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SUBSID. MATHEMATICS
PAPER 1
June 2024

CLEVERLAND HIGH SCHOOL
MID TERM II EXAMINATIONS 2024
S.5 SUBSIDIARY MATHEMATICS
Paper 1
2 hours 40 minutes

Instructions:
Attempt all questions in this paper.

1. The roots of the equation $2x^2 + 4x - 1 = 0$ are α and β.
Find the value of $\alpha^2 + \beta^2$.

2. Evaluate $\dfrac{\log_6 216 + 10g_2 64}{\log_3 243 - \log_{10} 0.1}$

3. Three events A, B and C are such that P(A) = 0.6, P(B) = 0.8, P(B/A) = 0.45 and P(BnC) = 0.28
Find (a) P(AnB) (b) P(C/B)

4. Given that $(x+1)$ and $(x-2)$ are factors of the polynomial $ax^3 - 3x^2 + bx + 2$.
Find the values of a and b.

5. Find the possible values of x such that AB = BA given that
$A = \begin{pmatrix} x^2 & 3 \\ 1 & 3x \end{pmatrix}$ and $B = \begin{pmatrix} 3 & 6 \\ 2 & x \end{pmatrix}$

6. The table below refers to the mean quantity rainfall (in cm) for the years 1975 and 1976.

	Jan – Mar	Apr – June	July – Sept	Oct – Dec
1975	26	14	33	a
1976	b	18	23	28

The 4 point moving averages for the above date are 29.5, 28.25, c, 26.75, d. calculate the values of a, b, c, d.

7. Using 9 as the working mean, calculate the mean number of accidents per day of the information below.

Accidents	0 – 4	5 – 7	8 – 10	11 – 13	14 – 18
Days	2	5	10	8	5

8. The table below shows the average retail prices in shillings of a kilogram of sugar during the years 1983 – 1988.

Year	1983	1984	1985	1986	1987	1988
Retail price	110	120	130	150	165	185

Using 1983 – 1985 as the base, find the retail price index for the given years.

SECTION B

9. The table below shows the number of motorcycles sold by a certain company from 2017 to 2019.

Year	Quarter			
	1st	2nd	3rd	4th
2017	65	82	67	84
2018	67	84	71	90
2019	73	90	75	96

(a) Calculate the four point moving averages for the data.

(b)(i) On the same axes, draw a graph of the original data and the moving averages.

(ii) Comment on the trend of the number of motorcycles sold over the 3-year period.

(c) Use your graph to estimate the number of motorcycles sold in the first quarter of 2020.

10(a) Find the value of k for which the equation $kx^2 + 4x + 9k = 0$ has equal roots.

(b) The polynomial $f(x) = ax^2 + bx - 7$ has $x - 1$ as its factor and it leaves a remainder of 6 when divided by $x + 2$. Find the values of a and b.

(c) The roots of the quadratic equation $2x^2 - 7x + 1 = 0$ are α and β. Form an equation whose roots are $\frac{\alpha}{\beta}$ and $\frac{\beta}{\alpha}$.

11(a) A family bought the following items for three successive days. The first day it bought three bunches of matooke, two kilograms of rice, five kilograms of meat and two kilograms of sugar. The second day it bought only one kilogram of sugar. The third day the family bought a bunch of matooke and two kilograms of rice.
A bunch of matooke costs shs15000, a kilogram of rice, meat and sugar cost shs3300, shs8000 and shs3000 respectively.

(i) Represent the family's requirements in a 3x4 matrix

(ii) Write down the cost of each item as a column matrix

(iii) Use the matrices above to find the family's total expenditure for the three days.

(b) Given the matrices $A = \begin{pmatrix} 3 & 5 \\ -2 & 4 \end{pmatrix}$ and $B = \begin{pmatrix} 8 & -3 \\ -4 & 7 \end{pmatrix}$

(i) Find matrix C such that $3A - 2C + B = I$ where I is a 2x2 identify matrix.

(ii) Find determinant of C

12(a) A bag contains 5 black pens and 4 red pens. Two pens are picked at random one after the other without replacement. Find the probability that both pens are of the same colour.

(b) A and B are mutually exclusive events such that P(A) = ⅗ and P(B) = ⅓
Find (i) P(AUB) (ii) P(A'nB') (iii) P(A'nB)

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S.S.S.MTC MIDTERM 2, 2024 GUIDE (Nuwe Aquila 0702285589)

SECTION A

1. $2x^2+4x-1=0$

$x^2+2x-\frac{1}{2}=0$

$\alpha+\beta=-2, \quad \alpha\beta=\frac{1}{2}$

$\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta$

$\alpha^2+\beta^2=4-2\times\frac{1}{2}=5$

2. $\dfrac{\log_6 216+\log_2 64}{\log_3 243-\log_{10} 0.1}=\dfrac{\log_6 6^3+\log_2 2^6}{\log_3 3^5-\log_{10} 10^{-1}}$

$=\dfrac{3\log_6 6+6\log_2 2}{5\log_3 3-(-1)\log_{10} 10}$

$=\dfrac{3+6}{5+1}=\frac{9}{6}=\frac{3}{2}$

3. $P(A)=0.6, P(B)=0.8, P(B/A)=0.45, P(B\cap C)=0.28$

i) $P(B/A)=\dfrac{P(A\cap B)}{P(A)}$

$0.45=\dfrac{P(A\cap B)}{0.6}$

$P(A\cap B)=0.27$

ii) $P(C/B)=\dfrac{P(C\cap B)}{P(B)}$

$=\dfrac{0.28}{0.8}$

$=0.35$

4. For $x=-1, R=0$.

$-a-3-b+2=0$

$a+b=-1$ —— (i)

For $x=2, R=0$

$8a-12+2b+2=0$

$4a+b=5$ —— (ii)

Solving (i) & (ii) simultaneously

$4a+b=5$

$-\ a+b=-1$

$3a=6$

$a=2$

$2+b=-1$

$b=-3$

5. $\begin{pmatrix} x^2 & 3 \\ 1 & 3x \end{pmatrix}\begin{pmatrix} 3 & 6 \\ 2 & x \end{pmatrix}=\begin{pmatrix} 3 & 6 \\ 2 & x \end{pmatrix}\begin{pmatrix} x^2 & 3 \\ 1 & 3x \end{pmatrix}$

$\begin{pmatrix} 3x^2+6 & 6x^2+3x \\ 3+6x & 6+3x^2 \end{pmatrix}=\begin{pmatrix} 3x^2+6 & 9+18x \\ 2x^2+x & 6+3x^2 \end{pmatrix}$

$6x^2+3x=9+18x$

$6x^2-15x-9=0$

$x=-\frac{1}{2}, \quad x=3$

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6. $29.5 = \frac{26+14+33+a}{4}$

$118 = 73 + a$

$a = 45$

$\frac{14+33+a+b}{4} = 28.25$

$14+33+45+b = 113$

$b = 21$

$\frac{33+a+b+18}{4} = c$

$\frac{33+45+21+18}{4} = c$

$c = 29.25$

$\frac{b+18+23+18}{4} = d$

$d = 22.5$

7.

class	x	f	d=x-A	fd
0-4	2	2	-7	-14
5-7	6	5	-3	-15
8-10	9	10	0	0
11-13	12	8	3	24
14-18	16	5	7	35
		$\Sigma f = 30$		$\Sigma fd = 30$

$\bar{x} = A + \frac{\Sigma fd}{\Sigma f}$

$= 9 + \frac{30}{30}$

$= 9 + 1$

$\bar{x} = 10$

8. $P_0 = \frac{110+120+130}{3} = 120$, $P.I = \frac{P_1}{P_0} \times 100$

1983

$P.I = \frac{110}{120} \times 100 = 91.67$

1984

$P.I = \frac{120}{120} \times 100 = 100$

1985, $P.I = \frac{130}{120} \times 100 = 108.3$

1986, $PI = \frac{150}{120} \times 100 = 125$

1987, $PI = \frac{165}{120} \times 100 = 137.5$

1988, $PI = \frac{185}{120} \times 100 = 154.17$

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SECTION B

9. a)

$M_1 = \frac{65+82+67+84}{4} = 74.5$

$M_2 = \frac{82+67+84+67}{4} = 75$

$M_3 = \frac{67+84+67+84}{4} = 75.5$

$M_4 = \frac{84+67+84+71}{4} = 76.5$

$M_5 = \frac{67+84+71+90}{4} = 78$

$M_6 = \frac{84+71+90+73}{4} = 79.5$

$M_7 = \frac{71+90+73+90}{4} = 81$

$M_8 = \frac{90+73+90+75}{4} = 82$

$M_9 = \frac{73+90+75+96}{4} = 83.5$

b) i) On Graph paper

ii) There is a general increase in the number of motorcycles sold over the given period.

c)

$M_{10} = 85$

But $M_{10} = \frac{90+75+96+x}{4}$

$85 = \frac{90+75+96+x}{4}$

$340 = 261 + x$

$x = 79$ as the no of motorcycles sold in 1st qrtr 2020.

10 a) $Kx^2 + 4x + 9K = 0$

$b^2 = 4ac$

$16 = 4 \times K \times 9K$

$36K^2 = 16$

$K^2 = 4/9$

$K = \pm \frac{2}{3}$

b) $x = 1, R = 0$

$a + b - 7 = 0$

$a + b = 7$ —— (i)

$x = -2, R = 6$

$4a - 2b = 13$ —— (ii)

$2a + 2b = 14$

$+ \quad 4a - 2b = 13$

$6a = 27$

$a = 9/2$, $a + b = 7$

$b = 5/2$

c) $2x^2 - 7x + 1 = 0$

$\alpha + \beta = 7/2$, $\alpha\beta = 1/2$

Sum: $\alpha/\beta + \beta/\alpha = \frac{\alpha^2+\beta^2}{\alpha\beta}$

$= \frac{(\alpha+\beta)^2 - 2\alpha\beta}{\alpha\beta}$

$= \frac{(7/2)^2 - 2 \times 1/2}{1/2} = 45/2$

Prdt $= \alpha/\beta \cdot \beta/\alpha = 1$

$x^2 - (\text{Sum})x + \text{Prdt} = 0$

$x^2 - \frac{45}{2}x + 1 = 0$

$2x^2 - 45x + 2 = 0$

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11 a) i) 3×4 matrix $\begin{pmatrix} 3 & 2 & 5 & 2 \\ 0 & 0 & 0 & 1 \\ 1 & 2 & 0 & 0 \end{pmatrix}$ ii) $\begin{pmatrix} 15000 \\ 3300 \\ 8000 \\ 3000 \end{pmatrix}$ 4×1 matrix

iii) $\begin{pmatrix} 3 & 2 & 5 & 2 \\ 0 & 0 & 0 & 1 \\ 1 & 2 & 0 & 0 \end{pmatrix} \begin{pmatrix} 15000 \\ 3300 \\ 8000 \\ 3000 \end{pmatrix} = \begin{pmatrix} 3\times15000 + 2\times3300 + 5\times8000 + 2\times3000 \\ 0\times15000 + 0\times3300 + 0\times8000 + 1\times3000 \\ 1\times15000 + 2\times3300 + 0\times8000 + 0\times3000 \end{pmatrix}$

$= \begin{pmatrix} 97600 \\ 3000 \\ 21600 \end{pmatrix}$ ← 1st day, ← 2nd day, ← 3rd day

Total expenditure = 97600 + 3000 + 21600

= shs. 122200

b) i) $3A - 2C + B = I$

$3\begin{pmatrix} 3 & 5 \\ -2 & 4 \end{pmatrix} - 2\begin{pmatrix} a & b \\ c & d \end{pmatrix} + \begin{pmatrix} 8 & -3 \\ -4 & 7 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

$\begin{pmatrix} 9 & 15 \\ -6 & 12 \end{pmatrix} - \begin{pmatrix} 2a & 2b \\ 2c & 2d \end{pmatrix} + \begin{pmatrix} 8 & -3 \\ -4 & 7 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

$\begin{pmatrix} 2a & 2b \\ 2c & 2d \end{pmatrix} = \begin{pmatrix} 16 & 12 \\ -10 & 18 \end{pmatrix}$

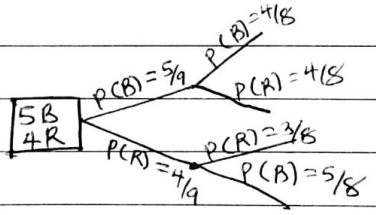
$2a = 16$, $2b = 12$, $2c = -10$, $2d = 18$

$a = 8$ $b = 6$ $c = -5$ $d = 9$

$\therefore C = \begin{pmatrix} 8 & 6 \\ -5 & 9 \end{pmatrix}$

ii) $\det C = 8\times9 - -5\times6 = 102.$

12 a)



P(Same colour) = $P(B_1B_2) + P(R_1R_2)$

$= 5/9 \times 4/8 + 4/9 \times 3/8$

$= 4/9$

b) i) $P(A \cup B) = P(A) + P(B)$

$= 3/5 + 1/3 = 14/15$.

iii) $P(A \cap B) + P(A' \cap B) = P(B)$

$0 + P(A' \cap B) = 1/3$

$P(A' \cap B) = 1/3$

ii) $P(A' \cap B) + P(A' \cap B') = P(A')$

$1/3 + P(A' \cap B') = 1 - P(A)$

$P(A' \cap B') = 1 - 3/5 - 1/3$

$= 1/15$

END.

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(To be fastened together with other answers to paper)

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