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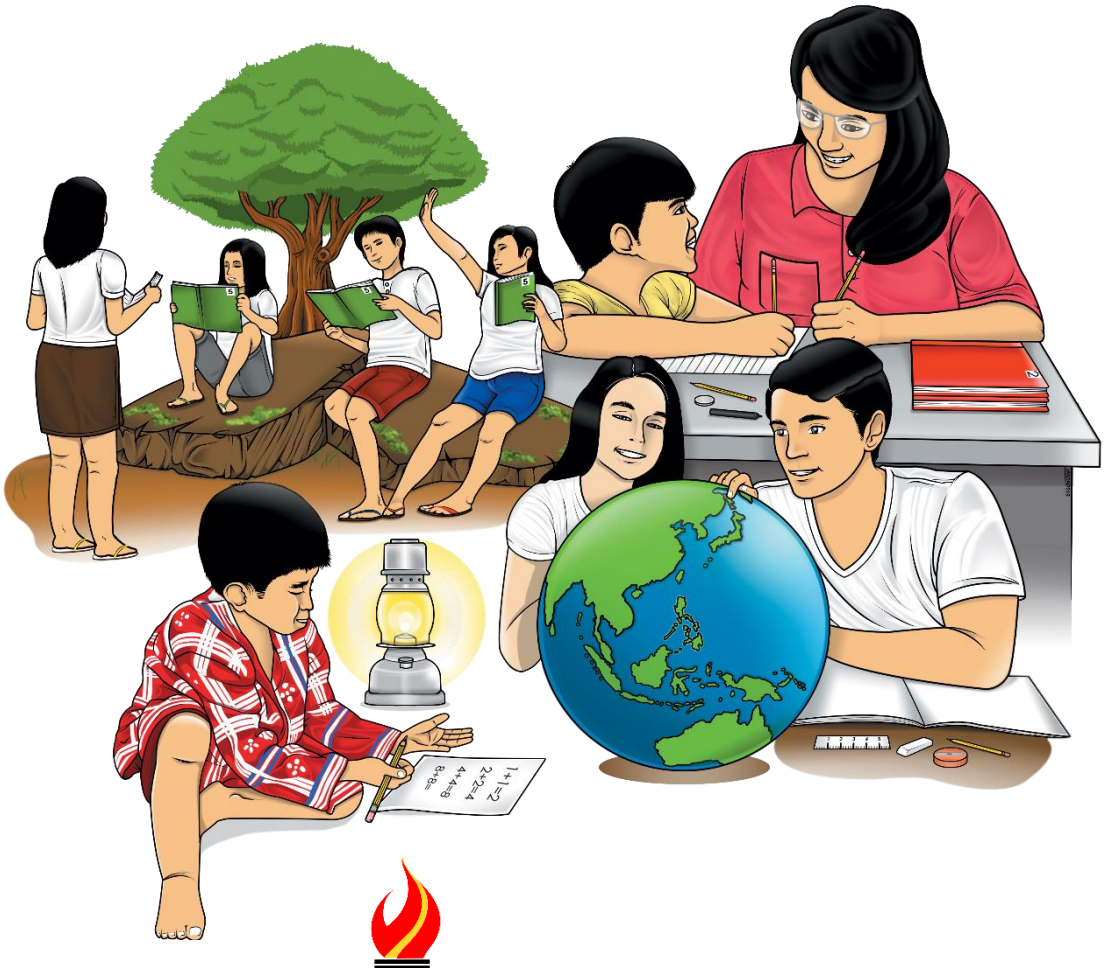
Mathematics

Quarter 4 – Module 18: Solving Routine and Non-Routine Problems on Experimental Probability



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Mathematics

Quarter 4 – Module 18: Solving Routine and Non-Routine Problems on Experimental Probability

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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

Good day Mathletes! This module was designed and written to help you gain understanding and test your ability in solving routine and non-routine problems on experimental probability. You have learned that a **routine problem** is a type of problem where there is an immediate solution. A **non-routine problem**, on the other hand, is a problem which requires analysis and insights into known principles of Mathematics. It involves a relatively more challenging problem solving that involves a couple more steps than routine problems.

Probability is the Mathematics of chance. This module will help you understand solving both routine and non-routine probability problems.

At the end of this module, you are expected to:

- solve routine and non-routine problems involving experimental probability. **(M5SP-IVj-18)**

Before going any further, let us check your understanding about solving routine and non-routine problems involving experimental probability.

What I Know

Directions: Read each statement below carefully and solve the given routine and non-routine problems. Write the letter of your choice on a separate sheet of paper.

1. Experimental probability is the ratio between the actual number of times the event occurs and the total number of conducted _____.
   A) trials B) chance C) probable D) experiment

2. A coin is tossed 30 times. A head appeared eighteen times. What is the experimental probability of getting a tail?
   A) $\frac{18}{30}$ B) $\frac{6}{30}$ C) $\frac{3}{5}$ D) $\frac{2}{5}$

3. You were hired as worker who checks cartons of eggs. On a certain day, you checked 15 cartons of eggs. Five of the cartons have at least one cracked egg. What is the experimental probability that a carton of eggs have at least one cracked egg?
   A) $\frac{1}{15}$ B) $\frac{1}{5}$ C) $\frac{1}{3}$ D) $\frac{3}{5}$

4. During a 24-hour period, the ratio of Pinoy pop songs played to Pinoy rap songs played on a radio station is 50:40. What is the experimental probability that the next song played is a Pinoy rap?
   A) $\frac{4}{5}$ B) $\frac{4}{9}$ C) $\frac{5}{9}$ D) $\frac{5}{4}$

For item numbers 5 & 6, please refer to the information given below.

Rollie rolled two dice 80 times and records the sum of the numbers on the top faces. The results are shown.

Rolling Two Dice											
Outcome (Sum)	2	3	4	5	6	7	8	9	10	11	12
Number of Times it Happened	2	3	5	9	11	14	12	9	7	5	3

5. What is the experimental probability of getting a sum less than 5?
   A) $\frac{9}{80}$ B) $\frac{5}{80}$ C) $\frac{1}{8}$ D) $\frac{1}{6}$

6. What is the experimental probability of getting an even-numbered sum?
   A) $\frac{1}{2}$ B) $\frac{1}{8}$ C) $\frac{28}{80}$ D) $\frac{30}{80}$

7. A spinner has 8 slots numbered 1 to 8. You spinned the spinner 20 times with the following results:

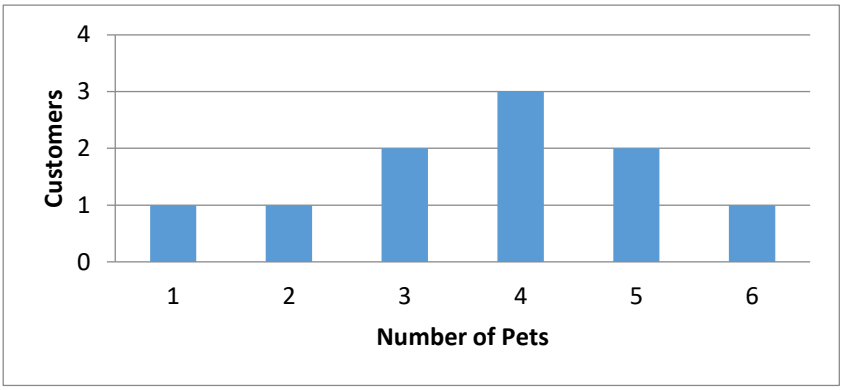
Number on the Spinner	1	2	3	4	5	6	7	8
Number of times it lands on it	3	2	3	3	4	2	2	1

What is the experimental probability of landing on an odd number?

A) $\frac{1}{2}$ B) $\frac{1}{4}$ C) $\frac{3}{5}$ D) $\frac{3}{8}$

For item number 8, please refer to the information given below.

The following bar graph shows how many pets each customer owned before entering Pedro's Pet Store today.



8. Based on this data, what is a reasonable estimate of the probability that the next customer to enter Pedro's Pet Store has exactly 3 pets?

A) $\frac{2}{3}$ B) $\frac{1}{5}$ C) $\frac{3}{10}$ D) $\frac{6}{10}$

9. The given frequency table at the right summarizes last week's bed sales at Rolly's Furniture. Based on this data, what is a reasonable estimate of the probability that the next bed sold is a twin bed?

Size of bed	Number of beds
Twin	33
Double	66
Queen	44
King	22

A) $\frac{1}{5}$ C) $\frac{3}{5}$

B) $\frac{2}{5}$ D) $\frac{4}{5}$

10. In a deck of 52 cards, Mario draws a card 25 times. In the 25 draws, a card in red suit was drawn 10 times. What is the probability that a black suit was drawn?

A) $\frac{10}{25}$ B) $\frac{15}{25}$ C) $\frac{10}{52}$ D) $\frac{15}{52}$

Lesson 1 Solving Routine and Non-Routine on Solving Experimental Probability

As previously introduced, **probability** is the branch of Mathematics that deals with the likelihood of the occurrence of a given event. Example events include getting a "face" when tossing a coin or getting "1" in tossing a die.

In this module you are going to learn how to solve routine and non-routine problems on experimental probability.

Experimental probability of an event is the ratio of the number of times an event occurs to the number of trials conducted. In order to determine the probability, there is a need for an actual experiment to be conducted.

But before we discuss experimental probability, let us first recall the basic concepts of simple probability.

What's In

As mentioned earlier, Probability is the Mathematics of chance. In real life, whenever we do an experiment with two possible results, two things can happen, either the one that we expect or the one that we do not. When the result is what we expected, then it is the favorable outcome. This is the fundamental concept of **simple probability**.

In simple probability, we compute the probability of a desirable or favorable event by getting the ratio of the favorable outcome to the total possible outcomes. In formula:

$$\text{Probability of a favorable event} = \frac{number\ of\ favorable\ outcomes}{total\ number\ of\ possible\ outcomes}$$

Let us answer the following example to help you better understand the lesson on simple probability.

Consider tossing a coin. In tossing a coin, there are two possible outcomes: head and tail. This means that there are 2 possible outcomes, head and tail only.

Let us say, you want to know the probability of getting a "head". The number of times you get a head is considered to be the favorable outcome. In getting the probability of this event, we use the equation:

Probability of a favorable event = $\frac{number\ of\ favorable\ outcomes}{total\ number\ of\ possible\ outcomes}$

Probability of getting a head = $\frac{number\ of\ head}{total\ number\ of\ possible\ outcomes}$

Probability of getting a head = $\frac{1}{2}$.

The number of **unfavorable outcomes** is the number of outcomes that is not that of what we want to get. In this case, getting a tail is unfavorable if we want to know the probability of getting tails. This means that the probability of unfavorable event is given as follows:

Probability of a unfavorable event = $\frac{number\ of\ unfavorable\ outcomes}{total\ number\ of\ possible\ outcomes}$

In our coin example, the probability of unfavorable event is:

Probability of a unfavorable event = $\frac{number\ of\ unfavorable\ outcomes}{total\ number\ of\ possible\ outcomes}$

Probability of a unfavorable event = $\frac{number\ of\ tails}{total\ number\ of\ possible\ outcomes}$

Probability of a unfavorable event = $\frac{1}{2}$

Notice that since there are only two possibilities, we get equal probabilities for both the favorable and unfavorable events. In symbols:

1 = Probability of getting unfavorable event + Probability of getting favorable event.

What's New

From the previous lesson, you were taught on how to solve simple probability. This time, we will talk about experimental probability. As initially presented, an **experimental probability** is the ratio between the number of times an event occurs and the total number of trials made. It is determined by doing an experiment.

Let us consider an example:

It is Trick or Treat season and Maria wore her Halloween costume and went around their subdivision to collect sweets. She also wanted to know about the probability of getting 5 different kinds of treats by collecting 100 of them. She went home with 100 pieces of sweet treats in her basket. She collected 10 bubble gums, 20 mint candies, 35 strawberry candies, 25 gummy bears, and 10 coffee candies. What is the probability that she got coffee candies?

To solve this, we have:

Probability of an event = $\frac{number\ of\ times\ an\ event\ occurs}{total\ number\ of\ trials}$

Probability (getting coffee candies) = $\frac{10}{100} = \frac{1}{10}$

From the sample problem above, we can say that the probability that Maria got coffee candies in the trick or treat is $\frac{10}{100}$. So we can write the probability in simplest form to be $\frac{1}{10}$.

Let us study another example.

Mario and Jose were playing a coin and a die. Mario tossed a coin while Jose rolled a die simultaneously for 6 times. The outcomes are given in the table below:

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9
Coin	H	H	T	T	H	T	H	T	H
Die	2	5	3	1	5	3	3	4	6

Based on the outcomes, they wanted to find the probability of getting a tail and a three together.

Can you help Mario and Jose on this?

What is It

The given problem in the previous section asks about determining the probability based on the outcome of the trials. Such is called experimental probability.

Experimental probability is the type of probability that is based on the **actual conduct of an experiment**. An **experiment** is the process of generating observations from a controlled set up. In the context of probability, it is the process of generating observations of events such as the number of times a "1" appears when a die is tossed.

Experimental probability is determined by getting the ratio between the number of times an event occurs and the total number of trials made.

In formula, we have

Experimental probability = $\frac{number\ of\ times\ an\ event\ occurs}{total\ number\ of\ trials}$

Now, that you know what experimental probability is, you can already help Mario and Jose.

Going back to the problem,

A coin is tossed and a die is rolled simultaneously for 6 times. The outcomes are given in the table below.

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9
Coin	**H**	**H**	**T**	**T**	**H**	**T**	**H**	**T**	**H**
Die	**2**	**5**	**3**	**1**	**5**	**3**	**3**	**4**	**6**

The following are steps to find the experimental probability of getting a tail and a three together.

Step 1
Understand:

- *Know what is asked:* The probability of getting a tail and a three.
- *Know the given facts:* 2 tail and a three out of 9 trials. These two outcomes are shown in trials 3 and 6.

Step 2

Plan: There are 9 trials. Two of the trials are tail and three

Use the formula, and then substitute.

- $P(E) = \frac{\text{number of times the event occurs}}{\text{total number of trials}}$

where E refers to the event

Step 3

Solve:

- The probability of getting a tail and a three is = $\frac{2}{9}$

Step 4

Check and Look Back:

- Since there are 9 trials and the tail and a three occurs 2 times, the probability of getting tail and a three is = $\frac{2}{9}$

Let's take another example.

A bag contains 14 red marbles, 6 yellow marbles, and 10 blue marbles. Ana took a marble and returned it. After 20 trials, blue marble was picked 7 times. Find the experimental probability of getting a blue marble.

Solution:

$$P(\text{blue marble}) = \frac{number\ of\ times\ the\ blue\ marble\ was\ picked}{total\ number\ of\ trials} = \frac{7}{20}$$

Therefore, the experimental probability of getting a blue marble is $\frac{7}{20}$.

What's More

Activity 1:

Directions: Read each problem and then solve. Write your answer on a separate sheet of paper.

Two dice are rolled twelve times and the total number of dots are added up. Here are the outcomes of the sum:

Outcomes (Sum)	4	7	12	9	8	2	4	6	5	3	10	7

1. What is the experimental probability that the sum is greater than 5?
2. What is the experimental probability that the faces with 5 and 6 dots appear?
3. What is the experimental probability that the sum is an even number?
4. What is the experimental probability that the sum is an odd number?
5. What is the experimental probability that the sum is 4?

Activity 2:

Directions: Read each problem and then solve. Follow the steps. Write your answer on a separate sheet of paper.

The table below shows the results of a card experiment. Each time a card was picked, it was returned to the bag.

Card Experiment	
Outcome	**Number**
Black	22
White	18
Blue	10

Answer the following questions relevant to the experiment:

1. How many trials of picking a card were made?
2. How many times was blue card picked?
3. What is the experimental probability of picking a black card?

Activity 3:

Directions: Determine the experimental probability. Write your answer on a separate sheet of paper.

Rock, Paper, Scissor Game

1. In 31 tries Eli beat Janine 11 times. What is the probability that Janine won?
2. In 60 tries, May won 20 times. What is the probability that May won?
3. In 40 tries, Ryan won over Ghie 10 times. What is the probability that Ghie won?

What I Have Learned

Directions: Fill in the blanks. Write your answer on a separate sheet of paper.

(1)_____ is the mathematics of chance. It is the field in mathematics that deals with (2) _____.

(3) An _____ is an activity when something is done and results are expected by chances. The uncertain result is called an (4) _____.

(5) An _____ is the ratio between the number of times the event occurs and the total number of trials.

What I Can Do

When making important decisions in life, do you list down all the possibilities first before you make a choice, or do you quickly make decisions? In real life, whenever we do an experiment, at least two things can happen, either the one we expect or the one that we do not. When the result is what we expected, then it is a favorable outcome. An outcome is the result of an experiment.

Directions: Perform the experiment, record your data in a table. Write your answer on a separate sheet of paper.

Experiment: Coin Flip

Flip a coin 20 times and record the results using the table below. Answer the questions that follow.

Trials	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Outcome																				

1) Which is more likely to appear in the majority, head or tail?
2) What is the experimental probability of getting heads?
3) How about tails?

Assessment

Directions: Read each statement below carefully and solve the given routine and non-routine problems. Write the letter of your choice on a separate sheet of paper.

1. _____ is the ratio between the number of times the event occurs and the total number of trials.
   A) Experimental Probability
   B) Theoretical Probability
   C) Simple Probability
   D) Experiment

2. A coin is tossed 20 times. A tail appeared twelve times. What is the experimental probability of getting a head?
   A) $\frac{12}{20}$ B) $\frac{4}{20}$ C) $\frac{3}{5}$ D) $\frac{2}{5}$

3. In a deck of 52 cards, Mario draws a card 18 times. In 18 draws a card in black suit was drawn 6 times. What is the probability that a red suit was drawn?
   A) $\frac{6}{18}$ B) $\frac{10}{18}$ C) $\frac{12}{18}$ D) $\frac{16}{18}$

4. The given frequency table at the right summarizes last week's bed sales at Khim's Furniture. Based on this data, what is a reasonable estimate of the probability that the next bed sold is a Queen bed?

Size of bed	Number of beds
Twin	30
Double	60
Queen	40
King	20

   A) $\frac{1}{15}$ C) $\frac{3}{15}$
   B) $\frac{2}{15}$ D) $\frac{4}{15}$

5. You are hired as worker that checks cartons of eggs. On a certain day, you check 20 cartons of eggs. Four of the cartons have at least one cracked egg. What is the experimental probability that a carton of eggs has at least one cracked egg?
   A) $\frac{1}{15}$ B) $\frac{1}{5}$ C) $\frac{1}{3}$ D) $\frac{3}{5}$

6. During a 24-hour period, the ratio of Pinoy pop songs played to Pinoy rap songs played on a radio station is 30:40. What is the experimental probability that the next song played is a Pinoy pop?
   A) $\frac{4}{5}$ B) $\frac{4}{7}$ C) $\frac{3}{7}$ D) $\frac{3}{4}$

7. In a spinner containing 6 slots numbered 1 to 6. You spin the spinner 15 times with the following results:

Number on the Spinner	1	2	3	4	5	6
Number of times it lands on it	3	2	3	2	4	1

What is the probability of landing on an even number?

A) $\frac{1}{2}$ B) $\frac{1}{3}$ C) $\frac{1}{5}$ D) $\frac{3}{5}$

For item numbers8 & 9, please refer to the information given below.

Eric rolls two dice 60 times and records the sum of the numbers on the top faces. The results are shown.

Rolling Two Dice											
Outcome (Sum)	2	3	4	5	6	7	8	9	10	11	12
Number of Times it Happened	2	3	5	6	8	10	9	7	5	3	2

8. What is the probability of getting a sum less than 6?

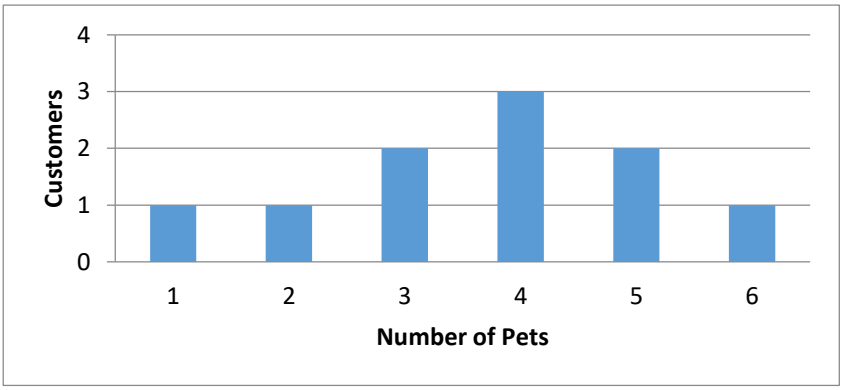
A) $\frac{24}{60}$ B) $\frac{2}{5}$ C) $\frac{16}{50}$ D) $\frac{4}{15}$

9. What is the experimental probability of getting an odd-numbered sum?

A) $\frac{1}{2}$ B) $\frac{1}{5}$ C) $\frac{29}{60}$ D) $\frac{31}{60}$

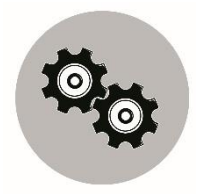
For item number 10, please refer to the given below.

The following bar graph shows how many pets each customer owned before entering Marc's Pet Store today.



10. Based on this data, what is a reasonable estimate of the probability that the next customer to enter Marc's Pet Store has exactly 4 pets?

A) $\frac{1}{5}$ B) $\frac{2}{5}$ C) $\frac{3}{5}$ D) $\frac{3}{10}$



Additional Activities

Directions: Solve this problem. Write your answer on a separate sheet of paper.

1. Two dice were tossed 50 times and a sum of 6 appeared 15 times. What is the probability that the sum that is not six appeared?

2. The following table shows the length (in days) of each of the Santos family vacations.

Length of Vacation	6	2	1	5	3	3

Based on this data, what is a reasonable estimate of the probability that the next Santos family vacation lasts less than 4 days?

Mario is choosing which shirt to wear on a day. He has 5 white shirts, 7 green shirts, and 3 black shirts. What is the probability that he will **NOT** choose a green shirt?

Answer Key

What I Know

1. A
2. D
3. C
4. B
5. C
6. A
7. C
8. B
9. A
10. B

What's More

Activity 1

1. $\frac{7}{12}$
2. $\frac{1}{12}$
3. $\frac{7}{12}$
4. $\frac{5}{12}$
5. $\frac{2}{12}$ or $\frac{1}{6}$

What's More

Activity 2

1. 50
2. 10
3. $\frac{22}{50}$ or $\frac{11}{25}$

Activity 3

1. $\frac{20}{31}$
2. $\frac{20}{60}$ or $\frac{1}{3}$
3. $\frac{30}{40}$ or $\frac{3}{4}$

What I Can Do

Experiment: Coin Flip

- The outcome would be different in every student

What I Have Learned

1. Probability
2. chances
3. experiment
4. outcome
5. experimental probability

Assessment

1. A
2. D
3. C
4. D
5. B
6. C
7. B
8. D
9. C
10. D

Additional Activities

1. $\frac{35}{50}$ or $\frac{7}{10}$
2. $\frac{4}{6}$ or $\frac{2}{3}$
3. $\frac{8}{15}$

References

Lumbre, Angelina P., and Alvin C. Ursua. 2016. *21St Century Mathematics 5 Textbook*. Quezon City: Vibal Group, Inc.

Northcutt, Ellen (Ed.). 2000. *Pre-GED Mathematics*. USA: Steck-Vaughn Company

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