2305/301, 2308/301 2306/301, 2309/301 2307/301 MATHEMATICS

Oct./Nov. 2016 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 FIVE questions of the EIGHT questions in the answer booklet provided.

All questions carry equal marks.

Maximum marks for each part of a question are shown.

Candidates should answer the questions in English.

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.

- Given that $Z_1 = 3 + 2j$; $Z_2 = -3 + 5j$ and $\frac{1}{Z^3} = \frac{1}{Z_1} + \frac{1}{Z_2}$; determine Z_2 in the form a + bj. (4 marks)
 - (b) Use Demoirve's theorem to find the following in terms of $\cos \theta$ and $\sin \theta$:
 - (i) Cos 3 θ
 - (iii) Sin 3 θ and hence
 - (iii) Show that $\tan 3\theta = \frac{3t t^3}{1 3t^2}$ where $t = \tan \theta$.

(6 marks)

- (c) Given that $Z' = -8 8\sqrt{3}j$, find Z in the form a + bj. (10 marks)
- 2 (a) Given that A = pi 6j 3k and B = 4i + 3j k, where p is a constant. Determine the value of p such that vectors A and B are perpendicular to each other.

(4 marks)

(6 marks)

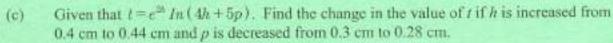
- (c) Given that $6 \sin \theta 8 \cos \theta = R \sin (\theta \alpha)$ where R > 0 and $0^* \le \alpha \le 90^*$.
 - (i) Determine the values of R and α and hence
 - (ii) Solve the equation $6 \sin \theta 8 \cos \theta = 5$ where $0^{\circ} \le \theta \le 360^{\circ}$.

(10 marks)

3. (a) Given that $V = x^3 \cos\left(\frac{y}{x}\right)$, show that $x \frac{\partial V}{\partial x} + y \frac{\partial V}{\partial u} = 3V$

(5 marks)

(b) A right circular cylinder has radius, r = 10 cm and height, h = 100 cm. If the radius is increasing at the rate of 0.5 cm/s, determine the rate at which the volume is changing. $\sqrt{=\pi r^2 t_0}$ (5 marks)



(10 marks)



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- 4. (a) (i) Given that $\cos^2\theta = \frac{1}{2}(1 + \cos 2\theta)$, evaluate $\int_0^{\frac{\pi}{3}} \cos^4\theta \, d\theta$, giving your answer correct to two decimal places.
 - (ii) Evaluate $\int_2^3 \frac{5x^2 + 15x 2}{(x-1)(x+2)^2} dx$

(13 marks)

- (b) (i) Determine the area of the region enclosed by $y = 6 \sin 3x$, and x-axis between x = 0 and $x = \frac{\pi}{3}$.
 - (ii) Find the volume generated when the area in b(i) is rotated about the x-axis through 360°.

(7 marks)

- Solve the differential equation $2xy\frac{dy}{dx} = x^2 + y^2$, given that when x = 3, $y = 2\sqrt{2}$. (8 marks)
 - (b) Solve the differential equation $\frac{d^2y}{dx^2} 3\frac{dy}{dx} + 2y = 4e^{3x}$, $\sqrt{1+3}\sqrt{1+3}$ given that when x = 0, y = 2 and $\frac{dy}{dx} = 0$.

(12 marks)

(a) Given that $A = \begin{bmatrix} 3 & 2 & -1 \\ 2 & -1 & 2 \\ 1 & -1 & -4 \end{bmatrix} \qquad B = \begin{bmatrix} 4 & 5 & 1 \\ 1 & -2 & -3 \\ 3 & -1 & -2 \end{bmatrix}$

Show that $(AB)^T = B^T A^T$

(7 marks)

(b) Use inverse matrix method to solve the simultaneous equations

$$2x-3y+2z=9, 3x+2y-z=4, x-4y+2z=6.$$

(13 marks)

 (a) A random sample of size 100 from an infinite population has a mean of 80 and a standard deviation of 15.

Determine the probability that the sample mean lies between 79 and 82.

(6 marks)

0 0 V (1+V) (0 (1+V)

Turn over

2305/301, 2307/301, 2309/301 2306/301, 2308/301 Oct/Nov. 2016 (b) A continuous Random variable x has probability density function defined by

$$f(x) = \begin{cases} Kx^2; & 0 \le x \le 1 \\ K; & 1 \le x \ 2 \\ O_r & elsewhere \end{cases}$$

Determine:

- (i) the value of the constant K.
- (ii) the mean and standard deviation of x.
- (iii) $P(x < \frac{1}{2})$

(14 marks)

8. (a) Two major brands of light bulbs A and B are used in an apartment. A sample of 50 bulbs of brand A revealed a mean life-time of 6.94 months and a standard deviation of 0.82 months. A sample of 60 bulbs from brand B revealed a mean life time of 7.34 months and a standard deviation of 1.53 months.
Test at 5% level of significance the claim that there is no difference in quality between

Test at 5% level of significance the claim that there is no difference in quality between the two brands of bulbs.

(7 marks)

(b) A experiment was carried out on small cantilevered steel beam, various masses were placed on the end of the beam and corresponding deflections measured as shown in table 1.

Table 1

Mass x (grammes)	Deflection y (mm)
0	0
50.15	0.6
99.90	1.8
150.05	3.0
200.05	3.6
250.20	4.8
299,95	6.0
350.05	6.2
401.00	7,5

- (i) Find the least squares line of Regression of y and x.
- (ii) Predict the deflection when the mass is 220g.

(13 marks)

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