

Academic Review - Physics

Dinan Mariano

UP Mindoreños

January 2024

Topics

- 1 Scalar and Vector
 - Scalar and Vector
 - Resultant Vector
- 2 Mechanics
- 3 Newton's Law of Motion
- 4 Momentum and Impulse
- 5 Work, Energy, and Power

Nobel and Ig Nobel Prizes

2023 Nobel Prize of Physics - for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter

Nobel and Ig Nobel Prizes

2023 Nobel Prize of Physics - for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter

Ig Nobel Prize

Honor "achievements that first make people laugh and then make them think."

Nobel and Ig Nobel Prizes

2023 Nobel Prize of Physics - for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter

Ig Nobel Prize

Honor "achievements that first make people laugh and then make them think."

2023 Ig Nobel Prize of Education - for methodically studying the boredom of teachers and students

Scalar and Vector

Scalar Quantity - a quantity which is expressed by magnitude only

Example

Mass
Time
Temperature
Area
Distance

Vector Quantity - a quantity which is expressed by magnitude and direction

Example

Force
Velocity
Weight
Acceleration
Displacement

Quiz

- 5 m
- 30 m/sec, East
- 5 km, North
- 20 degrees Celcius
- 1 GB
- 4000 calories

Quiz

- 5 m
 - 30 m/sec, East
 - 5 km, North
 - 20 degrees Celcius
 - 1 GB
 - 4000 calories
- Scalar

Quiz

- 5 m – Scalar
- 30 m/sec, East – Vector
- 5 km, North
- 20 degrees Celcius
- 1 GB
- 4000 calories

Quiz

- 5 m – Scalar
- 30 m/sec, East – Vector
- 5 km, North – Vector
- 20 degrees Celcius
- 1 GB
- 4000 calories

Quiz

- | | |
|----------------------|----------|
| • 5 m | – Scalar |
| • 30 m/sec, East | – Vector |
| • 5 km, North | – Vector |
| • 20 degrees Celcius | – Scalar |
| • 1 GB | |
| • 4000 calories | |

Quiz

- | | |
|----------------------|----------|
| • 5 m | – Scalar |
| • 30 m/sec, East | – Vector |
| • 5 km, North | – Vector |
| • 20 degrees Celcius | – Scalar |
| • 1 GB | – Scalar |
| • 4000 calories | |

Quiz

- | | |
|----------------------|----------|
| • 5 m | – Scalar |
| • 30 m/sec, East | – Vector |
| • 5 km, North | – Vector |
| • 20 degrees Celcius | – Scalar |
| • 1 GB | – Scalar |
| • 4000 calories | – Scalar |

Resultant Vector

Definition

Sum of two or more vectors which will give the same effect as the original vectors

Process of finding the Resultant Vector

- ① Addition/Subtraction
- ② Pythagorean Theorem
- ③ Component Method

Addition/Subtraction

Can only be used on 1D vectors
(same direction)

$$\begin{array}{c} \text{5} \\ \longrightarrow \end{array} + \begin{array}{c} \text{5} \\ \longrightarrow \end{array} = \begin{array}{c} \text{10} \\ \longrightarrow \end{array}$$

$$\begin{array}{c} \text{5} \\ \longrightarrow \end{array} + \begin{array}{c} \text{-5} \\ \longleftarrow \end{array} = 0$$

$$\begin{array}{c} \text{5} \\ \longrightarrow \end{array} + \begin{array}{c} \text{10} \\ \longrightarrow \end{array} = \begin{array}{c} \text{15} \\ \longrightarrow \end{array}$$

$$\begin{array}{c} \text{5} \\ \longrightarrow \end{array} + \begin{array}{c} \text{-10} \\ \longleftarrow \end{array} = \begin{array}{c} \text{-5} \\ \longleftarrow \end{array}$$

$$\begin{array}{c} \text{5} \\ \longrightarrow \end{array} + \begin{array}{c} \text{-15} \\ \longleftarrow \end{array} = \begin{array}{c} \text{-10} \\ \longleftarrow \end{array}$$

$$\begin{array}{c} \text{10} \\ \uparrow \end{array} + \begin{array}{c} \text{-5} \\ \downarrow \end{array} = \begin{array}{c} \text{5} \\ \uparrow \end{array}$$

Addition/Subtraction

Can only be used on 1D vectors
(same direction)

What if we encounter more complicated
vectors?

$$10\text{ N} \nearrow + 10\text{ N} \nwarrow = ???$$

$$10\text{ N} \nearrow + 10\text{ N} \leftarrow = ???$$

$$10\text{ N} \nearrow + 5\text{ N} \rightarrow = ???$$

$$\overset{5}{\rightarrow} + \overset{5}{\rightarrow} = \overset{10}{\rightarrow}$$

$$\overset{5}{\rightarrow} + \overset{-5}{\leftarrow} = 0$$

$$\overset{5}{\rightarrow} + \overset{10}{\rightarrow} = \overset{15}{\rightarrow}$$

$$\overset{5}{\rightarrow} + \overset{-10}{\leftarrow} = \overset{-5}{\leftarrow}$$

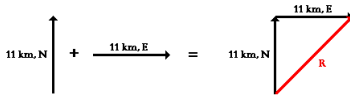
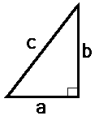
$$\overset{5}{\rightarrow} + \overset{-15}{\leftarrow} = \overset{-10}{\leftarrow}$$

$$\overset{10}{\uparrow} + \overset{-5}{\downarrow} = \overset{5}{\uparrow}$$

Pythagorean Theorem

Pythagorean Theorem

$$a^2 + b^2 = c^2$$



$$11^2 + 11^2 = R^2$$

$$242 = R^2$$

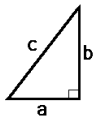
$$15.6 = R$$

Images from www.physicsclassroom.com

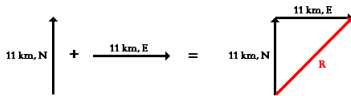
Pythagorean Theorem

Pythagorean Theorem

$$a^2 + b^2 = c^2$$



only use pythagorean theorem on perpendicular vectors!



$$11^2 + 11^2 = R^2$$

$$242 = R^2$$

$$15.6 = R$$

Component Method

Example

An airplane flies in a northeasterly direction at 100 km/h, at the same time there is a wind blowing at 20 km/h to the northwest. What is the resultant velocity of the plane?

X-components:

$$\begin{aligned}V_{xplane} &= V_{plane} \cos 45^\circ \\ &= 70.71 \text{ km/h}\end{aligned}$$

$$\begin{aligned}V_{xwind} &= -V_{wind} \cos 45^\circ \\ &= -14.14 \text{ km/h}\end{aligned}$$

V_{xwind} can be equal to $V_{wind} \cos 135^\circ$ with the same answer

Component Method (cont.)

Y-components:

$$\begin{aligned}V_{yplane} &= V_{plane} \sin 45^\circ \\ &= 70.71 \text{ km/h}\end{aligned}$$

$$\begin{aligned}V_{ywind} &= V_{wind} \sin 45^\circ \\ &= 14.14 \text{ km/h}\end{aligned}$$

Component Method (cont.)

Resultant Velocity

$$\begin{aligned}V_x &= V_{xplane} + V_{xwind} \\&= 70.71 - 14.14 \\&= 56.57 \text{ km/h}\end{aligned}$$

$$\begin{aligned}V_y &= V_{yplane} + V_{ywind} \\&= 70.71 + 14.14 \\&= 84.85 \text{ km/h}\end{aligned}$$

$$\begin{aligned}R &= \sqrt{56.57^2 + 84.85^2} \\R &= 101.978857613 \text{ km/h}\end{aligned}$$

$$\begin{aligned}\theta &= \arctan \frac{84.85}{56.57} \\ \theta &= 56.31^\circ\end{aligned}$$

Mechanics

Motion

Definition

Change in position of a object relative to other objects that are considered at rest

foo

foo

bar

bar

foo

Newton's Law of Motion

Momentum and Impulse

Work, Energy, and Power