DEPED - GENERAL SANTOS CITY
SIMPLIFIED SELF-LEARNING MODULE
(S S L M)

GENSAN's ProTUNA — General Santos City's Pro-Active Response in Turbulent, Uncertain, New and Ambiguous Environment

GENERAL PHYSICS 1 - GRADE 12

Name: _____ Date: _____

Grade: _____ Section: _____

Quarter: 1 Week: 1 SSLM No. 1 MELC(s): Solve measurement problems involving conversion of units, expression of measurements in scientific notation. (STEM_GP12EU-Ia1); Differentiate accuracy from precision (STEM_GP12EU-Ia2); Differentiate random errors from systematic errors (STEM_GP12EU-Ia3); Estimate errors from multiple measurements of a physical quantity using variance (STEM_GP12EU-Ia5); Differentiate vector and scalar quantities (STEM_GP12V-Ia-8); Perform addition of vectors (STEM_GP12V-Ia-9) and Rewrite a vector in component form (STEM_GP12V-Ia10).

Title of Textbook/LM to Study: General Physics 1: Measurements & Vector and Vector Addition SLM

Lesson 1. MEASUREMENT

- **Objectives:**
  1. Solve measurement problems involving conversion of units, expression of measurements in scientific notation.
  2. Differentiate accuracy from precision and random errors from systematic errors.
  3. Estimate errors from multiple measurements of a physical quantity using variance.

Let Us Discover

Measurement tells about the property of something. It is composed of a number and a unit, e.g. 2 meters. It is always done using devices or measuring tools like meter stick, weighing scale, etc. In addition, it is considered to be one of the fundamental concepts in science. Without the ability to measure and quantify things, it would be difficult for scientists to conduct experiments or form theories. Thus, measurement is vital in studying science and to our daily lives.

Activity 1.1. Decode Me! (Atbash Cipher)

Decipher the following terms that are associated with the concepts of measurement. Use the code below. Describe each term and use extra sheet of paper for your answer.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A

Code: Ex: SVOOL = HELLO

1. ZXXFIZXB = _____
2. KIVXRHRLM = _____
3. IZMWLN VIILI = _____
4. HBHGVNZGRX VIILI = _____

Questions:

1. Based from the given activity, what skills have you developed which can be used in studying Physics?
2. Based from the terms that you identified, how do you relate these terms in studying measurements? Cite an example. You may use extra sheet of paper for your answer.

Scientists all over the world will not be able to work systematically with one another if they use different systems of measurement. Thus, for them to work with consistent and coherent measurement system, an agreement was made among scientists to what standard unit of measurement will be used.

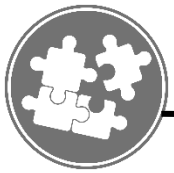
Are you familiar with SI units? What is SI Unit? SI units (Systeme International d'Unites). It is a measurement system that was agreed by the scientists following the *Conference Generale des Poids et Mesures* (CGPM). It is primarily based on the metric system and has seven fundamental units. Each physical quantity has only one unit; meter (m) for length; kilogram (kg) for mass; second (s) for time; Kelvin (K) for thermodynamic temperature; ampere (A) for electric current; candela (cd) for luminous intensity; and mole (mol) for the number of particles or amount of substance

Accuracy and Precision

In measurement, accuracy is the closeness of the measurements to a specific value, while precision is the closeness of the measurements to each other. Alternatively, ISO defines accuracy as describing a combination of both types of observational error, random and systematic, so high accuracy requires both high precision and high trueness. In simpler terms, given a set of data points from repeated measurements of the same quantity, the set can be said to be accurate if their average is close to the true value of the quantity being measured, while the set can be said to be precise if the values are close to each other. In the first, more common definition of "accuracy" above, the two concepts are independent of each other, so a particular set of data can be said to be either accurate, or precise, or both, or neither.

Random Error and Systematic Error

The main difference between systematic and random errors is that random errors lead to fluctuations around the true value as a result of difficulty in taking measurements, whereas systematic errors lead to predictable and consistent departures from the true value due to problems with the calibration of the equipment. This leads to two extra differences that are worth noting.



Let Us Try

Activity 1. 2 Convert and Transform!
Do what is being asked.

Example: Convert 4 mm to m. Express your answer in Scientific Notation form.
Solution: Use the conversion factor 1,000 mm = 1 m

$$4\ \cancel{mm} \times \frac{1\text{m}}{1{,}000\ \cancel{mm}} = \mathbf{0.004\ m}$$

Express **0.004 m** into Scientific Notation form:

Consider the general form: a x 10^b, where a = any number between 1 and less than 10
b = is an integer
In this case: a = **4.0**, b = **-3** Thus, the number in Scientific Notation form is **4.0 x 10^{-3} m .**

Solve the following items and express your answer in Scientific Notation form:

1. Convert 3 days to _____ minutes

2. Convert 45 m/s to _____ cm/s

Let Us Do

For you to determine if you understand the lesson, answer the given test items.

1. A snail moves 1cm in every 20 seconds. What is this in inches/second? km/h? Express your answer in scientific notation. Use extra sheet of paper for your answer.
2. How do you differentiate accuracy from precision? Random errors from systematic errors?

Let Us Apply

Suppose you measured the length of a certain stick using a ruler and you gathered the following set of data as presented in the table below. Determine the percentage uncertainty of the set of measurements using the given formula. Use extra sheet of paper for your answer.

Length (cm)	|x-μ|
10.35	
10.43	
10.45	
10.38	
10.40	
∑x=	∑|x-μ|=

Mean (μ) = $\frac{\sum x}{n}$

Average Deviation (a.d) = $\frac{\sum |x-\mu|}{n}$

Average Deviation of the Mean (A.D.) = $\frac{a.d.}{\sqrt{n}}$

Percentage Uncertainty = $\frac{\text{Uncertainty}}{\text{Mean}}$ x 100%

Lesson 2. Vector and Vector Addition

- **Objectives:**
  1. Differentiate vector and scalar quantities.
  2. Perform addition of vectors.
  3. Rewrite a vector in component form.

Let Us Discover

Motion in Physics always chooses a reference point, called the origin to describe the location of something and we give its distance from the origin and the direction. These two quantities, direction and distance, together constitute a vector quantity called the position of the object.

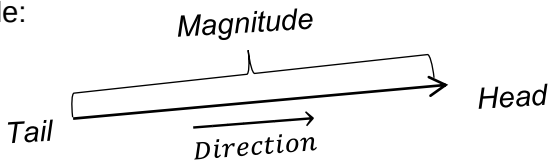
Today, we are going to study the difference between scalar and vector quantities.

- Since scalar quantities have no direction and vector quantities have direction, any vector quantity maybe represented by an arrow in the proper direction with its length proportional to the magnitude of the quantity.
- Magnitude is the number with a unit representing how far, how fast, how heavy, how long, how strong is the action of an object.
- The direction of a vector is often expressed as an angle of rotation of the vector about its "tail" from east, west, north, or south. ... A vector with a direction of 270 degrees is a vector that has been rotated 270 degrees in a counterclockwise direction relative to due east.
- A scale will be used to make the magnitude of a vector smaller.

A vector can be represented by the following parts:

- Tail indicates the origin or starting point.
- Length indicates the magnitude (how fast, how far, how long, how strong, etc.).
- Head indicates the direction of the action/motion.

Example:



Vectors can be added using the Graphical Method (Head-to-Tail Connection) and Component Method. Consider the sample problems.

Let Us Try

Activity 2.1 Add Me!

Read and understand the process on how to add vectors.

Given:

$\overrightarrow{A}$ = 3 units, 0°

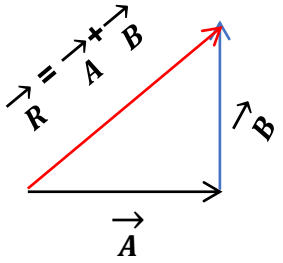
$\overrightarrow{B}$ = 4 units, 90°

Find: $\overrightarrow{A} + \overrightarrow{B}$

Method 1: Graphical Method (Head-to-Tail Connection) of Adding Vectors

Solution:

1. Draw the first vector using an arrow. Use appropriate scaling for the magnitude of the vector quantities.
2. Draw the second vector and connect its tail to the head of the first vector.
3. Connect the tail of the first vector to the head of the second/last vector. The arrow that will be made is called the resultant vector.
Note. You may use ruler and protractor to measure the magnitude and direction of the resultant vector.



Method 2: Trigonometric Method / Component Method of Adding Vectors

Hint: Since the two vectors, $\overrightarrow{A}$ & $\overrightarrow{B}$, form a right triangle, Pythagorean theorem can be used to solve for the magnitude of the resultant vector.

Solution:

Let, $\overrightarrow{R} = \overrightarrow{A} + \overrightarrow{B}$

$|R^2| = |A^2| + |B^2|$

$|R| = \sqrt{A^2 + B^2}$

$= \sqrt{3^2 + 4^2}$

$= \sqrt{9 + 16}$

$= \sqrt{25}$

= 5 units

To determine the direction of the resultant vector, use the equation:

$\tan\Theta = \frac{\text{opposite side}}{\text{adjacent side}}$

$= \frac{|B|}{|A|}$

$= \frac{4 \text{ units}}{3 \text{ units}}$

$= 1.33$

$\Theta = \arctan 1.33$

$= 53.06°$

Problem Solving Strategy: Adding Vectors Using x and y Components

1. Find the x and y – components of each vector to be added using the trigonometric functions.
2. Add the x-components (with their algebraic signs) of the vectors to find the sum of x-components ($\sum x$).
3. Add the y-components (with their algebraic signs) of the vectors to find the sum of y-components ($\sum y$).
4. Use the sum of x- and y- components to find the magnitude and direction of the vectors being added.
5. To find the magnitude of the sum (resultant displacement), use the Pythagorean theorem.

$|R| = \sqrt{\sum x^2 + \sum y^2}$

6. To find the direction of the resultant, use the trigonometric function:

$\Theta = \tan^{-1} \frac{\text{Opposite}}{\text{Adjacent}}$

Note: Refer to your vector diagram (head –to-tail) graphical addition of your vectors to identify what vector component is the opposite and adjacent side of your right triangle. Even when using the component method to add vectors, the graphical method is an important first step.

Let Us Do

For you to understand this lesson, answer the following questions. Use extra sheet of paper for your answer.

1. How do you differentiate Scalar Quantity from Vector Quantity? Give at least five examples of Scalar and Vector Quantities.

2. What are the magnitude and direction of the Resultant Vector ($\overrightarrow{R} = \overrightarrow{A} + \overrightarrow{B}$) based from the given quantities below? Use the Graphical Method and the Component Method in adding vectors. You may use extra sheet of paper for your answer.

Given:

$\overrightarrow{A}$ = 6 units, 0^o

$\overrightarrow{B}$ = 8 units, 90^o

Let Us Apply

Answer the given problem. Solve completely.

A plane is going north with a speed of 150 m/s. It is blown by a strong wind at 500 m/s going to west. What is the magnitude of plane's resultant velocity?

References

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