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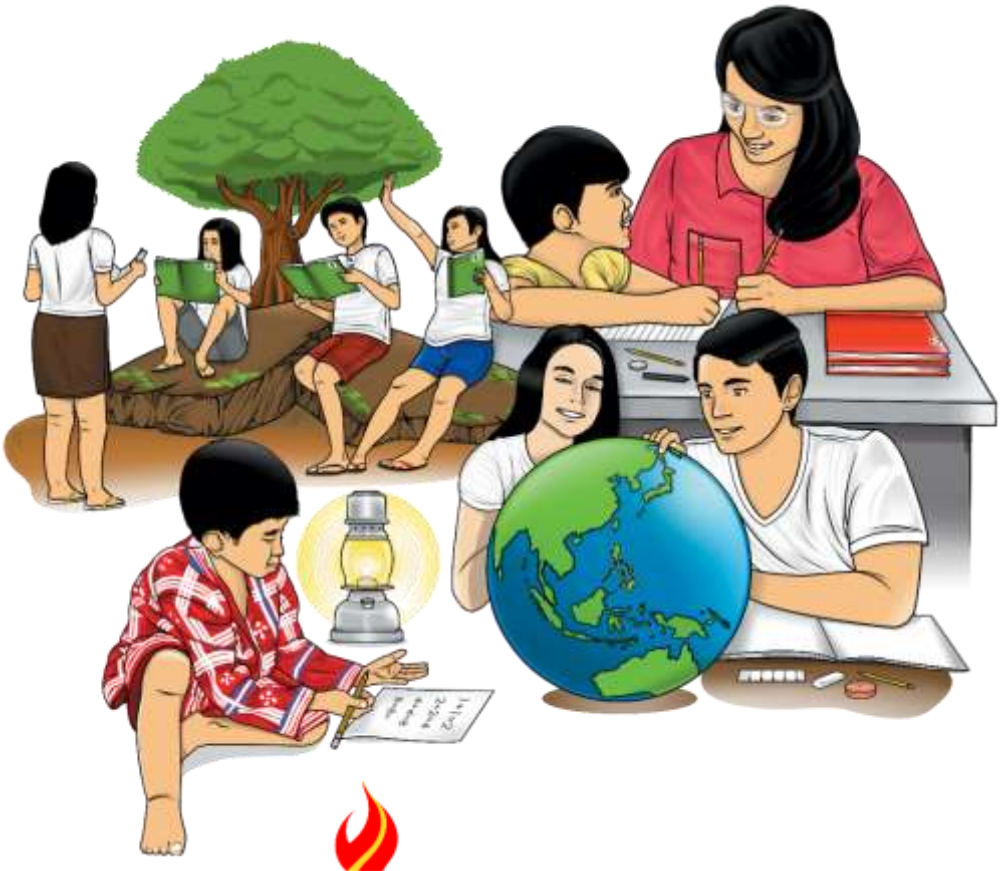
Mathematics

Quarter 2 – Module 3:
"Solving Problems Involving Linear Inequalities in Two Variables"



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Mathematics

Quarter 2 – Module 3:
"Solving Problems Involving Linear Inequalities in Two Variables"

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

In this module, you will be acquainted with key concepts of solving problems involving linear inequalities in two variables. You are given the opportunity to use your prior knowledge and skills in translating mathematical expressions to verbal phrase and vice-versa, then solve problems involving real-life situations. The lesson is arranged accordingly to suit to your learning needs.

This module contains:

Lesson 1- Solving Problems Involving Linear Inequalities in Two Variables

After going through this module, you are expected to:

1. translate statements into mathematical expressions.
2. solve problems involving linear inequalities in two variables; and
3. apply linear inequalities in two variables in real-life situation.

What I Know

PRE-ASSESSMENT

Directions: Choose the letter of the correct answer and write it on a separate sheet of paper.

1. Which of the following mathematical statements illustrates "seven less than thrice m is greater than eight"?

   A. $3m - 7 > 8$ C. $3m > -7 + 8$
   B. $7 - 3m > 8$ D. $7 > 3m + 8$

2. An apple (a) costs cheaper than an orange (o). Which of the following mathematical statements correctly shows its relationships?

   A. $a > o$ C. $a \geq o$
   B. $a < o$ D. $a \leq o$

3. Which of the following mathematical statements represents the "the sum of the ages of Bryan (B) and Chris (C) is greater than seventeen?"
   A. $B + C > 17$ C. $B + C \geq 17$
   B. $B + C < 17$ D. $B + C \leq 17$

4. The difference between x and y is less than five. Which of the following mathematical statements shows the correct translation?
   A. $x - y > 5$ C. $x - y \geq 5$
   B. $x - y < 5$ D. $x - y \leq 5$

5. Mariel bought three candies and two biscuits. The total amount she paid was at most $P12$. If m represents the number of candies and n the number of biscuits, which of the following mathematical statements represents the given situation?

   A. $3m + 2n > 12$ C. $3m + 2n \geq 12$
   B. $3m + 2n < 12$ D. $3m + 2n \leq 12$

6. Jasmine plans to sell hotdogs for $P6$ and hard-boiled eggs for $P10$. If she sells 15 hard-boiled eggs, what is the maximum number of hotdogs she should sell to have total sales of at least $P260$?
   A. 15 B. 16 C. 17 D. 18

7. The electric bill of Santos family for this month is at most $P110$ lower than the previous bill. If the previous bill marked $P1\,230$, at most how much does the present bill cost?
   A. $P1\,100$ B. $P1\,110$ C. $P1\,120$ D. $P1\,130$

8. What could be the maximum cost of a kilo of *pechay* to the nearest pesos if Mitchie has paid less than $P175$ for 4 kilograms of *pechay* and 5 kilograms of beans at $P20$ per kilogram?

A. $PhP\ 16$ B. $PhP\ 17$ C. $PhP\ 18$ D. $PhP\ 19$

9. The difference between the scores of Jules and Gerly in Math test is not more than 4 points. If Jules's score is 27 points, what could be the score of Gerly?

A. 23 to 26
B. 23 and below
C. 31 and above
D. between 23 and 31

10. Ben has a flower garden which has sunflowers and tulips. Every sunflower (S) requires 0.4 liters of water while every tulip (T) requires 0.5 liters of water. Ben has a maximum of 6 liters of water for watering the sunflowers and the tulips. Which of the following expressions satisfies the statement?

A. $0.4S + 0.5T \geq 6$
B. $0.5S + 0.4T \geq 6$
C. $0.4S + 0.5T \leq 6$
D. $0.5S + 0.4T \leq 6$

11. Dexter is using two mobile networks to make phone calls. Network X charges $P4$ for every minute of call to other networks while Network Y charges $P4.50$ for every minute of call to other networks. In a week, he spent at least $P400$ for these calls. Suppose he wants to show the total amount he spent in a week using a mathematical statement, which of the following would he use?

A. $4X + 4.50Y = 400$
B. $4X + 4.50Y > 400$
C. $4X + 4.50Y \geq 400$
D. $4X + 4.50Y \leq 40$

12. Bonin gave the fish vendor $P1{,}000 - bill$ for $1.2\ kg$ of bangus and $1\ kg$ of tilapia which cost less than $P300$. Suppose a kilogram of bangus costs $P180$, which of the following could be the cost of a kilogram of tilapia?

A. $P84$
B. below $P84$
C. $P85$
D. between $P84$ to $P85$

13. William bought 3 thick washable face masks and 4 thin washable face masks and paid a total amount of at most $P200$. If the thick washable face mask costs $P30$ each, what could be the maximum price of the other type of face mask?

A. $P27$
B. $P27.25$
C. $P27.50$
D. $P27.75$

14. Mark goes to the store to buy pens and pencils. He has $P38$ in his pocket, and he's planning to buy pens for $P6$ each and pencils for $P8$ each. If he buys 2 pens, what is the maximum number of pencils he can buy to the nearest whole number?

A. 2 B. 3 C. 4 D. 5

15. Jezza bought 5 big (b) and 3 small (s) notebooks that cost at least $PhP\ 150$. If the price of the big notebook is twice as much as the small notebook, how much does each small notebook cost to the nearest pesos?

A. $s \geq P11$
B. $s \leq P11$
C. $s \geq P12$
D. $s \leq P12$

Lesson 1 Solving Problems Involving Linear Inequalities in Two Variables

Have you tried asking your parents about how they budget for basic needs like food and clothing considering the family's limited income? Have you tried asking yourself how did you manage considering your small daily allowance? How do students like you spend and budget your time in studying, doing school requirements, surfing the internet and other tasks?

Suppose your parents give you a weekly allowance greater than *P*200 for your snacks and school needs. If you allotted *P*70 for your school needs, what would be the minimum budget for your snacks?

The situation above requires understanding of linear inequalities in two variables. To illustrate inequality, your prior knowledge and skills on translating verbal statements into mathematical statements and the correct use of different inequality symbols will be very useful.

Let us start by refreshing your knowledge in translating verbal phrase to mathematical phrase by accomplishing the activities below.

What's In

Activating Prior Knowledge

Activity 1: FIND MY PLACE

Directions: Fill in the table below with the correct word/phrase as to which inequality symbol it represents. Write your answer on a separate sheet of paper.

is less than	is more than	is at most	is at least
is no more than	smaller than	maximum	minimum

$>$	$<$	$\geq$	$\leq$

Questions:

1. Were you able to identify each phrase as to what inequality symbol it represents?
2. Which among the phrases is difficult to classify?
3. How will you transform the verbal statements into mathematical statements?

Activity B: PERFECT MATCH

Directions: Match the statements in column A to its mathematical translation in column B. Write your answer on a separate sheet of paper.

Column A	Column B
1. The sum of 5-peso coins (f) and 10-peso coins (t) is greater than Php 45.	A. $2g < y$
2. The difference between the height of Mark (m) and Rhea (r) is at least 5.	B. $2k + 3 < f$
3. Three years more than twice the age of Khian (k) is less than the age of his father (f).	C. $m - r \geq 5$
4. In a week, Martinez family spends at most Php3,000 for food (f) and educational expenses (e).	D. $f - t > 45$
5. Twice the number of green balls (g) is less than the number of yellow balls (y).	E. $5f + 10t > 45$
	F. $f + e \leq 3000$

Questions:

1. Were you able to correctly identify the mathematical translation of each statement?
2. When is the term “at most” used? How about “at least”?
3. What other terms are similar to “at most”? How about “at least”?
4. In what real-life situations are the terms “at most” and “at least” used?

In the next activity, you will find out how linear inequalities in two variables are used in solving real-life problems.

What's New

Directions: Read the situation below. Fill in the blanks with the correct answer then answer the questions that follow. Some answers are given as your guide to accomplish the activity. Do this on a separate sheet of paper.

If the difference of Anna and Ben's test scores is less than 5, what is the greatest possible score that Anna can obtain?"

Key words	**Anna's score**	**Ben's score**	**Is less than**	**five**
Variable/symbol	y	x		5
Mathematical statement				
Add x on both sides				
Simplify				

Questions:

1. How did you find the activity? Is it difficult to transform the verbal statement into mathematical statement?
2. Were you able to correctly name the expression to obtain Anna's score?
3. Suppose Ben's score is 45, what will be Anna's maximum possible score?

What Is It

To solve the problem about Anna and Ben's scores, you must identify the key words and its representing variables/symbols.

Let Anna's score be y
Let Ben's score be x
The mathematical phrase "The difference" is represented by the symbol " $-$ "
The mathematical phrase "is less than" is represented by the symbol " $<$ "

Then, it can be written mathematically as: $y - x < 5$

To get the value of y, eliminate x in the left side by adding the additive inverse of $-x$, that is:

$$y - x + x < 5 + x$$
$$y + (-x + x) < 5 + x$$
$$y + 0 < 5 + x$$
$$y < x + 5$$

The inequality $y < x + 5$ represents the value of Anna's score. If Ben's score is 45, then Anna's score would be $y < 45 + 5$. Simplifying it, becomes $y < 50$. Thus, Anna's possible maximum score is 49.

To simplify the solutions, remember the following steps below.

Steps in Solving Problems Involving Linear Inequalities in Two Variables

Step 1: Identify the words needed to be represented with variables/symbols.
Step 2: Translate the statement into mathematical expression.
Step 3: Identify what is asked in the problem then solve.

To clearly understand the steps in solving problems involving linear inequalities in two variables, consider the following illustrative examples.

Illustrative Example 1.
Your parents give you a weekly allowance greater than $P200$. The allowance is budgeted for your food and school needs. If you allotted $P70$ for your school needs, what would be the minimum budget for your food?

Solution:

Step 1: Identify the words needed to be represented with variables/symbols.
Let x represents the budget for the school needs
Let y represents the budget for food
The symbol for greater than is ">"

Step 2: Translate the statement into mathematical expression.
$x + y > 200$

Step 3: Identify what is asked in the problem then solve.
Solve for y given $x=70$

$x + y > 200$	Given
$x - x + y > 200 - x$	By adding the additive inverse on both sides of the inequality
$y > 200 - x$	By simplifying
$y > 200 - 70$	By substituting $x = 70$
$y > 130$	Simplified form

This means that the minimum budget for the food in a week is $P130$.

Illustrative Example 2
In a week, Martinez family spends less than $P3{,}021$ for food (f) and educational expense (e). Suppose the family spent PhP 1000 for education, what could be the family's maximum possible expenses for food?

Solution:

Step 1: Identify the words needed to be represented with variables/symbols.

Let f represents the amount spent for food expense
Let e represents the amount spent for educational expense
The symbol for less than is "<"

Step 2: Translate the statement into mathematical expression

$f + e < 3021$

Step 3: Identify what is asked in the problem then solve.

Solve for f given $e = 1000$

$f + e < 3021$	Given
$f + e - e < 3021 - e$	By adding the additive inverse on both sides of the inequality
$f < 3021 - e$	By simplifying
$f < 3021 - 1000$	By substituting $e = 1000$
$f < 2021$	Simplified form

This means that the maximum amount for food of Martinez family in a week is $P2021$.

Illustrative Example 3

The difference between the height of Mark (m) and Rhea (r) is at least 5 cm. If Rhea's height is 160 cm, what is the least possible height of Mark?

Solution:

Step 1: Identify the words needed to be represented with variables/symbols.

Let m represents Mark's height
Let r represents Rhea's height
The symbol for *"at least"* is "$\geq$"

Step 2: Translate the statement into mathematical expression.

$m - r \geq 5$

Step 3: Identify what is asked in the problem then solve.

Solve for m given r=160

$m - r \geq 5$	Given
$m - r + r \geq 5 + r$	By adding the additive inverse of r on both sides of the inequality
$m \geq 5 + r$	By simplifying
$m \geq 5 + 160$	By substituting $r = 160$
$m \geq 165$	Simplified

This means that the least possible height of Mark is 165 cm.

Illustrative Example 4

Abby enjoys gardening. She has snake plant and rose plant in her garden. Every snake plant requires 0.5 liters of water and every rose plant requires 0.3 liters of water. Abby has a maximum of 5 liters of water for watering the snake plants and the rose plants. If Abby waters 10 rose plants, how many snake plants can she water at most with the amount of water left?

Solution:

Step 1: Identify the words needed to be represented with variables/symbols.

Let S represents the number of snake plants
Let R represents the number of rose plants
The symbol for *maximum* is "≤"

Step 2: Translate the statement into mathematical expression.

$0.5S + 0.3R \leq 5$

Step 3: Identify what is asked in the problem then solve.

Solve for S given $R=10$

$0.5S + 0.3R \leq 5$	Given
$0.5S + 0.3R - 0.3R \leq 5 - 0.3R$	By adding the additive inverse on both sides of the inequality
$0.5S \leq 5 - 0.3R$	By simplifying
$0.5S \leq 5 - 0.3(10)$	By substituting $R = 10$
$0.5S \leq 5 - 3$	Simplified form
$0.5S \leq 2$	
$\frac{0.5S}{0.5} \leq \frac{2}{0.5}$	Dividing both sides by 0.5
$S \leq 4$	Simplified form

This means that the number of snake plants she can water with the remaining amount of water is at most 4.

What's More

Activity: Watch Your Steps

Directions: Complete the steps in solving word problems involving linear inequalities in two variables by determining the variable/value in the blanks. Write your answer on a separate sheet of paper.

1. A jeepney (j) and a motorcycle (m) left a certain place at the same time going to opposite direction. After 3 hours, the distance between them is at most 270 km. If the motorcycle travels at a speed of 40 kilometers per hour, what could be the maximum speed of the jeepney?

Solution:

Step 1: Identify the words needed to be represented with variables/symbols.
Let ____ represents the speed of the jeepney
Let ____represents the speed of the motorcycle

Step 2: Translate the statement into mathematical expression.

$3\_\_ + 3\_\_\_ \leq 270$

Step 3: Identify what is asked in the problem then solve.

Solve for ___ given the speed of motorcycle = $40\ km/hr$

$3\_\_ + \_\_\_ \leq 270$	Given
$\_\_ + \_\_\_ - 3\_\_ \leq 270 - 3\_\_$	By adding the additive inverse of ___ on both sides of the inequality
$3\_\_ \leq 270 - 3\_\_$	By simplifying
$\frac{3\_\_}{3} \leq \frac{270 - 3\_\_\_}{3}$	Dividing both sides of the inequality by 3
$\_\_ \leq 90 - \_\_$	Simplified form
$\_\_ \leq 90 - 40$	By Substitution
$\_\_ \leq 50$	Simplified form

This means that the maximum speed of the jeepney is ____ km/hr.

Activity 2: Know My Value

Directions: Read the following problems and answer what is asked. Write your answer and complete solutions on a separate sheet of paper.

.

1. The difference between Lian's height and William's height is not more than 4 inches. Suppose Lian's height is 65 inches, what could be the height of William?

2. The total amount Andrew paid for 3 kilos of rice and 2 kilos of fish is less than *P*400. Suppose Andrew paid more than *P*400 and each kilo of rice costs *P*45. What could be the greatest amount he will pay for 2 kilos of fish to the nearest pesos?

What I Have Learned

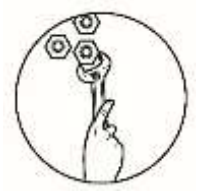
Activity: Inequalities In My Reality

Directions: Create a 2-stanza song about steps in solving word problems involving linear inequalities in two variables. Present instances as to the application of linear inequalities in two variables. Do this on a separate sheet of paper.

RUBRIC: Real Life Situations Involving Linear Inequalities in Two Variables

CRITERIA	1-2	3	4	5	Points
Content	Song lacks specific examples and is missing key elements of required information.	Song lacks one key information category, needs development through specific details.	Song contains all key information categories and is generally supported with specific details.	Song contains all key information categories, each supported with specific and engaging details.	
Word Choice	No evidence of thought in word selection.	Song needs revision to slot in better word	Most words add to effectiveness. Some	Words add color, engaging the reader.	

	Many examples of slang evident.	choice; contains some slang.	slotting to add color is needed.	No slang is evident.	



What I Can Do

Directions: Read the following selection and answer what is asked. Show your complete solutions and explanations. Do this on a separate sheet of paper.

In a variety show held for a cause, tickets cost $P25$ for adults and $P20$ for children. The organizer collected a total amount of not more than $P600$ from 27 adults and children who watched the play.

Questions:

1. What mathematical statement represents the given situation?
2. How will you find the number of children and adults who watched the play?
3. Give four possible numbers of adults and children who watched the play. Justify your answer.
4. The sponsor of the show realized that if the prices of the tickets were reduced, more people would have watched the play. If you were the sponsor of the play, would you reduce the prices of the tickets? Why?

Assessment

Directions: Choose the letter of the correct answer. Write your answer on a separate sheet of paper.

1. Which of the following is the mathematical translation of the statement "The difference between the height of Andrew (A) and Kristine (K) is at most five"?

A. $A - K > 5$ C. $A - K \geq 5$
B. $A - K < 5$ D. $A - K \leq 5$

2. A kilogram of banana (b) costs cheaper than a kilogram of orange (o). Which of the following mathematical statements correctly show its inequality?

A. $b > o$ C. $b \geq o$

B. $b < o$ D. $b \leq o$

3. Which of the following mathematical statements represents "the difference between the ages of Ann (a) and Ben (b) is at most 7"?

A. $a - b > 7$ C. $a - b \geq 7$

B. $a - b < 7$ D. $a - b \leq 7$

4. Jason bought two biscuits and five candies. The total amount he paid was at most $P20$. If b represents the number of biscuits and c the number of candies, which of the following mathematical statements represents the given situation?

A. $2b + 3c > 20$ C. $2b + 3c \geq 20$

B. $2b + 3c < 20$ D. $2b + 3c \leq 20$

5. Mae sells 15 biscuits and 20 fruits. The total amount she earned was at least $P320$. If x represents the number of biscuits and y as the number of fruits, which of the following mathematical statements represents the given situation?

A. $15x + 20y > 320$ C. $15x + 20y \geq 320$

B. $15x + 20y < 320$ D. $15x + 20y \leq 320$

6. Sean plans to sell hotdogs for $P10$ and hard-boiled eggs for $P7$. If he sells 22 hotdogs, what is the maximum number of hard-boiled eggs he should sell to have total sales of at least $P300$?

A. 11 B. 12 C. 13 D. 14

7. In June, the electric bill of Matalino family is at most $P90$ lower than the previous month. If the previous bill marked $P1\,430$, at most how much does the present bill cost?

A. $P1\,230$ C. $P1\,330$

B. $P1\,330$ D. $P1\,340$

8. The total amount Carla paid for 3 kilograms of pork and 4 kilograms of fish is less than $P1\,000$. Suppose a kilogram of pork costs $P195$. What could be the maximum cost of a kilogram of fish to the nearest pesos?

A. $P101$ C. $P103$

B. $P102$ D. $P104$

9. The difference between the scores of Rheyner and Lea in Math test is not more than 5 points. If Rheyner's score is 32 points, what could be the score of Lea?

A. 27 to 30
B. 37 and above
C. 27 and above
D. between 27 and 37

10. Ricky bought 4 big and 5 small notebooks. He paid at least $P125$. If B represents the cost for big notebooks and S for small ones, which of the following would represent the given situation?

A. $4b + 5s > 125$
B. $4b + 5s < 125$
C. $4b + 5s \geq 125$
D. $4b + 5s \leq 125$

11. Angie is using two mobile networks to make phone calls to her friends. One network charges $P6$ for every minute of call to other networks. The other network charges $P6.50$ for every minute of call to other networks. In 5 days, she spent at least $P355.50$ for these calls. Suppose she wants to show the total amount she spent using a mathematical statement. Which of the following will it show?

A. $6x + 6.50y = 355.50$
B. $6x + 6.50y > 355.50$
C. $6x + 6.50y \geq 355.50$
D. $6x + 6.50y \leq 355.50$

12. Donna paid less than $P500$ for 1.4 kg of milkfish and 1.5 kg of tilapia. If a kilogram of milkfish costs $P160$, how much does a kilogram of tilapia cost?

A. $P184$
B. above $P185$
C. below $P184$
D. between $P185$ to $P190$

13. Richelyn goes to a store to buy pens and pencils. She has $P50$ in her pocket, and she's planning to buy pens for $P8$ each and pencils for $P12$ each. If she buys 3 pens, what is the maximum number of pencils she can buy to the nearest whole number?

A. 1 B. 2 C. 3 D. 4

14. Jonard plans to buy $P8$-egg and $P12$-bacon per piece. If he bought 16 bacons, what is the maximum number of eggs to have a total amount of at most $P300$?

A. 11 B. 12 C. 13 D. 14

15. Michelle bought two types of facemasks with a total amount of at most $P333$. If she bought 4 pieces of one type that cost $P35$ each, what could be the maximum price in nearest pesos of 6 pieces of other type of facemask?

A. $P192$
B. $P193$
C. $P194$
D. $P195$

Additional Activities

Due to Corona Virus Disease 2019 (CoViD-19) pandemic, many business establishments have closed and people lost their jobs. One of the emerging trends in business is online selling/marketing. To help your family, you decided to establish an online pizza store. You consulted your parents and they are willing to give you the initial capital to start with your online business provided you can show to them your budgetary proposal. How will you make it?

Activity:

Make a budget proposal for establishing an online pizza store. You will be rated using the rubrics below.

RUBRIC:

4	3	2	1
The proposal is clear, accurate, practical, and the use of linear inequalities in two variables and other mathematical statements are properly illustrated.	The proposal is clear, practical and the use of linear inequalities in two variables is illustrated.	The proposal is fairly clear and the use of linear inequalities in two variables is fairly illustrated.	The proposal is not clear and the use of linear inequalities in two variables is not illustrated.

Answer Key

What I Can Do (variables used may vary)

1. $25a + 20c \leq 600; a + c = 27$

2. $a \leq 12; c = 15$

3.

a	12	11	10	9
c	15	16	17	18

What's More

Activity 1

Step 1:	Let j represents the speed of the jeepney Let m represents the speed of the motorcycle
Step 2:	$3j - 3m \leq 270$
Step 3:	Solve for j given the speed of motorcycle $m = 40\ km/hr$.

$3j - 3m \leq 270$	Given
$3j - 3m - 3m \leq 270 - 3m$	By adding the additive inverse of $-3m$ on both sides of the inequality
$3j \leq 270 - 3m$	By simplifying
$\frac{3j}{3} \leq \frac{270 - 3m}{3}$	Dividing both sides of the inequality by 3
$j \leq 90 - m$	Simplified form
$j \leq 90 - 40$	By Substitution
$j \leq 50$	Simplified form

This means that the maximum speed of the jeepney is 50km/hr.

Activity 2

1. 61 inches
2. Php 265

Assessment

1. D
2. B
3. D
4. D
5. C
6. B
7. D
8. C
9. D
10. C
11. C
12. C
13. B
14. C
15. B

What I Know

1. A
2. B
3. A
4. B
5. D
6. C
7. C
8. D
9. D
10. C
11. C
12. B
13. C
14. B
15. C

What's In

Activity 1

$>$	$<$	$\geq$	$\leq$
is more than	is less than smaller than	is at least minimum	is at most maximum is no more than

Activity 2

1. E
2. C
3. B
4. F
5. A

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