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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:
- $$\frac{1 - \tanh hx}{1 + \tanh hx} = e^{-2x}$$
- (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  $\frac{y}{x} = 1$  and  $y + x^2 = 8.$

(ii) Determine the volume of the solid produced in b (i) if it is rotated  $360^\circ$  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:  $158^\circ 58' 08''$

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

@K3.F.N.P2

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

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

@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  $\Delta$  and the distance BD are measured as follows:

A B D  $155^{\circ} 50'$       B D C  $136^{\circ} 12'$   
 BD 550 m

$$R = 650$$

$$\text{tan length} = R \tan \frac{\theta}{2}$$

$$\text{Chord} = 2R \cos \frac{\theta}{2}$$

$$\text{Curve} = \frac{R \pi \theta}{180}$$

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

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

$\theta$  = 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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