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P425
S5 MATHEMATICS
2 Hours 30 Minutes

MENGO SENIOR SCHOOL
END OF TERM 1 ASSESSMENT 2026
S5 MATHEMATICS
TIME: 2 Hours 30 Minutes

Instructions.

- This assessment consists of two sections, A and B.
- Attempt all items.
- Solutions in **section A** should **strictly** be written in separate booklets from those in **section B**
- Section A booklets should be fastened alone. Same should be done to section B booklets.

SECTION A : PURE MATHEMATICS

Item 1

In the bid to control numbers and have competitive candidates for oral and practical interviews, a new engineering company contracted a recruitment agency to select for them twenty potential candidates who would be interviewed by the company's technical team and four successful candidates would be selected for the available vacancies. **The company believes that the one who is good at mathematics is easily trainable.** The agency designs a simple aptitude test embracing algebraic ideas in solving, simplifying and evaluation of expressions and equations without using calculators or mathematical tables.

Your brother presents the following tasks to you to help him prepare for the aptitude test for Tuesday 21/04/2026

(a) Express in the simplest form

(i) $\sqrt{288} + 7\sqrt{2} - \sqrt{72}$

(ii) $\frac{2}{3\sqrt{3}+5}$

BOOMAS

(b) Evaluate

(i) $4^{(1-\frac{n}{2})} \cdot 2^{n+3} \cdot 16^{-\frac{1}{2}}$

(ii) $\log_{10} 120 + \frac{1}{3} \log_{10} 27 - 2 \log_{10} 6$

(iii) $\log_{81} \frac{1}{9}$

(c) Determine the unknown in the given pairs of equations

(i) $\log_3 a + \log_3 b = 4$, $3\log_a b = 1$

(ii) $5^{x+2} + 7^{y+1} = 3468$, $5^x - 7^y = 76$

(iii) $2m - 2n = 1$, $m^2 - mn - 4 = 0$

$ab = 81$
 $a = 81 - b$

$\log_a 81 - \log_a b$
 $3 \log_a 81 - \log_a b$

$b = 81 - a$

$\frac{3 \log_a (81 - a)}{3} = \frac{1}{3}$
 $\log_a (81 - a) = \frac{1}{3}$

$\frac{81 - a}{a} = \frac{1}{3}$
 $81 - a = a$

Task

As a mathematics student in Mengo Senior school in S 5 who has recently acquired knowledge in algebra help your older brother who feels that he needs to be reminded of some algebraic concepts, go through the tasks by providing solutions to the questions to help him refresh as he prepares for the test tomorrow, you never know you may be his Hero for the dream job.

Item 2

A school is designing its new compound lay out, which will feature both a robotics demonstration area and several architectural features such as monuments, classrooms and walk ways. As part of a STEM exhibition, a robot arm is programmed to move along a specific path. The position of the robot arm's end is described by the parametric equations; $x = 3 - 4 \sin Q$, $y = 4 \tan Q$ where Q is the angle in the rotation angle in degrees. The engineers need to analyze this path and find specific rotation angles.

During a safety check, the control system records that $\cos Q = \frac{4}{5}$ where Q is a reflex angle. The engineers must evaluate a trigonometric expression involving Q to calibrate the arm's feedback sensor.

Simultaneously, the school planners are working on the geometric lay out of the compound. A monument is placed at the coordinate $P(3, -1)$ and a proposed path nearby is given by the line $y = \frac{15}{8} - \frac{3}{4}x$. The perpendicular distance from the monument to this path must be calculated along with the foot of the perpendicular.

$\frac{\sin}{\cos} = \frac{1}{\cos}$
 $\frac{\cos}{\cos} = \frac{1}{\cos^2}$

$(3-x)$
 a
 $b = 100$
 $3 \log ab = 1$
 $25y + 7n = 36 \sqrt{3}$
 $b = 81 - a$
 $\log ab =$

Three classrooms are to be positioned at $A(2,1)$, $B(5,1)$ and $C(2,4)$. The planners notice that these three points form a triangle and wish to verify its geometric properties.

Finally, two main walk ways in the school are described by the equations $y = 2x + 1$ and $2y + x = 3$. The angle between these two walk ways needs to be determined for a proper intersection design.

Tasks

Part A: Robot Arm Movement

- Find the Cartesian equation of the path traced by the robot arm.
- Find the smallest rotation angle Q satisfying $y = 4$ when $x = 3 + 2\sqrt{2}$, for $180^\circ \leq Q \leq 360^\circ$
- Given that $\cos Q = \frac{4}{5}$ and Q is a reflex angle, evaluate $\frac{\cot Q - \sin Q}{\sec Q + \tan Q}$

Part B: School Compound Layout

- Find the perpendicular distance from the monument to the proposed path
- Determine the coordinates of the foot of the perpendicular from the monument onto the proposed path
- Show that the triangle formed by the three classrooms is right angled and isosceles
- Find the largest negative angle between the two main walk ways.

SECTION B : APPLIED MATHEMATICS

Item 3

The Uganda Bureau of Statistics (UBOS), in partnership with the Ministry of Gender, Labour and Social Development (MoGLSD), carried out a comprehensive socio-economic household survey aimed at assessing income distribution, living standards, and economic vulnerability in rapidly expanding peri-urban areas of Kampala. According to UBOS, it was advised that any household earning at most UGX.400 per day is said to living far below the poverty and as a government policy, the members in that household must be airlifted to refugee camp so as to receive the basic necessities of life.

Data was collected through self-reporting and supporting records by UBOS. A systematic random sampling technique was used to select 200 households across four divisions: Kawempe, Makindye, Nakawa, and Rubaga.

In a bid to alleviate peri-urban poverty, the ministry will need to.

- determine the annual income earned by each household (per capita income)
- assess the variability of income per month in order to reduce income inequality
- identify the monthly income earned by most of the households
- determine the number of households which will be air-lifted to the refugee camp
- know the annual income earned by the top half of the households (using a suitable graph)

UBOS provided the summarized monthly data as presented in the table below. (Every month is considered to have 30 days)

Monthly Income (UGX '000)	No. of households
0 - < 100	10
100 - < 180	32
180 - < 270	18
270 - < 350	12
350 - < 550	72
550 - < 560	16
560 - < 700	28
700 - < 800	12

Tasks

- (i) As a mathematics student, you have been requested by the Permanent Secretary of MoGSLD to write for him a written report for the speech he will give on the data that will help the ministry on poverty alleviation in peri-urban areas.
- (ii) Give one reason why did the government decide to airlift the economically incapacitated families into one refugee camp instead of supporting from their homes.



$$c^2 = 52F^2 + 48F^2 \cos 2\beta$$

$$\sqrt{c^2} = \sqrt{4F^2(13 + 12 \cos 2\beta)}$$

$$r = 2F(13 + 12 \cos 2\beta)^{\frac{1}{2}}$$

$$(6F + 4F \cos 2\beta) \tan = \frac{0}{A}$$

$$4F \sin 2\beta = \left(\frac{0}{4F}\right) 4F$$

$$0 = 4F \sin 2\beta$$

$$\frac{4F \sin 2\beta}{6F + 4F \cos 2\beta} = \frac{0}{A}$$

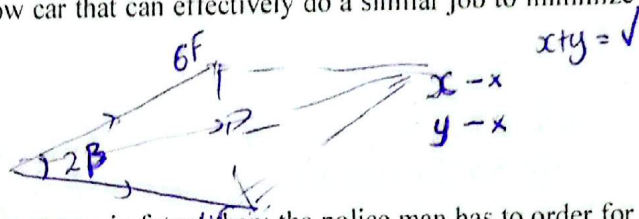
$$\frac{2F \sin 2\beta}{3 + 2 \cos 2\beta}$$

Item 4

An old car got a mechanical problem at Nakulabye traffic lights. The police man on duty immediately ordered for Wandegeya's breakdown truck to sort the mess but the mission was unsuccessful. He then ordered for Kasubi's breakdown truck which equally failed to do the job. The two vehicles had to do the job collectively finally accomplishing the mission by means of chains connected to the old car. The two chains were inclined at angle 2β and the tensions in the breakdown chains were $6F$ Newtons and $4F$ Newtons respectively. The police man wants to prepare in advance for just one reliable tow car that can effectively do a similar job to minimize prospective traffic build ups.

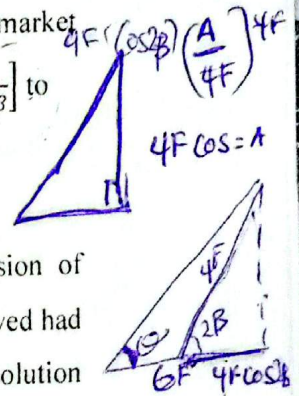
$$\frac{2F \sin 2\beta}{3 + 2 \cos 2\beta}$$

Tasks:

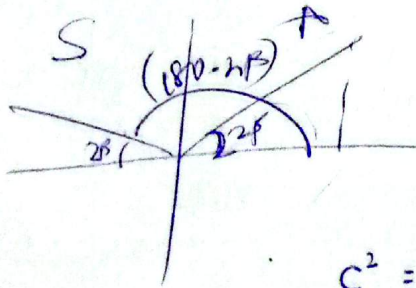


(a) Show that should a similar case appear in future then; the police man has to order for a tow car that can supply a pulling force of at least $[2F(13 + 12 \cos 2\beta)^{1/2}]$ newtons.

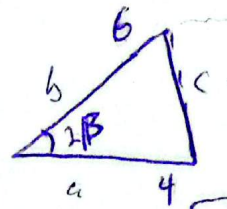
(b) Also show that if he had initially ordered for the best brand breakdown on the market to do the exact job, then its' chain had to be inclined at angle $\tan^{-1} \left[\frac{2 \sin 2\beta}{3 + 2 \cos 2\beta} \right]$ to the direction taken by the stronger breakdown.



(c) Suppose that $F = 50$ and $\beta = 60^\circ$, and that the maximum breaking tension of available long chain at the time was $223 N$; would the problem have been solved had he ordered for the strongest breakdown? If no suggest the immediate viable solution that can be employed.



END

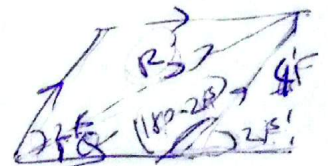


$$c^2 = a^2 + b^2 + 2ab \cos 2\beta$$

$$c^2 = 6^2 + 4^2 + 2(6 \times 4) \cos 2\beta$$

$$c^2 = 36 + 16 + 48 \cos 2\beta$$

$$c = \sqrt{52 + 48 \cos 2\beta}$$



$$6F \cos(180-2\beta) = 4F$$

$$-\cos 2\beta = \frac{2}{3}$$

$$\cos(180-30)$$