



NAAMI BIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY
FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

DEPARTMENT OF LAND AND SPATIAL SCIENCES

QUALIFICATIONS: BACHELOR OF GEOMATICS and DIPLOMA IN GEOMATICS	
QUALIFICATIONS CODES: 07BGEO, 06DGEO	QUALIFICATION LEVEL: Level 7 - 07BGEO Level 6 - 06DGEO
COURSE CODE: BSV521	COURSE NAME: Basic Surveying
DATE: June 2023	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER:	Mr F. J. Louw
MODERATOR:	Mr S. Sinvula

INSTRUCTIONS

1. You **MUST** answer **ALL QUESTIONS**
2. Write clearly and neatly.
3. Number the answers clearly.
4. Make sure your Student Number is on the EXAMINATION BOOK(s).
5. **MAKE SURE YOUR STUDENT NUMBER IS ON THE DATA SHEET AND THAT YOU SUBMIT IT WITH YOUR EXAMINATION BOOK(S).**

PERMISSIBLE MATERIALS

1. Calculator, ruler, pen, pencil, and eraser.

THIS QUESTION PAPER CONSISTS OF 8 PAGES (Including this front page and 3 Data Sheets)

Question 1

- 1.1. Surveying can be divided into fieldwork and office work, briefly explain BOTH. (4)
- 1.2. List the TWO principal classifications of surveying. Fully explain BOTH. (7)
- 1.3. Setting out is the process of using surveying equipment and techniques to transfer information from a plan to the ground. Describe the THREE distinct elements of setting out. (3)
- 1.4. Briefly explain the FOUR important aspects of a resection. (4)
- 1.5. Briefly describe the term "Trigonometrical Levelling". (2)

[20]**Question 2**

- 2.1. Use the levelling observations given in Data Sheet 1 or Data Sheet 2 to determine the final heights using **ANY METHOD** which provides a full arithmetic check. All usual checks must be done, and any mis-closures need to be distributed. Please detach the data sheet and submit it with your examination book. (10)
- 2.2. Use the field observations at **K15**, to calculate the final observed directions. (5)

@K15 HI = 1.655m

Point	Circle Left	Circle Right
ΔCC	299° 02' 38"	119° 02' 34"
K2	309° 48' 06"	129° 47' 55"
Gate	255° 14' 53"	75° 15' 03"
ΔRCCS	271° 46' 42"	91° 46' 44"
RO	299° 02' 33"	119° 02' 31"

- 2.3. Use the information below to calculate the final vertical directions at point **K15**. (5)

@K15 HI = 1.655m

Point	Circle Left	Circle Right
ΔCC	85° 56' 58"	274° 03' 08"
K2	92° 49' 17"	267° 10' 37"
Gate	94° 05' 59"	265° 54' 05"

[20]

Question 3

3.1. Use the following Formula and the observations at **RP1**, to answer the questions that follow.

Please note:

The Instrument Correction and Prism Constant, the Atmospheric Correction, and the Conversion to German Legal Metre are already applied to all measured distances.

Combined Sea level & Scale Enlargement Factor = $1 + [(y^2/(2R^2)) - (H/R)]$, where R = 6 370km.

Coordinates

Name	Y	X	Height
Δ CC	- 9 053.130	+ 62 813.860	
Δ CC	- 8 555.090	+ 62 481.930	
RP1	- 8 146.180	+ 62 570.831	1 666.665

@ RP1 Height of the Instrument is 1.658m.

Name	Final Observed Direction	Slope Distance	Zenith Angle
Δ RCCS	257° 44' 11"		87° 45' 48"
Δ CC	285° 00' 07"		85° 45' 48"
P1	323° 19' 48"	20.825m	91° 35' 35"

3.1.1. Calculate and apply all corrections to observations at **RP1** (directions & distances). (11)

3.1.2. Calculate the coordinates for P1. (4)

3.2. Use the following Formula to calculate the height of **H1**. (4)

$$\Delta H_{ab} = H_I - H_{sig} + S_{ab}/\tan(Z) + (1-k) \cdot S^2 / (2R) \quad H_a = H_b - \Delta H_{ab}$$

$$R = 6\,370\,000\text{m} \quad k = 0.13$$

Co-ordinates

Point	Y	X	Z
Δ EROS	-10 489.688	+60 272.255	1 810.685 (Ground Level)

The JOIN distance from H1 to Δ EROS is 4 104.000m

@ H1 HI = 1.780m		
Point	Zenith Angle	Height of Pillar
Δ EROS	87° 46' 45"	1.200m (Top of Pillar)

[20]

Question 4

4.1. Calculate the final coordinates for the traverse points on Data Sheet 3. Use the said data sheet for all your calculations. Use the Bowditch Rule to adjust the traverse. Please note that the directions are oriented, and the distances are final horizontal distances. Please detach the data sheet and submit it with your examination book. (10)

4.2. Use the following observations at **NEW**, to calculate the Y and X coordinates for **NEW**. (10)

Please note:

The Prism Constant, the Atmospheric Correction, the Conversion to German Legal Metre, and the Combined Sea level & Scale Enlargement Scale Factor correction are already applied to all measured distances.

Co-ordinates

Name	Y	X	Height
Δ Moltke	-18 508.640	+72 023.020	
ZB3214	-26 178.133	+60 627.395	1800.000

@ NEW**HI = 1.655m**

Point/Station	Final Observed Direction	Final Horizontal Distance	Zenith Angle
Δ Moltke	29° 23' 01"		87°35'28"
ZB3214	110° 54' 10"	190.613m	91°07'32"

[20]**Question 5**

5.1. Use the information and observations below to calculate the coordinates for the point **TOP**, by using the Q-point method of a resection calculation. (20)

Co-ordinates

Name	Y	X
Δ OLYMPIA	- 9 728.580	+ 66 201.950
Δ SWP	- 4 680.110	+ 62 348.570
Δ WACHTER	- 13 105.120	+ 52 799.350

<u>@ TOP</u>	Height of Instrument = 1.615m	
Name	Final Observed Dir.	
Δ SWP	120° 35' 18"	
Δ WACHTER	226° 49' 12"	Long Leg
Δ OLYMPIA	328° 24' 50"	

[20]

Student Number _____

Data Sheet 3

Question 4.1.

Bowditch Rule - Adjustment Sheet

Note: All answers must be rounded off to 3 decimal places

DIRECTION & DISTANCE	JOINS	DIFFERENCES		STATION	FINAL Y	COORDINATES X
		ΔY	ΔX			
				A	+ 3 961.307	+ 68 371.758
185° 18' 38"	Do NOT Calculate Joins					
391.227m						
				B		
111° 20' 33"						
356.826m						
				C		
90° 00' 05"						
295.892m						
				D		
84° 10' 10"						
381.265m				E	+ 4 932.565	+ 67 891.023