2705/301
2707/301
2709/301
2710/301
MATHEMATICS III AND
SURVEYING III
Oct./Nov. 2017
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN BUILDING CONSTRUCTION
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;
Scientific calculator;
Drawing instruments.
*This paper consists of **EIGHT** questions in **TWO** sections; **A** and **B**.*
*Answer **FIVE** questions choosing at least **TWO** questions from section **A**, **TWO** questions from section **B** and **ONE** question from either section.*
All questions carry equal marks.
Maximum marks for each part of a question are as shown.
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 at least **TWO** questions from this section.*

1. (a) Determine the values of x if matrix A is singular.

$$A=\begin{bmatrix} 2-x & -1 & 1 \\ -1 & 2-x & -1 \\ 1 & -1 & 2-x \end{bmatrix}$$

(10 marks)

(b) Three forces F_1, F_2 and F_3 in Newtons acting on a structural system satisfy the simultaneous equations:

$$\begin{aligned} 3F_1 + 2F_2 - 2F_3 &= 32 \\ 4F_1 + 3F_2 + 3F_3 &= 4 \\ -2F_1 + F_2 - F_3 &= 2 \end{aligned}$$

Use the inverse matrix method to determine the values of the forces. (10 marks)

2. (a) Given that X_n is an approximation tot he root of the equation $X^2 - 5X + 2 = 0$

(i) Show, using the Newton-Raphson method, that abetter approximation X_{n+1}, is given by:

$$X_{n+1} = \frac{X_n^2 - 2}{2X_n - 5}$$

(ii) Hence, find the root of the equation to three decimal places taking the first approximation $x_0 = 4$. (8 marks)

(b) **Table 1** represents a polynomial f(x).

Table 1

x	-1	0	1	2	3	4	5	6
$f(x)$	4	3	10	43	120	259	478	795

Use Newton-Gregory interpolation formula to determine:

(i) f(0.5)
(ii) f(5.3)

(12 marks)

3. (a) If 10% of nails produced by machine are defective. Determine the probability that in a random sample of 8 nails, at most two will be defective. (4 marks)

(b) Concrete blocks produced in a plant have weights that are normally distributed with a mean μ and standard deviation σ. Given that 9.18% have weights less than 35 kg and 3.92% have weights above 95 kg, determine the mean and standard deviation. (5 marks)

(c) The diameter of a steel pipe used in construction is assumed to be a continuous random variable x with a probability density function.

$$f(x)=\begin{cases} kx(1-x^3), & 0\le x\le 1 \\ 0, & \textit{elsewhere.} \end{cases}$$

Find the value of
(i) constant k;
(ii) mean of x;
(iii) mode of x. (11 marks)

4. (a) Two random variables having the least square regression lines with equations

$$4x+3y-28=0 \text{ and } 7x+2y-34=0;$$

determine the:

(i) mean valves of x and y.
(iii) Karl Pearson's coefficient of correlation. (8 marks)

(b) A random sample of 12 components has a mean weight of 50 grams and standard deviation of 9 grams. Determine the:

(i) 95% confidence limit;
(ii) 99% confidence interval for the mean of the components. (8 marks)

(c) The mean and standard deviation of a binomial distribution are 40 and 6 respectively. Determine the:

(i) probability of success;
(ii) sample size. (4 marks)

SECTION B: SURVEYING III

Answer at least TWO questions from this section.

5. (a) Outline:

(i) **two** systems of tacheometry
(ii) the field procedure of determining the tacheometric constants. (10 marks)

(b) Use the information in **Table 2** to determine the tacheometric constants. (10 marks)

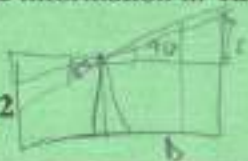

Table 2

Stadia readings		Vertical Circle reading	Horizontal distances (m)
Top	Mid		
1.509	1.286	90° 00′ 58″	48
2.847	2.448	85° 17′ 48″	60

6. (a) Differentiate between haul and average haul distance as used in earth work. (4 marks)

(b) (i) Define a mass haul diagram.
(ii) Outline the procedure of constructing mass haul diagram. (6 marks)

(c) **Table 3** shows observations made using a tacheometer fitted with an anallactic lens. Use this information to calculate:

(i) the distance PQ;
(ii) the reduced levels of P and Q. (10 marks)

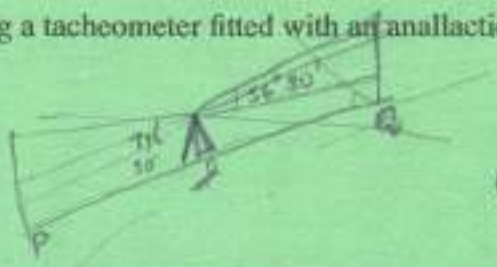

Table 3

Instrument station	Staff station	Bearing	Slope angle	Hair readings	Remark
R	P	56° 30′	07° 30′	2.155 2.755 3.355	Reduced level of R = 230 m
	Q	97° 30′	12′ 30′	2.250 3.000 3.750	

7. (a) With the aid of sketches, outline the procedure for setting out a rectangular structure using a theodolite and a tape. (9 marks)

(b) **Table 4** shows the chainages and offsets of a strip of land between a road and a river. Compute the area of the land in hectares using

(i) Simpson's rule;
(ii) Trapezoidal rule. (11 marks)

Table 4

Chainage (m)	0	10	20	40	60	90	120	130	140
Offset (m)	35.8	66.2	65.7	74.6	77	75.4	67.8	58.4	47

8. (a) Define the term "photogrammetry". (2 marks)

(b) State **three** differences between a map and a photograph. (6 marks)

(c) A vertical photograph at a scale of 1: 10,000 is to be taken of an area whose mean ground level is 400 m above mean sea level. If the camera has a focal length of 152 mm, find the flying height above mean sea level. (3 marks)

(d) In a pair of overlapping photographs, the mean photo base length is 99.85 mm and the mean ground level is 80 m above datum. Two near by points are observed and the following information in **Table 5** was obtained.

Table 5

Point	**Height above datum (m)**	**Parallex bar reading (mm)**
R	68	8.34
S		10.56

If the flying height is 3200 m above datum and the focal length of the camera is 210 mm find the height of S above datum. (9 marks)

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