

# Mathematics

## Quarter 3- Module 7 (Week 8) Solving Problems on Probability



**AIRs - LM**

PROPERTY  
SALE

**Mathematics 10**  
**Quarter 3 – Module 8 (Week 8)**  
**Solving Problems on Probability**

First Edition, 2021

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Region I

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**Development Team of the Module**

**Author:** Rustico R. Diaz

**Editor:** SDO La Union, Learning Resource Quality Assurance Team

**Illustrator:** Ernesto F. Ramos, Jr., *P II*

**Management Team:**

Atty. Donato D. Balderas, Jr.  
*Schools Division Superintendent*

Vivian Luz S. Pagatpatan, PhD  
*Assistant Schools Division Superintendent*

German E. Flora, PhD, *CID Chief*

Virgilio C. Boado, PhD, *EPS in Charge of LRMS*

Erlinda M. Dela Peña, EdD, *EPS in Charge of Mathematics*

Michael Jason D. Morales, PDO II

Claire P. Toluyen, *Librarian II*



## **Target**

**Problem-Solving** always plays a vital role in the success of every individual. It gives us a mechanism for identifying things, figuring out why they are broken and determining a course of action to fix them.

In this module, you will realize the importance of having proper skills in solving problems, choosing appropriate tools or skills to solve problems involving probability and learn to appreciate the importance of probability in the real-world.

The most essential learning competency (MELC) for this module is:

- Solves problems involving probability **(M10SP-IIIi-j-1)**

After going through this module, you are expected to:

1. Recall simple probability;
2. Illustrate the probability of compound events; and
3. Solve problems involving probability.

Before you start doing the activities in this lesson, find out how much you already know about this module. Answer the pre-test on the next page in a separate sheet of paper.



# Jumpstart

## PRE-ASSESSMENT

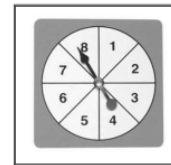
**Directions:** Read each mathematical statement carefully. Write the letter of your choice in a separate sheet of paper.

1. Brian likes to wear colored shirts. He has 10 shirts in the closet. Three of these are blue, four are in different shades of red, and the rest are of mixed or different colors. What is the probability that he will wear a blue or a red shirt?

A.  $\frac{7}{10}$       B.  $\frac{1}{2}$       C.  $\frac{3}{10}$       D.  $\frac{1}{10}$

2. The spinner on the right is spun. What is the probability of a spin that results in an even number or a number less than 4?

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



3. A nationwide survey revealed that 42% of the population likes eating pizza. If two people are randomly selected from the population, what is the probability that the first person likes eating pizza while the second one does not?

A.  $0.42 + (1 - 0.42)$       B.  $1 - 0.42$   
C.  $2(1 - 0.42)$       D.  $0.42(1 - 0.42)$

4. There are four batteries, and one of them is defective. Two are to be selected at random for use on a particular day. Find the probability that the second battery selected is not defective, given that the first was not defective.

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

For numbers 5-6, use the data given below.

A sample of 150 plastic pipes were selected and subjected to shock resistance and scratch resistance tests. The results are summarized in the table below.

Scratch Resistance	Shock Resistance	
	High	Low
High	125	12
Low	7	6

5. A pipe is selected at random. What is the probability that it has high shock resistance given that it has high scratch resistance?
- A.  $\frac{125}{132}$       B.  $\frac{125}{137}$       C.  $\frac{137}{150}$       D.  $\frac{132}{150}$
6. What is the probability that it has high scratch resistance and high shock resistance?
- A.  $\frac{125}{150}$       B.  $\frac{125}{137}$       C.  $\frac{137}{150}$       D.  $\frac{132}{150}$
7. A bag contains 7 green marbles, 3 yellow marbles and 5 red marbles. You choose two marbles. What is the probability of selecting a green then a red marble?
- A.  $\frac{1}{10}$       B.  $\frac{1}{9}$       C.  $\frac{1}{8}$       D.  $\frac{1}{6}$
8. A bag contains 7 green marbles, 3 yellow marbles and 5 red marbles. You choose two marbles. What is the probability of selecting a two yellow marbles?
- A.  $\frac{1}{10}$       B.  $\frac{1}{20}$       C.  $\frac{1}{35}$       D.  $\frac{1}{50}$
9. In a box there are 5 red pens, 3 green pens, and 2 blue pen. What is the probability of picking a red pen, replacing it, and then picking a blue pen?
- A.  $\frac{1}{10}$       B.  $\frac{1}{20}$       C.  $\frac{1}{30}$       D.  $\frac{1}{40}$
10. At Mathsagana NHS, the probability that a student joins VELG Club and Mathematics Club is 0.12. The probability that a student joins VELG Club is 0.7. What is the probability that a student joins Mathematics Club given that the student is taking VELG Club?
- A. 0.36      B. 0.17      C. 0.14      D. 0.05

For numbers 11-12, use the data below.

A class has the following grade distribution.

Grade	Number of Students
95	4
90	18
85	7
80	11
75	10

Suppose that a student passes the course if she or he gets a grade of 80.

11. If a student is randomly picked from the class, what is the probability that the student's grade is 95 if it is known that the student is passing the course?
- A.  $\frac{1}{7}$       B.  $\frac{5}{41}$       C.  $\frac{5}{43}$       D.  $\frac{1}{10}$

12. If a student is randomly picked from the passing class, what is the probability that the student's grade is 95 or greater than 85?
- A.  $\frac{11}{15}$       B.  $\frac{11}{20}$       C.  $\frac{11}{27}$       D.  $\frac{11}{40}$
13. Two men and three women are in a committee. Two of the five are to be chosen to serve as officers. If the officers are chosen randomly, what is the probability that both officers will be men?
- A.  $\frac{3}{4}$       B.  $\frac{1}{3}$       C.  $\frac{1}{10}$       D.  $\frac{1}{12}$
14. Mario has 15 red chips, 12 blue chips, and 13 white chips. What is the probability that Mario randomly selects a red chip or a white chip?
- A.  $\frac{1}{10}$       B.  $\frac{1}{2}$       C.  $\frac{7}{10}$       D.  $\frac{9}{10}$
15. Carl's basketball shooting records indicate that for any frame, the probability that he will score in a two-point shoot is 30%, a three-point shoot, 45%, and neither, 25%. What is the probability that Cindy will score either in a two-point shoot or in a three-point shoot?
- A. 25%      B. 45%      C. 50%      D. 75%

Well done. Now let's proceed to our module solving problems on probability.

## Lesson

# Solving Problems on Probability

In this module, the lesson starts with assessing your prior knowledge to basic probability (probability of simple events).

As you go through this lesson, always bear in mind that learning problem solving skills will build a mentally-ready individual like you in facing different challenges in life .

### Let's Recall:

Using the concepts that you have learned in the previous module involving simple probability, accomplish the given exercises below through:



1. If you spun the spinner once, what is the probability it would land on a shaded piece?
2. If you spun the spinner once, what is the probability it would land on unshaded piece?
3. If you spun the spinner once, what is the probability it would land on a piece with vowels?



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### ANSWERS

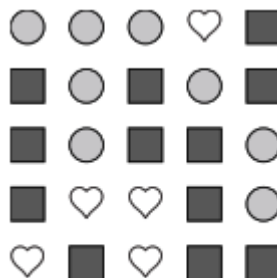
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_



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4. If you were to roll the dice one time, what is the probability it will land on a 3?
5. If you were to roll the dice one time, what is the probability it will **NOT** land on a 2?
6. If you were to roll the dice one time, what is the probability of it landing on an even number?

7. If you were to select 1 shape at random from the array, what is the probability it will be a circle?
8. If you were to select 1 shape at random from the array, what shape do you have the greatest



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- probability of selecting?
9. Which shape has a 32% chance  
(8 out of 25) of being selected?



## ***Discover***

**Probability** is the mathematical term for the likelihood that something will occur, such as drawing an ace from a deck of cards or picking a green piece of candy from a bag of assorted colors. You use probability in daily life to make decisions when you don't know for sure what the outcome will be. Most of the time, you won't perform actual probability problems, but you'll use subjective probability to make judgment calls and determine the best course of action.

As you go along with the different examples and exercises, you will learn deeply the different compound probabilities.

### **MUTUALLY EXCLUSIVE EVENTS**

- Mutually exclusive events, or disjoint events are events that cannot occur at the same time.
- If 2 events, A and B, are mutually exclusive, then the probability that either A **or** B occurs is the **sum** of their probabilities.

Formula:

$$\mathbf{P(A \text{ or } B) = P(A) + P(B)}$$

Example 1. Janet is going to an animal shelter to choose a new pet. The shelter has 8 dogs, 7 cats, and 5 rabbits available for adoption. If she randomly picks an animal to adopt, what is the probability it will be a cat **or** a dog?

Data Needed:

$$P(\text{cat}) = \frac{7}{20}$$

$$P(\text{dog}) = \frac{8}{20}$$

7 came from the number of cats while 20 came from the total number of animals.



Solution:

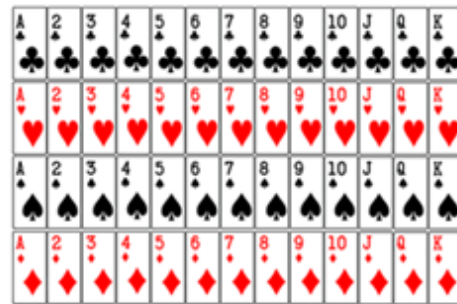
$$\begin{aligned}
 P(\text{cat or dog}) &= P(\text{cat}) + P(\text{dog}) \\
 &= \frac{7}{20} + \frac{8}{20} \\
 &= \frac{15}{20} \\
 P(\text{cat or dog}) &= \frac{3}{4}
 \end{aligned}$$

Example 2. Robert randomly drew one card from a standard deck of cards. What is the probability that the card he drew was a face card or a 10?

Data Needed:

$$P(\text{face card}) = \frac{12}{52}$$

$$P(10) = \frac{4}{52}$$



<https://images.app.goo.gl/j1c61t5rxhMZ5AgL6>

Solution:

$$\begin{aligned}
 P(\text{face card or } 10) &= P(\text{face card}) + P(10) \\
 &= \frac{12}{52} + \frac{4}{52} \\
 &= \frac{16}{52} \\
 P(\text{face card or } 10) &= \frac{4}{13}
 \end{aligned}$$

**Remember:** In a standard deck of cards, there are 52 cards in total.

### NOT MUTUALLY EXCLUSIVE EVENTS/ MUTUALLY INCLUSIVE EVENTS

- Mutually inclusive events are events that can occur at the same time.
- If 2 events, A and B, are mutually inclusive, then the probability that either A or B occurs is the sum of their probabilities, decreased by the probability of both occurring.

Formula:

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

Example 1. Suppose your dog had 9 puppies!

- 3 are brown females



- 2 are brown males
- 1 is a mixed color female
- 3 are mixed color males

If a puppy is randomly chosen from the litter, what is the probability that it will be male or be mixed color?

Data Needed:

$$P(\text{male}) = \frac{2+3}{9} = \frac{5}{9}$$

$$P(\text{mixed color}) = \frac{1+3}{9} = \frac{4}{9}$$

$$P(\text{male and mixed color}) = \frac{3}{9}$$



For male puppies, we combine 2 brown and 3 mixed color (2+3=5), while for mixed color we combine 1 mixed color female and 3 mixed color male (1+3=4) and for the probability of male and mixed color, you count the number of male puppies which has mixed colors.

Solution:

$$P(\text{male or mixed color}) = P(\text{male}) + P(\text{mixed color}) - P(\text{male and mixed color})$$

$$= \frac{5}{9} + \frac{4}{9} - \frac{3}{9}$$

$$= \frac{6}{9}$$

$$P(\text{male or mixed color}) = \frac{2}{3}$$

Example 2. In a bingo game, balls or tiles are numbered from 1 to 75. The numbers correspond to columns on a bingo card.

<b>B</b>	<b>I</b>	<b>N</b>	<b>G</b>	<b>O</b>
1-15	16-30	31-45	46-60	61-75

If a number is selected at random, what is the probability that it is multiple of 5 or in the “N” column?

Data Needed:

$$P(\text{multiple of 5}) = \frac{15}{75} = \frac{1}{5}$$

$$P(\text{number in the “N” column}) = \frac{15}{75} = \frac{1}{5}$$

$$P(\text{multiple of 5 and in the “N” column}) = \frac{3}{75}$$

Solution:

$$P(\text{multiple of 5 or in the "N" column}) = \frac{15}{75} + \frac{15}{75} - \frac{3}{75}$$

$$= \frac{27}{75}$$

$$P(\text{multiple of 5 or in the "N" column}) = \frac{9}{25}$$

### INDEPENDENT PROBABILITY

- For independent events, the outcome of one event does not affect the other event.
- The probability of two independent events can be found by multiplying the probability of the first event by the probability of the second event.

$$P(\mathbf{A \text{ and } B}) = P(\mathbf{A}) \cdot P(\mathbf{B})$$

Example 1. Two number cubes, one red and one blue, are rolled. What is the probability that the outcome of the red number cube is even and the outcome of a blue number cube is 5?

Data Needed:

$$P(\text{red number is even}) = \frac{3}{6} = \frac{1}{2}$$

there are 3 even numbers in a number cube (2, 4 and 6) while there are 6 numbers in a number cube (1, 2, 3, 4, 5, 6)

$$P(\text{blue number is 5}) = \frac{1}{6}$$

Solution:

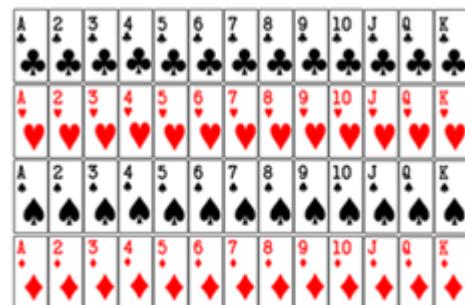
$$P(\text{even}, 5) = P(\text{even}) \cdot P(5)$$

$$= \left(\frac{1}{2}\right) \left(\frac{1}{6}\right)$$

$$P(\text{even}, 5) = \frac{1}{12}$$

there is only one 5 in a number cube while there are 6 numbers in a number cube (1, 2, 3, 4, 5, 6)

Example 2. A card is chosen at random from a deck of 52 cards. It is then replaced and a second card is chosen. What is the probability of choosing a jack and an eight?



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Data Needed:

$$P(\text{Jack}) = \frac{4}{52} = \frac{1}{13} ; \quad P(\text{Eight}) = \frac{4}{52} = \frac{1}{13}$$

Solution:

$$P(\text{Jack, Eight}) = P(\text{Jack}) \cdot P(\text{Eight})$$

$$= \left(\frac{1}{13}\right) \left(\frac{1}{13}\right)$$

$$P(\text{Jack, Eight}) = \frac{1}{169}$$

### DEPENDENT PROBABILITY

- If the outcome of one event affects the outcome of another event, the compound events are called dependent events.
- If two events, A and B, are dependent, then the probability of both events occurring is the product of the probability of A and the probability of B after A occurs.

$$P(\mathbf{A \text{ and } B}) = P(\mathbf{A}) \cdot P(\mathbf{B \text{ following } A})$$

Example 1. There are 6 black socks and 4 white socks in a drawer. If one sock is taken out without looking and then a second one is taken out, what is the probability that they both will be black?

Data Needed:

$$P(\text{first sock is black}) = \frac{6}{10} = \frac{3}{5}$$

6 represents the number of black socks while 10 represents the total number of socks in the drawer.

$$P(\text{second sock is black}) = \frac{5}{9}$$

Explanation: Assume that the first sock being taken out in a drawer is black, it means therefore that on the second draw there will be only 5 black socks out of remaining 9 socks.

$$P(\text{two black socks}) = P(\text{first sock is black}) \cdot P(\text{second sock is black})$$

$$= \left(\frac{3}{5}\right) \left(\frac{5}{9}\right)$$

$$= \frac{15}{45}$$

$$P(\text{two black socks}) = \frac{1}{3}$$

Example 2. An aquarium contains 5 male goldfish and 6 female goldfish. You randomly select a fish from the tank, do not replace it, and then randomly select a second fish. What is the probability that both fish are male?

Data Needed:

$$P(\text{male}) = \frac{5}{11}$$

$$P(\text{male}) = \frac{4}{10} = \frac{2}{5}$$

$$P(\text{male, male}) = P(\text{male}) \cdot P(\text{male})$$

$$= \left(\frac{5}{11}\right) \left(\frac{2}{5}\right)$$

$$= \frac{10}{55}$$

$$P(\text{male, male}) = \frac{2}{11}$$

## CONDITIONAL PROBABILITY

### Definition:

The conditional probability of  $A$  given  $B$  is the probability that event  $A$  occurs, given that event  $B$  has already occurred.

### Formula:

$$P(A/B) = \frac{P(A \cap B)}{P(B)}$$

Example 1. Sheila rolls a pair of number cubes. What is the probability that both numbers are odd if their sum is 6?

Let  $A$  be the event "Both numbers are odd."

Let  $B$  be the event "The sum of the numbers is 6."

You need to find the probability of  $A$  given  $B$ .

That is, you need to find  $P(A/B)$ .



<https://images.app.goo.gl/iEdS> image number cubes

Data Needed:

$$A = \{(1,1), (1,3), (1,5), (3,1), (3,3), (3,5), (5,1), (5,3), (5,5)\}$$

$$B = \{(1,5), (2,4), (3,3), (4,2), (5,1)\}$$

$$A \cap B = \{(1,5), (3,3), (5,1)\}$$

$$P(B) = \frac{5}{36}$$

### Note:

Rolling a pair of dice means there will be 36 sample space.

### Reason:

First number cube has 6 numbers and second number cube has 6 numbers, therefore  $6 \times 6 = 36$ .

$$P(A \cap B) = \frac{3}{36} = \frac{1}{12}$$

Solution 1:

$$P(A / B) = \frac{P(A \cap B)}{P(B)} = \frac{\frac{1}{12}}{\frac{5}{36}} = \left(\frac{1}{12}\right) \left(\frac{36}{5}\right) = \frac{36}{60} = \frac{3}{5}$$

Example 2. The probability that it is Friday and that a student is absent is 0.03. Since there are 5 school days in a week, the probability that it is Friday is 0.2. What is the probability that a student is absent given that today is Friday?

Let A be the event that a student is absent

Let B be the event that today is Friday

Find  $P(A / B)$ .

Data Needed:

$$P(A \cap B) = 0.03$$

$$P(B) = 0.2$$

Solution:

$$P(A / B) = \frac{P(A \cap B)}{P(B)} = \frac{0.03}{0.2} = 0.15$$

## ABSTRACTION

Compound Events	Formula	Clue Words
Mutually Exclusive Events	$P(A \text{ or } B) = P(A) + P(B)$	or
Mutually Inclusive Events	$P(A \text{ or } B) = P(A) + P(B) - P(A \cap B)$	or
Independent Events	$P(A \text{ and } B) = P(A) \cdot P(B)$	and
Dependent Events	$P(A \text{ and } B) = P(A) \cdot P(B \text{ following } A)$	and
Conditional Probability	$P(A / B) = \frac{P(A \cap B)}{P(B)}$	given that, if it is known that



## Explore

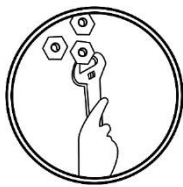
Read the given problems carefully. Under compound events column write **ME** if it describes a Mutually Exclusive Events, **NME** if it is Not Mutually Exclusive Events, **IE** if it is Independent Events, **DE** if it is Dependent Events and **CP** if it is Conditional Probability. Then solve the given problem and put your answer on probability column.

PROBLEMS	COMPOUND EVENTS	PROBABILITY
1. A litter of kittens consists of one gray female, three gray males, three black females, and one black male. You randomly pick one kitten. The kitten is black or male.		
2. A bag contains three white jerseys numbered one to three. The bag also contains five red jerseys numbered one to five. You randomly pick a jersey. It is white or has a number greater than four.		
3. A cooler contains nine bottles of sports drink: three lemon-lime flavored, three orange flavored, and three fruit-punch flavored. You randomly grab a bottle. Then you return the bottle to the cooler, mix up the bottles, and randomly select another bottle. The first time, you get a lemon-lime drink. The second time, you get a fruit-punch.		
4. Your sock drawer has four white socks, four brown socks, and two black socks. You randomly pick a sock and put it on your left foot and then pick another sock and put it on your right foot. You leave the house with a white sock on your left foot and a brown sock on your right foot.		

5. The following table shows the number of people that like a particular fast food restaurant.

	Jabee	Shawking	May Inasal
Male	20	15	10
Female	20	10	25

What is the probability that a person is male given that he likes Shawking?



**Deepen**

Read each problem carefully then solve . Show your complete solution.

- At Mathsagana National High School, the probability that a student joins VELG CLUB and Mathematics Club is 0.087. The probability that a student joins VELG Club is 0.68. What is the probability that a student joins the Mathematics Club given that the student is a member of the VELG Club?
- A random sample of parts coming off a machine is done by an inspector. He found that 5 out of 100 parts are bad on average. If he were to do a new sample, what is the probability that he picks a bad part and then, picks another bad part if he doesn't replace the first?
- Of 570 people, 365 were male and 368 had brown hair. Of those with brown hair, 108 were female. What is the probability that a person was male or had brown hair?





## Gauge

**Directions:** Read each mathematical statement carefully. Write the letter of your choice in a separate sheet of paper.

1. If you draw one card from a standard deck, what is the probability of drawing a 5 or a diamond? Are the events mutually inclusive or mutually exclusive?  
A. Mutually Exclusive                      B. Mutually Inclusive  
C. None of These                          D. Undecided
2. If you draw one card from a standard deck, what is the probability of drawing a 5 or a diamond?  
A.  $\frac{1}{13}$                       B.  $\frac{2}{13}$                       C.  $\frac{3}{13}$                       D.  $\frac{4}{13}$
3. If you draw one card from a standard deck, what is the probability of drawing a spade or a red card? Are the events mutually inclusive or mutually exclusive?  
A. Mutually Exclusive                      B. Mutually Inclusive  
C. None of These                          D. Undecided
4. If you draw one card from a standard deck, what is the probability of drawing a spade or a red card?  
A.  $\frac{1}{4}$                       B.  $\frac{1}{2}$                       C.  $\frac{3}{4}$                       D.  $\frac{5}{6}$
5. If you roll one die, what is the probability of getting an odd number or a 4?  
A.  $\frac{1}{2}$                       B.  $\frac{2}{3}$                       C.  $\frac{3}{4}$                       D.  $\frac{5}{6}$
6. A bag contains 9 green marbles, 5 yellow marbles and 6 red marbles. You choose one marble. What is the probability of selecting a green or red marble?  
A.  $\frac{1}{2}$                       B.  $\frac{2}{3}$                       C.  $\frac{3}{4}$                       D.  $\frac{5}{6}$
7. A bag contains 9 green marbles, 5 yellow marbles and 6 red marbles. You choose two marbles. What is the probability of selecting a green then a red marble?  
A.  $\frac{27}{190}$                       B.  $\frac{25}{190}$                       C.  $\frac{23}{190}$                       D.  $\frac{19}{190}$
8. A bag contains 9 green marbles, 5 yellow marbles and 6 red marbles. You choose two marbles. What is the probability of selecting a two yellow marbles?  
A.  $\frac{7}{20}$                       B.  $\frac{3}{20}$                       C.  $\frac{2}{19}$                       D.  $\frac{1}{19}$
9. In a box there are 3 red pens, 2 green pens, and 1 blue pen. What is the probability of picking a red pen, not replacing it, and then picking a blue pen?  
A.  $\frac{1}{10}$                       B.  $\frac{1}{20}$                       C.  $\frac{1}{30}$                       D.  $\frac{1}{40}$

10. At Don Eufemio Memorial NHS, the probability that a student takes CSS and Beauty Care is 0.15. The probability that a student takes CSS is 0.4. What is the probability that a student takes Beauty Care given that the student is taking CSS?

A. 0.36      B. 0.375      C. 0.39      D. 0.398

11. A class has the following grade distribution.

Grade	Number of Students
95	5
90	14
85	7
80	9
75	8

Suppose that a student passes the course if she or he gets a grade of 80.

If a student is randomly picked from the class, what is the probability that the student's grade is 95 if it is known that the student is passing the course?

A.  $\frac{1}{7}$       B.  $\frac{5}{41}$       C.  $\frac{5}{43}$       D.  $\frac{1}{10}$

12. Barbara, Carol, Alice, Perla and Sabrina are competing for two roles in a play. Assume that the two to get roles will be randomly chosen from the five girls. What is the conditional probability that Perla gets a role if we know that Carol does not get a role?

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

13. Two men and three women are in a committee. Two of the five are to be chosen to serve as officers. If the officers are chosen randomly, what is the probability that both officers will be women?

A.  $\frac{3}{4}$       B.  $\frac{1}{3}$       C.  $\frac{3}{10}$       D.  $\frac{3}{8}$

For number 14-15, refer on the given survey:

In a small town with two schools, 1 000 students were surveyed if they had mobile phone. The results of the survey are shown below.

	With Mobile Phone	Without Mobile Phone	Total
School A	365	156	521

School B	408	71	479
Total	773	227	1 000

14. If two students were picked randomly, what is the probability that both don't have a mobile phone?

A.  $\frac{25\ 651}{499\ 500}$     B.  $\frac{25\ 561}{499\ 500}$     C.  $\frac{25\ 165}{499\ 500}$     D.  $\frac{25\ 156}{499\ 500}$

15. What is the probability that a randomly selected student has a mobile phone given that the student attends school B?

A.  $\frac{521}{1\ 000}$     B.  $\frac{408}{1\ 000}$     C.  $\frac{408}{479}$     D.  $\frac{408}{521}$

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