

National Exams May 2014

04-Geom-A2, Adjustment of Observations and Data Analysis

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a **CLOSED BOOK EXAM**.
Any non-communicating calculator is permitted.
3. **FIVE (5)** questions constitute a complete exam paper.
The first five questions as they appear in the answer book will be marked.
4. Each question is of equal value.

04-Geom-A2, Adjustment of Observations and Data Analysis

Candidate ID: _____ Name: _____ Signature: _____

Give answers to any five (5) of the following seven questions (100% total, 20 marks each).

1. If the elevation of A is 437.596 m, adjust the following leveling data using the weighted least squares method.

From	To	Δ Elev (m)	Distance (km)
A	B	5.666	1
B	C	48.025	4.5
C	D	3.021	6
D	E	-13.987	2.5
E	F	20.677	5
F	G	-32.376	7.6
G	A	-30.973	2.4
A	C	53.700	5.8
C	F	9.634	4.3
F	D	-6.631	3.8

- a) What are the most probable values for the elevation of the stations?
 b) What is the reference standard deviation?
 c) Tabulate the adjusted observations and their residuals.
2. Determine relative weights and perform a weighted adjustment (to the nearest second) for angles A, B, and C of a plane triangle, given the following four observations for each angle:

Angle A	Angle B	Angle C
38° 47'58"	71° 22'26"	69° 50'04"
38° 47'44"	71° 22'22"	69° 50'16"
38° 48'12"	71° 22'12"	69° 50'30"
38° 48'02"	71° 22'12"	69° 50'10"

3. Compute the linear misclosure, relative precision, and adjusted lengths and bearings for the sides after the departures and latitudes are balanced by the compass rule in the following closed-polygon traverse.

Line	Length (m)	Departure (m)	Latitude (m)
AB	2119.287	-2014.119	+662.335
BC	4660.292	-1656.601	-4358.126
CA	5209.110	+3670.793	+3695.957

4. The following data apply to a closed link traverse. Compute preliminary azimuths, adjust them, and calculate departures and latitudes, misclosures in departure and latitude, and

traverse relative precision. Balance the departures and latitudes using the compass rule, and calculate coordinates of points B, C and D. Compute the final lengths and azimuths of lines AB, BC, CD and DE.

Station	Measured Angle (to the right)	Adjusted Azimuth	Measured Length (ft)	X (ft)	Y (ft)
AzMk1					
		310° 17'20"			
A	272° 40'00"			642,846.65	89,017.92
			1432.24		
B	267° 27'28"				
			1380.01		
C	87° 02'31"				
			1229.92		
D	109° 35'39"				
			1315.60		
E	270° 29'29"			644,905.59	91,251.50
		57° 32'42"			
AzMk2					

5. Calculate a best-fit parabola for the following data obtained on a survey of an existing vertical curve, and determine the deviation (residuals) of the road from this best-fit curve. The curve starts at station 10+00 and ends at station 18+00. List the adjusted station elevations and their residuals.

Station	Elevation (m)	Station	Elevation (m)
10+00	51.2	15+00	46.9
11+00	49.5	16+00	47.3
12+00	48.2	17+00	48.3
13+00	47.3	18+00	49.6
14+00	46.8		

6. A closed level network is observed with the following results (the elevation differences and standard deviations are given in meters, and the elevation of A is 437.596m), what are the most probable values for the elevations of B, C, and D?

From	To	Δ Elev (m)	σ (m)	From	To	Δ Elev (m)	σ (m)
A	B	10.509	0.006	D	A	-7.348	0.003
B	C	5.360	0.004	B	D	-3.167	0.004
C	D	-8.523	0.005	A	C	15.881	0.012

7. Given the following data, transform the points from the measured system to the control system using a three-dimensional conformal coordinate transformation. Assume that all coordinates have estimated standard deviations of ± 0.05 m. Use the general least-squares method.

Measured coordinates				Control coordinates		
Point	x (m)	y (m)	z (m)	X (m)	Y (m)	Z (m)
1	607.54	501.63	469.09	390.13	499.74	469.32
2	598.98	632.36	82.81	371.46	371.46	81.14
3	643.65	421.28	83.50	425.43	419.18	82.38
4	628.58	440.51	82.27			
5	666.27	298.16	98.29			
6	632.59	710.62	103.01			