

2705/201 2709/201
2707/201 2710/201
**MATHEMATICS II AND
SURVEYING II**
June/July 2017
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

**DIPLOMA IN BUILDING CONSTRUCTION
DIPLOMA IN CIVIL ENGINEERING
DIPLOMA IN ARCHITECTURE**

MODULE II

MATHEMATICS II AND SURVEYING II

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Mathematical table/Scientific calculator;

Drawing instruments.

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

Answer FIVE questions choosing TWO questions from each section and ONE other question from either section.

All questions carry equal marks.

Maximum marks for each part of a question are indicated.

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 II
 Answer at least **TWO** questions from this section.

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1. (a) Simplify $\frac{(2+j3)^2}{(1-j)^2}$, expressing the answer in the form $re^{j\theta}$. (8 marks)
- (b) Solve the equation: $z^2 - 3 + j5 = 0$ giving the roots in the form $a + jb$. (12 marks)
2. (a) A closed cylindrical container made of thin metal is to contain a volume of 13 cm^3 . If the surface area is to be minimum:
- (i) find the expression for the total surface area T ; (3 marks)
- (ii) obtain the radius and height of the cylinder. (4 marks)
- (b) Given the function: $f(x, y) = x^6 + 3x^4y^4 + xy^6$, find:
- $\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial x \partial y} - \frac{\partial^2 f}{\partial y \partial x}$. (8 marks)
- (c) Given that $Z = \sin(x^3 + y^3)$, find the change in Z when x increases by 0.3 while y decreases by 0.2 . (5 marks)
3. (a) Find: $\int \frac{(x^2 + 3)dx}{(x+2)(x^2+1)}$. (8 marks)
- (b) (i) Sketch the area enclosed between $y^2 = 3x$ and $y = 3x$. (3 marks)
- (ii) Determine the volume generated by rotating the area in (i) above through 360° about the x -axis. (9 marks)
4. (a) The equation of a body performing simple harmonic motion is given by:
- $\frac{d^2x}{dt^2} + 4x = 0$.
- Given that when $t = 0$, $x = 5$ and $v = 0$; solve for x . (8 marks)
- (b) A train of mass m kg is moved from rest by an engine which exerts a time dependent force $\frac{1}{3}(1 - e^{-2t})$ on the train. The resistance to motion is given by $R = \frac{1}{5}V$, where V is the speed of the train.
- (i) Write down in terms of V and t the differential equation for this motion. (1 mark)
- (ii) Determine the expression of V in terms of t . (9 marks)
- (iii) Deduce the expression for speed when t becomes large. (2 marks)

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SECTION B: SURVEYING II
 Answer at least **TWO** questions from this section.

5. (a) Define the following terms as used in compass surveying:

- (i) bearing;
- (ii) true meridian;
- (iii) magnetic meridian;
- (iv) magnetic declination.

(4 marks)

(b) Convert the following whole circle bearings to reduced bearings:

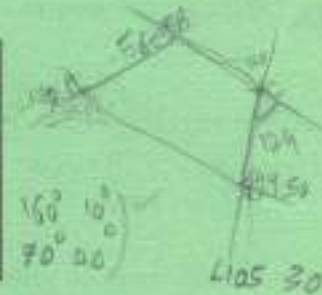
- (i) $65^{\circ}30'$;
- (ii) $140^{\circ}30'$;
- (iii) $255^{\circ}10'$;
- (iv) $336^{\circ}40'$.

(6 marks)

(c) **Table 1** shows the observed bearings of lines of a closed compass traverse ABCDA.

Table 1

Line	Forward Bearing
AB	$56^{\circ}10'$
BC	$129^{\circ}10'$
CD	$199^{\circ}50'$
DA	$289^{\circ}20'$



(i) With the aid of a diagram, calculate the interior angles of the traverse.

(ii) Check on the sum of the resulting angles.

(10 marks)

6. (a) State **three** reasons why rectangular coordinates of surveyed points are computed.

(3 marks)

(b) Outline the field procedure of determining the vertical circle index error of a theodolite.

(4 marks)

(c) The following vertical circle readings were taken for the purpose of determining the vertical circle index error.

Face left (F/L) reading to point A = $09^{\circ}58'00''$

Face right (F/R) reading to point A = $170^{\circ}00'20''$

Determine the vertical circle index error of the theodolite.

(2 marks)

- (d) An open traverse was run from point A to point E in order to determine the distance and bearing of line AE which could not be directly measured. Using the results of the traverse shown in **table 2**, compute the bearing and distance of line AE.

(8 marks)

Table 2

Line	Bearing	Distance (m)
AB	261°41'00"	1025.34
BC	09°06'10"	1087.38
CD	282°22'30"	925.89
DE	71°31'45"	1250.52

- (e) Explain the **two** methods of correcting for the effects of local attraction in compass bearings. (3 marks)
7. (a) With the aid of a diagram, list all the elements of a simple circular curve. (7 marks)
- (b) The following information is for a simple circular curve:

Chainage of intersection point = 60 + 94.72 m
 Intersection angle (I) = 13° 50' 20"
 Degree (D) of curve = 10"
 Chord length = 20 m

Using the information given, compute:

- (i) radius of the curve;
 (ii) tangent length;
 (iii) curve length;
 (iv) chainage of 1st and 2nd tangent points;
 (v) Length of 1st and 2nd sub-chords;
 (vi) 1st and 2nd deflection angles. (13 marks)

8. (a) Explain how the following errors in Electromagnetic Distance Measuring instruments are caused:

- (i) scale error;
 (ii) zero error;
 (iii) cyclic error. (5 marks)

(b) Table 3 shows computed changes in the Northings (ΔN) and Eastings (ΔE) for a traverse run between control points R and P. Use the information and the datum coordinates of R and P to:

- (i) determine the traverse misclosure in linear form;
- (ii) adjust the traverse by the transit method;
- (iii) determine the final adjusted coordinates of the new traverse points.

closed traverse

(15 marks)

Table 3

Line	+ ΔN <i>(L sin θ)</i>	+ ΔE <i>(L cos θ)</i>
R - K1	125.15	33.42
K1 - K2	168.54	138.78
K2 - K3	101.67	83.87
K3 - K4	86.74	82.66
K4 - P	80.08	119.91

Line angle direction adjusted bearings

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