an external f
telescope

Let A, C and B = The points cut by the three line of sight corresponding to the three wires.

b, c, and a = top, axial and bottom hairs of the diaphragm

ab = i = interval between the stadia hairs (stadia interval)

AB = S = staff intercept.

f = focal length of the objective

f_1 = Horizontal distance of the staff from the optical centre of the objective

f_2 = Horizontal distance of the cross wires from 'O'

d = Distance of the vertical axis of the instrument from O

D = Horizontal Distance of the staff from the vertical axis of the instrument

M = Centre of the instrument, Corresponding to the vertical axis

Since the rays BOb And AOa pass through the optical centre they are straight so that Δs AOB and aob are similar. Hence.

$f_2 \qquad i$

Again since f_1 and f_2 are conjugate focal distances, we have from lense formula.

$$\frac{1}{f} = \frac{1}{f_2} + \frac{1}{f_1}$$

Multiplying throughout by ff_1. We get $f_1 = \frac{f_1}{f_2} f + f$

Substituting the values of $\frac{f_1}{f_2} = \frac{s}{i}$ in above we get

$$\boxed{f_1 = \frac{s}{i} f + f}$$

The horizontal distance between the axis and the staff is $D = f_1 + d$

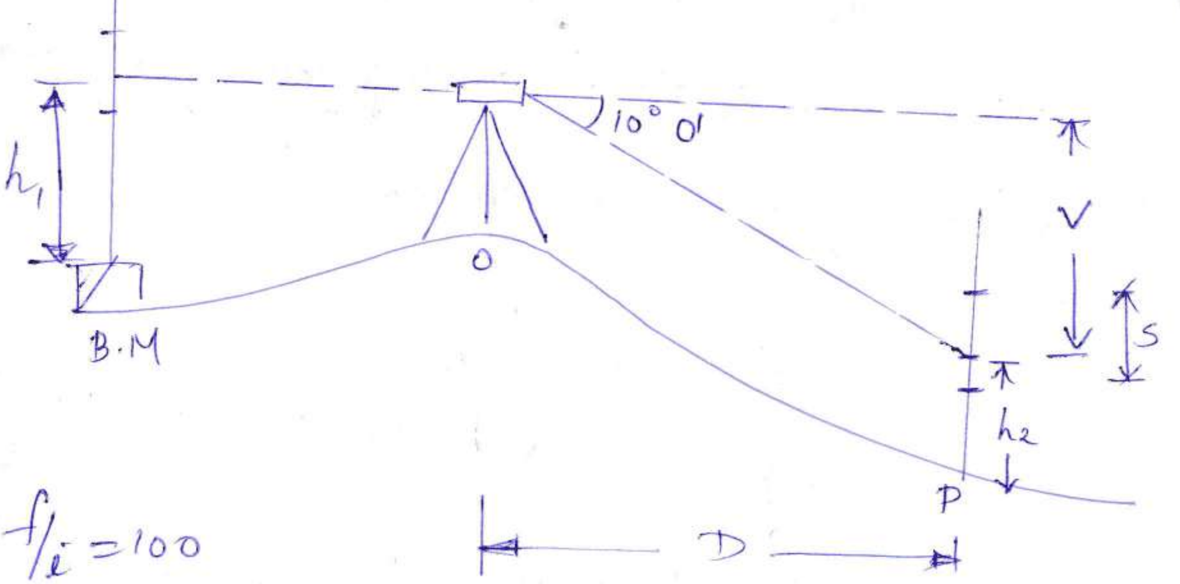
$$D = \frac{f}{i} s + (f + d) = k.s + c$$

$$\boxed{D = k.s + C} \qquad \text{——— (A)}$$

Equation (A) is known as the distance equation. In order to get the horizontal distance, Therefore, the staff intercept 's' is to be found by subtracting the staff readings corresponding to the top and bottom stadia hairs.

The Constant $k = f/i$ is known as multiplying Constant or stadia Interval factor

The Constant $(f+d) = C$ is known as additive Constant of the instrument.



$f/i = 100$

$f+d = 0.30$

$$D = \frac{f}{i} s \cos^2\alpha + (f+d) \cos\alpha$$

$$= 100(1.95 - 1.650)\cos^2 10°0' + 0.3 \cos 10°0'$$

$$= (100 \times 0.3 \times 0.9698) + 0.295$$

$$= \underline{\underline{29.389\ m}}$$

$$V = f/i\ s \cos\alpha \sin\alpha + (f+d)\sin\alpha$$

$$= 100 \times 0.3 \times \cos 10° \sin 10° + (0.3 \sin 10°)$$

$$= 5.13 + 0.052$$

$$= \underline{\underline{5.182\ m}}$$

R.L of P = R.L of B.M $+ h_1 - V - h_2$

$$= 145.867 + 2.150 - 5.182 - 1.800$$

$$= 141.035m$$

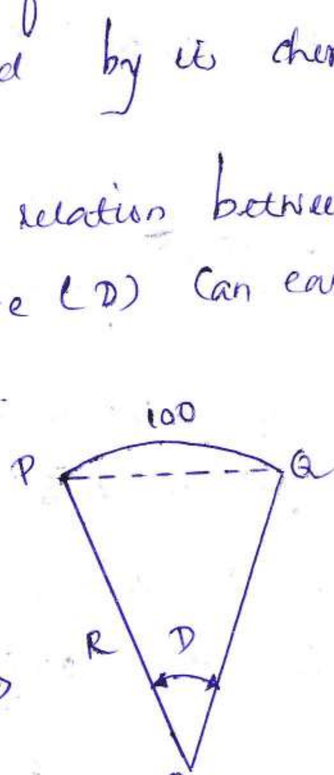
UNIT IV

IX (a) DESIGNATION OF CURVES

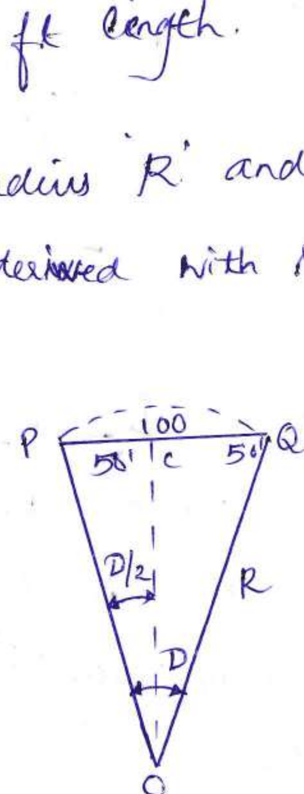
- The Degree of curvature has several slightly different definitions. According to the arc definition generally used in highway practice, the degree of the curvature is defined as the central angle of the curve that is subtended by an arc of 100 ft. length. According to the chord definition generally used in railway practice, the degree of the curve is defined as the central angle of the curve that is subtended by its chord of 100 ft length.

— The relation between the Radius 'R' and degree of the curve (D) can easily be derived with reference to figure.

Degree of curve (feet units)



(a) Arc definition



(b) Chord definition

$$100 : 2\pi R = D^\circ : 360^\circ$$

$$R = \frac{360^\circ}{D} \times \frac{100}{2\pi} = \frac{5729.578}{D} \text{ ft.} \quad \text{——— (1)}$$

Thus, radius of 1° curve is 5729.578 ft.

To the first approximation, we have

$$R = \frac{5730}{D} \quad \text{——— (2)}$$

Chord Definition

From ΔPOC

$$\sin \tfrac{1}{2} D = \frac{50}{R} \quad \text{——— (3)}$$

$$R = \frac{50}{\sin \frac{1}{2} D} \text{ (exact)} \quad \text{——— (4)}$$

When D is small, $\sin \frac{1}{2}D$ may be taken approximately equal to $\frac{1}{2}D$ radians.

$$R = \frac{50}{\frac{D}{2} \times \frac{\pi}{180}}, \text{ where } D \text{ is in degrees.}$$

$$= \frac{50 \times 360}{D \times \pi} = \frac{5729.578}{D} = \frac{5730}{D} \quad \text{——— (5)}$$

It will be seen that for smaller values of D, both equations (2) and (5) are the same. Both the Expressions, are not applicable to the curves of comparatively small radius. For more accurate work exact expressions should be ~~used~~ used.

1 - Vertical circle lock
2 - vertical tangent screw
3 - Horizontal circle lock
4 - Horizontal tangent screw
5 - Tribrach levelling screws
6 - optical plummet lens focus
7 - eyepiece focus
8 - Tripod
9 - Keyboard
10 - Tribrach lock

(b) Basic functions of E.D.M Instruments

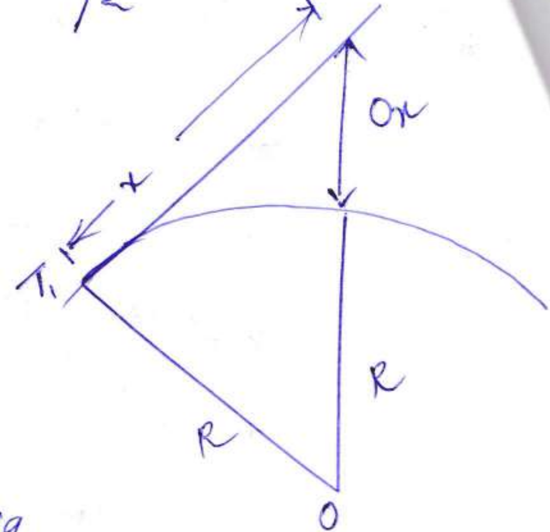
1 - Measuring lengths of survey line
2 - Establishing triangulation ground control stations
3 - Measuring base lines in triangulation work
4 - obtaining N and E coordinates
5 - Measuring vertical or sloping distance between stations.
6 - High precision and accurate measurements (1 in 100000)

(c) Components of GPS Reciever

1 - Battery charger, extra batteries
2 - Data storage device,
3 - External Antennas
4 - Tripod Mounting devices
5 - Interface - Consists of hardware & software

$$= 450 \times \tan \frac{127^\circ 30'}{2}$$

$$= 912.51\,m$$



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

$$O_{30} = \sqrt{450^2 + 30^2} - 450 = 0.99$$

$$O_{60} = \sqrt{450^2 + 60^2} - 450 = 3.98$$

$$O_{90} = \sqrt{450^2 + 90^2} - 450 = 8.91$$

$$O_{120} = \sqrt{450^2 + 120^2} - 450 = 15.7$$

$$O_{150} = \sqrt{450^2 + 150^2} - 450 = 24.3$$

$$O_{180} = \sqrt{450^2 + 180^2} - 450 = 34.6$$

$$O_{210} = \sqrt{450^2 + 210^2} - 450 = 46.5$$

$$O_{240} = \sqrt{450^2 + 240^2} - 450 = 60$$

$$O_{270} = \sqrt{450^2 + 270^2} - 450 = 74.7$$

$$O_{300} = \sqrt{450^2 + 300^2} - 450 = 90.8$$

$$O_{330} = \sqrt{450^2 + 330^2} - 450 = 108.0$$

$$O_{360} = \sqrt{450^2 + 360^2} - 450 = 126.2$$

$$O_{390} = \sqrt{450^2 + 390^2} - 450 = 145.5$$

$$O_{420} = \sqrt{450^2 + 420^2} - 450 = 165.5$$

$$O_{480} = \sqrt{450^2 + 480^2} - 450 = 207.9$$

$$O_{510} = \sqrt{450^2 + 510^2} - 450 = 230.14$$

$$O_{540} = \sqrt{450^2 + 540^2} - 450 = 252.92$$

$$O_{570} = \sqrt{450^2 + 570^2} - 450 = 276.22$$

$$O_{600} = \sqrt{450^2 + 600^2} - 450 = 300$$

$$O_{630} = \sqrt{450^2 + 630^2} - 450 = 324.2$$

$$O_{660} = \sqrt{450^2 + 660^2} - 450 = 348.8$$

$$O_{690} = \sqrt{450^2 + 690^2} - 450 = 373.77$$

$$O_{720} = \sqrt{450^2 + 720^2} - 450 = 399.05$$

$$O_{750} = \sqrt{450^2 + 750^2} - 450 = 424.64$$

$$O_{780} = \sqrt{450^2 + 780^2} - 450 = 450.49$$

$$O_{810} = \sqrt{450^2 + 810^2} - 450 = 476.6$$

$$O_{840} = \sqrt{450^2 + 840^2} - 450 = 502.9$$

$$O_{870} = \sqrt{450^2 + 870^2} - 450 = 529.48$$

$$O_{900} = \sqrt{450^2 + 900^2} - 450 = 556.23$$