Model Answer: Winter- 2018

Subject: Basic Surveying

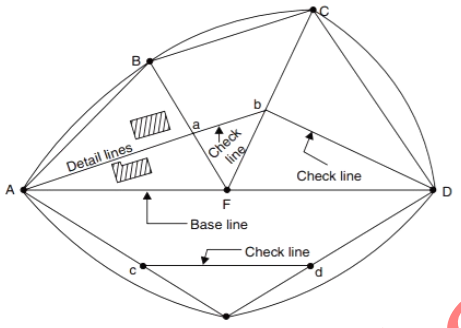
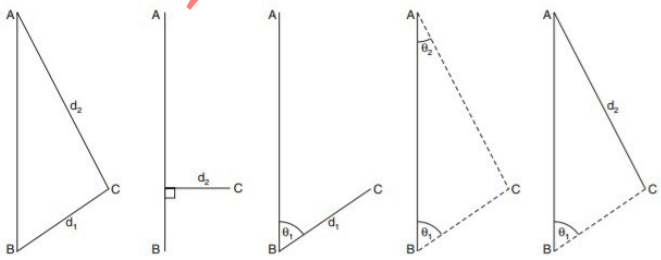
Sub. Code: 22205

Important Instructions to examiners:

1) The answers should be examined by key words 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 errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills.)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by the candidate and those in the 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 some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and the model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

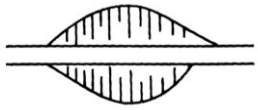
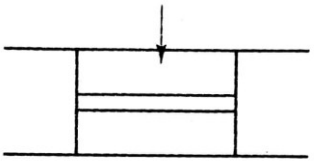
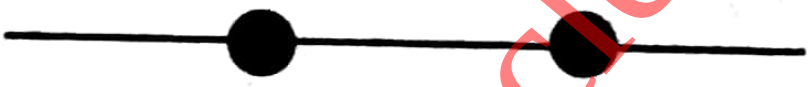
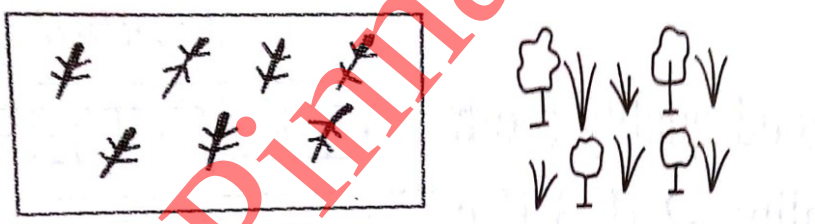
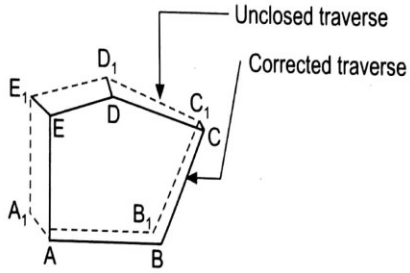
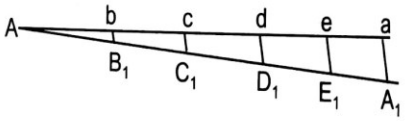
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.1		**Attempt any FIVE of the following :**		**(10)**
	a)	**State the classification of survey based on object of survey.**		
	Ans.	**Classification of survey based on object of survey –** When surveying is carried out for special purpose then survey is classified based on purpose or objective as follows - 1. Geological surveying – systematic investigation of geology of ground. 2. Mine surveying – for a mining operation. 3. Archaeological surveying – collect information about the location, distribution and organization of past human cultures across a large area. 4. Military surveying – to provide all kinds of data and geographic information in the form of digital geo databases and traditional topographic air and marine maps.	**½ mark each**	**2**
	b)	**Define representative fraction of scale.**		
	Ans.	**Representative fraction of scale:** A map scale in which figures representing units (as centimeters, inches, or feet) are expressed in the form of the fraction 1/x (as 1/250,000) or of the ratio 1:x to indicate that one unit on the map represents x units (as 250,000 centimeters) on the earth's surface.	**2**	**2**
	c)	**List different types of tapes based on material of which they are made.**		
	Ans.	1) Cloth or Linen tape 2) Metallic Tape 3) Steel Tape 4) Invar Tape 5) Fiber Glass wired Tape	**½ Each (any four)**	**2**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.1	**d)** **Ans.**	**List the types of meridian.** 1. True meridian 2. Magnetic meridian 3. Arbitrary meridian 4. Grid meridian	**2**	**2**
	e) **Ans.**	**Define the term "line of sight".** 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.	**2**	**2**
	f) **Ans.**	**Define the terms "contour" and "contour line".** **Contour:** An imaginary line on the ground, joining the points of same elevation or same R.L's is called as Contour. **Counter 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.	**1** **1**	**2**
	g) **Ans.**	**List component parts of digital planimeter.** **Components of digital planimeter:** i) Digital display ii) Rolling wheel or Rollers iii) Tracing arm iv) Function keys or buttons v) Sliding wheel vi) Magnifying glass	**2**	**2**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2		**Attempt any THREE of the following:**		**(12)**
	a) Ans.	**Explain the principles of surveying.** Principle of surveying are as follows: **i. To work from whole to part.**  According to the first principle, the whole area is first enclosed by main stations and main survey lines as shown in figure above. The area is then divided into a number of parts by forming well-conditioned triangles. A nearly equilateral triangle is considered to be the best well-conditioned triangle. The main survey lines are measured very accurately with a standard chain. The sides of triangles are measured. The purpose of this process of working is to prevent accumulation of error.	**2**	
		ii. To locate a new station by at least two measurement from fixed reference points.  The new stations should always be fixed by at least two measurements from fixed reference points. Linear measurements refer to horizontal distance measured by chain or tape. Angular measurements refer to the magnetic bearing or horizontal angle taken by a prismatic compass or theodolite. The new station or ground point is located using linear measurement or angular measurement or both measurements.	**2**	**4**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q. 2	b)	**Convert the following bearings into relevant bearings:** **i) 138^0 15' ii) 309^0 30' iii) N 42^0 E iv) S17° 25'W**		
	Ans.	**1) 138°15'** WCB lies in II[nd] quadrant RB = 180°- WCB RB = 180°- 138°15' **RB = S 41°45' E**	1	
		2) 309^0 30' WCB lies in IV[th] quadrant RB = 360°- WCB RB = 360°- 309^0 30' **WCB = N 50°30' W**	1	4
		3) N 42^0 E RB lies in I[st] quadrant WCB = RB **WCB = 42^0**	1	
		4) S 17° 25'W RB lies in III[nd] quadrant WCB = 180^0 + RB WCB = 180^0 + 17° 25' **WCB = 197° 25'**	1	
	c)	**Explain the temporary adjustments of prismatic compass.**		
	Ans.	**Temporary Adjustments of Prismatic Compass** **1. Fixing the compass to the tripod** The compass is fixed on a tripod by rotating screw head of tripod stand. **2. Centering the compass** The prismatic compass is centered over a survey station correctly by means of a plumb bob or by dropping a pebble from the center of the instrument and moving tripod legs accordingly. **3. Levelling the compass** The compass is quickly levelled by ball and socket arrangement by eye judgment. It should be levelled in such a way that dial moves freely and does not touch the rim of the compass. **4. Focusing the prism** The triangular prism is moved using focusing stud so that readings on graduated ring will be seen clearly.	4	4

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2	d)	**Define the following terms:** **i) Level line ii) Bench Mark iii) Change point iv) Profile levelling**		
	Ans.	**i) Level line –** It is line lying in a level surface; it is therefore, normal to the plumb line at all points.	**1**	
		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.	**1**	**4**
		iii) Change point – It is the point at which both back sight and foresight readings are taken before and after shifting the level instrument.	**1**	
		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.	**1**	

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q. 3		**Attempt any THREE of the following:**		**(12)**
	a) Ans.	**Draw conventional symbols for:** **i) Cutting ii) Dam iii) Electric line with pole iv) Forest** ii) Cutting  iii) Dam  iv) Electric line with pole  v) Forest 	**1** **1** **1** **1**	**4**
	b) Ans.	**Explain graphical method of adjustment of closing error of a traverse.**  (a)  (b) **Compass Traverse** **Bowditch Rule** **Explanation :** **1.** To distribute the closing error AA_1 (Fig. a), draw one horizontal line of length equal to perimeter of traverse with some reduced scale. **2.** Now mark the survey stations on it proportionally (Fig. b) and transfer closing error of same length using roller scale to point a. **3.** Join the point A and A_1 with straight line. Also draw parallel lines at point b, c, d and e.	**1** **3**	**4**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q. 3	**b)**	**4.** Transfer B_1b, C_1c, D_1d and E_1e to point B_1, C_1, D_1 and E_1 respectively in compass traverse. **5.** Finally join new points to get corrected traverse ABCDEA after graphical adjustment of closing error.		
	c) **Ans.**	**Distinguish between HI and rise and fall method.**	**1 Mark each (any Four)**	**4**
	d) **Ans.**	**List the sources of errors in levelling and explain any one in detail.** Sources of error in levelling The following are the different sources of error in levelling 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.	**2** **2** **(any one)**	**4**

Height of Instrument Method	Rise and Fall Method
This method is a rapid method and is less tedious because it requires less calculations	This method is a slower method than H.I. method as it involves more calculations.
There is no check on R.L.s of intermediate stations.	There is a complete check on all calculation work.
Following check is applied, Σ BS – Σ FS = Last R.L. – First R.L	Following check is applied, Σ BS – Σ FS = Σ Rise – Σ Fall = Last R.L. – First R.L
Error in calculations of RLs of intermediate stations is not carried forward.	Error in calculations of RLs of intermediate stations is carried forward
This method is less accurate.	This method is more accurate.
This system is suitable for profile levelling where there are numbers of intermediate sights	This system is suitable for fly levelling where there are no intermediate sights.
It is used for levelling works for canals, roads etc.	It is used for calculations of precise levelling works, check levelling.

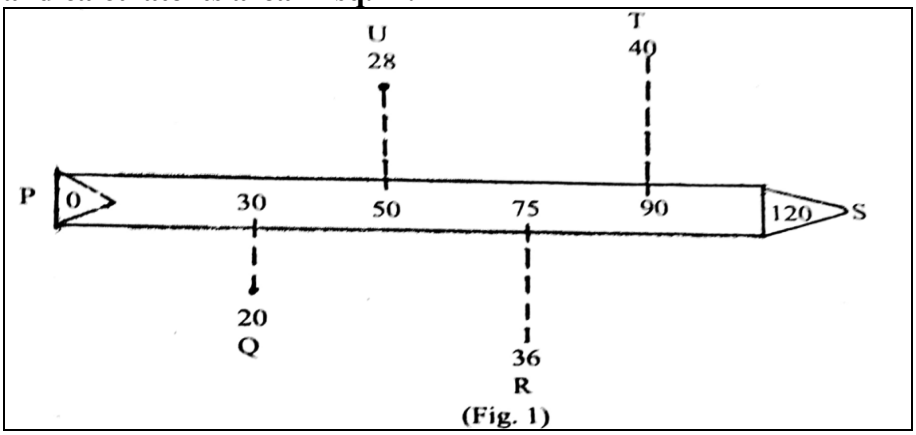
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q. 3	**d)**	vi. A wrong entry may be made in the level book. vii. The staff may not be properly and fully extended. **3. Errors due to Natural Causes** i. When the distance of sight is long, the curvature of the earth may affect the staff reading. ii. 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.		

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q. 4		**Attempt any THREE of the following:**		**(12)**
	a) Ans.	**Explain Types of bench marks.** **(a) 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.	**1**	
		(b) 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.	**1**	**4**
		(c) 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.	**1**	
		(d) 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.	**1**	
	b) Ans.	**State any eight component parts with its functions of dumpy level.** 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. ix. **Longitudinal bubble / Cross bubble tube** – to check the level of instrument x. **Shade** – to prevent the objective lens from sunlight or any other light rays which may cause disturbance to the line of sight.	**½ Mark each (any eight)**	**4**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q. 4	**c) Ans.**	**State the methods of contouring and explain any one in detail.** 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 chain or tape and by compass, theodolite or plane table for a large area. 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 contour, 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. ***(Note : Any one from direct or Indirect method should be consider.)***	**2** **2 Mark (any one)**	**4**

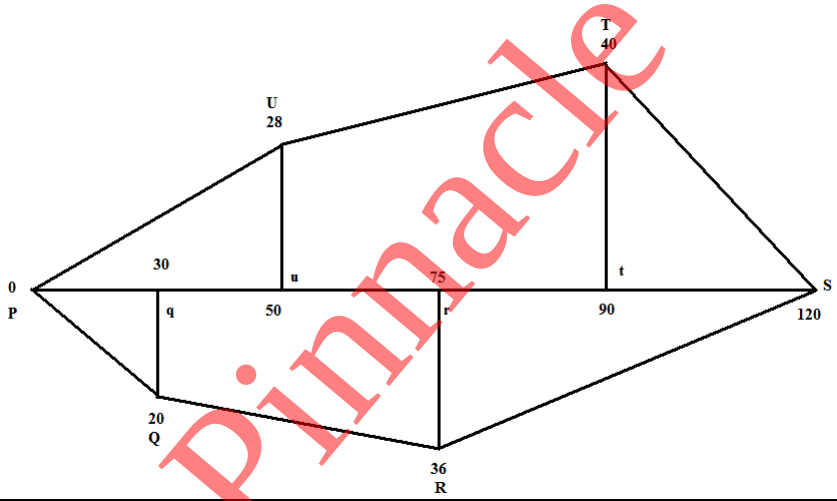
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q. 4	**d)** **Ans.**	**Describe the procedure for measuring the area using digital planimeter.** The procedure of measurement of an area using digital planimeter is as follows: i. Take the area on the plane surface of table and fix it with clips so that while measurement it does not move. ii. Start the planimeter by pressing on button on key pad of it. Screen will be displayed. iii. Set the scale by pressing scale button on key pad. iv. Mark one starting point on boundary of that area and place the point of magnifier of tracing arm of digital planimeter. v. Press the start button and move tracing arm on boundary of area and end it again at its starting point. Press the end button. vi. The area of given figure is displayed in digital display of digital planimeter.	**4**	**4**
	e) **Ans.**	**Explain the procedure of computing the volume of reservoir from any contour map.** Reservoirs are made for water supply and for power or irrigation projects. A contour map is very useful to study the possible location of a dam and the volume of water to be confined. All the contours are closed lines within the reservoir area. The areas A_1, A_2, A_3…..A_n between successive contour lines can be determined by a planimeter and if h is the contour interval, the capacity of the reservoir can be estimated by the application of either the trapezoidal or the prismoidal formula. **(a) Trapezoidal formula** Volume, $V = h\left[\frac{A_1 + A_n}{2} + A_2 + A_3 + \ldots + A_{n-1}\right]$ **(b) Prismoidal formula** Volume, $V = \frac{h}{3}[A_1 + A_n + 4(A_2 + A_4 + \ldots + A_{n-1}) + 2(A_3 + A_5 + \ldots + A_{n-2})]$	**2** **1** **1**	**4**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.5	a)	**Attempt any TWO of the following:** **Plot the given cross staff survey of the field PQRSTUP given fig. 1 and calculate its area in sq.m .**		(12)



(Fig. 1)

Ans.



1

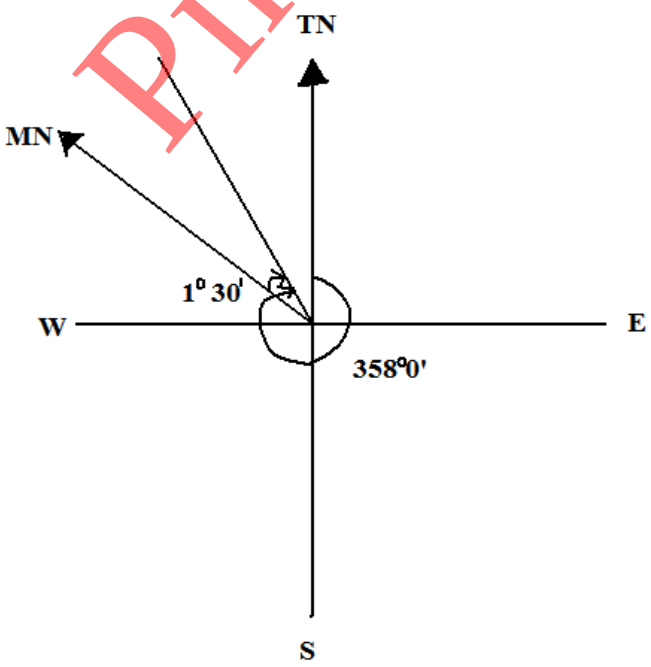
Sr. No.	Fig.	Chain age	Base	Offset	Mean Offset	Area (Mean Offset X Base)
1	Δ PQq	0-30	30	0&20	10	300
2	□ QqrR	30-75	45	20 & 36	28	1260
3	Δ RrS	75-120	45	36 & 0	18	810
4	Δ TtS	90-120	30	40 & 0	20	600
5	□ TtuU	50-90	40	28 & 40	34	1360
6	Δ PuU	0-50	50	28 & 0	14	700
					Total Area =	**5030 m^2**

4

1

6

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.5	b)	**i) Define the term magnetic declination and dip of the needle.** **ii) Calculate the magnetic declination at a point if the true bearing is $358^0 0'$ and magnetic bearing is $1^0 30'$.**		
	Ans.	**i)<u>Dip of the needle:</u>** It is the upward or downward movement of magnetic needle in vertical plane due to earth's gravitational force is known as dip of needle.	1 ½	
		<u>Magnetic declination</u>- It is the deviation or shifting magnetic needle from true or geographical north direction, hence the horizontal angle made by magnetic north with true north direction is known as Magnetic declination.	1 ½	
		ii) True bearing = $358^0 0'$ Magnetic bearing = $1^0 30'$. True Bearing = Magnetic Bearing ± Declination ∢ Aext = TB – MB = $358^0 0' - 1^0 30'$. = $356^0 30'$.	1	6
		Now, Magnetic declination = 360^0 - ∢ A_{ext} = $360^0 - 356^0 30'$ = $3^0 30'$ (West declination).	1 1	



Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q. 5	**c)**	**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.**	**5**	**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- **1**

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

2.895 – 10.095 = 328.235 – 335.435

-7.2 = -7.2

Q.6 — Total Marks: **(12)**

a) **Attempt any TWO of the following:**

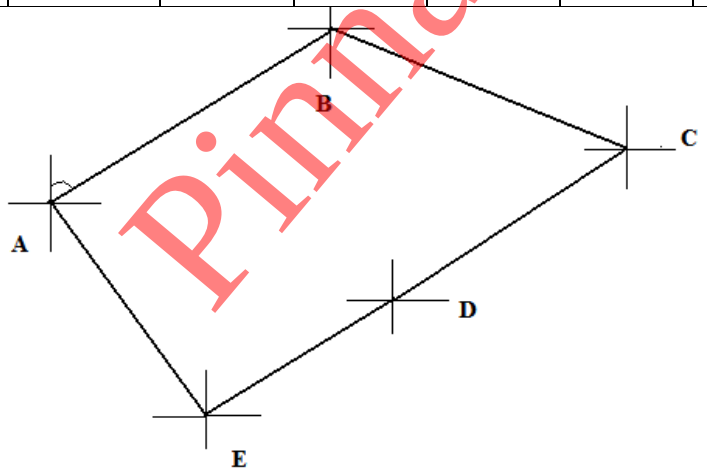
Following bearings were observed for the traverse ABCDEA. Detect the local attraction at the stations and correct the bearings of remaining lines. Also calculate included angles.

Line	FB	BB
AB	$68^0 15'$	$248^0 15'$
BC	$148^0 45'$	$326^0 15'$
CD	$224^0 30'$	$46^0 0'$
DE	$217^0 15'$	$38^0 15'$
EA	$327^0 45'$	$147^0 45'$

Ans.

Line	FB	BB	Diff.	Corrected FB	Corrected BB	Remark
AB	$68^0 15'$	$248^0 15'$	180^0	$68^0 15'$	$248^0 15'$	Stations A, B, E are free from Local attraction.
BC	$148^0 45'$	$326^0 15'$	178^0	$148^0 45'$	$328^0 45'$	
CD	$224^0 30'$	$46^0 0'$	$178^0 30'$	$227^0 00'$	$47^0 00'$	
DE	$217^0 15'$	$38^0 15'$	179^0	$218^0 15'$	$38^0 15'$	
EA	$327^0 45'$	$147^0 45'$	180^0	$327^0 45'$	$147^0 45'$	

Marks: **3**



Marks: **6**

$\angle A$ = BB of EA – FB of AB = $147^0 45' - 68^0 15' = 79^0 30'$

$\angle B$ = BB of AB – FB of BC = $248^0 15' - 148^0 45' = 99^0 30'$

$\angle C$ = BB of BC – FB of CD = $328^0 45' - 227^0 00' = 101^0 45'$

$\angle D = 360^0 00' - (\text{FB of DE} - \text{BB of CD})$
$= 360^0 00' - (218^0 15' - 47^0 00') = 188^0 45'$

$\angle E = 360^0 00' - (\text{FB of EA} - \text{BB of DE})$
$= 360^0 00' - (327^0 45' - 38^0 15') = 70^0 30'$

Marks: **2**

Arithmetic check-

Sum of included angles = $(2n - 4) \times 90^0$

$\angle A + \angle B + \angle C + \angle D + \angle E = (2n - 4) \times 90^0$

$79^0 30' + 99^0 30' + 101^0 45' + 188^0 45' + 70^0 30' = (2 \times 5 - 4) \times 90^0$

$540^0 = 540^0$

Marks: **1**

Q.6 b) **Calculate the missing readings and apply arithmetical checks also.**

Station	BS	IS	FS	Rise	Fall	RL	Remark
1	3.125					X	B.M.1
2	X		X	1.325		125.005	C P 1
3		2.320			0.055	X	
4		1.920		X		125.350	
5	X		2.655		X	124.615	C P 2
6	1.620		3.205		2.165	X	C P 3
7		3.625			X	122.450	
8			X	2.145		122.590	B.M.2

Ans.

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

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

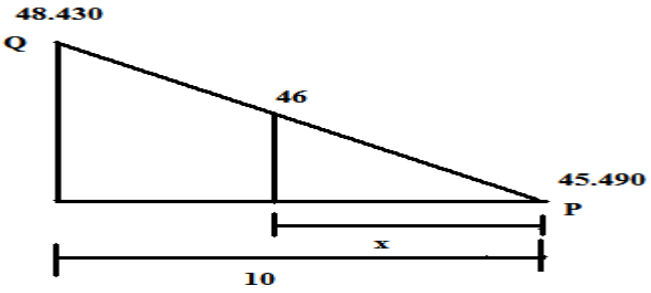
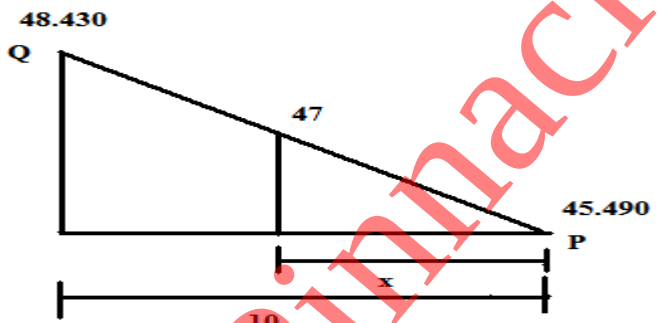
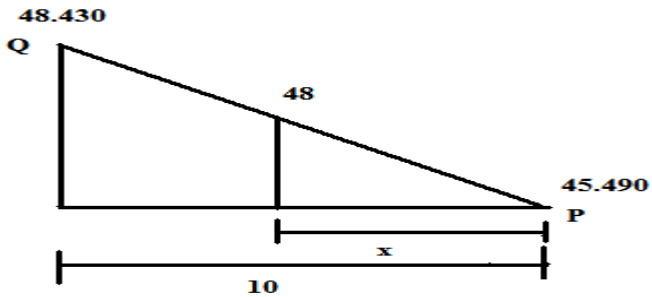
Fall at station 6 = BS of station 5 - FS of station 6

- 2.165 = X – 3.205

X = 3.205 -2.165 = 1.04

Marks: 1 + 4 = 5 | Total Marks: 6

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**b)**	**6. Fall at station 7** 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**	**1**	**6**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	c) Ans.	**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.**		
			1	
		$\frac{(48.430-45.490)}{10}=\frac{(46-45.490)}{x}$ $\frac{2.94}{10}=\frac{0.51}{x}$ $x=1.734\ m$	1	
				6
		$\frac{(48.430-45.490)}{10}=\frac{(47-45.490)}{x}$ $\frac{2.94}{10}=\frac{1.51}{x}$ $x=5.136\ m$	1 1	
				
		$\frac{(48.430-45.490)}{10}=\frac{(48-45.490)}{x}$ $\frac{2.94}{10}=\frac{2.51}{x}$ $x=8.537\ m$	1 1	