1301/311   1305/311
1304/311   1309/311
MATHEMATICS
June/July 2017
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN CARPENTRY AND JOINERY
CRAFT CERTIFICATE IN MASONRY
CRAFT CERTIFICATE IN PLUMBING
CRAFT CERTIFICATE IN ROAD CONSTRUCTION

MATHEMATICS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
    Drawing instruments;
    Mathematical tables/scientific calculator;
    Answer booklet.
*This paper consists of **EIGHT** questions.*
*Answer any **FIVE** questions in the answer booklet provided.*
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.

     Turn over

1. (a) Convert:

   (i) 1101101 to denary
   (ii) 204 to binary (4 marks)

   (b) Solve for x:

   (i) $4^{2x+1} = 16^{6x-4}$
   (ii) $\log(8-4x) - 1 = \log(2x - 4)$; (7 marks)

   (c) The sag S at the centre of a cable connecting two buildings is given by

   $$S = \sqrt{\frac{3d(l-d)}{8}}$$

   Make l the subject of the formula. (4 marks)

   (d) Use completing the square method to solve $x^2 + 2x - 8 = 0$. (5 marks)

2. (a) In a geometric progression, the sum of the first and third terms is 24 while the sum of the third and fourth terms is 72. Determine the:

   (i) common ratio;
   (ii) first term. (8 marks)

   (b) The average rate of depreciation in value of a water pump is 8% per annum. After three years its value is Ksh 140,700. Determine its value at the start of the three year period. (4 marks)

   (c) M varies directly as N and inversely as the square of r. Given that M = 8, N = 10 and r = 2, determine the:

   (i) coefficient of proportionality
   (ii) percentage change in N if M increased by 10% and r decreases by 5%. (8 marks)

3. (a) Table 1 shows marks scored by 40 students in a mathematics examination.

   Table 1

Marks	30 -39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89
No. of students	6	14	10	7	2	1

   (i) Calculate the interquartile range. (7 marks)

   (ii) Using an assumed mean of 54.5, determine the standard deviation. (9 marks)

(b) 6% of components produced by a machine are defective. If two components are chosen at random, determine the probability that:

    (i)   both will be non-defective;
    (ii)   the first will be non-defective while the second will be defective.   (4 marks)

4. (a) Given the matrices $A = \begin{bmatrix} 1 & 2 \\ 4 & 3 \end{bmatrix}$, $B = \begin{bmatrix} -2 & 4 \\ 3 & 1 \end{bmatrix}$ and $C = \begin{bmatrix} 0 & 2 \\ 1 & 4 \end{bmatrix}$, determine:

    (i) $3A - 2C$
    (ii) $(AB)^{-1}$ (8 marks)

(b) The total cost of 15 bags of cement and 10 bags of lime is Ksh 12,250 while 10 bags of cement and 8 bags of lime is Ksh 8, 500. Use the inverse matrix method to determine the costs of one bag of cement and one bag of lime.   (12 marks)

5. (a) If $\sin A = \frac{8}{10}$ and $\cos B = \frac{3}{5}$ where A and B are acute angles, determine

    (i) $\cos(A + B)$
    (ii) $\sin(A - B)$ (6 marks)

(b) Given that $4 \cos\theta + 5 \sin\theta = R \sin(\theta + \alpha)$ where $R > 0$ and $0° \le \alpha \le 90°$.

    (i)   Find the value of R and α;
    (ii)   Hence, solve the equation $4 \cos\theta + 5 \sin\theta = 6$, for $0° \le \theta \le 360°$.

                                                                (10 marks)

(c) A piece of land on a map is in the shape of a triangle PQR. Given that PR = 13 cm, PQ = 8 cm and angle PQR = 140°, determine angle PRQ.   (4 marks)

6. (a) Simplify;

    (i) $(x^2 - 1)^2 \times \sqrt{x+1} \div (x-1)^{\frac{3}{2}}$

    (ii) $(3a^2 b^{-2} c)^2 \times (a^{-3} b^8 c^{-1})^{\frac{1}{2}} \div 18 (a^6 b^4 c^5)^{\frac{1}{2}}$ (8 marks)

(b) **Table 2** shows accounts for the year ending 31st December 2015 for a hardware business.

Table 2

Stock as at 1.12.2015	Ksh 80,000
Stock as at 31.12.2015	Ksh 160,000
Net purchase for the year	Ksh 400,000
Gross profit mark up	50%
Expenses for the year	240,000
Capital	600,000

Calculate the:

(i) average stock
(ii) rate of stock turnover
(iii) gross profit margin. (12 marks)

7. (a) A rectangular piece of metal having dimensions of 6 cm by 5 cm by 13 cm is melted and recast into a right pyramid having a rectangular base measuring 2 cm by 3 cm. Calculate the perpendicular height of the pyramid. (6 marks)

(b) Determine the volume of a frustum of a cone if the diameters of the ends are 8 cm and 6 cm and the perpendicular height is 4 cm. (9 marks)

(c) **Table 3** shows the heights in cm of 50 students in a class.

Table 3

Height (cm)	Frequency
140 - 144	3
145 - 149	x
150 - 154	19
155 - 159	y
150 - 164	2

Given that the median is 151.342, find the values of 'x' and 'y'. (5 marks)

8. (a) **Table 4** shows the force (F) in newtons required to lift a load (L) in newtons by a machine.
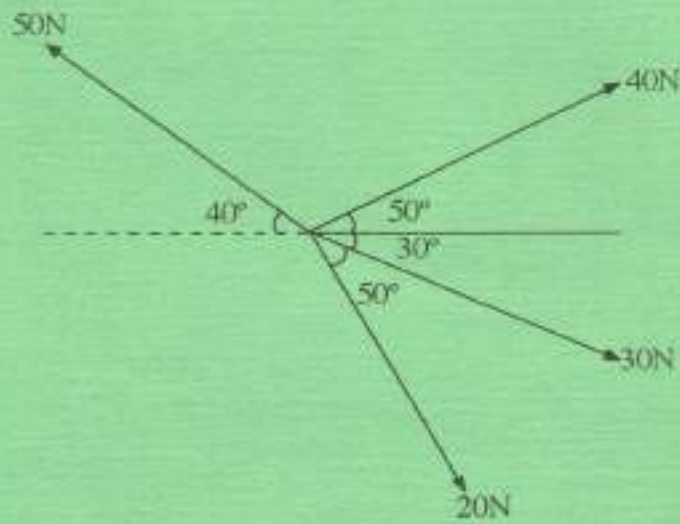
Table 4

Force (F)	9	25	40	83	115	137
Load (L)	30	110	220	400	530	670

Draw the graph of F against L and hence determine:

(i) slope of the graph;
(ii) the force required when the load is 440 N;
(iii) the load when the force is 90 N;
(iv) the linear relationship between F and L. (12 marks)

(b)   **Figure 1** shows four coplanar forces acting at a point.

Determine the magnitude and direction of the resultant force.   (8 marks)

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