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SENIOR HIGH SCHOOL

DepED
DEPARTMENT OF EDUCATION

General Physics1

Quarter 1 – Module 2:
Title: Vectors



ALTERNATIVE DELIVERY MODE

ADM

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Science – Grade 12
Alternative Delivery Mode
Quarter 1 – Module 2: Vectors
First Edition, 2020

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Published by the Department of Education
Secretary: Leonor Magtolis Briones
Undersecretary: Diosdado M. San Antonio

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Printed in the Philippines by _____

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General Physics1

Quarter 1 – Module 2: Vectors

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Introductory Message

For the facilitator:

Welcome to the General Physics 1 12 Alternative Delivery Mode (ADM) Module on Vectors!

This module was collaboratively designed, developed and reviewed by educators both from public and private institutions to assist you, the teacher or facilitator in helping the learners meet the standards set by the K to 12 Curriculum while overcoming their personal, social, and economic constraints in schooling.

This learning resource hopes to engage the learners into guided and independent learning activities at their own pace and time. Furthermore, this also aims to help learners acquire the needed 21st century skills while taking into consideration their needs and circumstances.

In addition to the material in the main text, you will also see this box in the body of the module:



Notes to the Teacher

This contains helpful tips or strategies that will help you in guiding the learners.

As a facilitator you are expected to orient the learners on how to use this module. You also need to keep track of the learners' progress while allowing them to manage their own learning. Furthermore, you are expected to encourage and assist the learners as they do the tasks included in the module.

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For the learner:

Welcome to the General Physics 1 12 Alternative Delivery Mode (ADM) Module on Vectors!

The hand is one of the most symbolized part of the human body. It is often used to depict skill, action and purpose. Through our hands we may learn, create and accomplish. Hence, the hand in this learning resource signifies that you as a learner is capable and empowered to successfully achieve the relevant competencies and skills at your own pace and time. Your academic success lies in your own hands!

This module was designed to provide you with fun and meaningful opportunities for guided and independent learning at your own pace and time. You will be enabled to process the contents of the learning resource while being an active learner.

This module has the following parts and corresponding icons:

 ***What I Need to Know***	This will give you an idea of the skills or competencies you are expected to learn in the module.
 ***What I Know***	This part includes an activity that aims to check what you already know about the lesson to take. If you get all the answers correct (100%), you may decide to skip this module.
 ***What's In***	This is a brief drill or review to help you link the current lesson with the previous one.
 ***What's New***	In this portion, the new lesson will be introduced to you in various ways such as a story, a song, a poem, a problem opener, an activity or a situation.
 ***What is It***	This section provides a brief discussion of the lesson. This aims to help you discover and understand new concepts and skills.
 ***What's More***	This comprises activities for independent practice to solidify your understanding and skills of the topic. You may check the answers to the exercises using the Answer Key at the end of the module.
 ***What I Have Learned***	This includes questions or blank sentence/paragraph to be filled in to process what you learned from the lesson.
 ***What I Can Do***	This section provides an activity which will help you transfer your new knowledge or skill into real life situations or concerns.

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 ***Assessment***	This is a task which aims to evaluate your level of mastery in achieving the learning competency.
 ***Additional Activities***	In this portion, another activity will be given to you to enrich your knowledge or skill of the lesson learned. This also tends retention of learned concepts.
 ***Answer Key***	This contains answers to all activities in the module.

At the end of this module you will also find:

References	This is a list of all sources used in developing this module.

The following are some reminders in using this module:

1. Use the module with care. Do not put unnecessary mark/s on any part of the module. Use a separate sheet of paper in answering the exercises.
2. Don't forget to answer *What I Know* before moving on to the other activities included in the module.
3. Read the instruction carefully before doing each task.
4. Observe honesty and integrity in doing the tasks and checking your answers.
5. Finish the task at hand before proceeding to the next.
6. Return this module to your teacher/facilitator once you are through with it.

If you encounter any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator. Always bear in mind that you are not alone.

We hope that through this material, you will experience meaningful learning and gain deep understanding of the relevant competencies. You can do it!

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What I Need to Know

This module was designed and written with you in mind. It is here to help you master the Vectors. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

The module has one lesson with subtopics, namely:

- Lesson 1 – Vectors
    - ✓ Components of Vectors
    - ✓ Unit Vectors

After going through this module, you are expected to:

1. rewrite a vector in component form;
2. calculate directions and magnitudes of vector;
3. identify the x-component and y-component of the given vector; and
4. use component method to determine the resultant vector

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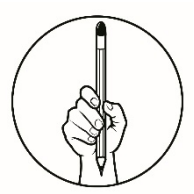

What I Know

Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. In a coordinate system, a vector is oriented at angle with respect to the x-axis. The x component of the vector equals the vector's magnitude multiplied by which trigonometric function?

   a. tan θ c. cot θ

   b. cos θ d. sin θ

2. A particular hurricane travels 678 km, 34.6^0 north of west before turning into a tropical storm. Find the northern displacement of the typhoon and the western displacement of the typhoon.

a. 558 km west, 385 km north b. 385 km west, 558 km north

c. 585 km west, 358 km north d. 468 km west, 468 km north

For numbers 3-4

3. Two forces act on an object. One force is 6.0 N horizontally towards west. The second force is 8.0 N vertically towards south. Find the magnitude and direction of the resultant.

a. 10N 53° N of E c. 10N 53° E of N

b. 10N 53° S of W d. 10N 53° W of S

4. If the object is in equilibrium, find the magnitude and direction of the force that produces equilibrium.

a. 10N, 53° W of S c. 10N, 53° E of N

b. 10N, 53° N of E d. 10N, 53° S of W

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5. Four members of the Main Street Bicycle Club meet at a certain intersection on Main Street. The members then start from the same location but travel in different directions. A short time later, displacement vectors for the four members are:

A = 2 km W

B = 1.6 km N

C = 2.0 km E

D = 2.4 km S

What is the resultant displacement R of the members of the bicycle club: R = A + B + C + D?

a. 0.8 km S

b. 0.4 km 450 SE

c. 3.6 km 370 NW

d. 4 km S

6. Given the following components for vectors A–C, find the x- and y-components for the resultant R.

Vector	x-component	y-component
A	+6	−2
B	−2	+6
C	+3	+3

a. +11, +11

b. +7, +7

c. –7, –7

d. +7, –11

7. Given the following components for vectors A–C, find the magnitude and direction for the resultant vector R.

Vector	x-component	y-component
A	+4	−1
B	−1	−6
C	+3	+3

a. 7, 320° in standard position

b. 10, 40° in standard position

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c. 7, 330° in standard position
d. 10, 30° in standard position

8. Find the x- and y-components for a displacement vector that is 23.8 km and 45.0° south of east.

a. +16.8 km, +16.8 km
b. –16.8 km, +16.8 km
c. +16.8 km, –16.8 km
d. –16.8 km, +16.8 km

9. A particular hurricane traveled 678 mi at 34.6° north of west before turning into a tropical storm. Find the northern displacement of the hurricane and the western displacement of the hurricane.

a. 558 mi east, 385 mi north
b. 385 mi west, 558 mi north
c. 558 mi west, 358 mi north
d. 468 mi west, 468 mi north

10. Find the x- and y-components to a vector that is 89.5 mm at 305° in standard position.

a. –73.3 mm, 51.3 mm
b. 73.3 mm, 51.3 mm
c. –51.3 mm, 73.3 mm
d. 51.3 mm, –73.3 mm

11. When resolving vectors into components or finding results _____ is/are more accurate than _____.

a. geometric vector addition, geometric vector subtraction
b. geometric techniques, mathematical techniques
c. mathematical techniques, geometric techniques
d. mathematical vector addition, mathematical vector subtraction

12. Resolve vector L into components L_x and L_y if the length of vector L is 15 m and its reference angle is 20^0.

a. 13.9 m, 5.10 m
b. 14 m, 5 m
c. 14.1, 5.13 m
d. 14.2, 5.20 m

13. Which is not true about vector magnitude?

a. it cannot be greater than the sums of magnitude of its component vectors.
b. it cannot be negative

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c. it is scalar quantity
d. trigonometry is necessary to compute it from component vectors

14. The vector resultant of an object's change in position is the same at its displacement.

a. either true or false
b. false
c. neither true nor false
d. true

15. Two vectors that are added together to produce a resultant are called the components of the resultant.

a. either true or false
b. false
c. neither true nor false
d. true

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Lesson 1 Vectors

In the discussion of vector addition, we saw that a number of vectors acting together can be combined to give a single vector (the resultant). In much the same way a single vector can be broken down into a number of vectors which when added give that original vector. These vectors which sum to the original are called components of the original vector. The process of breaking a vector into its components is called resolving into components.

In practice it is most useful to resolve a vector into components which are at right angles to one another, usually horizontal and vertical. Think about all the problems we've solved so far. If we have vectors parallel to the x- and y-axes problems are straightforward to solve.

Any vector can be resolved into a horizontal and a vertical component. If R⃗ is a vector, then the horizontal component of R⃗ is R⃗ x and the vertical component is R⃗ y.



What's In

Differentiate scalar and vector quantities.

Draw the given vector graphically 100 m NE.



Notes to the Teacher

It is significant that learners had background on integers and trigonometric functions and Pythagorean Theorem.

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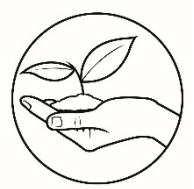


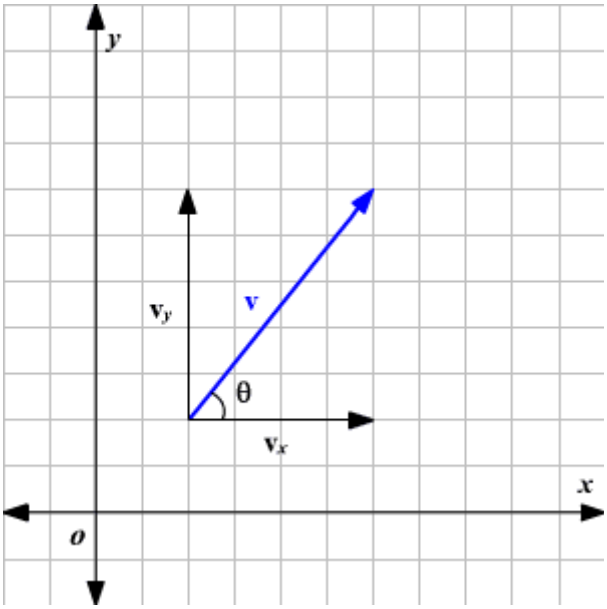
What's New

Components of a Vector

In a two-dimensional coordinate system, any vector can be broken into x -component and y -component.

$$V = V_x , V_y$$

For example, in the figure shown below, the vector $\vec{v}$ $v\rightarrow$ is broken into two components, V_x and V_y . Let the angle between the vector and its x -component be θ.



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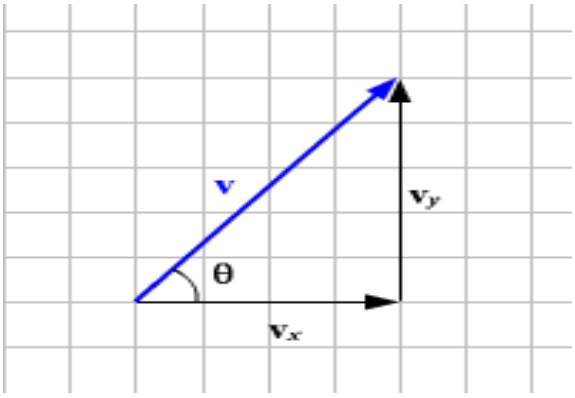
The vector and its components form a right angled triangle as shown below.



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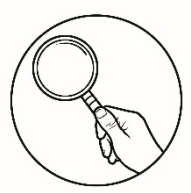
In the above figure, the components can be quickly read. The vector in the component form is $\vec{v} = \langle 4,5 \rangle v \rightarrow = \langle 4,5 \rangle$.
The trigonometric ratios give the relation between magnitude of the vector and the components of the vector.

$$Vx = V\cos\theta$$

$$Vy = V\sin\theta$$

Using the Pythagorean Theorem in the right triangle with lengths vx and vy :



What is It

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Determining the Resultant and Direction of Multiple Vectors

A = 50 N 30^0 N of E
B = 25 N 65^0 S of W
C = 45 N. 20^0 S of E

1. Draw the vectors in the Cartesian plane.
2. Compute the x and y components of each vector. Note the sign of each component based on the location in the Cartesian plane.
3. Add all the x-components and y-components.
4. Calculate the resultant and direction using the formula below.

$$\theta =$$

Vectors	x- component	y- component
A	50 N cos 30^0 = 43.3 N	50 N sin 30^0 = 25 N
B	-25 N cos 65^0 = 10.6 N	25 N sin 65^0 = 22.7 N
C	45 N cos 20^0 = 42.3 N	-45 N sin 20^0 = -15.4 N
	Σx = 75 N	Σy = 32.3 N

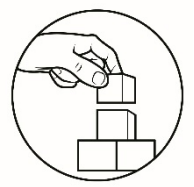
$$F =$$

$$F = 81.62 \text{ N}$$

$$\theta =$$

$$\theta = 23.3^0 \text{ N of E}$$

$$F = 81.62 \text{ N } 23.3^0 \text{ N of E}$$



What's More

Resultant Vector of Typhoon Yolanda

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Identify the velocity of Typhoon Yolanda as it enters and exit the Philippine Area of Responsibility. Calculate the resultant velocity.

Vector	Velocity (m/s)	x-component	y-component
425 km E SE			
64 km/h W			
241 km/h W			
34 km/h W			
250 km/h W			
314 km/h W			
378 km/h W			
314 km/h W			
298 km/h W			
		Σx = _____	**Σy =** _____

θ = _____

V_x = _____

V_y = _____

V = _____



What I Have Learned

1. The components of a vector are a series of vectors that, when combined, give the original vector as their resultant.

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2. Components are usually created that align with the Cartesian coordinate axes. For a vector $\vec{F}$ that makes an angle of θ with the positive x-axis the x-component is $\vec{R}_x = R\cos(\theta)$ and the y-component is $\vec{R}_y = R\sin(\theta)$.

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What I Can Do

Determine the resultant displacement of going to school from your house using component method.

Vector	Displacement (m)	x – component	y – component
d_1			
d_2			
d_3			
d_4			
d_5			
		$\Sigma x =$ _____	$\Sigma y =$ _____

$\theta =$ _____

d = _____



Assessment

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Multiple Choice. Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. In a coordinate system, a vector is oriented at angle with respect to the x-axis. The x component of the vector equals the vector's magnitude multiplied by which trigonometric function?

a. tan θ
c. cot θ
b. cos θ
d. sin θ

2. A particular hurricane travels 678 km, 34.6^0 north of west before turning into a tropical storm. Find the northern displacement of the typhoon and the western displacement of the typhoon.

a. 558 km west, 385 km north
b. 385 km west, 558 km north
c. 585 km west, 358 km north
d. 468 km west, 468 km north

For numbers 3-4

3. Two forces act on an object. One force is 6.0 N horizontally towards west. The second force is 8.0 N vertically towards south. Find the magnitude and direction of the resultant.

a. 10N 53° N of E
c. 10N 53° E of N
b. 10N 53° S of W
d. 10N 53° W of S

4. If the object is in equilibrium, find the magnitude and direction of the force that produces equilibrium.

a. 10N, 53° W of S
c. 10N, 53° E of N
b. 10N, 53° N of E
d. 10N, 53° S of W

5. Four members of the Main Street Bicycle Club meet at a certain intersection on Main Street. The members then start from the same location but travel in different directions. A short time later, displacement vectors for the four members are:

A = 2 km W
B = 1.6 km N
C = 2.0 km E
D = 2.4 km S

What is the resultant displacement R of the members of the bicycle club: R = A + B + C + D?

a. 0.8 km S
b. 0.4 km 450 SE

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c. 3.6 km 370 NW
d. 4 km S

6. Given the following components for vectors A–C, find the x- and y-components for the resultant R.

Vector	x-component	y-component
A	+6	− 2
B	− 2	+6
C	+3	+3

a. +11, +11
b. +7, +7
c. –7, –7
d. +7, –11

7. Given the following components for vectors A–C, find the magnitude and direction for the resultant vector R.

Vector	x-component	y-component
A	+4	− 1
B	− 1	− 6
C	+3	+3

a. 8, 320° in standard position
b. 10, 40° in standard position
c. 8, 330° in standard position
d. 10, 30° in standard position

8. Find the x- and y-components for a displacement vector that is 23.8 km and 45.0° south of east.

a. - 12.61 km, +20.23 km
b. +12.61 km, -20.23 km
c. +16.8 km, –16.8 km
d. –16.8 km, +16.8 km

9. A particular hurricane traveled 678 mi at 34.6° north of west before turning into a tropical storm. Find the northern displacement of the hurricane and the western displacement of the hurricane.

a. 558 mi east, 385 mi north
b. 385 mi west, 558 mi north
c. 671 mi west, 27.12 mi north
d. 468 mi west, 468 mi north

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10. Find the x- and y-components to a vector that is 89.5 mm at 305° in standard position.

a. –73.3 mm, 51.3 mm
b. 51.3 mm, 73.3 mm
c. 73.3 mm, 51.3 mm
d. 85.95mm, 23.45mm

11. When resolving vectors into components or finding results _____ is/are more accurate than _____.

a. geometric vector addition, geometric vector subtraction
b. geometric techniques, mathematical techniques
c. mathematical techniques, geometric techniques
d. mathematical vector addition, mathematical vector subtraction

12. Resolve vector L into components L_x and L_y if the length of vector L is 15m and its reference angle is 20^0.

a. 13.65 m, 6.15 m
b. 14 m, 5 m
c. 14.1, 5.13 m
d. 14.2, 5.20 m

13. Which is not true about vector magnitude?

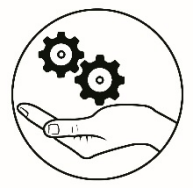
a. it cannot be greater than the sums of magnitude of its component vectors.
b. it cannot be negative
c. it is scalar quantity
d. trigonometry is necessary to compute it from component vectors

14. The vector resultant of an object's change in position is the same at its displacement.

a. either true or false
b. false
c. neither true nor false
d. true

15. Two vectors that are added together to produce a resultant are called the components of the resultant.

a. either true or false
b. false
c. neither true nor false
d. true



Additional Activities

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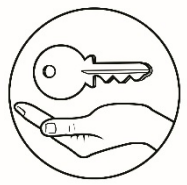
During the Enhanced Community Quarantine of COVID 19 Pandemic the mandate for the people in our country is to stay home. Kindly identify 5 displacements as you move inside your house. Determine your resultant displacement using component method.

Vector	Magnitude	d_x	d_y
Displacement 1			
Displacement 2			
Displacement 3			
Displacement 4			
Displacement 5			
		Σd_x = _____	Σd_y = _____



Answer Key

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Assessment

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

What's More

$\theta = 40.7^0$

V_x = -2118.25 km/h

V_y = - 36.25 km/h

V = 2118.56 km/h 40.7^0 SW

What I Know

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

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