



Subject: Engineering Surveying  
Division: All Divisions  
Examiner: Surveying Committee

Year: 2<sup>nd</sup> year  
Time: Three hours  
Date: -- / 6 / 2015

Answer Five Questions Only

**Q1)A. Answer the following:(9 marks)**

1-List the types of surveying.

Solution:

- 1- من حيث الدقة  
2- من حيث الاجهزة المستخدمة  
3- من حيث التطبيق

2- Convert 1.267<sub>rad</sub> to grad.

Solution : 80<sup>B</sup> 65<sup>CG</sup> 97<sup>CCG</sup>

3- Find the scale of map if the distance (AB) on the ground =2500 m and the distance (ab) on map =27.5cm.

Solution: 1/ 9090.90909090909091

**B.** If  $x_1=205.321 \pm 0.05$  m,  $x_2=205.325 \pm 0.01$  m and  $x_3=205.327 \pm 0.03$  m are the horizontal distances of line AB, compute the most probable value of the distance (AB) and its standard error. **(11 marks)**

$$Y = \frac{X_1 * P_1 + X_2 * P_2 + X_3 * P_3}{P_1 + P_2 + P_3}$$

$$P_1 = \frac{1}{0.05^2}, P_2 = \frac{1}{0.01^2}, P_3 = \frac{1}{0.03^2}$$

$$Y = \frac{205.321 * \frac{1}{0.05^2} + 205.325 * \frac{1}{0.01^2} + 205.327 * \frac{1}{0.03^2}}{\frac{1}{0.05^2} + \frac{1}{0.01^2} + \frac{1}{0.03^2}} = 205.3251 \text{ m}$$

$$v_i = \bar{x} - x_i$$

$$v_1 = 205.3251 - 205.321 = -0.0041$$

$$v_2 = 205.3251 - 205.325 = -0.0001$$

$$v_3 = 205.3251 - 205.327 = 0.0019$$

$$\delta_{xi} = \pm \sqrt{\frac{\sum P v^2}{n-1}} = \pm 0.073604 \text{ m}$$

$$\delta \bar{x} = \pm \frac{\delta_{xi}}{\sqrt{P_1 + P_2 + P_3}} = \pm 0.000686 \text{ m}$$

**Q2)A. Answer the following:-(12 marks)**

1) A rectangular parcel having dimensions  $W= 120,00\text{m} \pm 0.01\text{m}$  and  $L= 250,00 \text{ m} \pm 0.03\text{m}$ . Compute the area of the parcel and its standard error.

**Solution:**

$$A = 120.00 \times 250.00 = 30000 \text{ m}^2$$

$$\delta_A = \sqrt{120^2 \times 0.03^2 + 250^2 \times 0.01^2} = \pm 4.3829 \text{ m}^2$$

- 2) A (50 m) steel tape used to measure the horizontal distance (DC), the measurements are: DC=50.032 m, 50.029 m, 50.034 m.  
If the actual length of the tape = 49.98m. Compute the most probable value of the distance DC only.

$$X_1 = \frac{D_1}{L_T} L_{\bar{T}} = \frac{50.032}{50} 49.98 = 50.01199$$

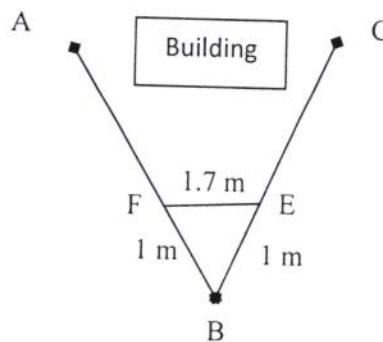
$$X_2 = \frac{D_2}{L_T} L_{\bar{T}} = \frac{50.029}{50} 49.98 = 50.00899$$

$$X_3 = \frac{D_3}{L_T} L_{\bar{T}} = \frac{50.034}{50} 49.98 = 50.01399$$

$$D_{DC} = \frac{X_1 + X_2 + X_3}{3}$$

$$D_{DC} = \frac{50.01199 + 50.00899 + 50.01399}{3} = 50.01165 \text{ m}$$

**B.** For the following figure:



If the horizontal distances AB= 45 m and BC =60 m, compute the horizontal distance AC. **(8 marks)**

$$\sphericalangle B = 2 * \sin^{-1} \left( \frac{FE}{2} \right) = 2 * \sin^{-1} \left( \frac{1.7}{2} \right) = 116^{\circ} 25' 24''$$

$$\cos B = \frac{AB^2 + CB^2 - AC^2}{2 * AB * CB}$$

$$AC = \sqrt{AB^2 + CB^2 - 2 * AB * CB * \cos B} = \sqrt{45^2 + 60^2 - 2 * 45 * 60 * \cos 116^{\circ} 25' 24''} = 89.599 \text{ m}$$

**Q3)A.** The following table represent the field data for two routes (R<sub>1</sub>, R<sub>2</sub>) for differential leveling using the level and leveling rod.

Route	From	To	No. of level setup	Measured difference in elevation (m)	Elevation (m)
R <sub>1</sub>	BM <sub>1</sub>	A	4	- 0.825	BM <sub>1</sub> =78.0 m
R <sub>2</sub>	BM <sub>2</sub>	A	?	?	BM <sub>2</sub> =75.8 m

The field data for route R<sub>2</sub> are:

Route	Level setup	Observed points	Rod reading (m)	Elevation (m)
R <sub>2</sub>	1	BM <sub>2</sub>	2.648	75.8
		TP <sub>1</sub>	1.941	
	2	TP <sub>1</sub>	1.789	
		A	1.125	

Compute the adjusted (most probable value) elevation of point A.

(10 marks)

Point	B.S	ELS	FS	Elevation (m)
BM2	2.648	78.448		75.8
TP1	1.789	78.296	1.941	76.507
A	1.748		1.125	77.171=X3

$$Y = \frac{X_1 * P_1 + X_2 * P_2}{P_1 + P_2}$$

$$P_1 = \frac{1}{4}, P_2 = \frac{1}{2}$$

$$X_1 = 77.175$$

$$X_2 = 77.171$$

$$Y = \frac{77.175 * \frac{1}{4} + 77.171 * \frac{1}{2}}{\frac{1}{4} + \frac{1}{2}} = 77.172m$$

**B.** The table below represents the ground elevations of profile leveling using the level along the center line of a road. If the grade line pass through station 0+00 and 0.5 m above station 2+00, compute the amount of cut or fill in all stations.

Station	0+00	1+00	1+50	2+00	3+00	3+50
Ground Elevation m	90.293	91.116	91.536	92.845	90.726	89.372

$$\therefore Z_1 = 90.293$$

(10 marks)

$$\therefore Z_2 = 92.845 + 0.500$$

$$\therefore Z_2 = 93.345m$$

$$\therefore g = \tan \theta = \frac{\Delta Z_{12}}{\Delta X_{12}} = \frac{Z_2 - Z_1}{x_2 - x_1} = \frac{93.345 - 90.293}{200 - 0.00}$$

$$\therefore g = +0.01526 = +1.526\%$$

$$Z_{1+00} = Z_{0+00} + (100 - 0.0) \times \frac{1.526}{100} = 91.819 \text{ m}$$

$$Z_{1+50} = Z_{0+00} + (150 - 0.0) \times \frac{1.526}{100} = 92.582 \text{ m}$$

Station	Ground elev.	Grade elev.	Cut	Fill
0+00	90.293	90.293		0.00
1+00	91.116	91.819		0.703
1+50	91.536	92.582		1.046
2+00	92.845	93.345		0.500
3+00	90.726	94.871		3.145
3+50	89.372	95.634		6.262

**Q4)A.** The table below represent the field measurements of horizontal angle using theodolite:

Theodolite station	Observed station	Telescope D or R	H.C.R
B	A	D	0°00'00"
		R	180°00'05"
	C	D	50°25'30"
		R	230°25'38"
	A	D	90°00'00"
		R	269°59'51"
	C	D	140°25'32"
		R	320°25'28"

Compute the most probable value and standard error of the angle to the right (ABC).

(10 marks)

Answer:

$$X_1 = 50^\circ 25' 30'' - 0^\circ 00' 00'' = 50^\circ 25' 30''$$

$$X_2 = 230^\circ 25' 38'' - 180^\circ 00' 05'' = 50^\circ 25' 33''$$

$$X_3 = 140^\circ 25' 32'' - 90^\circ 00' 00'' = 50^\circ 25' 32''$$

$$X_4 = 320^\circ 25' 28'' - 269^\circ 59' 51'' = 50^\circ 25' 37''$$

$$CBA = \frac{X_1 + X_2 + X_3 + X_4}{4}$$

$$CBA = \frac{50^\circ 25' 30'' + 50^\circ 25' 33'' + 50^\circ 25' 32'' + 50^\circ 25' 37''}{4} = 50^\circ 25' 33''$$

$$v_i = \bar{x} - x_i$$

$$v_1 = 50^\circ 25' 33'' - 50^\circ 25' 30'' = 3''$$

$$v_2 = 50^\circ 25' 33'' - 50^\circ 25' 33'' = 0''$$

$$v_3 = 50^\circ 25' 33'' - 50^\circ 25' 32'' = 1''$$

$$v_4 = 50^\circ 25' 33'' - 50^\circ 25' 37'' = -4''$$

$$\delta_{xi} = \pm \sqrt{\frac{\sum v^2}{n-1}} = \pm 4.434''$$

$$\delta \bar{x} = \pm \frac{\delta_{xi}}{\sqrt{n}} = \pm 2.217''$$

B. The table below represent a field measurements in traverse survey:

Line	Horizontal Distance (m)	Deflection angle (ABC)	Azimuth
AB	140.879	65°50'30" L	170°00'00"
BC	135.945		

If the  $X_A=500$  m,  $Y_A=500$  m compute the horizontal coordinates (X,Y) of point B and C. (10 marks)

The answer :

$$AZ_{BC} = AZ_{AB} + \angle ABC = 170^{\circ}00'00'' + (-65^{\circ}50'30'') = 104^{\circ}09'30''$$

$$X_B = X_A + D_{AB} \sin AZ_{AB}$$

$$X_B = 500 + 140.879 \sin 170^{\circ}00'00'' = 524.463 \text{ m}$$

$$Y_B = Y_A + D_{AB} \cos AZ_{AB}$$

$$Y_B = 500 + 140.879 \cos 170^{\circ}00'00'' = 361.261 \text{ m}$$

$$X_C = X_B + D_{BC} \sin AZ_{BC}$$

$$X_C = 524.463 + 135.945 \sin 104^{\circ}09'30'' = 656.278 \text{ m}$$

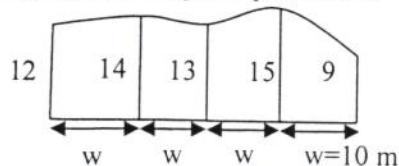
$$Y_C = Y_B + D_{BC} \cos AZ_{BC}$$

$$Y_C = 361.261 + 135.945 \cos 104^{\circ}09'30'' = 328.008 \text{ m}$$

Q5) Answer *two* of the following

A. Answer the following:- (10 marks)

1) Compute the area of following figure using Simpson Rule



$$\text{Area} = \frac{w}{3} \left[ y_1 + 2 \sum y_{\text{odd}} + 4 \sum y_{\text{even}} + y_n \right] = \frac{10}{3} [12 + 2(13) + 4(14 + 15) + 9] = 543.333 \text{ m}^2$$

2) A planimeter was used to measure the area of a parcel of land drawn in a map of a scale 1/10000, so that the fixation point placed outside the borders of the parcel. The initial reading is  $n_i = 0.000$  and the final reading is  $n_f = 5.368$ . and for the purpose of computing the constant of the instrument C, a square with 10cm side width has been draw, the initial reading is  $n_{ci} = 0.000$  and the final reading is  $n_{cf} = 2.572$ . what is the area of the parcel (on the ground) in square meters?

$$\therefore C = \frac{\text{Area}}{n}$$

$$C = \frac{10 * 10}{2.572} = 38.8802$$

$$\text{Area} = C * n = 38.8802 * 5.368 = 208.708 \text{ cm}^2 \text{ on map}$$

$Area = 208.708 * 10000 = 2087080 \text{ m}^2 \text{ on ground}$

**B.** The table below represent final cross-section of road having bed width  $b=12 \text{ m}$ .

Station	Left	Center	Right
12+50	$\frac{f}{27.0}$	$\frac{f}{0.0}$	$\frac{f}{12.0}$

Compute the area of the cross-section by coordinate method.

(10 marks)

The answer :

X	Y
6	0
12	2
0	5
-27	7
-6	0

$$A_{12+50} = \frac{1}{2} \sum_{i=1}^5 y_i (x_{i+1} - x_{i-1})$$

$$A_{12+50} = \frac{1}{2} [-2 \times (0 - 6) + (-5) \times (-27 - 12) + (-7) \times (-6 - 0)] = 124.5 \text{ m}^2$$

**C.** For a simple circular horizontal curve having a radius  $R=150 \text{ m}$ , the deflection angle  $\Theta=35^\circ$ , compute the basic elements of the curve.

(10 marks)

$$T = R \tan \frac{\theta}{2}$$

$$T = 150 \tan \frac{35}{2} = 47.294 \text{ m}$$

$$L = R \theta_{rad} = 150 \times 35 \times \frac{\pi}{180} = 91.629 \text{ m}$$

$$L_c = 2R \sin \frac{\theta}{2} = 2 * 150 \sin \frac{35}{2} = 86.036$$

$$\frac{R}{R+E} = \cos \frac{\theta}{2} \Rightarrow E = R \left[ \frac{1}{\cos \frac{\theta}{2}} - 1 \right] = 7.279$$

$$\frac{R-M}{R} = \cos \frac{\theta}{2} \Rightarrow M = R \left[ 1 - \cos \frac{\theta}{2} \right] = 6.942$$

**Q6)A.** The table below represent a field measurements of topographic surveying:

Theodolite station	Observed station	V.C.R	Rod Reading (m)		
			U	M	L
A	B	$89^0 30' 30''$	1.985	1.243	0.500
	C	$70^0 48' 10''$	---	0.314	---
		$80^0 34' 05''$	---	2.136	---

Knowing that the elevation of point B=90.648m.

Compute the elevation of point C.

(8 marks)