8

# Mathematics
## Quarter 1- Module 6:
## Solve problems involving linear equations in two variables

**AIRs - LM**

**Mathematics 8**
Quarter 1 - Module 6: Solve problems involving linear equations in two variables
Second Edition, 2021



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# 8

# Mathematics

## Quarter 1- Module 6:

## Solving problems involving linear equations in two variables

**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.

## *Target*

Good day mathematicians!

Have you ever asked yourself how businessmen make profits? How can farmers increase their yield or harvest? How parents budget their income on food, education, clothing and other needs? How cellular phone users choose the best payment plan? How students spend their daily allowances or travel from home to school? These are just some real -life situations wherein you can use your knowledge and skills in previous lessons to solve problems involving linear equations in two variables.

In this module, you will be learning more on linear equations. Particularly in solving problems and instances in real life where the application of linear equations is evident. Having a background of dealing such problems will steer you up in having a better understanding of the concept and equip you in dealing such occurrences for they are inevitable in life.

This module contains:

Solving problems involving linear equations in two variables. **M8AL-Ig-2**

After going through this module, you are expected to:

1. write an expression or value for the equation.
2. formulate linear equation.
3. solve problems involving linear equations in two variables as applied to real life instances.

## *Pre-test:*

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

1. Which of the statements below translates the mathematical equation "$4x + 3 = y$"?
   A. Four x plus three is equal to y.
   B. Four x a number increased by three is y.
   C. Four times a number increased by three is equal to y.
   D. Four times a number diminished by three is equal to y.
2. A square plywood platform has a perimeter which is 9 times the length of a side, decreased by 35. Find the length of a side.
   A. 1 B. 5 C. 7 D. 12
3. Mario has a job pruning in the grapefarm of his neighborhood and gets paid ₱40 per hour. What is the independent variable in computing his total pay?
   A. The job B. The pruning work
   C. The total pay D. number of hours worked
4. You want to buy a pizza and a mango pie. A pizza slice costs ₱25 each and mango pie at ₱15 each. You have ₱160 to spend. If x is the number of pizza and y is the number of mango pie, write an equation that models the different amount.
   A. $25x + 15y = 160$ B. $15x + 25y = 160$
   C. $15x + 160 = 25y$ D. $25x - 15y = 160$
5. Jonathan is six years older than Jessa. The sum of their ages is 48. Find Jessa's and Jonathan's age. What are the steps in solving Jessa and Jonathan's age in chronological order?
   I. Translate the problem into an equation, diagram or chart.
   II. Understand the problem. List all the components and data that are involve.
   III. Check if the information is used correctly and that the answer make sense.
   IV. Solve the equations you translated based on the given problem.
   A. I, II, III, IV B. II, IV, I, III C. II, I, III, IV D. II, I, IV, III
6. Refer to problem no. 5, what mathematical equation is needed to find Jessa's age? A. $x + 6 = 48$ B. $x + x + 6 = 48$
   C. $2x + x = 48$ D. $x + x = 48$
7. Still refer to problem no. 5, what is Jonathan's age?
   A. 21 years old B. 23 years old C. 25 years old D. 27 years old

*For items 8– 10, refer to the situation below:*

Mang Isko earns ₱400 per day and additional ₱80 for every hour overtime as technician.

8. What equation shall best represent the earnings of Mang Isko when he rendered overtime services as a technician?
   A. $y = x + 400$ B. $y = 2(x + 400)$ C. $y = 400x + 80$ D. $y = 80x + 400$
9. What is the amount earned by Mang Isko when he rendered 3 hours of overtime?
   A. 480 B. 500 C. 580 D. 640

10. If the equation in item 8 represents the amount paid for the labor in repairing computer units for every $x$ number of hours, how much will Mang Isko earn after 5 hours?
A. ₱ 800 B. ₱ 900 C. ₱ 1,000 D. ₱ 1,100
11. Lisa is a working student. She works in a fast-food chain and paid a minimum of
₱350.00 for a 6-hour service rendered plus P50.00 per additional hour of service. What equation will represent the total amount of payment to Lisa?
A. $y = 350x + 50$ B. $y = 50(x - 6) + 350$
C. $y = 50x + 350$ D. $y = 50(6\text{-}x) + 350$
12. A Shirt factory charges P300.00 per order plus P100.00 per shirt. How much will it costs if you order 50 shirts?
A. ₱ 4565 B. ₱ 4850 C. ₱ 5280 D. ₱ 5300
13. A cell phone repairman charges P150 for a repair service, plus 75 for each hour of work. How much will the repairman charge if he works for 4 hours?
A. ₱ 400 B. ₱ 450 C. ₱ 550 D. ₱ 600
14. A multicab passenger is charged P10.00 for the first 4 km and an addition P2.00 per succeeding kilometer as fare. What is the cost of a 28-km ride?
A. ₱ 46 B. ₱ 56 C. ₱ 58 D. ₱ 66
15. Refer to problem 14, how many succeeding kilometers did the passenger ride after he paid an amount of P54.00?
A. $26 - km$ B. $28 - km$ C. $32 - km$ D. $36 - km$

## *Jumpstart*

**Activity 1: Let's Play!**

Write an expression for each of the situations and formulate the equation to solve what is asked. The first is done for you.

1. If we add 9 to half of a number, the answer is twice the number.
   **The term for each situation:**

   A number ⟶ x (or any variable)

   Half of a number ⟶ $\frac{1}{2}$ x

   9 added to half a number ⟶ $\frac{1}{2}$ x + 9

   Twice the number ⟶ 2x

   The equation is $\frac{1}{2}$ x + 9 = 2x

2. The sum of three consecutive numbers is 24.

3. The length of a rectangle with a perimeter of 40 cm is three times more than its breadth.

4. The combined area of two rectangles is 49 square units. The area of one rectangle is six times more than the area of the other rectangle.

5. A pen costs twice as much as a ruler. The cost of 5 pens and 7 rulers is Ph102.

## *Discover*

Let us recall that a **solution of an equation in two variables** x and y is any ordered pair (x, y) that makes the equation true. To determine whether an ordered pair (x, y) is a solution of an equation, we will just substitute the values of x and y into the equation. On the other hand, equations in two variables usually have infinitely many solutions.

The processes of solving an equation discussed in the previous modules are very much helpful in solving problems involving linear equations in two variables. Translating verbal sentences into mathematical equations are also useful in this module.

There are many real-life situations that illustrate linear equation in two variables. Below are the steps to solve problems involving linear equations in two variables:

- First, read and understand the problem.
- Second, translate the problem into an equation in two variables.
- Third, find the solution using the formulated equation.
- Fourth, check the solution obtained by substituting the solution/s to the original equations.

Example 1.

Mike is playing his favorite mobile game. The objective of the game is for the player to earn a specific number of stars to progress to the next higher level. Mike has already earned 300 stars and he can earn 100 stars for every hour of playing the game.

**Step 1. Understand the problem.**
The number of hours spent in playing a mobile game is $\boldsymbol{x}$.
The total number of stars earned in playing the mobile game is $\boldsymbol{y}$
Mike has 300 stars
Mike can earn 100 stars for every hour of playing the game
The total number of stars Mike can earn after playing for $x$ hours is 100x

**Step 2. Translate the problem into an equation in two variables.**
Using the information above, the number of stars in playing the mobile game (y) is $\boldsymbol{y = 100x + 300}$

| Number of hours spent ($x$) | 1 | 2 | 3 |
|---|---|---|---|
| Number of stars earned ($y$) | 300 + 100(1) | 300 + 100(2) | 300 + 100(3) |
| | 400 | 500 | 600 |

**Step 3. Find the solution using the formulated equation.**

To determine the number of stars earned after playing the game in 4 hours, use the equation obtained in Step 2 and substitute the value of $x$:

$y = 100x + 300$
$y = 100(4) + 300$ *Substitute x by 4*
$y = 400 + 300$
$\boldsymbol{y = 700}$

The number of stars earned after 5 hours of playing will be:

$y = 100(5) + 300$ *Substitute x by 5*
$y = 500 + 300$
$\boldsymbol{y = 800}$

The number of stars earned after 6 hours of playing will be:

$y = 100x + 300$
$y = 100(6) + 300$ *Substitute x by 6*
$y = 600 + 300$
$\boldsymbol{y = 900}$

**Step 4. Check the solution obtained by substituting the solution/s to the original equations.**

Hence, the number of stars earned after playing the mobile game for 4, 5, and 6 hours is 700 stars, 800 stars, and 900 stars, respectively.

| $x = 4, y = 700$ | $x = 5, y = 800$ | $x = 6, y = 900$ |
|---|---|---|
| $y = 100x + 300$<br>$700 = 100(4) + 300$<br>$700 = 400 + 300$<br>$700 = 700$ | $y = 100x + 300$<br>$800 = 100(5) + 300$<br>$800 = 500 + 300$<br>$800 = 800$ | $y = 100x + 300$<br>$900 = 100(6) + 300$<br>$900 = 600 + 300$<br>$900 = 900$ |

*To have a deeper understanding on solving problems involving systems of linear equations in two variables, let's try to explore illustrative examples presented below.*

**Example 2:**

An upholstery shop charges Php750.00 for sewing a seat cover with a minimum of 20 pieces, plus Php100.00 per seat cover cloth. How much will it cost if you will order 20 seat covers?

***Step 1.***

Let x = number of additional seat covers made
Let y = total amount to be paid for seat cover plus the charges

(x – 20) + Php750 = shop charges for sewing a seat cover with a minimum of 20 pieces
Php100 = additional charge per seat cover made in excess of 20

***Step 2:***
$y$ = (x -20)100 + 750

***Step 3.*** Use the equation obtained in step 2 to solve the problem. Since the number of seat cover to be made is 20,
$y$ = (x -20)100 + 750 Substitute x in the equation by 20
$y$ = (20 – 20)100 + 750
$y$ = 0 + 750
$y$ = 750

***Step 4:*** Check answers directly against the facts of the problems. Substitute the value of x and y to the equation
750 = (x – 20)100 + 750
750 = (20 – 20)100 + 750
750 = 0 + 750
750 = 750

Therefore, the total amount to be paid is Php750.00

**Example 3:**

A tricycle passenger is charged Php25.00 for the first 5 kilometers and an additional of Php3.00 per succeeding kilometers. What is the cost of a 25-km ride?

**Step 1.**

Let x = charge per succeeding kilometers
Let y = total cost of a ride

**Step 2:** In this problem we will use the table of values to find what is ask.

| kilometers (x) | 5 | 6 | 7 | 8 |
|---|---|---|---|---|
| total cost (y) | 25 | 25 + 3(1) =28 | 25 + 3 (2) = 31 | 25 +3(3) = 34 |

To formulate the equation using the table of values, we can choose any two points in the form ($x$, $y$), from the table to find the slope:
For example, let us choose ( 5, 25 ) and ( 6, 28 ).

Use the slope formula. Substitute ( 2, 25) for ($x_1$, $y_1$) and (6, 28) for ($x_2$, $y_2$)

$$\text{(Slope) } m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{28-25}{6-5}$$

$$\mathbf{m = 3}$$

To find the *y-intercept*, we can use the slope and any point from the table. Using the slope-intercept form equation of a line: $y = mx + b$
Substitute $\boldsymbol{m} = \mathbf{3}$, and $(x, y) = (5, 25)$

$$\begin{aligned} y &= mx + b \\ 25 &= 3(5) + b \\ 25 &= 15 + b \\ \mathbf{10} &= \boldsymbol{b} \end{aligned}$$

Substitute the slope and the y-intercept obtained to the equation $y = mx + b$. Therefore, using the table above, we come up with the equation $\boldsymbol{y = 3x + 10}$

Step 3: Use the equation obtained in step 2 to solve the problem. Since you were ask for a total cost of a 25 km ride,

$y = 3x + 10$ *Substitute x in the equation by 25*
$y = 3(25) + 10$
$y = 75 + 10$
$y = 85$

Step 4. Check answers directly against the facts of the problems. Substitute the value of x and y to the equation

$85 = 3x + 10$
$85 = 3(25) + 10$
$85 = 75 + 10$
$85 = 85$ ✓

*Therefore, the total cost of a 25 km ride is Php 85.00*

**Example 4:**

Jianne wants to buy a new android mobile phone. She has already *Php*2,500 in her savings account, but the amount is not enough, so she needs to save more in order to buy the phone. Her total savings can be modelled as $y = 100x + 2{,}500$ where $y$ is her total savings, and $x$ is the number of days to save. Graph this equation and see how much she can save in 15 *days*. If the amount of the mobile phone is *Php*4,450, will Jianne be able to save enough in 20 days?

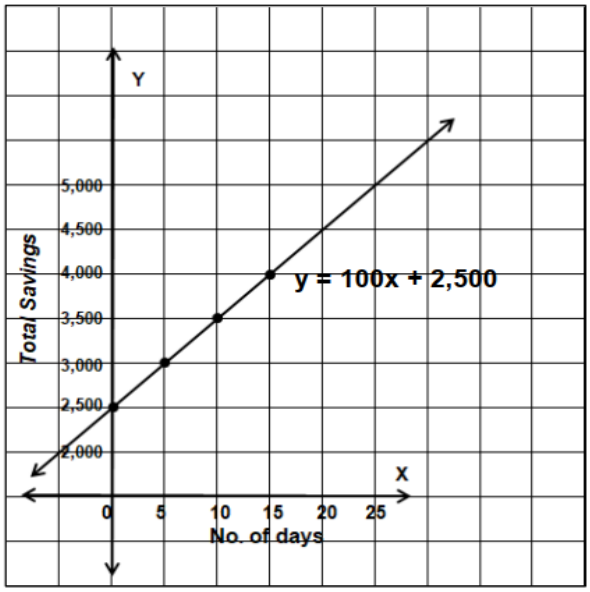
**Solution:**

First, we need to create a table of values for the equation $y = 100x + 2{,}500$. We can assign nonnegative values of $x$ to find the corresponding values of $y$.

| *Number of days* $(\boldsymbol{x})$ | $\boldsymbol{y = 100x + 2,500}$ | *(Number of days, total savings)* $(\boldsymbol{x}, \boldsymbol{y})$ |
|---|---|---|
| 0 | $y = 100\ (0) + 2{,}500$<br>$y = 0 + 2{,}500$<br>$y = 2{,}500$ | (0, 2500) |
| 5 | $y = 100\ (5) + 2{,}500$<br>$y = 500 + 2{,}500$<br>$y = 3{,}000$ | (5, 3000) |

| | | |
|---|---|---|
| 10 | $y$ = 100 (10) + 2,500<br>$y$ = 1000 + 2,500<br>$y$ = 3,500 | (10, 3500) |
| 15 | $y$ = 100 (15) + 2,500<br>$y$ = 1,500 + 2,500<br>$y$ = 4,000 | (15, 4000) |

Plot the ordered pairs on a Cartesian plane. Draw the line that passes through the points and contains all the solutions of the equation.



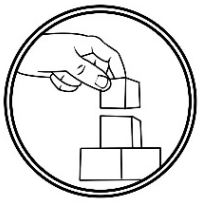

The graph above shows that Jianne can save **Php4,000** in **15 days**. If we are going to determine the corresponding ordered pair from the table, we have (15, 4000). To check whether this ordered pair satisfies the equation, let us substitute it to the equation $y$ = 100$x$ + 2,500:

y = 100x + 2,500
4,000 = 100(15) + 2,500
4,000 = 1,500 + 2,500
4,000 = 4,000 ✓

To answer if Jianne can save enough amount in 20 days to buy a mobile phone worth Php 4,450.00, we can substitute x = 20 to y = 100x + 2,500,

y = 100x + 2,500
y = 100(20) + 2,500
y = 2,000 + 2,500
y = 4,500

Notice also that in the graph, we have the coordinate (20, 4,500). This means that, in 20 days Jianne will be able to save enough amount to buy a mobile phone worth Php4,450.



## *Explore*

**Activity 2: Watch Your Steps**

Directions: Complete the steps in solving word problems involving linear equations in two variables by supplying the required information. Write your answer on a separate sheet of paper.

Rachelle begins to save for a new bag that cost PhP 2, 375.00. She already has PhP 500.00 and plans to save Php 75.00 per week. How long does she have to save to buy the bag?

**Solution:**

**Step 1. Understand the Problem.**

Given: _____

Asked:_____

**Let *x*** represents the _____

**Let *y*** represents the _____

**Step 2. Translate the problem into an equation in two variables.**

Make a table of values.

| | | | | | |
|---|---|---|---|---|---|
| **x** | | | | | |
| **y** | | | | | |

**Total amount saved =** (savings per week x number of weeks) **+** _____

$y =$ _____

**Step 3. Find the solution using the formulated equation.**

| | | | |
|---|---|---|---|
| y | = | _____ + 500 | Equation |
| 2375 | = | _____ + 500 | By substitution |
| $2375 + (-500)$ | = | _____ $+ 500 + (-500)$ | By Addition Property of Equality |
| _____ | = | _____ | By simplification |
| $\frac{1875}{\square}$ | = | _____ **x** | Division Property of Equality |
| _____ | = | **x** | By simplification |

**Step 4. Check the solution obtained by substituting the solution/s to the original equations.**

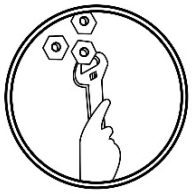
$y$ = _____ + 500

2375 = 75(____) + 500

2375 = _____ + 500

2375 = _____ _____

Hence, Rachelle needs to save for ____weeks



## *Deepen*

**Activity 3:** ***My fare share!***

Directions: Read the situation and answer the questions that follow.

A tricycle passenger is charged Php10.00 for the regular fare for the first 3 kilometers and an additional of Php 2 per succeeding kilometers.

Questions:

1. What equation shall represent the situation?
2. How much will a tricycle passenger pay for a total of 8 kilometers travel?

**Activity 4:** ***"Be Fit and Fab!"***

You want to achieve a fit and healthy body, so you joined a fitness club in your community and incorporate it with proper diet for you to lose an average of 7 pounds each month. At the end of 3 months, you weigh 130 pounds.

Questions:

a. What linear equation would best represent the situation?

b. What is your weight in 5 months of exercise?

c. If your original weight is 151 pounds, how many pound will you lose in 7 months?

## *Gauge*

**Post Assessment:** Read each item carefully. Identify the choice that best completes the statement or answers the question.

1. Which of the following is the correct sequence in solving problems involving linear equation in two variables?
   I. Read and understand the problem
   II. Translate the problem into an equation in two variables
   III. Find the solution using the formulated equation
   IV. Check the solution obtained by substituting the solution/s to the original equations
   A. I, II, III, IV  B. I, III, II, IV  C. I, III, IV, II  D. II, I, III, IV

*For item numbers 2 to 4, refer to the situation below.*

Suppose a survey is made on the number of people infected by the Corona Virus Disease-2019 (COVID-19) from February 2021 to June 2021. The result was tallied and it was observed to increase at a constant rate as shown in the table below.

| **Month** | February | March | April | May | June |
|---|---|---|---|---|---|
| Number of people infected by the Coronavirus Disease 2019 (COVID-19) | **20** | **28** | **36** | **44** | **52** |

2. What is the equation that would represent the situation?
   A. $y = -8x + 20$  B. $y = -8x + 12$  C. $y = 8x + 20$  D. $y = 8x + 12$
3. If the pattern continues, can you predict the number of infected people by the month of August 2021?
   A. Yes, the number of infected people by the month of August 2021 is 68.
   B. Yes, the number of infected people by the month of August 2021 is 76.
   C. No, because it is not stipulated in the problem.
   D. No, because the data is insufficient.
4. How many people will be infected by Coronavirus Disease 2019 (COVID-19) in the month of November?
   A. 58  B. 60  C. 86  D. 92

*For items 5 to 7:*

A vendor buys apples and oranges to be sold in a sidewalk. An apple costs Php20.00 each and an orange costs Php15.00 each. The vendor has only Php1,000.00 to spend.

5. If $x$ is the number of apples and $y$ refers to the number of oranges, which linear equation in two variables best models the situation?
   A. $20x + 15y = 1{,}000$  B. $15x + 1000y = 20$
   C. $15x + 20y = 1{,}000$  D. $20x - 15y = 1{,}000$
6. If the vendor wants to buy 35 apples, how many oranges can he buy from his remaining money?
   A. 15  B. 20  C. 25  D. 30

7. If the vendor wants to buy 32 oranges, how many apples can he buy from his remaining money?
   A. 26 B. 27 C. 28 D. 30
8. Mr. Willy has a rental business. He has bikes for rents with charges that can be estimated by a linear equation P = 5k + 50, where k is the number of kilometers a customer drives. If you are a customer, how much will you pay for the rent if you drive a total of 5 km?
   A. *Php* 55 B. *Php* 75 C. *Php* 85 D. *Php* 105
9. Jamie rents a generator for *Php* 1,200.00 and an additional charge of *Php*150.00 per hour of usage. How much will he pay after using it for 8 hours?
   A. Php 2,400.00 B. Php 2,500.00 C. Php 2,800.00 D. Php 3,000.00
10. A tricycle passenger is charged Php10.00 for the first 4 kilometers and an additional of Php 1.50 per succeeding kilometer. What equation can be used to model the situation?
   A. $y = 1.50x + 10$ B. $y = 10x + 1.50$
   C. $y = 1.50x + 4$ D. $y = 1.50 + 4x$
11. From item 10 above, how much should be paid for a total travel of 35 km?
   A. Php 56.50 B. Php 62.50 C. Php 72.50 D. Php 82.50

For numbers 12 – 14. Refer to the table below:

Gina rents a costume for her school activity. The amount she has to pay per hour is presented in the table below.

| $No.\ of\ hours\ (x)$ | 1 | 2 | 3 |
|---|---|---|---|
| $Cost\ in\ Pesos\ (y)$ | 30 | 40 | 50 |

12. What is the equation to represent the situation?
   A. $y = -10x + 20$ B. $y = -\frac{1}{10}x + 2$
   C. $y = 10x + 20$ D. $y = \frac{1}{10}x - 2$
13. How much should Gina pays in 5 hours?
   A. 55 B. 60 C. 70 D. 80
14. If Gina returned the costume after 24 hours, how much would she have to pay?
   A. *Php* 200.00 B. *Php* 220.00 C. *Php* 240.00 D. *Php* 260.00
15. In a room containing 45 students there were twice as many girls as boys. How many of each were there?
   A. 10 boys, 25 girls B. 12 boys, 26 girls
   C. 15 boys, 30 girls D. 16boys , 32 girls

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***Links***

"Chapter_4_practice_test_8", shepherd/staff/btknoblock/8hw/files http://www.mpsaz.org/ /chapter_4_practice_test_8th.pdf

"Word Problems in Linear Equations", ccfaculty.org http://www.wallace. /book/1.8%20Number%20Problems.pdf