

GREENHILL ACADEMY SECONDARY
PRINCIPAL MATHEMATICS HOLIDAY WORK TERM II 2026
SENIOR FIVE PAPER ONE

ITEM 1

A coffee exporting company is preparing its strategic plan for European union buyers. The plan started at the beginning of **2024** and will end at the end of **2033**.

The company began replanting in **2024** with **12,000** new arabica seedlings. The board policy requires that planting increases by **1500** seedlings every year to meet the rising European union demand.

The company wishes to widen its market to Asia if by the end of **2033** it may have planted at least **180,000** seedlings.

The company also wishes to improve the livelihoods of their neighbors by giving out some seedlings. The number of seedlings given out in hundreds is given by

$10(\log_5 n + \log_n 5)$. Where n is the number of years after **2024**. The company wishes to maintain the same number of seedlings it gives out if more than **2,500** seedlings are given out by **2026**.

The company's annual profit $P(t)$ from coffee sales in millions of shillings is $at^3 + bt^2 + 5t + 20$. Where t is the number of years after **2024**. The company made a profit of **29** million shillings in **2025** and in **2026**, the profit is expected to be **48** million shillings. The company wishes to increase on the number of its workers if the profit in **2033** exceeds **700** million.

Task:

Use mathematical reasoning to advise the coffee exporting company on the decisions to take.

ITEM 2

A certain financial organization is giving out an agriculture grant to local community groups. According to the grant officer, for a group to qualify for the grant, they must have a minimum number of bags of fertilizers and irrigation kits. For x bags of fertilizers and y irrigation kits, the sum of bags of fertilizers and irrigation kits must be at least 4.

A youth group had meetings in preparations for the application for a grant. In the first meeting they spent 5^{x+2} on fertilizers and 7^{y+1} on irrigation kits and they spent 3468 altogether. In another meeting, the amount 7^y was exactly 76 less than the amount 5^x . The group wishes to apply for the grant if they qualify.

The youth group has been dealing in maize and would wish to use the grant to boost maize production. The maize yield follows an arithmetic progression. The yield in third week was 11 bags and the yield in the fifth week was 17 bags. The group will to approve the funding if the total yield for the first 10 weeks exceeds 180 bags.

Task:

Based on mathematical skills, guide the youth group on the decisions to take.

ITEM 3

A construction company is designing a stepped viewing platform for a stadium. The heights of the steps above the ground form an arithmetic progression. The height of the eighth step is twice the height of the third step. The total height of the first eight steps is 39. The engineers wish to redesign the platform if the total height of the first three steps is greater than 9m.

The acoustics(sound) team wishes to reduce echo in the stadium by placing two sound meters a distance of x in tens of metres from the stage. One sound meter shows a reading of $(\log_4 x)^2$ and another meter shows a reading of $2\log_2 x$.

For people to hear clearly without echo, the sum of the two readings must be 3. The acoustics team wishes to adjust the sound meters if their distance from the stage is less than 20m

Task:

Based on mathematical evidence, advise the company on the decisions to make.

PAPER 2:

Item 1

A small courier business operating between Kabale and Mbarara uses motorcycles and small vans to transport parcels. The owner introduced a computerized system to estimate parcel charges, monitor fuel usage, and determine container capacities. However, he is not sure whether the calculations are reliable enough for business decisions.

Previous records showed that parcels of masses 200 g, 400 g, and 600 g were charged shs 700, shs 1200, and shs 3000 respectively. One customer brought a parcel weighing 185 g, while another claimed to have paid shs 2200, although the parcel mass was not recorded. The owner will keep the computerized charging

system if the charge for the 185 g parcel is less than shs 700, and the estimated mass corresponding to shs 2200 lies between 400 g and 600 g; otherwise, the fare estimates will be reviewed before use.

The business also manufactures conical metallic fuel containers for motorcycles. One container had radius 4.7 cm and height 12.65 cm, measured with possible errors of ± 0.3 cm and ± 0.45 cm respectively. The owner will use the container measurements for production if the difference between the upper and lower limits of the possible volume does not exceed 140 cm^3 ; otherwise, the container dimensions will be remeasured.

In addition, the fuel consumption of one motorcycle while climbing a hilly road near Kabale was represented by the function $\tan x$ over the interval $\pi/6 \leq x \leq \pi/3$.

The transport officer used 6 ordinates to estimate the total fuel used during the climb. The transport officer will use the fuel estimate for planning if the percentage error is less than 5%; otherwise, a more accurate numerical method will be required.

TASK

As a student of Mathematics, help the business owner interpret the information, choose suitable methods, and make justified decisions about the charging system, container measurements, and fuel estimate.

Item 2

A beverage company in Mbarara is testing the reliability of some production and recruitment decisions before introducing a new factory line.

The lifetime X , in years, of a machine component is modelled by the probability density function

$$f(x) = \begin{cases} \beta, & 2 < x < 3 \\ \beta(x-2), & 3 < x < 4 \\ 0, & \text{otherwise} \end{cases}$$

Management will buy the component in bulk if the median lifetime exceeds 3 years and the standard deviation less than 0.5 years otherwise, a more durable and reliable component will be sought.

The marketing department is studying two independent customer choices: buying mango juice and buying passion fruit juice. The probability that a customer buys both is $2/15$, while the probability that a customer buys at least one of them is $3/5$. A flavour will be retained on the production line if its individual buying probability is at least 0.30; otherwise, it will be redesigned or removed.

During recruitment, each trainee performs 7 independent machine-start trials. From past records, a correct start is twice as likely as an incorrect start. A trainee will proceed for further training if the probability of making exactly two incorrect starts is greater than 0.25; otherwise, the trainee will be given remedial practice first.

Task

As a student of mathematics, help management interpret the models, choose suitable methods, and make justified decisions on component purchase, flavour retention, and trainee selection.

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