

2305/301
2306/301
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MATHEMATICS
Oct./Nov. 2011
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
DIPLOMA IN BUILDING
DIPLOMA IN QUANTITY SURVEYING
DIPLOMA IN CIVIL ENGINEERING
DIPLOMA IN HIGHWAY ENGINEERING
DIPLOMA IN ARCHITECTURE

MATHEMATICS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

*Answer booklet
Mathematical tables/calculator
Drawing instruments.*

*Answer any FIVE of the EIGHT questions in this paper.
ALL questions carry equal marks.
Maximum marks for each part of a question are as shown.*

This paper consists of 4 printed pages.

**Candidates should check the question paper to ascertain that
all the pages are printed as indicated and that no questions are missing.**

1. (a) Find the value of $\frac{2-j}{3+j} + \frac{2+j}{3-j}$. (3 marks)
- (b) Determine the cube root of the complex number $3 - \sqrt{3}j$. (10 marks)
- (c) Given triangle ABC such that A (1,2,1), B(3,5,1) and C (4, -5,2). Use vector method to determine the area of triangle ABC. (7 marks)

2. (a) Given that $y = \tan^{-1} \frac{x}{2}$ find $\frac{dy}{dx}$. (5 marks)
- (b) For the function $f(x) = x^2 e^{2x}$ determine the stationary points and hence sketch the graph. (15 marks)

3. (a) Table 1 shows the distribution of the number of defective bolts found in 400 lots of manufactured bolts.

No. of defective bolts	0	1	2	3	4	5	6	7	8	9	10	11	12
No. of lots	55	108	80	56	34	21	19	11	8	4	1	2	1

The manufacturer of the bolts claim that the mean number of defective bolts in a lot is 3. Test this claim at 5% level of significance. (13 marks)

- (b) The percentage of rejects in the manufacturing process of an article is 1%. If the production follows the Poisson distribution, find the probability that in a sample of 500 items at least 3 are rejected. (7 marks)

4. (a) Given that $\theta = \tan^{-1} \left(\frac{y}{x} \right)$ determine $\frac{\partial^2 \theta}{\partial x^2} + \frac{\partial^2 \theta}{\partial y^2}$ (5 marks)

- (b) A rectangular cuboid have sides $a = 10\text{cm}$, $b = 20\text{cm}$ and $C = 40\text{cm}$
The errors made in measuring these sides are $+0.02\text{cm}$, -0.04cm and 0.03cm respectively.

Calculate the corresponding error in calculating volume. (5 marks)

- (c) A curve is given by the parametric equations $x = 3\cos^3\theta$, $y = 3\sin^3\theta$.

Determine the radius of curvature of the curve at the point where $\theta = \frac{\pi}{3}$. (10 marks)

5. (a) Given the matrices.

$$A = \begin{pmatrix} 1 & 2 & -1 \\ 3 & -1 & 1 \\ 1 & -1 & 2 \end{pmatrix} \text{ and } B = \begin{pmatrix} 3 & -2 & 1 \\ 2 & 1 & -2 \\ 1 & -2 & 0 \end{pmatrix}$$

determine:

- (i) $2A - 3B$
 (ii) $A^T + B^T$
 (iii) $C = AB$
 (iv) C^{-1}

(15 marks)

- (b) Use results in a(iv) above to solve the simultaneous equations.

$$6x + y - 3z = 20$$

$$6x - 9y + 7z = 0$$

$$3x - 5y + 3z = 2$$

(5 marks)

6. (a) Find $\int \frac{(3x^2 + 5x)dx}{(x+3)^2(3x^2+1)}$.

(14 marks)

- (b) Evaluate $\int_0^1 5x^2 e^{5x} dx$.

(6 marks)

7. (a) Determine the area enclosed between the curves

$$y_1 = 3 - 2x - 2x^2 \text{ and } y_2 = 3x^2 + x + 2.$$

(9 marks)

- (b) Calculate the centroid of the area bounded by the curve $y = e^{2x}$, the x -axis and the ordinates $x = 1$ and $x = 2$.

(11 marks)

8. (a) Solve the differential equation.

$$\frac{dy}{dx} = \frac{y(x+2y)}{x(2x+y)}$$

(7 marks)

- (b) Solve the differential equation $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = e^{4x}$

given that when $x = 0$, $y = 2$ and $\frac{dy}{dx} = 3$.

(13 marks)