GENERAL PHYSICS 1 - GRADE 12

Name: ______________________________________ Date: ____________________

Grade: ______________________________________ Section: ___________________

Quarter: 1 Week: 2 SSLM No. 2 MELC(s):

1. Covert a verbal description of a physical situation involving in one dimension into a mathematical description. (STEM_GP12 Kn-lb12)
2. Interpret displacement and velocity, respectively, as areas under velocity vs. time and acceleration vs. time curves (STEM_GP12KNIb-14)
3. Interpret velocity and acceleration, respectively, as slopes under position vs. time and velocity vs. time curves (STEM_GP12KNIb-15)
4. Construct velocity vs. time and acceleration vs. time graphs, respectively, corresponding to a given position vs. time-graph and velocity vs. time and vice versa (STEM_GP12KNIb-15)
5. Solve problems involving one-dimensional motion with constant acceleration in contexts such as, but not limited to, the "the tail-gating phenomenon", pursuit, rocket launch, and freefall problems (STEM_GP12KINIb-19)

Title of Textbook/LM to Study: **Self-Learning Module 3 in General Physics 1**

Lesson 1: Motion along a Straight Line

Objectives:

1. Differentiate average speed from instantaneous speed;
2. Determine average velocity and instantaneous velocity;
3. Convert a verbal description of a physical situation involving uniform acceleration in one dimension into mathematical description

Let Us Discover

Kinematics is the science that quantitatively describes motion as the rate at which the object is moving (velocity) and the rate at which its velocity is changing (acceleration) through words, diagrams, numbers, graphs, and equations.

Instantaneous speed is the speed of an object at an instant. Average speed, on the other hand, is the total distance covered by an object in a certain period of time. In everyday situations, speed and velocity are just the same. They only describe how fast an object moves. In physics, however, they are a lot different. Velocity is a speed in a given direction. It is known as the distance travelled in a particular direction in a given time interval.

Acceleration is a measure of how fast the velocity changes with respect to time. This means that a body accelerates whenever there is a change in speed; a change in direction, or a change in both the speed and direction. Acceleration is expressed in units such as m/s^2, km/h^2, m/min^2, etc.

Let Us Try

Activity 1.1: Determining Average Speed and Average Velocity
Analyze the problem below.
What is the average speed and velocity of the mischievous bunny's entire trip when she hops 6 meters to the east across the room in 11 seconds and then takes another 12 seconds to hop back to her initial position? Express your answer using the proper SI units. Round your answer to two decimal places, and include a direction if necessary.
Guide Questions:

1. Computations (show your solution).
   ____
2. How can you determine the average speed and the average velocity of the bunny? Illustration
   ____
3. Differentiate average speed and average velocity.
   ____

Let Us Do

Activity 1.2. Am I accelerating?
Direction: Write "**A**" if the situation shows an accelerated motion and write "**B**" if the situation shows that the motion of the object is not accelerated. Write your answer on the space before the number.
___1. The initial velocity of a boy in a bike is about 5 km/h E while his final velocity is about 7 km/h E.
___2. A boy on his bike moves around a curve with a constant speed of 5 km/h.
___3. A man initially running at 7 km/h E, moves west at the same speed of 7 km/h.
___4. A boy initially running at around 3 km/h suddenly stops because of a truck.
___5. A girl initially sitting on a bench stood up and started running.

Let Us Apply

Activity 1.3: I can see Velocity!
Give at least 10 daily life examples where velocity is applied. Example, revolution of the Earth around the sun.

Lesson 2: Motion Graphs
Objectives:
1. Determine the area under velocity-time graph-time graph and acceleration;
2. Interpret the meaning of slope under position-time and velocity-time graph.

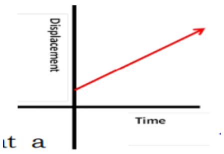
Let Us Discover

Graphs help make motion easier to picture out, and therefore easy to understand. These graphs will help to describe the motion of an object which is occasionally hard to do so in words.

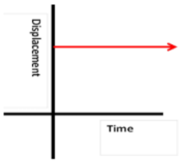
THE SLOPE OF THE GRAPH

Position-Time Graphs

A horizontal line on a position-time graph shows that the object is stationary. A sloping line on a position-time graph shows that the object is moving. In a position-time graph, the slope or gradient of the line, is equal to the velocity of the object.



The steeper the line (and the greater the gradient) the faster the object is moving. If an object is not moving, a horizontal line is shown



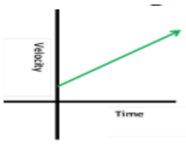
Time is increasing to the right, but its distance does not change. It is not moving.

If an object is moving at a constant velocity, it means it has the same increase in position in a given time. The object moves at a constant velocity. Constant velocity is shown by straight diagonal lines on a graph.

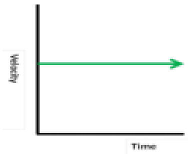
Both of the lines in the graph show that each object moved the same distance, but the steeper dashed line got there before the other one.

Velocity-Time Graphs

A velocity vs. time graph is a useful tool that can be used to describe motion with either constant or changing velocity. Any point on such a graph will have coordinates (t,v), in which v is the velocity after a time t.



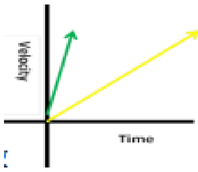
The slope of a velocity-time graph represents its acceleration. A horizontal line on a velocity-time graph means that velocity is constant. It is not changing over time.



A straight horizontal line does not mean that the object is not moving! This graph shows increasing velocity. The moving object is accelerating.

This graph shows decreasing velocity. The moving object is decelerating.

Both the yellow and green line shows increasing velocity. Both line reached the same top speed, but the green one takes longer.

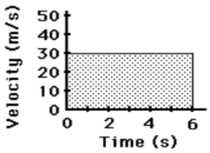


AREA UNDER THE GRAPH

Velocity- Time Graph

The method used to find the area under a line on a velocity-time graph depends upon whether the section bound by the line and the axes is a rectangle, a triangle or a trapezoid.

The shaded area in the graph is representative of the displacement during from 0 seconds to 6 seconds. This area takes on the shape of a rectangle can be calculated using the appropriate equation.



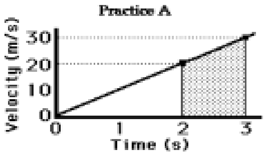
Rectangular	Triangle	Trapezoid
Area = b • h	Area = ½ • b • h	Area = ½ • b • (h_1 + h_2)

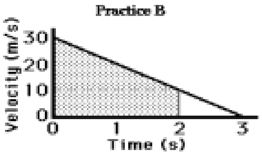
Let Us Try

Activity 2.1: Area under the Graph

Directions:

1. Determine the displacement of the object during the time interval from 2 to 3 seconds (Practice A) and during the first 2 second (Practice B).

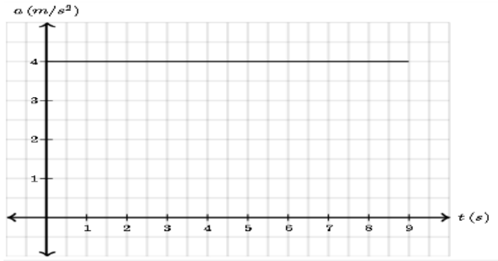




Solution:

2. Given the acceleration-time graph, what is the velocity of the moving particle?

Solution:



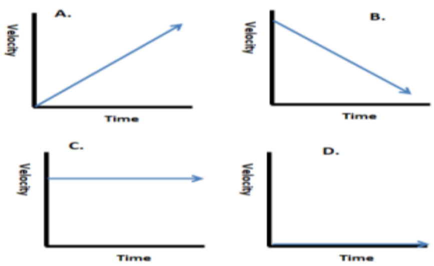
Let Us Do

Activity 2.2: The Car is in Motion!

Direction: The Velocity-Time graph below represents the motion of a car. Match the descriptions with the Graphs. Explain your answers.

Descriptions:

1. The car stopped. __________
2. The car is traveling at a constant speed. _____
3. The car is accelerating. _______
4. The car is slowing down._________



Let Us Apply

Activity 2.3. I am on my way!

How do you get to school? What are your means of transportation? Did you ever wonder how short or fast is your travel? In this activity, you need to plot, calculate and analyze your motion from your home to school. Here's what you need to do.

Directions:

1. Monitor your time of travel to and from school for a week.
2. Do an estimate of the total distance you travelled from your house to school.
4. If there are slight variations in your daily travel periods to cover the distances marked, take averages
5. Take note of your distance every 5 min. Follow the chart using the data you have gathered from the chart, make a position –time graph.

Time of Travel (min.)	Distance Travelled (km)
5	
10	
15	
20	
25	
30	
35	

$$\text{Slope} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{rise}}{\text{run}}$$

Lesson 3: Uniformly Accelerated Motion

Objectives:

1. Define uniformly accelerated motion;

2. Derive unknown equations of rectilinear for one-dimensional uniformly accelerated motion;
3. Solve problems involving uniformly accelerated motion

Let Us Discover

Uniformly Accelerated Motion

If a body maintains a constant change in its velocity in a given time interval along a straight line, then the body is said to have a uniform acceleration. Consider an airplane on a runway preparing for takeoff. Positions taken at equal time intervals are indicated in the figure below

Uniformly Accelerated Motion in Horizontal Dimension

You have learned about displacements, velocities and acceleration from your previous lesson. Now you will use those basic equations to derive formulae used in Uniformly Accelerated Motion (UAM). Using the following equations on velocity, average velocity, and acceleration, you can derive other equations.

Equation A: $v = \frac{d}{t}$

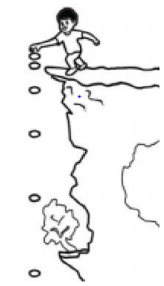
Equation B: $v_{ave} = \frac{v_f + v_i}{2}$

Equation C: $a = \frac{v_f - v_i}{\Delta t}$ or $a = \frac{v_f - v_i}{t_f - t_i}$

where: v = velocity
v_f = final velocity
v_i = initial velocity
v_{ave} = average velocity
d = displacement
t = time
t_f = final time
t_i = initial time
a = acceleration
Δ = change

Uniformly Accelerated Motion in Vertical Dimension

You learned from the past lesson that freefall refers to a situation in physics where the only force acting on an object is gravity and hence acceleration due to gravity. Freefall as its term says is a body falling freely because of the gravitational pull of the earth. The pull of gravity acts on all objects. So on Earth, when you throw something up, it will go down. Things thrown upward always fall at a constant acceleration which has a magnitude of 9.8 m/s^2. This means that the velocity of an object in free fall changes by 9.8 m/s2 every second of fall.



The formula for free fall:
Imagine an object body is falling freely for time t seconds, with final velocity v, from a height h, due to gravity g. It will follow the following equations of motion as:

Equation 1 $v = gt$

Equation 2 $h = \frac{gt^2}{2}$

Equation 3 $v^2 = 2gh$

Where,
h Height traveled
v Final velocity
g Acceleration due to gravity
t Time taken

Let Us Try

Activity 3.1: Let's Study!

Consider the following examples below:

1. An airplane accelerates down a runway at 3.20 m/s2 for 32.8 s until is finally lifts off the ground. Determine the distance traveled before takeoff.

Given: $a = +3.2\ m/s^2$

$t = 32.8\ s$

$v_i = 0 m/s$

$d = ?$

Solution: $d = v_i t + \frac{at^2}{2}$

$= 0 m/s\ (32.8s) + \frac{[(+3.2 m/s^2)(32.8s)^2]}{2}$

$= \mathbf{1\ 720\ m}$

Let Us Do

Activity 3.2: Problem Solving

Direction: Apply what you have learned from the topics above and answer the following word problems about uniformly accelerated motion below.

1. A golf ball rolls up a hill toward a miniature-golf hole. Assign the direction toward the hole as being positive.

   a. If the ball starts with a speed of 2.0 m/s and slows at a constant rate of 0.50 m/s^2, what is its velocity after 2.0 s?

   b. If the constant acceleration continues for 6.0 s, what will be its velocity then?

   b. How fast was it going when it took off?

Let Us Apply

Activity 3.3: What's around me?

1. List down at least five events in your surrounding which show uniformly accelerated motion.

Reference

Bongon, Resa et.al (2020). General Physics-Self-Learning Module (SLM) Quarter 1 – Module 3: Motion in Straight Line. Printed in the Philippines by Department of Education – SOCCSKSARGEN Region. Regional Center, Brgy. Carpenter Hill, City of Koronadal. First Edition.

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