1306/311
1307/311
1308/311
MATHEMATICS
June/July 2021
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN CARTOGRAPHY
CRAFT CERTIFICATE IN PHOTOGRAMMETRY
CRAFT CERTIFICATE IN LAND SURVEYING

MATHEMATICS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Mathematical tables/Scientific calculator;
*This paper consists of **EIGHT** questions.*
*Answer any **FIVE** questions.*
All questions carry equal marks.
Maximum marks for each part of a question are as 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.

4. (a) Solve the equations

(i) $2^{3x+1}=8^{4x-3}$;

(ii) $2^{x+3}=3^{2x-5}$.

(10 marks)

(b) Solve the equation

$\log(x-2)+\log(x+2)=2\log(x+5)$. (5 marks)

(c) Solve the quadratic equation $3x^2-7x-11=0$ by completing the square.

(5 marks)

12. (a) Given the matrices

$$A=\begin{bmatrix}4 & 1\\ -3 & 0\end{bmatrix}, \qquad B=\begin{bmatrix}2 & 2\\ -1 & 3\end{bmatrix}$$

Determine:

(i) $A+B$;
(ii) AB;
(iii) $(A+B)^{-1}$.

(8 marks)

(b) Given that $N=\begin{bmatrix}4-x & 1\\ 3 & x\end{bmatrix}$ is a singular matrix,

determine the:

(i) possible values of x;
(ii) two possible matrices.

(8 marks)

(c) Prove the identity

$$\frac{2}{1+\sin\theta}+\frac{2}{1-\sin\theta}=4\sec^2\theta.$$ (4 marks)

3. (a) Covert:

(i) 65_{10} to a binary number.

(ii) 1100110101_2 to a denary number.

(6 marks)

(b) Given the data

42, 60, 85, 28, 11, 10, 12, 14, 17, 15, 22, 31, 85, 72, 12 determine the:

(i) first quartile;
(ii) third quartile
(iii) inter quartile range.

(7 marks)

(c) Use logarithms to evaluate

$$\sqrt[3]{\frac{468 \times 0.0374}{0.00264}}$$

(7 marks)

4. (a) The seventh term of a geometrical progression is 125 and the fifth term is 5. Determine the sum of the first 10 terms. (8 marks)

(b) The seventh term of an arithmetical progression is 8 and the tenth term is 23. Determine the sum of the first 15 terms of the progression. (8 marks)

(c) (i) Make y the subject of the formula $m = 5y - n^2$.

(ii) Determine the values of y when $m = 1$ and $n = 3$.

(4 marks)

5. (a) Given that θ is an acute angle and $\sin\theta = \frac{4}{5}$; without using tables of calculator determine:

(i) $\cos\theta$;
(ii) $\tan\theta$;
(iii) $\text{cosec}\,\theta$;
(iv) $\sec\theta$.

(6 marks)

(b) Solve the equation $10\sin^2\theta - 3\cos\theta = 9$ for $0° \leq \theta \leq 360°$. (10 marks)

(c) Determine the value of

$$\frac{2}{7} \times \left(1\frac{10}{11} - \frac{9}{22}\right) \div 1\frac{7}{11}.$$

(4 marks)

6. (a) A metal cube of side 4.4 cm is melted and the molten material is used to make a sphere Calculate to 3 significant figures the radius of the sphere $\left(Take\ \pi = \frac{22}{7}\right)$. (4 marks)

(b) Mr X is employed as a groundsman in a technical institute. He earns Ksh 12,000 per month and he is entitled to a house allowance of Ksh 2,250. He is a married man. During the month of July he worked overtime and was paid Ksh 3,000 as overtime allowance.
Calculate the tax for the month of July if he is entitled to a family relief of £ 132 per year. Use the data given in **table 1**.

Table 1

Income slab £	Rates %
0 - 2640	10
2641 - 5280	15
5281 - 7920	20
7921 - 10560	25
10561 - 13200	35
13201 - above	40

(16 marks)

7. (a) In a triangle **ABC**, **D** is the midpoint of AB. If $\underset{\sim}{a}$ represents $\overrightarrow{AB}$ and $\underset{\sim}{b}$ represents $\overrightarrow{BC}$, express the vectors $\overrightarrow{CA}$ and $\overrightarrow{DC}$ in terms of $\underset{\sim}{a}$ and $\underset{\sim}{b}$. (6 marks)

(b) If the position vector $\overrightarrow{OA} = \underset{\sim}{i} - 3\underset{\sim}{j}$ and the position vector of $\overrightarrow{OB} = 2\underset{\sim}{i} + 5\underset{\sim}{j}$, find:

(i) $|\overrightarrow{AB}|$;
(ii) the position of the midpoint of AB.

(6 marks)

(c) **Figure 1** shows a system of forces acting on a particle.

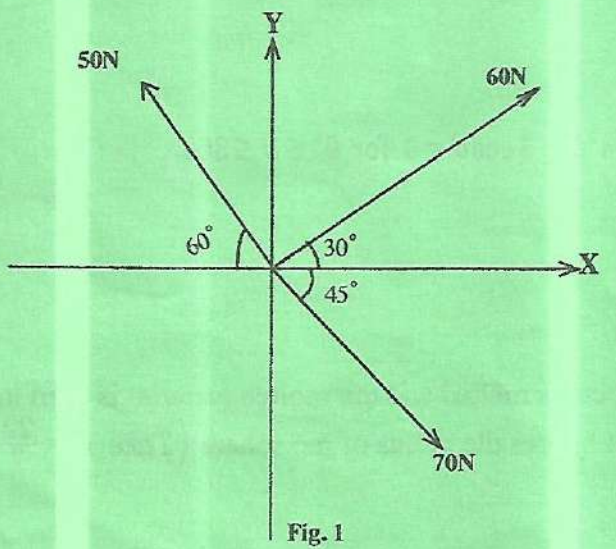

Fig. 1

Use the resolution of forces to determine the magnitude of the resultant force.

(8 marks)

8. (a) A set of 12 identical cards are numbered 1 to 12 inclusive. Two cards are picked at random without replacement. Determine the probability that the numbers on both cards:

(i) odd;
(ii) even;
(iii) prime.

(8 marks)

(b) Solve the equation $6x^2 - 13x + 6 = 0$ by factorization. (6 marks)

(c) Use the method of substitution to solve the simultaneous equation

$x - 2y = 8$
$2x - 5y = 9$

(6 marks)

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