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MATHEMATICS III AND SURVEYING III

June/July 2022

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

**DIPLOMA IN BUILDING TECHNOLOGY
DIPLOMA IN CIVIL ENGINEERING
DIPLOMA IN ARCHITECTURE
MODULE III**

MATHEMATICS III AND SURVEYING III

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

answer booklet;

drawing instruments;

scientific calculator.

This paper consists of EIGHT questions in TWO sections A and B.

Answer FIVE questions choosing at least TWO questions from each section.

All questions carry equal marks.

Maximum marks for each part of a question are indicated.

The standard normal distribution table is attached.

Candidates should answer the questions in English.

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A: MATHEMATICS III

Answer TWO questions from this section.

1. (a) Given the matrices:

$$A = \begin{bmatrix} 1 & 2 & 1 \\ 2 & -3 & 1 \\ 4 & 0 & 1 \end{bmatrix} \text{ and } B = \begin{bmatrix} 2 & 1 & -1 \\ -2 & 3 & 1 \\ 1 & 4 & 0 \end{bmatrix},$$

determine the:

- (i) $B^T + A^T$
 (ii) AB .

(6 marks)

- (b) Use inverse matrix method to solve the simultaneous equations:

$$3x - 2y + z = -2$$

$$x + 4y - 2z = 11$$

$$2x + 3y + z = 7$$

(14 marks)

2. (a) (i) Show that a root of the equation $2x^3 - 3x^2 + 3x - 5 = 0$, lies between $x = 1$ and $x = 2$.

- (ii) Use Newton-Raphson method to determine correct to 5 decimal places the root of the equation in (i) starting with $X_0 = 1.5$.

(12 marks)

- (b) A function $f(x)$ is defined by the data in **table 1**.

Table 1

| | | | | | | |
|--------|-------|-------|--------|--------|--------|--------|
| x | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 |
| $f(x)$ | 9.012 | 9.960 | 11.008 | 12.166 | 13.445 | 14.859 |

Use Newton-Gregory interpolation method to evaluate correct to 3 decimal places, $f(1.13)$.

(8 marks)

3. (a) Only 80% of sunflower seeds from a supplier germinate when planted. If 10 of the seeds are planted, determine the probability that 8 or more will germinate. (5 marks)
- (b) A random variable x has a probability density function $f(x)$ given by
- $$f(x) = \begin{cases} k(1-x), & 0 \leq x \leq 1 \\ 0, & \text{otherwise} \end{cases}$$
- where k is a positive constant, determine:
- the value of k ;
 - $\text{Var}(x)$;
 - $P(x > \mu)$.
- (15 marks)
4. (a) A manufacturer of a certain product knows that the life of the product is normally distributed with the standard deviation, $\sigma = 6,000$ hours. From a test sample of 144 products he calculates $\bar{x} = 31,000$ hours. Determine a 99% confidence interval estimate for μ . (8 marks)
- (b) When a machine is adjusted correctly it turns out parts with mean length of 5 cm and a standard deviation $\sigma = 0.6$ cm. A sample of nine parts from the machine is tested and the sample mean is found to be $\bar{x} = 5.4$ cm. Test at $\alpha = 0.05$ level of significance the claim that the machine is in adjustment. (12 marks)

SECTION B: SURVEYING III

Answer *TWO* questions from this section.

5. (a) A stadia tube is 300 mm long and has upper and lower stadia lines apart. When sighted on a vertical levelling staff, the upper stadia reading was 2.5 m and the lower stadia reading 1.5 m. Calculate the distance from the eyepiece to the staff. (3 marks)
- (b) State **four** reasons why preliminary survey is required before tacheometric surveying. (4 marks)
- (c) Explain the principle of stadia tacheometry. (5 marks)
- (d) Outline field procedure for carrying out tacheometric survey. (8 marks)

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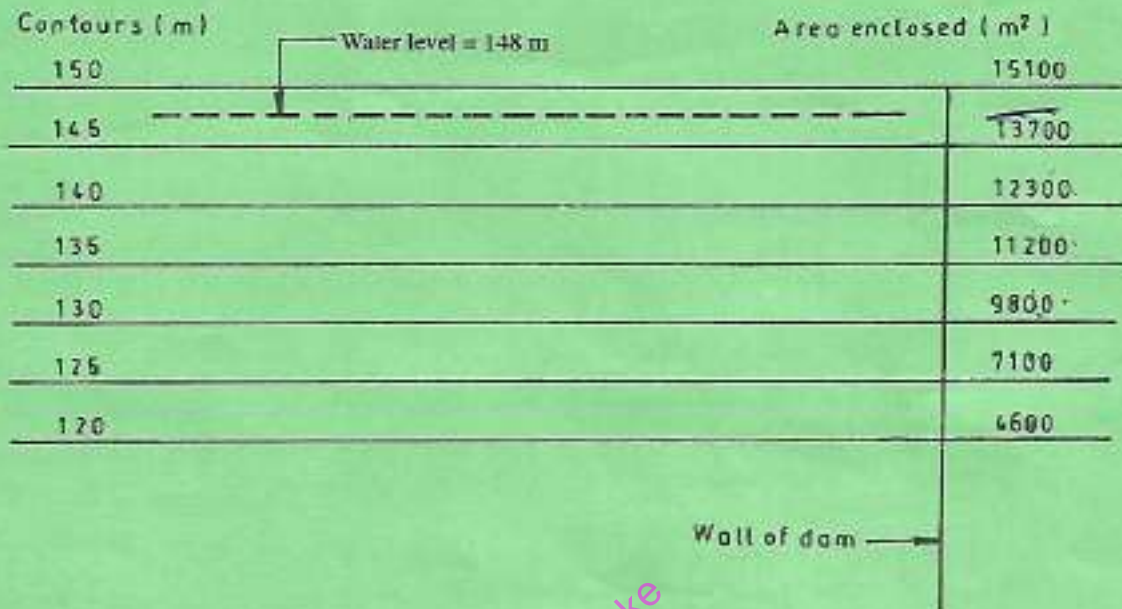
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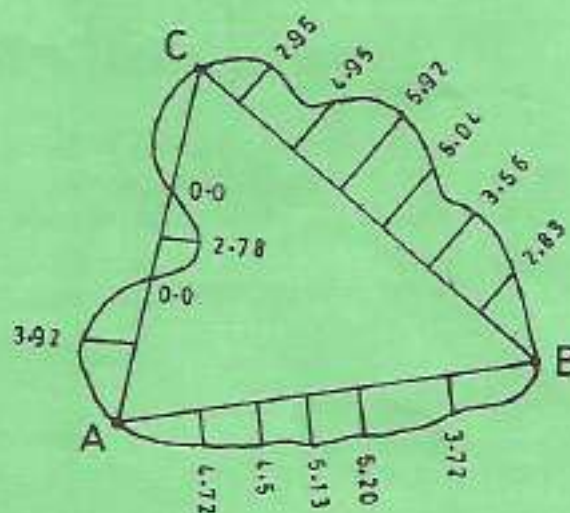
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6. (a) State five characteristics of Mass haul diagram. (5 marks)
- (b) Figure 1 shows the height of contours and the areas enclosed. Calculate the volume between contours 145 m and 120 m. (Use end area method) (5 marks)



- (c) Figure 2 shows a sketch of a plan of an irregularly bounded area where a linear survey has been carried out, offsets were taken at 5.00 m intervals. The three stations are located on the perimeter with horizontal distances of $AB = 30$ m, $BC = 35$ m and $CA = 25$ m. Determine the area within the boundary. Use trapezoidal method. (10 marks)



7. (a) With the aid of a diagram, outline the procedure for providing control for a multi-storey structure. (10 marks)
- (b) State four applications of Automatic site plumb. (4 marks)
- (c) The following readings were taken through a survey of a small irregular plot of land. Calculate the area. (6 marks)

(Use mid-ordinate rule)

| | | | | | | | |
|---------------|----|----|----|----|----|-----|-----|
| Distance (m) | 0 | 20 | 40 | 60 | 80 | 100 | 120 |
| Ordinates (m) | 18 | 21 | 24 | 26 | 23 | 18 | 20 |

8. (a) Using illustrations, define the following terms as used in aerial photographs: (6 marks)
- (i) fiducial marks;
- (ii) principal points.
- (b) Explain two types of stereoscopes. (6 marks)
- (c) A line AB measures 11.00 cm on a photograph taken with a camera having a focal length of 21.5 cm. The same line measures 3.00 cm on a map drawn to scale of $\frac{1}{45000}$. Calculate the flying height of the aircraft, if the average altitude is 350 m. (4 marks)
- (d) State four errors in aerial survey. (4 marks)

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