



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

(Autonomous)

(ISO/IEC-270001 – 2005 certified)

SUMMER-14 EXAMINATION

Subject code: 17310

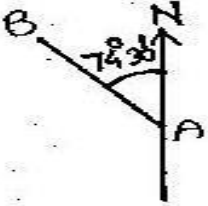
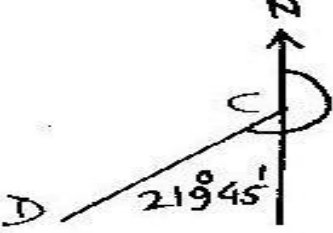
Model Answer

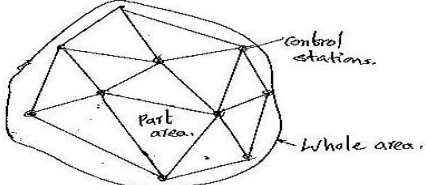
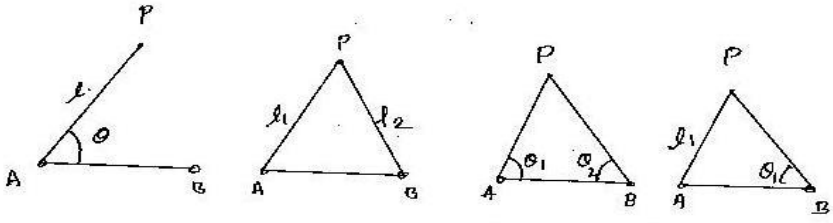
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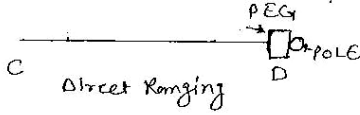
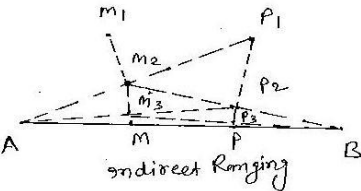
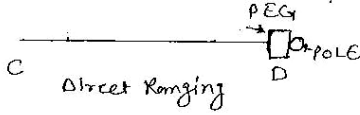
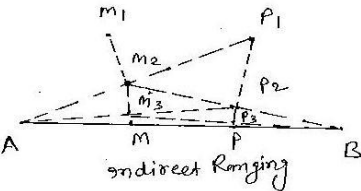
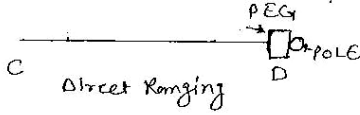
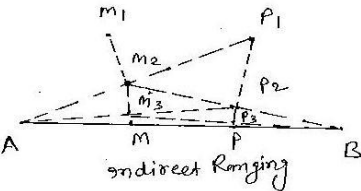
Important Instructions to examiners:

- 1) The answer should be examined by keywords and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language error such as grammatical, spelling errors should not be given more importance.(Not applicable for subject English and communication skill).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figure drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In the some cases, the assumed constants values may vary and there may be some difference in the candidates answer and model answer.
- 6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidates understanding.

Q1) a).Attempt any SIX of the following	12
i) State the Primary classification of survey	
Ans.: Surveys are classified as plane survey and geodetic survey	
Plane Survey: It is the type of survey in which the mean surface of the earth is considered as a plane that is curvature of the earth surface is neglected.	1
Geodetic Survey : It's the type of survey in which the shape of the earth surface is taken into account that is curvature of the earth surface is consider	1
ii) State different objective of survey.	
Ans.: Objective of Surveys are as follows	
1) Preparation of map or Plan.	1

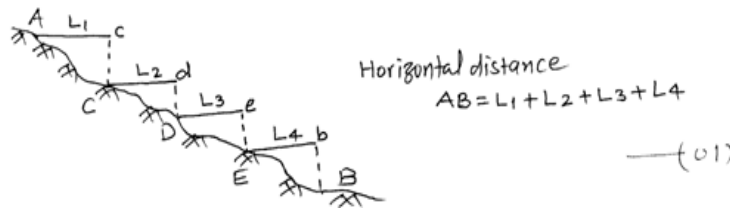
2) Object of survey is to determine the precise position on the surface of the earth.	1
iii) Define ranging and list the instrument required for ranging.	
<p>Ranging: - “The operation of establishing intermediate points on a straight line between the terminal Stations (end points) is known as ranging.”</p> <p>Instrument required for ranging</p> <p>1) Ranging Rods.</p> <p>2) Line ranger or thedolite</p>	1
<p>iv) Write the bearing of line AB and line CD.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>1)</p>  </div> <div style="text-align: center;"> <p>2)</p>  </div> </div>	
<p>Ans.: 1) Bearing of line AB ---- 285°30’</p> <p>2) Bearing of line CD ---- 219°45’</p>	1
v) Write any four personnel errors in compass survey.	
<p>Ans.: 1) Inaccurate leveling of the compass box.</p> <p>2) Inaccurate centering of the compass over the stations.</p> <p>3) Inaccurate bisection of the object.</p> <p>4) Taking wrong reading and recording wrongly.</p> <p>5) Reading the Bearing in wrong direction.</p>	(1/2 mark each any four)
vi) List the accessories required for plane table survey.	
<p>Ans.: Following are the accessories required for plane table survey.</p> <p>1) Plumbing / U- Fork with plumb bob</p> <p>2) Plane Alidade or telescopic Alidade</p> <p>3) Set of Level tube.</p> <p>4) Trough compass</p>	(1/2 mark each)
vii) Define datum line and Bench Mark.	
<p>Ans.: <u>Datum line:</u> “It can be defined as the line parallel to the mean spheriodal earth Surface from which the vertical distances are measured”.</p>	1
<p><u>Bench Mark:</u> “It can be defined as the point of known elevation”</p>	1

viii) Describe in brief negative staff reading.	
<p>Ans.: In leveling work some points are situated below the line of sight and some points are situated above the line of sight. The reduced levels of points below the line of sight can be determined by taking the reading on the staff normal, where as when the points are situated above the line of sight the staff is required to be held inverted for taking the readings. The Reading taken in this position known as negative staff reading.</p>	2
b) Attempt any two of the following	8
i) Explain the principals of surveying.	
<p>Ans.: Following are the principles of surveying</p> <ol style="list-style-type: none"> 1) To work from the whole to the part. 2) To fix the position of new station by at least two independent processes (i.e the processes may be both linear, both angular, one linear & one angular. <p>According to the first principal the whole area is first enclosed by main station and main survey line. The area is the divided in to the no. of well condoned (Equilateral triangles).The propose of this is to prevent accumulation of errors. But if the process is reverse from part to the whole then minor errors in the measurement will be magnified and becomes uncontrolled</p> <div style="text-align: center;">  <p>Fig.: First Principle of surveying.</p> </div>	<p>01</p> <p>01</p> <p>01</p>
<p>According to the Second principal the new station should be fixed by at least two measurements from fixed reference point. This two measurements may be both liner and both angular or one linear and one angular.</p> <div style="text-align: center;">  <p>second principle of surveying</p> </div>	01

ii) State the uses of surveying.												
1) It is used for measurement of areas.		1										
2) It is used for engineering commercial scientific military and navigation proposes.		1										
3) It is used for making plans for legal documents.		1										
4) Accurate map of wide areas can be obtained by using surveys.		1										
iii) Explain linear measurement by pacing and by speedometer.												
<p>Ans.: Linear measurement by Pacing: This method is used only for knowing approximate distanced between the objects. In preliminary survey this method can be used for linear measurement. This method consists of counting the number of paces between the two points of a line. The length of the line can then be computed by knowing the average length of the pace. The length of the pace varies with individuals, and also with the nature of the ground and the speed of pacing.</p> <p>Linear measurement by speedometer: If the nature of the ground is the smooth than speedometer of an automobile can be used to measure the distance approximately. It works on the principals that the no of revolutions registered by the wheel and multiplied by the circumference of the wheel to get the distance.</p>		2										
Q.2 Attempt any four of the following.		16										
a) Differentiate between direct ranging and indirect ranging												
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Direct ranging</th> <th style="text-align: center;">Indirect ranging</th> </tr> </thead> <tbody> <tr> <td>It is done when terminal stations are visible</td> <td>It is done when terminal stations are not indivisible</td> </tr> <tr> <td>It is suitable when the distance is less</td> <td>It is adopted when distance is more and if obstacle like hill is intervening between the stations</td> </tr> <tr> <td>Intermediate points are located on the survey line by line ranger</td> <td>Intermediate two points are located approximately in between terminal stations.</td> </tr> <tr> <td> <p>Fig.</p>  </td> <td>  </td> </tr> </tbody> </table>		Direct ranging	Indirect ranging	It is done when terminal stations are visible	It is done when terminal stations are not indivisible	It is suitable when the distance is less	It is adopted when distance is more and if obstacle like hill is intervening between the stations	Intermediate points are located on the survey line by line ranger	Intermediate two points are located approximately in between terminal stations.	<p>Fig.</p> 		1
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Intermediate points are located on the survey line by line ranger	Intermediate two points are located approximately in between terminal stations.											
<p>Fig.</p> 												
		1										
		1										
		1										

- b) Explain the process of chaining on sloping ground by stepping method with neat sketch.

Direct Method By Stepping :-



By stepping: It consist in measuring the distance in small horizontal lengths (e.g. L_1) Let the horizontal distance between A and B be measured by a chain or tape. A portion of chain say 2m, 4m, 5m, and 10 m is stretched horizontally with one end resting on the ground and other held in line at a convenient height say 1 to 1.5 m. The point vertically below this end is then accurately marked with the help of plumb bob. The next step will then start from this point and method is continued in the correct line with point B.

- c) A 30 m Chain was found to be 5 cm too short after chaining 1200 m. it was found to be 10 cm too short after chaining 2100 m. If the chain was correct before commencement of work find the true distance.

Part I: Chain was correct before commencement of work.

Length of chain L : 30 m , Error in chain 5 cm = 0.05 m too short.

Measured distanced D' = 1200 m

$$L^1 = \text{Incorrect length of chain} = 30.00 - \left(\frac{0.05 + 0.00}{2} \right) = 29.975 \text{ m.}$$

$$D1 = (\text{True distance}) = \text{Correct distance} = \left(\frac{L^1}{L} \right) D'$$

$$= \left(\frac{29.975}{30.00} \right) 1200 = 1199 \text{ m.}$$

Part II:

Length of chain L : 30 m

Measured distanced D' = (2100-1200) = 900

$$\text{Error in chain} = \left(\frac{0.05 + 0.10}{2} \right) = 0.075$$

$$L^1 = \text{Incorrect length of chain} = 30.00 - \left(\frac{0.05 + 0.10}{2} \right) = 29.925 \text{ m.}$$

$$D2 = (\text{True distance}) = \text{Correct distance} = \left(\frac{L^1}{L} \right) D'$$

$$= \left(\frac{29.925}{30.00} \right) 900 = 897.75 \text{ m.}$$

Total True distance = 1199.00 + 897.75

Ans. = 2096.75 m

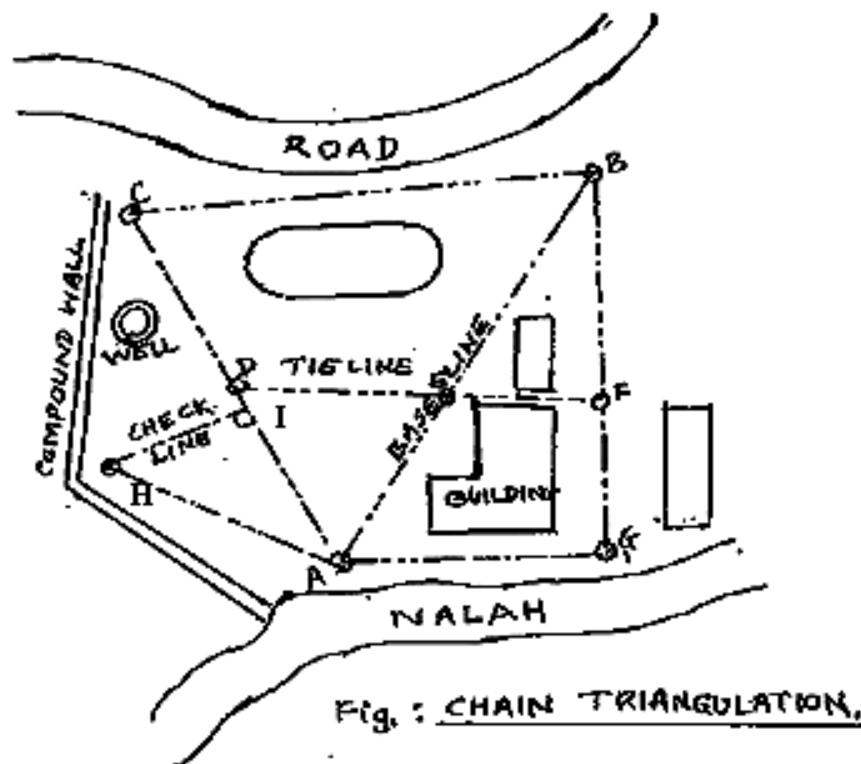
d) States the points to be consider while selecting survey station.

Ans.: Following points to be considered while selecting survey stations.

- 1) Main survey station should be mutually visible.
- 2) All triangles should be well conditioned.
- 3) The survey line should lie over the leveled ground.
- 4) The no of survey line should be as few as practicable.
- 5) Each triangle should be provided at least one check line.
- 6) The principle of survey i.e. To work from whole to the part should be strictly observed.
- 7) Base line should run through the center of the area so as to form the frame work of triangles on it to cover maximum area.

1
mark
each
Any
four

e) Draw the sketch of chain triangulation and label the different lines.



03

AB :- Base line, DE :- Tie Line, HI -Check Line

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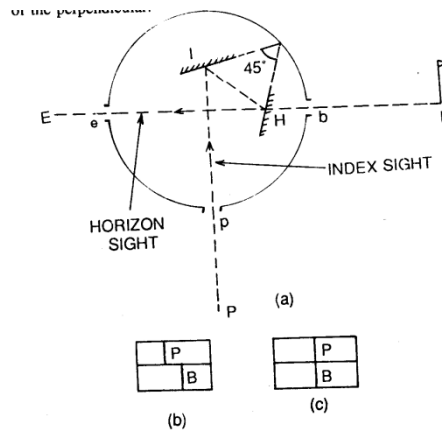
f) Explain the principal of optical square with neat sketch.

Principal of optical square :- the angle between the first incident ray and the last reflected ray is twice the angle between the two mirrors

OR

If there are two plane mirrors whose reflecting surfaces make a given angle with each other and if a ray of light in plane perpendicular to the plains of both mirrors is reflected successively from both, it undergoes a deviation of twice the angle between the reflecting surfaces.

In the case of optical square the angle between the mirrors is 45° while that between the first incident ray and last reflected ray is 90° .



02

02

Q.3 Attempt any four of the following

16

a) Write the obstacles in chaining and explain how you overcome when building comes across the chain line.

Obstacles in chaining

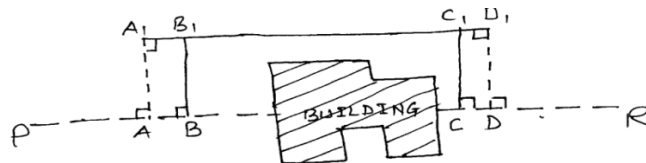
During chaining operations various operation such as River, Hill, Building, and Woods etc. are met with. All such obstacles are classified in to following categories.

- 1) Vision free chaining obstructed.
- 2) Chaining free vision obstruction.
- 3) Both Chaining and vision obstructed.

1) Both Chaining and vision obstructed: Typical example of this case is building obstructing the chain line. It's therefore required to prolong the line beyond the obstacle and then find out the distance across it. The right angle should be set out accurately.

02

02



b) Distinguish between true meridian and magnetic meridian and explain dip of needle.

True meridian	Magnetic meridian
The line joining the true north and the south pole is called the true meridian.	The direction indicated by freely suspended and properly balanced Magnetic needle unaffected by local attractive force is called magnetic meridian.
In geodetic survey true meridian is considered	In Plane survey magnetic meridian is considered.
True meridian remains constants at all places	Magnetic meridian varies from place to place
Local attraction doesn't affects the true meridian	Magnetic meridian is affected by local attraction

1
mark
each
(any
two)

Dip of needle. If the needle is perfectly balanced before magnetization it will not remain so after its magnetized on account of the magnetic influence of the earth. But it will be inclined downwards towards the pole. This inclination of the needle with the horizontal is known as deep of the needle.
The amount of deep of needle is not constants but it varies from place to place in northern hemisphere north end of the needle is deflected downwards and southern hemisphere south end of the needle is deflected downwards.

02

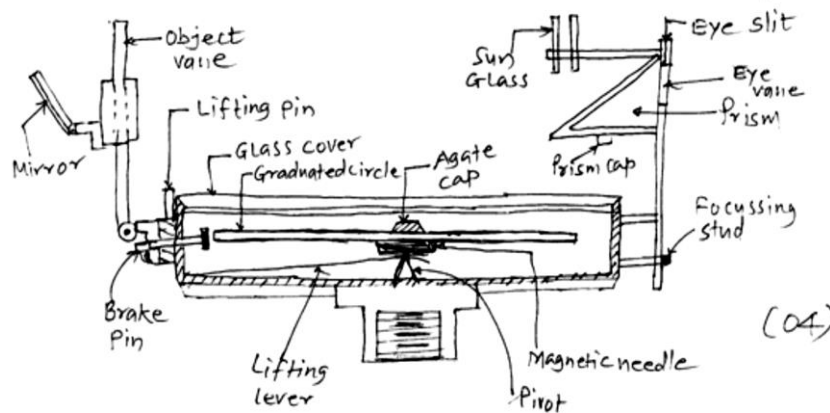
c) Why zero is marked at south end on a prismatic compass.

When the needle is freely suspended on the pivot it must shows north, the reading under prism should be zero.
But since the prism placed exactly opposite the sight vane, the south end will be under the prism.
Obviously the zero of marked must be placed at the end of the needle.
The bearing is thus obtained from south end in clock wise direction.

02

02

d) Draw a labeled sketch of prismatic compass and give example of reading taken on prismatic compass.



c/s of Prismatic Compass.

*(Fig. 2 mark labeling 1mark)

*

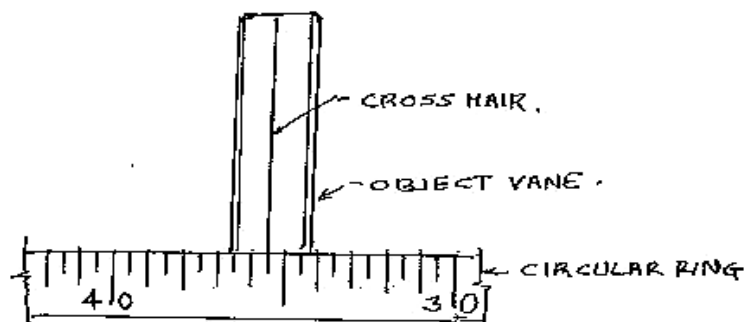


Fig. 1: PRISMATIC COMPASS READING

READING = $35^{\circ}30'$.

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e) Define Bearing of a line and convert following fore Bearing in to back bearing

1) $127^{\circ}30'$ 2) $S\ 38^{\circ}30'\ W$ 3) $54^{\circ}45'$

Bearing of line: the horizontal angle made by survey line with respect to north is known as bearing of a line.

Back bearings : 1) $307^{\circ}30'$ 2) $N\ 38^{\circ}30'\ E$ 3) $234^{\circ}45'$

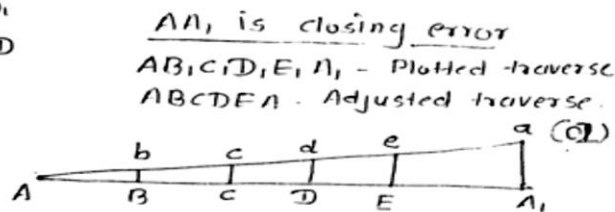
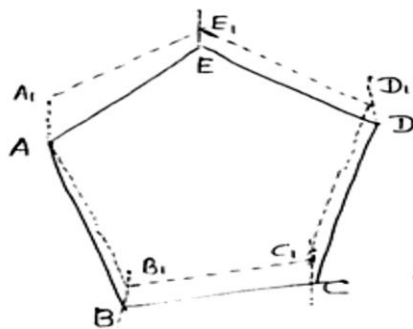
*(One mark for each back bearing)

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*

f) Define closing errors and explain graphical method of adjusting closing errors.

Closing error: The distance by which the traverse fails to close is called closing error



Explanation related to above figure

(CI)

01

Step 1) Draw a horizontal line AA1 Equal to the length of perimeter of the traverse to a suitable scale

- 1) Mark the distances AB, BC, CD, ... Etc on the line as per their lengths
- 2) Draw a perpendicular or (parallel to the direction of closing errors) to the line AA1 Equal to the closing errors.
- 3) Join 'Aa' as shown in figure.
- 4) Draw perpendiculars B, C, D, E, To join the line 'Aa' at b, c, d, e
- 5) Transfer the ordinates to the respective stations on the traverse parallel to the closing errors
- 6) Join the the new points which gives the closed traversed. A, B, C, D and A.

02

Q.4 Attempt any FOUR of the following :

16

a) Calculate interior angle in a closed traversed PQRST By following observational

Line	PQ	QR	RS	ST	TP
F. B.	S 37 ⁰ 30' E	S 43 ⁰ 15' W	N 74 ⁰ 0' W	N 11 ⁰ 00' E	N 57 ⁰ 45' E

Bearing

Line	Fore Bearing (R.B.)	Fore Bearing (W.C.B.)	Back Bearing (W.C.B.)
PQ	S 37 ⁰ 30' E	142 ⁰ 30'	322 ⁰ 30'
QR	S 43 ⁰ 15' W	223 ⁰ 15'	43 ⁰ 15'
RS	N 74 ⁰ 0' W	286 ⁰ 00'	106 ⁰ 00'
ST	N 11 ⁰ 00' E	11 ⁰ 00'	191 ⁰ 00'
TP	N 57 ⁰ 45' E	57 ⁰ 45'	237 ⁰ 45'

*

Calculations :

Included angle = Fore bearing of next line – B.B of previous line

= Difference (if less than 180⁰ then = interior angle(if greater than 180⁰ than = Exterior angle)And interior angle = 360⁰ – Exterior angleIncluded angle P = 237⁰45' - 142⁰30' = **95⁰15'**Included angle Q = 322⁰30' - 223⁰15' = **99⁰15'**Included angle R = (286⁰00' - 43⁰15') = 242⁰45' >180⁰ (i.e. exterior angle)Interior angle = (360⁰00' - Exterior angle)= (360⁰00' - 242⁰45')= **117⁰15'**Included angle S = 106⁰00' - 11⁰00' = **95⁰00'**Included angle T = 191⁰00' - 57⁰45' = **133⁰15'****Total (< P + < Q + < R + < S + < T)= 540⁰00'*****(one mark each any four correct included angle)**

Procedure: Let plot the traverse ABCD

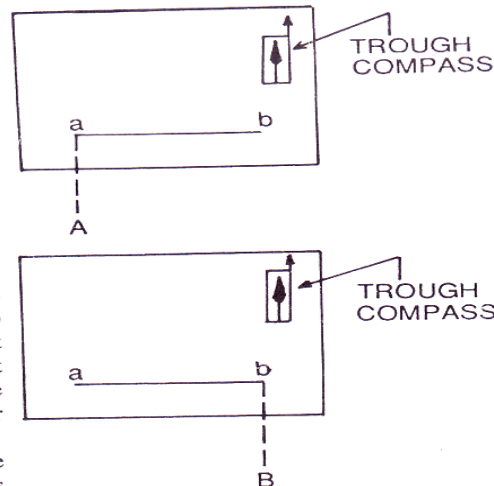
- 1) Set up the plane table at station A.
- 2) Select the suitable point a on the sheet.
- 3) Carry out all temporary adjustment i.e. Centering, Levelling, and Mark north direction.
- 4) With Alidade Touching at point a Bisect Station B, Draw the ray, Measure distance AB and plot point b on the ray AB with suitable scale
- 5) Shift the table to the station B, Carry out all temporary adjustment and orientation by back sighting clamp the table.
- 6) Similarly repeat the above steps at successive station at C, D,.
- 7) At the end traverse A, B, C, D is obtained.
- 8) Checks lines may run to check the traverse.
- 9) If any error is then may be adjusted.
- 10) It is as shown in fig.

03

E) Explain with neat sketch method of orientation by back sighting of plane table survey

Orientation: The method of setting up the plane table at each of the successive stations parallel to the position it occupied at the starting station is known as orientation.

Orientation by back sighting: Procedure- Ref Fig. bellow



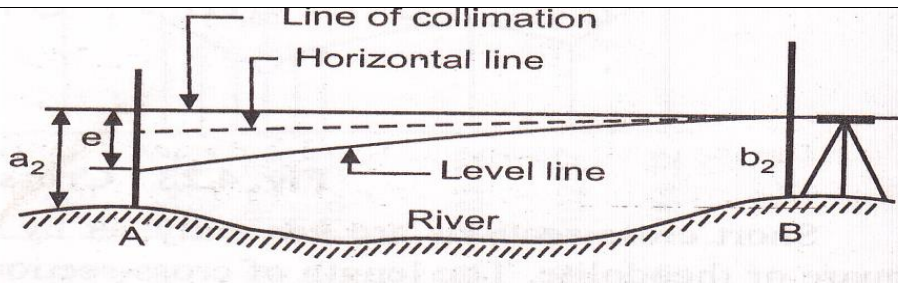
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i) Suppose A and B are two stations. The plane table is set up over A. the table is leveled by spirit level and centered by U-fork so that point 'a' is just over station A. The north line is marked on the right hand top corner of the sheet by trough compass.

ii) With the alidade touching 'a', the ranging rod at B is bisected and a ray is drawn. The distance AB is measured and plotted to any suitable scale. So the point 'b' represents station B.

iii) The table is shifted and set up over B. It is leveled and centered so that 'b' just over B. Now the alidade is placed along the line 'ba', and the ranging rod at A is bisected by turning the table clockwise or anticlockwise. When the centering, leveling and bisection of the ranging rod at A are perfect, then the orientation is said to be perfect.

02



3) Let d = true difference of level between A and B
 Let e = Total error (error due to curvature and refraction , imperfect adjustment)
 In Case I, The correct reading on B = $b_1 - e$
 In case II , the correct reading on A = $a_2 - e$
 From A, the true difference of level between A and B, $d = (b_1 - e) - a_1$
 Or $d = (b_1 - a_1) - e$ equation 1
 From B, the true difference of level between A and B , $d = b_2 - (a_2 - e)$
 $= (b_2 - a_2) + e$ equation 2
 To eliminate total error e adding equation 1 and 2
 $2d = (b_1 - a_1) - e + (b_2 - a_2) + e$
 $d = ((b_1 - a_1) + (b_2 - a_2)) / 2$
 The error is eliminated and the true difference is equal to the mean of the two apparent differences of level between A and B
***(Procedure 02 mark and sketch 01 mark)**

c) Distinguish between the following

i) Back sight and Foresight

Back sight	Fore sight
It is a staff reading taken on a point of known elevation i.e. B.M. or C.P.	It is a staff reading taken on a point whose elevation is to be determined. i.e. C.P
It is the first reading taken after the level is set up and levelled.	It is the last staff reading denoting the shifting of the instrument or closing of leveling work.

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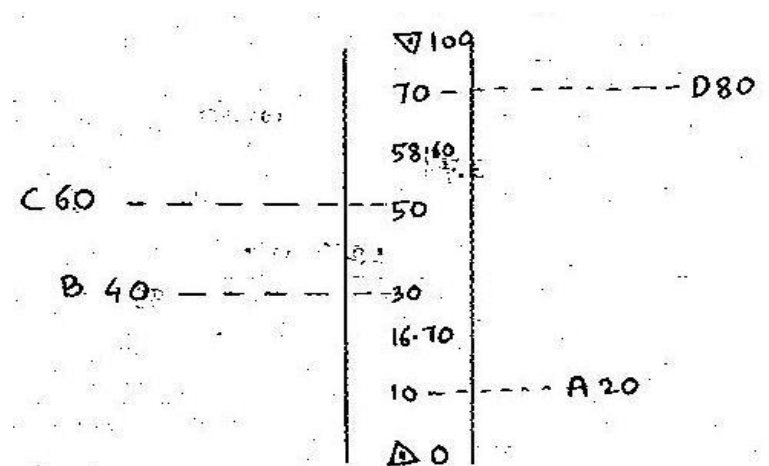
ii) Simple leveling and differential leveling

Simple leveling	Differential leveling
In this difference in elevation between two point is determined, when two points are visible, small distance apart, small difference in elevation between two points.	In this difference in elevation between two point is determined if the points are too far apart, elevation between two point is more or any obstacle in between.,

01

01

<p>f) Explain the precautionary measures in leveling</p> <p>Precautionary measures in leveling work are as follow</p> <ol style="list-style-type: none"> 1) Do not take sighting distance too large (less than 100m) depending upon range of instrument 2) Held the staff exactly vertical 3) Do the adjustment of instrument properly and carry out tests of instruments 4) See that bubble must be in center always 5) Leveling must be carried out in favorable conditions only. 6) Balance the B.S. and F.S. distances to avoid the errors. 7) Use good quality and correct leveling staff. 8) Check the leveling work at the end of every day. 9) Read the staff correctly 	<p>01 mark (any four)</p>
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<p>Q6) Attempt any TWO of the following:</p> <p>a) i) Find the area of the plot ABCD from the data collected in the chain and cross staff survey (Refer Figure No.1)</p> 	<p>16</p>
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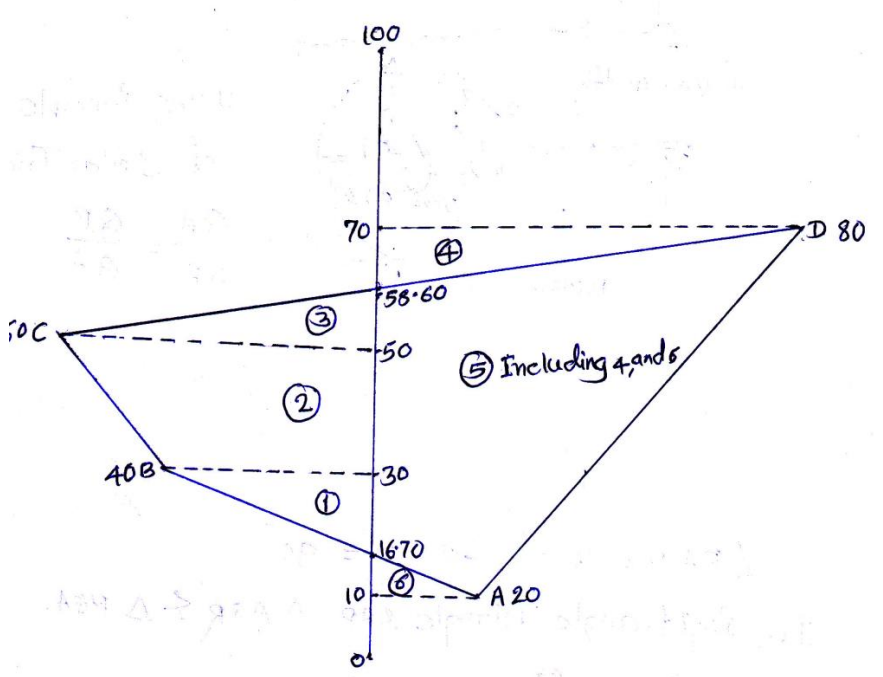
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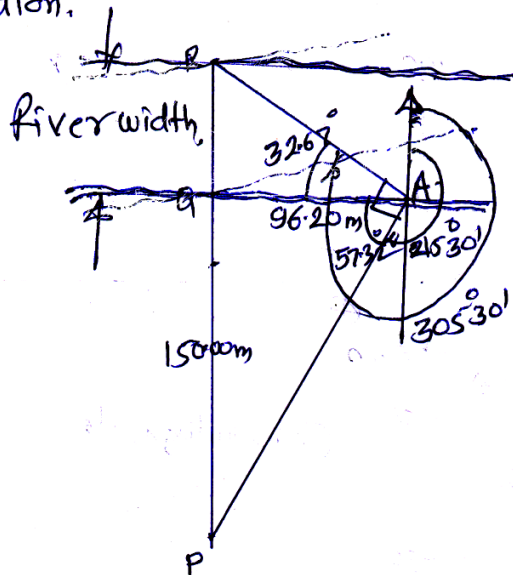
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2		30	50	20	40	60	50	1000		
3		50	58.60	8.60	60	0	30	258		
4		58.60	70	11.40	0	80	40		456	
5		10	70	60	20	80	50	3000	67	
6		10	1670	670	20	0	10		67	
Total								4524	523	

Ans:- Area of the plot ABCD = 4001 m²
 (Note also consider area calculation of each fig. separately)

*(1/2 mark for each area and 1/2 mark for total Area)

ii) Q and R are two points on the opposite banks of a river along a chain line PQR which crosses the river at right angles to the bank. From a point A which is 96.2m from Q along the bank, the bearing of R is 305° 30' and the bearing of P is 215° 30'. If the length of PQ is 150m. Find the width of river.

Solution.



Using Principle of similar Triangle

$$\frac{QA}{QR} = \frac{QP}{QA}$$

01

$\angle RAP = 305^{\circ}30' - 215^{\circ}30' = 90^{\circ}$
 In Right angle Triangle RAP, $\Delta AQR \cong \Delta PQA$.

$$\frac{AQ}{QR} = \frac{PQ}{QA}$$

Given $\Rightarrow PQ = 150.0m$, $AQ = 96.20m$.

$\therefore QR = \text{Width of River}$.

$$\therefore \frac{96.20}{QR} = \frac{150.0}{96.20}$$

$$\therefore \boxed{QR = 61.69m} \text{ Ans. = Width of River.}$$

OR: In ΔQAP , $\angle A = \tan^{-1}\left(\frac{150.00}{96.20}\right) = 57.32^{\circ}$

\therefore In ΔQAR $\angle A = 90^{\circ} - 57.32 = 32.67^{\circ}$

$$\therefore \text{In } \Delta QAR, \tan 32.67 = \frac{QR}{96.20}$$

$$\therefore \boxed{QR = 61.96m = \text{Width of River.}} \text{ Ans.}$$

02

01

Q.6. b) Following bearings were observed in running a closed traverse PQRST with prismatic compass Calculate the included angle and find out corrected F.B. and B.B. with usual check

Line	F.B.	B.B.
PQ	$80^{\circ}10'$	$259^{\circ}0'$
QR	$120^{\circ}20'$	$301^{\circ}50'$
RS	$170^{\circ}50'$	$350^{\circ}50'$
ST	$230^{\circ}10'$	$49^{\circ}30'$
TP	$310^{\circ}20'$	$130^{\circ}15'$

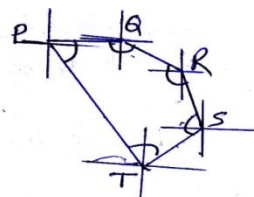
Tabular Result.

Line	Obs. F.B.	Obs. B.B.	Obs. Incl. Angle	Corr- ection	Correct- ed Angle	Correct F.B.	Correct B.B.
PQ	$80^{\circ}10'$	$259^{\circ}00'$	$\angle P = 50^{\circ}05'$	$05'$	$50^{\circ}10'$	$80^{\circ}40'$	$260^{\circ}40'$
QR	$120^{\circ}20'$	$301^{\circ}50'$	$\angle Q = 138^{\circ}40'$	$05'$	$138^{\circ}45'$	$121^{\circ}50'$	$301^{\circ}55'$
RS	$170^{\circ}50'$	$350^{\circ}50'$	$\angle R = 131^{\circ}00'$	$05'$	$131^{\circ}05'$	$170^{\circ}50'$	$350^{\circ}50'$
ST	$230^{\circ}10'$	$49^{\circ}30'$	$\angle S = 120^{\circ}40'$	$05'$	$120^{\circ}45'$	$230^{\circ}05'$	$50^{\circ}05'$
TP	$310^{\circ}20'$	$130^{\circ}15'$	$\angle T = 99^{\circ}10'$	$05'$	$99^{\circ}15'$	$310^{\circ}50'$	$130^{\circ}50'$
			SUM		$539^{\circ}35'$		$25 \quad 1540^{\circ}00'$

Calculations-

I] Included angles-

$$\begin{aligned} \angle P &= 130^{\circ} 15' - 80^{\circ} 10' = 50^{\circ} 05' \\ \angle Q &= 259^{\circ} 40' - 120^{\circ} 20' = 138^{\circ} 40' \\ \angle R &= 301^{\circ} 50' - 170^{\circ} 50' = 131^{\circ} 00' \\ \angle S &= 350^{\circ} 50' - 230^{\circ} 10' = 120^{\circ} 40' \\ \angle T &= 310^{\circ} 20' - 49^{\circ} 30' = 99^{\circ} 10' \\ \text{observed, SUM} &= 539^{\circ} 35' \end{aligned}$$



Sketch, closed traverse. PQRST.

Theoretical sum of all included = $(2n-4)90$
 $= (2 \times 5 - 4)90 = 540^{\circ} 00'$

observed sum = $539^{\circ} 35'$, therefore, correction is required.
 Assuming equal precautions at all station, equal correction at each station, $25'/5 = 05'$, corrected angle as above.

II] Corrected bearing.

Consider the line RS; F.B. and B.B. diff. = 180° ;

$$\begin{aligned} \text{B.B. of line RS} &= 350^{\circ} 50' \\ - \angle S &= 120^{\circ} 45' \\ \hline \text{F.B. of line ST} &= 230^{\circ} 05' \end{aligned}$$

F.B. of line ST.	$230^{\circ} 05'$
-	$180^{\circ} 00'$
B.B. of line ST	$50^{\circ} 05'$
- $\angle T$	$- 99^{\circ} 15' + 360^{\circ} 00'$
F.B. of line T.P.	$310^{\circ} 50'$
-	$180^{\circ} 00'$
BB of line T.P.	$130^{\circ} 50'$
- $\angle P$	$50^{\circ} 10'$
F.B. of line P.Q.	$80^{\circ} 40'$
-	$+ 180^{\circ} 00'$
B.B. of line P.Q.	$260^{\circ} 40'$
- $\angle Q$	$138^{\circ} 45'$
F.B. of line Q.R.	$121^{\circ} 55'$
-	$+ 180^{\circ} 00'$
BB of line Q.R.	$301^{\circ} 55'$
- $\angle R$	$131^{\circ} 05'$
F.B. of line R.S.	$170^{\circ} 50'$
-	$+ 180^{\circ} 00'$
B.B. of line R.S.	$350^{\circ} 50' = \text{obs. B.B. of line R.S.}$

O.K. check, is verified.

All calculated values are shown in table

17310

c) The following page of old level book having few staff reading missing find out the missing reading and rewrite the page. Apply usual checks.

Stn	Staff reading			H.I.	R.L.	Remark
	BS	IS	FS			
1	2.650				100.000	B.M.
2		X			98.910	
3		3.830			98.820	
4	4.640				98.380	CP1
5		0.380				
6	1.640			103.700	102.060	CP2
7		2.840			100.860	
8		3.480		104.900	100.220	CP3
9					102.700	End Stn

Solution :

Stn	Staff reading			H.I.	R.L.	Remark
	BS	IS	FS			
1	2.650			102.650	100.000	B.M.
2		3.740			98.910	
3		3.830			98.820	
4	4.640		4.270	103.020	98.380	CP1
5		0.380			102.640	
6	1.640		0.960	103.700	102.060	CP2
7		2.840			100.860	
8	4.680		3.480	104.900	100.220	CP3
9			2.200		102.700	End Stn
	Σ = 13.610		Σ = 10.910			

Calculation:

$$1) 100.000 + 2.650 = 102.650$$

$$2) 102.650 - 98.910 = 3.740$$

$$3) 102.650 - 98.380 = 4.270$$

$$4) 98.38 + 4.640 = 103.020$$

$$5) 103.020 - 0.380 = 102.640$$

$$6) 103.020 - 102.060 = 0.960$$

$$7) 104.900 - 100.220 = 4.680$$

$$8) 104.900 - 102.700 = 2.200$$

Check $\Sigma BS - \Sigma FS = \text{Last R.L.} - \text{First R.L.}$

$$13.610 - 10.910 = 102.700 - 100.000$$

$$2.700 = 2.700$$

O.K Check is verified.

*(correct missing reading 04 marks rewriting the page of field book 2 mark,02 marks for check)