



**MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)**

(ISO/IEC -270001 – 2005 certified)

Summer- 2017 EXAMINATION







Subject code:17310 SURVEYING

Model Answer

Page No:01/21

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

Question and Model Answers		Marks					
Q.1. A) Attempt ANY SIX of the following		12M					
a) State the principles of surveying							
<ol style="list-style-type: none"> 1) To work from whole to the part 2) To locate position of new station by atleast two independent measurements or processes. 	02M						
b) Differentiate between ‘ Plain Survey ’ & ‘ Geodetic Survey ’							
<table border="1"> <thead> <tr> <th align="left">Plain Survey</th> <th align="left">Geodetic Survey</th> </tr> </thead> <tbody> <tr> <td> <ol style="list-style-type: none"> 1) Effect of curvature of earth is not considered 2) They are carried out for small areas 3) Degree of accuracy is comparatively low 4) It involves plain trigonometry 5) Extent of surveys up to 260 sq.km are considered suitable for plane surveying </td> <td> <ol style="list-style-type: none"> 1) The curvature of earth is taken into considered 2) Used for surveying of large areas 3) It is carried out with a high degree of accuracy 4) It involves spherical trigonometry 5) It is carried out for locating distant control points & for surveying large areas i.e. beyond 260 sq. km </td> </tr> <tr> <td> <p>6) </p> </td> <td> <p></p> </td> </tr> </tbody> </table>	Plain Survey	Geodetic Survey	<ol style="list-style-type: none"> 1) Effect of curvature of earth is not considered 2) They are carried out for small areas 3) Degree of accuracy is comparatively low 4) It involves plain trigonometry 5) Extent of surveys up to 260 sq.km are considered suitable for plane surveying 	<ol style="list-style-type: none"> 1) The curvature of earth is taken into considered 2) Used for surveying of large areas 3) It is carried out with a high degree of accuracy 4) It involves spherical trigonometry 5) It is carried out for locating distant control points & for surveying large areas i.e. beyond 260 sq. km 	<p>6) </p>	<p></p>	1M each point any two
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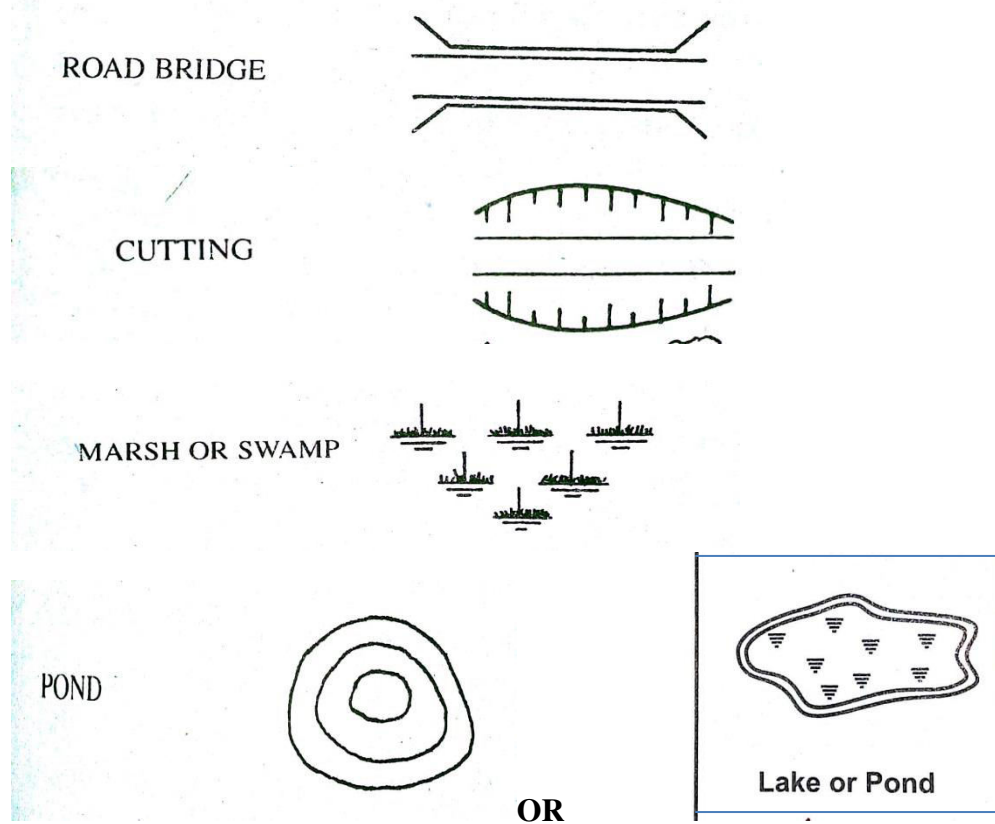
<p>c) Define ‘ Fore bearing ’ & ‘ back bearing ’ of line with a neat sketch</p>	
<p>Fore bearing : The bearing of line observed in the direction of progress of survey is called fore bearing of the line. Bearing of line AB is observed at ‘A’ towards ‘B’ is called as fore bearing of the line ‘AB’</p> <p>Back bearing : The bearing of line observed in opposite direction of the progress of survey is called back bearing of the line. The bearing observed at ‘B’ towards ‘A’ is called as back bearing of the line ‘AB’</p> <div data-bbox="555 488 927 846" data-label="Diagram"> </div>	<p>1M (1/2 M each)</p> <p>1M</p>
<p>d) State the situations under which chain survey is most suitable</p>	
<p>Situations under which chain survey is most suitable</p> <ol style="list-style-type: none"> 1) It is suitable for moderately small areas 2) When the ground is fairly level with simple details (free from obstructions such as trees, building, poles etc) 	<p>2M</p>
<p>e) Enlist various type of Bench Marks</p>	
<ol style="list-style-type: none"> 1) Great Trigonometrical Survey Bench marks 2) Permanent Bench marks 3) Arbitrary Bench marks 4) Temporary Bench marks 	<p>½M each</p>
<p>f) State importance of Change Point in levelling</p>	
<p>During the process of levelling, sometimes some staff readings are not possible. In such circumstances with respect to last staff position, the instrument is shifted to new positioning and the levelling is continued. This is the importance of change point. It is a point on which fore sight & back sight readings are taken.</p>	<p>2M</p>
<p>g) State the use of alidade in plane table surveying</p>	
<ol style="list-style-type: none"> 1) It is used for sighting the objects to be located. 2) It is used for drawing the rays. 	<p>1M each</p>
<p>h) What is Level surface & Datum surface</p>	
<p>Level surface : It is surface parallel to the mean spheroidal surface of the earth. It is normal to the direction of plumb line at all points.</p> <p>Datum surface : It is an arbitrary level surface from which elevations of points may be referred. Vertical distances (elevations) of the points are measured with respect to this datum.</p>	<p>1M each</p>

Q.1. B) Attempt any TWO of the following

08

a) Draw conventional symbols for the following

- i) Road Over Bridge
- ii) Cutting
- iii) Marshy land
- iv) Pond



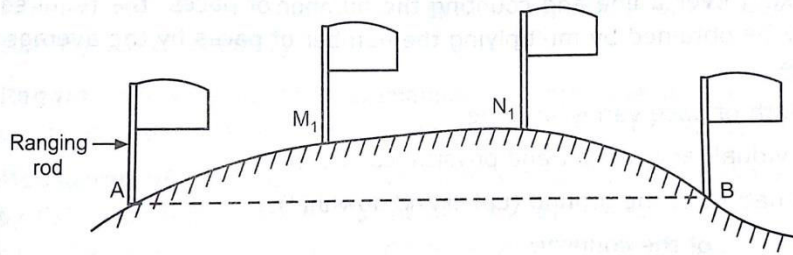
1M each

b) Explain code of signals in Ranging

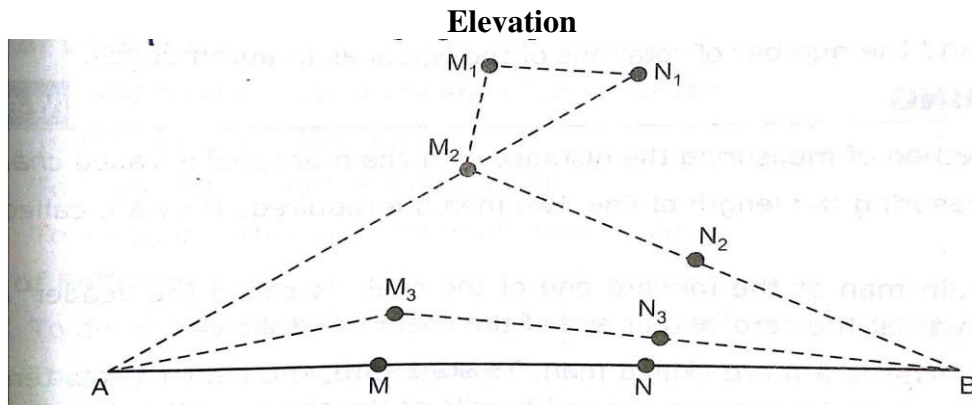
Signal by the surveyor (Follower)	Action taken by Assistant (Leader)
1) Rapid sweeps with right hand on right side	Move considerably to the right
2) Rapid sweeps with left hand on left side	Move considerably to the left
3) Slow sweeps with right hand on right side	Move slowly to the right
4) Slow sweeps with left hand on left side	Move slowly to the left
5) Right arm extended	Continue to move to the right
6) Left arm extended	Continue to move to the left
7) Right arm up & move towards right	Make the rod vertical by moving towards right
8) Left arm up & move towards left	Make the rod vertical by moving towards left
9) Both hands above head & brought down	Correct position

1M each any four

c) Explain indirect ranging with neat sketch



1M



1M

Plan

Indirect or Reciprocal ranging is done when the ends of survey line are not inter visible due to high ground or a hill intervening. It also done when the ends of survey line are not clearly visible due to long distance between them

Let 'A' and 'B' be two survey stations. They are not mutually visible due to high ground between them. It is required to measure the distance between 'A' and 'B'

Let two chainman at 'M1' & 'N1' are as shown in figure

The chainman at 'M1' can see the both the ranging rods at 'N1' and 'B' The chainman at 'N1' can see the ranging rods at 'M1' and 'A'.

The two chainman then directs each other alternately. The chainman at 'N1' directs the chainman at 'M1' to come in line with 'AN1' to occupy position 'M2'

Then the chain man at 'M2' directs the chainman at 'N1' to come in line with 'M2B'

By successively directing each other, they finally occupy position 'M' and 'N' on line 'AB' Now 'AMNB' are exactly in the same line

2M

Q. 2. Attempt Any FOUR of the following

16

a) State the different point to be considered in selection of survey station for a closed traverse

- 1) Main survey stations should be inter visible.
- 2) The main survey lines should form well-conditioned triangles.
- 3) Each triangle or portion of skeleton must be provided with sufficient check lines.
- 4) As far as possible the main survey lines should not pass through obstacles.
- 5) The lines must run through a level ground as possible.
- 6) The frame work should have one or two base lines. The base line should run through the middle of the area.
- 7) To avoid trespassing, the main survey line should fall within the boundaries of the property to be surveyed.
- 8) Survey line must be as few as possible so that the frame work can be plotted conveniently.

1M
each
any
four

b) The length of survey line measured with a 20m chain was found to be 2500m. The same length was again measured with a 30m chain & found to be 2492m. If the 20m chain was found to be 5cm too short, what was error in 30m chain?

The true length of survey line = $L'/L \times$ Measured length of line

Where

L' = Faulty (incorrect) length of the chain

L = True length of the chain

For 20 m chain,

$L' = 20 - 0.05 = 19.95\text{m}$, $L = 20\text{ m}$

True length = $L'/L \times$ Measured length

= $19.95/20 \times 2500 = \underline{2493.75\text{m}}$

Now for 30 m chain,

True length = $L'/L \times$ Measured length

$2493.75 = L'/30 \times 2492$

$L' = \underline{30.02106\text{ m}}$

Error in 30m chain = $30.02106 - 30\text{ m}$

= 0.02106 m

= $\underline{2.106\text{ cm}}$

1M

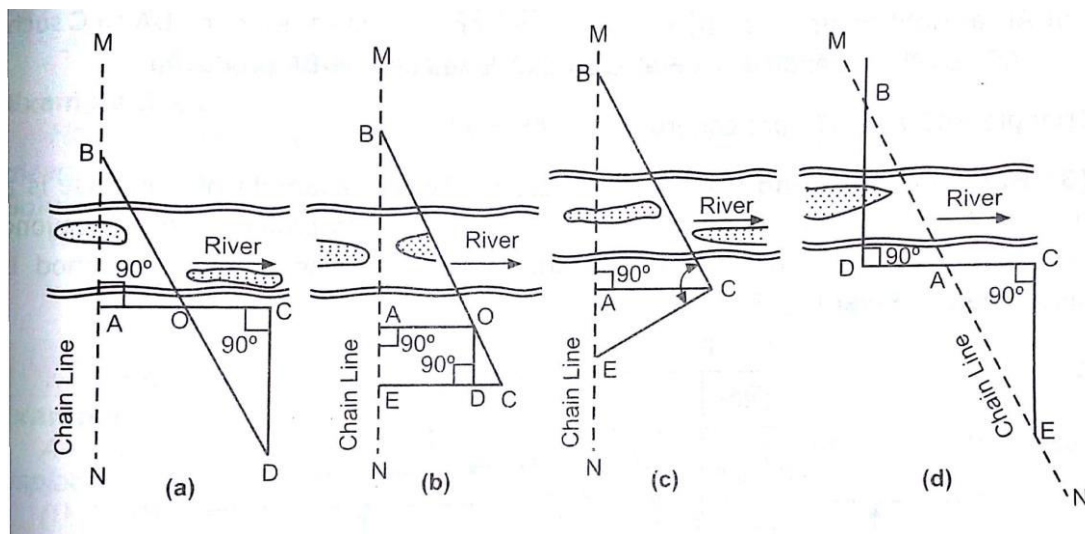
1M

1M

1M

c) How do you overcome the obstacle when chaining across a river ? Explain with neat sketch

This is a case of chaining obstructed vision free.



2M

Fig-a) A & B are two points on opposite banks of river as shown in fig 1. obstructed length is AB on the chain line MN , Set AC perpendicular to AB & bisect at O . Erect perpendicular at C & mark a point D in a line with BO , measure the length CD , from principle of similar triangles ABO & CDO , $AB = CD$

OR

Fig.c) In fig 2, A & B are two points on either side of the river, set out perpendicular AC at A of sufficient length. Erect perpendicular CE at C , measure the length AC & AE

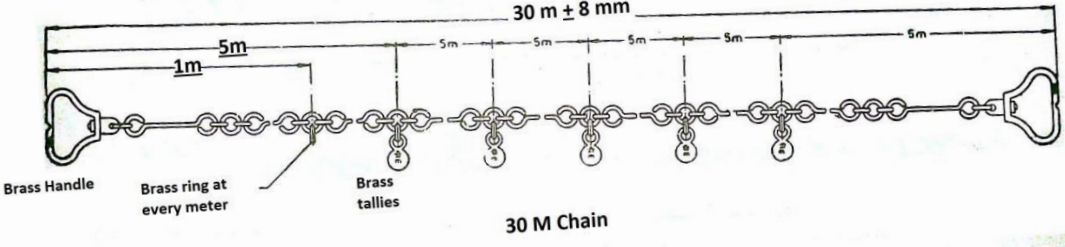
Triangles ABC & ACE are similar Triangles

$AB/AC = AC/AE$

$AB = (AC)^2 / AE$

(Note- If the students write explanation on similar lines for fig. b & d credit may be given)

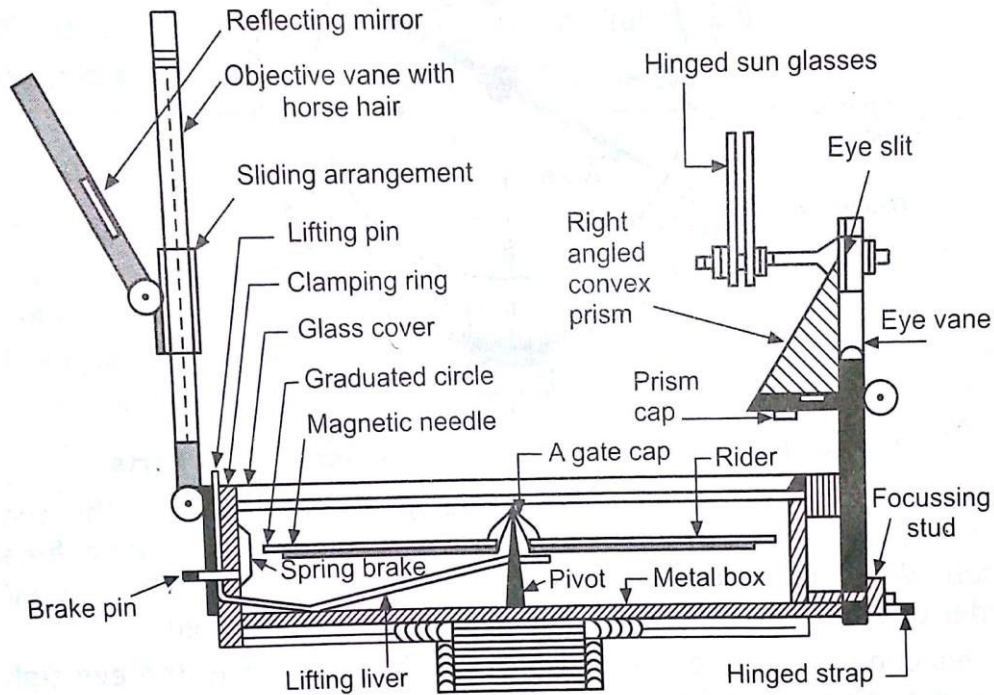
2M
For
any
one
expl.

<p>d) Explain principle of chain surveying</p>	
<ol style="list-style-type: none"> 1) Principle of chain surveying is triangulation 2) Triangulation consists of frame work of triangles. The whole area is divided into network of triangles. 3) A triangle is the only simple plane figure which can be plotted by measuring its sides alone in the field. 4) No angular measurements are taken. 5) To obtain good result, the framework should consists of triangles which are nearly equilateral. Such triangles are known as well shaped or well conditioned triangles. 6) Well conditioned triangles can be plotted more accurately than the ill conditioned triangles. 7) Ill conditioned triangles should always be avoided. 8) The frame work of triangles to be adopted depends upon the shape & configuration of the ground & the natural obstacles. 	<p>4M</p>
<p>e) Write the uses of following survey instruments</p>	
<ol style="list-style-type: none"> i) Ranging Rod ii) Pegs iii) Cross-staff iv) Plumb bob 	
<ol style="list-style-type: none"> i) Ranging Rod : Ranging rod are used for ranging. ii) Pegs : Pegs are used for marking the positions of stations or terminals points of survey lines. iii) Cross-staff : It is used for setting out perpendicular or right angle to given chain line. It is also used to find out the foot of the perpendicular on chain line. iv) Plumb bob : It is used to transfer the point to the ground . It is also used for accurate centering of the surveying instruments like theodolite, compass, plane table etc. 	<p>1M each</p>
<p>f) Draw a labelled sketch of 30 meter metric chain .</p>	
<div style="text-align: center;">  </div>	<p>3M for sketch</p> <p>1M for labelling</p>

Q.3 Attempt Any Four of the following:

16

(a) Draw a neat labelled sketch of Prismatic Compass.



**3 M
Diag.
And
1 M
for
labellin
g**

Prismatic Compass

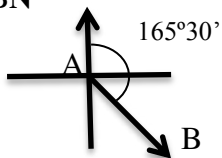
b) Convert the following Whole Circle Bearings to Quadrantal Bearing:

(i) 165°30' (ii) 72°15' (iii) 323°45' (iv) 218°30'

Ans:-

i) 165°30'

Diagram: Let Line be ABN

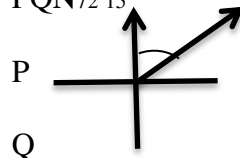


The Quadrantal bearing of line = $180^\circ - 165^\circ 30'$
= $14^\circ 30'$
= **S14°30'E**

(since Line lies in second quadrant)

ii) 72°15'

Diagram: Let Line be PQN

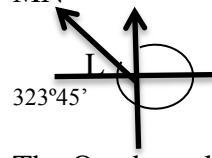


The Quadrantal bearing of line = $72^\circ 15'$
= **N72°15'E**

(since Line lies in First quadrant)

iii) 323°45'

Diagram: Let Line be LMN

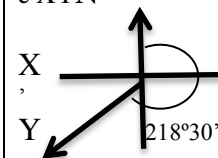


The Quadrantal bearing of line = $360^\circ - 323^\circ 45'$
= $36^\circ 15'$
= **N36°15'W**

(since Line lies in Fourth quadrant)

iii) 218°30'

Diagram: Let Line be XYN



The Quadrantal bearing of line = $218^\circ 30' - 180^\circ$
= $38^\circ 30'$
= **S38°30'W**

(since Line lies in Third quadrant)

**1M
each**

<p>c) Explain with reasons i) The zero is marked at south end in prismatic compass ii) Prism is provided in Prismatic Compass</p>		<p>2M each</p>
<p>i) The zero is marked at south end in prismatic compass Ans:- prismatic compass gives WCB directly. WCB is read by prism. When object is bisected by object vane, reading on aluminium graduated ring exactly below object vane should be the value of WCB. But prism is placed diametrically opposite to object vane. Therefore zero is marked on south end..</p>	<p>ii) Prism is provided in Prismatic Compass Ans: a) Prism is provided to see the magnified image of the reading on graduated ring. Inverted graduations are converted to true image when seen through prism.</p>	

<p>d) Following are the bearings observed in a closes traverse survey with prismatic compass at a place where local attraction was suspected.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Line</th> <th>FB</th> <th>BB</th> </tr> </thead> <tbody> <tr> <td>PQ</td> <td>285° 30'</td> <td>105° 30'</td> </tr> <tr> <td>QR</td> <td>32° 00'</td> <td>210° 00'</td> </tr> <tr> <td>RS</td> <td>149° 00'</td> <td>331° 30'</td> </tr> <tr> <td>SP</td> <td>198° 30'</td> <td>180° 0'</td> </tr> </tbody> </table> <p>Find the station affected by local attraction and find the corrected bearings of lines.</p>			Line	FB	BB	PQ	285° 30'	105° 30'	QR	32° 00'	210° 00'	RS	149° 00'	331° 30'	SP	198° 30'	180° 0'
Line	FB	BB															
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RS	149° 00'	331° 30'															
SP	198° 30'	180° 0'															

<p>Ans: Given :</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Line</th> <th>FB</th> <th>BB</th> <th>Difference</th> <th>Error</th> </tr> </thead> <tbody> <tr> <td>PQ</td> <td>285° 30'</td> <td>105° 30'</td> <td>180°00'</td> <td>0°00'</td> </tr> <tr> <td>QR</td> <td>32° 00'</td> <td>210° 00'</td> <td>178°</td> <td>2°00'</td> </tr> <tr> <td>RS</td> <td>149° 00'</td> <td>331° 30'</td> <td>182°30'</td> <td>-2°30'</td> </tr> <tr> <td>SP</td> <td>198° 30'</td> <td>18° 0'</td> <td>180°30'</td> <td>-30'</td> </tr> </tbody> </table> <p>By Direct Method . As Difference of FB and BB of Line PQ is exactly 180°, Station P And Station Q are free from local attraction. Stations R and S are affected by local attraction.</p> <p>To Find Corrected FB and BB: At station P , FB of line PQ = 285°30' is correct. (since station P is free from local attraction) Therefore BB of line PQ= 285°30'-180°=105°30' is correct.</p> <p>At station Q, FB of line QR = 32° is correct (since station Q is free from local attraction) Therefore corrected BB of line QR= 32°+180°=212°. But observed bearing is 210° so correction of + 2° is added for station R</p> <p>At station R, Observed FB of Line RS=149° Corrected FB of line RS= 149°+2°=151°</p> <p>Corrected BB of Line RS= 151°+180°=331° .</p>	Line	FB	BB	Difference	Error	PQ	285° 30'	105° 30'	180°00'	0°00'	QR	32° 00'	210° 00'	178°	2°00'	RS	149° 00'	331° 30'	182°30'	-2°30'	SP	198° 30'	18° 0'	180°30'	-30'	<p>*4</p>
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RS	149° 00'	331° 30'	182°30'	-2°30'																						
SP	198° 30'	18° 0'	180°30'	-30'																						

Observed BB of line RS=331°30'
 Correction at station S= - 0°30'

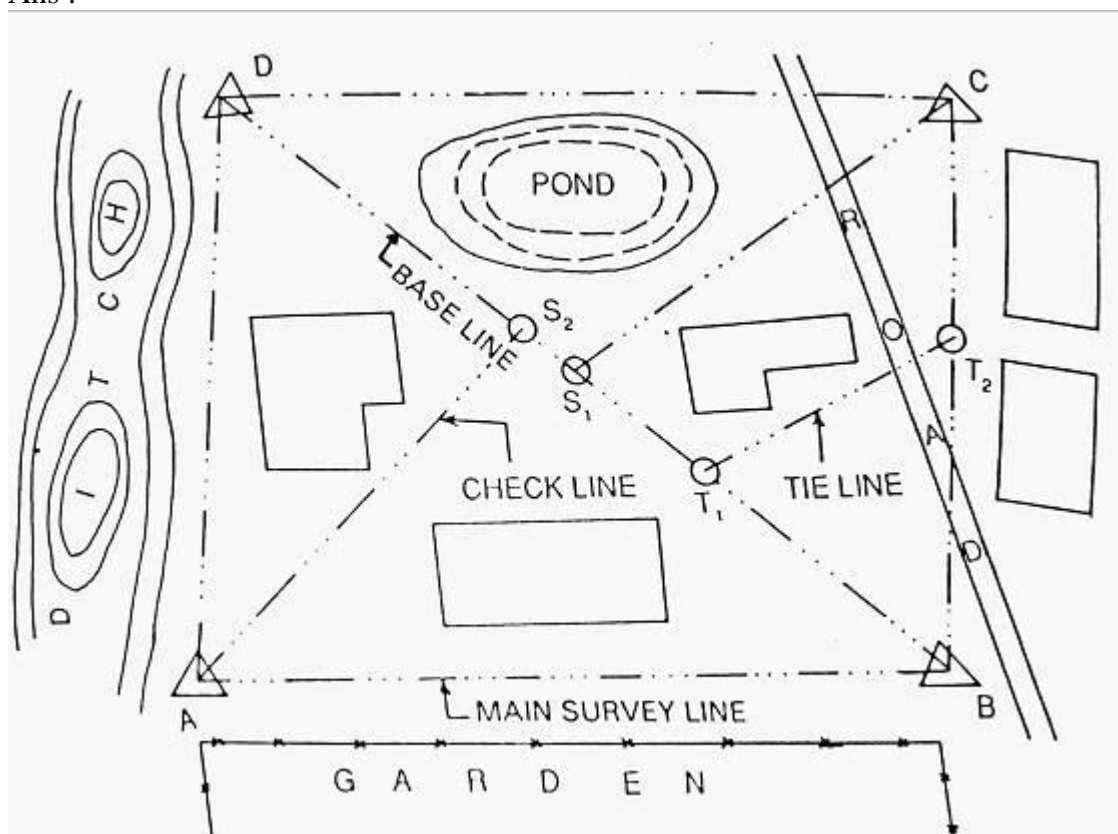
At station S,
 Observed FB of Line SP=198°30'
 Corrected FB of line SP= 198°30'-0°30'=198° .
 Corrected BB of Line SP=198°-180°=18°

Line	FB	BB	Corrected Bearing	
			FB	BB
PQ	285° 30'	105° 30'	285° 30'	105° 30'
QR	32° 00'	210° 00'	32°	212°
RS	149° 00'	331° 30'	151°	331°
SP	198° 30'	180° 0'	198°	18°

* Note: 1 M for identifying stations affected by local attraction, 1/2 mark each for calculating FB and BB of line QR, RS, SP

e) Describe with neat sketch i) base line ii) check line iii) Tie line iv) Tie station.

Ans :



2M
 marks
 for
 diag.

1) Baseline :- The line on which the framework of the survey is built is known as baseline. Generally longest of the main survey lines is considered as baseline. It should be taken on fairly level ground and measured carefully and accurately.

02) Check line :- The line joining the apex point of a triangle to some fixed point on the

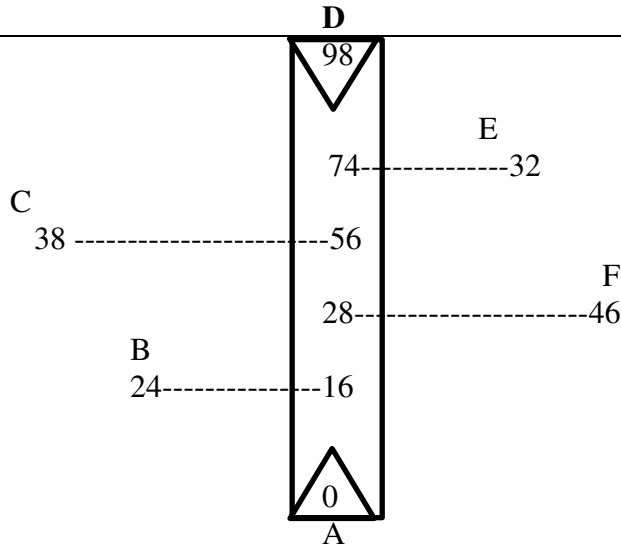
And
 1/2 M
 for
 each
 descrip
 tion

baseline is called as check line. It is taken to check the accuracy of the triangle.

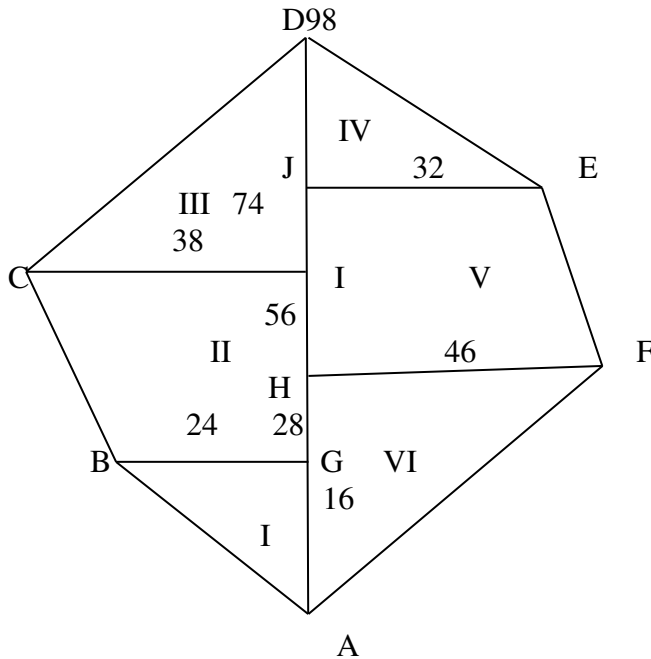
03) Tie line:- The line joining the tie stations are known as the Tie Lines. Tie Lines are taken to locate the interior details.

04) Tie Stations: The subsidiary or secondary stations taken on the main survey lines are known as Tie stations. Tie stations are denoted by symbol \bigcirc With letters T_1, T_2, T_3 etc. in figure.

f) Plot the following cross staff survey of field and calculate area.



Ans: Plotting the given traverse survey



Calculating Area : (Tabular Form)

Fig no.	Figure	Base	Offset	Mean Offset	Area= Base x Mean offset	Area
I	Tri AGB	16	0 & 24	12	16x12	=192
II	Trap BGIC	56-16=40	24 & 38	31	40x31	=1240
III	Tri DIC	98-56=42	38 & 0	19	42x19	=798

**1M
diagram**

**½ M
for
each
area**

IV	Tri DJE	98-74=24	32 & 0	16	24x16=384	=384	
V	Trap JEFH	74-28=46	32 & 46	39	46x39	=1794	
VI	Tri AHF	28	46 & 0	23	28x23	=644	
TOTAL Area						5052	
						Sq.m	

Q.4 Attempt Any Four of the following:

16

(a) Following are bearings of lines of a closed traverse ABCD:

Line	FB
AB	N45°10' E
BC	S60°40'E
CD	S9°50'W
DA	N80°40' W

Calculate the interior angles of traverse.

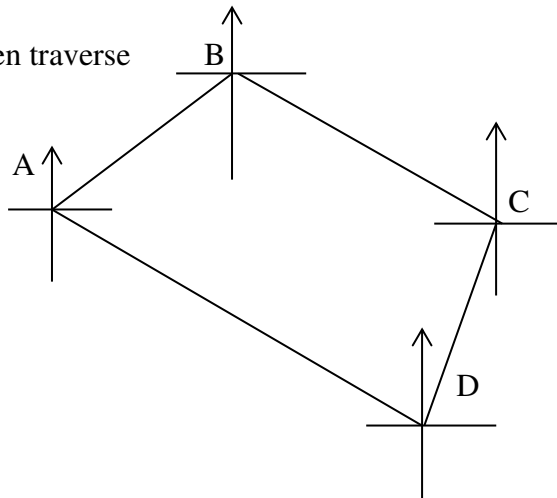
Ans:

Given :

Line	FB	FB	BB
AB	N45°10'E	45°10'	225°10'
BC	S60°40'E	119°20'	299°20'
CD	S9°50'W	189°50'	9°50'
DA	N80°40'W	279°20'	99°20'

***4M**

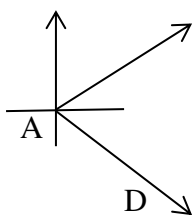
Plotting the given traverse

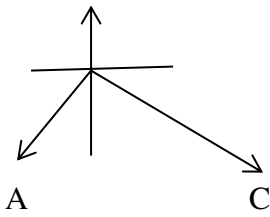


To calculate Interior Angles:

Consider station A:

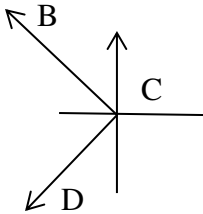
$$\begin{aligned}
 \text{B Included angle A} &= \text{BB of line DA} - \text{FB of Line AB} \\
 &= 99^\circ 20' - 45^\circ 10' \\
 &= \mathbf{54^\circ 10'}
 \end{aligned}$$





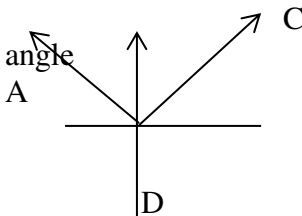
Consider station B :

$$\begin{aligned} \text{Included angle B} &= \text{BB of Line AB-FB of line BC} \\ &= 225^{\circ}10' - 119^{\circ}20' \\ &= \mathbf{105^{\circ} 50'} \end{aligned}$$



Consider station C:

$$\begin{aligned} \text{Included Angle C} &= \text{BB of line BC- FB of line CD} \\ &= 299^{\circ}20' - 189^{\circ}50' \\ &= \mathbf{109^{\circ}30'} \end{aligned}$$



Consider station D.

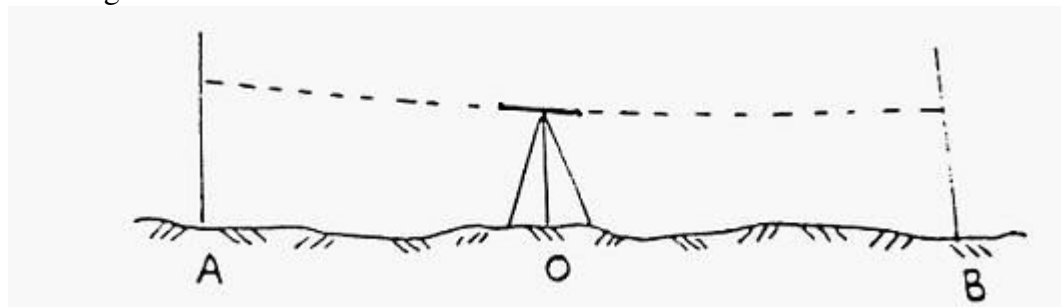
Included Angle D = BB of Line CD + Remaining

$$\begin{aligned} \text{Remaining angle} &= 360^{\circ} - 279^{\circ}20' = 80^{\circ}40' \\ \text{Included Angle D} &= 9^{\circ}50' + 80^{\circ}40' \\ &= \mathbf{90^{\circ}30'} \end{aligned}$$

Note: 1 M for BB, 1 M for plotting the traverse, 1/2 mark for each included angle.

b) Differentiate between Simple Levelling and Differential Levelling with neat sketch.

Ans:- Simple Levelling : When the difference of level between two points is determined by setting the levelling instrument midway between the point the process is called Simple levelling.



Suppose A&B are two points whose difference of level is to be determined. The level is setup at O; exactly midway between A&B , then it is called Simple levelling.

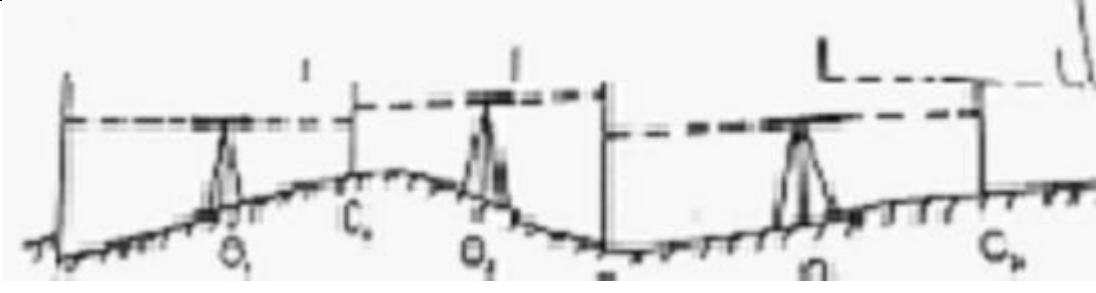
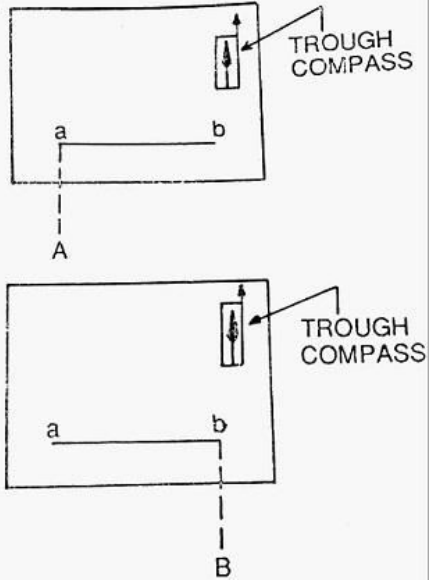
Differential Levelling: If the level is set up at several suitable positions & staff readings are taken at all of these then it is called as Differential levelling. This method is also called as compound or continuous levelling. This method is adopted when the points are at great distance apart and the difference of elevation between the points is large or there are obstacles between points.

1 M for description

and

1 M for diag.

1 M for description

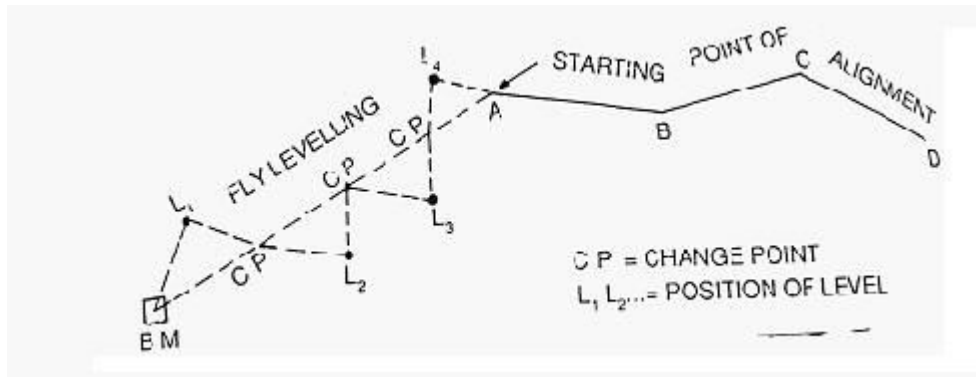
 <p>Suppose it is required to know the difference between A&B , O_1, O_2, O_3 are the set up points and C_1, C_2, C_3 are the change points.</p>	<p>and</p> <p>1 M for diagram</p>
<p>c) Explain Orientation of plane table by Back-sighting Method.</p>	
<p>Ans:- The method of setting up the plane table at each of the successive stations parallel to the position it occupied at the starting station is known as an Orientation. Orientation must be done when the plane table is set up at more than one station.</p> <p>Procedure of back sighting Method:</p> <p>a) Suppose A and B are two stations. The plane table is set up over A. The table is levelled by spirit level and centered by U- fork so that point 'a' is just over the station A. The North line is marked on the right hand top corner of the sheet by trough compass.</p> <p>b) With the alidade touching 'a', the ranging at 'B' is bisected and ray is drawn. The distance AB is measured and plotted to any suitable scale. So the point 'b' represents station B.</p> <p>c) The table is shifted and set up over 'B'. It is levelled and centered so that 'b' is 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 Anti clockwise. At the same time the centering may be disturbed and should be adjusted immediately if required. Then the centering, levelling and bisection of the ranging rod at a are perfect then orientation is said to be perfect.</p>	<p>2 M for explaination</p>
	<p>2 M for diagram</p>

d) Explain Fly Levelling with neat sketch. State situation under which fly levelling is needed.

Ans: When Differential Levelling is done in order to connect a bench mark to the starting point of the alignment of any project, it is called as fly levelling. Fly levelling is also done to connect the B.M at any intermediate point of the alignment for checking accuracy of work.

In such levelling only the back sight and foresight are taken at every setup of level and no distance are measured along the direction of levelling. The level should be set up just midway between B.S and F.S.

***4M**



- Situations :
- i) fly levelling is used in setting Temporary Bench mark.
 - ii) if distance is more between two points.
 - iii) if there are obstacles between the two points.

***Note: 1 M for def., 1 M for explanation, 1 M for diagram, 1M for situation.**

e) Explain Procedure for chain and compass traversing.

Chain and compass traversing :

- 1) Reconnaissance of the area to be surveyed is done.
- 2) Traverse stations are fixed.
- 3) The F.B and B.B of the traverse are measured by prismatic compass and the sides of the traverse by chain or tape.
- 4) Then the observed bearings are verified and necessary corrections for the local attraction are applied.
- 5) In this method, closing error may occur when the traverse is plotted.
- 6) This error is adjusted graphically by using 'Bowditch Rule'.

4M

f) State merits and demerits of plane table survey.

- Merits:
- 1) It is the most rapid method of surveying.
 - 2) There is no need for field book as plotting is done along with the field work, so the problem of mistakes in booking field notes does not arise.
 - 3) Plotted work can be compared with actual object whether or not they are properly represented.
 - 4) There is no possibility of overlooking any important object.
 - 5) There is no possibility of overlooking any measurement as plotting is done in the field.
 - 6) Irregular objects may be represented accurately.
 - 7) It is suitable in magnetic area.
 - 8) The maps can be prepared easily and does not require any great skill.
 - 9) Errors in measurement and plotting can be detected by check lines.
 - 10) Inaccessible points can be easily located by intersection method.

1/2M each any four

- Demerits: 1) The plane table is not suitable for accurate work as the fitting arrangements is not perfect.
 2) Plane table surveying is not suitable in wet climate, rainy season, on foggy mornings and in windy weather.
 3) The number of accessories required in such survey is large and they are likely to be lost.
 4) The instrument is very heavy and difficult to carry.
 5) The map cannot be replotted to different scale as there is no field book.

**½ M
Each
any
four**

Q.5 Attempt Any TWO of the following

a) Following consecutive readings were taken with dumpy level and a 4 m leveling staff on a continuously slopping ground at interval of 30 m. 0.965,1.100,1.245,1.680,2.100,2.345,0.860,1.005,1.380,1.965,2.450,2.800,1.135,1.785,2.965,3.450, RL of first point was 275.50 m. Calculate R.L. of points by H.I. method & apply arithmetic checks.

08

Ans:

Staff station chainage	B.S.	I.S.	F.S.	H.I.	RL.	Remarks
0	0.965			276.465	275.500	BM
30		1.100			275.365	
60		1.245			275.220	
90		1.680			274.785	
120		2.100			274.365	
150	0.860		2.345	274.980	274.120	CP1
180		1.005			273.975	
210		1.380			273.600	
240		1.965			273.015	
270		2.450			272.530	
300	1.135		2.800	273.315	272.180	CP2
330		1.785			271.530	
360		2.965			270.350	
B 390			3.450		269.865	L.P.

***08**

Arithmetic check
 $\Sigma B.S. - \Sigma F.S. = \text{Last R.L.} - \text{First R.L.}$
 $2.960 - 8.595 = 269.865 - 275.500$
 $-5.635 = -5.635$
Note: *Draw the table=01 Mark, Entry of Correct readings = 01 Marks, calculations of RL and H.I. = 4 Marks and exact check = 02 Marks.

b) Calculate the missing readings marked 'X'

Stn.	B.S.	I.S.	F.S.	Rise	Fall	R.L.	Remark
A	X					275.00	BM
B	1.060		1.975		1.500	X	CP1
C		1.550					
D		X				272.44	
E	2.380		1.785				CP2
F	1.325		0.895			X	CP3
G			X		0.500	X	L.P.

08

Find missing marked 'X'. Calculate R.Ls of all points and apply usual checks.

Ans:

1) Station A:

B.S. of station A – F.S. of Station B = Fall at station B

$$X - 1.975 = -1.500$$

$$X = -1.500 + 1.975$$

$$X = \text{B.S. of station A} = \mathbf{0.475}$$

2) Station B:

X = R.L. of station B = 275.000 - Fall at station B

$$X = 275.000 - 1.500$$

$$X = \text{R.L. of station B} = \mathbf{273.500m}$$

3) Station C:

Fall at station C = 1.060 - 1.550 = **-0.490m**

R.L. at station C = 273.500 - 0.490 = **273.010m**

4) Station D:

Fall at station D = 273.010 - 272.440 = **-0.570m**

I.S. at station C - I.S. at station D = **-0.570m**

$$1.550 - X = -0.570$$

$$X = 1.550 + 0.570 = \mathbf{2.120m}$$

5) Station E:

Rise at station E = 2.120 - 1.785 = **0.335 m**

X = R.L. at station D = 272.440 + 0.335 = **272.775m**

6) Station F :

Rise at station F = 2.380 - 0.895 = **1.485m**

X = R.L. at station F = 272.775 + 1.485 = **274.260m**

*08M

7) Station G :

R.L at station G = 274.260 – 0.500 = 273.760m

B.S. at station F - F.S. at station G = -0.500m

1.325 - X = -0.500

X = 1.325 + 0.500 = **1.825m**

Stn.	B.S.	I.S.	F.S.	Rise	Fall	R.L.	Remark
A	0.475					275.00	BM
B	1.060		1.975		1.500	273.500	CP1
C		1.550			0.490	273.010	
D		2.120			0.570	272.440	
E	2.380		1.785	0.335		272.775	CP2
F	1.325		0.895	1.485		274.260	CP3
G			1.825		0.500	273.760	L.P.

Arithmetic check:-

$|\Sigma BS - \Sigma FS| = |\Sigma Rise - \Sigma Fall| = |Last\ RL - First\ RL|$

$|5.240 - 6.480| = |1.820 - 3.060| = |273.76 - 275.000|$

$-1.24 = -1.24 = -1.24$

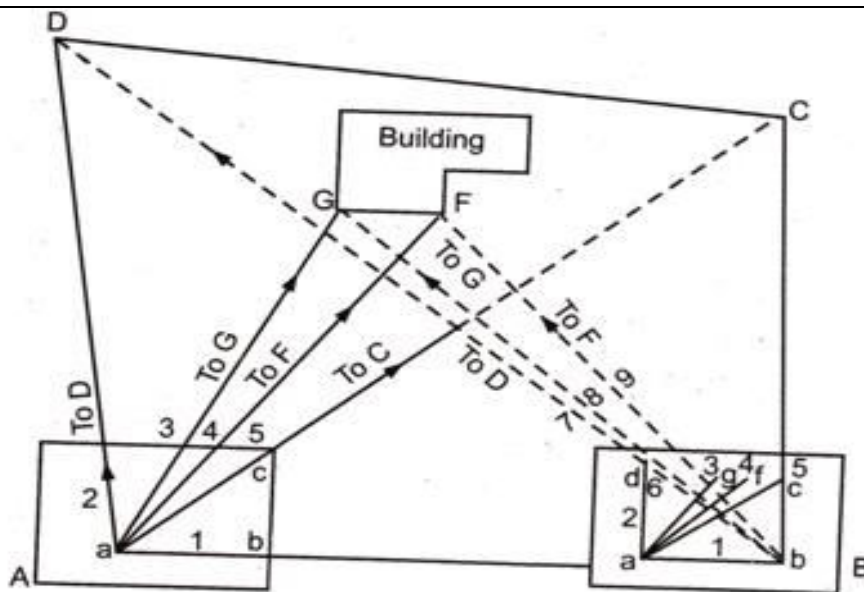
**(Note- correct missing reading and calculation of RLs 06 marks ,02 marks for check)*

c) Explain 'Intersection Method' of plane table surveying with neat sketch. Also give situation when intersection method is used.

Ans:

1. Lay out a base line AB and measure it and Plot a distance 'ab' on sheet using any scale.
2. Set up instrument at 'A' with 'a' over 'A'
3. Orient the table by placing alidade 'ab' and turn table until ranging rod at 'B' is bisected and clamp it.
4. With alidade touching point 'a' draw rays 1, 2,3,4,5 of indefinite length as shown in figure below.
5. The table is then moved to station 'B' orient by back sighting on 'A'. Draw rays towards points previously sighted i.e. 6,7,8,9 rays are drawn to determine points intersection, d, g, f, c.

04M



02M

Situation when used:

1. Locating details of area.
2. For locating distant and inaccessible points, broken boundaries, bank of river etc.
3. For plotting position of points to be used subsequently as the instrument station.
4. It is suitable when it is difficult or impossible to measure distance as in the case of the survey of mountainous country.
5. The only linear measurement required is that of a base line.

02M
Any
four
points 1/2
mark
each

Q.6 Attempt Any FOUR of the following

16

a) State sources of error in leveling.

There are three sources of Error

a) Instrumental Error :-

- Imperfect permanent adjustment
- Sluggish bubble
- Faulty focusing tube
- The erroneous leveling staff

2M

b) Refraction Error (error due to natural causes):-

- Earth's curvature
- Atmospheric refraction
- Variations in temperature
- Settlement of tripod
- Wind vibration

1M

c) Personal Error :-

- Mistakes in manipulation

<ul style="list-style-type: none"> • Mistake in reading the rod • Errors in sighting • Mistakes in recording 	1M
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b) Compare Rise & Fall method and H.I. method. **04**

Ans:

Sr.No.	Rise and Fall Method	H.I. Method
1	It is slow and more tedious.	It is more rapid and less tedious
2	It is laborious as it involves more calculations.	It is simple as it involves less calculation.
3	In this method there is complete check on all calculation work.	In this method there is no check on calculations of R.L. of intermediate sight and mistakes made remain unchecked
4	In this method the mistake made in calculating the R.L. of any point will be carried forward.	In this method the error in calculating the R,L, of I.S. is not carried forward as the R,L, are calculated from the respective plane of collimation
5	It is used in precise leveling work, check leveling calculations.	It is usually used in profile leveling calculation.
6	Arithmetical check $\Sigma B.S. - \Sigma F.S = \Sigma Rise - \Sigma fall = Last RL - First RL$	Arithmetical check $\Sigma B.S. - \Sigma F.S = Last RL - First RL$

***04**

**(Any four points 1 mark each)*

c) Explain Graphical adjustment of closing error in a closed traverse. **04**

Explanation related to above figure (01)

AA₁ is closing error

AB₁C₁D₁E₁A₁ - Plotted traverse

ABCDEA - Adjusted traverse.

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

02M

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

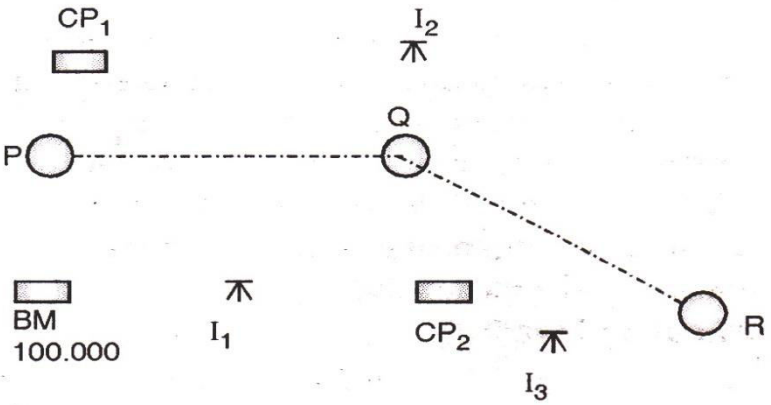
02M

d) Explain the procedure for profile leveling with neat sketch.

04

ANS:

- 1) Let PQR be the given line of section.



01M sketch

- 2) Mark point at 10 m intervals on this line.
- 3) Level is set up on a firm ground at a suitable point I₁.
- 4) Temporary adjustment of level is done and B.S. is taken on B.M.
- 5) The RL of collimation (HI) is worked out by adding B.S. to the R.L. of B.M. The chain is stretched from P toward the point Q.
- 6) Also, the staff readings are taken at 10 m points, and entered in the I.S column against the respective changes.
- 7) Beside these points, the staff readings are taken at the representative points, for example slope of ground surface changes appreciably.
- 8) When it is found necessary to shift the instruments on account of the length of sight exceeding about 100 m or the further points not being possible to be observed owing to the irregularities of the ground, CP1 is taken at suitable position, and F.S is taken on it and entered in F.S column.
- 9) The instrument is then shifted and set up on firm ground at I₂ as before.
- 10) B.S is taken on CP1 and new HI is calculated

03M Proced.

<p>e) State advantages of Auto-Level over dumpy level.</p>	<p>04</p>
<p>Ans:</p> <ol style="list-style-type: none"> 1) Auto level gives quick and easy leveling with less effort than dumpy level. 2) It is most accurate and precise which gives least error about 0.5 to 0.8 in 5 km. 3) It is simply to use, compact in nature and easy to handle than dumpy level 4) Auto level telescope facilitates normal readings to read; which reflects inverted in some dumpy level. 5) It gives more operational comfort to surveyor. <p><i>*(Any four points 1 mark each)</i></p>	<p>*04</p>
<p>f) Explain ‘Declination of Magnetic needle’ and types of declination.</p>	<p>04</p>
<p>Ans:</p> <ul style="list-style-type: none"> • The magnetic meridian at a place does not coincide with the true meridian at that place. • The horizontal angle made by the magnetic meridian with the true meridian is called ‘magnetic declination’. • The magnetic meridian varies from place to place and also from time to time on the surface of the earth and hence, the declination is also different at different places. <p>Types of declination:-</p> <ul style="list-style-type: none"> • In some cases the magnetic meridian is deflected to the East side of the true meridian called as ‘East declination’ while in others it points to the west of the true meridian called as ‘West declination’ <div style="display: flex; justify-content: space-around; align-items: center;"> <div data-bbox="172 1368 576 1854" style="text-align: center;"> <p>East declination</p> </div> <div data-bbox="730 1368 1078 1854" style="text-align: center;"> <p>West declination</p> </div> </div>	<p>02M</p> <p>01M</p> <p>01M sketch</p>