MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)

(ISO/IEC -270001 – 2005 Certified)

WINTER -2019 EXAMINATION **Subject code:** **22205**

Model Answer

Important Instructions to the 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.

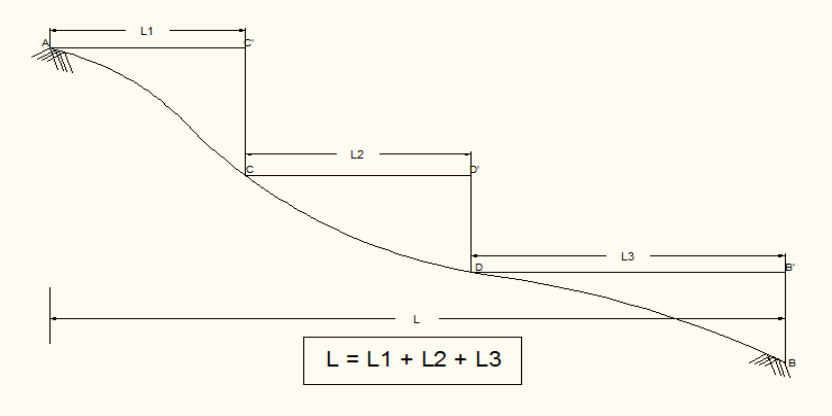
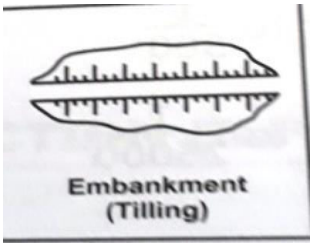
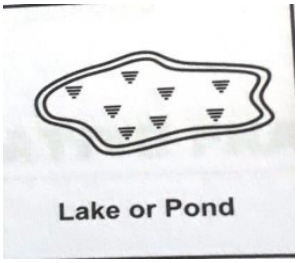
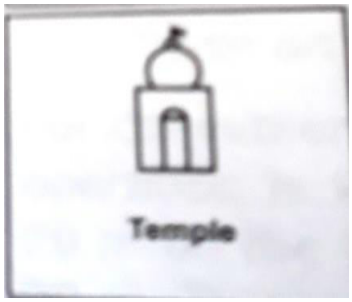
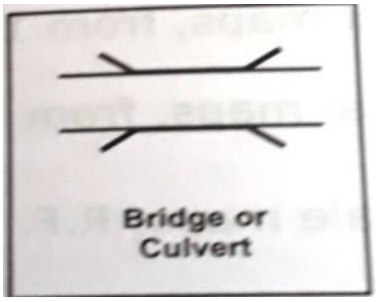
5) Credits may be given step wise for numerical problems. In the some cases, the assumed constants values may vary and there may be some difference in the candidates answer and model answer.

6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidates understanding

7) For programming language papers, credit may be given to any other program based on equivalent concept.

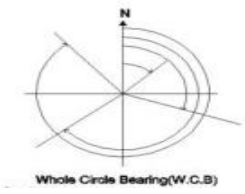
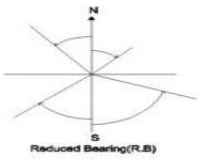
QUE NO	ANSWER WITH QUESTION	MARKS
1	**Attempt any FIVE of the following:**	**10**
a)	**State the classification of surveying based on nature of field.**	
Ans.	a) Land surveying b) Marine or Navigation surveying c) Astronomical surveying	**2 Marks**
b)	**State the object of surveying.**	
Ans.	1. The object of surveying is to prepare a plan / map to show the relative positions of the objects on the surface of the earth. It shows the natural features of a country such as rivers, hills, lakes and artificial such as villages, roads, railways, bridges etc. 2. To determine relative heights of different points. 3. To determine area of given piece of land. 4. To prepare contour maps.	**1 mark each** **(Any Two)**
c)	**List any four instruments used for linear measurement**	
Ans.	1) Chain 2) Tape 3) Arrows 4) Pegs 5) Ranging rod	**1/2 mark each (Any four)**
d)	**State any four types of tapes**	
Ans.	1) Cloth / Linen Tape 2) Metallic Tape 3) Steel Tape 4) Invar Tape 5) Digital Tape 6) Synthetic Tape	**1/2 mark each** **(Any four)**
e)	**State the types of benchmarks**.	
Ans.	1) Great Trigonometrical Survey benchmark (GTS) 2) Permanent Benchmark 3) Temporary Benchmark 4) Arbitrary Benchmark	**1/2 mark each**

f)	**Define i) Back Sight Reading ii) Height of instrument**	
Ans.	**i) <u>Back Sight Reading</u>:** 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) <u>Height of instrument</u>:** 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.	**1 mark** **1 mark**
g)	**Write any two precautions to be taken while using planimeter.**	
Ans.	1. Set the anchor point inside or outside the figure depending on size of figure. If the area is very large ,it can be divided into number of sections. 2. The value of C (constant) is added only when the anchor point is inside the figure. 3. N is considered positive when zero of the dial passes the index mark in clockwise direction 4. N is considered negative when zero of the dial passes the index mark in anticlockwise direction 5 Tracing is always done in clockwise direction. **OR** **Precautions to be taken for Digital Planimeter:** 1. Set the scale as per given drawing to the planimeter. 2. Tracing point is moved preciously over the boundary of figure. 3. Operating manual shall be referred before operating different functions	**1 mark each** **(Any two)**
2)	**Attempt any THREE of the following**	**12**
a)	**A road actually 1420m long was found 1414m when measured by a defective chain 30m chain. How much correction does the chain need?**	
Ans.	**Given:** L=30m True length=1420m, Measured length =1414m **Solution:** True Length = (L'/L) * Measured Length 1420 = (L'/30) * 1414 L'= (1420 * 30) / 1414 **L'= 30.12 m.** Now L' is greater than L. So, the chain is **too long**. Amount of correction (e) = 30 – 30.12 = **- 0.12m.**	**2 mark** **2 mark**

b)	**Explain the Stepping method of measuring the horizontal distance of sloping ground with sketch.**	
Ans.	In direct method which is also known as stepping method, horizontal distance is directly measured as shown in fig. **<u>Stepping Method</u>** Horizontal distance between A and B is required to be measured. **Procedure:** i) A portion of tape say 2 to 4m is stretched horizontally with one end resting on ground and other end held horizontally at convenient height. ii) The point vertically below the other end is transferred on the ground with the help of plumb bob (Say C). iii) The next step starts from the C and the method is continued till point B reached.  	**2 marks** **2 marks**
c)	**Draw conventional symbol for i) Embankment, ii) Pond, iii) Temple, iv) Bridge**	
Ans.	1) Embankment  2) Pond  3) Temple  4) Bridge  	**1 Mark each**

d)	**Following are the observed fore bearing of the line. Find their back bearings. i) 40^0 30' ii) N38^0 30'W iii) 169^0 30' iv) N25^0 30'E**	
Ans.	i) FB =40^0 30' BB=FB+180^0 = 40^0 30'+180^0 **= $220^0$30'** ii) FB = N 38^0 30' W **BB = S 38^0 30'E** iii) FB = 169^0 30 BB = FB+180^0 = 169^0 30+180^0 **= 349^0 30'** iv) FB = N 25^0 30'E **BB = S 25^0 30'W**	**1 mark** **1 mark** **1 mark** **1 mark**
Q.3	**Attempt any <u>THREE</u> of the following:**	**12**
a)	**Differentiate between WCB & RB**	

Ans.

Whole circle bearing (WCB)	Reduced Bearing (RB)
1. The horizontal angle made by a line with the magnetic north in the clockwise direction is the whole circle bearing of the line.	1.The horizontal angle made by a line with the magnetic north or south (whichever is closer from the line) in the eastward or westward direction is the Quadrantal Bearing or Reduced Bearing of the line
2. Only the magnetic north line is considered as reference line in whole circle bearing system.	2. Both magnetic north and south lines are considered as reference line in <u>quadrantal bearing</u> system.
3. The clockwise angle from the reference line is only taken	3. Both clockwise and anticlockwise angle from the reference lines are taken.
4. The value of the whole circle bearing varies from 0° to 360°	4. The value of the reduced bearing varies from 0° to 90°
5. Example: 26°, 121°, 245°, 350° etc.	5. Example: N26°E, S59°E, S65°W, N10°W etc.
6. Fig.  Whole Circle Bearing(W.C.B)	6. Fig.  Reduced Bearing(R.B)

1 Mark each

(Any Four)

b)	**Convert the Following WCB to RB. Give Quadrant of the line.** **(i) 60^0 30' (ii) 298^0 (iii) 128^0 30' (iv) 269^0 30'**	
Ans.	**i) 60º 30'** RB = WCB **R.B. = N 60^0 30' E** **ii) 298º 00'** RB =360^0- WCB RB =360^0- 298º 00' **R.B. = N 62^0 00' W** **ii) 128º 30'** RB =180^0- WCB RB =180^0- 128º 30' **R.B. = S 51^0 30' E** **iv) 269º 30'** RB = WCB- 180^0 RB = 269º 30'- 180^0 **R.B. = S 89^0 30' W**	**1 Mark** **1 Mark** **1 Mark** **1 Mark**
c)	**State the functions of any four component parts of prismatic compass.**	
Ans.	**Component parts of prismatic compass are as follows:** **1. Break pin** - It is used to stop the oscillations of aluminum ring. **2. Lifting pin** – It lifts the magnetic needle when sight vane is folded. **3. Sight vane** – It is used to sight/bisect object. **4. Graduated ring / Aluminum ring** – It is used to observe the angle OR to show the graduations **5. Adjustable Mirror –** to bisect the object when it is too high or too low from the line of collimation. **6. Sun Glasses –** Used to bisect the luminous object to reduce strain on eyes. **7. Magnetic needle-** To direct magnetic north. **8. Pivot-** To support the magnetic needle. **9. Reflecting prism-**observer can see the graduation erect and magnified. **10. Metal cover-** It is provided over the glass lid and sighting vane when the compass is not in use to protect the compass from dirt, dust etc.	**1 Mark each** **(Any Four)**

d) **The following bearing were taken in a closed compass traverse survey. Determine the correct bearing. Find station affected by local attraction.**

Line	FB	BB
AB	**$48^0$25'**	**230^0**
BC	**$177^0$45'**	**356^0**
CD	**$104^0$15'**	**$284^0$55'**
DE	**$165^0$15'**	**$345^0$15'**
EA	**$259^0$30'**	**79^0**

Ans. All the bearings are observed and difference of their FB and BB are determined below. **1 Mark**

Line	Difference	Error
AB	$181^0$35'	$1^0$35'
BC	$178^0$15'	$1^0$45'
CD	$180^0$40'	$0^0$40'
DE	$180^0$0'	$0^0$0'
EA	$180^0$30'	$0^0$30'

The difference between FB and BB of the line DE is exactly equal to $180^0$0'. Hence station D and E are free from local attraction and bearing observed from D and E are corrected.

For line EA:

Observed FB of line EA= $259^0$30' is corrected, as station E is free from local attraction.

Corrected BB of line EA= $259^0$30'- 180^0 = **$79^0$30'** ½ **Mark**

But observed BB of line EA **$79^0$00'**

Observed BB < Corrected BB

Error is negative and correction is positive

Error = $79^0$00'- $79^0$30'= **$-0^0$30'**

Correction at A=**$+0^0$30'**

For line AB:

Observed FB of line AB= $48^0$25'

Apply correction of **+**$0^0$30' at A ½

Corrected FB of line AB= $48^0 25' + 0^0 30' = 48^0 55'$ **Mark**

Corrected BB of line AB= $48^0 55' + 180^0 00' = 228^0 55'$

Observed BB > Corrected BB

Error is positive and correction is negative

Error = $230^0 00' - 228^0 55' = +\mathbf{1^0 05'}$

Correction at B= $\mathbf{-1^0 05'}$

For line BC:

Observed FB of line BC= $177^0 45'$

Apply correction of $-1^0 05'$ at B

Corrected FB of line BC= $177^0 45' - 1^0 05' = 176^0 40'$ **½**

Corrected BB of line BC= $176^0 40' + 180^0 00' = 356^0 40'$ **Mark**

Observed BB < Corrected BB

Error is negative and correction is positive

Error = $356^0 00' - 356^0 40' = \mathbf{-0^0 40'}$

Correction at C=$\mathbf{+0^0 40'}$

For line CD:

Observed FB of line CD= $104^0 15'$

Apply correction of $+0^0 40'$ at C

Corrected FB of line CD= $104^0 15' + 0^0 40' = 104^0 55'$ **½**

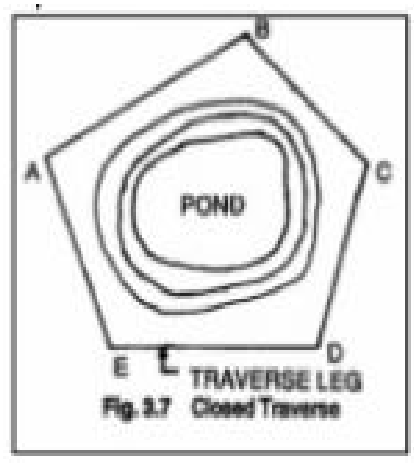
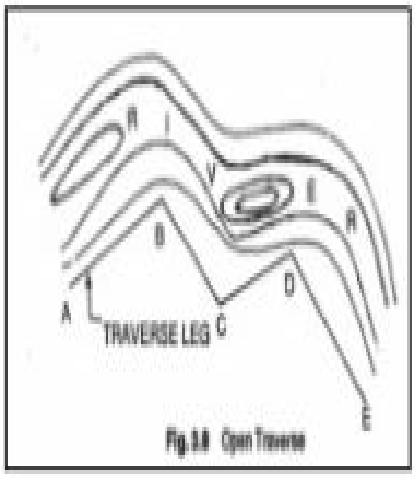
Corrected BB of line CD= $104^0 55' + 180^0 00' = 284^0 55'$ **Mark**

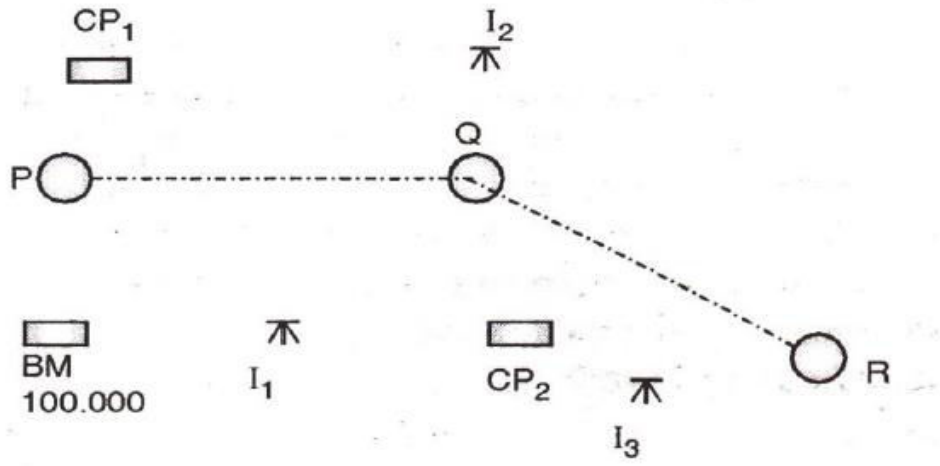
Check:

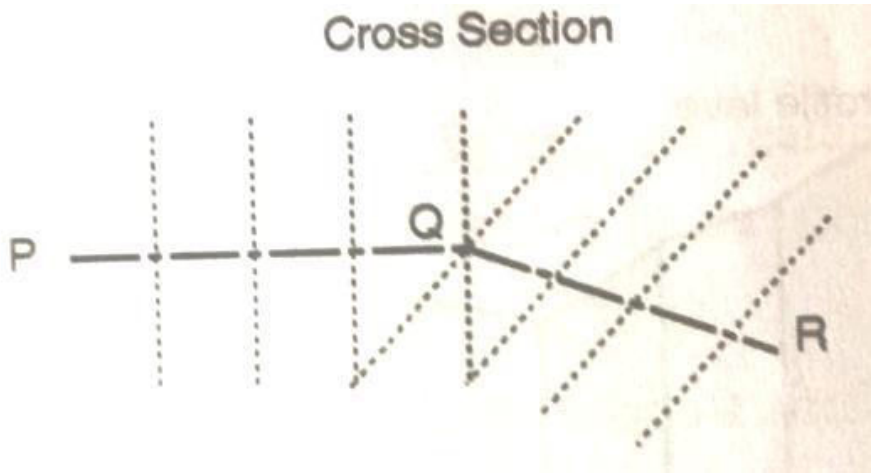
The observed bearing is also $284^0 55'$ which tallies with corrected bearing, since the station D free from local attraction.

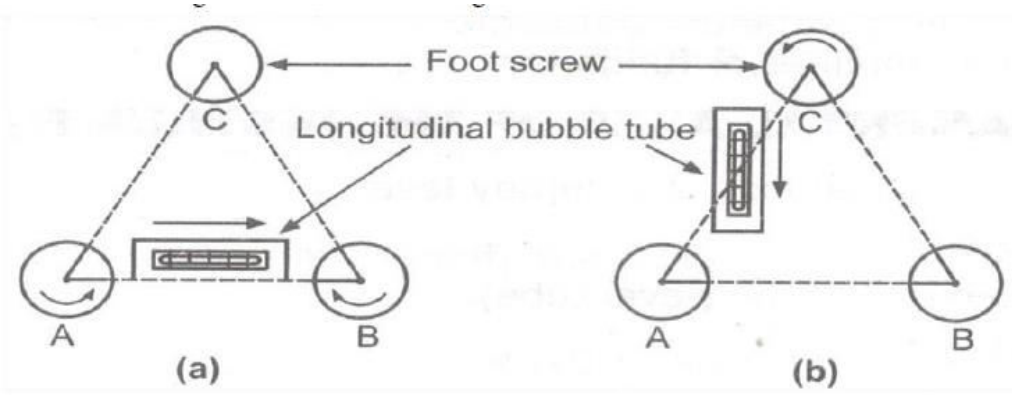
Line	Correction	Corrected		Remark
		FB	BB	
AB	$-1^0 05'$ at B	**$48^0 55'$**	**$228^0 55'$**	station D and E are free from local attraction
BC	$+0^0 40'$ at C	**$176^0 40'$**	**$356^0 40'$**	
CD	$0^0 0'$ at D	**$104^0 55'$**	**$284^0 55'$**	
DE	$0^0 0'$ at E	**$165^0 15'$**	**$345^0 15'$**	
EA	$+0^0 30'$ at A	**$259^0 30'$**	**$79^0 30'$**	

1Mark

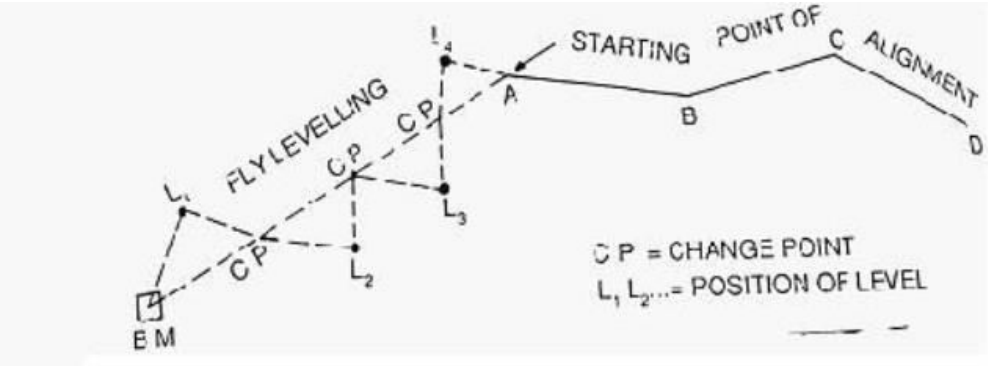
Q.4	Attempt any Three of the following:		12
a)	**Distinguish between closed traverse and open traverse.**		
Ans.	**Closed traverse Survey**	**Open traverse Survey**	**1 Mark each** **(Any four)**
	1. In Closed traverse survey the bearing of first line and included angles are measured.	1. In open traverse survey bearing of all survey lines are measured.	
	2. When the finishing point of survey coincides with the starting point of the survey, it is known as closed traverse.	2. When starting point of survey does not coincide with last point of the survey, it is known as open traverse.	
	3. It is suitable for the survey of boundaries of plots, forests, estate, etc.	3. It is used for the survey of roads, rivers, coastal line, railways. etc.	
	4. Fig.  Fig. 3.7 Closed Traverse	4. Fig.  Fig.3.8 Open Traverse	
	5.**Check:** a) Sum of all internal included angles = (2N-4) x 90^0 b) Sum of all external angles = (2N + 4) x 90^0	5. **Check:** a) Length of check line on map = Length of check line on ground b) Bearing of check line on map = Bearing of check line on ground	

b)	**Explain the procedure for profile levelling and cross Sectioning**	
Ans.	**For Profile levelling:**  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.	**1 Mark** **1 Mark** **1 Mark**

	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.  	**1 Mark**
c)	**State and explain the temporary adjustments of a dumpy Level.**	
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 90^0 as shown in fig. below and now with the help of third screw bring the bubble of levelling tube in the center.	**1 Mark** **1 Mark**

	 **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.	**1 Mark** **1 Mark**
d)	**Explain Fly levelling and also state its purpose.**	
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 FS stations. 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	**2 Marks**

on B. M should have same R. L of B. M.



1 Mark

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.

1 Mark (Any two)

5. Attempt any <u>TWO</u> of the following: **12**

a) 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.

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

(Marking sckeme: Correct entry of readings - 1 Mark, rise calculation – 2 Marks, RL calculations - 2 Marks, Arithmetic check – 1 Mark)

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Please see the marking scheme given at the end of answer

b) 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.

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 = $\frac{6.737}{270}$ x100 = 2.495 %

OR

Gradient = $\frac{6.737}{270} = \frac{1}{270/6.737} = \frac{1}{40.077}$ = 1 in 40.077

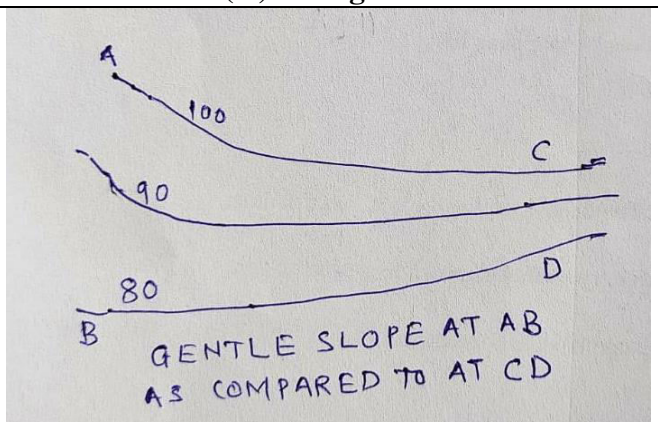
(Marking scheme: Correct entry of readings - 1 Mark, H.I. calculations - 1 M, R.L. calculations – 2 M, Arithmetic check – 1 M, gradient Calculation – 1 M

*** Pl see the marking scheme given at the end of answer**

c) Draw a contour lines representing different features :

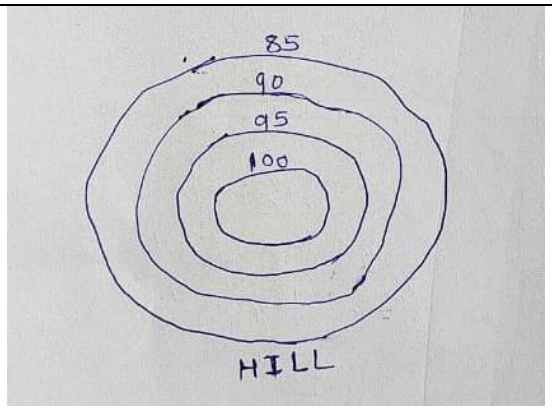
(i)A gentle slope (ii) A hill
(iii)A pond (iv) Overhanging cliff
(v)A valley lines (vi) A ridge lines

Ans:

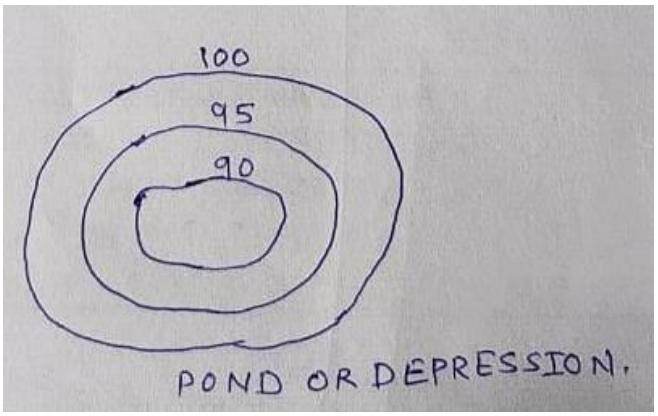


A gentle slope

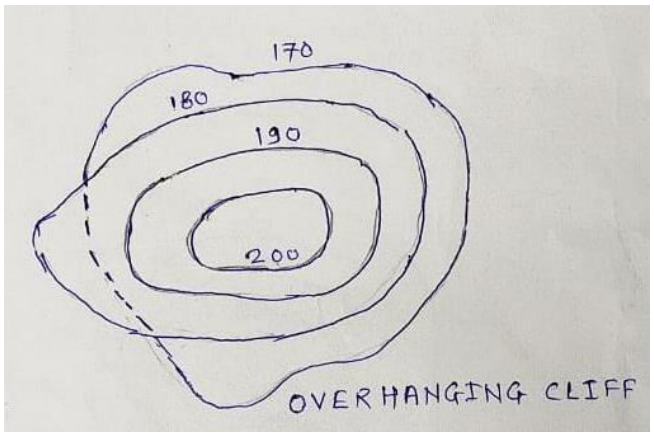
1 Mark



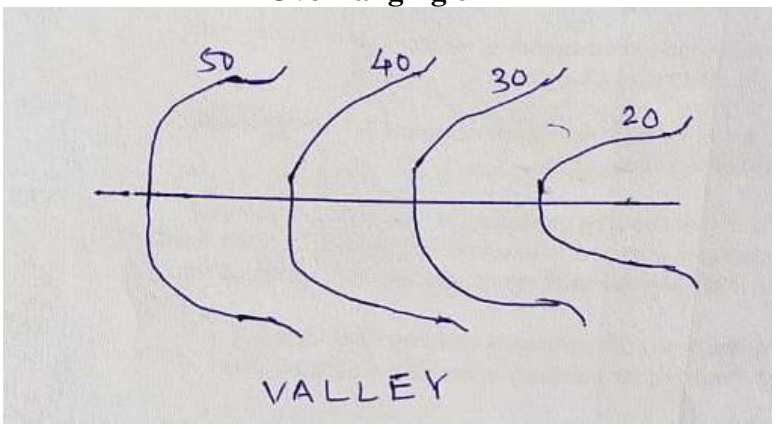
A hill **1 Mark**



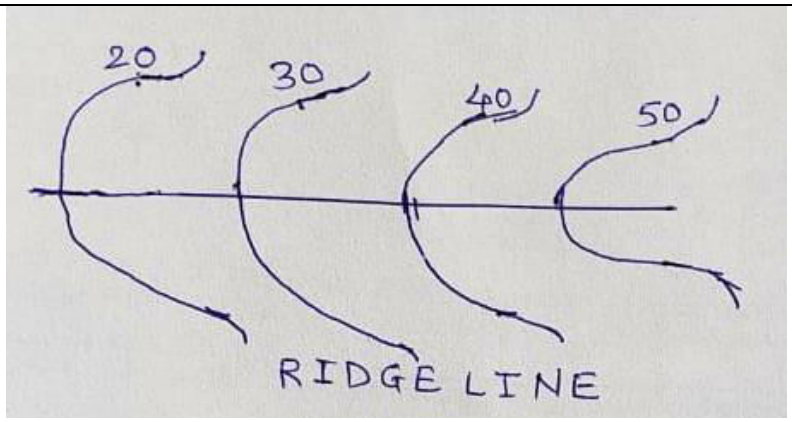
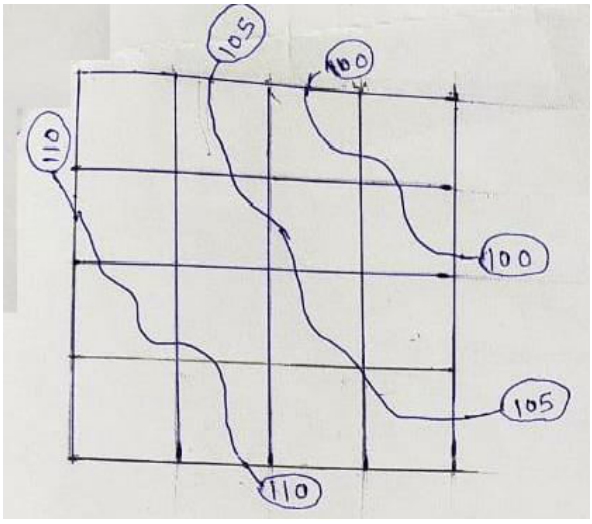
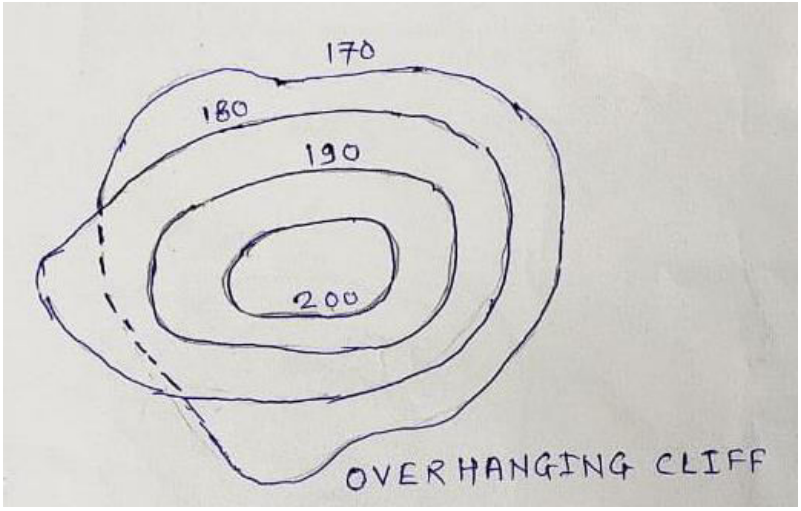
A pond **1 Mark**



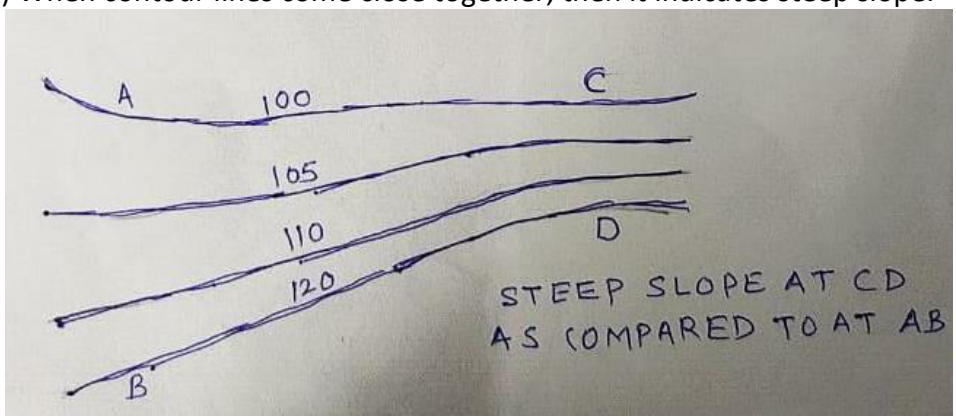
Overhanging cliff **1 Mark**



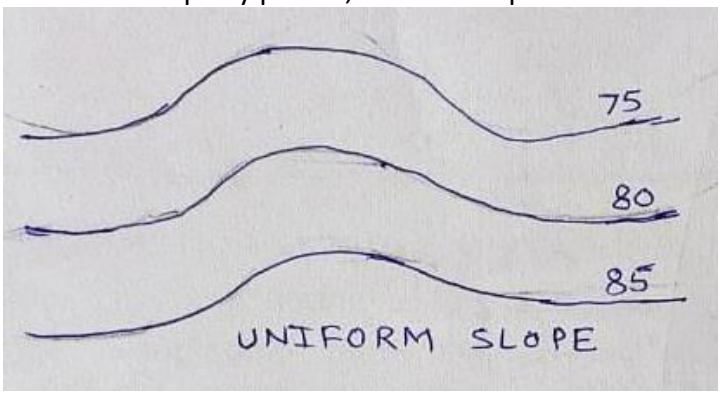
A valley lines 1 Mark

	 **A ridge lines**	**1 Mark**
6.	**Attempt any <u>TWO</u> of the following:**	**12**
a)	**Explain the characteristics of contour with suitable sketch.**	
Ans :	**Characteristics of contour lines are:** 1. All points on contour lines have the same elevation.  2. Two contours of different elevations can not cross each other except in overhanging cliff. 	**2 Marks each** **(Any three)**

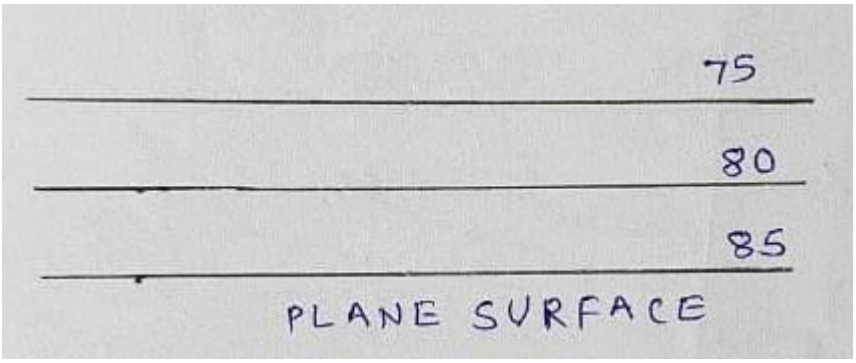
3. (i) When contour lines come close together, then it indicates steep slope.



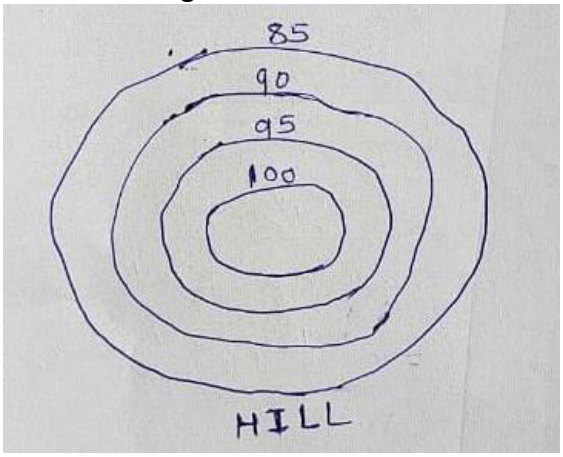
(ii) If contour lines are equally placed, uniform slope is indicated.



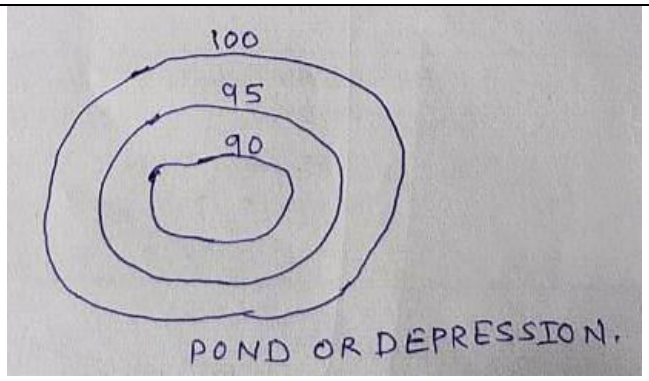
(iii) A series of straight, parallel and equally spaced contours represent a plane surface.



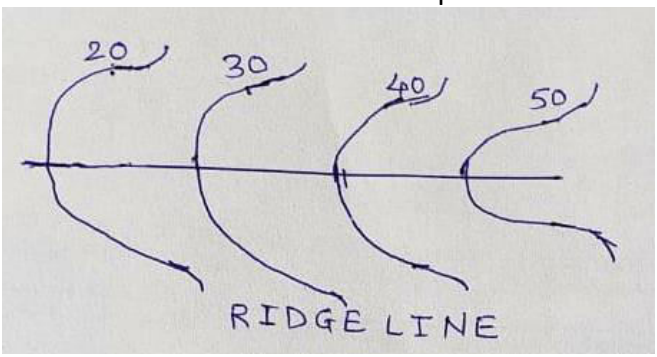
4. (i) Closed contour lines with higher values inside indicate hill.



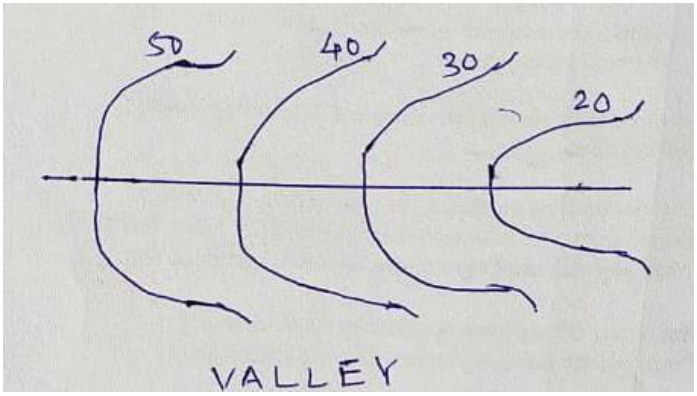
(ii) Closed contour lines with lower values inside indicate depression.



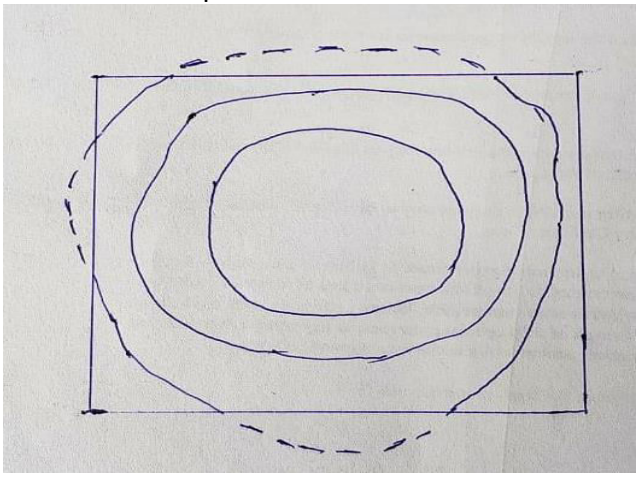
5. (i) Ridge line and contour lines cross each other at right angle. For ridge line the higher elevation contour are inside the loop or bend.



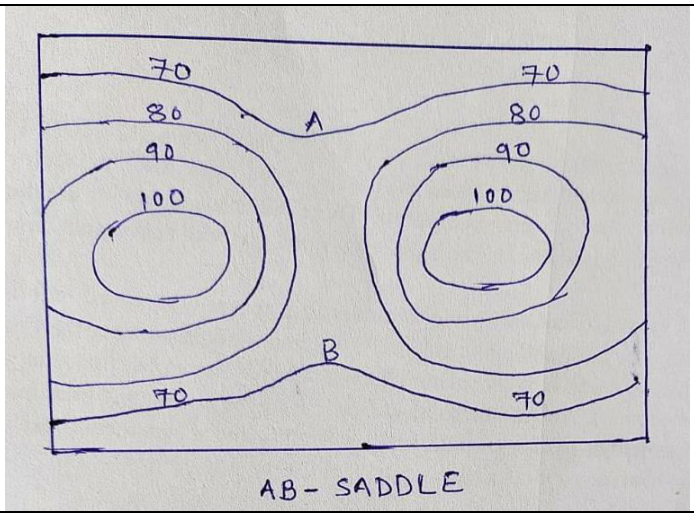
(ii) Valley line and contour lines cross each other at right angle. Valley line is indicated by higher elevation contours outside the loop or bends.



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.



b) **Explain the procedure of finding area of irregular figure by polar planimeter. Also draw sketch of polar planimeter.**

Ans :

Procedure:

1. Set the scale on the tracing arm as per manufacturer's instruction.
2. Select the position of anchor point inside or outside the figure such that tracing point reaches all positions of figure.
3. Mark the starting point on figure.
4. Place tracing point on starting point.
5. Take initial reading.
6. Move tracing point along the boundary of figure clockwise direction and note down number of times zero on dial crosses fixed index mark and also direction of crossing.
7. Continue till tracing point reaches starting point.
8. Take final reading.
9. Area of figure is given by relation:

$$A = M (FR – IR \pm 10 N + C)$$

Where A = Area

M = Multiplying constant as given by manufacturer

IR = Initial Reading

FR = Final Reading

N = Number of times zero of dial crosses fixed index mark.

C = additive constant to be added only when anchor point is inside figure.

Use + sign for clockwise and – sign for anticlockwise crossing of zero of dial.

3 Marks

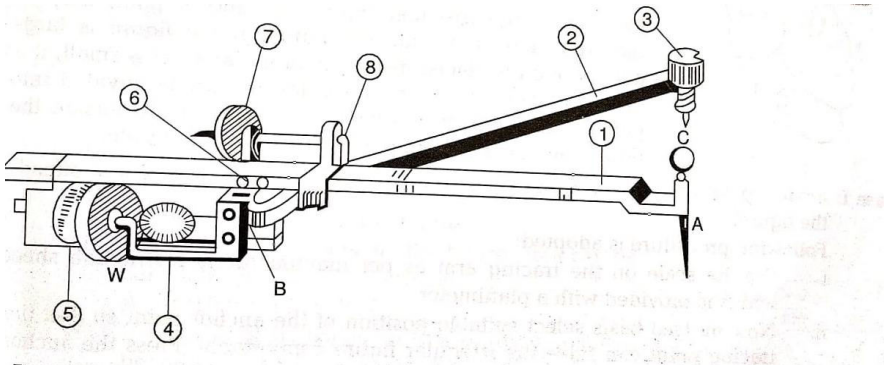


Figure 6.1: (A) Tracking point, (B) Hinge, (C) Needle point,(D) Wheel (1) Tracing bar, (2) Radius bar, (3) Weight, (4) Dial,(5) Vernier, (6) Clamp, (7) Slow motion screw,(8) Index

2 Marks for figure

1 Mark for Labeling

c) **The following reading were taken when area was measured by a polar planimeter, the tracing arm being set to 100 sq. cm. Determine the area of fig.**

IR	FR	Position of Anchor point	Remarks
7.825	**3.425**	**Outside the fig.**	**The zero of disc passed fixed index mark once in clockwise direction**
1.250	**4.370**	**Inside the fig.**	**Index marks passes twice in reverse direction**

Ans :

***Assumptions – 1) There is single figure traced once anchor point outside and second time anchor point inside*.**

When anchor point is outside figure:

IR = 7.825, FR = 3.425, N = 1 (Clockwise)

M = 100 Sq. cm, C = 0

Area A = M (FR – IR ± 10 N + C) **2 M**

A = 100 (3.425 – 7.825 + 10 x 1 + 0) **2 M**

= 560 Sq. cm **2 M**

NOTE- As the first condition (i.e.position of anchor point outside the fig.) gives the area of figure, there is no need of second condition.