Elevation Measurements

1 Define Leveling.

The art of determining the relative heights of different points on or below the surface of the earth is know as Leveling.
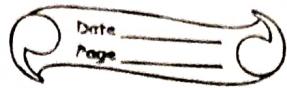
Leveling deals with measurements in the vertical plane.

Leveling is widely used to measure geodetic height.

=) Write object and use of Leveling.

-) Object: Find the elevation of given point with respect to some assumed reference line.

To establish the points at a provided elevations with respect to a given line or ground.

=> Use of Leveling.

This are the main use of Leveling.

1 To establish bench mark as vertical control points.

2 To enable surveyor measurements to be reduced to the horizontal at sea level.

3 To prepare a layout map for water supply, sanitary or drainage schemes.

4 To obtain contour map of an area.

5 To determine the difference in levels of points.

6 To obtain cross section of roads, canals etc.

7 To Find the elevations of points on the earth's surface for topographic maps.

2. What are the methods of Leveling? Explain classification of direct Leveling in brief.

This are the methods of Leveling.

1. Direct Leveling
2. Trigonometric Leveling
3. Barometric Leveling
4. Hypsometric Leveling.
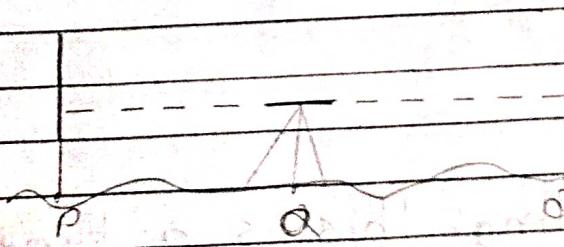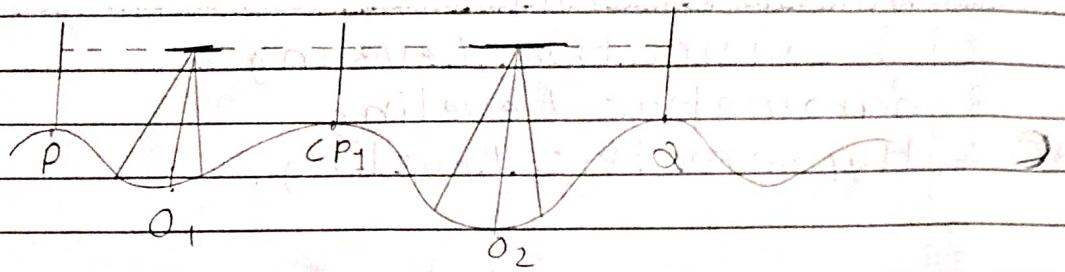
1. Direct Leveling:

This are the classification of direct Leveling
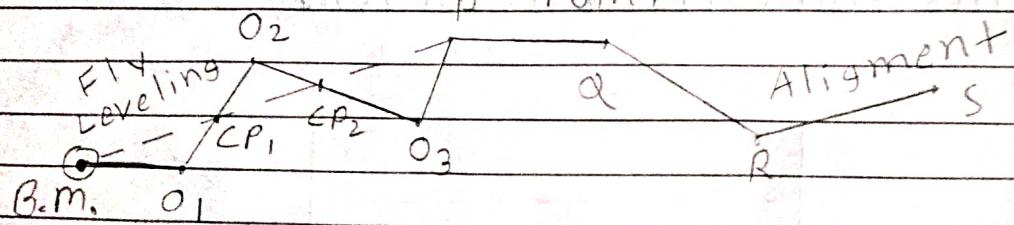
1. Simple Leveling: In this method, the level difference between two points is determined by setting the leveling instruments on midway.
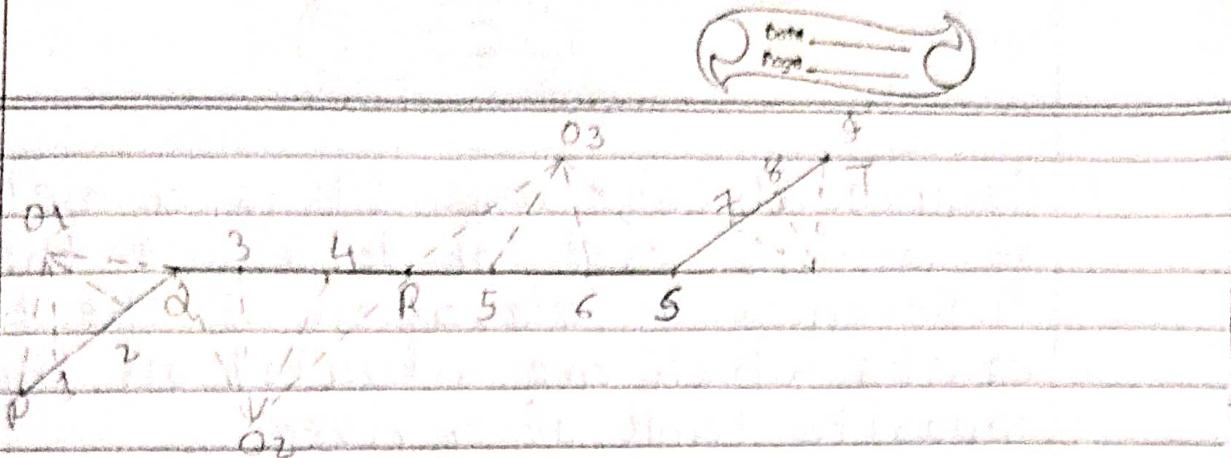
2 Differential Leveling: In this method, the level setup at suitable positions and staff readings are taken till the last point can be changed.
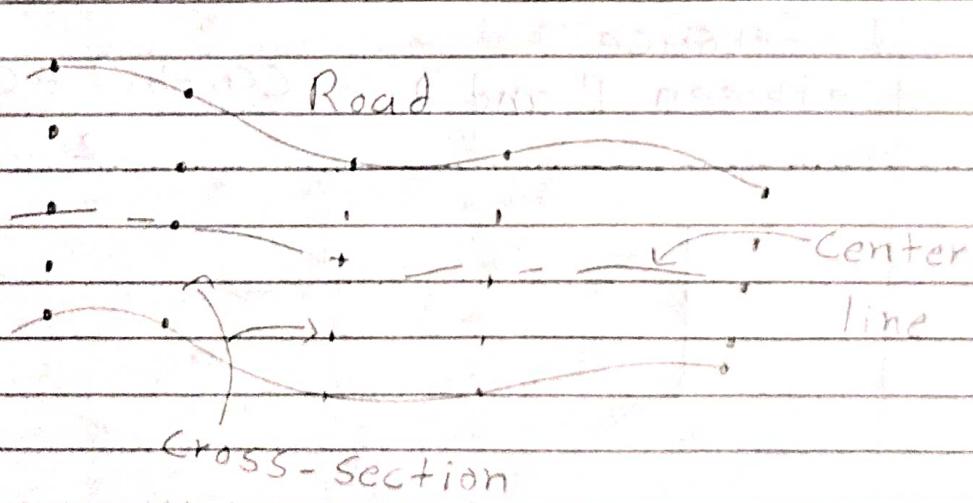

3 Fly Leveling: When differential Leveling is done in order to connect a bench mark to the starting point of the aligment of any construction it is called Fly Leveling.
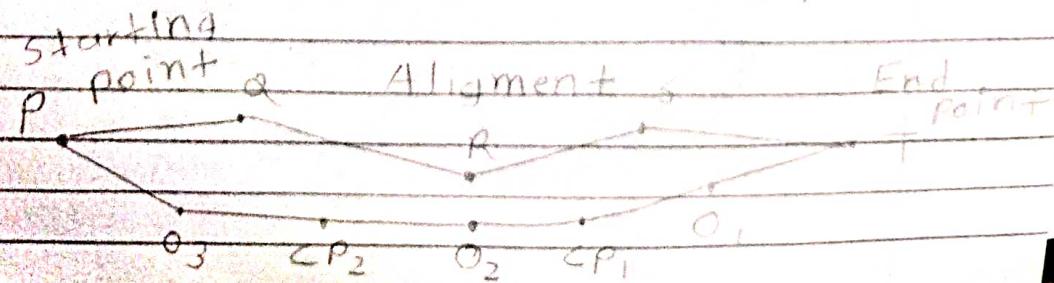

4 Profile Leveling: This is a type of differential Leveling done for the purpose of determining the elevation of the ground surface along an aligment.

5 Cross-Section Leveling: In this method, determine the difference of elevation of the ground surface along the lines perpendicular to the aligment of the proposed road, railway etc.

Cross-Section
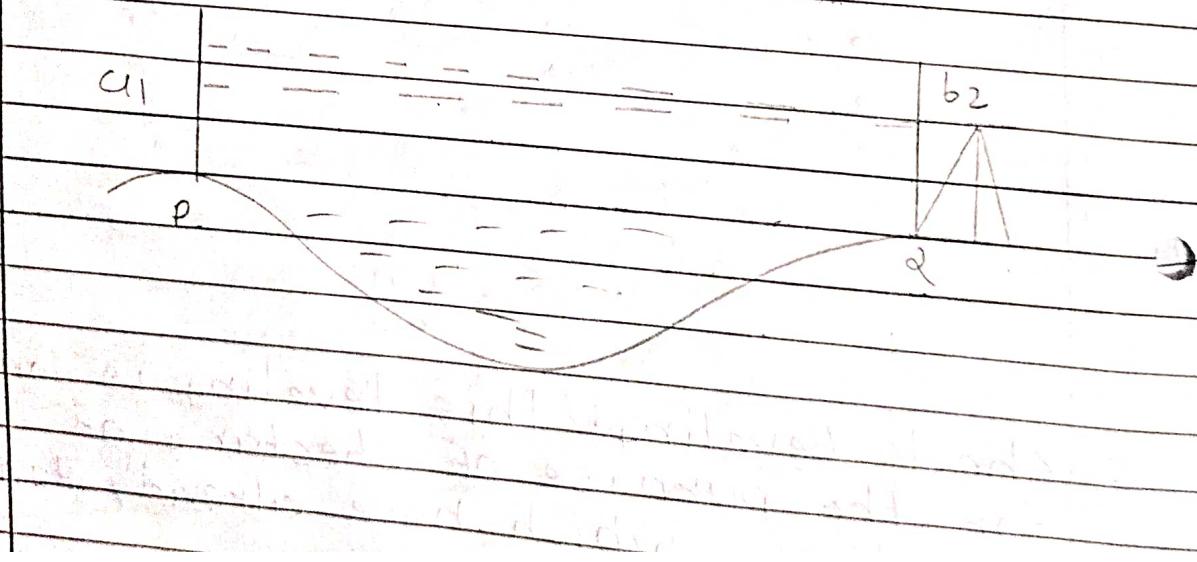
6 Check Leveling: This leveling is done for the purpose of checking of elevations which have already done.
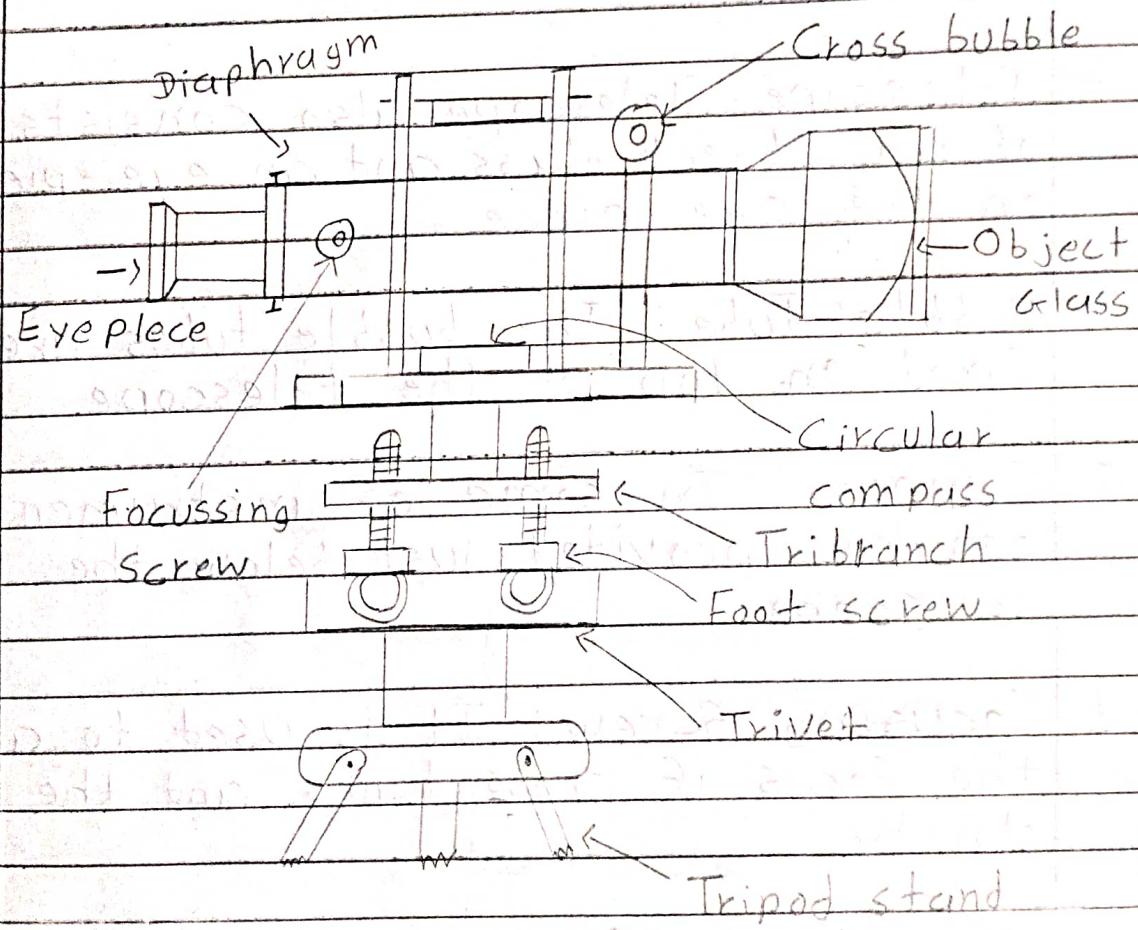
7 Reciprocal Leveling :- It is a method
of leveling used for determine the
difference of elevation of the two
points which are situated on the
opposite bank of a river

Difference
between P and Q $= \dfrac{(a_1 - b_1) + (a_2 - b_2)}{2}$
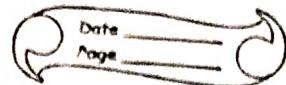
3 Explain with sketch temporary adjusment of a dumpy level.

Diaphragm

Cross bubble

Eyepiece

Object Glass

Focussing Screw

Circular compass

Tribranch

Foot screw

Trivet

Tripod stand

This are the basic components of Dumpy level.

1 Tripod Stand: The tripod stand consists of three legs which may be solid.

2 Leveling Head: The leveling head consists of two parallel plates having three support foot screws.

3 Foot Screws: Turning the foot screws the tribach can be raised or lowered to bring the bubble to the centre of its run.

4 Telescope: Telescope also consists of an object glass and an eye-piece on the eye-piece.

5 Bubble Tube: The bubble tubes are fixed on top of the telescope.

6 Compass: In some of instrument compass provided just below the telescope.

7 Focusing Screw: It is used to adjust the focus if cross hairs and the image clarity.

8 Eye piece: Eye piece is used by the observer's eye to view the distant object.

9 Objective lens: Objective lens are provided at the other end of the telescope.

4. Define the following terms.

(1) Station: A definite point on the earth whose location has been determined by surveying method.

(2) Back sight: This is first staff reading taken after setting up the instrument. The BS is used to determine the height of the instrument.

$$\text{Height of Instrument} = RL + BS$$

(3) Forsight: This is the last staff reading in any set up of instrument. The FS is used to determine the staff station.

$$RL \text{ of station} = RL \text{ of } HI - FS.$$

(4) Intermediate Sight: It is any other staff reading between the BS and IS staff reading. The IS is used to determine the staff station

$$RL \text{ of station} = RL \text{ of } HI - IS.$$

(5) **Changing Point:** A change point is the point where both the Fore sight and back sight are made on a staff held at that point.

(6) **Height of Instrument:** When the leveling instrument is properly leveled, the RL of the line of collimation is t known as Height of Instrument.

$$\text{RL of HI} = \text{RL of BM} + \text{BS}$$

r)

$$\text{RL of HI} = \text{RL of CP} + \text{BS}$$

(7) **Balancing of Sights:** The distance of the point whers BS is taken and the distance of the point where FS is taken, as measured from the instrument station should be approximately equal, This is called Balancing of sights.

(8) **Datum Surface:** This is a horizontal surface of known height to which the elevation of all other points is referenced.

5. Compare Line of Collimation system with Rise and fall system.

|	Collimation System	Rise and fall System
1	It is more rapid and save time and labour.	It is labourious, involving several calculations.
2	There is no check on the RLs of intermediate station	There is a check on the RLs of intermediate station.
3	Errors in intermediate RLs cannot be detected.	Errors in intermediate RLs can be detected.
4	Calculation of RLs. $\Sigma BS - \Sigma FS =$ Last RL - First RL	Calculation of RLs: $\Sigma BS - \Sigma FS = \Sigma$ Rise $- \Sigma$ fall $=$ Last RL - First RL
5	It is well adapted for reduction of levels for construction work	It is well adapted for determining the difference in level of two points.

6 8 What are contours? Discuss characteristic of contours with suitable sketches.
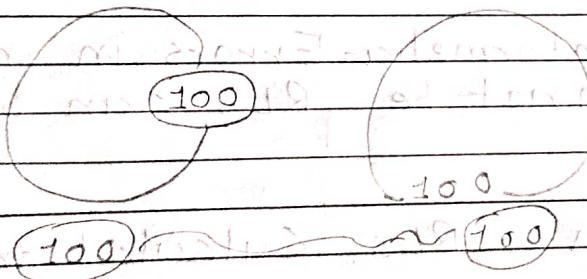
=> Contours : Contours is the determination of elevation of various points on the land and fixing these points of same horizontal positions in the contour map.

=> Characteristicts of Contours.

1 All the points on a contour line have the same elevation.

(100)

100

(100)   (100)
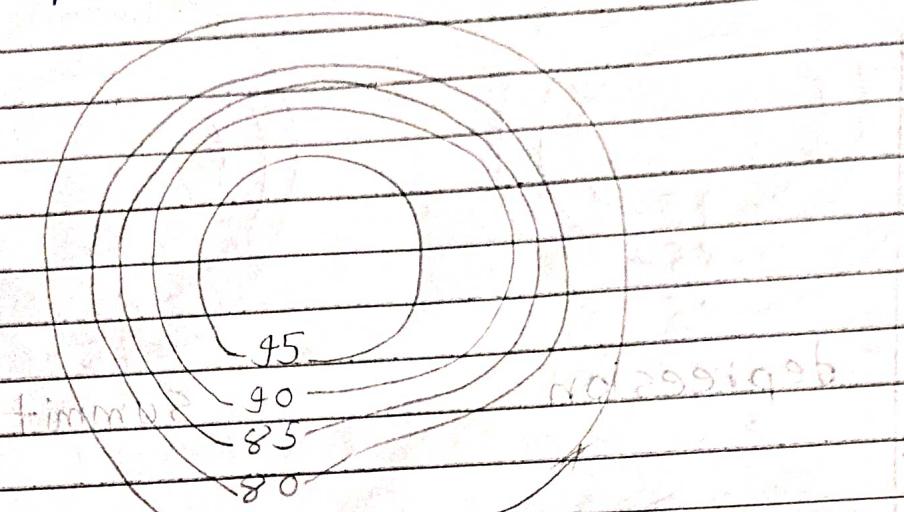
2 Two contour lines do not interset with each other.

3 A contour line must close itself but cannot end on the plane.
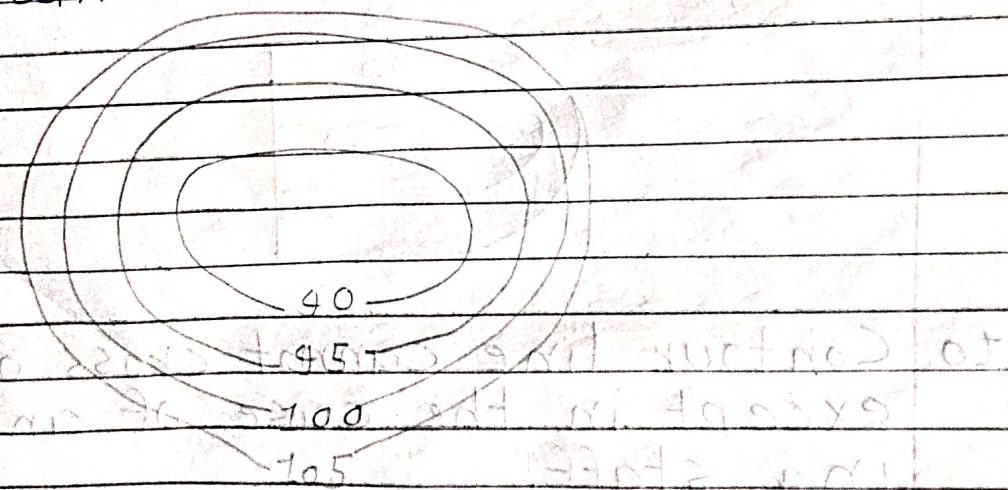
4 Contours do not have sharp turning.

5 The contours line are closer near the top of a hil or high ground.

45
90
85
80
70
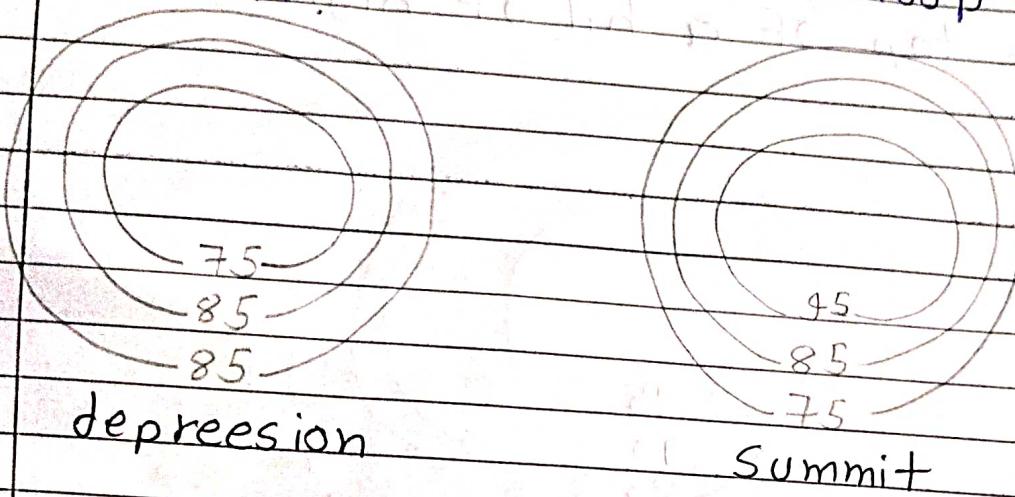
6 The contours line are closer near the bank of a pond or depression.

40
95
100
105
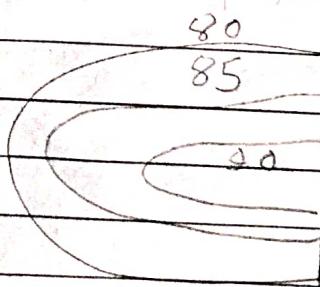
7 Uniformly spaced, contour lines indicate a uniform slope.

103
102

8 The lower values being inside the loop
indicates depreesion, the higher
values being inside the loop indicates
summit.

75
85
85
depreesion

45
85
75
Summit

9 Contour line meeting at a point
indiate a vertical staff

80
85
80

10 Contour line cannot cross one onther,
except in the case of an overhang-
ing staff.

7. Write a short note on Benchmark.

A Benchmark is a reference point that helps one to calculate something.

Benchmark is the point laid above or below the datum line with a known elevation.

- There are four types of Benchmark
1. GTs Benchmark
2. Permanent Benchmark
3. Arbitrary Benchmark
4. Temporary Benchmark

1. GTs Benchmark:

The full form of GTS is Great Triangulation Survey.

- These benchmark are established by the survey of Indian Department.

2. Permanent Benchmark:

These are fixed points or marks established by the Survey of India or other government.

3. **Arbitrary Benchmark:**

When the RLs of some fixed points are arbitrary assumed they are called Arbitrary Benchmark.

4. **Temporary Benchmark:**

When the bench mark are established temporary at the end of the work they are called temporary benchmark.

→ Benchmark is also use to measure RL of Height line.

$$RL \text{ of } HI = RL \text{ of } + BS$$
$$BM$$

8. The following staff readings were recorded in a leveling operation. 1.175, 2.605, 1.835, 2.405, 1.145, 0.965, 1.115, 1.785, 1.225, 1.645 and 1.715.
STA. is the bench mark with reduced level 175.680 m. Find the RLs of all the other points by the rise and fall method. The first reading was taken on point A and the instrument was shifted after 2nd, 6th and 9th reading.

Station	BS	IS	FS	Rise	Fall	RL $\uparrow$	Remark
BM	1.175					175.680	BM
1	1.835		2.605	-	1.430	174.250 (1)	CP₁
2		2.405		-	0.570	173.680 (2)	
3		1.145		1.260	-	174.940 (3)	
4	1.115		0.965	0.180	-	175.120 (4)	CP₂
5		1.785		-	0.670	174.450 (5)	
6	1.645		1.225	0.560	-	175.010 (6)	CP₃
7			1.715	-	0.070	174.940 (7)	
	$\Sigma BS =$ 5.770		$\Sigma FS =$ 6.510	$\Sigma Rise =$ 2.000	$\Sigma Fall =$ 2.740		

=> Arithmetic check:

$$\Sigma BS - \Sigma FS = \Sigma Rise - \Sigma Fall = \underset{RL}{Last} - \underset{RL}{First}$$

$$5.770 - 6.510 = 2.000 - 2.740 = 174.940 - 175.680$$

$$\therefore \ -0.74 = -0.74 = -0.74$$

9 The following staff reading were taken with a dumpy level. The instruments was shifted after the 4th, 7th and 10th reading. RL of the starting BM is 100 m. Enter the readings in the from a level book Page and reduce the level by HI method and apply the usual checks.

2.64, 3.640, 3.820, 4.270, 4.650, 0.480, 0.970, 1.750, 2.950, 3.580, 4.780, 4.910

Station	BS	IS	FS	HI	RL	Remark
BM	2.640			102.64	100	BM
BM	2.640			↑	99 (1)	
1		3.640			98.820 (2)	
2		3.820			98.370 (3)	
3	4.650		4.270	103.020	102.540 (4)	CP$_1$
4			0.480		102.050 (5)	
5	1.750		0.970	103.800	100.850 (6)	CP$_2$
6		2.950			100.220 (7)	
7	4.780		3.580	105.000	100.090 (8)	CP$_3$
8			4.910			
	$\Sigma BS =$		$\Sigma FS =$			
	13.820		13.730			

$$\Sigma BS - \Sigma FS = \text{Last RL} - \text{First RL}$$

$$13.820 - 13.730 = 100.090 - 100.00$$

$$0.09 = 0.09$$