THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

FORM TWO NATIONAL ASSESSMENT

073 CIVIL ENGINEERING SURVEY

Time: 2:30 Hours **ANSWERS** **Year: 2023**

Instructions

1. This paper consists of Section **A, B** and **C** with a total of **ten (10)** questions
2. Answer **al**l questions.
3. Section **A** and **C** carry **fifteen (15)** marks each and section **B** carries **seventy (70)** marks
4. Cellular phones and unauthorized materials are not allowed in the assessment room
5. Write your **Assessment Number** at the top right-hand corner of every page.

FOR ASSESSOR'S USE ONLY

QUESTION NUMBER	SCORE	ASSESSOR'S INITIALS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
TOTAL		
CHECKER'S INITIALS		

Prepared by: Maria Marco for TETEA

SECTION A (15 Marks)

Answer all questions in this section

1. Choose the correct answer from the given alternatives and write its letter in the box provided.

(i) The school area was surveyed before the reconnaissance exercise is conducted. Select the type of sketch which is prepared during reconnaissance survey.

A. Reference sketch

B. Offset sketch

C. Index sketch

D. Survey sketch

During a reconnaissance survey, an index sketch is prepared to show the general layout of the area, including main features and proposed survey stations.

Answer: C

(ii) The reading of 315°45' was recorded in the whole circle bearing when the compass surveying was conducted. Convert

A. N 135°45' W

B. N 44°15' W

C. S 244°15' E

D. N 135°45' E

Whole circle bearing (WCB) 315°45' is converted to quadrant bearing:

315° is in the 4th quadrant (270° to 360°).

Angle from North = 360° - 315° = 45°.

Since it's west of north, the bearing is N 45° W (or N 44°15' W, adjusting for minutes).

Answer: B

(iii) When carrying out leveling operations, a reference point is chosen so that the elevation of all points is related. Which of the following do surveyors use to denote reference point in the field?

A. Level line

B. Horizontal line

C. Datum

D. Reducing level

A datum is a reference point or surface (e.g., mean sea level) used in leveling to relate the elevation of all points in the survey.

Answer: C

(iv) A supervisor warns you to handle with care tools, equipment and materials used in surveying works. In what category of safety does this regulation belong?

A. Personal safety

B. Student safety

C. Workshop safety

D. Site safety

Handling surveying tools and equipment with care falls under site safety, as it pertains to safe practices during fieldwork on a survey site.

Answer: D

(v) A surveyor went to visit the site for preliminary inspection of the area to be surveyed for construction works. Which item is the most important to use during setting out works?

A. Theodolite

B. Dump level

C. Compass

D. Notebook

A theodolite is the most important tool for setting out works, as it accurately measures angles to establish precise positions and alignments for construction.

Answer: A

(vi) A surveyor stationed at point B observed the bearing of line BC from point B towards point C. What bearing is the surveyor intending to measure?

A. Fore bearing

B. Back bearing

C. BC bearing

D. CB bearing

The bearing from point B to point C (forward direction) is called the fore bearing. The back bearing would be from C to B.

Answer: A

(vii) The distance measured on the ground with the help of a chain, tape or any other instrument, is known as

A. Direct measurements

B. Indirect measurements

C. Computative measurements

D. Instrumental measurements

Distance measured on the ground using a chain or tape is a direct measurement, as it involves physically measuring the distance.

Answer: A

(viii) Students were measuring perpendicular offsets by setting right angled triangle. Identify the right mathematical expressions used for that particular work.

A. 1:2:5

B. 1:4:5

C. 3:4:5

D. 3:4:8

The 3:4:5 ratio represents a right-angled triangle (based on the Pythagorean theorem: $3^2 + 4^2 = 5^2$), commonly used to set perpendicular offsets in surveying.

Answer: C

(ix) A surveyor used large scale to draw the map of 1 cm = 1 m. Convert the value into RF scale.

A. 1/10

B. 1/100

C. 1/1,000

D. 1/10,000

Representative Fraction (RF) = Map distance / Ground distance.

1 cm = 1 m = 100 cm.

RF = 1 cm / 100 cm = 1/100.

Answer: B

(x) A surveyor wishes to determine the relative position of different objects on the surface of the earth. Which principles are to be used by a surveyor to perform his work?

A. Working from the whole to the part and locate a new station by at least two measurements from fixed reference points

B. Locating a new station by at least two measurements from the fixed reference points and bench mark

C. Working from whole to the part and determine the natural features of a country

D. Working from whole to the part and locate a new station by one measurement

The fundamental principle of surveying is to work from the whole to the part (establish a control framework first) and locate new stations using at least two measurements (e.g., angles or distances) from fixed reference points for accuracy.

Answer: A

2. Match the items (i-v) in List A with the corresponding correct response in List B by writing a letter of the correct response in the table provided.

LIST A

LIST B

(i) Rapid sweep with right hand

A. Plum the rod to the right

(ii) Slow sweep with left hand

B. Continue to move to the right

(iii) Right arm up and move to right

C. Continue to move to left

(iv) Left arm extended

D. Fix the rod

(v) Both hands above head then move below down

E. Move slowly to left

F. Move slowly to the right

G. Correct position

i) Rapid sweep with right hand → B (Continue to move to the right)

ii) Slow sweep with left hand → E (Move slowly to left)

iii) Right arm up and move to right → F (Move slowly to the right)

iv) Left arm extended → C (Continue to move to left)

v) Both hands above head then move down → G (Correct position)

SECTION B (70 Marks)

Answer all questions from this section

3. Suppose you are among the students who are assigned to survey an area for the construction of a school library. What will be your three basic duties as a surveyor?

(a) Reconnaissance Survey: Conduct a preliminary inspection to identify key features, obstacles, and suitable survey stations.

(b) Measurement and Recording: Accurately measure distances, angles, and elevations, and record data for mapping and design.

(c) Setting Out: Mark the positions of the library's foundation and boundaries on the ground using survey equipment.

Answer:

(a) Reconnaissance Survey: Inspect area, identify features.

(b) Measurement and Recording: Measure and record data.

(c) Setting Out: Mark foundation and boundaries.

4. (a) One of the temporary adjustments to the prismatic compass in the field is centering. Explain two ways that you can use to check whether the prismatic compass is exactly centered:

i) Drop a Plumb Bob: Suspend a plumb bob from the compass center and check if it aligns directly over the station mark on the ground.

ii) Observe Alignment with Pegs: Sight two known points or pegs through the compass; if the compass is centered, the line of sight should pass through the station mark.

Answer:

i) Drop a Plumb Bob: Check alignment over station mark.

ii) Observe Alignment with Pegs: Sight known points for alignment.

(b) A linen tape is not always used in conducting chain surveying. Support this statement by giving three reasons:

i) Stretching: Linen tape stretches under tension, leading to inaccurate measurements.

ii) Moisture Sensitivity: It absorbs moisture, causing expansion or contraction, which affects accuracy.

iii) Durability: Linen tape is less durable and prone to wear and tear compared to steel or fiberglass tapes.

Answer:

i) Stretching: Stretches under tension, inaccurate.

ii) Moisture Sensitivity: Expands with moisture, affects accuracy.

iii) Durability: Less durable, prone to wear.

5. Describe five common procedures to be taken when measuring the length of a line from point A to B by using a tape:

i) Align the Tape: Stretch the tape straight between points A and B, ensuring it follows the ground or is held horizontal for sloping terrain.

ii) Mark the Ends: Place ranging rods or pegs at points A and B to mark the start and end of the line.

iii) Apply Tension: Pull the tape with consistent tension (e.g., using a spring balance) to avoid sagging or stretching.

iv) Correct for Slope: If the ground slopes, measure the slope angle and correct the taped distance to the horizontal distance using trigonometry.

v) Record Measurements: Take multiple readings, note any offsets or obstacles, and record the final length accurately.

Answer:

i) Align the Tape: Stretch straight between A and B.

ii) Mark the Ends: Use rods to mark A and B.

iii) Apply Tension: Pull tape with consistent tension.

iv) Correct for Slope: Adjust for sloping ground.

v) Record Measurements: Note readings and offsets.

6. (a) The surveyor is conducting a linear measurement on the sloping area. The length of the slope AB is 40.50 m and the angle measured is 30°. Calculate the true length of line AC.

Assuming a right triangle where AB is the hypotenuse, AC is the horizontal base, and the angle of 30° is the slope angle:

$AC = AB \times \cos(30°)$

$\cos(30°) = \sqrt{3}/2 \approx 0.866$

$AC = 40.50 \times 0.866 \approx 35.07$ m

Answer: True length of AC = 35.07 m

(b) Before linear measurements are taken on the ground the chainman is supposed to be at the forward end of the chain. What are the three duties of a chainman on that context?

i) Lead the Chain: Move forward with the chain, ensuring it is aligned straight along the survey line.

ii) Mark the Position: Place a peg or arrow at the end of each chain length to mark the measurement point.

iii) Clear Obstacles: Remove minor obstacles (e.g., small rocks or vegetation) to ensure accurate chain placement.

(c) During linear measurements, a follower should be at the rear end of the chain and holds zero end of the chain at the station. Why the follower should stay on that position?

The follower stays at the rear to hold the zero end of the chain at the starting station, ensuring the chain remains anchored and measurements are taken from a fixed point, maintaining accuracy.

7. Suppose you have been awarded a project to establish the elevations of all the buildings in Masoko town. Prepare a checklist of pieces of equipment you will use to conduct this project basing on the following guidelines:

(a) Four equipment for measuring elevations:

i) Leveling Instrument (Dumpy Level): To measure height differences between points.

ii) Tripod: To mount the leveling instrument securely.

iii) Leveling Staff: To read elevation differences at various points.

iv) Bench Mark: A fixed reference point to establish elevations.

(b) Four self-leading staves for vertical measurement:

i) Telescopic Staff: Collapsible staff for easy transport, used with a level.

ii) Folding Staff: Hinged staff that folds for portability, used for leveling.

iii) Aluminum Staff: Lightweight, durable staff for vertical measurements.

iv) Fiberglass Staff: Non-conductive staff, safe for use near electrical lines.

(c) Six tools for linear measurements:

i) Steel Tape: For accurate distance measurement over long distances.

ii) Chain: For measuring distances in chain surveying.

iii) Ranging Rods: To mark and align survey lines.

iv) Pegs: To mark stations or points on the ground.

v) Arrows: To mark chain lengths during measurements.

vi) Plumb Bob: To ensure vertical alignment of points.

(d) Two equipment for measuring angles:

i) Theodolite: Measures horizontal and vertical angles with high precision.

ii) Total Station: Combines angle and distance measurement for precise positioning.

(e) Two equipment for measuring bearings:

i) Prismatic Compass: Measures magnetic bearings in the field.

ii) Surveyor's Compass: Used to determine bearings relative to magnetic north.

(f) One equipment for measuring area:

Planimeter: A device used to measure the area of irregular shapes on a map or plan.

8. Prepare five equipment you would need for conducting chain surveying at a sisal farm and identify their uses:

i) Chain (20 m or 30 m): Measures linear distances along survey lines.

ii) Ranging Rods: Marks and aligns straight survey lines between stations.

iii) Arrows: Marks the end of each chain length during measurement.

iv) Pegs: Marks survey stations or key points on the ground.

v) Tape: Measures offsets perpendicular to the chain line for detailed features.

9. Readings recording during chain surveying suffers from series of different errors which can be either positive or negative. In each case, what are the five causes of errors that can be corrected before using the data?

(a) Positive errors:

i) Tape Too Short: If the tape has shrunk, recorded distances are longer than actual.

ii) Sagging Tape: Tape sagging due to improper tension overestimates the distance.

iii) Incorrect Alignment: Measuring along a curved path instead of a straight line increases the recorded length.

iv) Temperature Expansion: Tape expands in high temperatures, overestimating distances.

v) Slope Not Corrected: Measuring along a slope without correcting to horizontal distance overestimates length.

(b) Negative errors:

i) Tape Too Long: If the tape has stretched, recorded distances are shorter than actual.

ii) Temperature Contraction: Tape contracts in cold temperatures, underestimating distances.

iii) Obstacles Ignored: Shortening the measurement by not accounting for obstacles.

iv) Improper Tension: Too much tension stretches the tape, reducing recorded length.

v) Human Error: Misreading the tape or marking incorrect points underestimates distance.

SECTION C (15 Marks)

Answer all questions from this section

10. (a) Reconnaissance survey is done based on the thinking about the possible arrangement of the framework of survey and hence index sketch is prepared. Describe three common survey stations obtained in the prepared index sketch:

i) Main Stations: Key points forming the framework of the survey, often at corners or intersections.

ii) Tie Stations: Points used to connect main stations to nearby features for additional control.

iii) Base Stations: Reference points with known coordinates or elevations to start the survey.

Answer:

i) Main Stations: Key points of survey framework.

ii) Tie Stations: Connect main stations to features.

iii) Base Stations: Reference points to start survey.

(b) In chain surveying when the area is large, too much rising and falling and crowded with many details, triangulation is not possible. Account for three obstacles and how can each one be solved for the process to become possible:

i) Obstacle: Large Area with Rising/Falling Terrain

Solution: Break the area into smaller sections and use leveling to account for elevation changes, or use offset measurements to simplify the terrain.

ii) Obstacle: Crowded with Details (e.g., Trees, Buildings)

Solution: Use offset measurements to record details without disturbing the main survey lines, or clear minor obstacles if permissible.

iii) Obstacle: Inability to Form Triangles Due to Obstructions

Solution: Use traverse surveying instead, establishing a series of connected lines with measured angles and distances to bypass obstructions.