

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.

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 $\theta = \frac{\pi}{6}$. (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 rad s^{-1} , find the velocity of the moving contact when $\theta = \frac{\pi}{6}$ and $\beta = \frac{\pi}{4}$. (10 marks)

3. (a) Given that:

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

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

- (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:

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

$(x+1)(x-1)$
 x^2

(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 $X = 0.5 \text{ m}$, 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:
- whole circle bearing system;
 - quadrantal bearing system. (8 marks)
- (b) Convert the following reduced bearings to whole circle bearings:
- N 56° 30' E;
 - S 32° 15' E;
 - S 85° 45' W;
 - N 15° 10' W. (6 marks)
- (c) **Figure 1** shows a traverse AB'C'D'E'A' as plotted from bearings and 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)

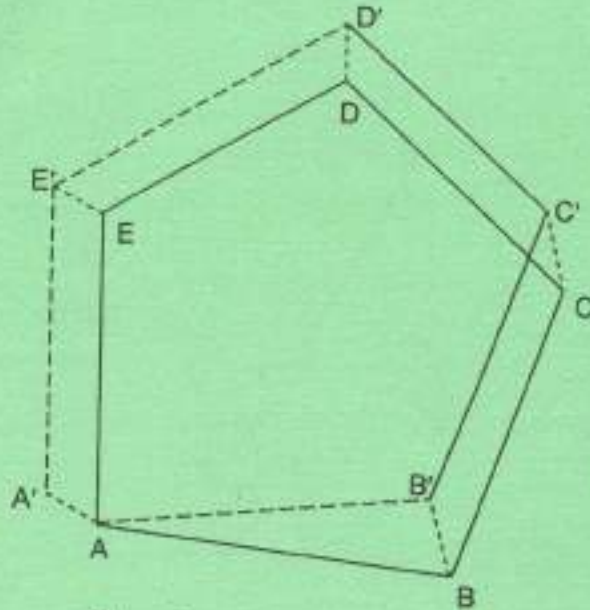


Figure 1



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)

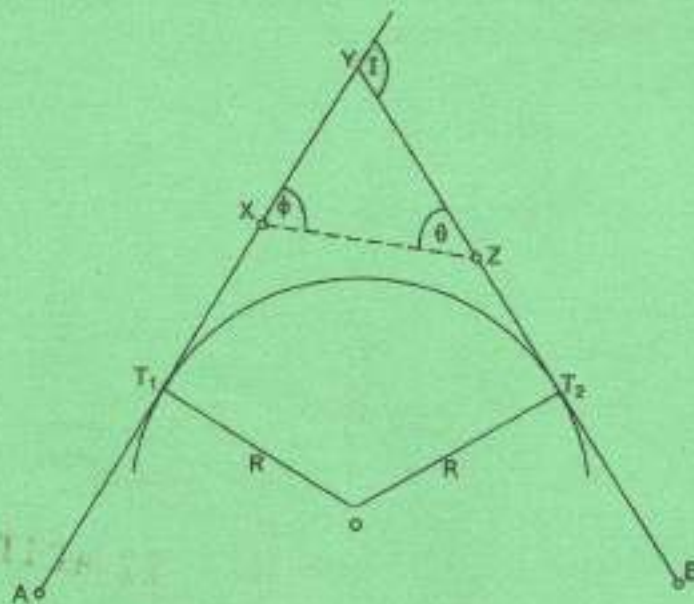


Figure 2

Radius (R) = 1350m
 AX = BZ = 1300m
 Angle AXZ = $123^{\circ}50'$
 Angle XZB = $127^{\circ}00'$

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)

<u>At Pt 2</u>		<u>At Tr 1</u>	
Pt1	205° 29' 36"	Pt2	205° 29' 47"
Pt3	115° 32' 40"	Tr2	50° 00' 49"
Tr1	25° 29' 30"		
<u>At Tr2</u>		<u>At Tr3</u>	
Tr1	230° 00' 30"	Tr2	230° 03' 28"
Tr3	50° 03' 27"	Tr4	54° 09' 35"
<u>At Tr4</u>		<u>At Pk1</u>	
Tr3	234° 09' 54"	Tr4	246° 48' 35"
Pk1	66° 48' 31"	Pk2	308° 06' 09"
		Pk3	126° 50' 24"
<u>Datum Bearings</u>			
PT2 - PT1	205° 29' 42"		
PT2 - PT3	115° 32' 48"		
PK1 - PK2	308° 06' 11"		
PK1 - PK3	126° 50' 29"		

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