

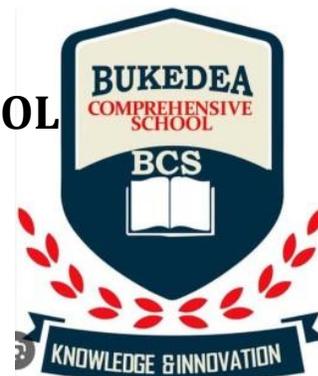


# BUKEDEA COMPREHENSIVE SCHOOL

## MATHEMATICS CLUB B.M.C

(Southern campus)

PRESENTS



S5 Holiday Activities: Transition to S6 2026

**INSTRUCTIONS:** Respond to all activities and submit for scoring to the office of The Club General Secretary HON KANSANA JACKLINE by Second week of term one 2026

PURE MATHEMATICS

**CHEBET ELI'S COMPILATION DECEMBER 2025 TEL +256773218574**

### ITEM 1

Eli is a project manager at wonderboys construction company, and he's working on a new building project. The project's progress is modeled by the equation

$x^2 - 10x + 16 = 0$ , where  $x$  represents the project's completion rate. The roots of this equation,  $\alpha$  and  $\beta$ , represent the critical points in the project timeline.

Eli's team is now tasked with analyzing the inverse of these critical points, which represent the rates at which the project's resources are being utilized. Eli needs to come up with a new equation that models these inverse critical points.

**TASKS:**

- Write the inverse of each of the critical points  $\alpha$  and  $\beta$ .
- Help Eli come up with an equation that models the inverse critical points.

### ITEM 2

Nancy's grandmother was given a two-digit code to open a safe, but after two months, she can no longer remember the exact numbers. However, she recalls that the two digits differ by five and that their product is 24. And that the first digit was smaller than the second digit.

Task: Help her grandmother to obtain the correct code.

**ITEM 3**

Chebet deposited shs 180,000 at the beginning of every year in a microfinance bank with the understanding that at the end of seven years he is paid back his money with 5% compound interest. He plans to start up a business with at least 3 million shillings at the time of withdrawing.

**TASKS:** With the knowledge of series, help Chebet know if the money will be enough by the time of withdrawal

**ITEM 4**

A store sells three types of fruit baskets: small, medium and large. The cost of each basket depends on the fruits inside. The store owner sets up the following price equations based on the recent sales.

- 3 small, 2 mediums and 1 large baskets cost Shs 5,000
- 2 small, 3 mediums and 2 large baskets cost Shs 6,000
- 1 small, 1 medium and 1 large basket cost Shs 2,500.

Simotwo wants to buy 4 small, 3 mediums and 5 large baskets, but does not know how much it will cost.

**TASKS:** Using matrices, help Simotwo by finding out the cost of each type of basket and how much his order will cost?

**ITEM 5**

A new number machine that uses the expansion of  $\sqrt{\frac{1+3x}{1-3x}}$  up to the term in  $x^4$  is to be used to obtain an approximate value of  $\sqrt{\frac{52}{28}}$ .

**TASKS**

- a) Obtain the range of values of  $x$  for which the machine considers the expansion of  $\sqrt{\frac{1+3x}{1-3x}}$  as valid
- b) Obtain the approximate value  $\sqrt{\frac{52}{28}}$  the machine is expected to give. Hence deduce the approximate value of  $\sqrt{91}$

### ITEM 6

A company has three products x, y and z, with prices Shs 10, shs 20 and shs 30 respectively. The total revenue from sales is shs 1,000, and the total number of items sold is 50. The number of units sold of product z is twice the number of units sold of product y.

**TASKS:** For record purpose help the company find the number of units sold for each product.

### ITEM 7

Three rods  $\overline{WX} = \begin{pmatrix} 2 \\ -5 \\ 1 \end{pmatrix}$ ,  $\overline{WY} = \begin{pmatrix} 6 \\ 4 \\ -4 \end{pmatrix}$ , and  $\overline{WZ} = \begin{pmatrix} 4 \\ 2 \\ -1 \end{pmatrix}$  are to be painted according to the following criterion

- If the length of the rod is less than 4 units, the rod will be painted green
- If the length of the rod is greater than 4 units, the rod will be painted red

The painter also wanted to paint the fourth rod  $\overline{WV} = \begin{pmatrix} 3 \\ k \\ 4 \end{pmatrix}$  which is

perpendicular to the rod  $\overline{WX}$  but has found it difficult to determine its length since he can't determine the value of k

#### TASKS

- a) Help the painter to determine the colors to be painted on the rods  $\overline{WX}$ ,  $\overline{WY}$  and  $\overline{WV}$
- b) Determine the angles between the rods  $\overline{WX}$  and  $\overline{WY}$
- c) Determine the value of k and the color that will be painted on the rod  $\overline{WV}$
- d) Find the vector of the wire  $\overline{WU}$  which is perpendicular to both rods  $\overline{WY}$  and  $\overline{WZ}$

### ITEM 8

The Uganda National Roads Authority (UNRA) is studying traffic patterns on the Kampala-Jinja highway. They've developed a mathematical model to predict traffic density at different times of the day.

The traffic density function (vehicles per kilometer) at time  $t$  hours after 6:00 AM is given by;

$$D(t) = \frac{3t^3 + 2t^2 + 2t - 3}{(t^2 + 2)(t + 1)^2}$$

Tasks: As a traffic engineer, you need to analyze this model to optimize traffic flow and plan future road expansions. Representing the function as a sum of partial fractions.

### ITEM 9

Angel is a student at BCS trying to master trigonometry, while opening Backhouse one of the reference books suggested by Mr Chebet Eli, she came across  $\tan 2A = \frac{2\tan A}{1-\tan^2 A}$ . On further exploration, she finds out this relation can be used to obtain an expression for  $\tan 4A$  in terms of  $\tan A$  and it can be used to solve the equation  $t^4 + 4t^3 - 6t^2 - 4t + 1 = 0$

TASK: help angel to

- a) Prove that  $\tan 2A = \frac{2\tan A}{1-\tan^2 A}$ .
- b) Express  $\tan 4A$  in terms of  $\tan A$
- c) Solve the equation  $t^4 + 4t^3 - 6t^2 - 4t + 1 = 0$
- d) Solve the equation  $\tan 2A = \frac{2\tan A}{1-\tan^2 A}$

### ITEM 10

The Entebbe Municipal Council is planning to develop a new neighborhood with roads, residential areas, and a community center. The planning department uses a coordinate system where each unit represents 100 meters. An urban planner, needs to design the road network and determine optimal locations for key facilities. Road A is planned to connect points  $A(2, 3)$  and  $B(8, 15)$  and another road B will connect points  $C(4, 5)$  and  $D(12, 9)$ .

#### Tasks

- a) Help the urban planner to determine
  - i) The length of the road A in kilometers.
  - ii) The gradient of the road A and the equation that models the path of the road.
- b) Establish whether the two roads A and B intersect, and if so, at what point and the angle between the two roads to the nearest degree.
- c) If a community center needs to be located at a point that is equidistant from points A, B, and C. Find the coordinates of this point

### ITEM 11

Victor operates a delivery company that uses drones to deliver packages within Kampala city. A drone needs to fly from distribution center A which is 2km east and 3km north of the control center to the customers' house B which is 8km west and 7km south of the control center.

Task:

- a) Obtain the equation of the straight path that the control system can use to issue corrections if the drone deviates
- b) Compute the shortest distance between A and B
  - a) Describe the position of the booster tower that is midway the straight path between A and B

### ITEM 12

During the BCS MATHEMATICS CLUB TOURNAMENT your group was assigned the following activities.

**Task:** Present your presentation workout

- a) Use calculus of small changes to obtain the cube root of 510
- b) Solve  $2\cos^2(4\theta - 20^\circ) = 1$ , for  $-180^\circ \leq \theta \leq 180^\circ$
- c) Solve the equation:  $2\sin(60^\circ - x) = \sqrt{2}\cos(135^\circ + x) + 1$  for  $-180^\circ \leq x \leq 180^\circ$
- d) solve for x and y such that  $2^{2x+3} + 2^{x+3} = 1 + 2^x$  and  $6\log_4 y - 5y \log_4 y + 20y = 24$
- e) Use first principles, find the derivative and hence the turning points of the curve  $y = x^3 - 2x^2$ . sketch the curve
- f) Obtain the square root of the complex number 3-4i
- g) Solve the inequality  $3x + 5 \leq \frac{6}{2-x}$  and clearly provide the solution set.

### ITEM 13

A farmer has a piece of land and wishes to ensure that he plans fruits in the space left.

The space left is a right angled triangle and wants to ensure that the sum of the base and the height is always 36m and to maximize its area

Task: help him know the dimensions of the height and the base that gives a maximum area, hence find the maximum area.

### ITEM 14

A spherical balloon is inflated such that such that the rate at which its radius is increasing is 0.5cm/s.

Task: find the rate at which

- Its volume is increasing at the instant when the radius is 5cm
- Its surface area is increasing at the instant when the radius is 8.5cm

**For inquiries or suggestions, please contact:**



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