

National Exams December 2019

18-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.
A Casio or Sharp approved 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.

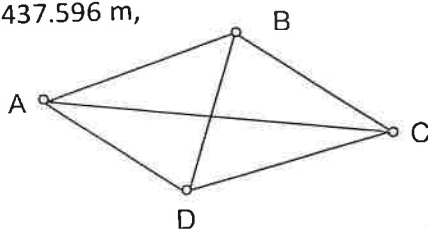
18-Geom-A2, Adjustment of Observations and Data Analysis

Candidate Name:

Signature:

Give answers to any five (5) of the Questions 1 to 7 (20 marks each).

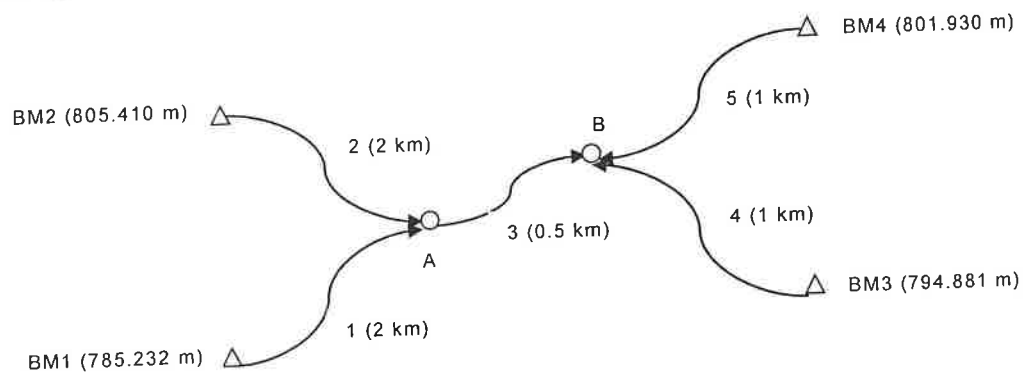
1. The following figure shows a level net that is observed with the following results: the elevation differences and standard deviations are given in metres, and the elevation of A is 437.596 m,



From	To	Δ Elev (m)	Std. dev. (m)	From	To	Δ Elev (m)	Std. dev. (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

What are the most probable values for the elevations of B, C, and D?

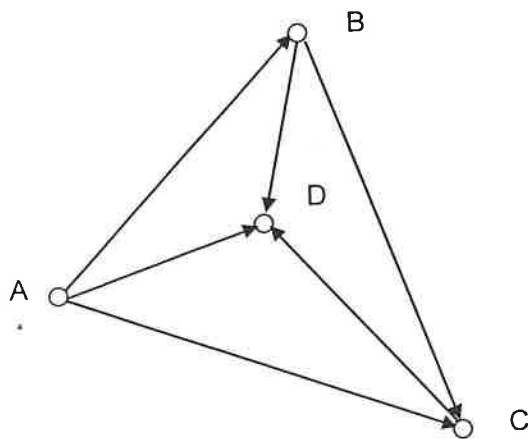
2. Adjust the level net (see the figure below) by weighted least-squares, and compute precisions of the adjusted bench-marks. The figure shows a level net with the observed elevation differences for courses 1 through 5 (given in order) that are +10.997 m, - 9.169 m, + 3.532 m, + 4.858 m, and - 2.202 m. Arrows on the courses in the figure indicate the direction of leveling. Thus for course 1 having a length of 2 km, leveling proceeded from BM1 to A and the observed elevation difference was 10.970 m.



3. Angle GAB was observed as $107^{\circ}29'40''$. The backsight station G, instrument station A, and foresight station B had the following approximate X and Y coordinates, respectively: (578.741 m, 1103.826 m); (415.273 m, 929.868 m); and (507.934 m, 764.652 m). Write the linearized observation equation for this angle GAB.

4. The length of a line AB was measured as 132.823 m. The approximate coordinates for stations A and B are: (1023.151 m, 873.018 m) and (1094.310 m, 985.163 m), respectively. Write the linearized observation equations for this distance AB.

5. A local leveling network composed of 6 sections was observed. The arrow heads indicate the direction of increasing elevation. The following table summarizes the observed differences in elevations along with the corresponding length of each section. Given the elevation of the station A to be 0 m, adjust this leveling net by the parametric method of adjustment.



Section	Station		Observed difference in elevation (m)	Section length (km)
	From	To		
1	A	C	6.16	4
2	A	D	12.57	2
3	C	D	6.41	2
4	A	B	1.09	4
5	B	D	11.58	2
6	B	C	5.07	4

6. Given a 5-side traverse, compute the departures and latitudes, the error of closure, and precision, and balance each of the latitudes and departures.

Course	Length (m)	Azimuth	Departure (m)	Latitude (m)
AB	1,352.562	245°16'24"		
BC	1,999.670	147°06'37"		
CD	1,329.127	95°33'20"		
DE	2,427.328	23°45'21"		
EA	2,163.325	274°01'46"		

7. The following table represents the observed elevations for the Benchmark A and three turning points in a closed level loop, determine the adjusted elevations based on number of instrument setups.

Point	Observed elevations (ft)	Corrections (ft)	Adjusted elevations (ft)
BM A	200.00		
TP1	209.20		
TP2	216.44		
TP3	211.86		
BM A	200.30		