

**PAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY
FACULTY OF ENGINEERING AND SPATIAL SCIENCES**

DEPARTMENT OF ARCHITECTURE 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 2022	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, pencil and eraser.

THIS QUESTION PAPER CONSISTS OF 7 PAGES (Including this front page and 1 Data Sheet)

Question 1

- 1.1. Differentiate between a Measurement and an Observation. (4)
- 1.2. Distinguish between "Zero south orientation" and "True orientation". (4)
- 1.3. To carry out a survey one needs to consider certain principle factors before executing the survey, describe **ALL** these principle factors. (5)
- 1.4. How would you test for the presence of parallax in the telescope of a theodolite? (2)

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Question 2

- 2.1. Use the following information and the sketch below to answer the questions below.

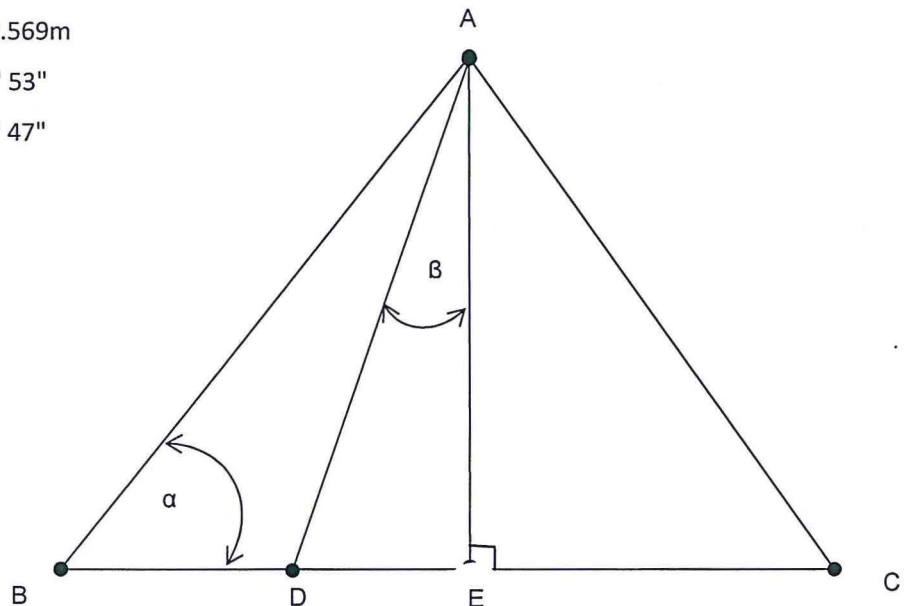
Distance AC = 77.105m

Distance BE = 62.663m

Distance DE = 13.569m

Angle $\alpha = 37^\circ 14' 53''$

Angle $\beta = 15^\circ 53' 47''$



- 2.1.1. Calculate the sides AB and AE, using angle α and distance BE in the $\triangle ABE$. Check your answer. (5)
- 2.1.2. Calculate the side EC using $\triangle ACE$. (2)
- 2.1.3. Calculate the side AD using $\triangle ABD$. (3)

- 2.2. Use the levelling observations given on the levelling field sheet below 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. Note that the **BOLD** values are the Inverted Staff Readings.

(10)

Levelling field sheet

Point	B.S.	I.S.	F.S.	Final Heights
ROOF 1	-0.524			1217.016
A		0.817		
B	0.966		0.975	
ROOF 2		0.899		
C	-0.838		-0.920	
D		1.207		
E		1.231		
ROOF 3			-0.802	1217.355

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Question 3

- 3.1. Use the field observations at **ROCK**, to calculate final observed directions.

(5)

@Rock HI = 1.587m

Point	Circle Left	Circle Right
ΔWind	287°53'45"	107°53'38"
ΔOutlook	298°19'11"	118°18'54"
Stok	131°04'53"	311°05'03"
Pole	169°59'54"	350°00'08"
RO	287°53'48"	107°53'45"

3.2. Use the following Formula and the observations at **POP**, to answer the questions that follows.

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 $R = 6\,370\text{km}$.

Co ordinates

Name	Y	X	Z/Height
Δ DURANT	+ 40312.280	- 54 416.470	
Δ JAGER	+ 56 141.390	- 50 981.830	
POP	+ 39 774.150	- 57 965.790	1 750.000

@ POP Height of Instrument is 1.658m.

Name	Final Observed Direction	Slope Distance	Zenith Angle
Δ DURANT	8° 37' 18"		89° 45' 48"
Δ JAGER	66° 53' 37"		89° 45' 48"
ST1	127° 34' 36"	332.319m	91° 24' 44"

3.2.1. Calculate and apply all corrections to observations at POP(directions & distances). (11)

3.2.2. Calculate the co-ordinates for ST1 (4)

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Question 4

4.1. Calculate the traverse on Data Sheet 1. 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. Please detach the Data Sheet and submit with your examination book. (10)

- 4.2. Use the following observations at **ST2**, to calculate the Y and X co-ordinates for **ST2**. (11)

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	Z/Height
Δ Eros	-10 489.688	+60 272.255	1 810.680
TSM14	- 5 297.730	+59 471.920	

@ ST2 Height of Instrument is 1,750m.

Name	Fin. Observed Direction	Slope Distance	Zenith Angle	Height of Target
Δ Eros	278° 28' 38"		87° 59' 24"	1.210m - Top of Pillar
TSM14	212° 05' 02"	28.665m	94° 14' 28"	1.500m - Target

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Question 5

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

Co-ordinates

Name	Y	X
Δ DRAAI	- 27 114.600	+ 154 255.400
Δ NAB	- 35 842.500	+ 153 064.100
Δ SES	- 29 097.400	+ 171 069.100

@ DOP Height of Instrument = 1.719m

Name	Final Observed Dir.	
Δ DRAAI	147° 16' 05"	
Δ NAB	253° 23' 23"	
Δ SES	10° 05' 58"	Long Leg

- 5.2. Use the following Formula to calculate the height of **H100**. (4)

$$\Delta H_{ab} = H_i - H_{sig} + S_{ab}/\tan(Z) + (1-k).S^2/(2R)$$

$$H_a = H_b - \Delta H_{ab}$$

Where R is earth radius (use R = 6 370 000m), and k is an assumed relative ray curvature factor (use k = 0.13).

Co-ordinates

Point	Y	X	Z
Δ Slangkop	-10 489.680	+60 272.260	1 807.300 (Ground Level)
H1	- 6 845.587	+63 371.410	

The JOIN distance from H100 to Δ Slangkop is **4 783.738m**

@ H100 **HI = 1.780m**

Point/Station	Oriented Dir.	Slope	Distance	Zenith Angle	Height of Pillar/Target
Δ Slangkop	178°20'25"			89°50'57"	1.200m (Top of Pillar)
WP1	41°37'04"	696.561		90°02'07"	1.865m (Top of Target)

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Student Number _____

Data Sheet 1

Question 4.1.

Bowditch Adjustment Sheet

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

DIRECTION & DISTANCE	JOINS	DIFFERENCES		STATION	FINAL	COORDINATES
		ΔY	ΔX		Y	X
				R	- 13 896.750	+ 11 812.180
299° 56' 00"	Do NOT Calculate Joins					
644.760m						
				TR1		
27° 51' 19"						
542.780m						
				TR2		
102° 47' 21"						
825.270m						
				S	- 13 397.065	+ 12 431.053