1704/202
MATHEMATICS
June/July 2016
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN BUILDING TECHNOLOGY
MODULE II

MATHEMATICS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
- *Answer booklet;*
- *Non programmable scientific calculator;*
- *Mathematical tables;*
- *Drawing instruments.*

*Answer any **FIVE** questions of the following **EIGHT** questions.*
All questions carry equal marks.
Maximum marks for each part of a question are indicated.
Candidates should answer the questions in English.

This question paper consists of 5 printed pages.

Candidates must check the question paper to ascertain that all the pages are printed and that no questions are missing.

Turn over

1. (a) The sand used in the construction of a building is obtained from three sources X,Y and Z. The sand from each source has the probability of being defective by containing excess silt. The probability of the sand from the sources X,Y and Z being defective are $\frac{2}{10}$, $\frac{3}{10}$, and $\frac{15}{100}$ respectively. Find the probability that at any time the site is visited there is no defective sand. (6 marks)

(b) The heights in centimetres (cm) of 30 students are given in the data below

140	154	144	163	170	155	150	149	143	164
153	153	154	165	167	154	152	150	154	142
165	165	170	165	164	141	147	151	150	152

Using a class interval of 5 cm enter the data on a frequency distribution table. (6 marks)

(c) Table 1 below, shows an incomplete frequency distribution of the lengths, in millimetres, of seventy bars. Complete the table and determine:-

(i) the modal class.
(ii) the mean length in millimetres.
(iii) the standard deviation. (8 marks)

Length in (mm) X	Central value Xm	Frequency (f)
21.2 - 21.4	21.3	3
21.5 - 21.7	21.6	5
21.8 - 22.0	21.9	10
22.1 - 22.3	22.2	16
22.4 - 22.6	22.5	18
22.7 - 22.9	22.8	12
23.0 - 23.2	23.1	6

2. (a) Three entrepreneurs decided to form a partnership business. They contributed the working capital in the ratio 2:3:4. They also borrowed a loan to add to the working capital. After the end of the month they found that the profit had accumulated to sh.36,000. They deiced that the profit will be divided according to the individuals contributions to the working capital and also the debts amounting to 24% of the profit must be paid. Calculate the amount each man will get as profit. (8 marks)

(b) Mr. Onyango returns to Kenya from Canada after a business tour with Can \$ 8,000 and US\$1500. On his way to Kenya he made a stop over in London and exchanged all the US& he had into UK£ and paid a hotel bill of UK £150. When Mr. Onyango arrived in Kenya, he exchanged all the money he had into Kenya shillings and for each transaction he paid a commission of 2% to the bank. How much money in Ksh was he given after the transactions? Use the following exchange rates:

1 UK£ = 147 Ksh
1 UK£ = 1.6359 US\$ ✓ £ 150
1 US\$ = 87.9 Ksh
1 Can\$ = 80.3 Ksh (6 marks)

(c) The cost of a machine from a manufacturer is Ksh 100,000. 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 after 8 years. (6 marks)

3. (a) Show that the area of a triangle PQR $= \frac{1}{2}$ pr $\sin\theta$. (6 marks)

(b) Change the function $15\sin\theta + 8\cot\theta$ into the form R sin $(\theta+\alpha)$.
Hence solve $15\sin\theta + 8\cos\theta = 10$. (8 marks)

(c) Solve for the angle $A\hat{B}C$ in a triangle in which AB = 44.8 cm, CA = 34.4 cm and angle $B\hat{A}C = 105.6^\circ$. (6 marks)

4. (a) Using mathematical tables find:

(i) Cos 127°
(ii) Sin 327°
(iii) tan 330° (6 marks)

(b) Prove the trigonometric identity
$1+\tan^2\theta = \sec^2\theta$ (4 marks)

(c) Solve the equation
$8\cos^2\theta - 2\cos\theta - 3 = 0$ (4 marks)

(d) A surveyor on a level ground walks straight towards a vertical pole. At one point the angle of elevation of the top of the pole is 27°. After walking for 15 metres further towards the pole, the new angle of elevation is 42°. Find the height of the pole if the eye level is 1.42 m above ground level. (6 marks)

5. (a) Given the matrices $A = \begin{pmatrix} 2 & 3 \\ 5 & 3 \end{pmatrix}$, $B = \begin{pmatrix} 4 & 6 \\ 1 & 2 \end{pmatrix}$ find:-

(i) $A^2 + B^2$
(ii) $(AB)^{-1}$ (6 marks)

(b) Two forces F_1 and F_2 acting on a body are such that

$$2F_1 + 3F_2 = 6N$$
$$F_1 + F_2 = 6N$$

Use the inverse matrix method to determine the magnitude of F_1 and F_2. (6 marks)

(c) When an effort e is applied to the gear box on a diesel motor it is found that a resistance R can be overcome and that E and R are connected by a formula $E = a + bR$; a and b are constants. An effort of 3.5 Newtons overcomes a resistance of 5 ohms and an effort of 5.3 Newtons overcomes a resistance of 8 ohms. Use matrices to find the values of a and b. (8 marks)

6. (a) In figure 1, O is a point of origin and $\underset{\sim}{p}$, $\underset{\sim}{q}$ and $\underset{\sim}{r}$ are position vectors of M, N and R respectively. Given $\overrightarrow{MR} = \frac{2}{3}\overrightarrow{RN}$, express $\underset{\sim}{OR}$ in terms of $\underset{\sim}{p}$ and $\underset{\sim}{q}$. (6 marks)

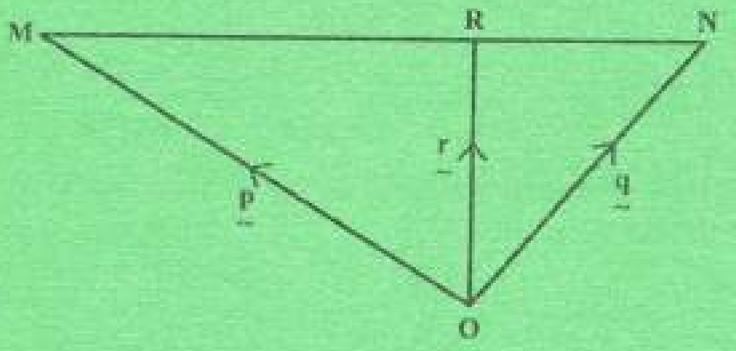

Fig. 1

(b) Figure 2 represents a system of four forces acting on a particle. By calculation determine the magnitude and direction of the resultant force. (8 marks)

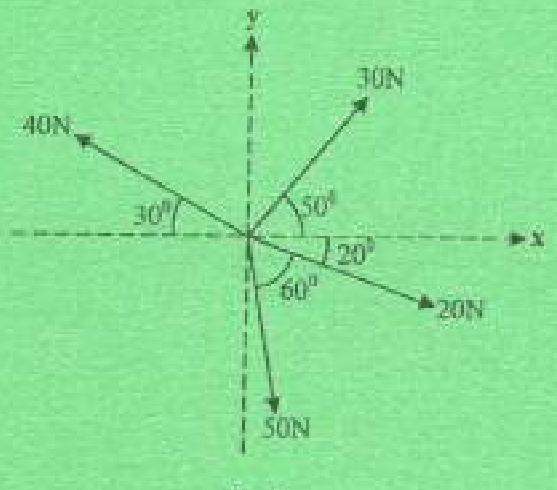

Fig. 2

(c) If $\underset{\sim}{a} = -3\underset{\sim}{i} + 5\underset{\sim}{j}$, $\underset{\sim}{b} = 3\underset{\sim}{i} - 4\underset{\sim}{j}$ and $\underset{\sim}{c} = 2\underset{\sim}{i} + 3\underset{\sim}{j}$, find $\left| a - b + 3c \right|$ and the direction of $\overrightarrow{AC}$. (6 marks)

7. (a) The distance x metres moved by body in t seconds is given by

$$x = 3t^3 - \frac{11}{2}t^2 + 2t + 5$$

Find its velocity after t seconds. (2 marks)

(b) A rectangular site 1600 m^2 is to be fenced off from the rest of the farm. If the cost per metre of fencing for the frontage is three times as much as the cost per metre of the fencing for the remainder, calculate the dimensions for which the cost of the fencing is a minimum. (6 marks)

(c) Find the stationary points of $y = 5 + 24x - 9x^2 - 2x^3$ and hence sketch the graph. (6 marks)

(d) Differentiate $y = 2x^2$ using the first principles. (6 marks)

8. (a) Determine

(i) $\int (x+2)(x+2)\,dx$.

(ii) $\int \frac{\sqrt{x+1}}{x^2}\,dx$. (6 marks)

(b) A metal plate is bounded by the curve $y = 4x^3$ and the ordinates $x = -2$ and $x = 2$ and the X-axis. Find its area. (6 marks)

(c) The velocity V of a body, t seconds after a certain instant is $(6t^2 + 8)\ ms^{-1}$. Find how far it moves in the interval from t = 2 seconds to t = 8 seconds.

Hint: Let distance travelled be $\int_{t_1}^{t_2} V\ dt$. (8 marks)

THIS IS THE LAST PRINTED PAGE.