



S.5 MATHEMATICS- 2025

GROUP ASSIGNMENT M004

GROUP NAME:STREAM:

GROUP CHAIRPERSON:EXPECTED SCORE:.....

ITEM 1: POLYNOMIALS.

At a high-tech agro-processing facility in Uganda, a programmable robotic arm is used to dispense powdered nutrients into small sachets for export. The team noticed that the arm's movement wasn't consistent, causing underfilled or overfilled packets on some cycles.

To resolve the issue, engineer Wagogo was assigned to analyse the arm's position function, which shows the vertical displacement, $P(t)$ of the dispensing nozzle (in millimetres) over time, t . The function is:

$$P(t) = t^4 - 8t^3 + 21t^2 - 18t + k$$

where:

- k is the system-calibration constant.

From a recent test:

- At $t = 4$ seconds, the nozzle was 48 mm above the rest level.
- The engineers believe the nozzle passes cleanly through the 0 mm mark (resting position) at $t = 2$ seconds .

Wagogo must analyse this function before resuming production.

? Task:

Help Engineer Wagogo to:

- Comment about the degree of the motion path.
- Determine the system calibration constant.

c). Determine all times when the nozzle passes through the rest position.

d). Calculate the nozzle's exact height:

- 5 seconds before the cycle begins.
- at the start of the cycle
- 2 minutes after the start of the cycle.

e). Tell how the nozzle would behave at the following checkpoints.

(a) $t - 5$

(b) $3 + t$

(c) $2t + 1$

(20 scores)

ITEM 2: INTEGRATION I.

KweziTech Ltd is testing a new precision agriculture drone designed to spray fertilizer over Ugandan farms. The drone's software engineer, Lydia, needs to program its movement and nutrient dispensing functions using calculus.

During calibration, Lydia collects and analyses the following:

- The forward motion of the drone (in metres) is based on a thrust profile modeled by:

$$\text{Displacement} = \int 4x^2 dx$$

- The spray radius (in metres) over time follows:

$$\text{Spray radius} = \int \sqrt{5x} dx$$

- A terrain scan from $x = -5$ to $x = 0$ shows the drone's altitude change is determined by:

$$\int_{-5}^0 (2 - 4x^3) dx$$

- The nutrient program runs a long-term consumption model:

$$\int_1^{\infty} \frac{(x^2+2)(x^2-3)}{x^2} dx$$

- A sensor scans the field along the y-axis at a fixed instant, returning:

$$\int_{-4}^{-2} \left(y - \frac{3}{\sqrt{y}}\right) dy$$

- The drone's flight path must match the gradient:

$$\frac{dy}{dx} = 3x^2 - 2 \quad ; \text{and pass through the point } (-2, 6).$$

? Task:

As a learner of Mathematics, help Engineer Lydia:

- a). Calculate the drone's forward displacement function.
- b). Find how wide the drone can spray after 9 seconds.
- c). Compute the net altitude change. Did the drone gain or lose altitude overall?
- d). State whether the nutrient consumption model is sustainable.
- e). Interpret the result of the sensor scan for field-wide nutrient distribution.
- f). Determine the exact path equation of the drone.

(20 scores)

ITEM 3: TRIGONOMETRY.

At SafeScan Drones Ltd, a team of engineers is testing the angular precision of a new autonomous drone system. During one of the simulations, the lead engineer, Lukman, notices unusual oscillations in the drone's pitch and yaw movements during low-altitude surveillance.

He records the following system behaviors and equations logged by the onboard sensors:

- The angular error margin from one sensor follows the relationship:

$$3\cos 2\theta + \sin \theta = 1$$

- A signal verification routine attempts to validate the identity:

$$\operatorname{cosec} 2\theta + \cot 2\theta = \cos \theta$$

- To reduce redundant input data, Lukman tries to eliminate the angle θ from two tracking logs:

$$x + 1 = \cos 2\theta$$

$$y = \sin \theta$$

- During signal blending, a trigonometric pattern appears in the software as:

$$\sin(A + B)\sin(A - B) = \sin^2 A - \sin^2 B$$

- The control algorithm used to process inverse tangent signals logs this instruction:

$$\tan^{-1} 3x + \tan^{-1} x = \frac{\pi}{4}$$

- As the drone rotates, the angle readings from two gyroscopic sensors differ:

$$\cos(x + 20^\circ) - \cos(x + 80^\circ) = 0.5$$

- Finally, Lukman programs two angular outputs into sinusoidal form to simplify the motion model:

$$4\cos x - 5\sin x$$

and

$$2\sin x + 5\cos x$$

These equations must be analyzed before the drone's firmware can be approved for deployment.

? Tasks:

- Solve the angular error margin equation
- Check whether the validated identity is true or false.
- Eliminate θ from the tracking logs.
- Prove the identity that shows up during signal blending.
- Solve the instruction logged by the control algorithm.
- Obtain the angle readings as the drone rotates 0° through 360°
- Express the angular outputs in the sinusoidal forms $R\cos(x+\alpha)$ and $R\sin(x+\alpha)$ respectively.

- For each, deduce:

- The maximum angular output.
- The smallest drone rotation at which the maximum output is registered.

(20 scores)


END!!!

- READ THE CONGRATULATIONS AND GOOD-NEWS BELOW!!!

CONGRATULATIONS!!!!!!:

- 90% OF THE MATH TOPICS OF TERM 1 & 2 AS PAR THE NEW SYLLABUS BOOK HAVE BEEN ASSESSED BY CMoS AS FOLLOWS:
- M001 HAD EQUATIONS, DESCRIPTIVE STATISTICS, CO-ORDINATE GEOMETRY I, NUMERICAL CONCEPTS (INDICES & LOGARITHMS) AND TRIGONOMETRY- MAKING IT (5) TOPICS.
- M002 HAD NUMERICAL CONCEPTS (INDICES, SURDS & LOGARITHMS), TRIGONOMETRY, EQUATIONS, DESCRIPTIVE STATISTICS AND MECHANICS (FORCES)- WITH ONLY (1) NEW TOPIC
- M003 HAD COORDINATE GEOMETRY I, PARTIAL FRACTIONS & INEQUALITIES, SCATTER DIAGRAMS & CORRELATIONS, PROBABILITY THEORY AND DIFFERENTIATION I- WITH (4) NEW TOPICS
- M004 HAS POLYNOMIALS (UNDER EQUATIONS), INTEGRATION I AND TRIGONOMETRY- WITH (1) NEW TOPIC.
- THIS MAKES IT (11) TOPICS ASSESSED OUT OF THE (12) TOPICS OF TERM 1 & 2 AS PAR THE SYLLABUS BOOK__THE TOPIC LEFT OUT IS TOPIC 12 CALLED "PERMUTATIONS & COMBINATIONS" WHICH IS COMING IN M005_____ THIS MAKES IT 90% SUCCESS OF ASSESSMENT BY CMoS_____ CONGS TO CMoS & PAULTUTOR!!!

GOOD NEWS!!!!:

- I HEREBY ANNOUNCE THAT OUR HOLIDAY ONLINE LESSONS ARE BEGINNING ON MONDAY 11TH AUGUST, 2025_____ AND THE MISSED LESSONS SHALL BE ACCESSED ON OUR WEBSITE AND PREMIUM GOOGLE DRIVE_____ BE REMINDED THAT THE LESSONS SHALL BE **FREE** FOR THAT WEEK, SO ENDEAVOUR TO BE PART OF THE FREE CLASSES FOR THAT WEEK- THIS IS FOR SCHOOLS BREAKING OFF FROM 8TH AUGUST.
- SCHOOLS THAT SHALL BREAK-OFF LATER SHALL ALSO HAVE THEIR FREE WEEK OF LESSONS SCHEDULED- BE REMINDED THAT OUR VIDEO LESSONS INCLUDE ANSWERING OUR SCENARIOS FROM SCRATCH!!!
- TO JOIN OUR HOLIDAY-COACHING ONLINE PROGRAMME, TO ACCESS THE MISSED ASSIGNMENTS M001-M003 & OTHER ACADEMIC MATERIAL SUCH AS TEXTBOOKS, SUMMARISED NOTES, SCORING GUIDES, ETC
- TAP THE LINK BELOW  :
- <https://chat.whatsapp.com/F7DJbOPetAvAQHQ3Kk4p9h> (for more INFO!)

"CMoS- CREATING COMPETENT CHEMISTRY & MATH STUDENTS IN UGANDA"

