

Name: _____ Index No. _____

2705/301 2709/301

2707/301 2710/301

MATHEMATICS III AND SURVEYING III

Oct./Nov. 2015

Time: 3 hours

Candidate's Signature: _____

Date: _____



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN BUILDING CONSTRUCTION

DIPLOMA IN CIVIL ENGINEERING

DIPLOMA IN ARCHITECTURE

MATHEMATICS III AND SURVEYING III

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided above.

Sign and write the date of the examination in the spaces provided above.

You should have the following for this examination:

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 as shown.

Candidates should answer the questions in English.

For Examiner's Use Only

Section	Question	Maximum Score	Candidate's Score
A			
B			
TOTAL SCORE			

This paper consists of 20 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) Given matrix $A = \begin{bmatrix} \alpha & 4 & -6 \\ 3 & 2 & 2 \\ 2 & 0 & 4\alpha \end{bmatrix}$. Find the values of α for which A is singular. (5 marks)

- (b) Using the matrix inverse method, solve the following simultaneous equations:

$$3x + 4y - 6z = -29$$

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

$$2x + 12z = 50$$

(15 marks)

2. (a) Consider the data in **table 1** and estimate $f(4.12)$ using the Newton-Gregory difference interpolation polynomial.

Table 1

x	0	1	2	3	4	5
$f(x)$	1	2	4	8	16	32

Give your answer correct to four decimal places.

(10 marks)

- (b) A probability density function is given by:

$$f(x) = \begin{cases} kx^2, & 0 \leq x \leq 4 \\ 0, & \text{elsewhere} \end{cases}$$

Determine:

- (i) value of k ;
- (ii) the expected value of x ;
- (iii) the probability that x is greater than 2.8.

(10 marks)

3. (a) The data in **table 2** gives the corresponding values of x and y .

Table 2

x	11	9	10	12	8	10	7	9
y	24	17	17	18	16	20	12	16

- (i) Compute the Pearson's product moment coefficient of correlation.
- (ii) Interpret your results in (i) above.

(10 marks)

- (b) The data in **table 3** shows the expenditure and income for Juhudi enterprises.

Table 3

Expenditure (x)	12	23	10	16	26	32	22	17
Income (y) (sh in thousands)	24	34	28	30	41	44	37	31

Determine the least squares regression equation of y on x. (10 marks)

4. (a) Given that x_n is an approximate root of the equation $x^3 - 3x + 3 = 0$;
- (i) show using Newton-Raphson method that a better approximation x_{n+1} is given by:
$$x_{n+1} = \frac{2x_n^3 - 3}{3x_n^2 - 3}$$
- (ii) Find correct to four decimal places the root of the equation taking $x_0 = -2$. (10 marks)
- (b) KK traders have a number of vehicles of which on average 3 are in use at any instant. Assuming that the number of vehicles in use at any instant follow a Poisson distribution, find the probability that at any given instant:
- (i) not more than two vehicles are in use;
- (ii) at least four vehicles are in use. (7 marks)
- (c) The years of experience of 100 surveyors are normally distributed with a mean of 18 years and standard deviation of 0.7 years. All possible samples of size 25 are drawn from this population and the means computed. Determine the mean and the standard error of the sampling distribution of the sample means. (3 marks)

SECTION B: SURVEYING III

Answer at least TWO questions from this section.

5. (a) **Table 4** shows observations taken from station T to locate points P, R and S. Given the instrument constants are $k = 100$ and $c = 0$ compute:
- (i) the horizontal distances TP, TR and TS;
 - (ii) the height differences between SP, SR and RP.
- (18 marks)

Table 4

STAFF STATION	STAFF READINGS (m)			VERTICAL ANGLES
	UPPER	MIDDLE	LOWER	
P	3.935	3.465	2.995	02° 10' 59"
R	2.321	2.032	1.743	03 35 40
S	3.045	2.821	2.597	-05 36 15

- (b) List **two** errors in stadia tacheometry. (2 marks)
6. (a) **Figure 1** shows height above a formation level taken at each grid intersection. Given the grid size is 25 m x 25 m, compute the volume of the excavation. (5 marks)

A		B	
5.28 m	5.58 m	5.78 m	6.78 m
3.73 m	3.78 m	4.33 m	4.78 m
4.28 m	4.18 m	3.93 m	4.78 m
4.66 m	4.30 m	3.78 m	3.66 m
D		C	

Figure 1

(b) Table 5 shows volume in m^3 at each chainage.

(i) compute the aggregate volumes.

(ii) plot the mass haul diagram to a vertical scale of 1 cm to $200 m^3$ and horizontal scale of 1 cm to 50 m.

(15 marks)

Table 5

Chainage (m)	Volume (m^3)	
	'Cut' (+)	Fill (-)
0	-	-
50	40	800
100	730	-
150	910	-
200	760	-
250	450	-
300	80	110
350	-	520
400	-	900
450	-	1120
500	-	970
550	-	620
600	200	200
650	590	-
700	850	-
750	1120	-

7. (a) Using illustrations where appropriate, outline **three** methods used to check verticality of multistorey buildings. (9 marks)
- (b) Calculate the area of the plot defined by the data given in **table 6** using:
- trapezoidal;
 - simpson's;
 - comment on the results.
- (11 marks)

Table 6

Chainage (m)	Offset to the edge of the plot (m)
0	16.76
10	19.81
20	20.42
30	18.59
40	16.76
50	17.68
60	17.68
70	17.37
80	16.76
90	17.68

8. (a) **Table 7** shows coordinates of images of points, S and T as they appear on a vertical photograph. Given the following information:

camera focal length = 220 mm
 altitude of S = 450 m
 altitude of T = 750 m
 altitude of aircraft = 3000 m

determine the ground distance ST.

(10 marks)

Table 7: Photo coordinates

Point	x(mm)	y (mm)
S	+ 24.5	+ 17.1
T	- 12.9	- 29.0

- (b) Illustrate the operating principle of a mirror stereoscope.

(10 marks)