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312339 - Basic Surveying (Sem II)

As per MSBTE's K Scheme

CE / CR / CS

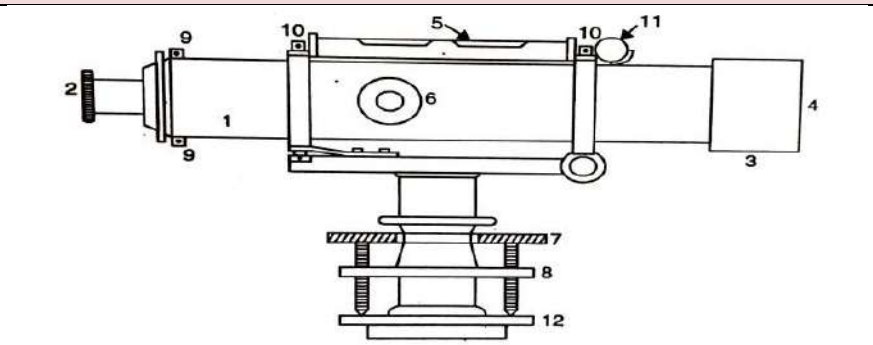
Unit IV	Levelling And Contouring	Marks - 34

S. N.	MSBTE Board Asked Questions	Exam Year	Marks
1	**Enlist various methods of levelling.**	S18	4M
Ans.	**Methods of leveling:** i. Simple levelling ii. Differential levelling iii. Longitudinal levelling iv. Cross section levelling v. Fly levelling vi. Check levelling vii. Reciprocal levelling **viii.** Profile levelling		
2	**Define "Contour" and "Contour line".**	S18	2M
Ans.	**Contour:** An imaginary line on the ground, joining the points of same elevation or same R.L's is called as 'Contour'. **Contour line:** A line passing through points of equal elevation or equal R.L's is called as contour line. OR The line of intersection of a level surface with ground surface is known as contour line.		

3	**Explain Temporary adjustment of dumpy level.**	**S18**	**4M**

Ans

- **Setting up the level.**
  - i. The level fixed on tripod.
  - ii. The legs of tripod stand are well spread so that the level will remain stable on tripod.
  - iii. Bring all the three foot screws in the Centre of their run so that they can be turned clockwise or anticlockwise as required, for Levelling purpose.
  - iv. Adjust the height of the instrument so that the observer can Comfortably see through the telescope and note the readings.
  - v. Fix two legs of tripod and adjust third leg in such a way that the levelling head will become as horizontal as possible by eye judgment.
- **Levelling up the level.**
  - i. The base of the tripod is already leveled with the help of cross bubble.
  - ii. To make accurate adjustment of the level, the longitudinal level is adjusted in the Centre of its run, with the help of three foot screws.
  - iii. Make the bubble parallel to the any selected pair of foot screws.
  - iv. Now; turn both the foot screws either inward or outward with the help of foot screws till the bubble appears in the center.
  - v. Turn the telescope through 90° and now with the help of third screw bring the bubble of levelling tube in the center.
  - vi. Repeat above process, until bubble will remain at centre in both position. Then levelling is said to be completed.
- **Focusing the eye piece.**
  - i. Hold a sheet of white paper in front of the objective glass 4 to 6 cm away from objective glass and see through the eye piece.
  - ii. Turn the eye piece inwards or outwards in the socket so that the cross hair on the diaphragm appears sharp and clear.
- **Focusing the object glass.**
  - i. Direct the telescope towards any object, say a levelling staff in the field which is kept at a distance. See through eyepiece whether the staff is visible, distinct or not.
  - ii. If not, then turn the focusing screw till the image is distinct and clear.
  - iii. The cross hair on the diaphragm should also be seen clearly.

4	**Explain importance of benchmark in levelling.**	**S18**	**4**
Ans.	i. As bench mark is the ground point whose elevation or R.L. is known or preassumed; the back sight reading (first reading) is taken on it. This back sight (BS) reading is useful to calculate height of instrument (HI) in line of collimation. This HI is useful to calculate R.L.'s of other ground points, in all types of levelling. ii. Thus bench mark (BM) is essential to commence the survey work. It is not possible to calculate reduced levels (RL's) of ground points without knowing BM. iii. The BM is important to check the RL calculations by applying arithmetical checks in both methods i.e. HI method and Risefall method. iv. The BM is useful to check the one day's observation through check levelling.		
5	**Draw sketch of dumpy level and name all parts.**	**S18**	**4M**
Ans	 DUMPY LEVEL 1. TELESCOPE 2. EYE-PIECE 3. RAY SHADE 4. OBJECTIVE END 5. LONGITUDINAL BUBBLE 6. FOCUSING SCREWS 7. FOOT SCREWS 8. UPPER PARALLEL PLATE (TRIBRACH) 9. DIAPHRAGM ADJUSTING SCREWS 10. BUBBLE TUBE ADJUSTING SCREWS 11. TRANSVERSE BUBBLE TUBE 12. FOOT PLATE (TRIVET STAGE)		
6	**Explain four uses of contour map.**	**S18**	**4**
	Following are uses of contour map: i. To draw longitudinal section and plan of given map. ii. To determine inter-visibility between two points. iii. To trace contour gradient and to locate route for alignments of railways, roadways, canals etc. iv. To measurement of drainage areas. v. To calculate reservoir capacity. vi. To find intersection of surfaces and measurement of earth work. vii. To determine nature of ground in proposed area.		

7 | **Differentiate between height of instrument and rise and fall method.** | **S-18 W-18** | **4M**

Ans

	Height of Instrument Method		Rise and Fall Method
I	This method is a fast method and is less tedious because it requires less calculations.	I	This method is a slower method than H.I. method as it involves more calculations.
II	There is no check on R.L.s of intermediate stations	II	There is a complete check on all calculation work.
III	Following check is applied, $\Sigma BS - \Sigma FS$ = Last R.L. – First R.L.	III	Following check is applied, $\Sigma BS - \Sigma FS$ = Σ Rise – Σ Fall = Last R.L. – First R.L.
IV	Error in calculations of RLs of intermediate stations is not carried forward.	IV	Error in calculations of RLs of intermediate stations is carried forward.
V	This method is less accurate.	V	This method is more accurate.
VI	It is used for calculations of profile levelling in construction works such as canals, roads etc.	VI	It is used for calculations of precise levelling works, check levelling.

8 | **Following consecutive readings were taken with a level on 4 m staff on continuously slopping ground at common interval 30 m.**
0.76, 1.515, 1.935, 2.400, 2.985, 3.650, 1.015, 1.855, 2.495, 3.57, 0.875, 1.085, 1.790, 2.450.
RL of first point is 200.500 m.
Calculate RL of all points by HI method. | **S18** | **6**

Ans

Staff Stn.	BS	IS	FS	HI	RL	Remark
0	0.760			201.26	200.500	First RL
30		1.515			199.745	
60		1.935			199.325	
90		2.400			198.860	
120		2.985			198.275	
150	1.015		3.650	198.625	197.610	CP1
180		1.855			196.770	
210		2.495			196.130	
240	0.875		3.570	195.930	195.055	CP2
270		1.085			194.845	
300		1.790			194.140	
330			2.450		193.480	Last RL
Σ	**2.650**		**9.670**			

Check:
Σ BS – Σ FS = Last R.L. – First R.L.
2.65 – 9.67 = 193.48 – 200.50
- 7.02 = - 7.02

9	**Following consecutive readings are taken on leveling staff on continuous sloping ground at an interval 25m.** **0.950, 1.615, 1.925, 2.515, 2.895, 3.495, 1.125, 1.980, 2.450, 3.750, 0.925, 1.455, 1.750, 2.850.** **The RL of first point 100.000 m. Rule out page of level of field book and enter the above reading. Calculate RL of all points by rise and fall method. Also find gradient of line joining first and last point**	**S18**	**6**

Ans

Sr. No.	Chainage	BS	IS	FS	Rise	Fall	RL	Remark
1	0	0.950					100.000	First RL
2	25		1.615			0.665	99.335	
3	50		1.925			0.310	99.025	
4	75		2.515			0.590	98.435	
5	100		2.895			0.380	98.055	
6	125	1.125		3.495		0.600	97.455	C.P.1
7	150		1.980			0.855	96.600	
8	175		2.450			0.470	96.130	
9	200	0.925		3.750		1.300	94.830	C.P.2
10	225		1.455			0.530	94.300	
11	250		1.750			0.295	94.005	
12	275			2.850		1.100	92.905	Last RL
	Σ	**3.000**		**10.095**	**0**	**7.095**		

Check: Σ B.S.-Σ F.S. = Σ Rise -Σ Fall = Last R.L. -First R.L.

3.00 – 10.095 = 0 - 7.095 = 92.905 – 100.000

-7.095 = -7.095 = -7.095

Gradient = (Last RL – First RL) / Distance

= (92.905 – 100.000) / 275

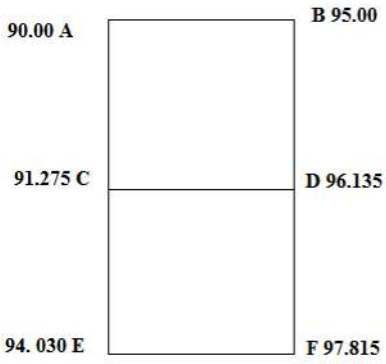
= -0.0258

= -1 / 38.75

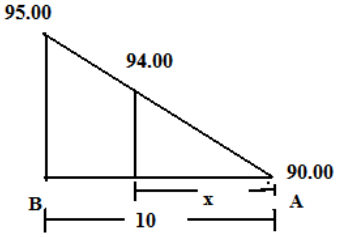
i.e. 1 in 38.75 falling gradient

10	Counter survey data of a field is shown in given figure. Draw 94.000 m contour line by linear interpolation method. Show all the calculations grid size is 10 m x 10 m.	S18	6M

Ans



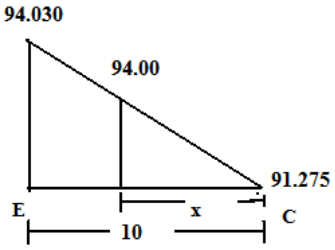
Ans:



$$\frac{95.00 - 90.00}{10} = \frac{94.00 - 90.00}{x}$$

$$\frac{5}{10} = \frac{4}{x}$$

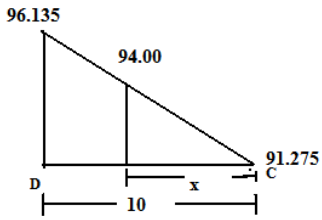
$x = 8.0$



$$\frac{94.030 - 91.275}{10} = \frac{94.00 - 91.275}{x}$$

$$\frac{2.755}{10} = \frac{2.725}{x}$$

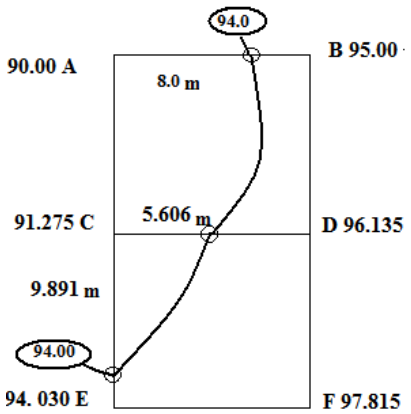
$x = 9.891$ m



$$\frac{96.135 - 91.275}{10} = \frac{94.00 - 91.275}{x}$$

$$\frac{4.86}{10} = \frac{2.725}{x}$$

$x = 5.606$ m



11	Find the missing readings marked as „X" and apply the usual	S18	6M

Ans.

Stn.	B.S.	I.S.	F.S.	Rise	Fall	R.L.	Remark
1	2.345					129.50	BM1
2	1.650		X	0.035			
3		2.210			X		
4	X		1.850	X			
5	1.850		1.925		0.455		C.P.
6			X	0.37		129.00	

Check

2.345 – X = 0.035

X = 2.310

1.650 – 2.210 = X

X = 0.560

2.210 – 1.850 = X

X =0.360

X – 1.925 = - 0.455

X = 1.470

1.850 –X = 0.37

X = 1.480

Stn.	B.S.	I.S.	F.S.	Rise	Fall	R.L.	Remark
1	2.345					129.500	First RL
2	1.650		**2.310**	0.035		**129.535**	CP1
3		2.210			**0.560**	**128.975**	
4	**1.470**		1.850	**0.360**		**129.335**	CP2
5	1.850		1.925		0.455	**128.880**	CP3
6			**1.480**	0.370		**129.250**	Last RL
Σ	**7.315**		**7.565**	**0.765**	**1.015**		

Check :

Σ B.S.-Σ F.S. = Σ Rise -Σ Fall = Last R.L. – First R.L.

7.315 –7.565 = 0.765 - 1.015 = 129.50 – 129.25

- 0.25 = - 0.25 = - 0.25

12	Define the term "line of sight".	W18	2M

Ans.

It is the line joining the intersection of cross hairs of diaphragm to the Optical center of object glass and its continuation. It is also called as Line of collimation.

13	**Define the following terms:** **i) Level line ii) Bench Mark iii) Change point** **iv) Profile levelling**	**W18**	**4M**
Ans	**i. Level line –** It is line lying in a level surface; it is therefore, normal to the plumb line at all points. **ii. Bench Mark –** These are fixed points or marks of known RL determined with reference to the datum line. They serve as reference points for finding RL of new points. **iii. Change point –** It is the point at which both back sight and foresight readings are taken before and after shifting the level instrument. **iv. Profile levelling –** The process of determining the elevations of a series of points at measured intervals along a line such as the centerline of a proposed ditch or road or the centerline of a natural feature such as a stream bed.		
14	**List the sources of errors in levelling and explain any one in detail. Sources of error in leveling**	**W18**	**4**
Ans.	**The following are the different sources of error in leveling :** 1. Instrumental Errors. 2. Personal Errors. 3. Errors due to Natural Causes. **1. Instrumental Errors** i. The permanent adjustment of the instrument may not be perfect. That is the line of collimation may not be parallel to the axis of the bubble tube. ii. The internal arrangement of the focusing tube is not perfect. iii. The graduation of the levelling staff may not be perfect. **2. Personal Errors** i. The instrument may not be levelled perfectly. ii. The focusing of the eyepiece and object glass may not be perfect and the parallax may not be eliminated entirely. iii. The position of the staff may be displaced at the change point at the time of taking FS and BS readings. iv. The staff may appear inverted when viewed through the telescope. By mistake, the staff readings may be taken upwards instead of downwards.		

	v. The reading of the stadia hair rather than the central collimation hair may be taken by mistake. vi. A wrong entry may be made in the level book. vii. The staff may not be properly and fully extended **3. Errors due to Natural Causes** i. When the distance of sight is long, the curvature of the earth may affect the staff reading. ii. The effect of refraction may cause a wrong staff reading to be taken. iii. The effect of high winds and a shining sun may result in a wrong staff reading.		
15	**Explain Types of bench marks.**	**W-18, W-19**	**4M**
Ans	**1. GTS Bench-Marks –** These bench-marks are established by the Survey of India Department at large intervals all over the country. The values of reduced levels, the relevant positions and the number of bench-marks are given in a catalogue published by this department. **2. Permanent Bench-Marks –** These are fixed points or marks established by different Government departments like PWD, Railways, Irrigation, etc. The RLs of these points are determined with reference to the GTS bench-mark, and are kept on permanent points like the plinth of a building, parapet of a bridge or culvert and so on. Sometimes they are kept on underground pillars. **3. Arbitrary Bench-Marks –** When the RLs of some fixed points are assumed. They are termed arbitrary bench-marks. These are adopted in small survey operations when only the undulation of the ground surface is required to be determined. 4. **Temporary Bench-Marks** - When the bench-marks are established temporarily at the end of a day's work, they are said to be temporary bench-marks They are generally made on the root of a tree, the parapet of a nearby culvert, a furlong post, or on a similar place		

16	**State any eight component parts with its functions of dumpy level.**	**W18**	**4**
Ans.	i. **Levelling head (Trivet) –** To support foot screws ii. **Foot screw –** To regulate the tribrach position and hence the instrument can be leveled. iii. **Tribrach –** To support trivet and foot screw, the horizontal level of the instrument can be achieved by adjusting this tribrach plate. iv. **Circular compass –** For taking magnetic bearing of line when required. v. **Telescope –** To bisect the object appropriately or to observe the distant object through line of sight provided by its arrangement. vi. **Eyepiece –** To view the distant object. It contains magnifying glass which magnify the observing image and also the cross hairs of diaphragm. So, accurate reading can be obtained. vii. **Focusing screw –**To adjust and focus cross hairs and the image clearly. The magnification of eye piece is managed by this focusing screw. viii. Diaphragm - It contains cross hairs made of dark metal which are arranged in perfect perpendicular positions. These cross hairs are used by the eye piece to bisect the objective through objective lens. viii. **Longitudinal bubble / Cross bubble tube** – to check the level of instrument ix. **Shade –** to prevent the objective lens from sunlight or any other light rays which may cause disturbance to the line of sight		
17	**State the methods of contouring and explain any one in detail.**	**W18**	**4**
19	Methods of locating contours :- 1) Direct method 2) Indirect method i. Method of Squares (Block Contouring) ii. Method of cross section iii. Plane table method iv. Tachometric Method **1) Direct Method** The field work in contouring consists of horizontal and vertical control. The horizontal control for a small area can be exercised by a hain or tape and by compass, theodolite or plane table for a largearea. For vertical control either a level and staff or a hand level may be used.		

By Level and Staff - The method consists of locating a series of points on the ground having the same elevation. To do this an instrument ground station is selected so that it commands a view of most of the area to be surveyed. The height of the instrument is fixed from the nearest benchmark. For a particular contour value, the staff reading is worked out. The staff man is then directed to move right or left along the expected contour until the required reading is observed. A series of points having the same staff readings and thus the same elevations, are plotted and joined by a smooth curve.

By Hand Level -The principle used is the same as that used in the method using level and staff. However, this method is very rapid and is preferred for certain works. The instruments used are a hand level, giving an indication of the horizontal line from the eye of the observer and a level staff or a pole having a zero mark at the height of the observer's eye and graduated up and down from this point. Instead of the hand level, an Abney level may also be used. When an observation is made on the pole, the reading on it is the difference in elevation between the foot of the observer and that of the pole. In this method, the instrument man stands over the benchmark and the staff man is moved near to a point on the contour which has to be plotted. As soon as the instrument man observes the required staff reading for a particular ontour, he instruct the staff man to stop and locate the position of the point to be mapped. Reading for a particular contour, he instructs the staff man to stop and locates the Position of the point to be mapped point on as the instrument man.

2) Indirect Methods

i. Method of Squares or block contouring - This is also called coordinate method of locating contours. The entire area is divided into squares or rectangles forming a grid. The elevations of the corners are then determined by spirit levelling. Thereafter levels are interpolated. This method is very suitable for a small open area where contours are required at a close vertical interval.

ii. Method of cross section

iii. Plane table method

Tachometric Method

19	**The following readings were observed with a dumpy level. 1.265, 2.345,2.420,3.625,0.365,3.255,1.265,2.380 and 3.215 The instrument was shifted after fourth and sixth readings and first staff reading was taken on B.M of RL 335.435 m. Prepare the level page of field book, enter the readings and calculate the reduced levels of all the points by HI method. Also apply usual arithmetic checks.**	**W18**	**6**
Ans.			

Station	BS	IS	FS	HI	RL	Remark
1	1.265			**336.7**	**335.435**	B.M.1
2		2.345			**334.355**	
3		2.420			**334.280**	
4	0.365		3.625	**333.44**	**333.075**	CP-1
5	1.265		3.255	**331.45**	**330.185**	CP-2
6		2.380			**329.070**	
7			3.215		**328.235**	
	Σ BS = 2.895		**Σ FS = 10.095**			

Arithmetic check-

Σ BS - Σ FS = RL of Last Point – RL of First Point

2.895 – 10.095 = 328.235 – 335.435

-7.2 = -7.2

20	**Calculate the missing readings and apply arithmetical checks also.**	**W18**	**6**

Station	BS	IS	FS	Rise	Fall	RL	Remark
1	3.125					**123.68**	B.M.1
2	**2.265**		**1.80**	1.325		125.005	C P 1
3		2.320			0.055	**124.95**	
4		1.920		**0.4**		125.350	
5	**1.04**		2.655		**0.735**	124.615	C P 2
6	1.620		3.205		2.165	**122.45**	C P 3
7		3.625			**2.005**	**120.445**	
8			**1.48**	2.145		122.590	B.M.2

Ans.	**1. FS of station 2 :** Rise at station 2 = BS of station 1 - FS of station 2 1.325 = 3.125 – X X = 3.125 – 1.325 = 1.80 **2. BS of station 2** Fall at station 2 = BS of station 2 - IS of station 3 - 0.055 = X – 2.320 X = 2.265 **3. Rise at station 4**		

Rise at station 4 = IS of station 3- IS of station 4

= 2.320 – 1.920

= 0.40

4. Fall at station 5

Fall at station 5 = IS of station 4 - FS of station 5

= 1.920 - 2.655

= - 0.735

5. BS of station 5

Fall at station 6 = BS of station 5 - FS of station 6

- 2.165 = X – 3.205

X = 3.205 -2.165 = 1.04

Fall at station 7 = BS of station 6 - IS of station 7

= 1.620 - 3.625

= - 2.005

7. FS of station 8 :

Rise at station 8 = IS of station 7 - FS of station 8

2.145 = 3.625 – X

X = 3.625 – 2.145 = 1.48

8. RL of station 1

RL of station 1 + Rise at station 2 = RL of station 2

X + 1.325 = 125.005

X = 125.005 – 1.325 = 123.68

9. RL of station 3

RL of station 3 = RL of station 2 – Fall at station 3

X = 125.005 - 0.055

X = 124.95

10. RL of station 6

RL of station 6 = RL of station 5 – Fall at station 6

X = 124.615 – 2.165

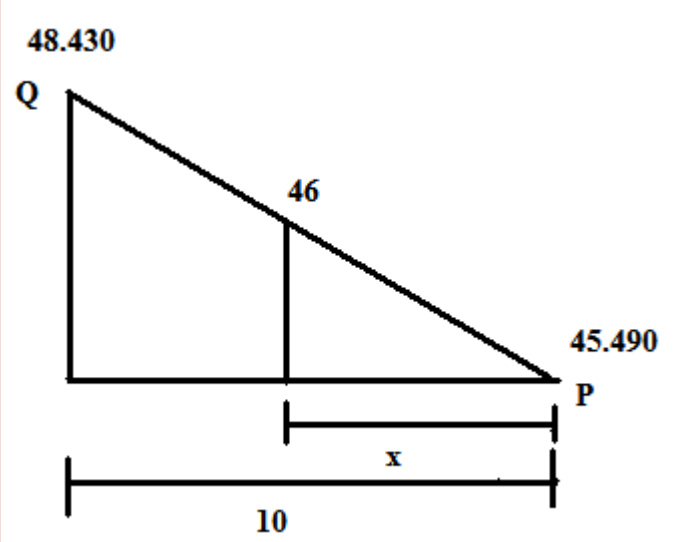
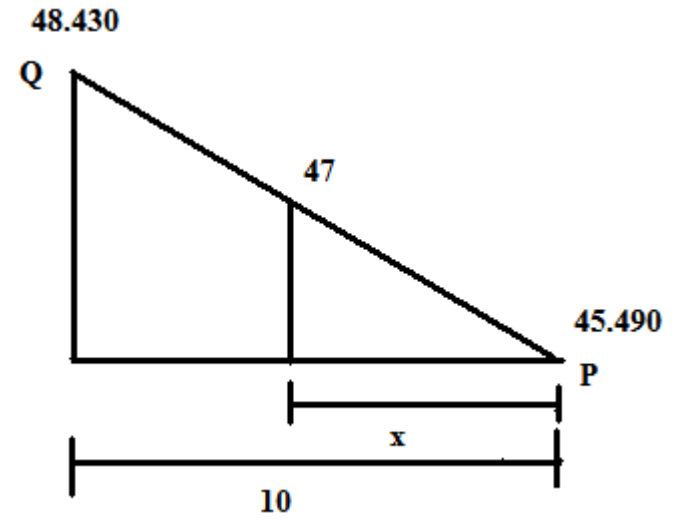
X = 122.45

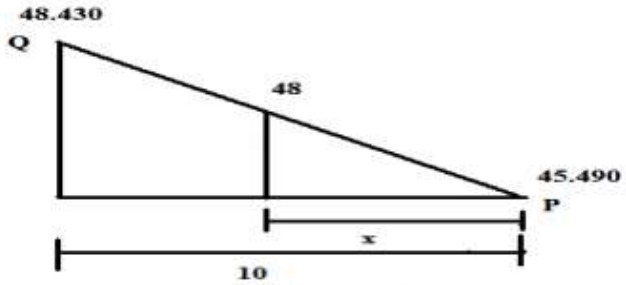
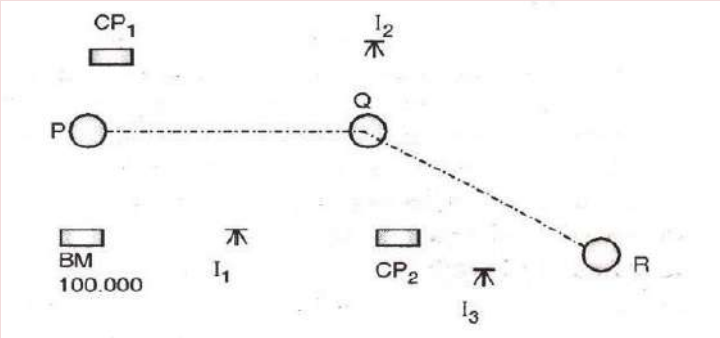
11. RL of station 7

RL of station 7 = RL of station 6 – Fall at station 7

X = 122.45 – 2.005

X = 120.445

	Arithmetic check- Σ BS - Σ FS = Σ Rise - Σ Fall = RL of Last Point – RL of First Point 8.05 – 9.14 = 3.87 – 4.96 = 122.590 – 123.680 -1.09 = -1.09 = -1.09		
21	**Points P and Q are two ground points at a distance of 10 m , with their reduced levels 45.490 and 48.430 m respectively . Interpolate the contours of 46, 47 and 48 m between points P and Q**  	**W-18**	**6m**
Ans.	$\frac{(48.430-45.490)}{10}=\frac{(46-45.490)}{x}$ $\frac{2.94}{10}=\frac{0.51}{x}$ $x = 1.734\ m$  		

	$\frac{(48.430-45.490)}{10}=\frac{(47-45.490)}{x}$ $\frac{2.94}{10}=\frac{1.51}{x}$ $x=5.136\ m$  $\frac{(48.430-45.490)}{10}=\frac{(48-45.490)}{x}$ $\frac{2.94}{10}=\frac{2.51}{x}$ $x=8.537\ m$		
22	**Define i) Back Sight Reading ii) Height of instrument**	**W-19**	**2M**
Ans.	**i. Back Sight Reading:** This is the first staff reading taken in any set up of the instrument after leveling has been perfectly done. This reading is always taken on a point of known RL i.e on bench mark or change point **ii. Height of instrument:** When the levelling instrument is properly levelled, the RL of the line of collimation is known as Height of instrument. This is obtained by adding the BS reading to the RL of the BM or CP on which the staff reading was taken.		
23	**Explain the procedure for profile levelling and cross Sectioning** **For Profile levelling:**  	**W19**	**4**
Ans.	1) Let PQR be the given centre line. 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.

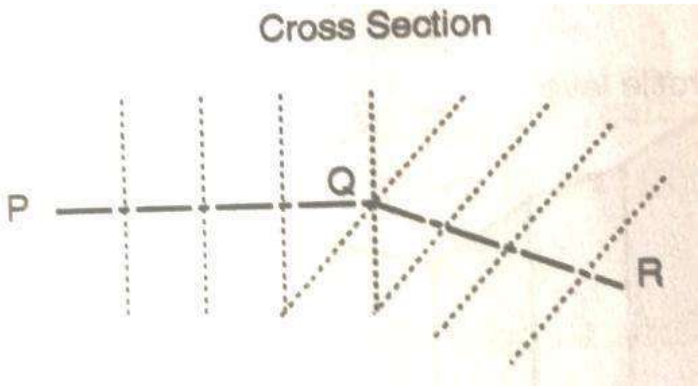
7) Beside these points, the staff readings are taken at the representative points. For example slope of ground surface changes appreciably.

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.

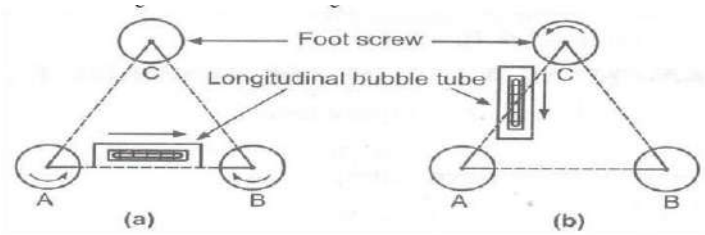
10) B.S is taken on CP1 and new HI is calculated.

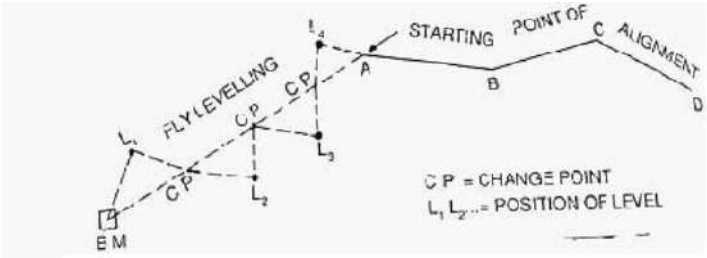
For cross Sectioning:



While profile leveling is in progress, cross-sectional leveling should also be done. The cross-sections are taken perpendicular to the Centre line of the alignment at some regular intervals (say 20m, 40m etc). The purpose of cross-sectional leveling is to know the undulation of the ground surface transverse to the centre of the road. The length depends upon the nature of the work. In case of ordinary work, the length may be 20 or 40 m on each side of the center line. The levels are taken at an interval of 5 m on each side. Additional readings may be taken if the nature of the ground surfaces suddenly changes

24	**State and explain the temporary adjustments of a dumpy Level.**	**W19**	**4**
Ans	1. Setting up the level. a. The level fixed on tripod. b. The legs of tripod stand are well spread so that the level will remain stable on tripod.		

	c. Bring all the three foot screws in the centre of their run so that they can be turned clockwise or anticlockwise as required, for levelling purpose d. Adjust the height of the instrument so that the observer can comfortably see through the telescope and note the readings. e. Fix two legs of tripod and adjust third leg in such a way that the levelling head will become as horizontal as possible by eye judgment. 2. Levelling up the level. a. The base of the tripod is already leveled with the help of cross bubble. b. To make accurate adjustment of the level, the longitudinal level is adjusted in the centre of its run, with the help of three foot screws. c. Make the bubble parallel to the any selected pair of foot screws. Now; turn both the foot screws either inward or outward with the help of foot screws till the bubble appears in the center. d. Turn the telescope through 900 as shown in fig. below and now with the help of third screw bring the bubble of levelling tube in the center.  3. Focusing the Eye piece. a. Hold a sheet of white paper in front of the objective glass 4 to 6 cm away from objective glass and see through the eye piece. b. Turn the eye piece inwards or outwards in the socket so that the cross hair on the diaphragm appears sharp and clear. 4. Focusing the Object glass. a. Direct the telescope towards any object, say a levelling staff in the field which is kept at a distance. See through eyepiece whether the staff is visible, distinct or not. b. If not, then turn the focusing screw till the image is distinct and clear. The cross hair on the diaphragm should also be seen clearly.		
26	**Explain Fly levelling and also state its purpose.**	**W19**	**4**
Ans	**Procedure:** 1. Set up the level at a point from where BM is visible and perform temporary adjustments. 2. Position of the level should be approximately midway between the BS and		

	FSstations. 3. Rotate the telescope towards the leveling staff on BM, observe and record the staff readings in the BS columns of the level book. 4. Take a FS on the point towards working site. This point would be change point(CP). 5. Shift the instrument to new position. First reading from the new instrument position is the BS on change point. 6. Continue the procedure till the readings on the suitable station at working site is recorded. 7. Return back by shortest route to the B.M and take the last reading on B. M 8. Find the elevations of the points by HI or rise and fall method. Last reading taken  **Purposes:** 1. Carrying of B.M to the required survey site. 2. At the end of survey works for checking the accuracy of survey. **3.** To connect the B.M at any intermediate point of the alignment**.**		
26	**The following consecutive readings were taken with a dumpy level and 4 m levelling staff on a continuously sloping ground at a common interval of 30 metre.** **3.820 on A, 3.125, 2.350, 1.580, 0.830, 3.500, 2.830,2.010, 1.400, 0.550, 3.650, 2.650, 1.850, 0.965 on B.** **The R.L. of A was 500 m, make up a level book page and apply usual checks.** **Use rise and fall method.**	**W19**	**6**

Ans

Station	BS	IS	FS	Rise	Fall	RL	Remark
A	3.820					**500.000**	Point A
1		3.125		0.695		500.695	
2		2.350		0.775		501.470	
3		1.580		0.770		502.240	
4	3.500		0.830			502.990	CP1
5		2.830		0.670		503.660	
6		2.010		0.820		504.480	
7		1.400		0.610		505.090	
8	3.650		0.550	0.850		505.940	CP2
9		2.650		1.000		506.940	
10		1.850		0.800		507.740	
B			0.965	0.885		**508.625**	Point B
	∑BS = **10.970**		∑FS = **2.345**	∑Rise = **8.625**	∑Fall = **00**		

Arithmetic check : ∑BS - ∑FS = ∑Rise - ∑Fall = Last RL – First RL = 8.625

27	**Determine the gradient of line 'AB' if the following readings were taken from A to B at a 30 m interval. 0.578, 0.933, 1.768, 2.450, 3.005, 0.567, 1.181, 1.888, 3.679, 0.612, 0.705 and 1.810.The instrument was shifted after 5th and 9th reading. The R.L. of first station was 100 m. Use H.I. method.**	**W19**	**6**

Ans

Station	Chainage	B.S	I.S	F.S	H.I	RL	Remark
A	00	0.578			100.578	**100.000**	Point A
1	30		0.933			99.645	
2	60		1.768			98.810	
3	90		2.450			98.128	
4	120	0.567		3.005	98.140	97.573	CP1
5	150		1.181			96.959	
6	180		1.888			96.252	
7	210	0.612		3.679	95.073	94.461	CP2
8	240		0.705			94.368	
B	270			1.810		**93.263**	Point B
		∑BS = **1.757**		∑FS = **8.494**			

Arithmetic check : ∑ BS - ∑ FS = Last RL – First RL = - 6.737

Vertical distance between A and B = 6.737.

Horizontal distance between A and B = 270

Gradient between A and B =

6.737

270 x100 = 2.495 %

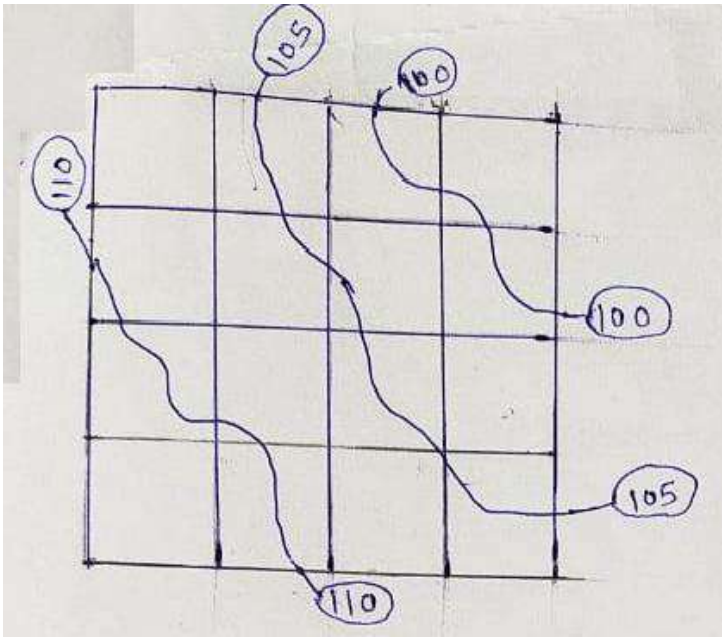
OR

Gradient = 6.737

270 = 1 270/6.737 = 1 40.077 = 1 in 40.077

28	Explain the characteristics of contour with suitable sketch.	W-19	6M

1. All points on contour lines have the same elevation.



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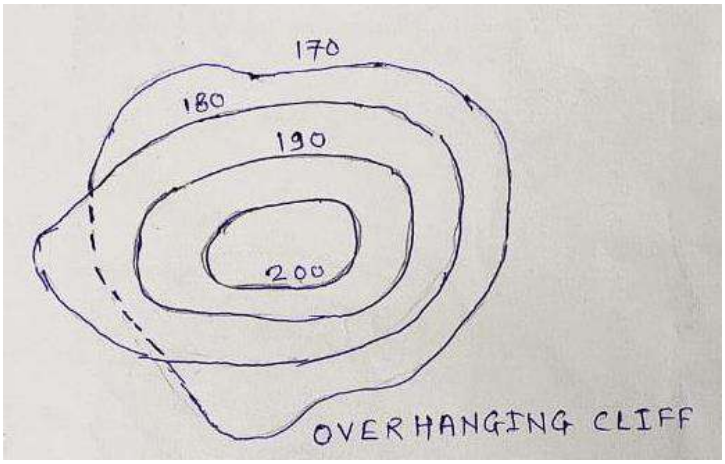
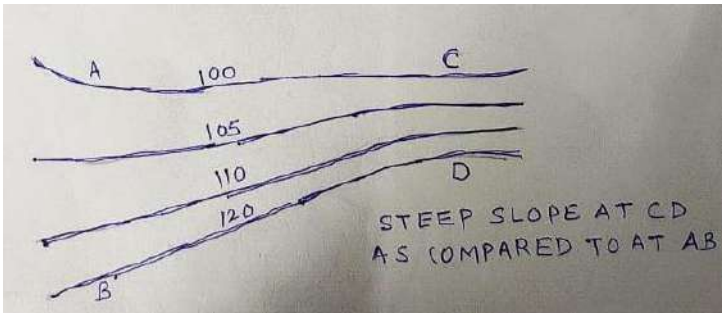
Two contours of different elevations can not cross each other except in overhanging cliff.

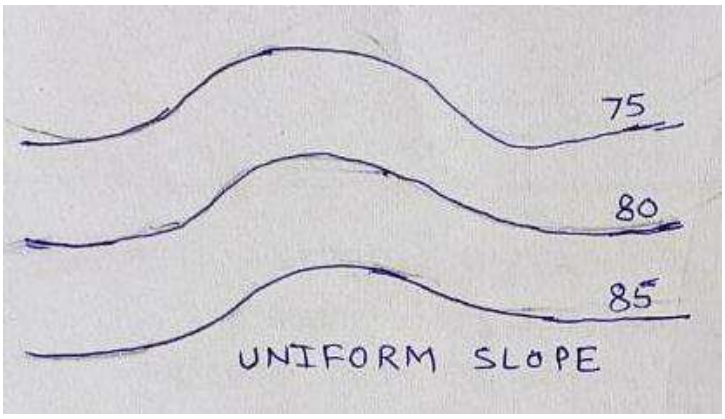
Ans



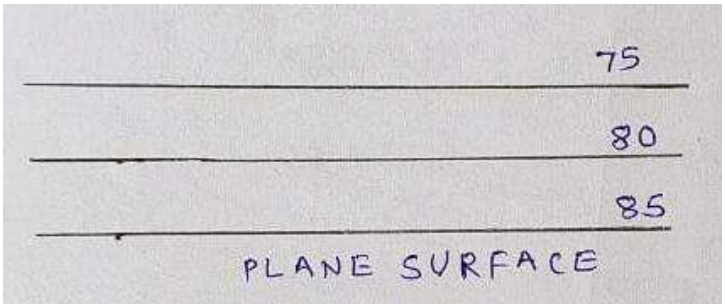
3. (i) When contour lines come close together, then it indicates steep slope.



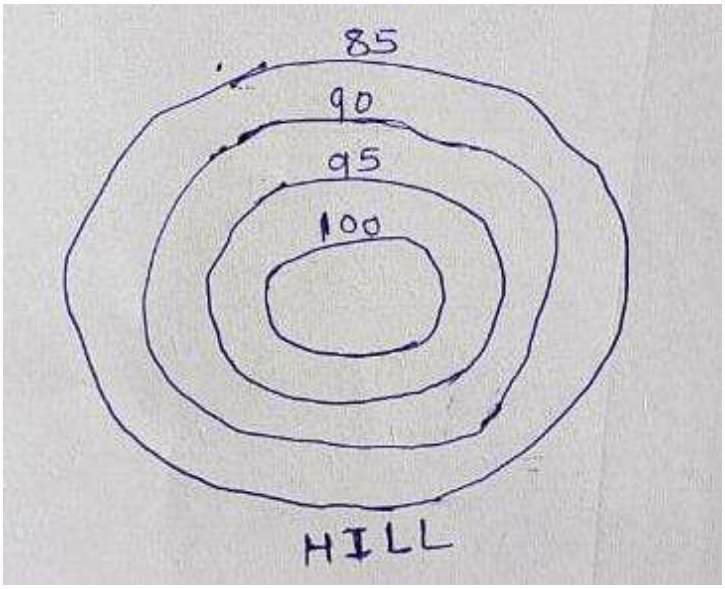
(ii) If contour lines are equally placed, uniform slope is indicated.



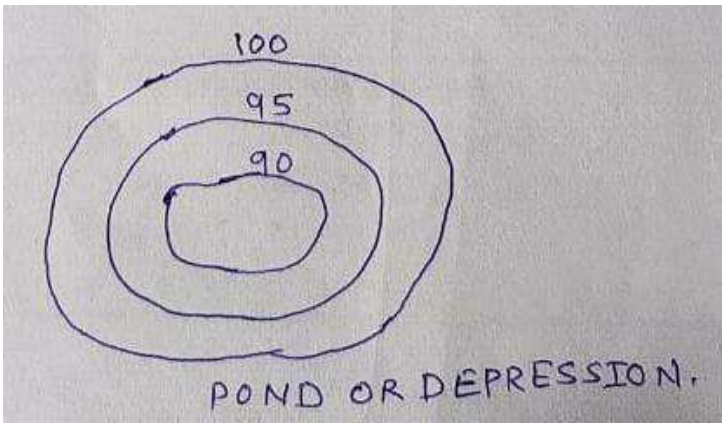
(iii) A series of straight, parallel and equally spaced contours represent a plan surface.



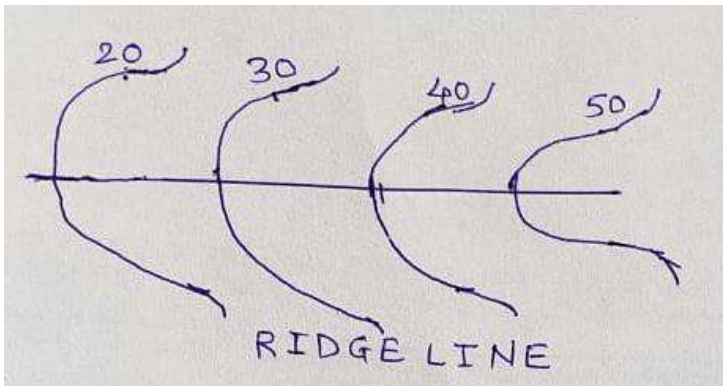
4. (i) Closed contour lines with higher values inside indicate hill.



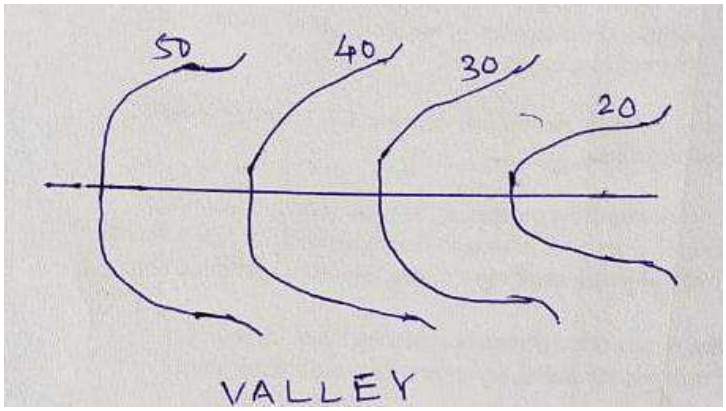
(ii) Closed contour lines with lower values inside indicate depression.



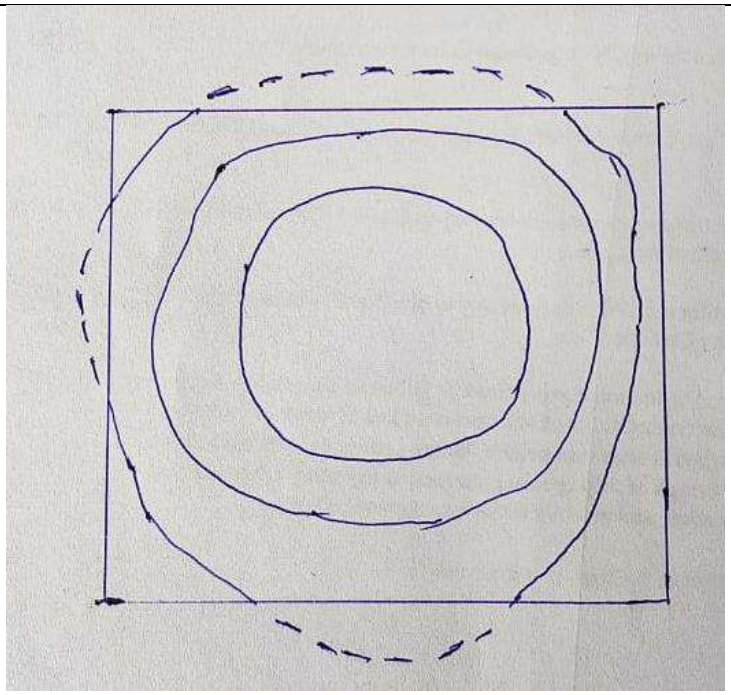
4. **(i) Ridge line and contour lines cross each other at right angle. For ridge line the higher elevation contour are inside the loop or bend.**

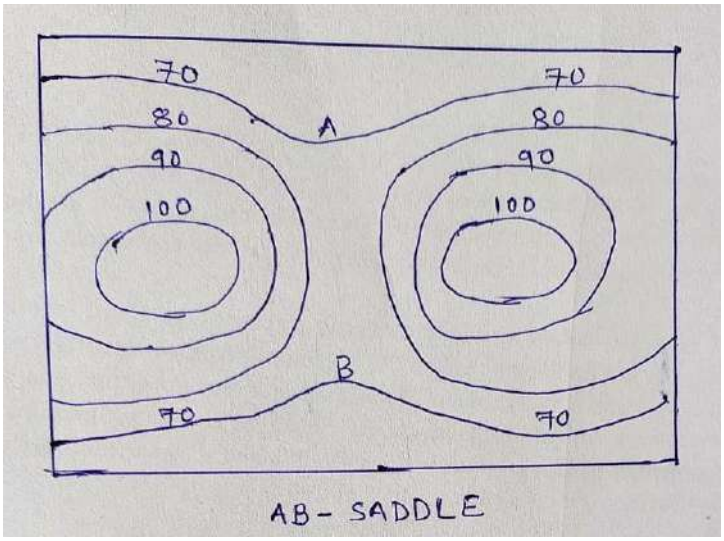


5. **(ii) Valley line and contour lines cross each other at right angle. Valley line is indicated by higher elevation contours outside the loop or bends.**



6. Contour lines can not end anywhere, but close on themselves either within or outside the limit of map.

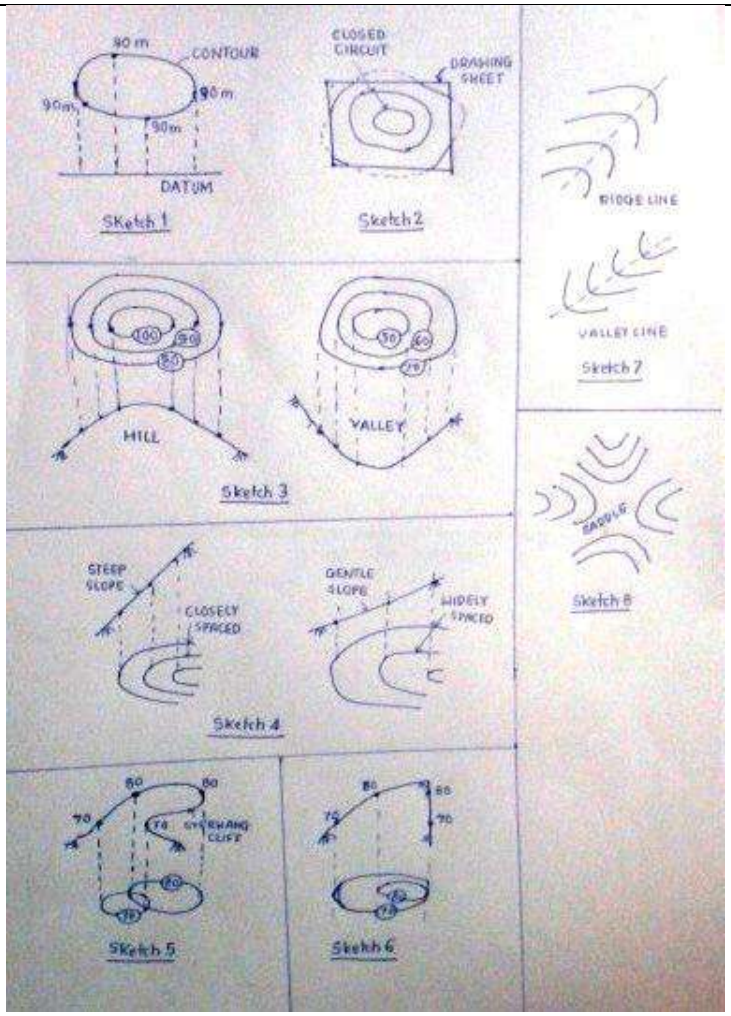




7. Saddle is the area between two hills on a ridge.

29	**State the use of Dumpy level**	**W-22**	**2M**
Ans.	**Use of Dumpy level are as follows**: 1. It is used for leveling. 2. It is used to determine relative height among different locations. 3. To determine relative distance among different locations. 4. It is used to prepare a contour.		
30	**Define offset.**	**W-22**	**2M**
Ans.	**Offset:** It is the lateral distance measured from the survey line to the object in right or left side is called as offset.		

31	**Define contour.**	**W-22**	**2M**
Ans.	**Contour:** It is an imaginary line on the ground joining the points of same elevation or same R.L's.		
32	**Define fly levelling.**	**W-22**	**2M**
Ans.	**Fly leveling:** It is the leveling operation in which only BS and FS are taken and no intermediate sights are observed.		
33	**Explain the characteristics of contour with neat sketches.**	**W-22**	**4M**
34	**The characteristics of contours are described in following statements with the help of necessary sketches.** 1. All the points on contour line represent same reduced level or equal elevation from reference level as shown in sketch 1. 2. Two contour lines always forms closed circuit within the boundary of drawing sheet as shown in sketch 2. 3. When the reduced levels goes on increasing at centre of contour, then it represent hill whereas when the R.L's goes on decreasing at centre, then it represent valley as shown in sketch 3. 4. The contour lines for steep slope in closely spaced while for gentle sloped ground it is widely spaced as shown in sketch 4. 5. The contour lines may intersect each other for overhanging cliff as shown in sketch 5. 6. The contour lines may overlap each other at a point for vertical cliff as shown in sketch 6. 7. The continuous increase and decrease in reduced level represents ridge and valley lines as shown in sketch 7. 8. The summit of four ridge lines represents saddle as shown in sketch 8.		

			
34	**State different types of bench marks and explain permanent bench mark.**	**W-22**	**4M**
Ans.	**Types of Benchmarks:** 1. Great trigonometrical survey bench mark 2. Permanent benchmark 3. Arbitrary benchmark 4. Temporary benchmark **Permanent Benchmark:** These are the benchmarks established by state government agencies like PWD. They are established with reference to GTS benchmarks. They are usually on the corner of plinth of public building		
35	**Define the following:** **i. Datum ii. Back sight iii. Fore sight iv. Change point**	**W-22**	**4M**
Ans	**1. Datum:** It is the imaginary level surface or level line from which the vertical distances of different points are measured.		

	2. Foresight: It is last staff reading taken before shifting the instrument. **3. Back sight:** It is first staff reading taken on a point of known elevation i.e. B.M. or change point. **OR** It is first reading taken after the level is set up and leveled. **4. Change point:** It is the point at which both back sight and foresight reading		
36	**Explain the procedure for determination of reduced levels by line of collimation.**	**W-22**	**4M**
Ans.	1. In this method, the RL of plane of collimation (HI) is found out for every set up of the level and then reduced levels of the points are worked out with respect plane of collimation. 2. Before starting work of leveling, we must prepare the level page of the field book		

Staff Station	Reading			HI	Reduced level	Remark
	BS	IS	FS			

3. Determine the RL of plane of collimation for the first set up of the level by adding BS to the RL of BM .(RL of plane of collimation = RL of B.M. + B.S)
4. Obtain the RL's of the intermediate points and the first change Point by subtracting the staff readings (RL of a point = RL of plane of collimation (HI) – IS or FS)
5. When the instrument is shifted and set up at new position take a back sight reading on change point. A new plane of collimation is determined by addition of B.S to R.L of change point.Thus, the levels from two set ups of the instruments can be correlated by means of B.S. and F.S taken on C.P R.L. of new collimation Point = R.L. of change point + B. S.reading
6. Find out RL 's of the successive points and the second C.P by subtracting their staff readings from tis plane of collimation RL
7. Repeat the procedure until all the RL's are worked out.

37	**State the advantages of tilting level and auto level.**	**W22**	**2M**
Ans.	**Advantages of tilting level:** 1. It is helpful in quick leveling.		

2. Ball and socket arrangements permits the head to be tilted and quickly locked nearly level.

Advantages of auto level:

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.

	The following readings were recorded with a dumpy level and a 4.0m staff: 2.500, 2.815, 3.100, 0.845, 2.720, 2.955, 3.150, 0.675, 1.405, and 1.840. The level was shifted after the third and seventh reading. The first reading was taken on BM having RL =100.000m. Calculate the RLs of all the stations by Rise and Fall method. Perform usual checks.	**W-22**	**4M**

Ans

Sr. No.	BS	IS	FS	Rise	Fall	RL	Remark
1	2.500			-		100.000	BM
2		2.815		-	0.315	99.685	
3	0.845		3.100	-	0.285	99.400	CP- I
4		2.720		-	1.875	97.525	
5		2.955		-	0.235	97.290	
6	0.675		3.150	-	0.195	97.095	CP- II
7		1.405		-	0.730	96.365	
8			1.840	-	0.435	95.930	Last Point
	∑BS= 4.02		∑FS= 8.09	∑Rise = 0	∑Fall= 4.07		

Check – |∑BS - ∑FS| = |∑Rise - ∑Fall |= |Last RL – first RL|

|4.02 - 8.09| = |0 - 4.07| = |95.390 - 100.00|

|4.07| = |4.07| = |4.07| Hence ok

Calculation:

Rise / Fall at point 2 = BS – IS = 2.500 - 2.815 = - 0.315

RL of point 2 = RL of point 1–Fall of Point 2 = 100.00–0.315= 99.685

Rise / Fall at point 3 = IS – FS = 2.815 – 3.100 = - 0.285

RL of point 3=RL of point 2 – Fall of Point 3 = 99.685-0.285= 99.400

Rise/Fall of point 4 = BS-IS = 0.845-2.720=-1.875

RL of point 4 = RL of point 3-Fall of point 4= 99.400-1.875= 97.525

Rise /Fall of point 5 = IS of point 4-IS of point 5= 2.720-2.955=-0.235

	RL of point 5 = RL of point 4 – Fall of point 5 = 97.525-0.235=97.290 Rise/Fall of point 6= IS-FS= 2.955-3.150 = -0.195 RL of point 6= RL of point 5-Fall of point 6 = 97.290-0.195 = 97.095 Rise /Fall of point 7 = BS-IS = 0.675-1.405 = -0.730 RL of point 7 = RL of point 6 – fall of point 7= 97.095-0.730 = 96.365 Rise/Fall of point 8 = IS- FS = 1.405 – 1.840 = -0.435 RL of point 8 = RL of point 7– Fall of point 7= 96.365-0.435 = 95.930		
39	**Explain the temporary adjustment required for dumpy level with neat sketch.**	**W-22**	**6M**
Ans	Temporary adjustments required for dumpy level are as follows: **1. Setting up the level:** a. The level fixed on tripod. b. The legs of tripod stand are well spread so that the level will remain stable on tripod. c. Bring all the three foot screws in the Centre of their run so that they can be turned clockwise or anticlockwise as required, for levelling purpose. d. Adjust the height of the instrument so that the observer can comfortably see through the telescope and note the readings. e. Fix two legs of tripod and adjust third leg in such a way tha the levelling head will become as horizontal as possible by eye judgment. **2. Leveling up the level:** a. The base of the tripod is already leveled with the help of cross bubble. b. To make accurate adjustment of the level, the longitudinal level is adjusted in the Centre of its run, with the help of three foot screws. c. Make the bubble parallel to the any selected pair of foot screws. Now; turn both the foot screws either inward or outward with the help of foot screws till the bubble appears in the center. d. Turn the telescope through 900 as shown in fig. below and now with the help of third screw bring the bubble of levelling tube in the center. **3. Focusing the Eye piece:** a. Hold a sheet of white paper in front of the objective glass 4 to 6 cm away from objective glass and see through the eye piece. b. Turn the eye piece inwards or outwards in the socket so that the cross hair on the diaphragm appears sharp and clear.		

	4. Focusing the Object glass: a. Direct the telescope towards any object, say a levelling staff in the field which is kept at a distance. See through eyepiece whether the staff is visible, distinct or not. b. If not, then turn the focusing screw till the image is distinct and clear. The cross hair on the diaphragm should also beseen clearly		
40	**Explain Arithmetic method of Interpolation of contours.**	**W-22**	**6M**
Ans	**Arithmetic method of interpolation of contour is as follows:** 1. This is very tedious but accurate method. 2. It is used for small areas where accurate results are necessary. **The contours are interpolated as under:** Suppose A and B are two points at a distance of 30 m and the reduced level of A and B are 25.45m and 27.54m respectively . Taking the contour interval as 1m, 26 and 27 m contours may be interpolated in between A and B. The difference of level between A and B is 2.09m. The difference of level between A and 26 m and A and 27m is 0.55m and 1.55 m respectively. Therefore the horizontal distance between A and 26 m contour = 0.55/2.09 x 30m = 7.89m The horizontal distance between A and 27 m contour =1.55/2.09 x 30m = 22.248 m. These distances are then plotted to scale on the map		
41	**State and explain the types of errors in leveling.**	**W-22**	**6M**
Ans	The types of errors in leveling are as follows: **Instrumental Errors:** 1. Error due to imperfect adjustment: When the level is not in adjustment, line of sight will be inclined upwards and downwards and this will cause serious errors. 2. Bubble being sluggish: If the bubble is sluggish it may apparently be in the centre though the bubble line not horizontal. 3. **Faulty focussing tube:** The focussing tube is faulty. Due to this, the objective does not move in horizontal plane but moves in inclined direction during focussing. 4**. The levelling staff:** Erroneous divisions of the levelling staff will cause some errors.		

	Personal Errors: **1. Errors of manipulation:** a) Careless levelling of the instrument. b) The bubble not being exactly centre while sighting. c) Resting the hand on tripod legs while taking staff reading. d) The staff not being held exactly vertical. **2. Imperfect sighting:** The error is caused due to poor focusing of eye piece and object glass. **3. Error due to settlement of staff and level:** The level, staff or change point settles if proper precautions are not taken and cause cumulative errors and may be very serious. **Natural Errors:** 1. Curvature of earth. 2. Refraction. 3. Effect of wind and sun on the level.

Thank You