

LUBIRI SECONDARY SCHOOL
TERMINAL INTEGRATION OF COMPETENCES II, 2025

MATHEMATICS

PAPER ONE

3 HOURS

SENIOR FIVE

NAME _____ STREAM B

- ✓ Answer item one in section A (40 mark) and
- ✓ Any four items in section B (60 marks)

SECTION A

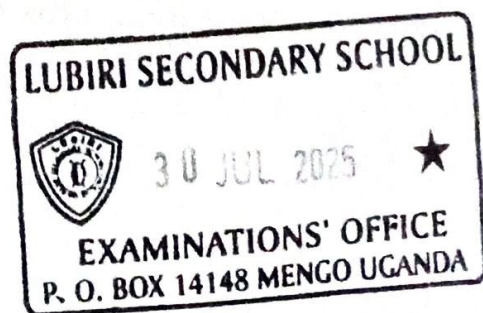
ITEM 1

- a. You are given three points $P(-2 - 3)$, $Q(2 0)$ and $R(8 - 8)$. Illustrate that $P\hat{Q}R = 90^\circ$ and generate the area of ΔPQR .
- b. It's given that $f(x) \equiv 3 - 7x + 5x^2 - x^3$, explain mathematically the fact that $3 - x$ gives a remainder zero and identify the other two factors which give zero as the remainder.
 $3 - 294 + 8520 - 7400$
- c. Identify the range of values of x for which $4x^2 - 12x + 5 < 0$
- d. Trigonometry is a branch of mathematics which uses identities. Use knowledge of this branch of mathematics to explain the fact that $\sec^2 A + \operatorname{cosec}^2 A = 4\operatorname{cosec}^2 2A$.
- e. James is a farmer dealing in carrots. He monitors production depending on number of sacks got due climatic factors basing on the equation $Q = 8\cos x - 15\sin x$, where Q is number of sacks and x is in degrees. ($0^\circ \leq x \leq 60^\circ$) Help James know the price P of each sack when the Quantity Q is zero, where $P = \frac{x}{360^\circ} \times 100,000 \text{ shs}$.
- f. Th distance covered by a car depends on the velocity V of the car according to the equation $D = 3(2^{2v}) + 2(2^v)$. Find the velocity V when the distance is 1 unit.

$$D = 3(2^{2v}) + 2(2^v)$$

$$1 = 3(2^{2v}) + 2(2^v)$$

$$\frac{1}{3} = 2^{2v} + \frac{2}{3}2^v$$



- g. At the national debate competition involving six schools, each team presents three participants. If each team sits together with the speaker in the middle. In how many ways can the teams be arranged at a round table?
- h. Determine the sum and product of the equation whose roots are $\frac{\alpha}{\beta}$ and $\frac{\beta}{\alpha}$, given that the equation $2x^2 - 3x + 2 = 0$ has roots α and β .

SECTION B

ITEM 2

A community has been contributing towards the construction of a new place of worship. Their plan is to have face with an isosceles triangular roof shape. The corners are assumed to be at $(5, -3)$, $(-6, 1)$ and $(1, 8)$. A construction company has been contracted to develop the building and you are one of the engineers in charge of the task. The challenge is to identify which points should form the horizontal base and which point to form tip. Furthermore, a big cross is to be placed in the middle of the shape as an identification symbol of the faith.

The community also requested that the front compound should be in a triangular shape with total perimeter of 4200m, one side to be of length 1400m and total area of compound to be $2100\sqrt{15}m^2$

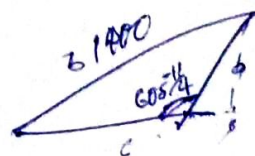
Task:

- As the head of the team of engineers help the company to accomplish the request of the community by identifying the horizontal corners, tip and how to place the cross.
- Identify the other lengths of the compound and make sure the cosine of the largest angle formed is $\frac{1}{4}$.

ITEM 3.

A chemical company has come up with a new jelly product on the market developed using the formula $\frac{11x+12}{2x^3+x^2-15x-18}$ from three different components. The feedback from the market shows that the product has been rejected due to fact that affects the skin which has caused losses to the company. Their chemist believes that the percentages of the three components used where not balanced so there is need to separate the formula into different units to identify the percentages used of each component. The chemist is

2



$$\cos x = \frac{1}{4}$$

$$x = \cos^{-1} \frac{1}{4}$$

$$\frac{1}{2}bh = 2100\sqrt{15}$$

$$p = 4200$$

b) Help
for

Item 7 challenged with this task and the company has contacted a mathematic consultancy company to solve the task.

A
?

Task.

As an expert in this area in the mathematic company identify the units from the formula so that the chemist can balance the percentages.

ITEM 4.

One side of a container at KUKU sea port has a rectangular face marked as PKMN with PK being on a horizontal plane having a length of 8 meters and MK being 6 meters. The container is to be lifted by a crane attached at point M and turned through an angle of 30° at point P. The driver of the crane is concerned about vertical and horizontal distance of the point M from point P before he continues to lift the container due to risks that might occur.

At the same port there are two observation points A and B in a straight coastline one kilometer apart. Peter and Tom are stationed at these two points observing incoming ships loaded with containers. Tom is due east of Peter. Peter observes a ship on bearing of 167° and Tom observe the same ship on bearing of 205° .

Task:

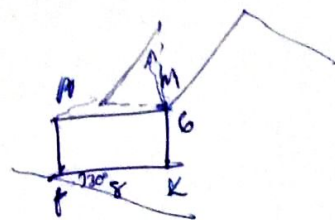
a) You are tasked with generating the distance Vertical and horizontal distance of point M from point P so that the driver of the crane is aware of the risks involved in lifting he container.

b) Help Peter and Tom Know how far the ship is from the port so that their get set to off load the containers

ITEM 5.

A road from Kampala towards Entebbe goes via a hill is expressed using the equation $y = x^3 - 9x^2 + 20x - 8$. Due to heavy trucks which use the road a company has been contracted to find the inclination of the road at a point 1600m horizontally and 4000m vertically where trucks find it hard to ascend the hill so that adjustments are made to ease movement of the trucks

An alternative road is to be constructed at a lower point on the same hill 1100m horizontal and 3000m vertical but parallel to the original road in case trucks find it hard to use the main road.



$$1 + \tan^2 A + 1 + \cot^2 A$$

$$1 + \tan^2 A + \left(1 + \frac{1}{\tan^2 A}\right)$$

Task:

As a young engineer you are tasked with find the inclination of the road at that point (1600m, 4000m) and the angle of inclination. Also form the expression of the alternative road in terms of x and y at the point (1100m, 3000m)

ITEM 6.

In mathematics students study a branch dealing with factorial and arrangements. Mary has arranged a birth day party and invited twelve friend's both boys and girls from her former schools. She has one round table to fit the friends.

A friend advised her that among the invited friends there are two who cannot sit next to each other,

A couple is organizing a party to thank friends who have stood with them during the period of organizing their wedding successfully but they want to use invitation cards with six-digit figures. They have decided to use these six digits 2, 3, 4, 5, 7, 6 to form the figure but the value of the figure formed should not be less than 400,000. This will determine the number of cards to be printed hence eliminating n invited visitors. The cost of print a card is 3000 shillings

Task:

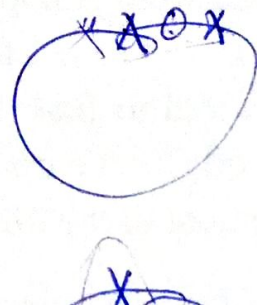
- Assist Mary determine the number of different arrangements the friends can be sited around the table in order without fighting for chairs.
- Help Mary make adjustments in the different ways of siting the friends on the table.
- Also help the couple to know how many visitors they can invite and the total cost needed to print the cards.



(a) !!

$(n-1)!$

END



INSTRUCTIONS:

- Section A has five items and is compulsory.
- Section B has five items out of which choose only three.

Item 1.

An organization in a country offers one primary school bursary to the eldest child of each family in a village. Kato a guardian to three non - biological children. Unfortunately, he doesn't have the official birth records but know that their ages follows an arithmetic progression. However, records show that the sum and product of these children's ages is 21 and 315 respectively. To apply for the bursary, Kato must know the eldest child.

Task.

As a mathematics student , assist Kato to determine the ages of the children and identify which child deserves the bursary.

$$S_n = \frac{n}{2}(2a + (n-1)d) = 21$$

$21 = \frac{3}{2}(2a + (3-1)d)$
 $42 = 3(2a + 2d)$
 $14 = 2a + 2d$
 $7 = a + d$
 $a - b = 315$
 $a = \frac{315}{b}$

Item 2.

A school is in the process of organizing a dedication function for the senior Six candidates. For proper coordination, the administration is interested in forming a committee comprising of both students and teachers. The committee will have four (4) members chosen from five (5) Teachers and three (3) Senior Six students.

Task.

As a head prefect, advise the school administration on how this can be done provided the committee contains at least one teacher.

$${}^5C_1 + {}^5C_2$$

$${}^4C_1 + {}^4C_2 + {}^4C_3 + {}^5C_1 + {}^5C_2 + {}^5C_3$$

Item 3.

A school management committee appreciated the support staff for maintaining the school environment natural especially in maintaining the grass green. The committee has also tasked the support staff to design another area in school to maintain grass green, and this area is to be surrounded by straight edges designed by equations.

$$x - 2y + 11 = 0, \quad y = 7 \quad \text{and} \quad 2x - y + 7 = 0$$

However, the support staff is challenged with locating the corners to demarcate this area.

Task.

As a compound prefect, help the support staff to identify the corners of this area for easy planting of the grass.

Item 4.

In order to keep and maintain time, travelers and tourists normally use drone taxis that move from Busega tax park and move along a straight Entebbe express bypass road whose displacement (x , kilometers) expressed in terms of time t (minutes) is modeled by.

$$x = t^3 + t^2 + 9t$$

$$3t^2 + 2t + 9$$

One tourist from Murchison falls park boarded a taxi from 2pm from the taxi park in order to keep time as he goes to the airport to move out of the country. However, he is disappointed with the number of times the taxi stops moving.

Task.

As a mathematician employed by the road safety authorities in the Ministry of works, help the taxi managers to identify the time when the taxi was not moving in order to improve on transportation.

Item 5 :

Mary baked a cake using a tin whose diameter is 7cm. She wants to serve the cake at a party but she has to keep a portion of area 18.375 cm^2 for her Aunt who may not attend the party. She is interested in knowing the length of the arc of the portion that is kept.

Task.

As a friend to Mary, Guide Mary on how to find the length of the Arc.

SECTION B**Item 6.**

A Teacher explained to students that a multiple is a number which when divided by a factor gives no reminder. Students are challenged with justifying the fact that $6^n - 1$ is a multiple of five.

Students are also challenged in their project of build a triangular hut to keep Rabits using bricks. They want one brick in the top row, two bricks in the second, three in the third and so on. They are planning to use 100 bricks. A brick costs 3500/=

Task.

- a) As one who understood the teacher, guide your fellow students to justify the challenge above

$$(6^n - 1) \times x = 5$$

$$9 = 0$$

- b) Help your friends to complete their project by establishing how many rows they can form and the cost of the bricks to be used.

Item 7.

A highway road towards western Uganda is expressed as $f(x) = 3x^4 + 16x^3 + 24x^2 + 3$. There are two spots where accidents usually occur and the ministry of works has contracted a company to identify these two spots and advice on their nature so that improvements are made on these spots.

To safe guard their equipment the company is to construct a rectangular yard with an existing edge using 3000mes of fencing wire.

Task.

- a) As one of the company's engineers generate the two spots and advice the on the nature of the spots.
- b) Also guide on the dimensions of the rectangular yard to be constructed for keeping the equipment.

Item 8.

Mr. Tomuki in down town city invests in two identical shops dealing in hard ware. He observes that the monthly profits (in thousand shillings) from one shop can be modeled by the equation $x^2 - 8x + k = Q$. Where Q is the profit and x the number of months. He observed that after two months his profit was 6. He tasked his manager to find the number of months when there was no profits. The manager obtained two different roots α and β .

Task: Mr Tomuki,

- a) is interested in knowing the valves of $\alpha^2 + \beta^2$ and $\alpha^3 + \beta^3$, guide the manager how to solve the challenge above.
- b) Generating the equation whose roots are $\frac{1}{\alpha^2}$ and $\frac{1}{\beta^2}$.

Item 9.

In a factory dealing in posho, the production of posho (x sacks) depends on the price of a kilo of posho (p) in the market. In the past month the sales manager found out that the production of posho was according to the curve $X = p^3 - 2p^2 - p + 2$. The sales manager has been tasked to report to the C.E.O of the factory on how the factory performed last season.

Task.

Help the manager generate

- a) the price of posho when production was at zero sacks.
- b) Price of posho that encourages the workers to produce maximum output
- c) Price of posho when production was minimum

Item 10.

During a physics practical in a senior three class, a pendulum is released from an angle θ with the vertical. The relationship between the time T in seconds and the angle θ in degrees is modeled by the equation $3\cos 2\theta = 1 + 2\sin \theta$ for $0^\circ \leq \theta \leq 360^\circ$.

During a discussion a group of students were challenged as to how $\frac{1 - \tan^2 \theta}{1 + \tan^2 \theta} = \cos 2\theta$. They approached a teacher to guide them on how this is done.

Task.

As a teacher who has been approached by the students,

- a) Guide the learners on how to come up with the angle in the experiment present them in a solution set.
- b) Take the students through the steps on how the $\cos 2\theta$ come about.

END

$$\sqrt{3^2 - (4 \times 6 \times 2)}$$