S. 5 PURE MATHEMATICS REVISION QUESTION:

TOPIC: NUMERICAL CONCEPTS, EQUATIONS AND INEQUALITIES AND GEOMETRY ONE:

ITEM ONE:

John, a Ugandan city tycoon, has a rectangular piece of land around Nakivubo center.

He wants to rent out this land to road – side traders in a way that each trader rents **2 square metres** of this land at **UGX 840,000** per month.

The length, $\boldsymbol{x}$ meters, and the width, $\boldsymbol{y}$ meters, of his land are defined by the following simultaneous logarithmic equations;

$$\boldsymbol{log_y^x = 5} \text{ and } \boldsymbol{log_2^x = 2 + log_2^y}$$

He wants to determine the number of $\boldsymbol{2\ m^2}$ plots he can have out of his full rectangular piece of land, for renting.

Tasks:

a) Calculate the number of plots He can divide out of His rectangular piece of land.
b) How much is He likely to earn in a month from His land if all the plots are rent out?

ITEM TWO:

Mrs. Nankya runs a poultry farm in Mukono.

She buys three essential types of feeds (in kilograms) for her poultry birds; **chick mash**, **Growers mash**, and **Layers mash**. To manage her costs, she tracks her bulk purchases from the supplier each week as follows;

	NUMBER OF;			
WEEK	**Chick Mash (kg)**	**Growers Mash (kg)**	**Layers Mash (kg)**	**Total cost (UGX)**
One	**10**	**20**	**30**	**160,000**
Two	**20**	**10**	**40**	**185,000**
Three	**30**	**20**	**10**	**140,000**

Given that Nankya intends to purchase **50** Kilograms of Layers Mash**,** and unknown number of kilograms of Chick Mash and Growers Mash in week four.

The number of Chick Mash ($\boldsymbol{y}$ Kilograms) and Growers Mash ($\boldsymbol{x}$ Kilograms) to be purchased by Nankya satisfy the following simultaneous Logarithmic Equations;

$$\boldsymbol{log_2^{(3x+4)} = 1 + log_2^y} \text{ and } \boldsymbol{2log_2^y = 3log_2^x}$$

Tasks:

a) Generate a system of three linear simultaneous equations to represent Mrs. Nankya's weekly expenditure on poultry feed.
b) Solve this system of equations to determine the exact price per kilogram for each type of feed.
c) Calculate the total amount Mrs. Nankya is likely to spend in Week Four.

ITEM THREE:

Mugisha, a builder in Kampala, is constructing the roof for a new community library.

He uses wooden beams to support the roof structure and needs to calculate the number of cement bags required for the base of the beam support system.

He wants to ensure stability while minimizing unnecessary expenditure.

The strength of the beam support system is modeled by the polynomial function;

$$\boldsymbol{S(n) = -n^4 + 26n^3 - 239n^2 + 910n}$$

Where; $\boldsymbol{S(n)}$ is the structural strength score and $\boldsymbol{n}$ is the number of beams that support the roof structure.

Each beam requires a base made with cement. The number of cement bags $\boldsymbol{C}$ needed for maximum number of beams is modeled by the inequality;

$$\boldsymbol{C^2 - 7C + (n + 2) \leq 0}$$

The builder wants to stay within the recommended range of cement usage to avoid wastage. The cost of a **bag of cement** is **UGX 35,000**, and each wooden beam costs **UGX 42,000**.

Tasks:

Help Mugisha calculate the;

a) Maximum possible number of wooden beams required given that the structure is only considered stable if the strength score is at least **1200.**
b) Maximum number of bags required.
c) Total cost is likely to incur.

ITEM FOUR:

Mzee Okello from a village near Gulu, Uganda, needs to lay a new water pipe to irrigate his crops.

All the water system and the main channel have been mapped on a 2D grid system as follows;

The main water channel runs along a straight path; $\mathbf{2}\boldsymbol{x} - \boldsymbol{y} + \mathbf{5} = \mathbf{0}$. His farm is located at $\mathbf{P}(\mathbf{6}, \mathbf{8})$. To save pumping costs, Okello plans to use short – cut pipe,$\boldsymbol{l}$**,** from the main channel at point **Q** to his farm.

However, Mzee Okello's farm engineer suggests a pipe, $\boldsymbol{l_1}$, that meets the main channel at, $\boldsymbol{R}$**,** at an angle of; $\mathbf{45^0}$**,** then to the Mzee Okello's farm.

His Neighbor, Ms. Tinah, wants to lay a pipe,$\boldsymbol{l_0}$, that runs parallel to the main channel, passes through Mzee Okello's farm up to Her home's tap.

Each unit represents **100** metres.

Tasks:

a) Calculate the length of the short – cut pipe, $\boldsymbol{l}$**,** needed. Correct your answer to 1 decimal place.
b) Find the possible equation(s) of the Engineer's suggested pipe, $\boldsymbol{l_1}$**.**
c) Obtain the equation of Ms. Tinah's pipe, $\boldsymbol{l_0}$**.**
d) Calculate the coordinates of; **Q** and $\boldsymbol{R}$**.**

END:

HAPPY HOLIDAYS