1301/311   1305/311
1304/311   1309/311
MATHEMATICS
Oct./Nov. 2018
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;
        Answer booklet;
        Mathematical tables/scientific calculator;
This paper consists of EIGHT questions.
Answer FIVE questions.
All questions carry equal marks.
Maximum marks for each part of the 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) (i) Given $\log_2 x + \log_2 2 = 2$, find the value of x.

(ii) Solve the equation $2(2^{2x}) - 5(2^x) + 2 = 0$.

(13 marks)

(b) Simplify the following expressions:

(i) $\dfrac{a^2 b^3 c^4}{ab^2 c}$.

(ii) $\left(p^{\frac{1}{2}} q^2 r^{-3}\right)\left(p^{\frac{1}{3}} q^{\frac{1}{2}} r^{\frac{1}{2}}\right)$.

(7 marks)

2. (a) (i) The sum of the first "n" terms of an A.P is $n(1 + 5n)$. Find:

(I) first term
(II) common difference.

(4 marks)

(ii) A ball is dropped from a height 1 m from the ground. It bounces to three-fifth of the original height. The bouncing continues like that with the ball reaching a height of three fifths of the previous bounce. Calculate:

(I) the total height covered by the ball before it stops bouncing;

(II) the total height covered after the first five bounces.

(10 marks)

(b) In the first week of a production 10,000 articles were made. If the rise in weekly production is 10% per week, how many weeks are necessary to produce 150,000 articles? (6 marks)

3. (a) In two relationships connecting α, β and γ, α is found to be directly proportional to γ while β is inversely proportional to γ. When γ is 3, the value of $(\alpha + \beta)$ is 12, and when γ is 2, the value of $(\alpha + \beta)$ is also 12. Calculate the proportionality constants. (8 marks)

(b) **Figure 1** shows frustum of a pyramid whose ends are squares of 64 mm and 36 mm respectively and thickness of 40 mm. Find:

(i) the volume;
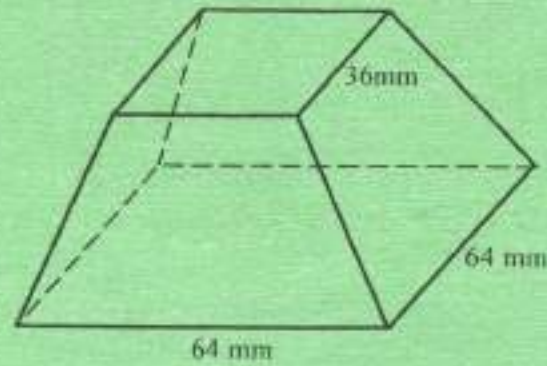
(ii) total surface area of the frustum.

(12 marks)

Fig. 1

4. (a) Given the matrices

$$A=\begin{pmatrix} 3 & 1 \\ 4 & 2 \end{pmatrix} \quad B=\begin{pmatrix} 5 & 1 \\ 3 & 4 \end{pmatrix} \quad \text{Evaluate:}$$

(i) $(A+B)^2$

(ii) $A^2 + 2AB + B^2$

(iii) AB

(iv) $(A+B)^{-1}$

(10 marks)

(b) Two cinema theatres A and B carry 700 people each. Each of them carries 300 people upstairs and 400 downstairs. Theatre A charges Ksh 280 for upstairs and Ksh 200 for downstairs. Theatre B charges Ksh 250 upstairs and Ksh 180 downstairs. Using matrix method, calculate the total collection of each theatre during one show when all seats are booked. (10 marks)

5. (a) The probability of an event happening is $\frac{4}{7}$. Determine the probability of the event not happening. (2 marks)

(b) A bag contains four green balls, six red balls and five white balls. Determine the probability of having (with replacement):

(i) two green balls;

(ii) a green ball and a white ball, if two balls are drawn from the bag.

(4 marks)

(c) **Table 1** shows the wages earned by the workers in a factory per week.

Wages in K £	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89
No. of workers	6	10	9	7	5	3

(i) Draw

(I) a histogram

(II) a frequency polygon.

(6 marks)

(ii) Calculate the mean wages using an assumed mean of 54.5. (4 marks)

(iii) Calculate the standard deviation of the wage. (4 marks)

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

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

(i) $|\overrightarrow{AB}|$

(ii) the position vector of the mid-point **AB**.

(6 marks)

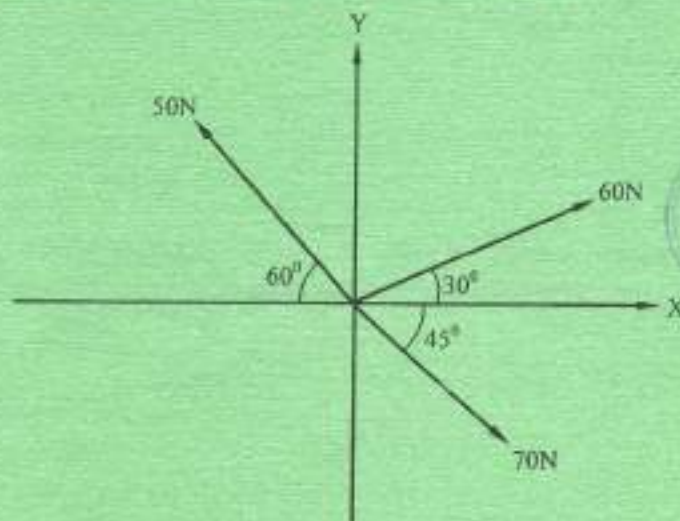(c) **Figure 2** shows a system of forces acting on a particle.

Fig. 2

Use resolution of forces to determine the magnitude of the resultant force. (8 marks)

7. (a) Draw the graph of $y = -2x^2 + 4x + 7$ for values of x between -2 and 4 inclusive. Use the graph to solve the following equations:

   (i) $-2x^2 + 4x + 4 = 0$

   (ii) $-2x^2 + x + 6 = 0$

   (10 marks)

   (b) (i) Prove the trigonometric identity:

   $$\frac{\cos\theta}{1 - \sin\theta} = \sec\theta + \tan\theta$$

   (4 marks)

   (ii) Solve the trigonometric equation

   $$7\tan^2\theta + \sec\theta = 4 \text{ for } 0° \le \theta \le 360°.$$

   (6 marks)

8. (a) The cost of a machine from a manufacturer is US$ 10,200. The machine was later sold to a firm at a profit of 15%. If the machine depreciates at the rate of 2% from the time it is acquired by the firm, calculate its value in sterling pounds after 8 years.

   1 US$ = Ksh 105.0

   1 sterling £ = Ksh 156.0

   (7 marks)

   (b) Mr Ongoro is employed as a groundsman in a technical institute. He earns Ksh 12,000 per month. He is married and lives with his wife in a house provided by the institution free of charge.

   During the month of July he worked overtime and he was paid Ksh 3000 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 2** to answer the questions.

   Table 2

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

   (13 marks)

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