

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.**

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) $\frac{z_1 z_2}{z_1 + z_3}$. (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:

$$\frac{1 - \tanh x}{1 + \tanh x} = e^{-2x}$$
 (4 marks)
- (d) Solve the equation $2 \cosh 2x - \sinh 2x = 4$, 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 $\frac{d^2z}{dx^2} - \frac{d^2z}{dy^2} = 5z$. (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) $\int \frac{x^3 + 2}{(x+1)^2} dx.$

(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: $237^\circ 01' 06''$

K1: $251^\circ 43' 54''$

C: $338^\circ 58' 16''$

@K5.F.N.P2

K4: $246^\circ 19' 31''$

K6: $338^\circ 06' 22''$

@K1.F.N.P1

A: $71^\circ 43' 34''$

K2: $354^\circ 02' 54''$

@K6.F.N.P3

K5: $158^\circ 06' 37''$

C: $298^\circ 32' 26''$

@K2.F.N.P1

K1: $174^\circ 02' 52''$

K3: $43^\circ 07' 38''$

@C.F.N.P3

K6: $118^\circ 32' 31''$

A: $158^\circ 58' 08''$

@K3.F.N.P2

K2: $223^\circ 07' 39''$

K4: $05^\circ 20' 21''$

B: $220^\circ 00' 45''$

@K4.F.N.P2

K3: $185^\circ 20' 27''$

K5: $66^\circ 19' 24''$

Datum Coordinates

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

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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 B I and C D I 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 $155^{\circ} 50'$ B D C $136^{\circ} 12'$
 BD 550 m
- Calculate the:
- $R = 650$
 $\tan \text{ length} = R \tan \frac{\theta}{2}$
 $\text{Chord} = 2R \cos \frac{\theta}{2}$
 $\text{Curve} = \frac{R \pi \theta}{180}$
- (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

743.67

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 $32^\circ 14' 50''$ 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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