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Name: _____ Index No: _____/____

2305/301, 2307/301, 2309/301
2306/301, 2308/301
MATHEMATICS
Oct./Nov. 2015
Time: 3 hours

Candidate's Signature: _____

Date: _____

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

Write your name and index number in the spaces provided above.
Sign and write the date of the examination in the spaces provided above.
You should have mathematical tables/scientific calculator for this examination.
*Answer any **FIVE** of the **EIGHT** questions in the spaces provided in this question paper.*
All questions carry equal marks.
Maximum marks for each part of a question are as shown.
*Do **NOT** remove any pages from this question paper.*
Candidates should answer the questions in English.

For Examiner's Use Only

Question	1	2	3	4	5	6	7	8	TOTAL SCORE
Candidate's Score									

This paper consists of 16 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) If $P=\begin{bmatrix}2 & 3 & 1\\4 & 2 & 0\\2 & 3 & 4\end{bmatrix}$, $Q=\begin{bmatrix}0 & 3\\-4 & 2\\2 & 4\end{bmatrix}$ and $R=\begin{bmatrix}-4 & 2 & 3\\2 & 4 & 5\end{bmatrix}$.

Find

(i) $(RQ)^{-1}$

(ii) Adjoint P.

(9 marks)

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

$$\begin{aligned}4x-3y-z &= 29\\-5x+2y-2z &= -42\\3x+2z &= 22\end{aligned}$$

(11 marks)

2. (a) Solve the differential equation

$$xy\frac{dy}{dx}=4x^2+2y^2+4xy$$

given that when x = 1, y = 0.

(8 marks)

(b) Use the method of undetermined coefficients to solve the differential equation.

$$\frac{d^2y}{dx^2}-7\frac{dy}{dx}+10y=x+e^{3x}$$

given that when x = 0, y = -1 and $\frac{dy}{dx}=0$

(12 marks)

3. (a) Find the first moment of area about axis XX for the shape shown in Fig.1 correct to 2 decimal places.

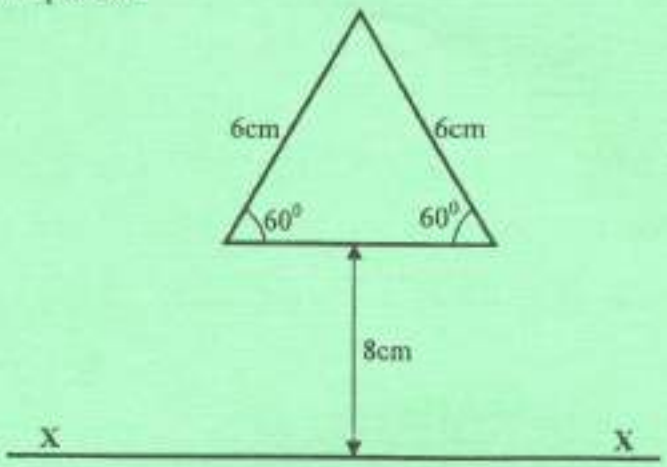


Fig. 1

(4 marks)

(b) Find the volume generated when the plane figure bounded by $y = \cos^2 x$, the x-axis and the ordinates at x = 0 and $x = \frac{\pi}{3}$, rotates about the x-axis through a complete revolution.

(7 marks)

(c) Determine the position of the centroid of the area enclosed by the curve $y = 6x^2$, the y-axis and ordinates y = 1 and y = 8, correct to 3 decimal places.

(9 marks)

4. (a) Express $\frac{3+4j}{4+5j}$ in the form a + bj.

(3 marks)

(b) If $Z = x + yj$, find the value of x and y such that

$$\frac{1}{z} + \frac{3}{z} = 2 + j$$

(6 marks)

(c) Use De Moivres theorem to show that

$$\cos 4\theta = 8\cos^4\theta - 8\cos^2\theta + 1$$

(5 marks)

(d) Simplify:

$$4 + 3j + 6(4 - 2j) + j(4j - 5)$$

expressing the result in the polar form. (6 marks)

5. (a) Expand $(1-x)^{\frac{1}{2}}$ in ascending powers of x as far as the fourth term. Hence by taking the first two terms of the expansion and substituting $x = \frac{1}{1000}$.
Find the value of $\sqrt[3]{37}$ correct to six significant figures.

(9 marks)

(b) If $A = 2\underline{i} - 6\underline{j} + 3\underline{k}$, $B = 4\underline{i} + 3\underline{j} - \underline{k}$ and $C = \underline{i} - 2\underline{j} + 2\underline{k}$.

(i) show that $(A \times B) \times C \neq A \times (B \times C)$

(ii) determine the unit vector that is perpendicular to the plane of A and B.

(11 marks)

6. (a) The parametric equation of an ellipse is given by:

$x = 5\cos t$, $y = 3\sin t$ where t is a parameter.

(i) show that the cartesian form of this equation is:

$$\frac{x^2}{25} + \frac{y^2}{9} = 1.$$

(6 marks)

(ii) differentiate y with respect to x, leaving your expression in t only.

(4 marks)

(b) Find the stationary points of the function.

$Z = (x^2 + y^2)^2 - 8(x^2 - y^2)$

and determine their nature.

(10 marks)

7. (a) A random sample of 1200 tiles are drawn from the output of a machine periodically for inspection. A defect rate of 5% is acceptable, but if it exceeds this value the machine is stopped and adjusted.

Determine the type I error for the decision rule, "to stop production and adjust the machine if a sample contains 70 or more defective tiles".

(7 marks)

(b) Given the data:

$\sum X = 250, \sum Y = 300, \sum XY = 7900, \sum X^2 = 6500, \sum Y^2 = 1,000$ and N = 10.

Use the data to determine the two regression lines of

(i) x on y;

(ii) y on x.

hence compute the Karl Pearson's coefficient of correlation.

(13 marks)

8. (a) The following frequency distribution represents the age of building in a certain locality. Determine the mean and standard deviation.

Age years	30-40	40-50	50-60	60-70	70-80
Frequency	6	9	18	14	7

(7 marks)

(b) The weight of metal bars made in a factory are normally distributed. If 6⅓ of the bars weigh less than 90.5 kg and 4% weigh more than 100.25 kg, determine the

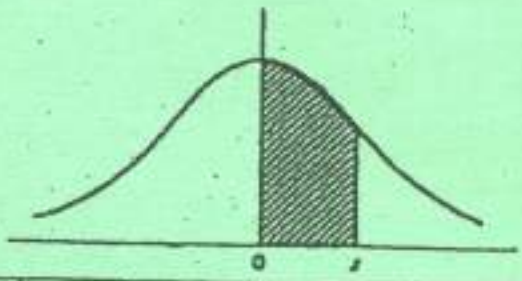
(i) mean and variance of the weight of the bars;

(ii) percentage of bars which would be expected to weigh less than 88 kg.

(iii) if the variance of the weight distribution was reduced by ⅓ determine the percentage of the production that would be expected to weigh less than 88 kg, assuming the mean is not changed.

(13 marks)

Partial areas under the standardised normal curve



$z = \frac{x-\bar{x}}{\sigma}$	0	1	2	3	4	5	6	7	8	9
0.0	0.0000	0.0040	0.0080	0.0120	0.0159	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0678	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1388	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1891	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2086	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2760	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3215	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3451	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4430	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4762	0.4767
2.0	0.4772	0.4778	0.4783	0.4785	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4882	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4980	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.7	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.8	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000

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