2705/201 2709/201
2707/201 2710/201
MATHEMATICS II AND
SURVEYING II
Oct./Nov. 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 tables/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.

Turn over

SECTION A: MATHEMATICS II

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

1. (a) Simplify $(2+j4)^3$ giving the answer in the form $r(\cos\theta + j\sin\theta)$. (6 marks)

(b) Given that $z = x + jy$ and that $\frac{z+j}{z+2}$ is purely imaginary, show that: $x^2 + y^2 + 2x + y = 0$. (4 marks)

(c) Solve the equation: $z^3 - j = 0$. (10 marks)

2. (a) The parametric equations of a certain curve is given by $x = 3\cos\theta, y = 3\sin\theta$. Determine the radius of curvature of the curve at the point where $\theta = \frac{\pi^c}{6}$. (10 marks)

(b) The displacement s on a certain moving contact from a fixed point is given by:

$$S = \frac{7\sin\theta\cos\beta}{\sin(\theta+\beta)}$$

Given that θ and β are designed to increase at $0.2\ \text{rad}\,S^{-1}$, find the velocity of the moving contact when $\theta = \frac{\pi^c}{6}$ and $\beta = \frac{\pi^c}{4}$. (10 marks)

3. (a) Given that:

$I_n = \int_0^{\frac{\pi}{2}} \cos^n\theta\, d\theta$, deduce the reduction formula:

$I_n = \frac{n-1}{n} I_{n-2}$ hence evaluate $\int_0^{\frac{\pi}{2}} \cos^7\theta\, d\theta$. (12 marks)

(b) Find the x-coordinates of the centroid of the area enclosed between the curve $y = e^{3x}$ and the x-axis between $x = 0$ and $x = 2$. (8 marks)

4. (a) Solve the differential equation:

$5x^2\frac{dy}{dx} = 6x^2 + y^2$ given that when $x = 1$ $y = 5$. (13 marks)

(b) A particle P is moving along a straight line with point O on the line. The magnitude of its acceleration is proportional to its displacement x from the point O, while the direction of the acceleration is always directed towards O. At a point where $X = 0.5$ m, the velocity $V = 0$.

(i) Write down the differential equation representing the motion;

(ii) Find the equation of V in terms of displacement X. (7 marks)

SECTION B: SURVEYING II

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

5. (a) With the aid of diagrams, explain the following bearing systems as used in compass traversing:

(i) whole circle bearing system;

(ii) quadrantal bearing system. (8 marks)

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

(i) N 56° 30′ E;

(ii) S 32° 15′ E;

(iii) S 85° 45′ W;

(iv) N 15° 10′ W. (6 marks)

(c) **Figure 1** shows a traverse AB′C′D′E′A′ as plotted from bearings an distances of the lines, where AA′ is the amount of closing error which is to be adjusted. With the aid of a diagram, explain how the magnitudes of errors at each of the stations B′, C′, D′ and E′ are determined graphically. (6 marks)

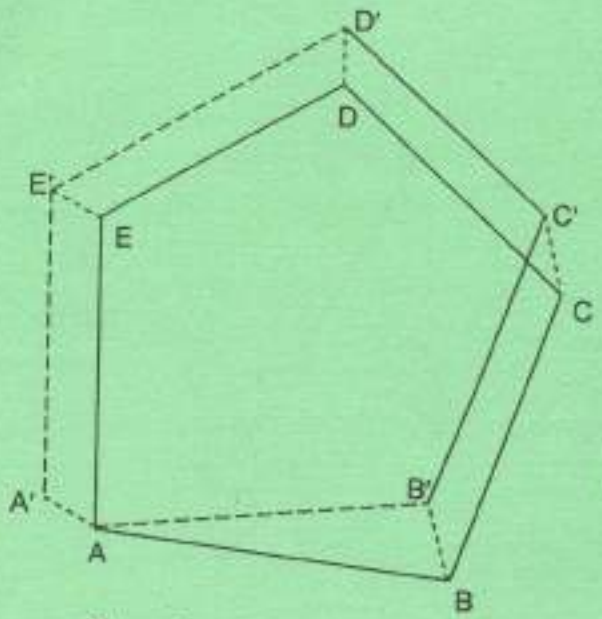

Figure 1

6. (a) State **four** relationships that must hold true for a theodolite to be in perfect adjustment. (4 marks)

(b) With the aid of diagrams, describe the given types of traverses:

(i) open traverse;

(ii) closed traverse. (12 marks)

(c) State the sequence of steps to be followed when computing and adjusting a theodolite traverse. (4 marks)

7. (a) State the purpose of curves in surveying. (2 marks)

(b) State the **two** types of curves giving **two** examples of each. (3 marks)

(c) **Figure 2** shows two straights AY and BY tangent to a circular curve T_1T_2 intersecting at point Y which is inaccessible. Use the given information to determine how far:

(i) T_1 is from A;

(ii) T_2 is from B. (15 marks)

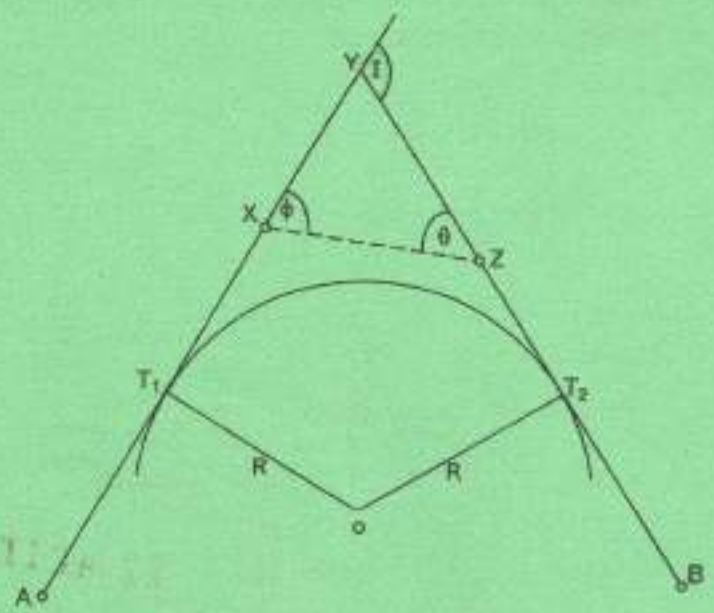

Figure 2

Radius (R) = 1350m
AX = BZ = 1300m
Angle AXZ = 123°50'
Angle XZB = 127°00'

8. (a) State **three** corrections applied on distances measured with a tape in catenary quoting the relevant formula for each. (6 marks)

(b) The data below is an extract of observed bearings from a field note book for a control traverse run between two control points PT2 and PK1. Using the information and the given datum coordinates, prepare a traverse bearing sheet. (14 marks)

At Pt 2		At Tr 1	
Pt1	205° 29′ 36″	Pt2	205° 29′ 47″
Pt3	115° 32′ 40″	Tr2	50° 00′ 49″
Tr1	25° 29′ 30″		

At Tr2		At Tr3	
Tr1	230° 00′ 30″	Tr2	230° 03′ 28
Tr3	50° 03′ 27″	Tr4	54° 09′ 35″

At Tr4		At Pk1	
Tr3	234° 09′ 54″	Tr4	246° 48′ 35″
Pk1	66° 48′ 31″	Pk2	308° 06′ 09″
		Pk3	126° 50′ 24″

Datum Bearings	
PT2 - PT1	205° 29′ 42″
PT2 - PT3	115° 32′ 48″
PK1 - PK2	308° 06′ 11″
PK1 - PK3	126° 50′ 29″

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