2705/201 2709/201
2707/201 2710/201
MATHEMATICS II AND SURVEYING II
June/July 2018
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;
Scientific calculator.
*This paper consists of **EIGHT** questions in **TWO** sections; **A** and **B**.*
*Answer **FIVE** questions choosing at least **TWO** questions from section **A**, at least **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 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) Use Taylor's theorem to expand $\cos\left(\frac{\pi}{6}+h\right)$ up to the third term and hence determine $\cos(30.5^\circ)$ correct to four decimal places. (8 marks)

(b) The equation of vibration of a system subject to external forces is given by:

$$2\frac{d^2x}{dt^2}+3\frac{dx}{dt}-x=6\cos 2t$$

Use the method of undetermined coefficients to solve the differential equation. (12 marks)

2. (a) Given the complex numbers $z_1=-2+j3$, determine:

(i) $z_1+z_2-z_3$;

(ii) $\frac{z_1z_3}{z_1+z_3}$. (5 marks)

(b) Use Demoivre's theorem to show that $\cos 4\theta = 8\cos^4\theta - 8\cos^2\theta + 1$. (5 marks)

(c) Prove the hyperbolic identity:

$$\frac{1-\tan hx}{1+\tan hx}=e^{-2x}.$$ (4 marks)

(d) Solve the equation $2\cosh 2x - \sin h\,2x = 4$, correct to three decimal places. (6 marks)

3. (a) Differentiate $\frac{1}{x}$ from first principles. (5 marks)

(b) Find $\frac{dy}{dx}$ for the functions:

(i) $x^2\sin^2 2x$;

(ii) $xy^2+y^2x^3+2=0$. (5 marks)

(c) Given that $z=\cos(2x+3y)$, show that $\frac{d^2t}{dx^2}-\frac{d^2t}{dy^2}=5z$. (5 marks)

(d) Given that the volume of a cone is $V=\frac{1}{3}\pi r^2 h$, determine the approximate change in volume if the radius increases from 5 cm to 6 cm and the height decreases from 4 cm to 3 cm. (5 marks)

4. (a) Determine the integrals:

(i) $\int_0^1 x^2 e^{3x}\,dx$;

(ii) $\int \frac{x^3+2}{(x+1)^3}\,dx$. (12 marks)

(b) (i) Sketch the region bounded by the curves $\frac{y}{x^2} = 1$ and $y + x^2 = 8$.

(ii) Determine the volume of the solid produced in b (i) if it is rotated 360° about the x - axis. (8 marks)

SECTION B: SURVEYING II

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

5. Using the following field observation abstracts and data, prepare a traverse bearing sheet. (20 marks)

@A F.N.P1
B: 237° 01′ 06″
K1: 251° 43′ 54″
C: 338° 58′ 16″

@K1 F.N. P1
A: 71° 43′ 34″
K2: 354° 02′ 54″

@K 2F.N. P1
K1: 174° 02′ 52″
K3: 43° 07′ 38″

@ K3: F.N. P2
K2: 223° 07′ 39″
K4: 05° 20′ 21″

@K4 F.N. P2
K3: 185° 20′ 27″
K5: 66° 19′ 24″

@K5 F.N. P2
K4: 246° 19′ 31″
K6: 338° 06′ 22″

@K6 F.N. P3
K5: 158° 06′ 37″
C: 298° 32′ 26″

@ C F.N. P3
K6: 118° 32′ 31″
A: 158° 58′ 08″
B: 220° 00′ 45″

Datum Coordinates

Point	+N (m)	+E
A:	26594.36	686431.52
B:	23857.59	682214.04
C:	28162.86	685828.56

6. (a) With the aid of a sketch, show **five** elements of a curve. (4 marks)

(b) A circular curve of 650 m radius is to connect two straights A BI and C DI at A and C respectively. The intersection point I is inaccessible and therefore the deflection angle is indeterminable. If the angles at A and Δ and the distance BD are measured as follows:

A B D 155° 50′ BDC 136° 12″

BD 550 m

R = 650
tan length = R tan θ/2
Chord = 2R cos θ/2
Curve = Rπθ/180

Calculate the:

(i) distance of the tangent points from B and D on the respective straights;

(ii) length of the final sub chord, if the curve is set out at 30 m interval taking the chainage at A to be 1200 m;

(iii) deflection angles of the first suchord, standard chord and last sub chord. (16 marks)

7. (a) Explain the following terms as applied to theodolite surveying:

(i) face right observations;

(ii) centering;

(iii) transiting;

(iv) swinging the telescope. (6 marks)

(b) Differentiate between temporary and permanent adjustments as applied to a theodolite. (4 marks)

(c) **Table 1** shows reduced distances and adjusted bearings of a traverse run between two known points TR1 and TR2. Given the datum coordinates of TR1 and TR2 as:

Station	− Northings (m)	− Eastings (m)
TR1	250276.66	128783.92
TR2	249714.47	128325.37

Compute:

(i) The adjusted coordinates of the new traverse points N1, N2, N3 and N4 by Bowditch's method of adjustment.

(ii) Traverse accuracy. (10 marks)

Table 1

Line	Adjusted bearing	Reduced distance (m)
N1 - TR1	194°57'08"	129.54
N1 - N 2	39°28'11"	218.32
N3 - N 2	219°31'10"	131.80
N3 - N 4	43°37'19"	119.82
TR - N 4	236°15'57"	144.19

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8. (a) With the aid of a sketch, show that the mid-ordinate of the long chord of a simple circular curve is given by the expression $R\left(1-\cos\frac{\theta}{2}\right)$ where:

R = Radius of curve and
θ = deviation angle. (4 marks)

(b) A circular curve is to be set out with pegs at every 25 m continuous chainages between two straights intersecting at chainage 936.37 m. If the deflection angle of the curve is 32°14'50" and the minimum distance of the curve from the intersection of the two straights is 36.5 m, calculate:

(i) the radius of the curve;

(ii) the chainage at the beginning and end of the curve;

(iii) the length of the long chord. (10 marks)

(c) Differentiate between each of the following terms:

(i) quadrantal bearing and whole circle bearing;

(ii) fore bearing and back bearing. (6 marks)

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