THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATION COUNCIL OF TANZANIA

FORM TWO NATIONAL ASSESSMENT

073 **CIVIL ENGINEERING SURVEY**

Time: 2:30 Hours. **ANSWER** **Year: 2024**

Instructions

1. This paper consists of sections **A**, **B** and **C** with a total of **ten (10)** questions.
2. Answer **all** questions.
3. Section A carries **15** marks; section B carries **70** marks and section C carries **15** marks.
4. All writing must be in **black** or **blue** ink and drawings must be in **pencil**.
5. Cellular phones and unauthorized materials are **not allowed** in the examination room.
6. Write your **Assessment Number** at the top-right hand corner of every page.

FOR EXAMINER'S USE ONLY		
QUESTION NUMBER	SCORE	EXAMINER'S INITIALS
1		
2		
3		
4		
5		
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7		
8		
9		
10		
TOTAL		
CHECKER'S INITIALS		

SECTION A (15 Marks)

Answer all questions from this section

1. For the item (i)–(x), choose the correct answer from among the given alternatives and write its letter in the box provided.

(i) Identify a set of important tools which are required for compass surveying.

A. Compass, Arrows, Metallic tape, Picks axe and Plumb bob

B. Compass, Ranging rods, Metallic tape, Arrows and Plumb bob

C. Compass, Ranging rods, Metallic tape, Square and Plumb bob

D. Compass, Ranging rods, Linear tape, Hammer and Plumb bob

Correct answer: B

Reason: These are the main tools needed in compass surveying. The compass is used for measuring bearings, ranging rods for marking stations, metallic tape for measuring distances, arrows for marking chain lengths, and plumb bob for centering.

(ii) When tape is used to conduct chain survey in the field, systematic errors may occur. Which factor might be the source of the error?

A. Misreading of the tape

B. Variation in tension to the tape

C. Miscounting of tape lengths

D. Poor straightening of the tape

Correct answer: B

Reason: Systematic errors occur due to consistent factors like changes in tape tension. Varying tension alters the tape length, causing measurement errors.

(iii) Suppose you are a surveyor and you are planning to make linear measurements in a certain plot. Which method will you use?

A. Direct measurement

B. Indirect measurement

C. Precise measurement

D. Electrical measurement

Correct answer: A

Reason: Direct measurement is the basic and most common method for determining linear distances using chains or tapes in a plot.

(iv) Linear and chaining surveying is conducted at a small area for correct and accurate measurements. Which among the following is the acceptable shape of the area?

A. Trapezium

B. Triangle

C. Rectangle

D. Parallelogram

Correct answer: B

Reason: A triangle is the most acceptable shape because it can be easily plotted and checked for accuracy. Errors can be detected by verifying the sum of angles.

(v) A surveyor surveying the site was taking linear measurements of a line AB by using a tape of 30 m long. After completing the survey, the tape was extended to 30.023 m long due to expansion. Determine the distance of a line AB which is supposed to be 125.510 m long if the tape did not expand.

A. 125.550 m

B. 125.600 m

C. 125.606 m

D. 125.625 m

Correct answer: C

Reason: True length = (Measured length × Actual tape length) ÷ Nominal tape length = (125.510 × 30.023) ÷ 30 = 125.606 m.

(vi) Which one of the following are temporary adjustments for the prismatic compass?

A. Centering, levelling, focusing the prism

B. Centering, focusing the prism, adjustment of sight vane

C. Adjustment of needle, focusing the prism, adjustment of levels

D. Centering adjustment of needle, adjustment of pivot point

Correct answer: A

Reason: Temporary adjustments ensure the compass is correctly positioned for accurate readings, which include centering, levelling, and focusing the prism.

(vii) The reference meridian used by surveyors to measure bearings that passes through the geographical South Pole, North Pole and any point on the surface of the earth is known as

A. Grid meridian

B. True meridian

C. Arbitrary meridian

D. Magnetic meridian

Correct answer: B

Reason: The true meridian passes through the geographical poles and the observer's location. It is used as a reference for measuring true bearings.

(viii) Before surveying the school area, reconnaissance was conducted. Which sketch was prepared during reconnaissance?

A. Reference sketch

B. Offset sketch

C. Check line sketch

D. Index sketch

Correct answer: D

Reason: An index sketch is drawn during reconnaissance to show the general layout of the area and the arrangement of survey lines before actual surveying begins.

(ix) The notebook in which measurements are noted is known as the field book. How should it be arranged?

A. Single line and double line

B. Single line and three line

C. Double line and three line

D. Double line and triple line

Correct answer: C

Reason: A field book is arranged in double line and three-line forms to clearly record chainages, offsets, and other measurements systematically.

(x) In chain surveying a problem arises if chaining is free but vision is obstructed. To solve this problem reciprocal ranging is resorted and chaining is done. Which of the following methods is used in a reciprocal ranging?

A. Indirect method

B. Direct method

C. Stepping method

D. Rise and fall method

Correct answer: A

Reason: In reciprocal ranging, the indirect method is used because the surveyor and assistant alternately align themselves to establish a straight line when direct sighting is not possible.

2. Match the descriptions of hazards encountered in land surveying in **List A** with correct types of hazards in **List B** by writing a letter of the corresponding response below the item number in the table provided.

List A	List B
(i) When surveyors work in outdoor environments they may be exposed to slips, trips, falls, and uneven ground that increase the risk of injury. (ii) Mishandling of surveying devices such as total stations, GPS devices, or device failure can lead to injuries or accidents. (iii) Surveyors working near roads or highways are at risk of being struck by passing vehicles. (iv) Surveying involves assessing existing slabs or groundwork such as bridges posing a risk of collapse or slab failures. (v) Incorrect information can lead to misunderstanding, errors in data collection, or delays in emergency response.	A. Communication hazards B. Psychological hazards C. Traffic hazards D. Physical hazards E. Equipment hazards F. Structural hazards G. Weather condition

Answers:

(i)	(ii)	(iii)	(iv)	(v)
D	**E**	**C**	**F**	**A**

SECTION B (70 Marks)

Answer all questions from this section.

3. (a) Surveying

Surveying is the process of determining the relative positions of points on or near the earth's surface by measuring distances, angles, and elevations. The results are used to prepare maps, plans, and other documents for engineering or construction purposes.

(b) Levelling

Levelling is the process of finding the relative heights or elevations of different points on the earth's surface. It helps in determining gradients for construction projects such as roads, drains, and pipelines.

(c) Chaining

Chaining is the method of measuring distances on the ground using a chain or tape. It involves stretching the chain between two points and recording the measured length accurately.

(d) Plane Surveying

Plane surveying is a type of surveying in which the earth's surface is assumed to be flat. This method is suitable for small areas where the effect of the earth's curvature can be neglected.

(e) Reconnaissance

Reconnaissance is the preliminary inspection of the area to be surveyed. It helps the surveyor to plan the survey, identify obstacles, and determine the best positions for stations and lines.

4. (a) Describe the two methods of measuring the distance directly.

(i) The first method is chaining, which involves measuring distances on the ground using a chain or tape between two fixed points. It is suitable for relatively short and straight distances.

(ii) The second method is pacing, where the surveyor measures the distance by counting the number of steps between two points and multiplying by the average length of a pace. This method is faster but less accurate and often used for rough measurements.

(b) (i) Determine the total number of pipes which are used to cover the entire distance.

Distance to cover = 6600 m

Length of one pipe = 6 m

Number of pipes = 6600 ÷ 6 = 1100 pipes

(ii) If the cost of one pipe of 6 m long is Tsh. 60,000/= what is the total cost of pipe used?

Total cost = Number of pipes × Cost per pipe

Total cost = 1100 × 60,000 = Tsh. 66,000,000/=

5. During surveying practices, the field data are entered in the field book and later these data should be worked on. Suggest five precautions which should be taken while entering data in the field book.

(a) Data should be recorded immediately after measurement to avoid forgetting or mixing values.

(b) All figures and notes should be written clearly and neatly to prevent confusion or misinterpretation during plotting.

(c) The surveyor should use proper headings and labeling for stations, lines, and angles to ensure the data are organized.

(d) Corrections or alterations should be made neatly with a single line through the error instead of erasing or overwriting.

(e) The field book should be protected from damage by water, dirt, or rough handling to preserve the accuracy of recorded data.

6. (a) In taking measurement in the field by using chain, the chain can be adjusted when it is found too long or too short under normal circumstances.

(i) Adjustment when the chain is too long.

• Close up the joints by hammering the rings slightly.

• Replace worn or elongated rings with new ones.

• Remove one or two rings from the chain to shorten it.

• Tighten the end hooks or shackles properly.

(ii) Adjustment when the chain is too short.

• Open the joints slightly to extend the rings.

• Replace bent or damaged links with correct-sized ones.

• Add one or two rings to the chain to increase its length.

• Straighten any twisted or kinked links to their normal shape.

(b) During data collection, the surveyor established the data in the given table. Calculate the area of each figure.

Area = (Base × Mean offset)

(i) AJG = 100 × 25 = 2500 m²

(ii) JGFM = 200 × 150 = 30,000 m²

(iii) MFEP = 350 × 230 = 80,500 m²

(iv) PED = 100 × 105 = 10,500 m²

(v) ABK = 180 × 80 = 14,400 m²

(vi) BKNC = 310 × 170 = 52,700 m²

7. Summarize the ten procedures you will follow to plot chain survey data.

(i) Prepare a suitable sheet of drawing paper or plotting board and mark the title and scale to be used.

(ii) Draw the reference or base line to the chosen scale accurately using a straightedge.

(iii) Plot the main survey stations on the baseline according to their measured distances.

(iv) Plot the offsets taken from the main line at their respective distances and directions.

(v) Use protractor or set square to draw perpendiculars for offsets.

(vi) Join the plotted offset points to form the boundaries or features of the area.

(vii) Plot tie lines to check the accuracy of the plotted points and make corrections if necessary.

(viii) Plot all details such as roads, buildings, and trees using suitable conventional symbols.

(ix) Neatly label all points, lines, and features to make the plan clear and readable.

(x) Finally, check the whole plan for accuracy, complete the legend and north arrow, and sign the drawing.

8. (a) Back sight and Height of instrument.

   Back sight is the first staff reading taken on a known point of elevation such as a benchmark. The height of instrument is obtained by adding the back sight reading to the reduced level of that point. Therefore, the back sight is used to determine the height of instrument.

(b) Datum and benchmark.

A datum is a reference surface or level from which elevations are measured. A benchmark is a fixed physical point whose elevation above the datum is known. Therefore, benchmarks serve as practical references to the datum during levelling.

9. (a) Mention two duties of each of the following persons during chaining process:

(i) A leader

The leader carries the forward end of the chain and places the arrows to mark the measured distance. He ensures the chain is properly aligned and straight in the direction of measurement.

(ii) A follower

The follower holds the rear end of the chain at the starting point and checks for alignment with the ranging rods.

He collects the arrows from the leader after each chain length is measured.

(b) Differentiate the stepping method from indirect method as used in chaining on sloping ground.

In the stepping method, the horizontal distance on a slope is measured by dividing the slope into short horizontal steps using the chain and plumb bob. Each step is measured separately and added to get the total distance.

In the indirect method, the slope distance and the angle of inclination are measured, and the horizontal distance is calculated mathematically using trigonometric relations such as Horizontal distance = Slope length × cos(angle).(Pythagoras theorm)

10. Analyse five differences between prismatic and surveyor's compass instruments.

The prismatic compass has a prism for reading the bearing while sighting, while the surveyor's compass does not have a prism.

In the prismatic compass, the graduations are marked clockwise from 0° to 360°, while in the surveyor's compass they are marked in quadrantal form (0° to 90° in each quadrant).

The prismatic compass allows simultaneous sighting and reading, while the surveyor's compass requires separate steps for sighting and reading.

The prismatic compass needle remains stationary and the graduated ring moves, while in the surveyor's compass the ring is fixed and the needle moves.

The prismatic compass provides readings with higher precision and is more suitable for engineering surveys, while the surveyor's compass is simpler and mainly used for rough or reconnaissance surveys.