University Of Technology
Building and Construction Eng. Dept.
Final Exam 1st Attempt – 2014/2015

Subject :Surveying Computations **Class: 3ed**
Branch : Geomatic Engineering **Time : 3 Hours.**
Examiner : Tariq Naji **Date : 31/5/2015**

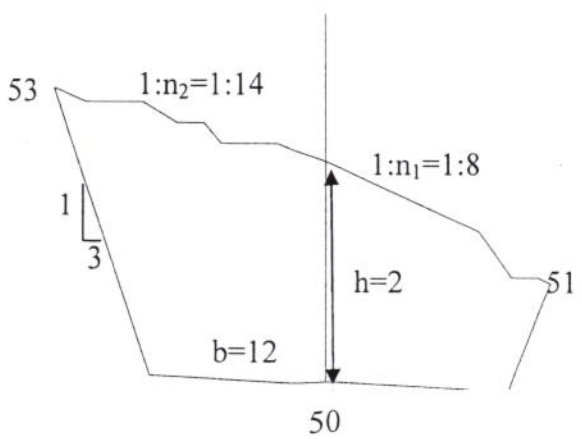
Answer Five Questions Only

Q1) **A.** The following table represent balanced latitude and departure:

Line	Dep.	Lat.
AB	125.66	255.96
BC	590.65	-153.53
CD	-192.69	- 694.07
DA	-523.62	591.64

Compute the area by DMD method. *10 marks*

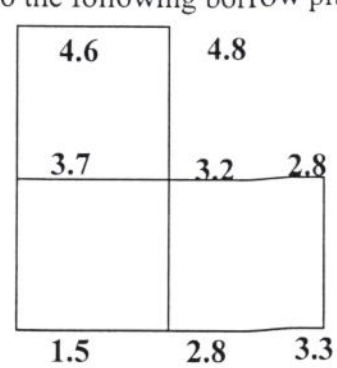
B. Compute the area of the following cross section by equation



10 marks

Q2) Answer *two* of the following

A. Compute the total volume of cut to the following borrow pit, if the dimension of the grid (20 m x 20 m).



10 marks

B. The areas of sections along a 1200-m length of proposed road are shown below, positive areas denoting cut, and negative areas denoting fill:

Station	0+00	1+00	2+00	3+00	4+00	5+00	6+00	7+00	8+00
Area	+210	+280	+160	-90	-200	-460	-470	-240	+110

Compute the cumulative volume for cut and fill after adding 10% for the fill volume.

10 marks

The area of cut and fill has been measured along the center line of road as follow :

$= 400\ m^2\ , A_f = 300\ m^2$

10 marks

e cut and fill distances measured as follow:

$L_c = 170\ m, L_f = 120\ m$

If the bed width for cut $b_c = 12$ and side slope of cut =1:2, the bed width of fill $b_f = 24\ m$ and side slope of fill =1:3, find the total volume of cut and the total volume of fill using the approximate method

Q3) A. The following table represent the ground elevation and curve elevation of vertical curve, compute the total amount of earthworks if the road width = 12m and side slope in cut and fill =1:3.

Station	Ground Elevation	Curve Elevation
44+5	36.10	40.00
45+0	36.6	39.28
45+75	37.35	39.00
46+00	37.6	39.02
47+00	38.6	40.50

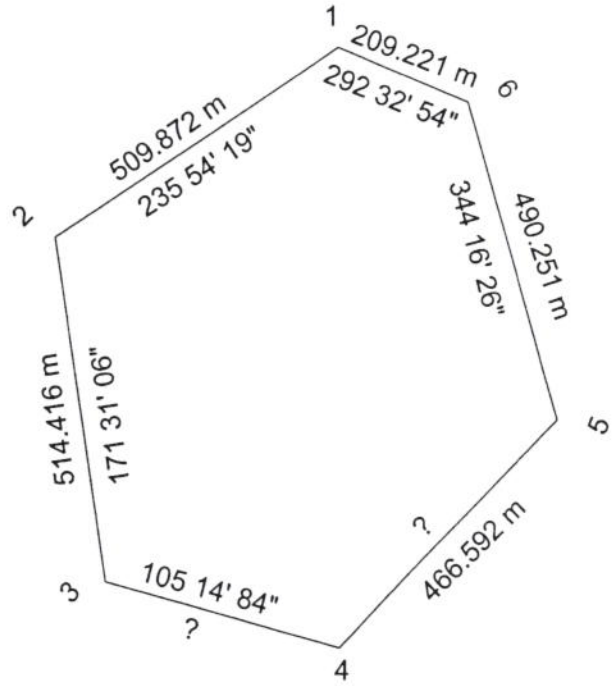
10 marks

B. The following table represent the total chords and the deflection angles required for laying out the horizontal curve from station (PC). If the coordinates of point PC=(X=5000, Y=5000) and the azimuth of the back tangent (PI-PC) =190°40'20". Compute the data needed to layout the curve using the coordinates method.

Station	Total Chord length	Deflection angle
PC 43 + 46.04		
44+00	53.96	$0^0$48' 34"
45+00	153.92	$2^0$18' 34"
46+00	253.78	$3^0$48' 34"
PT 46 + 21.04	274.76	$4^0$07' 30"

10 marks

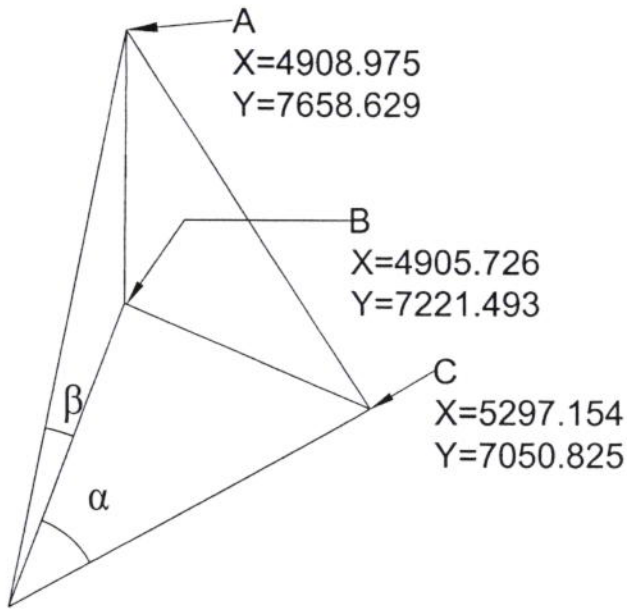
Q4) For the following figure, compute the missing data



20 marks

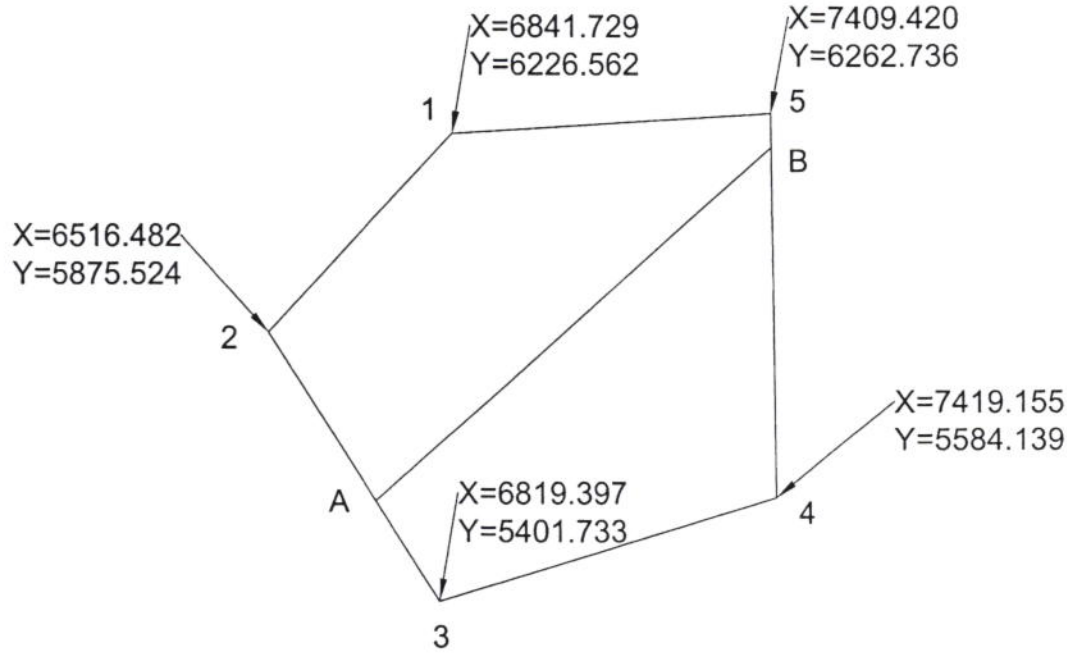
Note: This question may have two solutions

For the following figure, compute the horizontal coordinates of point P knowing that: $\alpha=40^{o}35'22.1"$ and $\beta=9^{o}18'32.4"$



20 marks

Q6) The following figure represent a parcel of land



The parcel is to be divided into two equal parts by a line "AB" having an Azimuth Of 48^{o} 20'35"

20 marks

Q1) A.

Line	Dep.	D.M.D	Lat.	2A
AB	125.66	125.66	255.96	32163.9336
BC	590.65	125.66+125.66+590.65=841.97	-153.53	-129267.654
CD	-192.69	841.97+590.65-192.69=1239.93	- 694.07	-860598.215
DA	-523.62	1239.93-192.69-532.62=514.62	591.64	309794.5368
				-647907.399
				-323953.699

B.

$$A = \frac{1}{2}\left(h + \frac{b}{2S}\right)^2 \left(\frac{2n_1.n_2S + n_1S^2 - n_1S^2}{(n_1 + S)(n_2 - S)}\right) - \frac{b^2}{4S}$$

$$A = \frac{1}{2}\left(2 + \frac{12}{2 \times 3}\right)^2 \left(\frac{2 \times 8 \times 14 \times 3 + 14 \times 3^2 - 8 \times 3^2}{(8 + 3)(14 - 3)}\right) - \frac{12^2}{4 \times 3} = 48.00\ m^2$$

Q2) Answer *two* of the following

A.

$$\text{Vol} = \frac{d^2}{4}\left(\Sigma h_1 + 2\Sigma h_2 + 3\Sigma h_3 + 4\Sigma h_4\right)$$

$$\sum h_1 = 4.6 + 4.8 + 2.8 + 3.3 + 1.5 = 17\ m$$

$$\sum h_2 = 2(3.7 + 2.8) = 13\ m$$

$$\sum h_3 = 3(3.2) = 9.6\ m$$

$$Vol\ of\ Cut = 400\left(\frac{17 + 13 + 9.3}{4}\right) = 6140.625\ m^3$$

B.

Station	Area		volume		Fill + 10 %	Cumulative volume
	cut	fill	cut	fill		
0+00	210					0.00
			24500			
1+00	280					24500
			22000			
2+00	160		5333.3			46500

3+00		90		3000	3300	48533
				14500	15950	
4+00		200				32583
				33000	36300	
5+00		460				-3717
				46500	51150	
6+00		470				-54867
				35500	39050	
7+00		240		8000	8800	-93917
8+00	110		3666.6			

C. The area of cut and fill has been measured along the center line of road as follow :

$A_c = 400\ m^2\ , A_f = 300\ m^2$

The cut and fill distances measured as follow:

$L_c = 170\ m, L_f = 120\ m$

If the bed width for cut $b_c = 12$ and side slope of cut =1:2, the bed width of fill $b_f = 24\ m$ and side slope of fill =1:3, find the total volume of cut and the total volume of fill using the approximate method

$$d_c = \frac{A_c}{L_c} = \frac{400}{170} = 2.353\ m$$

$$a_c = d_c(b_c + S_c.d_c) = 2.353(12 + 2 \times 2.353) = 39.309218\ m^2$$

$$V_C = a_c \times L_c = 39.309218 \times 170 = 6682.56706\ m^3$$

Total volume of fill (V_F):

$$d_f = \frac{A_f}{L_f} = \frac{300}{120} = 2.5\ m$$

$$a_f = d_f(b_f + S_f.d_f) = 2.5(24 + 3 \times 2.5) = 78.75 m^2$$

$$V_F = a_f \times L_f = 78.75 \times 120 = 9450\ m^3$$

Q3) A.

Station	Ground Elevation	Grade Elevation	Depth		Area=d(b+s.d)		Volume=(A1+A2)/2 X L	
			Fill	Cut	Fill	Cut	Fill	Cut
44+00	36.1	40.00	-		3.9(10+3x3.9)=			
5	0	39.28	3.9		84.6		$\frac{84.6 + 34.84}{2} \times 50 = 2986$	
45+00	36.6	39.00	-		2.68(10+3x2.68)=			
0	37.3	39.02	2.68		34.84		$\frac{34.84 + 24.66}{2} \times 75 = 2231.25$	
45+75	5 37.6	40.50	- 1.65		24.66			
46+00	38.6		- 1.42		20.25		$\frac{24.66 + 20.25}{3} \times 25 = 561.375$	
47+00			- 1.9		29.83		$\frac{20.25 + 29.83}{3} \times 100 = 2504$	

$$\sum Volume\ of\ cut = 0 m^3$$

$$\sum Volume\ of\ fill = 5803.665\ m^3$$

B.

Station	Distance (m)	Azimuth	ΔX	ΔY	X	Y

PC 43 + 46.04					5000	5000
	53.96	11°28' 54"	10.741	52.880		
44+00					5010.741	5052.88
	153.92	12°58' 54"	33.266	150.282		
45+00					5033.266	5150.282
	253.78	14°28' 54"	63.463	245.717		
46+00					5063.463	5245.717
	274.76	14°47' 50"	70.173	265.648		
PT 46 + 21.04					5070.173	5265.648

Q4)

$X_2 = X_1 + D * \sin AZ = 8652.074 + 507.872 * \sin 235\ 54\ 19 = 8231.499$
$Y_2 = Y_1 + D * \cos AZ = 6721.075 + 507.872 * \cos 235\ 54\ 19 = 6436.381$
$X_3 = X_2 + D * \sin AZ = 8231.499 + 514.416 * \sin 171\ 31\ 6 = 8307.372$
$Y_3 = Y_2 + D * \cos AZ = 6436.381 + 514.416 * \cos 171\ 31\ 6 = 5927.591$
$X_6 = X_1 + D * \sin AZ = 8652.074 + 209.221 * \sin 292\ 32\ 54.5 = 8845.301$
$Y_6 = Y_1 + D * \cos AZ = 6721.075 + 209.221 * \cos 292\ 32\ 54.5 = 6640.846$
$X_5 = X_6 + D * \sin AZ = 8845.301 + 514.416 * \sin 344\ 16\ 26 = 8978.178$
$Y_5 = Y_6 + D * \cos AZ = 6640.846 + 514.416 * \cos 344\ 16\ 26 = 6168.946$

$D_{35} = \sqrt{\Delta X^2 + \Delta Y^2} = 712.9051\ m$
$AZ_{35} = \tan^{-1}\frac{\Delta X}{\Delta Y} = 70^o12'9"$
$< 534 = AZ_{34} - AZ_{35} = 35^o02'07.1"$
$\sin < 354 = \frac{\sin < 534}{D_{45}} * D_{35} = 61^o17'56.3"$
$< 543 = 180 - (< 534 + < 354) = 83^o39'56.6"$
$D_{34} = \frac{D_{45}}{\sin < 534} * \sin < 543 = 807.8014\ m$

$X_4 = X_3 + D * \sin AZ = 8652.074 + 507.872 * \sin 235\ 54\ 19 = 9086741$
$Y_4 = Y_3 + D * \cos AZ = 6721.075 + 507.872 * \cos 235\ 54\ 19 = 5715.159$

$< 543' = 180 - (< 534 + < 354) = 26^o15'49.2"$
$D'_{34} = \frac{D_{45}}{\sin < 534} * \sin < 543' = 359.6498\ m$

$X_4{}' = X_3 + D * \sin AZ = 8652.074 + 507.872 * \sin 235\ 54\ 19 = 8654.363$
$Y_4{}' = Y_3 + D * \cos AZ = 6721.075 + 507.872 * \cos 235\ 54\ 19 = 5833.012$

For the following figure, compute the missing data

		Azim uth						
Sta	Dist	Deg	Min	Sec	Departure	Latitude	X	Y
1							8652.074	6721.075

	507.872	235	54	19	-420.575	-284.694		
							8231.499	6436.381
	514.416	171	31	6	75.873	-508.790		
3							8307.372	5927.591
	807.8014	105	14	48	779.369	-212.432		
4							9086.741	5715.159
	466.592	346	32	44.3	-108.562	453.787		
5							8978.178	6168.946
	490.251	344	16	26	-132.877	471.900		
6							8845.301	6640.846
	209.221	292	32	54.5	-193.227	80.229		
1							8652.074	6721.075
	2996.1534				0.000	0.000		

Q5)

$D_{AB} = \sqrt{\Delta X^2 + \Delta Y^2} = 437.148\ m$

$D_{BC} = \sqrt{\Delta X^2 + \Delta Y^2} = 427.017\ m$

$D_{AC} = \sqrt{\Delta X^2 + \Delta Y^2} = 721.186\ m$

$AZ_{BA} = \tan^{-1}\frac{\Delta X}{\Delta Y} = 0^o25'33"$

$AZ_{CB} = \tan^{-1}\frac{\Delta X}{\Delta Y} = 293^o33'28.3"$

$AZ_{AC} = \tan^{-1}\frac{\Delta X}{\Delta Y} = 147^o26'07.2"$

From azimuth

$< A = 32^o55'25.8"$

$< B = 113^o07'55.3"$

$< C = 33^o52'38.9"$

$< S = (< \theta + \omega) = (< B - < \alpha - < \beta) = 63^o14'0.8"$

$< \emptyset = \tan^{-1}\left(\frac{AC \sin\beta}{AB \sin\alpha}\right) = 22^o18'4.7"$

$\tan < \theta = \frac{\sin < S}{\tan < \emptyset + \cos < S} =$

$< \theta = 46^o03'23.86"$

$\tan < \omega = \frac{\sin < S}{\cot < \emptyset + \cos < S} =$

$< \omega = 17^o10'36.94"$

Q6) The following figure represent a parcel of land

من النقطة 5 يرسم خط 5-6 موازي للخط AB ومن التقاطع الاول يتم تعيين موقع النقطة 6

$X_6 = 6682.4188$

$Y_6 = 5615.9809$

Area of 6,2,1,5,6= 241762.1226

Area of A,B,5,1,2=area 1,2,3,4,5/2= 568321.8206/2=28416.9103

مساحة شبه المنحرف 56AB = مساحة الشكل 6,2,1,5,6 – مساحة الجزء A,B,5,1,2 (التي تساوي نصف مساحة المضلع).

Area 56AB=-42398.7877

X= 44.283

Or X=2717.2896

Area Calculations

Point	X	Y
1	6841.729	6226.562
2	6516.482	5875.524
3	6819.397	5401.733
4	7419.155	5584.139
5	7409.42	6262.736
1	6841.729	6226.562

Sum #1 = 206078921.6706
Sum #2 = 204942278.0295
2 Area = 1136643.641
Area = 568321.8206

The desired area is ½ the total area of the original polygon = 284.160.9103 sq. ft.

Area of initial estimated polygon 1-2-B-5:

Area Calculations

Point	X	Y
1	6841.729	6226.562
2	6516.482	5875.524
B	6682.4188	5615.9809
5	7409.42	6262.736
1	6841.729	6226.562

Sum #1 = 164780619.1881
Sum #2 = 164297094.9430
2 Area = 483524.2451
Area = 241762.1226

Area of final polygon 1-2-6-7-5:

Area Calculations

Point	X	Y
1	6841.729	6226.562
2	6516.482	5875.524
6	6706.5741	5578.1994
7	7410.2596	6204.2123
5	7409.42	6262.736
1	6841.729	6226.562

Sum #1 = 210701701.0259
Sum #2 = 210133379.1422
2 Area = 568321.3837
Area = 284160.9419