DEPARTMENT OF MATHEMATICS

S6 MATHEMATICS TEST 2 TERM 2 2026

TIME: 2 HOURS 30 MINUTES

Answer **all** the questions.

ITEM 1 (COMPULSORY)

A new mast is to be erected in a remote town in order to aid connectivity in the surrounding villages. Surveyors are to use a 3D Cartesian system where 1 unit represents 100 m. The ground level is the plane $z = 0$.

The base of the mast is fixed at $B(2,1,0)$ and the top of the mast is at $T(2,1,2)$.

Two proposed underground fibre cables are surveyed along straight lines with equations L_1: $\frac{x-1}{2} = \frac{y+1}{1} = \frac{z}{-2}$ and L_2: $\frac{x-1}{-3} = \frac{y-2}{0} = \frac{z-2}{4}$.

The surveyor needs to ascertain the coordinates of the point of intersection, E, of the underground cables, the angle between the cables and the distance from E to the base of the mast, B.

An assistant to the surveyor standing at a supermarket at $P(7\ ,\ 6\ ,\ 0)$ observes the top of the mast and he wishes to determine the angle of elevation of T from P and the angle made between ET and EP.

TASK

As a student of mathematics, help the surveyor give a report about the field measurements.

ITEM 2

A renowned welder with a workshop in the Kampala suburb of Kawempe has been hired by a bakery business owner in the same locality, to make a rectangular cake dish from sheets of metal. Each metal sheet measures $25\ cm\ by\ 40\ cm$.

To form an open cake container, identical square pieces each of length $x\ cm$ are cut from each corner of the sheet, the sides are then folded up to form the dish. The welder has also been directed to ensure that the volume of each cake dish is maximized so that larger cakes can be baked for customers during Christmas season. The consulted technician has modelled the volume of the cake dishes as $V = x(40 - 2x)(25 - 2x)$.

The business owner also wishes to know the area of the plot of land he is to lease in order to construct the bakery. It was found out that the plot is bounded between a marked line $y = 8 - x$ and the curve $y = 8x - x^2$.

Give a report clearly to the business owner in regard to the dimensions needed for the cake dishes and the area of the plot to be leased for the bakery project.

ITEM 3

A village SACCO bank was established to help the community people develop by borrowing money given to the communities through EMYOOGA. The bank manager of the bank branch found out that the number of clients who come to the bank in a week, was uniformly distributed in the interval $\alpha \leq x \leq \beta$ clients. He also found out that the probability that more than 60 clients come to the bank was $\frac{7}{8}$ and the probability that less than 90 clients come to the bank was $\frac{5}{16}$. It was found out that 1 in 10 of the clients who get loans in the bank default.

The bank manager wished to find the 80^{th} percentile and the percentage of loan defaulter so that they may make crucial strategic decisions.

(a) Help the bank manager to find the average number of clients who come to the bank and the 80^{th} percentile.

(b) Find the probability, that in a random sample of 250 clients, between 23 and 28 clients inclusive were found to have defaulted.

ITEM 4

A businessman wants to construct a rectangular roof design *ABCD* of mass 25 kg and dimensions *AB* = 12 m and *AD* = 5 m that corresponds to axes *X* and *Y* respectively, with forces of 50 N, 60N, 30N, 20N and 69 N acting along sides *AB*, *BC*, *CD*, *DA* and *AC* respectively. The businessman would wish to know the single force that represents the five forces and its direction and would wish it does not exceed 17 N, the businessman is worried that the roof can fall to the ground which is at the height of 8 m from ground level and does not want the design to have a final velocity greater than 13 ms^{-1} on falling to the ground, it moves with a force of 20 N on a rough horizontal plane with the coefficient of friction as 0.25 until it comes to rest, the wall is 50 m from the point of dropping and would like to know the safety of the wall.

TASK

As a student of mathematics, explain and justify the problem to the businessman.

END