***SOLUTIONS ORGANIZED FOR THE SCENARIO BASED NATH QNS, AFTER BEING ANALYSED FOR THREE WEEKS, BY KATO WYCLIFF BAGOOLE, TR. CHEMISTRY AND MATHEMATICS, MAKERERE UNIVERSITY,***

***WARM READING,***

**ITEM ONE:**Based on the information provided, the member of the family re-wrote the 4-digit ATM card PIN from the decimal (base 10) number system to a number system less than four. The given PIN is written as “12\_20 . 22 10”, which suggests that the number system used is base 3 (ternary).

In the ternary number system, the digits used are 0, 1, and 2. The PIN “12\_20 . 22 10” can be interpreted as follows:

The first two digits are 12 in base 3, which is equivalent to 5 in base 10.

The third digit is represented by the underscore “\_”, which indicates that the original digit is unknown.

The fourth digit is 20 in base 3, which is equivalent to 8 in base 10.

The fifth digit is 22 in base 3, which is equivalent to 8 in base 10.

The sixth digit is 10 in base 3, which is equivalent to 3 in base 10.

(ii) To regenerate the original PIN in the decimal (base 10) number system, we need to convert the ternary representation back to decimal.

The original PIN in decimal would be: 5\_83

(b) (i) The nurse checks on the patient every 2 hours, and the medical doctor checks on the patient every 4.5 hours. They last checked on the patient together at 9:30 AM.

To find the next time they will check on the patient together, we need to find the least common multiple (LCM) of 2 and 4.5 hours.

The LCM of 2 and 4.5 hours is 9 hours.

Therefore, the next time the nurse and medical doctor will check on the patient together is at 6:30 PM (9:30 AM + 9 hours).

© The patient was advised to spend:

3/8 of the day resting

1/6 of the day eating

2/3 of the remaining time having a healthy diet

The rest of the time visiting the hospital for further checkup

To calculate the time spent visiting the hospital, we need to first find the remaining time after

resting and eating.

Total time in a day = 24 hours Time spent resting = 3/8 × 24 = 9 hours Time spent eating = 1/6 × 24 = 4 hours Remaining time = 24 - 9 - 4 = 11 hours

Time spent having a healthy diet = 2/3 × 11 = 7.33 hours Time spent visiting the hospital = 11 - 7.33 = 3.67 hours

In a week (7 days), the total time spent visiting the hospital would be: 3.67 hours × 7 days = 25.69 hours

Therefore, the patient will spend 25.69 hours per week visiting the hospital.

**ITEM 2**(a) To determine the cost the wholesale dealer will pay for the 1200 bags, we need to calculate the total cost of transporting each bag and then multiply it by the total number of bags.

From the information given:

- In January, the cost of transporting each bag was $UGX4500$.

- In February, the cost of transporting each bag was $UGX8500$.

Let's calculate the average cost per bag:

Average cost per bag = $\frac{(300 \times 4500) + (700 \times 8500)}{1000}$

Average cost per bag = $\frac{1350000 + 5950000}{1000}$

Average cost per bag = $\frac{7300000}{1000}$

Average cost per bag = $UGX7300$

Total cost for 1200 bags = $1200 \times 7300$

Total cost for 1200 bags = $UGX8,760,000$

Therefore, the wholesale dealer will pay $UGX8,760,000$ for the 1200 bags.

(b) To minimize the cost of transport for the 1200 bags, we need to find out how many trips each vehicle will make. The constraints are that the number of bags to be transported must exceed 120, and the number of trips made by the pickups should not exceed those made by the Isuzu Diana by more than 2.

Let:

- Number of trips made by Pickup = $x$

- Number of trips made by Isuzu Diana = $y$

The objective function to minimize the cost is:

Cost = $240,000x + 300,000y$

Subject to the constraints:

$x \times 18 + y \times 30 = 1200$

$240,000x + 300,000y \leq 2,400,000$

$y \leq x + 2$

Solving these equations will give us the optimal number of trips each vehicle will make to

minimize the cost of transport.

**ITEM THREE**;

(a) The shortest route the honorable MP should take from Mbarara to Kayunga is as follows:

1. From Mbarara to Masaka (160km North)

2. From Masaka to Kampala (150km West)

3. From Kampala to Mukono (90km in the direction S75°W)

4. From Mukono to Kayunga (148km South)

The shortest distance between Mbarara and Kayunga can be found by adding up the distances of each leg of the journey:

160km + 150km + 90km + 148km = 548km

(b) The total cost incurred in purchasing the cows can be calculated as follows:

Total cost = Number of cows \* (Cost per cow - Total discount)

Number of cows = 400

Cost per cow = UGX850,000

Total discount = 5% + 10% = 15%

Total cost = 400 \* (UGX850,000 - (15/100 \* UGX850,000))

Total cost = 400 \* (UGX850,000 - UGX127,500)

Total cost = 400 \* UGX722,500

Total cost = UGX289,000,000

(c) The maximum amount of Yoghurt he can buy for his guests can be calculated using the volumes of the buckets:

Volume of smaller bucket = 45 liters = 0.045 cubic meters

Volume of larger bucket = π \* r^2 \* h = π \* (50cm)^2 \* h

Assuming the height of both buckets is the same, we can compare the volumes based on the base areas.

Volume ratio = (30cm/50cm)^2 = (3/5)^2 = 9/25

Maximum amount of Yoghurt = 4 \* 0.045 + 2 \* (π \* (50cm)^2 \* h) \* (9/25)

**ITEM FOUR**:

(a) The cost of constructing the church can be determined by finding the area of the hexagonal church and multiplying it by the cost per unit area:

Cost of constructing the church = Area of hexagonal church \* Cost per unit area

Area of hexagonal church = 6 \* Area of one triangle

Cost of constructing the church = 6 \* UGX128,000,000

(b) The extra amount paid for the Sino Truck can be calculated by comparing the total amount paid through installments with the cash price. The extra amount is due to interest or financing fees associated with the installment plans.

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**ITEM 5**

(a) (i) To help the head teacher make an informed decision about the fate of the mathematics department based on the students' marks, we can calculate the average performance of the students.

The student's marks are:

50 71 40 48 61 70 30 62 44 63 60 51 55 25 32 65 54 45 65 50 45 40 25 45 48 45 30 38 30 28 24 48 30 48 28 35 50 48 50 60

Calculating the average:

Average = (Sum of all marks) / Number of students

Average = (1910) / 40

Average = 47.75

Since the average performance for this year is 47.75, which is higher than the previous year's average of 47, the head teacher should not add another teacher or buy more books.

(ii) Displaying the students' marks in groups on a simple statistics diagram:

Grouping the marks into intervals and representing them on a histogram or bar chart would be an effective way to display the data.

(b) (i) The head teacher should replace the book that no student read alone, which is the Fountain publisher. This is because if no student used it alone, it may not have been as effective or popular among the students compared to the other books.

(ii) To find the probability that a student selected from the class failed, we need to calculate the total number of students who failed and divide it by the total number of students.

Total number of students who failed = Number of students who did not use any book + Number of students who used Fountain publisher only

Total number of students who failed = 0 (since all students who did not use any book failed greatly)

Probability of a student failing = Total number of students who failed / Total number of students

Probability of a student failing = 0 / 40

Probability of a student failing = 0

Therefore, the probability that a student selected from the class failed is 0..

Certainly, let's address the tasks for Item 6 as wel

**ITEM 6:**

(a) To find how much each school paid for the bus, we need to calculate the total distance traveled and the total cost of the bus hire.

Given information:

- The bus charges 25,000 UGX per km moved.

- The bus started at 4:30 am and reached Mpigi at 6:45 am, covering the distance at a speed of 90 km/hr.

- From Mpigi, the bus maintained the same speed for 2 1/4 hours, reaching Masaka.

- From Masaka, the bus reduced speed, reaching Lyantonde at 9:30 am.

Step 1: Calculate the distance traveled.

Time taken from 4:30 am to 6:45 am = 2 hours 15 minutes = 2.25 hours

Distance traveled = Speed × Time = 90 km/hr × 2.25 hours = 202.5 km

Time taken from Mpigi to Masaka = 2 1/4 hours

Distance traveled = Speed × Time = 90 km/hr × 2.25 hours = 202.5 km

Total distance traveled = 202.5 km + 202.5 km = 405 km

Step 2: Calculate the total cost of the bus hire.

Total cost = Distance traveled × Cost per km

Total cost = 405 km × 25,000 UGX/km = 10,125,000 UGX

Step 3: Calculate the cost per school.

Cost per school = Total cost / 3 schools

Cost per school = 10,125,000 UGX / 3 = 3,375,000 UGX

Therefore, each school paid 3,375,000 UGX for the bus hire.

(b) To decide the cash prize for each school, we need to calculate the total points obtained by each school and then distribute the prize money accordingly.

Given information:

- School A won 3 games, drew 2, and lost 1.

- School B won 4 games and lost 2.

- School C won 2 games and drew 4.

- The total prize money is 16,500,000 UGX.

Step 1: Calculate the points obtained by each school.

School A:

3 wins × 3 points = 9 points

2 draws × 1 point = 2 points

Total points for School A = 9 + 2 = 11 points

School B:

4 wins × 3 points = 12 points

2 losses × 0 points = 0 points

Total points for School B = 12 points

School C:

2 wins × 3 points = 6 points

4 draws × 1 point = 4 points

Total points for School C = 6 + 4 = 10 points

Step 2: Distribute the prize money based on the points obtained.

Total points obtained = 11 + 12 + 10 = 33 points

Prize money per point = 16,500,000 UGX / 33 points = 500,000 UGX/point

School A: 11 points × 500,000 UGX/point = 5,500,000 UGX

School B: 12 points × 500,000 UGX/point = 6,000,000 UGX

School C: 10 points × 500,000 UGX/point = 5,000,000 UGX

Therefore, the cash prize for each school is:

School A: 5,500,000 UGX

School B: 6,000,000 UGX

School C: 5,000,000 UGX

**ITEM 7**

(a) To determine how many tree seedlings the man needs to buy for the first phase of planting trees, we need to calculate the total distance on each side of the road until another pair of trees is planted directly opposite each other.

For the side where a tree is planted every 5m:

Total distance = $500m^{2} \times 25\% = 125m$

Number of trees = Total distance / Distance between each tree = 125m / 5m = 25 trees

For the side where a tree is planted every 6m:

Total distance = $500m^{2} \times \frac{1}{5} = 100m$

Number of trees = Total distance / Distance between each tree = 100m / 6m ≈ 16.67 trees (round up to 17 trees)

Total number of tree seedlings needed = 25 trees + 17 trees = 42 tree seedlings

Therefore, the man needs to buy 42 tree seedlings to plant in the first phase.

(b) Size of land for growing maize:

$500m^{2} \times 25\% = 125m^{2}$

The size of the land to be used for growing maize is 125 $m^{2}$.

(c) Size of land for growing beans:

$500m^{2} \times \frac{1}{5} = 100m^{2}$

The size of the land to be used for growing beans is 100 $m^{2}$.

(d) Area for growing ground nuts in standard form:

Given area for growing ground nuts = $205m^{2}$

In standard form, $205m^{2}$ remains as $205m^{2}$.

(e) No, the entire land was not partitioned properly because the sum of the areas allocated for maize, beans, and ground nuts is 430 $m^{2}$, which is less than the total land area of 500 $m^{2}$. There is an unallocated area of 70 $m^{2}$

**.**

**ITEM 8;**

(a) (i) Length and width of the floor:

Perimeter of rectangle = 2(length + width) = 25m

Area of rectangle = length \* width = 25 $m^{2}$

Solving the equations:

2(x + 3 + y) = 25

xy = 25

From the second equation, we can express y in terms of x:

y = 25/x

Substitute y = 25/x into the first equation:

2(x + 3 + 25/x) = 25

Solve for x:

x = 5m

Now, find y:

y = 25/5 = 5m

Therefore, the length of the house is 8m and the width is 5m.

(ii) Sketch of the floor:

A rectangular shape with dimensions 8m by 5m.

(b) Number of workers needed to complete the house:

Area completed by 3 men = $5m^{2}$

Area to be completed = $25m^{2} - 5m^{2} = 20m^{2}$

If 3 men can complete 5 $m^{2}$ in one day, then 1 man can complete 5 $m^{2}$/3 = $5/3 m^{2}$ in one day.

Number of workers needed to complete 20 $m^{2}$ in one day = $20m^{2}/(5/3 m^{2}) = 12/5 = 2.4$

Since we cannot have a fraction of a worker, your friend would need to hire 3 workers to complete the house in one day.

**ITEM 9;**

**(a) To determine the score with the highest chance of occurring on top, we need to count the frequency of each score in the diagram provided. By counting the occurrences of each symbol representing a score, we can identify the score that appears most frequently. In this case, the score with the highest chance of occurring is represented by the symbol "E" which appears the most number of times.**

**(b) To find the probability that an odd number occurred when the die was rolled, we need to count the total number of occurrences of odd numbers (represented by symbols other than "=" and ":") and divide it by the total number of rolls. From the given diagram, we can see that odd numbers are represented by the symbols "E" and ".". By counting the occurrences of these symbols and dividing by the total number of rolls, we can calculate the probability.**

**(c) To present the information of the above scores on a statistical graph, you can create a bar graph or histogram showing the frequency of each score. Each score (represented by symbols) will have a corresponding bar showing how many times it appeared in the data.**

**(d) Whether your friend will compete favorably in the competitions depends on the distribution of scores and the rules of the competition. If the most frequent score (in this case, represented by "E") has a high value and is favorable for winning in the competition, then your friend may have a good chance of competing favorably. However, if the most frequent score is not advantageous in the competition, then your friend may need to improve his performance**

**ITEM TEN;**

**(a)**

**(i) The total responses for each reason A, B, and C are as follows:**

**A: 17**

**B: 20**

**C: 13**

**(ii) Reason B (no school fees) has the highest probability.**

**(iii) Based on the value of probability, they should build the school. The reason is that the highest probability indicates that the most significant barrier to schooling in the community is the lack of school fees.**

**ITEM ELEVEN;**

**(a)**

**(i) The circular design will cover an area equal to the area of a circle with a diameter equal to the width of the door frame, which is 1.5 meters.**

**(ii) One tin of vanish will be enough for the circular design since the area to be covered by the circular design is less than one square meter.**

**(b) To determine the cost of buying vanish to paint the entire front face of the door, we calculate the area of the front face of the door, which is 2.5m \* 1.5m = 3.75 square meters. Therefore, the carpenter will need 4 tins of vanish to paint the entire front face of the door, costing UGX 9,000 \* 4 = UGX 36,000..**

**ITEM TWELVE:**

**(a) The total distance that the athlete ran is the sum of the distances in each leg of the race.**

**Distance from home to P: 5km**

**Distance from P to Q: 4km**

**Distance from Q back to home: 4km**

**Total distance = 5km + 4km + 4km = 13km**

**(b) The total time taken by the athlete to run the 13km distance is from 4:50pm to 5:12pm, which is 22 minutes.**

**(c) To calculate the speed of the athlete, we use the formula: Speed = Distance / Time**

**Speed = 13km / (22 minutes / 60) = 35.45 km/h**

**(i) Yes, the athlete will likely win the race.**

**(ii) The athlete's speed was calculated to be 35.45 km/h, which is faster than the competitor's speed of 10 m/s. Therefore, based on the speed comparison, the athlete has a higher chance of winning the race.**

**ITEM THIRTEEN:**

**(a)**

**(i) Grouping the marks:**

**- 25-39: 6 students**

**- 40-54: 14 students**

**- 55-69: 15 students**

**- 70-84: 8 students**

**- 85-99: 7 students**

**(ii) Simple statistics diagram:**

**Marks Range | Number of Students**

**25-39 | 6**

**40-54 | 14**

**55-69 | 15**

**70-84 | 8**

**85-99 | 7**

**(b)**

**(i) The head teacher should replace the Baroque book because it had the least number of students using it (20 students) compared to Longhorn (13 students) and Maths Clinic (17 students).**

**(ii) Probability of a student failing = (Number of students who failed) / (Total number of students)**

**Number of students who failed = 6 (students with marks 25-39)**

**Total number of students = 50**

**Probability of a student failing = 6/50 = 0.12 or 12%**

**Item 14;**

**(i) Let's denote the number of coasters as \( x \) and the number of buses as \( y \).**

**The inequalities representing the information are:**

**1. \( 40x + 80y \geq 400 \) (Total number of students to be transported)**

**2. \( x \leq 4 \) (Number of available coasters)**

**3. \( x, y \geq 0 \) (Non-negativity constraint)**

**4. \( 3s + 2t = 105,000 \) (Cost of three shirts and two trousers)**

**5. \( 2s + 5t = 180,000 \) (Cost of two shirts and five trousers)**

**(ii) The graph will have a feasible region where all the inequalities are satisfied.**

**(iii) To find the possible number of coasters and buses that can be used, we need to solve the inequalities and determine the minimum cost. By solving the equations, we can find that the minimum cost is achieved when 4 coasters and 1 bus are used, with a total cost of $shs.600,000$.**

**(b)**

**(i) To find the cost of each shirt and each trouser, we can solve the system of equations:**

**\( 3s + 2t = 105,000 \) and \( 2s + 5t = 180,000 \). Solving these equations gives \( s = 30,000 \) and \( t = 22,500 \).**

**(ii) To find the cost of three items of each type at the shop, we can substitute the values of \( s \) and \( t \) into the equations. Three shirts would cost $90,000$ and three trousers would cost $67,500$.**

**ITEM FIFTEEN:**

**(a) To find the size of Simon's farm, we can use the given information.**

**Let the total size of the farm be x acres.**

**1. One-third of the farm is used for bananas.**

**Banana farm size = 1/3 \* x acres**

**2. One-quarter of the farm is used for coffee.**

**Coffee farm size = 1/4 \* x acres**

**3. Two-fifths of the remaining land is used for mixed farming.**

**Remaining land = x - (1/3 \* x) - (1/4 \* x) = 5/12 \* x**

**Mixed farming size = 2/5 \* (5/12 \* x) = 1/3 \* x**

**4. The remaining land is 6 acres.**

**Remaining land = x - (1/3 \* x) - (1/4 \* x) - (1/3 \* x) = 6 acres**

**x - 5/12 \* x = 6**

**7/12 \* x = 6**

**x = 12 acres**

**The farm can be illustrated as follows:**

**- Banana farm: 1/3 \* 12 = 4 acres**

**- Coffee farm: 1/4 \* 12 = 3 acres**

**- Mixed farming: 1/3 \* 12 = 4 acres**

**- Remaining land: 6 acres**

**(b) The total number of students in Buddo S.S. is 1200.**

**1/5 of the boys and 1/4 of the girls went to the sports meeting.**

**Let the number of boys be b and the number of girls be g.**

**Then, the number of boys who went to the meeting is 1/5 \* b, and the number of girls who went to the meeting is 1/4 \* g.**

**The number of students left behind is 936, so:**

**b + g - (1/5 \* b) - (1/4 \* g) = 936**

**Solving this equation, we get:**

**b - g = 72**

**Therefore, there are 72 more boys than girls who attended the meeting.**

**(c) The value of the house at the end of the second year:**

**Initial value of the house = 45 million shillings**

**After the first year, the value increased by 25%, so the new value is:**

**45 million + (25% of 45 million) = 45 million + 11.25 million = 56.25 million shillings**

**In the second year, the value depreciated by 10%, so the final value is:**

**56.25 million - (10% of 56.25 million) = 56.25 million - 5.625 million = 50.625 million shillings**

**Therefore, the value of the house at the end of the second year is 50.625 million shillings.**

**(a) For item SIXTEEN:**

**(a) The difference in time when the two vehicles arrive at their destinations can be calculated by finding the time taken by each vehicle to reach its destination. The bus travels at a steady speed of $100km/hr$ until it is stopped at town C, and then continues at a reduced average speed of $50km/hr$. The lorry travels at an average speed of $60km/hr$ from Kampala to Arua. By calculating the time taken for each vehicle to reach its destination, we can find the difference in their arrival times.**

**(b) To determine when and at what distance from Arua the two vehicles meet, we can use the concept of relative speed. We can calculate the time taken for the two vehicles to meet and then use this time to find the distance from Arua where they meet.**

**(c) The average speed of the bus can be found by calculating the total distance traveled by the bus and dividing it by the total time taken for the journey.**

**For item SEVENTEEN:**

**(a) To help the chairperson get the right ages of you and your sibling, we can solve the system of equations formed by the information given by the mother and father about the age difference and the sum of the squares of the ages.**

**(b) The final area of the flower bed can be calculated using the original dimensions and the dimensions after the changes are made.**

**(c) The distance between the bicycle and the car can be found using trigonometric concepts and the angles of depressions provided.**

**(d) The number of balls in the bag can be determined by solving the probability equation involving the red and white balls.**

**Correct answer:**

**For item SIXTEEN:**

**(a) The difference in time when the two vehicles arrive at their destinations.**

**(b) Determine when and at what distance from Arua the two vehicles meet.**

**(c) Find the average speed of the bus**

**ITEM 17;**

**(a)**

**To find the ages of the two children, we can set up a system of equations based on the information given. Let's denote the ages of the two children as x and y.**

**From the given information:**

**1. The mother informs that the two ages differ by 4: This gives us the equation y = x + 4.**

**2. The father informs that the sum of the squares of your ages is 136: This gives us the equation x^2 + y^2 = 136.**

**Substituting the value of y from the first equation into the second equation:**

**x^2 + (x + 4)^2 = 136**

**Expanding and simplifying:**

**2x^2 + 8x - 120 = 0**

**x^2 + 4x - 60 = 0**

**(x + 10)(x - 6) = 0**

**So, x = 6 or x = -10. Since age cannot be negative, x = 6. Then, y = 6 + 4 = 10.**

**Therefore, the ages of the two children are 6 and 10.**

**(b)**

**To find the final area of the flower bed after the changes in its dimensions, we can use the given information about the changes in length and breadth to calculate the final area.**

**Let the original length and breadth of the flower bed be L and B respectively. After the changes, the new length becomes (L - 2) and the new breadth becomes (B + 3).**

**According to the given information, the increase in area is 20 square meters:**

**(L - 2)(B + 3) - LB = 20**

**LB + 3L - 2B - 6 - LB = 20**

**3L - 2B - 6 = 20**

**3L - 2B = 26**

**This equation represents the relationship between the original length and breadth of the flower bed. However, without specific values for L and B, the final area cannot be determined.**

**(c)**

**To find the distance between the car and the bicycle, we can use trigonometric principles. Given the angles of depressions, we can use the tangent function to find the distances.**

**Let d1 be the distance to the car and d2 be the distance to the bicycle. Using the tangent function:**

**tan(50°) = 34 / d1**

**tan(65°) = 34 / d2**

**Solving for d1 and d2:**

**d1 = 34 / tan(50°)**

**d2 = 34 / tan(65°)**

**(d)**

**To find the number of balls in the bag, we can use the given probability and the total number of balls in the bag.**

**Let x be the number of red balls and (x-8) be the number of white balls. The probability of drawing a red ball is given as 2/3:**

**x / (x + (x-8)) = 2/3**

**x / (2x - 8) = 2/3**

**3x = 4x - 24**

**x = 24**

**So, the number of red balls in the bag is 24, and the number of white balls is 16**

**ITEM 18;**

**Okay, let's solve Item 18 as well.**

**(a) To find the minimum and maximum cost for the production of Blue Band, we need to solve the optimization problem given the constraints.**

**The cost function is given as c = x + 2y, where x is the amount of milk and y is the amount of flavor.**

**The constraints are:**

**3y + 2x ≤ 15**

**2x - 3y ≤ 5**

**x ≥ 1**

**y ≥ 0**

**To find the minimum cost:**

**We can use the method of Lagrange multipliers to solve this optimization problem.**

**The Lagrangian function is:**

**L = x + 2y + λ1(3y + 2x - 15) + λ2(2x - 3y - 5)**

**Solving the system of equations obtained by taking the partial derivatives of L with respect to x, y, λ1, and λ2, we can find the values of x, y, λ1, and λ2 that minimize the cost.**

**The minimum cost would be the value of the cost function c = x + 2y at the optimal solution.**

**To find the maximum cost:**

**Since the cost function is linear, the maximum cost will occur at one of the vertices of the feasible region defined by the constraints.**

**We can evaluate the cost function at each vertex and find the maximum value.**

**(b) To find the number of chickens on the farm, we can use the information about the total number of heads and the total number of legs.**

**Let the number of chickens be x and the number of goats be y.**

**We know that the total number of heads is 200 and the total number of legs is 540.**

**We can set up a system of equations:**

**x + y = 200 (total number of heads)**

**4x + 4y = 540 (total number of legs)**

**Solving this system of equations, we can find the values of x and y.**

**The number of chickens on the farm is x.**

**. ITEM 19;**

**(a) The number of adult tickets sold can be represented by $x$ and the number of children's tickets sold can be represented by $y$. The total revenue from ticket sales is given by the equation $9x + 5y = 1380$. Solving this equation along with the fact that 180 tickets were sold will give us the values of $x$ and $y$.**

**(b) To find the total expenditure, we need to calculate the cost of each item bought in each week and then sum them up.**

**(c) To find the maximum cost for fencing the land, we can use the cost function $C=45000x+30,000y$ and substitute the values of $x$ and $y$ obtained from the inequalities to find the maximum cost.**

**For ITEM TWENTY:**

**(a) We can solve the problem by setting up an equation using the given information about the length and width of the rectangular plot of land.**

**(b) To determine the amount received by each partner, we can calculate the profit earned, apply the conditions set for ploughing back profits and keeping for emergencies, and then distribute the remaining profit according to the ratio of their capital contributions.**

**ITEM 21;**

(a)

(i) To determine the capacity of the bucket in litres, we first need to calculate the volume of the frustrum-shaped bucket. The formula for the volume of a frustrum is given by:

$V = \frac{1}{3} \pi h (R^2 + r^2 + Rr)$

where:

$V$ = Volume of the frustrum

$h$ = Height of the frustrum (42 cm)

$R$ = Radius of the open end of the frustrum (15 cm)

$r$ = Radius of the bottom end of the frustrum (10 cm)

Substitute the values into the formula:

$V = \frac{1}{3} \times 3.142 \times 42 \times (15^2 + 10^2 + 15 \times 10)$

$V = \frac{1}{3} \times 3.142 \times 42 \times (225 + 100 + 150)$

$V = \frac{1}{3} \times 3.142 \times 42 \times 475$

$V = 3.142 \times 42 \times 158.333$

$V = 19860.858$

Therefore, the capacity of the bucket is approximately 19860.858 cubic centimeters, which is equal to 19.861 liters (since 1 liter = 1000 cubic centimeters).

(ii) The capacity of the tank can be calculated using the formula for the volume of a cylinder:

$V = \pi r^2 h$

where:

$V$ = Volume of the cylinder

$r$ = Radius of the cylinder (0.9 m)

$h$ = Height of the cylinder (1.2 m)

Substitute the values into the formula:

$V = 3.142 \times 0.9^2 \times 1.2$

$V = 3.142 \times 0.81 \times 1.2$

$V = 3.142 \times 0.972$

$V = 3.003144$

Therefore, the capacity of the tank is approximately 3.003144 cubic meters, which is equal to 3003.144 liters.

(iii) The number of buckets that must be drawn to fill the tank is given by:

Number of buckets = Capacity of tank / Capacity of bucket

Number of buckets = 3003.144 / 19.861

Number of buckets ≈ 151

(b)

(i) Amount of each paint in the mixture:

Let the total amount of paint in the mixture be 360 litres.

Given the ratios:

A:B = 3:2

B:C = 1:2

Let the amounts of paints A, B, and C be 3x, 2x, and 4x respectively.

Then, 3x + 2x + 4x = 360

9x = 360

x = 40

Amount of paint A = 3x = 3 \* 40 = 120 litres

Amount of paint B = 2x = 2 \* 40 = 80 litres

Amount of paint C = 4x = 4 \* 40 = 160 litres

(ii) The cost of making 1 litre of the mixture:

Total cost = (Amount of A \* Cost of A) + (Amount of B \* Cost of B) + (Amount of C \* Cost of C)

Total cost = (120 \* 1800) + (80 \* 2400) + (160 \* 1275)

Divide the total cost by the total amount of paint (360 litres) to get the cost per litre.

(iii) Percentage profit made by selling the mixture at shs 2,210 per litre:

Calculate the total revenue from selling 360 litres at shs 2,210 per litre.

Calculate the total cost of producing 360 litres.

Calculate the profit as the difference between total revenue and total cost.

Calculate the percentage profit using the formula: (Profit / Total cost) \* 100%.

**ITEM 22;**

**(a) The number of teachers who teach none of the three subjects can be found using the principle of inclusion-exclusion. We have:**

**Total teachers = 22**

**Teachers teaching mathematics = 8**

**Teachers teaching physics = 7**

**Teachers teaching chemistry = 4**

**Teachers teaching both math and physics = 3**

**Teachers teaching math and chemistry = 1**

**No teacher teaches all three subjects.**

Using the principle of inclusion-exclusion:

Total teachers = Math + Physics + Chemistry - (Math & Physics) - (Math & Chemistry) + Neither

22 = 8 + 7 + 4 - 3 - 1 + Neither

Neither = 7

So, there are 7 teachers who teach none of the three subjects.

(b) The probability that a teacher picked at random teaches only one subject can be calculated as follows:

Probability = (Teachers teaching only math + Teachers teaching only physics + Teachers teaching only chemistry) / Total teachers

Probability = (8 - 3 - 1 + 4 - 3 - 1 + 7 - 4 - 1) / 22

Probability = 10 / 22

Probability = 5 / 11

(c) To find the surface area of the smaller can, we can use the formula for the surface area of a cylinder:

Surface Area = 2πrh + 2πr^2

Given that the larger can's surface area is 840 cm^2 and its height is 9 cm, we can solve for the radius using the given information.

**ITEM 23;**

**Okay, let's solve item 23.**

**(a) To find out if the motorist will be arrested, we need to calculate the average speed of the motorist for the entire journey.**

**For the first 90 km, the motorist traveled at an average speed of 60 km/hr.**

**For the next 3.5 hours, the motorist traveled at an average speed of 80 km/hr.**

**To find the total distance traveled in the second part of the journey, we can multiply the average speed by the time:**

**Distance = 80 km/hr × 3.5 hr = 280 km**

**The total distance traveled is 90 km + 280 km = 370 km.**

**The total time taken for the journey is 90 km / 60 km/hr + 3.5 hr = 5 hr.**

**The average speed for the entire journey is 370 km / 5 hr = 74 km/hr.**

**Since the speed limit on the Kampala-Jinja highway is 80 km/hr, the motorist will not be arrested.**

**(b) To find the stopping distance for a car moving at 46 km/hr and 85 km/hr, we can use the given formula:**

**d = s^2 / 200 + s / 10**

**For a car moving at 46 km/hr:**

**d = (46^2 / 200) + (46 / 10) = 21.16 + 4.6 = 25.76 m**

**For a car moving at 85 km/hr:**

**d = (85^2 / 200) + (85 / 10) = 72.25 + 8.5 = 80.75 m**

**To find the speed at which a car is moving if its stopping distance is 35 m, we can rearrange the formula to solve for s:**

**d = s^2 / 200 + s / 10**

**35 = s^2 / 200 + s / 10**

**200 × 35 = s^2 + 20s**

**7000 = s^2 + 20s**

**s^2 + 20s - 7000 = 0**

**Solving this quadratic equation, we get:**

**s = 60 km/hr**

**Therefore, the car is moving at a speed of 60 km/hr if its stopping distance is 35 m.**

**ITEM 24;**

**(a)**

**(i) To find the number of people who used all three forms of transport, we can use the principle of inclusion-exclusion. Let M represent the set of people who used bicycles, N represent the set of people who used buses, and P represent the set of people who used motorbikes.**

**From the given information:**

**- 46 people only used bicycles (M)**

**- 21 people only used buses (N)**

**- 11 people only used motorbikes (P)**

**- 5 people used buses and bicycles but not motorbikes**

**- 3 people used buses and motorbikes**

**- 6 people used bicycles and motorbikes**

**Let x be the number of people who used all three forms of transport.**

**Total number of people = 100**

**Number of people who declined to respond = 9**

**Using the principle of inclusion-exclusion:**

**Total = M + N + P - (people using exactly two forms) - 2\*(people using all three) + neither + declined**

**100 = 46 + 21 + 11 - (5 + 3 + 6) - 2x + 0 + 9**

**100 = 69 - 14 - 2x + 9**

**2x = 64**

**x = 32**

**Therefore, the number of people who used all three forms of transport is 32.**

**(ii) To find the percentage of people who used only two forms of transport, we need to calculate the total number of people who used only two forms of transport.**

**People who used only two forms = People using exactly two forms - People using all three forms**

**People who used only two forms = 5 + 3 + 6 = 14**

**Percentage of people who used only two forms = (14/100) \* 100% = 14%**

**(b)**

**To find the total amount levied on a disco deck valued at 1.7 million:**

**Customs duty = 35% of the value of the good = 0.35 \* 1.7 million**

**Purchase tax = 15% of (value + duty) = 0.15 \* (1.7 million + 0.35 \* 1.7 million)**

**Total amount levied = Customs duty + Purchase tax**

**.Okay, let's solve item 25 as well.**

**Item 25:**

**The figure shows a net of a right pyramid with a rectangular base ABCD. If V is the vertex of the pyramid VABCD above the base ABCD, AB=16cm, BC=12cm, and the slant sides of each triangle measure 26cm.**

**a) Draw the right pyramid showing clearly points VABCD.**

**To draw the right pyramid, we can visualize the 3D shape based on the given information:**

**- The base is a rectangle ABCD with AB=16cm and BC=12cm.**

**- The vertex of the pyramid is V, which is above the center of the rectangular base.**

**- The slant sides of each triangular face (VAB, VBC, VCD, VAD) measure 26cm.**

**The resulting 3D shape is a right pyramid with a rectangular base ABCD.**

**b) Find the height of the pyramid.**

**To find the height of the pyramid, we can use the Pythagorean theorem.**

**Let the height of the pyramid be h.**

**The slant height of each triangular face is 26cm.**

**Using the Pythagorean theorem:**

**(Slant height)^2 = (Base length)^2 + (Height)^2**

**26^2 = 16^2 + h^2**

**676 = 256 + h^2**

**h^2 = 420**

**h = √420 = 20.49 cm**

**Therefore, the height of the pyramid is approximately 20.49 cm.**

**c) Find the area of plane VAB.**

**The area of the triangular face VAB can be calculated using the formula:**

**Area = 1/2 × base × height**

**The base of the triangle VAB is 16 cm.**

**The height of the triangle VAB is the slant height of 26 cm.**

**Area of VAB = 1/2 × 16 × 26 = 208 cm^2**

**d) Find the angle between:**

**(i) Edge VA and the base**

**(ii) Face VAB and the base**

**(i) Angle between edge VA and the base:**

**This is the angle between the slant height and the base of the pyramid.**

**Using the Pythagorean theorem:**

**tan(θ) = opposite/adjacent**

**tan(θ) = height/base length**

**θ = tan^-1(height/base length)**

**θ = tan^-1(20.49/16)**

**θ = 52.5 degrees**

**(ii) Angle between face VAB and the base:**

**This is the angle between the triangular face VAB and the rectangular base ABCD.**

**Since the pyramid is a right pyramid, the angle between the face and the base is 90 degrees.**

**ITEM 26;**

**(a)**

**(i) To find the distance BE, we can use the Pythagorean theorem in triangle ABE:**

**$AB^2 = AE^2 + BE^2$**

**$12^2 = (9+OH)^2 + BE^2$**

**$144 = 81 + OH^2 + BE^2$**

**Given that $OH = 3m$, we can substitute this into the equation:**

**$144 = 81 + 9 + BE^2$**

**$BE^2 = 54$**

**$BE = \sqrt{54}$**

**$BE = 3\sqrt{6}$ meters**

**(ii) To find the distance OH, we can use the Pythagorean theorem in triangle BOH:**

**$OB^2 = OH^2 + BH^2$**

**$OB^2 = 9^2 + 3^2$**

**$OB^2 = 81 + 9$**

**$OB = \sqrt{90}$**

**$OB = 3\sqrt{10}$ meters**

**(b)**

**(i) The angle formed between line BE and the base is the angle between line BE and plane ABCD. Since BE is perpendicular to the base, the angle formed is 90 degrees.**

**(ii) The angle formed between plane BDH and the base is the angle between plane BDH and plane ABCD. Since plane BDH is perpendicular to the base, the angle formed is 90 degrees.**

**(c)**

**To calculate the capacity of the cuboid in liters, we first need to find the volume of the container:**

**Volume = length x width x height**

**Volume = AB x BC x OH**

**Volume = 12m x 9m x 3m**

**Volume = 324 cubic meters**

**Since each bag occupies 0.8 cubic meters, we can calculate how many bags can be accommodated:**

**Number of bags = Volume of container / Volume of one bag**

**Number of bags = 324 / 0.8**

**Number of bags = 405 bags**

**Therefore, the capacity of the cuboid above is 324 cubic meters, and it can accommodate 405 bags of cement.**

**ITEM 27;**

**(a) (i) To find the value of the watch in Swiss Francs:**

**$1\quad Swiss\quad Franc = 1.28\quad Deutsche\quad Marks$**

**Therefore, the value of the watch in Swiss Francs is:**

**$54\quad Deutsche\quad Marks \times \dfrac{1\quad Swiss\quad Franc}{1.28\quad Deutsche\quad Marks} = 42.1875\quad Swiss\quad Francs$**

**(ii) To find the value of the watch in Ugandan Shillings:**

**$1\quad Swiss\quad Franc = 1,350\quad Ugandan\quad Shillings$**

**Therefore, the value of the watch in Ugandan Shillings is:**

**$42.1875\quad Swiss\quad Francs \times 1,350\quad Ugandan\quad Shillings = 56,875\quad Ugandan\quad Shillings$**

**(b) To determine the teacher's Net-income:**

**Gross income = $Shs.760,000$**

**Allowances:**

**Marriage allowance: $50,000$**

**Water and electricity: $60,000$**

**Housing allowance: $150,000$**

**Medical allowance: $300,000$ per annum ($300,000/12 = $25,000 per month)**

**Transport allowance: $3,000$ per day ($3,000 \times 30 = $90,000 per month)**

**Insurance and relief: $180,000$ per annum ($180,000/12 = $15,000 per month)**

**Family allowance:**

**For children aged 0-10: $12,000 \times 2 = $24,000**

**For children aged 10-15: $9,000 \times 2 = $18,000**

**For child aged 18: $5,000**

**Total allowances = $50,000 + $60,000 + $150,000 + $25,000 + $90,000 + $15,000 + $24,000 + $18,000 + $5,000 = $387,000**

**Net income = Gross income - Total allowances = $760,000 - $387,000 = $373,000**

**(c) To determine the percentage of his gross income that goes to tax:**

**Taxable income = Gross income - Total allowances = $760,000 - $387,000 = $373,000**

**Using the tax structure provided:**

**Tax rate for $180,001 - $300,000 bracket is $18\%$**

**Tax rate for $300,001 - $400,000 bracket is $30\%$**

**Tax payable = $(180,000 \times 0.15) + (193,000 \times 0.18) = $27,450 + $34,740 = $62,190**

**Percentage of gross income that goes to tax = $\dfrac{Tax payable}{Gross income} \times 100\% = \dfrac{62,190}{760,000} \times 100\% \approx 8.18\%$**