**1a) Methods of levelling**

**Height of collimation system**

**Advantages**

* It is rapid as it involves few Calculation
* There are two checks on the accuracy of RL calculation
* This system is suitable for longitudinal leveling where number of intermediate sights
* Visualization is not necessary regarding the nature of the ground

**Disadvantages**

* There is no check on the RL of the intermediate sight
* Errors in the intermediate RLs cannot be detected.

**Rise and fall system**

**Advantages**

* There is a check on the RL of the intermediate points
* Errors in the intermediate RLs can be detected as all the points are correlated
* There are three checks on the accuracy of RL calculation
* This system is suitable where there are no intermediate sights

**Disadvantages**

* It is laborious involving several calculations.
* Visualization is necessary regarding the nature of the ground

**1b)**

RL=110+matric No.=110+46=156

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| B.S | I.S | F.S | H OF C | R.L | DISTANCE | REMARKS |
| 0.771 |  |  | 156.771 | 156 | 0 | RL |
| 0.802 |  | 1.52 | 156.053 | 155.251 | 10 | CP |
|  | 2.311 |  |  | 153.742 | 20 |  |
| 3.580 |  | 1.990 | 157.643 | 154.063 | 30 | CP |
|  | 1.220 |  |  | 156.423 | 40 |  |
|  | 3.675 |  |  | 153.968 | 50 |  |
| 2.408 |  | 4.020 | 156.031 | 153.623 | 60 | CP |
|  | 0.339 |  |  | 155.692 | 80 |  |
| 0.780 |  | 0.157 | 156.654 | 155.874 | 90 | CP |
|  | 1.535 |  |  | 155.119 | 100 |  |
|  | 1.955 |  |  | 154.699 | 110 |  |
|  | 2.430 |  |  | 154.224 | 120 |  |
|  | 2.985 |  |  | 153.669 | 130 |  |
| 1.155 |  | 3.480 | 154.329 | 153.174 | 140 | CP |
|  | 1.960 |  |  | 152.369 | 150 |  |
|  | 2.365 |  |  | 151.964 | 160 |  |
| 0.935 |  | 3.640 | 151.624 | 150.689 | 170 | CP |
|  | 1.045 |  |  | 150.579 | 180 |  |
|  | 1.630 |  |  | 149.994 | 190 |  |
|  |  | 2.545 |  | 146.079 | 200 |  |
| $Σ$=10.431 |  | $Σ$=17.352 |  |  |  |  |

HC=RL+BS

HC(1)=156+0.711=156.771

RL=HC-FS

RL(1)=156.771-1.52=155.251

HC(2)=155.251+0.802=156.053

RL(2)=156.053-2.311=153.742

RL(3)=156.053-1.990=154.063

HC(3)=154.063+3.580=157.643

RL(4)=157.643-1.220=156.423

RL(5)=157.643-3.675=153.968

RL(6)=157.643-4.020=153.623

HC(4)=153.623+2.408=156.031

RL(7)= 156.031-0.339=155.692

RL(8)= 156.031-0.157=155.874

HC(5)=156.654+0.780=156.654

RL(9)= 156.654-1.535=155.119

RL(10)= 156.654-1.955=154.699

RL(11)= 156.654-2.430=154.224

RL(12)= 156.654-2.985=153.669

RL(13)= 156.654-3.480=153.174

HC(6)=154.329+1.155=154.329

RL(14)= 154.329-1.960=152.369

RL(15)= 154.329-2.365=151.964

RL(16)= 154.329-3.640=150.689

HC(7)=150.689+0.935=151.624

RL(17)= 151.624-1.045=150.579

RL(17)= 151.624-1.630=149.994

RL(17)= 151.624-2.545=146.079

Check=$ΣF.S-ΣB.S$=R.L at first point-R.L at last point

 =6.921=6.921

QUESTION 2

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Chainage(m) | 0 | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 |
| Offset length(m) | 0 | 2.65 | 3.80 | 3.75 | 4.65 | 3.60 | 5.00 | 5.80 | 6.10 | 5.85 |

Using Mid-ordinate rule:

A=$Σ$hd

h1= $\frac{0+2.65}{2}$=1.325m

h2= $\frac{2.65+3.80}{2}$=3.225m

h3= $\frac{3.80+3.75}{2}$=3.775m

h4= $\frac{3.75+4.65}{2}$=4.2m

h5= $\frac{4.65+3.60}{2}$=4.125m

h6= $\frac{3.60+5.00}{2}$=4.3m

h7= $\frac{5.00+5.80}{2}$=5.4m

h8= $\frac{5.80+6.00}{2}$=5.9m

h9= $\frac{6.00+5.85}{2}$=5.925m

$$Σh=1.325+3.225+3.775+4.2+4.125+4.3+5.4+5.9+5.925$$

$Σh=$38.175m

d=30m

A=$Σhd$

= $38.175×30$

A= $1145.25m^{2}$

Using average ordinate rule

A=$\frac{ndΣO}{n+1}$

n=9

d=30

$$ΣO=0+2.65+3.80+3.75+4.65+3.60+5.00+5.80+6.10+5.85$$

$ΣO=$41.2m

A=$\frac{9×30×41.2}{9+1}$

A=$112.4m^{2}$

Using trapezoidal rule

A=$d(\frac{0\_{1}+0\_{n }}{2}+0\_{2}+0\_{3}+0\_{4}............0\_{n-1})$

$$d=30$$

A=$30(\frac{0+5.85}{2}+2.65+3.80+3.75+4.65+3.60+5.00+5.80+6.10)$

A=$30(38.275)$

A=$1148.25m^{2}$

Using Simpson's rule

$$A=\frac{d }{3 }\left[\left(0\_{1}+0\_{n}\right)+4\left(0\_{2}+0\_{4}+.........0\_{n-1}\right)+2\left(0\_{3}+0\_{5}........0\_{n-1}\right)\right]$$

$$d=30$$

Note: Last offset was removed because number of offsets were even

$$A=\frac{30}{3 }\left[\left(0+6.10\right)+4\left(2.65+3.75+3.60+5,80\right)+2\left(3.80+4.65+5.00\right)\right]$$

$$A=962m^{2}$$

Calculating for last offset using trapezoidal rule

A=$d(\frac{0\_{1}+0\_{n }}{2}+0\_{2}+0\_{3}+0\_{4}............0\_{n-1})$

$$A=30\left[\frac{6.40+5.85}{2}\right]$$

$$A=183.75m^{2}$$

Therefore $ΣA=962+183.75$

$$A=1145.75m^{2}$$