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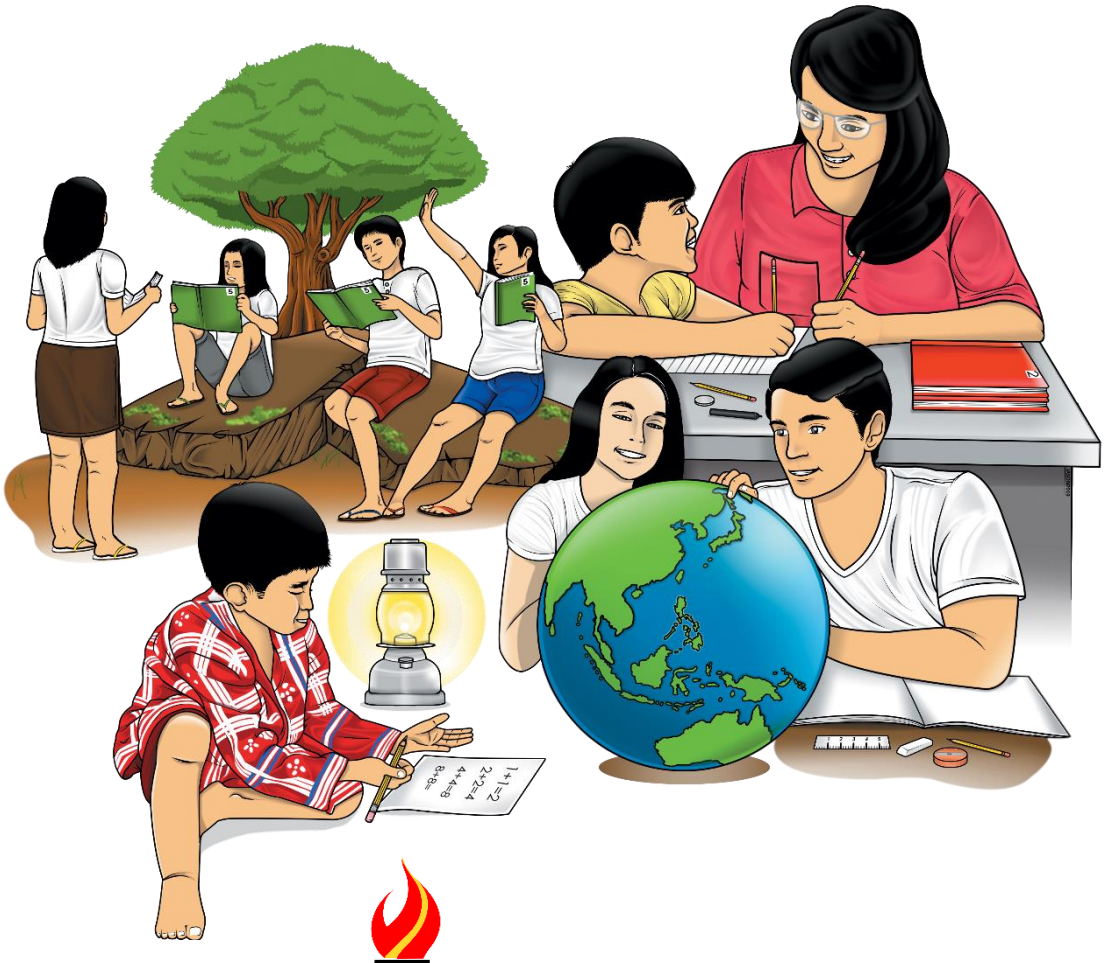
Science

Quarter 3 – Module 1:
Let's Do The Motion



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Secretary: Leonor Magtolis Briones
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Development Team of the Module

Writers & Illustrators: Glenn Frey L. Pepito, Leah Joy Desamparado-Walan

Editors: Lenie G. Forro, Cynthia S. Bustillo, Miraflor O. Albios

Reviewers: Agabai S. Kandalayang, Marry Anne A. Barrientos,
Mary Joy D. Bautista, Yusof A. Aliudin

Layout Artist: Glen D. Napoles, Analyn J. Madera, Jacqueline E. Libut

Management Team: Allan G. Farnazo
Isagani S. Dela Cruz
Gilbert B. Barrera
Arturo D. Tingson, Jr.
Peter Van C. Ang-ug
Elpidio B. Daquipil
Juvy B. Nitura
Lenie G. Forro

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Department of Education –Region XII

Office Address: Regional Center, Brgy. Carpenter Hill, City of Koronadal
Telefax: (083) 2281893
E-mail Address: region12@deped.gov.ph

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Quarter 3 – Module 1:
Let's Do The Motion

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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.

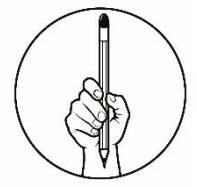
What I Need to Know

You observe a lot of moving objects every day. Some objects move along a straight line like a car traversing the highway while other objects move in circles like a rotating disk. Because you experience motion on a daily basis, you may find it ordinary and unnecessary to learn. In Physics, however, learning about motion requires understanding of the quantities related to it. These quantities include distance or displacement, speed or velocity, and acceleration.

This module provides you with the essential concepts and activities necessary to describe motion along a straight path and in terms of position, distance, and speed. You will learn to interpret and analyze motion of objects through charts, diagrams and graphs.

After going through this module, you are expected to:

1. describe the point of reference of an object; and
2. differentiate the distance and displacement covered by an object



What I Know

Directions: Choose the best answer from the given choices. Write the letter of your choice on a separate sheet of paper.

1. Which refers to the length of the entire path travelled by an object?
   A. Displacement
   B. Distance
   C. Motion
   D. Time

2. Which refers to the shortest distance between to object's two positions?
   A. Displacement
   B. Distance
   C. Motion
   D. Time

3. The change in position over an interval of time is called _____.
   A. Displacement
   B. Distance
   C. Motion
   D. Time

4. The distance travelled by an object, how fast the object is travelling, and the direction in which the object travels to, is measured with respect to _____.
    A. Motion
    B. Distance
    C. Displacement
    D. Reference Point

5. If an object is in motion, it changes position relative to its _____.
    A. Time
    B. Angle
    C. Speed
    D. Reference Point

6. Displacement can be equal to distance when _____.
    A. object is in circular motion.
    B. path travelled is a straight line.
    C. ball is rolling on an inclined plane.
    D. car is travelling on the road upward.

7. Which of the following describes the distance covered by an object?
    A. 5 s
    B. 8 m
    C. 10 m/s
    D. 12 m, North

8. Which of the following shows the displacement travelled by an object?
    A. 9 s
    B. 18 km
    C. 27 km/h
    D. 36 km, South

9. All of the following are the materials used in measuring the distance covered by an object EXCEPT _____.
    A. Ruler
    B. Timer
    C. Meter stick
    D. Measuring tape

10. Ethan claims that the house where he lives is actually constantly moving. Which of the following points of references do you think will best support his claim?
    A. Earth
    B. Floor
    C. House
    D. Sun

11. When is an object considered to be in motion?

I. When its position changes with respect to a point of reference. II. When its distance changes with respect to a point of reference. III. When its direction changes with respect to a point of reference.

A. I, II, and III
B. I and II only
C. I and III only
D. II and III only

12. Jeofrey walked 300 m East from home to visit Mattheus. He then walked another 500 m East to fetch Jhen and both of them walked 300 m West to watch the birds. Which of the following statements is true?
A. Jeofrey went home.
B. Jeofrey has travelled a total distance of 1,000 m.
C. Jeofrey's displacement is shorter than the total distance he has travelled.
D. Jeofrey's displacement is zero if he has travelled 700 m West together with Jhen.

13. Which of the following is true about an object that travels 5 meters to the left, then another 5 meters to the right?
A. The displacement of the object is equal to 10 meters.
B. The displacement of the object is equal to 10 meters, right.
C. The total distance travelled by the object is equal to 10 meters.
D. The total distance travelled by the object is equal to 10 meters, right.

14. Jenelene was asked by her science teacher if an object's displacement can be longer than distance. She answered no. Is Jenelene's answer correct?
A. Yes, displacement can be longer to the distance.
B. No, displacement is the total length covered by an object in motion.
C. Yes, displacement is the longest length between two object's point of origin and its point of destination.
D. No, displacement is the shortest length between two object's point of origin and its point of destination.

15. Leah, an aspiring athlete, runs the oval. The oval has a total length of 1500 meters. She always finished running 2 laps as part of her daily routine. Is it true that her total displacement is 3000 meters, East?
A. No, because her total displacement is equal to zero.
B. Yes, because she finished 2 laps which is equal to 3000 meters.
C. No, because her total displacement should be 3000 meters, West
D. Yes, because her displacement is equal to her total distance covered.

Lesson 1 Distance and Displacement

What's In

How an object moves is described relative to something else. Before you will be able to describe the motion of an object, you must first be able to tell exactly where it is positioned. Describing exact position entails two ideas: a) describing how far the object is from the point of reference and, b) describing its direction relative to that point of reference. In other words, the distance travelled by an object, how fast the object is travelling, and the direction in which the object travels to, are measured with respect to a **point of reference**.

In a general sense, you can say that motion is accompanied by a series of movements. That is, for an object to be in motion, it must move from its initial position to a final position. **How do you scientifically describe the motion of an object?**

What's New

Activity 1. Introduction to Motion

Directions: Study the picture and answer the succeeding questions. Write your answer on a separate sheet of paper.

A ball rolls rightward towards the tree while the car moves leftward towards the same tree.

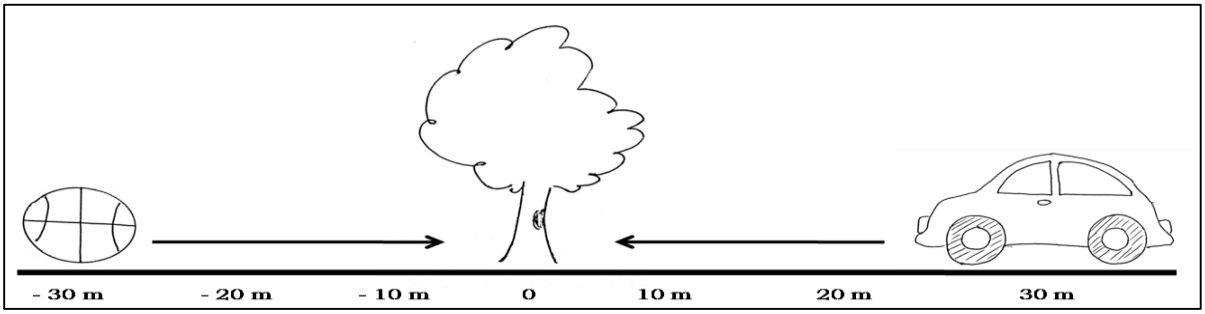


Figure 1. The ball and the car moving toward the tree.

Illustrated by Glenn Frey L. Pepito

Guide Questions:

Directions: Write your answers on a separate sheet of paper.

1. *How far originally is the car from the tree?*
2. *Before they started moving, what is the original distance between the car and the ball?*
3. *If the car moves a distance of 2 meters in one second, how far will it be from the tree after 5 seconds?*
4. *Suppose the ball covers a distance of 1 meter in one second, how much distance can it cover in 5 seconds?*

What is It

Motion of an Object

In the illustration above, you could say that both the ball and car moved with respect to something else that is considered to be not moving- the tree. You know that the ball moved because its position has changed from its initial position to the location of the tree after some time has passed. The same can be said of the car. The location of an object at any particular time is its **position**. An object is moving if it changes position relative to a reference point after a passage of time.

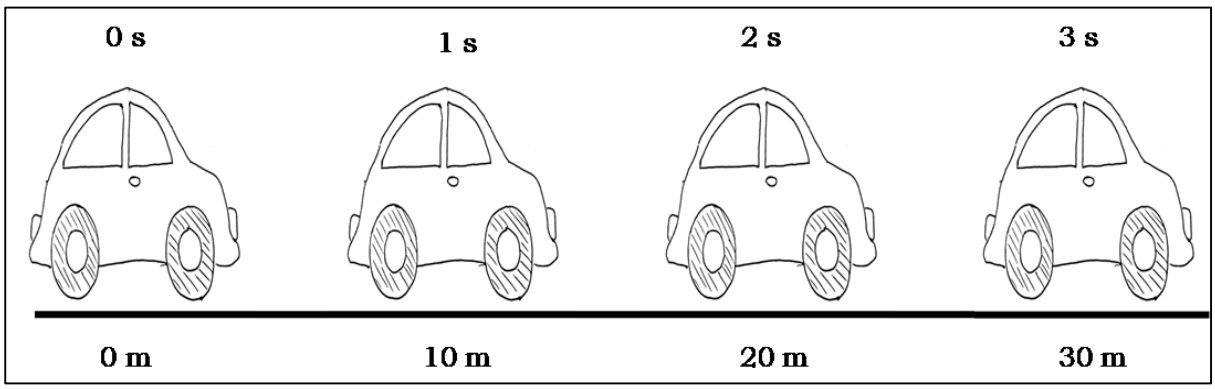


Figure 2. A car in motion

Illustrated by Glenn Frey L. Pepito

Suppose you take the 0 m-mark at time t = 0 s as the point of reference in figure 2. After 2 seconds, the car travelled a distance of 20 meters. However, if you take the 20 m-mark as a point of reference, you will find that the car will cover a distance of 10 meters after a second. Generally, you are free to choose whichever point of reference you favor but most would choose the origin (starting point or position at t = 0 s) for convenience. Objects that are fixed relative to Earth such as a tree, building, or post make good **points of reference**.

To fully describe motion, you need to describe first the object's position. Before the car moves towards the tree, the car was in its starting position. Upon reaching the tree, the car has changed its position. Its new position was in front of the tree. How far has the car moved? The car has moved 30 meters. The **distance** an object moves is the total length of path travelled from its initial position to its final position. It refers to how much ground the object has covered during its motion.

The description of an object's motion often includes more than just the distance it covers. If the distance between the car and the tree is 30 meters, then the distance travelled by the car is 30 meters. But imagine that the car moved back to its initial position from the tree. This time, the car has travelled a total distance of 60 meters but the car ended up in its same starting point. Even though the car has moved a total distance of 60 meters, its displacement is 0 meter. **Displacement** is the object's overall or net change in position. It refers to how far out of place an object is from its initial position.

If you only describe the car's initial movement, then the distance travelled and the displacements are the same which is 30 meters. But if you describe the back-and-forth movements of the car, the distance and displacement are different. In describing distance, only the **magnitude or size** (amount) of the distance travelled is considered. However, in describing **displacement**, both the magnitude of the change in positions and the direction of the movement are considered. As such, distance is a scalar quantity while displacement is a vector quantity.

Take a look at other illustration below.

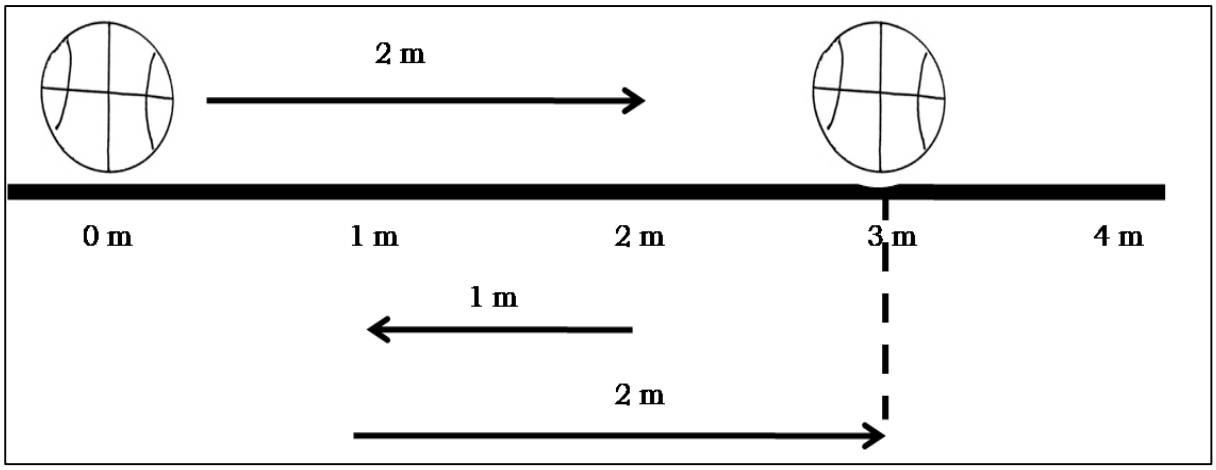


Figure 3. A ball at the 0 m position.

Illustrated by Glenn Frey L. Pepito

A ball is rolled 2 meters to the right, then rolled 1 meter to the left. It is again rolled 2 meters to the right. During the course of this motion, the ball has covered a total distance of 5 meters (2 m + 1 m + 2 m = 5 m). However, the ball's displacement is 3 meters to the right or 3 meters East [2 m, East + 1 m, West + 2 m, East= 3 m, East].

In this case, add the magnitude of the same directions.

2 m, East + 2 m, East = **4 m, East**

Then, subtract the magnitude of opposite directions and follow the direction of the bigger magnitude.

4 m, East – 1 m, West = **3 m, East**

Note that direction is present when describing the displacement of an object or body.

POINTS TO REMEMBER:

- ✓ In solving for the distance, get the sum of all the magnitude of the object in motion.
- ✓ In solving for the displacement, get the sum of the magnitude of the same directions. Then, subtract the magnitude of opposite directions and follow the direction of the bigger magnitude.

What's More

Activity 2. How far?

Directions: Study the illustrations below showing the displacement and distance covered by the dog.

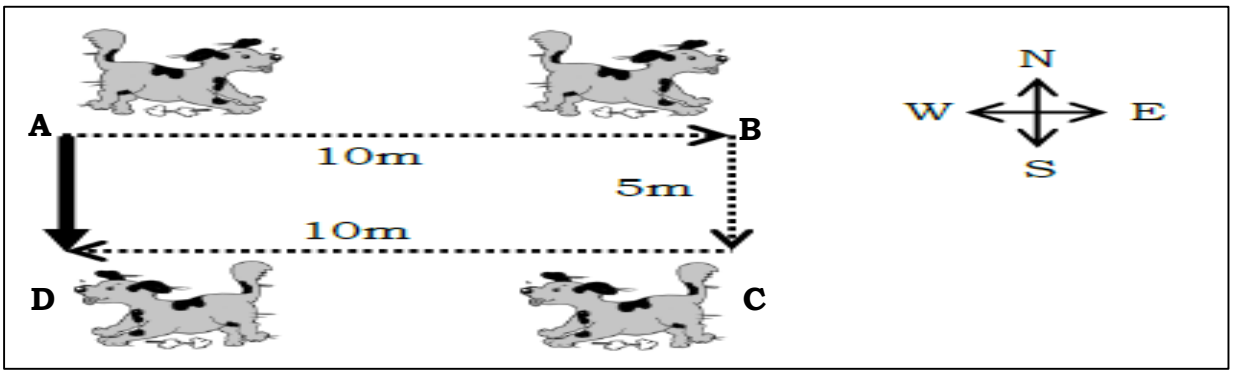


Figure 5. A dog showing its total distance and displacement covered.
Source: DepEd Grade 7 LM

Guide Questions:

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

5. *What is the starting point of the dog?*
6. *Define point of reference in your own words.*
7. *What is the distance covered by the dog from point A to point D?*
8. *What is the displacement of the dog?*

9. *Suppose the dog goes back to point A as its final position, what will be its displacement?*
10. *It is possible to get zero displacement? When can displacement be equal to zero?*
11. *Suppose the dog travels only from point A to point B, What will be its total distance covered? How about its displacement?*
12. *When can displacement be equal to distance?*
13. *Can displacement be greater than distance? Why or why not?*
14. *Give one difference between distance and displacement based on the given example.*

What I Have Learned

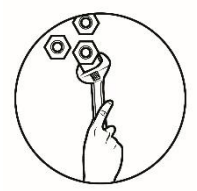
Directions: Read the paragraph carefully and identify the word from the box that will complete each sentence correctly. Write your answers in your activity notebook.

Distance	Moving	Motion
Reference point	Add	Displacement
Direction	Difference	Destination

_____ is defined as the change in position over an interval of time with respect to a reference object. An object is said to be _____ when it has travelled a certain distance from the reference point, or it is displaced from the reference point. In other words, the distance travelled by an object, how fast the object is travelling, and the direction in which the object travels to, are measured with respect to a _____.

_____ is a scalar quantity. It has magnitude but no direction. To get the total distance travelled by a body, all we have to do is _____ all the distances travelled. On the other hand, displacement, a vector quantity for it has both magnitude and _____, is the _____ between two positions.

Moreover, distance does not always follow a straight line unlike with displacement that always follows a straight line. _____ measures the length of the straight line that connects the object's point or origin and its point of _____ while distance measure's the length of the path travelled by the object.



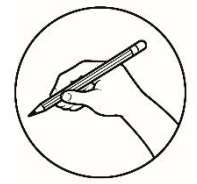
What I Can Do

Directions: Elaborate the Filipino quote below and relate it to the concept on the importance of specifying the reference point when describing the distance and displacement covered by an object. Write your answers on a separate sheet of paper.

"Ang hindi marunong lumingon sa pinanggalingan, ay hindi makakarating sa paroroonan"- Anonymous

Rubrics

	Excellent (5 points)	**Strong (4 points)**	**Fair (3 points)**	**Needs Improvement (2 points)**
Content	Main ideas are clear and well-supported by detailed and accurate information.	Main ideas are clear but are not well-supported by detailed information.	Main ideas are somewhat clear.	Main ideas are not clear.
Organization	Information is relevant and presented in a logical order.	Information is relevant but not presented in a logical order.	Information is somewhat relevant.	Information is not relevant.



Assessment

Directions: Choose the best answer from the given choices. Write the letter of your choice on a separate sheet of paper.

1. Which refers to the length of the entire path travelled by an object?
   A. Displacement
   B. Distance
   C. Motion
   D. Time

2. Which of the following describes displacement?
   A. It has direction only.
   B. It has magnitude only.
   C. It lacks magnitude and direction.
   D. It has both the magnitude and direction.

3. Which of the following measures the length of the straight line that connects the object's point or origin and its point of destination?
    A. Motion
    B. Distance
    C. Displacement
    D. Point of reference

4. Which of the following shows a distance covered by an object?
    A. 15 s
    B. 20 m
    C. 10 m/s
    D. 5 m East

5. Which of the following best differentiates distance from displacement?
    A. Distance is a vector quantity while displacement is a scalar quantity.
    B. Distance always follows a straight line while displacement does not always follow a straight line.
    C. Distance is the total length of the entire path travelled by an object while displacement is the shortest distance between the object's two positions.
    D. Displacement is the total length of the entire path travelled by an object while distance is the shortest distance between the object's two positions.

For numbers 6-12, analyze the illustration given below and answer the questions.

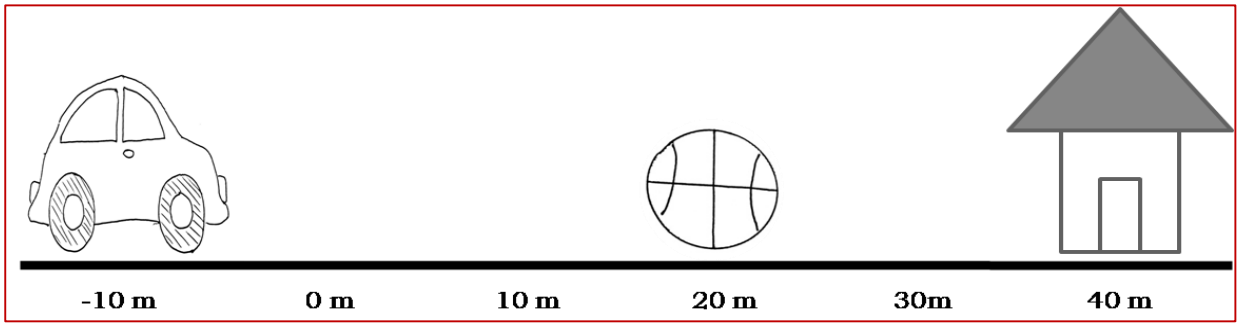


Figure 6. Reference point of the car, the ball and house.

Illustrated by Glenn Frey L. Pepito

6. What is the position of the car with the house as its reference point?
    A. – 10 m
    B. 0 m
    C. 40 m
    D. 50 m

7. What is the position of the ball with the house as its reference point?
    A. 0 m
    B. 10 m
    C. 20 m
    D. 40 m

8. How far is the car from the ball?
    A. The car is 30 meters to the left of the ball.
    B. The car is 20 meters to the left of the ball.
    C. The car is 30 meters to the right of the ball.
    D. The car is -10 meters to the right of the ball.

9. If the ball moves from its position to the 30-meter mark, what is its displacement?
    A. 0 m
    B. 10 m
    C. 20 m
    D. 30 m

10. Suppose the car moved 20 meters to the right, then turned 10 meters back to the left. What are its distance travelled and its displacement?
    A. The distance will be 30 meters and the displacement will be 0.
    B. The distance will be 20 meters and the displacement will be 10 m, right.
    C. The distance will be 30 meters and the displacement will be 10 m, right.
    D. The distance will be 10 meters and the displacement will be 10 m, right.

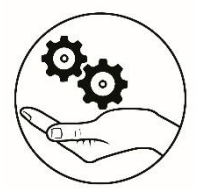
11. Assume that the ball moved to the house and rolled back to its original position, how far would the ball travel and what would be its displacement?
    A. The distance and the displacement of the ball from its reference point would be both 40 meters.
    B. The distance and the displacement of the ball from its reference point would be both 0 meter.
    C. The distance of the ball from its reference point will be 40 meters and its displacement would be 0 meter.
    D. The distance of the ball from its reference point will be 0 meter and its displacement would be 20 meters.

12. Assume that the car moved to the house and moved back to its original position, what would be its distance and its displacement?
    A. The distance travelled and the displacement of the car would be both 100 meters.
    B. The distance travelled by the car will be -10 m and its displacement would be 40 m.
    C. The distance travelled by the car will be zero and its displacement would be 100 meters.
    D. The distance travelled by the car will be 100 meters and its displacement would be zero.

13. If the position of an object is not changing, what do you think does this indicate about its displacement?
    A. The displacement is zero.
    B. The displacement is lesser than the distance.
    C. The displacement is greater than the distance.
    D. The displacement is the same with the distance travelled by an object.

14. Glenn was asked by his science teacher if an object's displacement could be shorter than distance. He answered yes. Is Glenn's answer correct?
    A. Yes, displacement is always equal to zero.
    B. No, displacement is the total length covered by an object in motion.
    C. No, displacement is the longest length between two object's point of origin and its point of destination.
    D. Yes, displacement is the shortest length between two object's point of origin and its point of destination.

15. Is it correct to say that our house is constantly moving when its reference point is the sun?
    A. No, the house will only move when an earthquake occurs.
    B. No, the house as the reference point is not affected by the sun.
    C. Yes, since the house is placed on the Earth's ground where the sun is constantly moving.
    D. Yes, since the house is placed on the ground where the Earth is constantly moving around the sun.



Additional Activities

Activity 3. Measuring Distance and Displacement

Objective: To measure and determine displacement of a 10-centavo coin

Materials: 10 centavo-coin, centimeter ruler paper

Procedures:
1. Place a 10-centavo coin on the number line with the center of the 10-centavo coin at the position marked zero.
2. Draw a circle around the inside of the 10-centavo coin.
3. Mark the center of this circle with the letter I for the word "initial" position of the coin.
4. Move the coin 8.0 cm to the right. Draw a circle and mark its center with 1.
5. Move the coin again to 2.0 cm to the left. Draw a circle and mark its center with 2.
6. Move the coin for the third time to 3.0 cm to the left. Draw a circle and label this circle F for the "final" position of the coin.

Guide Questions:

Directions: Write your answers on a separate sheet of paper.

1. What was the initial position of the coin?
2. What is the final position of the coin?
3. What is the distance travelled by the coin?
4. What is the displacement of the coin?

What I Need to Know

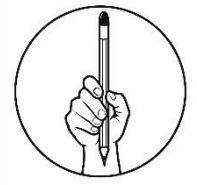
Hello! How are you? Have you observed the road signs near your school zone? Have you seen signs like “School Zone” and “Speed limit: 20km/h.” What do these signs mean?

In lesson 1 of this module, you were able to describe the motion of an object in terms of distance and displacement. Distance and displacement answers the question, “How far did the object travel?” After determining how far the object moves, the next question in describing motion will be “How fast did the object move?”

This lesson will help you understand how fast an object moves quantitatively through its speed, velocity and acceleration.

After going through this lesson, you are expected to:

1. define speed, velocity and acceleration;
2. differentiate instantaneous speed and constant speed; and
3. solve problems involving speed and velocity.



What I Know

Direction: Choose the best answer from the given choices. Write the letter of your choice on a separate sheet of paper.

1. Which of the following is defined as the displacement covered per unit time?
   A. Acceleration
   B. Displacement
   C. Speed
   D. Velocity

2. Which of the following is a unit of speed?
   A. Meter
   B. Second
   C. Meter/Second
   D. Meter/Second/Second

3. What is shown when you look at the speedometer in a moving car?

A. Average speed
B. Average acceleration
C. Instantaneous speed
D. Instantaneous acceleration

4. Which of the following is defined as the change of velocity per unit time?

A. Acceleration
B. Displacement
C. Distance
D. Velocity

5. Which of the following statements refers to velocity?

I. Boy walks 30m east	III. Ball rolls 10 m/s north
II. Car runs 40 m/s west	IV. Air moves 100 km/hr

A. I only
B. II only
C. II and III only
D. II, III and IV only

For questions 6 and 7, refer to the table below. Data were obtained from a 200-meter dash competition.

Female Athlete	Recorded Time	Male Athlete	Recorded Time
1	26.5 s	1	22.4 s
2	26.1 s	2	21.9 s
3	25.3 s	3	23.0 s
4	26.7 s	4	22.6 s

6. Which of the following statements is/are true?

I. The female athletes are as fast as the male athletes.
II. The male athletes are faster than the female athletes.
III. The fastest athlete has a recorded time of 26.7 seconds.
IV. Compared to the speed of the fastest male athlete, the average speed of the fastest female athlete is slightly less.

A. II and IV only
B. III and IV only
C. I, II and III only
D. II, III and IV only

7. How do you compute for the average speed of each athlete?

A. Divide the recorded time of travel by 200 meters.
B. Divide 200 meters by the recorded time of travel.
C. Multiply 200 meters by the recorded time of travel.
D. Divide 200 meters by twice the recorded time of travel.

8. Which of the following statements is NOT true about the object moving with constant speed?
   A. The object is not accelerating
   B. The speed of the object is equal to zero.
   C. The distance travelled by the object increases uniformly.
   D. The speed of the object remains the same all throughout the travel

9. What is the speed of a moving vehicle in going upward in an inclined road?
   A. Increases
   B. Decreases
   C. The same
   D. Both increasing and decreasing

10. A moving jeepney is approaching an intersection. What should a responsible driver do?

I. Continue driving	III. Decrease the speed
II. Increase the speed	IV. Step the break immediately

   A. I only
   B. III only
   C. II and III only
   D. III and IV only

For question 11, refer to the table below.

RUNNERS	DISTANCE (m)	TIME (s)
W	70	10
X	80	10
Y	95	10
Z	105	10

11. Who among the runners had the greatest speed?
   A. Runner W
   B. Runner X
   C. Runner Y
   D. Runner Z

12. Which of the following situation/s exhibit/s accelerated motion?

I. A car travels 10km in 1hour.
II. A boy on his bike moves around a curve with a constant speed of 6km/h.
III.A girl initially running around 2km/h suddenly stops because of a truck.
IV. A man initially running at 7km/h E, moves west at the same speed of 7km/h.

   A. II, III
   B. I, II, III
   C. II, III, IV
   D. I, II, III, IV

13. Given the table below, which of the following statements about the learners' speeds is true?

Learner	Distance Travelled (m)	Time (s)
Rhea	40	8
April	20	5
Stella	60	12

A. Stella >Rhea >April
B. Rhea =Stella <April
C. April <Stella =Rhea
D. April <Rhea >Stella

14. Edmar conducted an experiment on speed using his toy car. He listed all the data he gathered in the table below. Upon analyzing his data, he concluded that toy car C is the fastest among the four. Do you think his conclusion is correct?

TOY CAR	DISTANCE (cm)	TIME (s)
A	100	10
B	100	15
C	100	20
D	100	18

A. Yes, because its speed is 20m/s.
B. Yes, because it has the greatest time recorded.
C. No, because all the toy cars travelled the same distance.
D. No, because the fastest toy car is the one that took the least time.

15. Leigh was asked by her teacher how to solve the speed of an object. She said that to solve for the speed of an object, one must multiply the distance travelled by the recorded time of travel. Do you think her process is correct?
A. Yes, because multiplication is the way to solve for speed.
B. Yes, because she had all the needed data like distance and time.
C. No, because in solving for speed one must divide the distance travelled by the recorded time of travel.
D. No, because in solving for speed one must add the recorded time and the distance travelled.

Lesson 2 Speed, Velocity and Acceleration

What's In

Hello! In the previous lesson, you have learned that objects can be described by measuring and identifying certain properties such as distance and direction. You have also learned that motion involves a change in the position and passage of time. Hence, the motion of objects can also be described by measuring the properties of distance and time. Combining these measurements describe the three quantities of motion such as *speed, velocity,* and *acceleration.*

Activity 1: Distance and Displacement

You walked 40 m east from your house to school. However, you forgot to bring your books so you decided to return home. On your way back home 20 m due west, you met your brother carrying the books you forgot. After receiving the books, you turned east and walked an additional distance of 30 meters to reach your school. *(1) What is the total distance that you've walked? (2) What is your total displacement?*

When you arrived at school, you found out that classes for that day were suspended. You went back home through the same path. *(3) What is the total distance you walked in going to school and returning home? (4) What is your total displacement?*

What's New

Activity 2: Fun Walk

Objective: After performing this activity, you should be able to gather data to determine who walks the fastest.

Materials: stopwatch/timer, marker/chalk/any materials that can be used as marker

Procedure:

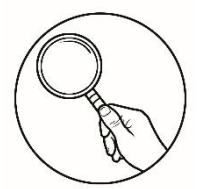
1. Start by choosing the participants for this activity. Invite your family members who are able to walk to be your participants. Assign a recorder who will record the data.
2. On a spacious place, mark the starting and finish lines on the ground.
3. Each participant will walk as fast as s/he can to reach the finish line. No running is allowed.

4. The recorder will take note of the time each participant takes to finish the straight course.
5. The participants will walk the course for a total of three tries.
6. You will compute for the average time it takes for each participant to finish the course.

Guide Questions:

Directions: Write your answers on a separate sheet of paper.

1. *Who came out as the fastest among all the participants? What about the slowest participant?*
2. *How did you determine the winners of the game/activity?*
3. *What quantities did you calculate to determine the winner?*
4. *How did you combine these quantities to determine how fast or slow the participants walked?*



What is It

What is Speed?

A description of how fast or slow an object moves is its **speed.** It is the rate at which an object changes its location. Like distance, speed is a scalar quantity because it only considers magnitude but not direction. Average speed is the distance travelled divided by the time it takes to travel the distance. The SI unit of speed is meters per second (m/s), but other units of speed such as kilometers per hour (km/h) or miles per hour (mph) are sometimes used.

As an equation, speed is shown as:

$$v = \frac{d}{t}$$

where:

v	=	speed
d	=	distance covered
t	=	time of travel

Example 1

Elma Muros, the fastest female sprinter in Southeast Asia, can run a 200-m distance course in 24.42 seconds. What is Elma's speed?

Given:	d	=	200 m
	t	=	24.42 s
Find:	*v*	=	*?*

Solution:

$$v = \frac{d}{t}$$

$$v = \frac{100m}{10.49s}$$

$$v = 9.53 \text{ m/s}$$

What is Velocity?

Sometimes, describing the speed of the object requires direction. **Velocity** describes the speed and direction of an object Velocity, like speed, has SI units of meters per second (m/s), kilometers per hour (km/h), or miles per hour (mph) but because it is a vector, the direction of the motion is included. Like speed, you can describe either the average velocity over a time period or the velocity at a specific moment (**instantaneous velocity)**. Average velocity is displacement divided by the time over which the displacement occurs.
Thus,

$$\mathbf{v} = \frac{d}{t_{\text{int}}}$$

where:

v = velocity
d = displacement
t_t = time interval

Example 2

Leighmar drove to the city to pick up a friend. She went 3000 km east in about 10 hours. Calculate her velocity.

Given: d = 3000 km, east
t = 10 hours
Find: *v* = *?*

Solution:

Equation:

$$\mathbf{v}_{\text{ave}} = \frac{d}{t_{\text{int}}}$$

Solution:

$$\mathbf{v}_{\text{ave}} = \frac{d}{t_{\text{int}}}$$

$$\mathbf{v}_{\text{ave}} = \frac{3000\ km,E}{10\ hr}$$

$$\mathbf{v}_{\text{ave}} = 300 \text{ km/h, E}$$

Constant Speed vs. Instantaneous Speed

In the earlier example, Leighmar drove at an average speed of 300 km per hour. In her course of driving, it is possible that Leighmar's speeds varied. There may be times that she increased or decreased her speed at certain points in her travel.

However, it is also possible that Leighmar was neither speeding up nor slowing down. Her driving speed would be the same the entire trip. If the car or any object

was moving over equal distances in equal periods of time, it would have a constant speed. It is usually difficult to maintain a constant speed particularly in driving.

The speed at any specific instant is called the instantaneous speed. Similarly, the velocity of a moving object is called the instantaneous velocity. The easy way to determine the speed at any moment in a moving vehicle is through the speedometer.

Take a look at the dashboard of car or a jeep when you ride in one of them. The circular gauge as shown in Figure 1 is called a speedometer. A speedometer is an instrument that determines the instantaneous speed of a vehicle. Does the speedometer always register the same speed? At a red light, the car has a 0 km/h speed, and along the highway, its speed is probably 80 km/h. Speedometers are important to the drivers because they need to know how fast they are going so they know if they are already driving beyond the speed limit or not.

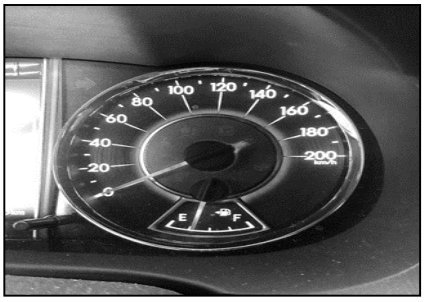


Fig. 1 Speedometer
Photo taken by
Leah Joy D. Walan

Speed limit is either a maximum or minimum speed allowed for vehicles. The maximum speed limit in school zones is usually 20km/h. But in highways, vehicles are required to run at a minimum speed of 60km/h. Drivers are required to observe the speed limit for the safety of passengers and pedestrians.

Motion with constant velocity is very rare. In our daily trip to school, the traffic signals, the stop lights, the turns, the bumps, and pedestrian crossing the street make us change velocities. The vehicle we are in speeds up, slows down or changes directions. In addition, on a roller coaster ride, passengers experience rapid changes in velocity. What type of motion do these objects exhibit? What other measurement do you need to describe these types of motion?

Acceleration

Drivers can change the speed and direction of the car depending on the need. They can step on the gas pedal to increase the speed of the car. At times, they push on the brake pedal to slow down or come to a stop. They can also turn the steering wheel to change the direction of the car's motion. You need two quantities to calculate velocity- speed and direction. Changing either of these quantities or both changes the velocity of the object. Another quantity to describe a change of motion is how much time elapsed while the change was taking place. This is called **acceleration.**

Acceleration tells how fast an object or a body changes its velocity. An object is accelerating when *(a) it is travelling in one direction with changing speed (either speeding up or slowing down), (b) moving at a constant speed but changes its direction, and (c) when it changes both the speed and its direction*. In other words, acceleration is the *rate of change in velocity*. Slowing down is called *deceleration*. .

The SI unit of acceleration is meters per second per second (m/s/s) or it can be mathematically simplified to meters per second squared (m/s^2) but other units of

acceleration such as kilometers per hour per hour (km/h/h or km/h^2) and miles per hour per hour (mi/h/h or mi/h^2) are sometimes used.

As an equation, acceleration is shown as:

$$a = \frac{v_f - v_i}{t}$$

where:

a	=	acceleration
v_f	=	final velocity
v_i	=	initialvelocity
t	=	time of travel

Examine the figure below showingthe velocity of the car changing.

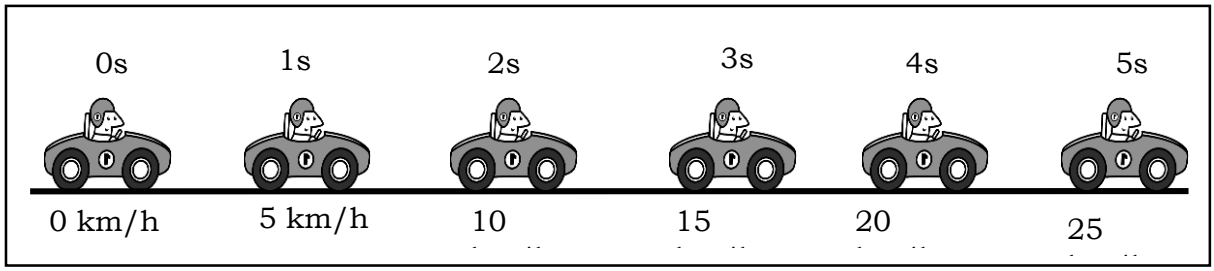


Figure 2. The car moved from rest to 25 km/h in 5 seconds. What was the acceleration of the car?

Illustrated by Leah Joy D. Walan

The diagram shows that the velocity of the car was 0 km/h at the start (initial velocity). At the end of 1 s, the velocity was 5 km/h. At the end of 2 s, it was 10 km/h; at the end of 3 s, 15 km/h; at the end of 4 s, 20 km/h; at the end of 5 s, (total time elapsed), the velocity was 25 km/h (final velocity). In this case, the car's speed is increasing an average of 5 km/h in each second.

Solution: $a = \frac{v_f - v_i}{t}$

$$a = \frac{25\text{km/h} - 0\text{km/h}}{5s}$$

$$a = \frac{25km/h}{5s}$$

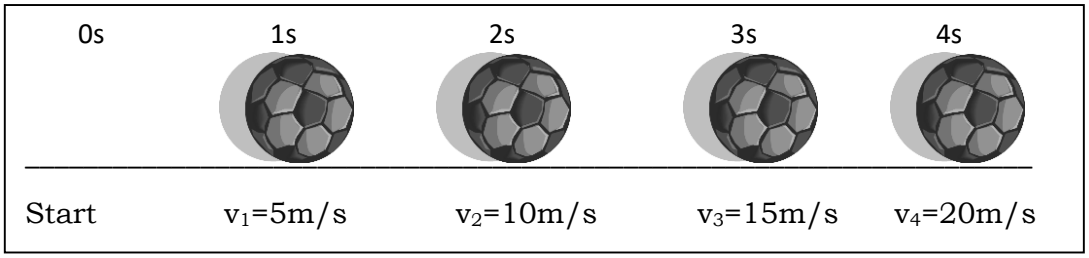
$$a = \frac{5km}{h}/s$$

What's More

Activity 3: Is It Accelerating or Not?

Directions: Study the diagram below and answer the questions the follow.

Diagram A: A rolling ball

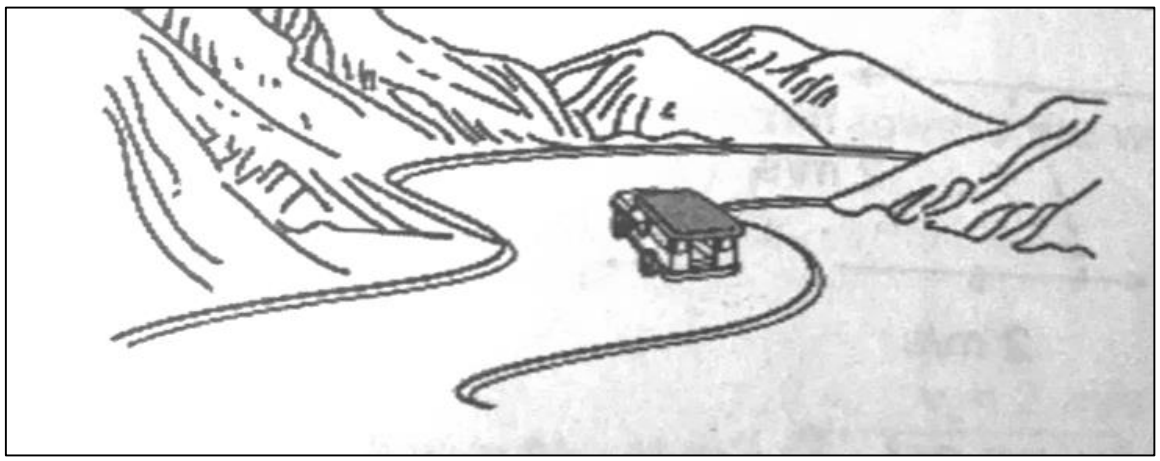


Illustrated by Leah Joy D. Walan

Guide Question:

5. Is the ball accelerating? Why or why not?

Diagram B: A jeepney travelling along mountainside

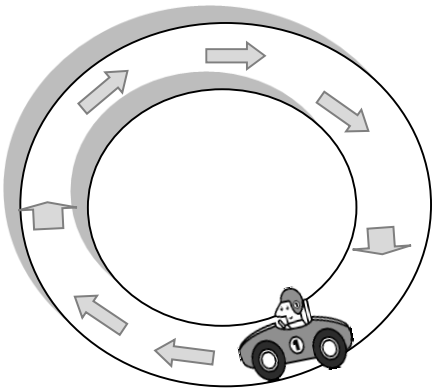


Source: SEDIP Physics Book

Guide Questions:

6. Describe the direction of the car's motion in Diagram B.
7. Is the car accelerating? Why or why not?

Diagram C: A car travelling around the oval



Illustrated by Leah Joy D. Walan

Guide Questions:

8. Is the car changing its direction as it travels around the oval?
9. Is the car accelerating? Why or why not?
10. Based on the three diagrams, what are the conditions that should be present to say that an object is accelerating?

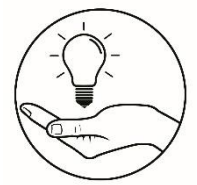
Activity 4: It's Solving Time!

Directions: Solve the following problems below involving speed and velocity. Show your solution.

1. A bird can fly a distance of 250 miles in 5 hours. What is the average speed of the bird ?

2. If you travel 300km in 6 hours, what is your average speed?

3. A jeepney moves along a straight road at an average speed of 10m/s. What is the distance travelled by the jeepney in 2.5 s?



What I Have Learned

Directions: Answer the questions below. Write your answer on a separate sheet of paper.

11. What is speed?
12. How will you differentiate speed from velocity?
13. At constant distance, how is speed related to the time of travel?
14. At constant time of travel, how is speed related to the distance travelled?
15. Who is travelling faster, a person who covered 10meters in 5 seconds or the one who took 10 seconds to cover 20 meters?
16. When can we say that an object is accelerating?

What I Can Do

Congratulations! You've done a great job! To apply what you have learned in this module, do the next activity.

Road safety is an extremely necessary thing people should always bear in mind. Safety along the roads can be maintained as long as everybody follows the traffic laws. One of these traffic laws is the compliance to the different road signs and speed limits set by the government. So what do these speed limits mean? Why is it important to follow these speed limits? In the activity below, interpret the different speed limits in school zones and highways as shown in the picture. Write your interpretation on a separate sheet of paper.

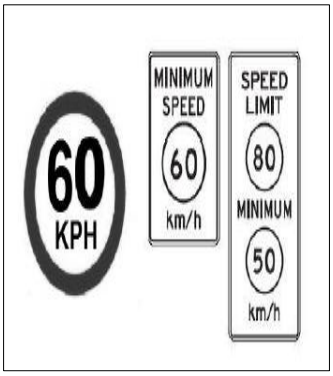
A

Source: https://www.flickr.com/photos/ell-r-brown/50203121727

B

Source: https://commons.wikimedia.org/wiki/File:UK_50_mph_speed_limit_sign_on_a_single-carriageway.jpg

C



Source: DepEd Science 7 LM

Assessment

Directions: Choose the best answer from the given choices. Write the letter of your choice in a separate sheet of paper.

1. Which of the following instruments is best used for measuring the time of moving object?
   A. Stop watch
   B. Wrist watch
   C. Alarm clock
   D. Digital clock

2. Jay wants to measure the speed of his motorcycle. What instrument will he use?
   A. Ammeter
   B. Barometer
   C. Speedometer
   D. Voltmeter

3. Which of the following is an example of velocity?
   A. 30 s
   B. 30 m/s
   C. 30 m, East
   D. 30 m/s, East

4. Which of the following is the formula used for solving speed?
   A. v= dt
   B. v=d/t
   C. v= t/d
   D. v= d/t/t

5. Which of the following is defined as the distance covered per unit time?
   A. Acceleration
   B. Displacement
   C. Speed
   D. Velocity

6. Which of the following is **NOT** a unit of speed?
   A. KPH
   B. Miles/Hour
   C. Meter/Second
   D. Meter/Second/Second

7. What is shown when you look at the speedometer in a moving car?
   A. Average speed
   B. Average acceleration
   C. Instantaneous speed
   D. Instantaneous acceleration

8. Which of the following is defined as speed with direction?
   A. Acceleration
   B. Distance
   C. Displacement
   D. Velocity

9. Which of the following shows that an object is accelerating?
   A. A cart moving at 5km/h.
   B. A car changes velocity 5km/h in every second.
   C. A cyclist moving with constant speed of 6km/h.
   D. A car is moving at 10km/h going west along the highway.

10. The data below were obtained from a 500-m dash competition final in the Olympics.

Athletes	Recorded Time (s)
Philippines	57.3
Japan	59.6
Nigeria	54.3
USA	57.4
China	59.7
United Kingdom	58.6
Ghana	55.3

Which of the following statement(s) is/are true?

I. Philippines athlete beat Japan.
II. An Asian beats a European in the finals.
III. Africans are the fastest runners in the finals.

A. I, II and III
B. I and II only
C. I and III only
D. II and III only

11. A cyclist drives along a straight highway for 25h with a displacement of 100km south. What is the cyclist's average velocity?
A. 0.4 km/h north
B. 0.4 km/h south
C. 4 km/h north
D. 4 km/h south

12. Refer to the table below. What is the speed of runner Z?

RUNNERS	DISTANCE (m)	TIME (s)
W	70	10
X	80	10
Y	95	10
Z	105	10

A. 0.10 m/s
B. 1.05 m/s
C. 10.5 m/s
D. 1,050 m/s

13. Based on the table below, what will be the speed of the moving object in 2 seconds?

Speed (m/s)	0	5	**?**	5	**5**
Time (s)	0	1	2	3	4
Distance (m)	0	5	10	15	20

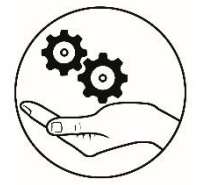
A. 2
B. 3
C. 4
D. 5

14. Michelle Ann conducted an experiment on speed using her toy car. She listed all the data she gathered in the table below. Upon analyzing her data, she concluded that toy car C is the slowest among the four. Do you think her conclusion is correct?

TOY CAR	DISTANCE (cm)	TIME (s)
A	100	10
B	100	15
C	100	20
D	100	18

A. Yes, because its speed is 20m/s.
B. Yes, because it has the greatest time recorded.
C. No, because all the toy car travelled the same distance.
D. No, because the slowest toy car is the one that took the least time.

15. Marlow was asked by her teacher how to solve the speed of an object. She said that to solve for the speed of an object, one must multiply the distance travelled by the recorded time of travel. Do you think her process is correct?
A. Yes, because multiplication is the way to solve for speed.
B. Yes, because she had all the needed data like distance and time.
C. No, because in solving for speed one must divide the distance travelled by the recorded time of travel.
D. No, because in solving for speed one must add the recorded time and the distance travelled.

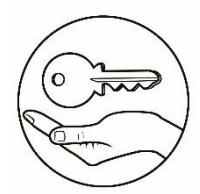


Additional Activities

Wow! That was a tough job. At last! You have finished studying lesson 2. But, before you completely exit, try to answer this additional activity.

Directions: Graph the given velocities and the time interval as shown in the table below. Label your graph correctly. Place the velocity on the y-axis and time on the x-axis. Connect the points after graphing. Then compute and analyze the acceleration of the object between: 1) point A—C, 2) point C—D and 3) point D—E.

POINT	VELOCITY	TIME INTERVAL
A	5 m/s	2 sec
B	10 m/s	4 sec
C	15 m/s	6 sec
D	15 m/s	8 sec
E	5 m/s	10 sec



Answer Key

Lesson 1

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

Lesson 2

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

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For inquiries or feedback, please write or call:

Department of Education - Bureau of Learning Resources (DepEd-BLR)

Ground Floor, Bonifacio Bldg., DepEd Complex
Meralco Avenue, Pasig City, Philippines 1600

Telefax: (632) 8634-1072; 8634-1054; 8631-4985

Email Address: blr.lrqad@deped.gov.ph * blr.lrpd@deped.gov.ph