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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.

Turn over

1. (a) Find the value of $\dfrac{2-j}{3+j} + \dfrac{2+j}{3-j}$. (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 rector method to determine the area of triangle ABC. (7 marks)

2. (a) Given that $y = \tan^{-1}\dfrac{x}{2}$ find $\dfrac{dy}{dx}$. (5 marks)

   (b) For the function $f(x) = x^2 e^{3x}$ determine the stationery 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 $\theta = \tan^{-1}\left(\dfrac{y}{x}\right)$ determine $\dfrac{\partial^2\theta}{\partial x^2} + \dfrac{\partial^2\theta}{\partial y^2}$ (5 marks)

   (b) A rectangular cuboid have sides
   a = 10cm, b = 20cm and C = 40cm
   The errors made in measuring these sides are +0.02cm, -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 $\theta = \dfrac{\pi}{3}$.   (10 marks)

5.   (a)   Given the matrices.

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

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 $\displaystyle\int \frac{(3x^2 + 5x)dx}{(x+3)^2(3x^2+1)}$.   (14 marks)

(b)   Evaluate $\displaystyle\int_0^1 5x^2 e^{5x}\, dx$.   (6 marks)

7.   (a)   Determine the area enclosed between the curves
$y_1 = 3 - 2x - 2x^2$ 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)

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8.   (a)   Solve the differential equation.

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

(7 marks)

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

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

(13 marks)